

# **Investigation of Puerto Rico communities focused on mosquitoes' habitats and awareness**

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## **ABSTRACT**

The massive spread that mosquitoes are having in Puerto Rico is why we want to investigate in detail about Puerto Rico's communities focus on mosquito habitats and awareness. Their growth process, where to find them, how to identify breeders among others are important factors Puerto Ricans should be aware of. We carried out four methods in this research from June 10, 2020 to July 26, 2020. The Mosquito Larvae Trap Method was used to investigate the mosquitos around the selected area and to define which experiment was effective. The GLOBE Observer App Method was used to compare the observations taking of the Mosquito Habitat Mapper and Land Cover sections and helped identify the mosquitoes' species. Collect Earth Online Method was used to locate and analyze the experiment sites of the mosquito larvae traps. The Google Forms Online Survey Method was used to identify if Puerto Ricans know about the descriptions of the mosquito, the diseases they transmit, how to identify mosquito habitats, in what way to personal protect against mosquito bites, actions taken to reduce mosquitoes in the area, and the use of pesticide. A total of 219 residents of Puerto Rico answered the survey during July 22, 2020 to July 25, 2020. Throughout the experiments, mosquito habitats were found of the mosquitoes' species *Aedes Aegypti* and *Culex*, some impostors such as ants, flies ants, lizards, and midge larvae (*Clinotanypus*). We considered that one of the factors that attracted mosquitoes was the CO<sub>2</sub>. Puerto Ricans found water sources that can be invaded by mosquitoes. At the same time, the population is aware of eliminating these breeding mosquito habitats. It is recommended that this study be continued on the island. In addition, the young population must understand the responsibility that must be had on our environment and health.

**Keywords:** mosquito larvae, mosquito pupa, imposters, water sources, artificial containers

## **RESEARCH QUESTIONS**

*How mosquitoes' habitats influence the massive spread of mosquitoes?*

If the climate of Puerto Rico is a warm-humid tropical climate with well distributed rainfall throughout the year, mosquitoes will be captured and observed in the larvae mosquito traps. In addition, since Puerto Rico is an island with high mosquito increases the majority of Puerto Ricans will have the necessary knowledge and awareness about mosquitoes.

## INTRODUCTION AND LITERATURE REVISION

Puerto Rico is a Caribbean island with a landscape of mountains, waterfalls, rivers, and beautiful beaches. It's located in the coordinates 18.2208° N, 66.5901° W. In the paper The Journal of Agriculture of the University of PR said that Puerto Rico is a mountainous tropical island. A large central mountainous region surrounded by a relatively narrow coastal plain. On the basis of variation of rain-fall, the island may be divided in a general way into three regions: (1) the wet coastal plains of the north, east, and west; (2) the dry southern coastal plain, and (3) the central mountainous area, which is subject to heavy rainfall" [1]. The mosquitoes are one of the insects best known for their characteristic of carrying diseases that could be fatal to humans. A mosquito is an insect that bites and feeds on the blood of humans and other animals. We have the knowledge of the great damage that these can cause, and our desire is to provide information with proof to Puerto Ricans and not only them but also those who are able to read our information. According to National Geographic "Mosquitoes are carriers, or vectors, for some of humanity's most deadly illnesses, and they are public enemy number one in the fight against global infectious disease" [2].

The problem of our research is identify potential larvae mosquito habitats, for this reason we want to inform about their growth process, where to find them, how to identify breeders among other important factors. If the climate of Puerto Rico is a warm-humid tropical climate with well-distributed rainfall throughout the year, mosquitoes will be captured and observed. We carried out four methods in this research: Mosquito Larvae Traps, Globe Observer App, Collect Earth Online, and Google Forms Online Survey. The mosquito larvae research took place in Manatí and Vega Baja, Puerto Rico. Science creates new knowledge, improves education, increases the quality of our lives, and helps a great quantity of people and even communities. Informing people throughout science is a key to have people attention.

The Globe Program said that "Mosquitoes rely on places where water collects. The availability of mosquito habitat depends on factors like land cover and precipitation." mosquitoes are carriers, or vectors, for some of humanity's most deadly illnesses, and they are public enemy number one in the fight against global infectious disease [3]. Being part of NASA SEES interns Mosquito Mappers Research Group gave us amazing tools and advantages that we're both aware of the great benefit it's provided us in this research. Having the ability to use satellites and programs provided by NASA helped us understand much more how mosquitoes act and even where larvae mosquitoes can be found and identify. Being guided by experts in mosquitoes and all the informative meetings was a factor of great importance to achieve a small contribution to the scientific knowledge of other people. This helped us understand much more how mosquitoes act and even where mosquitoes and larvae can be found and identify.

[1]Tulloch, G., The Journal of Agriculture of the University of PR. (July 5, 1935 - June 1, 1936). THE MOSQUITOES OF PUERTO RICO. Recovered from <https://revistas.upr.edu/index.php/jaupr/article/view/14331/11918>

[2] National Geographic. (April 11, 2010). Mosquitoes. Recovered from <https://www.google.com.pr/amp/s/api.nationalgeographic.com/distribution/public/amp/animals/invertebrates/group/mosquitoes>

[3] The Globe Program. (N.D) GLOBE MOSQUITO HABITAT MAPPER. Recovered from <https://observer.globe.gov/toolkit/mosquito-habitat-mapper-toolkit>

## MATERIALS AND METHODS

### *Mosquito Larvae Traps Method*

One method of investigation used was the mosquito larvae traps experiment. The mosquito larvae traps help contain the eggs of mosquitoes. Once the mosquito lays the eggs, life cycle stages can be seen, but when they grow they cannot escape preventing its breeding. The study was conducted in two separate land sites; locate in Manatí and Vega Baja both towns of Puerto Rico. The first experiment materials are: 2 liter plastic bottles, duct tape, double sided tape, scissors, black pantyhose, magnifier, pipette, iPhone (camera), tweezers, pad, notebook, pencil, and water. When building the trap, first, cut the top off of the bottle using the scissors. Second, invert the top and use the duct tape to tape it to the bottom. Third, use the leg of the pantyhose and cut the part of the toes so it can be open. Pass the pantyhose through the bottle. Fourth, use the double sided tape to hold the pantyhose. During experiment number one, outside in the garage and balcony, five mosquito larvae traps were created with different baits for each land site. Manatí land site 2 cups baits measure are: water, sugar, grass, rice starch, and the seeds and the juice of the patch. In Vega Baja land site the baits measure are ¼ cup of brown sugar, 1 gram of yeast, and water. Experiment number two consisted of adding 1 trap with a different design in both land sites that only had water and exchanging the seed and patch juice trap for one of brown sugar with yeast. The third experiment consists of use a 10L plastic paint container with plain water in the garden.

### *Globe Observer App Method*

It is necessary to use the experiment together with The GLOBE Observer App. The GLOBE Observer App is the other method of investigation used. Its function is to share collected observations. This app is designed to help scientists better understand satellite data collected by NASA from space. The section GLOBE Mosquito Habitat Mapper was used to locate mosquito habitats, observe and identify mosquito larvae, and reduce the potential threat of mosquito borne disease. To begin the observations, firstly, enter the local date and time of the observation. Afterwards, enter the location coordinates; there will be a map below to adjust the location. After that, identify a possible mosquito breeder by identifying the source of the water. Eventually, when selecting the source of water, take a picture of the site which shows the water source and surrounding area. It is important to avoid adult faces or children in the photos. Later then, identify any mosquito larvae in the water. Then, perform a larvae sample and count. Finally, the mosquito breeding habitat has been successfully documented. The section GLOBE Land Cover is an app-based tool used to document what is on the land. To start the observations, it is necessary to enter the local date, time and location of the observation. Next, select the surface conditions of the area that is being observed. After that, take up and down pictures to capture the current conditions. Then, take pictures of the cardinal directions, these being North, East, South, and West. Sequent, add field notes of any additional information about the location, such as historical, recent or planned changes. When completing photographing the locations, making sure no person is included, continue to analyze the land cover. When identifying the land cover, there will be a series of classifications in every cardinal direction such as: trees, shrubs, herbaceous/grassland, barren, wetlands, open water, cultivated and urban. Lastly, review everything is classified and the land cover has been efficiently finished.

### ***Collect Earth Online Method***

Collect Earth Online is a software tool for land monitoring. This allows handling and analyzing geographic information by visualizing geographical statistics. Collect Earth Online was used to locate and analyze the land site of Manatí and Vega Baja, both towns of Puerto Rico.

### ***Online Survey***

Another research method use to collecting data for this investigation is the online survey. It is made using Google forms. This questionnaire is designed to investigate Puerto Rico citizen's knowledge, attitudes, and practices concern the mosquito and develop an understanding of the status of Puerto Rico communities' awareness. The questionnaire has 30 multiple selection questions (18 multiple choice and 12 qualitative questions). It compiled in six sections. The first section includes 4 questions about demographic data to outline the participants in this survey. The second section includes 4 questions about mosquito description, stages, and develops. The third section includes 5 questions about community awareness regarding mosquitos and mosquito borne diseases to identify community concerns about mosquitos, personal protection against mosquito bites, and actions you take to reduce mosquitos in your area. The fifth section includes 5 questions to identify community concerns around pesticide use, and comfort levels on when to implement pesticide use. The sixth section includes 6 questions to identify community needs and requirements regarding communication to identify community awareness around communication method and preferred communication frequency. The survey distributions consist of posting on the social network (Facebook, Snapchat, and Instagram), email, and WhatsApp. The results will be analyze in our Investigation of Puerto Rico Communities Focused on Mosquito Habitats and Awareness to complete the final project of NASA SEES MOSQUITO MAPPER RESEARCH and allow us to inform resources, understanding of outreach, and communication needs of the communities. The total number of individuals expect in this particular method is over 200 residents of Puerto Rico communities. The participants will be answering in approximately 8 minutes.



Image 1 Material and Methods

# RESULTS

The Collect Earth Online showed the two separate land sites; locate in Manatí and Vega Baja both towns of Puerto Rico.

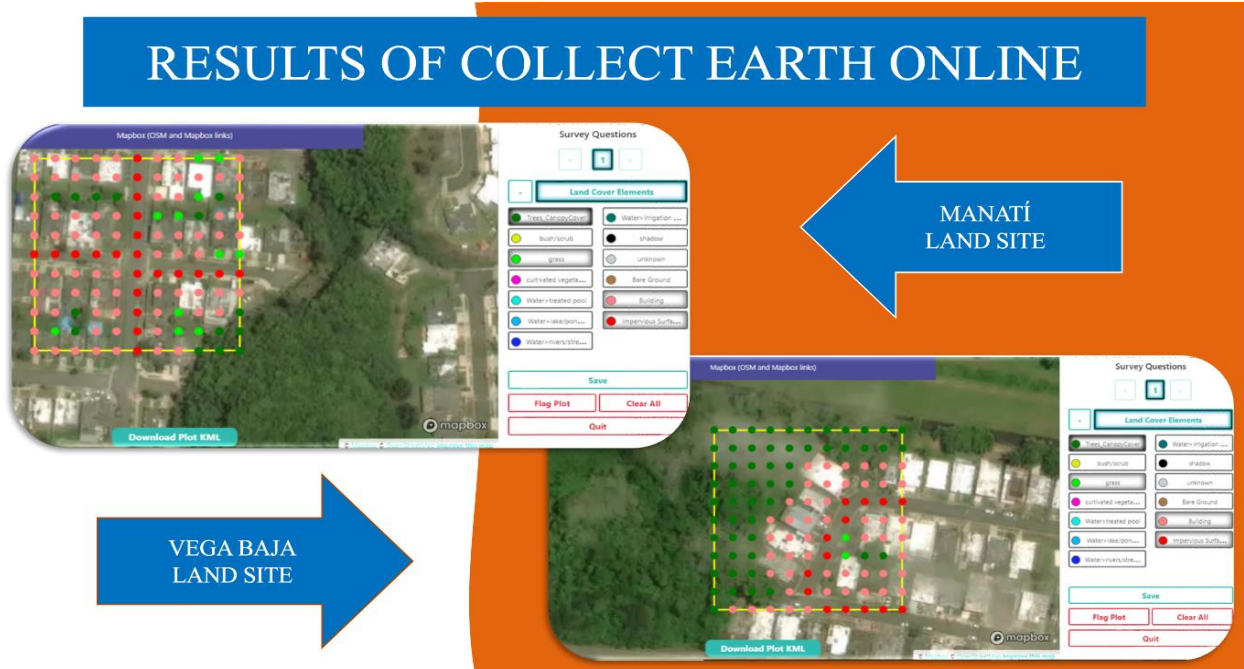


Image 2 Land Sites using Collect Earth Online

The followings results are presented in tables and images of the five Mosquito Larvae Traps.

## TABLE A RESULTS OF MOSQUITO LARVAE TRAP EXPERIMENT #1 by Yarianis R.



June 10th – June 24th (Observations made in Week 1 & 2 in Manatí)

Table A	Temperatures		Monthly Precipitation	Location Manatí	Mosquito egg, pupa, larvae presence	Imposters	Bait Type
<b>WEEK 1</b>	June 10 - 86° June 11 - 87° June 12 - 88° June 13 - 87°	June 14 - 87° June 15 - 88° June 16 - 89°	<ul style="list-style-type: none"> <li>Chance of rain 60%</li> <li>Precipitation 4 in</li> <li>Rainy days 18</li> </ul>	Outside in the garage.	No mosquito eggs, pupa, larvae or adult mosquito were observed.	No imposters were observed.	<ul style="list-style-type: none"> <li>All bait types.</li> <li>Water</li> <li>Rice Starch</li> <li>Grass</li> <li>Sugar</li> <li>Seed and Juice of Passion Fruit</li> </ul>
<b>WEEK 2</b>	June 17 - 86° June 18 - 88° June 19 - 89° June 20 - 89°	June 21 - 89° June 22 - 90° June 23 - 90° June 24 - 89°	<ul style="list-style-type: none"> <li>Chance of rain 60%</li> <li>Precipitation 4 in</li> <li>Rainy days 18</li> </ul>	Outside in the garage.	No mosquito eggs, pupa, larvae or adult mosquito were observed.	Imposters such as flies & lizard (Seed and Juice of Passion Fruit, ants & flying ants (Sugar)	<ul style="list-style-type: none"> <li>All bait types.</li> <li>Water</li> <li>Rice Starch</li> <li>Grass</li> <li>Sugar</li> <li>Seed and Juice of Passion Fruit</li> </ul>



# EXPERIMENT #1

by Yarianis R.

IMPOSTERS

Image 3 Experiment 1 imposters

## TABLE B RESULTS OF MOSQUITO LARVAE TRAP EXPERIMENT #1 by Jeriel A.

June 10th – June 24th (Observations made in Week 1 & 2 in Vega Baja)

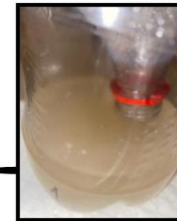


Table B	Temperatures		Monthly Precipitation	Location Vega Baja	Mosquito egg, pupa, larvae presence	Imposters	Bait Type
<b>WEEK 1</b>	June 10 - 90° June 11 - 85° June 12 - 91° June 13 - 93°	June 14 - 92° June 15 - 92° June 16 - 91°	<ul style="list-style-type: none"> <li>• Chance of rain 60%</li> <li>• Precipitation 4 in</li> <li>• Rainy days 18</li> </ul>	Outside in balcony.	No mosquito eggs, pupa, larvae or adult mosquito were observed.	No imposters were observed.	All bait types: <ul style="list-style-type: none"> <li>• brown sugar, yeast and water</li> </ul>
<b>WEEK 2</b>	June 17 - 91° June 18 - 91° June 19 - 93° June 20 - 91°	June 21 - 93° June 22 - 90° June 23 - 89° June 24 - 89°	<ul style="list-style-type: none"> <li>• Chance of rain 60%</li> <li>• Precipitation 4 in</li> <li>• Rainy days 18</li> </ul>	Outside in balcony.	No mosquito eggs, pupa, larvae or adult mosquito were observed.	Imposters such as ants were observed.	All bait types: <ul style="list-style-type: none"> <li>• brown sugar, yeast and water</li> </ul>

EXPERIMENT  
#1  
by Jeriel A.

IMPOSTER

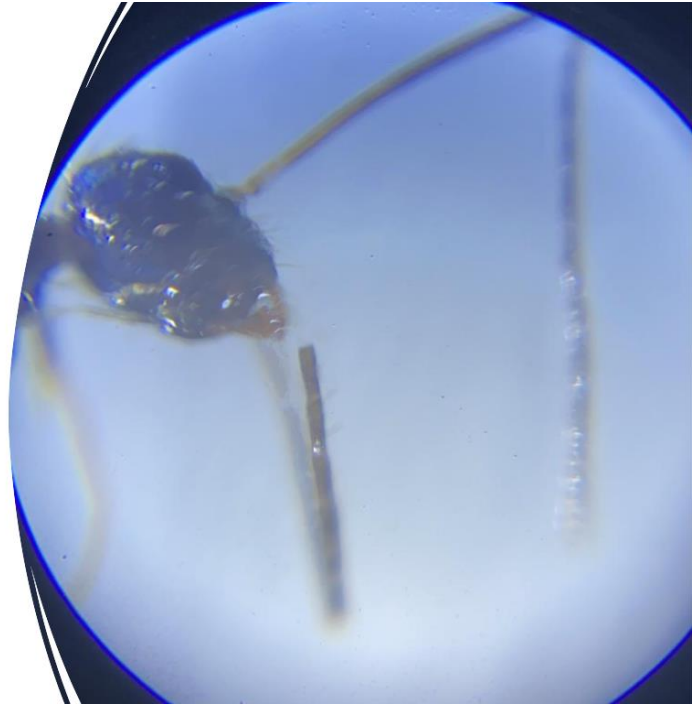


Image 4 Experiment 1 imposters

TABLE C RESULTS OF  
MOSQUITO LARVAE TRAP  
EXPERIMENT #2 by Yarianis R.



June 24th – July 8th (Observations made in Week 3 & 4 in Manatí)

Table C	Temperatures		Monthly Precipitation	Location Manatí	Mosquito egg, pupa, larvae presence	Imposters	Quantity Of Mosquito	Type of Mosquito Found
<b>WEEK 3</b>	June 24 - 89° June 25 - 89° June 26 - 90° June 27 - 91°	June 28 - 89° June 29 - 87° June 30 - 87°	<ul style="list-style-type: none"> <li>• Chance of rain 70%</li> <li>• Precipitation 4 in</li> <li>• Rainy days 21</li> </ul>	Inside the house.	No mosquito eggs, pupa, larvae or adult mosquito were observed.	Imposters such as grasshoppers. (Water Bait)	0	-
<b>WEEK 4</b>	July 1 - 89° July 2 - 88° July 3 - 88° July 4 - 88°	July 5 - 88° July 6 - 90° July 7 - 86° July 8 - 88°	<ul style="list-style-type: none"> <li>• Chance of rain 70%</li> <li>• Precipitation 4 in</li> <li>• Rainy days 21</li> </ul>	Inside the house.	Mosquito larvae were observed in 5.25L Plastic Container.	Imposters not identify.	10	Aedes Aegypti

# Experiment #2 by Yarianis R.



Image 5 Experiment 2 imposters and mosquitoes larvae

## TABLE D RESULTS OF MOSQUITO LARVAE TRAP EXPERIMENT #2 by Jeriel A.



June 24th – July 8th (Observations made in Week 3 & 4 in Vega Baja)

Table D	Temperatures		Monthly Precipitation	Location Vega Baja	Mosquito egg, pupa, larvae presence	Imposters	Quantity	Type of Mosquito Found
<b>WEEK 3</b>	June 24 - 89° June 25 - 91° June 26 - 90° June 27 - 90°	June 28 - 89° June 29 - 89° June 30 - 90°	<ul style="list-style-type: none"> <li>• Chance of rain 70%</li> <li>• Precipitation 4 in</li> <li>• Rainy days 21</li> </ul>	Outside in the patio.	No mosquito eggs, pupa, larvae or adult mosquito were observed.	No imposters were observed.	0	-
<b>WEEK 4</b>	July 1 - 90° July 2 - 91° July 3 - 92° July 4 - 91°	July 5 - 90° July 6 - 90° July 7 - 89° July 8 - 91°	<ul style="list-style-type: none"> <li>• Chance of rain 70%</li> <li>• Precipitation 4 in</li> <li>• Rainy days 21</li> </ul>	Outside in the patio.	Mosquito pupa and larvae were observed in 5.25L Plastic Container.	Imposters such as ants were observed.	Approx. 40	Aedes Aegypti



Experiment #2  
by Jeriel A.

MOSQUITOS

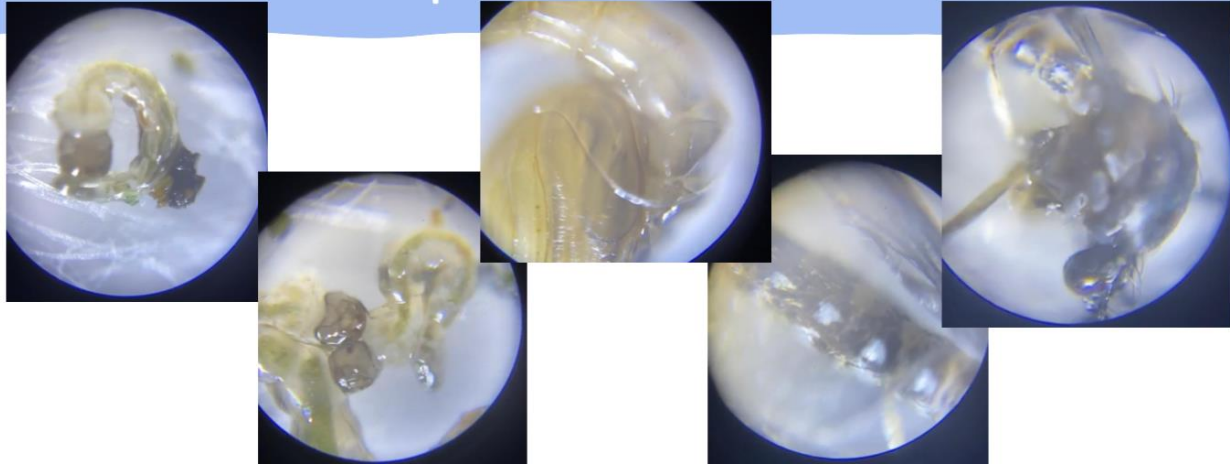


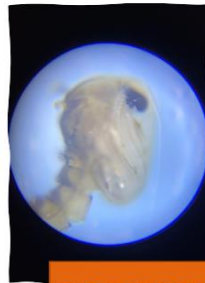
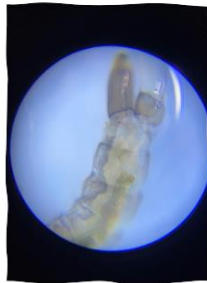
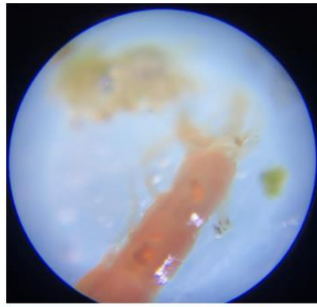
Image 6 Experiment 2 mosquitoes

**TABLE E RESULTS OF  
MOSQUITO LARVAE TRAP  
EXPERIMENT #3 by Yarianis R.**



July 8th – July 26th (Observations made in Week 5 & 6 in Vega Baja)

Table E	Temperatures		Monthly Precipitation	Location Manatí	Mosquito egg, pupa, larvae presence	Imposters	Quantity	Type of Mosquito Found
<b>WEEK 5</b>	July 8 - 88° July 9 - 89° July 10 - 89° July 11 - 90°	July 12 - 88° July 13 - 89° July 14 - 90°	<ul style="list-style-type: none"> <li>• Chance of rain 70%</li> <li>• Precipitation 4 in.</li> <li>• Rainy days 21</li> </ul>	Outside in the garden.	No mosquito eggs, pupa, larvae or adult mosquito were observed.	No imposters observed.	0	-
<b>WEEK 6</b>	July 15 - 89° July 16 - 87° July 17 - 88° July 18 - 89°	July 19 - 88° July 20 - 89° July 21 - 88° July 22 - 87°	<ul style="list-style-type: none"> <li>• Chance of rain 70%</li> <li>• Precipitation 4 in</li> <li>• Rainy days 21</li> </ul>	Outside in the garden.	Mosquito larvae is observed in 10-liter plastic paint container and 2L plastic bottle with grass bait.	Midge larvae is observed in 10L plastic paint container.	Approx. 90	Aedes Aegypti



## Experiment #3 by Yarianis R.

MOSQUITOS

IMPOSTERS

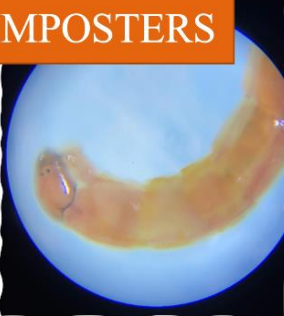


Image 7 Experiment 3 imposters

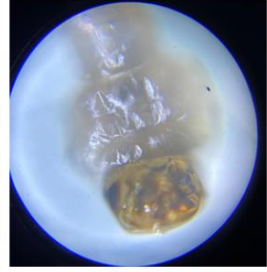
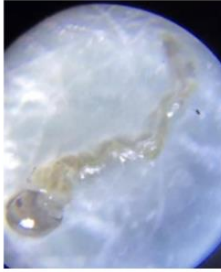
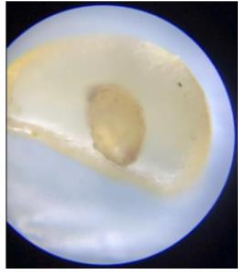
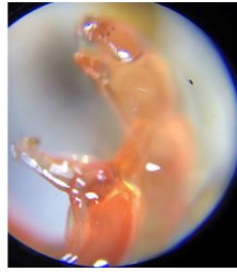
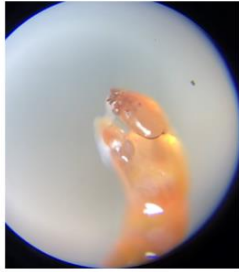
## TABLE F RESULTS OF MOSQUITO LARVAE TRAP EXPERIMENT #3 by Jeriel A.



July 8th – July 26th (Observations made in Week 5 & 6 in Vega Baja)

Table F	Temperatures		Monthly Precipitation	Location Vega Baja	Mosquito egg, pupa, larvae presence	Imposters	Quantity	Type of Mosquito Found
<b>WEEK 5</b>	July 8 - 91° July 9 - 90° July 10 - 91° July 11 - 91°	July 12 - 89° July 13 - 90° July 14 - 90°	<ul style="list-style-type: none"> <li>• Chance of rain 70%</li> <li>• Precipitation 4 in</li> <li>• Rainy days 21</li> </ul>	Outside in the garden.	No mosquito eggs, pupa, larvae or adult mosquito were observed.	No imposters observed.	0	-
<b>WEEK 6</b>	July 15 - 89° July 16 - 88° July 17 - 90° July 18 - 88°	July 19 - 89° July 20 - 90° July 21 - 90° July 22 - 89°	<ul style="list-style-type: none"> <li>• Chance of rain 70%</li> <li>• Precipitation 4 in</li> <li>• Rainy days 21</li> </ul>	Outside in the garden.	Mosquito pupa and larvae is observed in 10-liter plastic paint container.	Midge larvae is observed in 10L plastic paint container.	Approx. 107	Aedes Aegypti and Culex

## IMPOSTERS



## MOSQUITOS

# Experiment #3 | by Jeriel A.

Image 8 Experiment 3 imposters and mosquitoes

The following table shows the results using the Globe Observer App to locate mosquito habitats, observe and identify mosquito larvae, and reduce the potential threat of mosquito borne disease.

## TABLE G RESULTS OF GLOBE OBSERVER APP

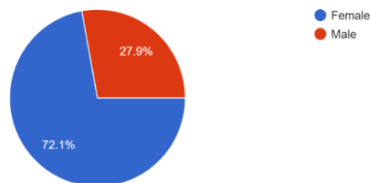
	Land Cover		Mosquito Habitat Mapper					
	Location	MUC Description	Mosquito Habitat (Water Source)		Mosquito egg, pupa, larvae presence	Quantity Of Mosquito	Type Of Mosquito	
<b>Yarianis</b>	<ul style="list-style-type: none"> <li>North</li> <li>South</li> <li>West</li> <li>East</li> <li>Metro</li> <li>Central</li> </ul>	<ul style="list-style-type: none"> <li>Grassland</li> <li>Residential Property</li> <li>Urban</li> <li>Trees</li> <li>Shrubs</li> </ul>	<ul style="list-style-type: none"> <li>Cultivated</li> <li>Roads</li> <li>Parking</li> <li>Open Water</li> <li>Marine</li> <li>Athletic Field</li> <li>Other</li> </ul>	<ul style="list-style-type: none"> <li>Tire</li> <li>Can or Bottle</li> <li>Trash Container</li> <li>Still water next to a river</li> <li>Still water next</li> <li>Plant Clumbs</li> </ul>	<ul style="list-style-type: none"> <li>Pond</li> <li>Ditch</li> <li>Wetland</li> <li>Adult Mosquito Trap</li> <li>Artificial Feature</li> <li>Old Car</li> <li>Jar</li> </ul>	Mosquito larvae presence	100	Aedes Aegypti
<b>Jeriel</b>	<ul style="list-style-type: none"> <li>North</li> </ul>	<ul style="list-style-type: none"> <li>Grassland</li> <li>Residential Property</li> <li>Urban</li> <li>Trees</li> </ul>	<ul style="list-style-type: none"> <li>Plastic Tank</li> <li>Cement</li> <li>Metal</li> </ul>	<ul style="list-style-type: none"> <li>Other</li> <li>Tire</li> <li>Plant Clumbs</li> </ul>	Mosquito pupa and larvae presence	147	Aedes Aegypti Culex	

The Online Survey showed Puerto Rico citizen's knowledge, attitudes, and practices concern the mosquito and develop an understanding of the status of Puerto Rico communities' awareness. The questionnaire has 30 multiple selection questions. It compiled in six sections about demographic data, mosquito description, stages, and develops, community awareness regarding mosquitos and mosquito borne diseases to identify community concerns about mosquitos, personal protection against mosquito bites, and actions you take to reduce mosquitos in your area, community concerns around pesticide use, and comfort levels on when to implement pesticide use, community needs and requirements regarding communication to identify community awareness around communication method, and preferred communication frequency.

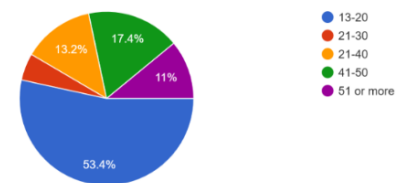
## RESULTS OF GOOGLE FORMS ONLINE SURVEY

### GRAPH 1 DEMOGRAPHIC DATA

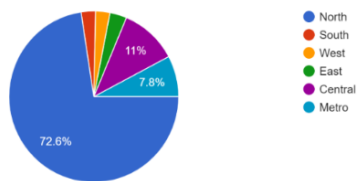
Gender?  
219 responses



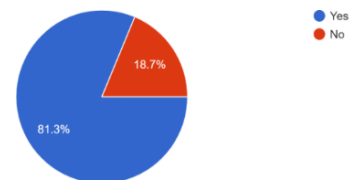
How old are you?  
219 responses



In which region of Puerto Rico do you live? (Map below)  
219 responses



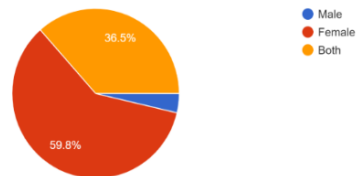
Is this the first outreach on mosquito control you have had?  
219 responses



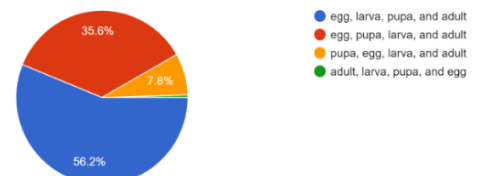
## RESULTS OF GOOGLE FORMS ONLINE SURVEY

### GRAPH 2 MOSQUITO KNOWLEDGE

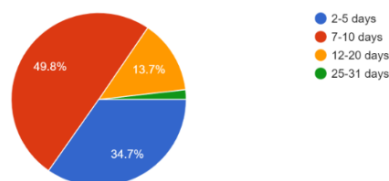
Which mosquito bites?  
219 responses



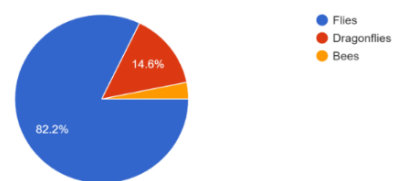
Which one is the correct stages of a mosquito life cycle?  
219 responses



How many days takes for the mosquito to fully develop?  
219 responses



What insects are most closely related to mosquito?  
219 responses

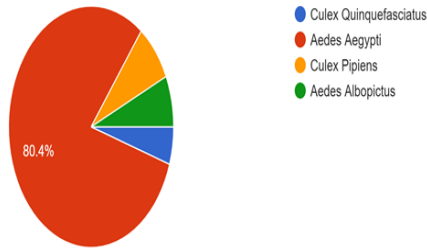


# RESULTS OF GOOGLE FORMS ONLINE SURVEY

## GRAPH 3 Community Awareness Regarding Mosquitos and Mosquito Borne Diseases

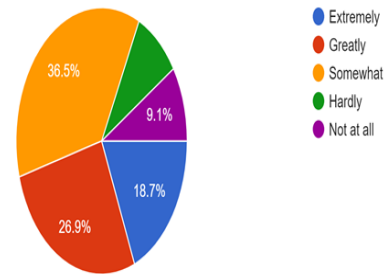
Currently there are more than 40 mosquito species on our island. Which mosquito is responsible for the transmission of dengue, chikungunya and zika.

219 responses



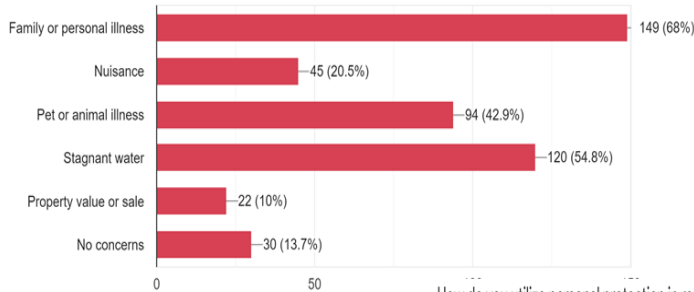
How concerned are you about the presence of mosquitos in your community?

219 responses



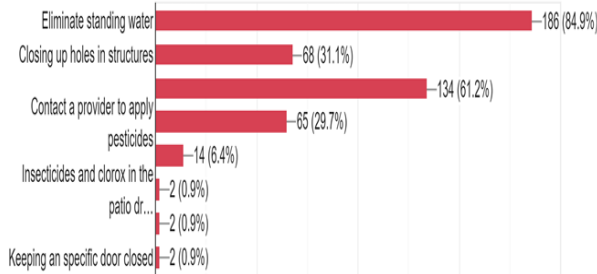
What, if any, concerns do you have about mosquitos in your community? (check all that apply)

219 responses



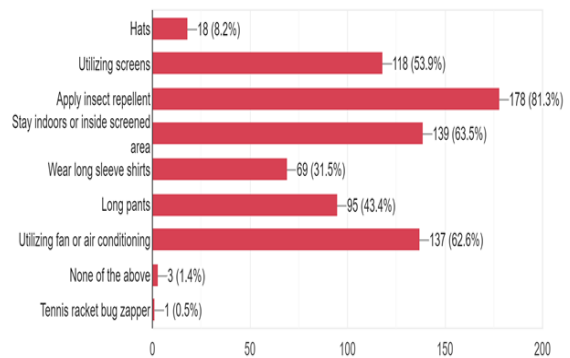
How do you currently reduce sources of mosquitos in your yard? (check all that apply)

219 responses



How do you utilize personal protection in regards to mosquitos? (check all that apply)

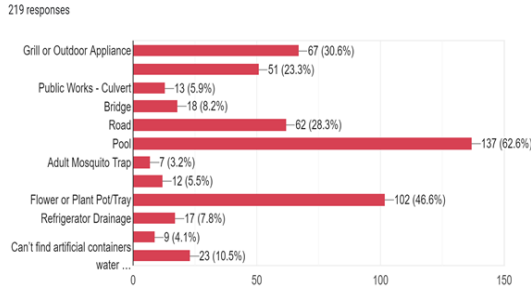
219 responses



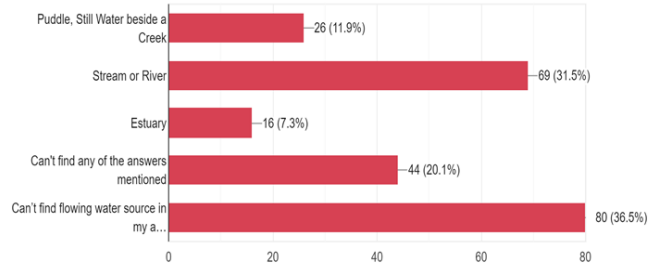
# RESULTS OF GOOGLE FORMS ONLINE SURVEY

## GRAPH 4 Know About Your Water Source Surroundings

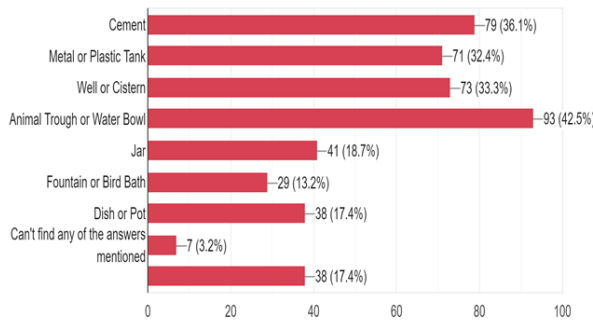
Which artificial container or other objects water sources do you identify in your area? (check all that apply)  
219 responses



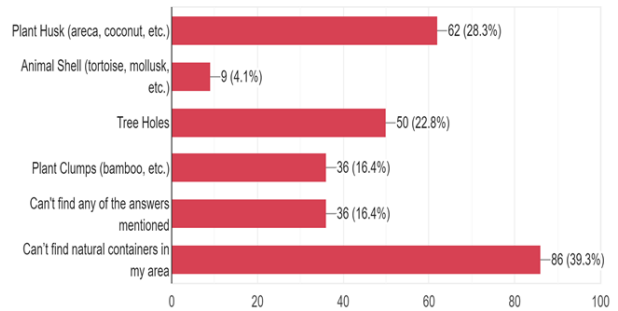
Which flowing water sources do you identify in your area? (check all that apply)  
219 responses



Which artificial water storage containers do you identify in your area? (check all that apply)  
219 responses



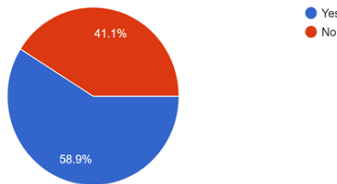
Which natural containers do you identify in your area? (check all that apply)  
219 responses



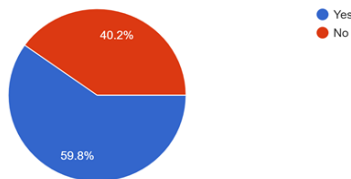
# RESULTS OF GOOGLE FORMS ONLINE SURVEY

## GRAPH 5 Community Input around Mosquito Control Activities – Pesticide Use

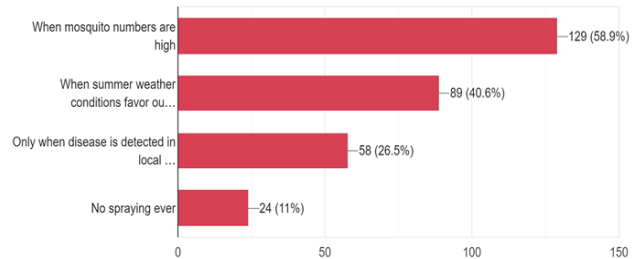
Are you aware of the benefits of properly utilizing pesticides (per guidelines/labeling)?  
219 responses



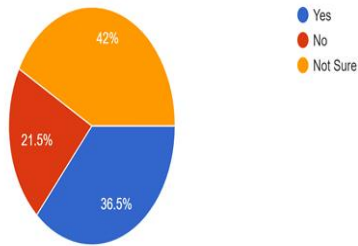
Are you aware of the risks around utilizing pesticides?  
219 responses



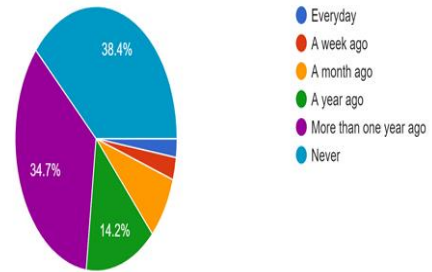
When do you feel aerial pesticide spraying should be utilized to reduce mosquito populations? (check all that apply)  
219 responses



Do you have any concerns about the application of pesticides to control mosquitos in your neighborhood?  
219 responses



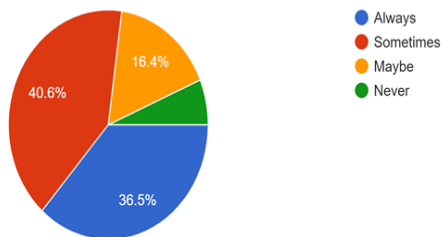
When was the last time your community received spraying pesticide to control mosquito?  
219 responses



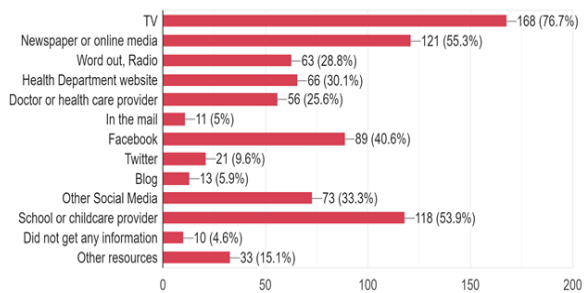
## RESULTS OF GOOGLE FORMS ONLINE SURVEY

### GRAPH 6 Community Needs and Requirements Regarding Communication

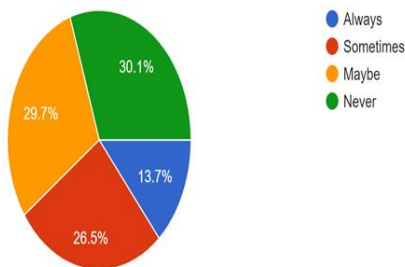
Are you aware of actions that you can take to reduce mosquito populations?  
219 responses



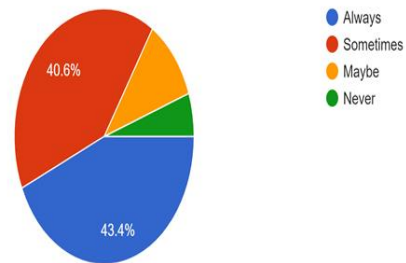
How did you learn about actions being taken to reduce mosquitos, protect yourself from mosquito bites actions, and regarding mosquito control activities? (check all that apply)  
219 responses



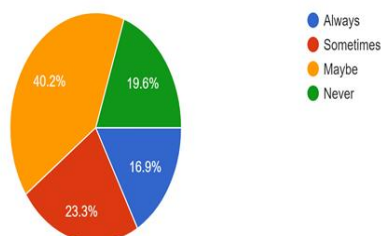
Are you aware of actions being taken to reduce mosquitos in your community?  
219 responses



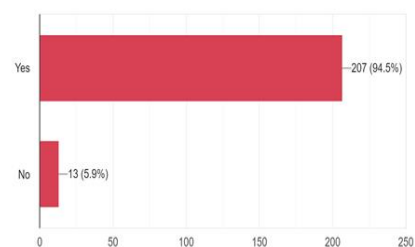
Are you aware of actions that you can take to protect yourself from mosquito bites?  
219 responses



Would you use the GLOBE Observer App? This app is used to help NASA scientists by sharing collected observations. The section GLOBE Mosquit... the potential threat of mosquito borne disease.  
219 responses



Would you like that the Health Department and/or Control of Mosquitos Organizations educate more about mosquitos, control methods, or personal protection?  
219 responses



## DISCUSSION

By using different method to investigate mosquitoes larvae habitats we found a positive results from the Mosquitoes Larvae traps. Collect earth grid point was used for the description of the area where Manatí and Vega Baja analyzed sites are located. The temperature, CO<sub>2</sub> concentration, and precipitation are very important factors. *Aedes Aegypti* larvae and pupae were concentrated in artificial containers experiments during the last 3 weeks. This highlights the potential utility of tools like the Globe Observer App that have been developed to identify mosquitoes. The larvae found move in a gliding motion in the water. The temperature of the water varies between 85° and 93 ° F, indicating that Vega Baja had the higher temperatures than Manatí. In comparison with the results of the journal Mosquitoes in Puerto Rico, the records available indicate that *Aedes Aegypti* species is fairly common on the coastal plain of Puerto Rico [4]. Also report that “*Aedes Aegypti* is one of the two species of mosquitoes that is nearly always found in the neighborhood of dwellings in Puerto Rico” [5]. The precipitation received during the month of July was higher than the month of June. That means that mosquitoes have more possibilities to create breeding around. The *Culex* mosquito was another species we found in the traps along with the *Aedes Aegypti*. The photos capture larvae, pupa, and mosquitoes’ wings, antenna, segmented abdomen, and head. Other observations made during the investigation indicated the presence of imposters such as ants, flies, flies ants, lizard, and grasshopper. In the third experiment, take our attention red larvae found in the container. Looking for an identification of this species, we search for facts according to its description and we found that it could be an imposter called midge larva because they are often confused with mosquitoes. Although, they can be distinguished from mosquitoes because, unlike mosquitoes, they do not bite and lack scales on their wings. The survey was used for the purpose of collect data from residents of Puerto Rico about mosquitoes’ habitats and awareness. A total of 219 residents of Puerto Rico answered the survey during July 22, 2020 to July 25, 2020.

### *Mosquito Larvae Traps Discussion*

The study was conducted in two separate places. Each consisted of having mosquito larvae traps. Three experiments were carried out. In all three experiments the temperature of Vega Baja stayed higher than Manatí. During experiment number one, in Yarianis Rivera’s home, five mosquito larvae traps were created with different baits. The baits, with a measure of 2 cups, were: water, sugar, grass, rice and the seeds and the juice of the passion fruit. All traps were placed outside the garage. In Jeriel Allende’s home, five mosquito larvae traps were created to measure ¼ cup of brown sugar, 1 gram of yeast and water. In Experiment number one, both traps were not very effective in the first two weeks. Only animals such as: ants, flying ants, flies, and lizards were caught. In both places, no mosquitoes were observed in the traps. Despite the fact, that the seed and passion juice trap rotted the lizard was caught here. Experiment number two consisted of adding 1 trap with a different design this being a 5.25L plastic container with only water. It was located in both places. During the observations of experiment number two, it was possible to capture in the 5.25L trap: *Aedes Aegypti* mosquito pupae and mosquito larvae in the water in both Yarianis and Jeriel. Approximately about 10 mosquito larvae were observed in Yarianis traps. Meanwhile, in Jeriel Traps approximately about 40 mosquito larvae were observed. Also, imposters in Jeriel trap such as ants were detected. In experiment number three, a 10-liter paint container was placed in another location in Vega Baja and both outside in the garden. Mosquito pupa and larvae are observed in both places. Also imposters were observed:



midge larvae. Approximately about 90 *Aedes Aegypti* mosquito larvae were observed in Yarianis in the 5.25L container trap and in the 2L plastic bottle with grass bait. Meanwhile, in Jeriel Traps approximately about 107 *Aedes Aegypti* and *Culex* mosquito larvae and pupa were observed. Also, imposters were seen in both traps: midge larvae. We considered that one of the factors that attracted mosquitoes was the CO<sub>2</sub>.

### ***Collect Earth Online Discussion***

Collect earth grid point was used for the description of the area where the analyzed samples are located. The grid point is 11 x 11 points; with a legend we can describe what we see in each point of 11 x 11. The legend has the following topics: trees bush / scrub, grass, cultivated, water> pool, water> lake, water> rivers, water> irrigation, shadow, unknown, bare ground, building and impervious surfaces. Yarianis grid points have: 75 buildings grid points, 21 impervious surfaces grid points, 14 trees grid points, and 11 grass grid points. In comparison, Jeriel Allende grid points are the following: 50 building grid points, 14 impervious surfaces grip points, 56 trees grid points, 2 grass points. With that data we can conclude that Yarianis Rivera investigation place has more houses around; that include more people that produce co<sub>2</sub>, one factor that bitten mosquito is attracted with. Meanwhile Jeriel have more green places, perfect places to mosquito breed their larvae safely with no human around to interrupt the progress. Both places have their pros and cons but, in a way, or other are perfect to start mosquitoes' investigations, no matter what mosquitos are going to be in all Puerto Rico places.

### ***The Globe Observer App Discussion***

The GLOBE Program defines The GLOBE Observer App as “A way to collect data to track changes in the environment in support of Earth system science research, and interpret NASA and other satellite data” [6] The Globe observer application is a tool that was used to identify mosquito larvae and the terrain near the traps investigated. It is a free app that everyone with a phone can install. The current version includes four capabilities. GLOBE Clouds allows observers to make regular observations of the Earth's cloud cover and compare them to NASA satellite observations. With GLOBE Mosquito Habitat Mapper, users locate mosquito habitats, observe, and identify mosquito larvae, and reduce the potential threat of mosquito borne disease. GLOBE Land Cover is designed to allow users to document what is on the land (trees, grass, buildings, etc.). GLOBE Trees asks users to estimate a tree's height by taking pictures of trees with their device. Globe Observer is a very simple and easy to use application. The instructions were direct to the point, making the experience very easy and comfortable to use from the start. Thanks to the mosquito larvae program, it made the identification of larvae very fast and simple. With just having a microscope you can identify if what you are observing are mosquito larvae or not. I am grateful for the existence of this application and the great help and influence it had with the research.

### ***Google Forms Online Survey Discussion***

Google Docs Editors Help explain that “You can use Google Forms to create online surveys and quizzes and send them to other people.” [7] The survey was used for the purpose of collect data from residents of Puerto Rico about mosquitoes' habitats and awareness. A total of 219 residents of Puerto Rico answered the survey during July 22, 2020 to July 25, 2020. For 81.3% of the participants this was the first outreach on mosquito control, and it was an effective method according to the results because Puerto Ricans wants to prevent mosquitoes' habitats and

diseases. Also, 82.2% knows that the female mosquito is the one who bites and 49.8% knows that mosquitoes fully develop in 7-10 days. An 80.4% of the participants awareness regarding mosquitoes and mosquitoes borne diseases by knowing that the mosquito *Aedes Aegypti* is responsible for the transmission of dengue, chikungunya and zika and currently reduce sources of mosquitoes in your yard and utilize personal protection in regards to mosquitoes. The participants identified water source surrounding their community. Most of this water source comes from pool, river, and trash containers. They are concerns around pesticide use, and comfort levels on when to implement pesticide use and would like that the Health Department and/or Control of Mosquitos Organizations educate more about mosquitos, control methods, or personal protection.

[4] Tulloch, G., The Journal of Agriculture of the University of PR. (July 5, 1935 - June 1, 1936). THE MOSQUITOES OF PUERTO RICO. Recovered from <https://revistas.upr.edu/index.php/jaupr/article/view/14331/11918>

[5] Tulloch, G., The Journal of Agriculture of the University of PR. (July 5, 1935 - June 1, 1936). THE MOSQUITOES OF PUERTO RICO. Recovered from <https://revistas.upr.edu/index.php/jaupr/article/view/14331/11918>

[6] The Globe Program. (N.D). What is Globe Observer? Recovered from <https://observer.globe.gov/>

[7] Google Docs Edidors Help. (N.D) How to use Google Forms. Recovered from <https://support.google.com/docs/answer/6281888?co=GENIE.Platform%3DDesktop&hl=en>

## CONCLUSION

In conclusion, investigates about mosquitoes' larvae habitats are a necessary field work to find a way to make a better environment to live. All the objectives of the project were accomplished. We can say that anyone can use for future research. It was very interesting capture mosquito life cycle using an iPhone camera and a magnifier. In addition, we now have the knowledge about Puerto Ricans knowing and having awareness of mosquitoes. With this research done, we can use our new acquired knowledge and do workshops based on informing Puerto Ricans about mosquito knowledge and awareness. The impact on society was based on the survey since it helped us to have direct contact and know about mosquito habitats all over Puerto Rico. The importance is to let Puerto Ricans know that mosquitoes are serious and it is vital to know them in order to avoid tragedies. The Mosquito Larvae Trap Method can be improved using other prototypes. Collect Earth Online Method is surely recommended to analyze land cover and compare with others. The Google Forms Method can be improved by making it a quiz, add questions and sections or change the questions and sections. Working with NASA mentors was an advantage and real good experience. They made us feel not alone. Their expertise, guidance and tips did help us a lot. Thanks to them we learned to use satellites, The GLOBE Observer App and even scientific and technical knowledge! Definitely a great help and we are very grateful for it.

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