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FACILITY OR FREEDOM? THAT IS THE QUESTION!

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School: Minas Gerais Public School.

TITLE: FACILITY OR FREEDOM? THAT IS THE QUESTION!

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ABSTRACT

In the current research, we investigated whether by placing the artificial captive breeding sites (traps) with smelling fish food used to attractive the female mosquito, side by side, with the free artificial breeding sites such as wasted ice cream boxes, acting as standing water tanks, the female mosquito still prefers free artificial breeding sites in our school gardens. **FACILITY OR FREEDOM? THAT IS THE QUESTION!**

Last year, we carried out an investigative study on the preference of breeding sites of the *Aedes aegypti* mosquitoes around Minas Gerais School, Rio de Janeiro, Brazil. Samples for the study were obtained by collecting mosquito larvae from different free artificial breeding (water tanks) sites and artificial captive breeding sites (traps) and placed in six school sites in a six-month period.

The results showed that artificial deposits as free breeding sites have a higher positivity for *Aedes aegypti*.

The presence of *Aedes aegypti* in an urban area represents a potential risk of the interrelation of this mosquito species with the population because we know that *Aedes aegypti* is the mosquito that transmits Dengue, Urban Yellow Fever, Chikungunya and Zika Virus diseases.

Keywords: *Aedes aegypti*, artificial deposits, traps, preference, free deposits, captives' deposits, breeding sites, diseases.

INTRODUCTION (Research History)

Mosquitoes are commonly known to pose a significant threat to public health. Mosquitoes cause more human suffering than any other organism. They are the most dangerous animals in the world: mosquitoes carry diseases that kill one million people a year. More than a hundred species of mosquitoes can transmit various diseases to humans and other animals, such as Malaria, Dengue, Zika Virus, Chicungunya and Urban Yellow Fever. Not only can mosquitoes carry diseases that afflict humans, they also transmit several diseases and parasites to animals, as dogs and horses are very susceptible to. There is a major ongoing effort to eliminate mosquito breeding sites all around the world!

They are also known for being irritating biting pests. Sometimes, their nuisance bites are so severe that they make outdoor activities almost impossible in many parts of the world. In addition, mosquito bites can cause severe skin irritation through an allergic reaction to the mosquito's saliva - this is what causes the red bump and itching. (*American Mosquito Control Association*)

Climate change - for mosquitoes will be the feast, for humans, chaos! Mathematical predictions show that climate change can increase the spread of vector-borne diseases, suggest that by 2085, about 50% of the world's population will live in areas at high risk of transmission of mosquito-borne diseases, especially dengue and malaria epidemics.

In countries where there is a high density of insects in the lowlands, if the continent is heated, these mosquitoes will rise and spread over previously cold areas. (GALILEU MAGAZINE, Ed.187)

Climatic changes such as the El Niño and La Niña climatic phenomena alter temperatures and rainfall amounts in different regions of the country, in the case of the Southeast Region of Brazil, there is an increase in temperature and rainfall and may have significant impacts on the population of the city of Rio de Janeiro, especially in the urban areas of Rio. Their effects can lead to exposure to extreme conditions, such as natural disasters of droughts and floods, as well as to the increase in the spread of mosquito-borne diseases.

The association of global climate change, urban heat islands, population increase, and poor sanitation conditions forms the perfect combo for the proliferation of our number one enemy - the *Aedes aegypti* mosquito.

Most of Brazil has warmed up more than the world average in the last century, according to data from the Brazilian Panel on Climate Change. The country has experienced a temperature rise of approximately 1.4 ° C since 1960. The number of hot nights has grown throughout the country. In some places, the minimum temperatures also rose. Minimal temperature is an important parameter for the mosquito because the Aedes need heat and water - and a series of cold nights can be the difference between a new generation of insects born or not. (FIOCRUZ)

The population and public health of cities, communities and neighborhoods need to unite in actions to combat mosquitoes. Among the major efforts are the identification and destruction of mosquito habitats, effective action of the population in prevention actions, especially in the Rio summers, when there is an increase in temperature and rainfall.

Dengue, Yellow Fever, Chikungunya and Zika - cause serious impacts on the health of the population as it has been verified in previous years in the summers of Rio. The years 2008 and 2016 had the strongest cycles of the El Niño climate phenomenon recorded to date and are associated with intense rainfall in the Brazilian Southeast and record *Aedes aegypti*-transmitted diseases.

The *Aedes aegypti* is a small mosquito, smaller than the stilt (mosquito of the Culex genus), his body is covered with transparent stripes and wings. The male is a vegetarian and the female needs blood to feed her eggs. Urban mosquito and opportunist live, flies and stings in an area of maximum 200 meters around. He loves hot, dark places with lots of water ... Therefore, he is very adapted to the tropical regions like Rio de Janeiro. The presence of *Aedes aegypti* in urban areas represents a potential risk of diseases to the population, because we know that *Aedes aegypti* is the mosquito that transmits dengue, urban yellow fever, chikungunya and Zika virus. Recently, since, 2015, the Zika Virus (transmitted by *Aedes aegypti*) was associated with an increase in cases of infants with Microcephaly disease in Brazil.

But we must not forget that mosquitoes play an important role in our ecosystems as pollinators, they serve as food for animals, such as frogs, fish, birds and others.

Aedes aegypti places eggs in containers such as cans and empty bottles, tires, gutters, uncovered water boxes - wasted ice cream boxes -, dishes under plant pots, or any other object that can store rainwater. The mosquito can also look for natural breeding grounds, such as bromeliads, bamboos and tree leaves. Research has shown that large containers such as water tanks, gallons and vats (widely used for storing water for domestic use) and dark tires are the breeding sites that produce more mosquitoes, such as *Aedes aegypti*, and therefore are the most hazardous waste.

In a competition of deposits, it was possible to observe and verify that the highest number of mosquitoes in urban areas as in the school environment (larva stage) has a positive correlation

with the type of breeding site. That is, free artificial reproduction sites are preferred over artificial captive breeding sites (transparent PET bottle traps) even if they are put side by side and full of smelling fish food.

1. Research Question and Hypothesis

Figure 1. Free artificial Containers *near* Captivity Traps = Which one is the preferred Aedes female?

When we put artificial captive breeding sites (traps) - full of attractive smelling fish food pick to attract the female mosquito - side by side with free artificial breeding sites (wasted ice cream boxes) what kind of deposit will the mosquito females choose to lay their eggs (Figure 1)?

Mosquitoes are widely distributed throughout the world and they utilize different water bodies for their breeding. Many species put their eggs in both natural and artificial containers such as pools, tires, coconut shells, tree holes, bamboo stumps etc. The distribution of mosquitoes is influenced both directly and indirectly by climatic and environmental factors. Mosquitoes prefer an environment with certain resources (food, shelter, breeding sites, favorable temperature and suitable humidity) in sufficient amount and at appropriate time for survival and development.

The recent increase in ecological and environmental changes due to agricultural activities and urbanization has been observed to contribute to the appearance of various mosquito species and to increase genus where were not possible before. (*Brazilian Journal of Health Research (2008), Vol. 10)*

In this paper, we will demonstrate, for a better comparison between free breeding sites (wasted ice cream boxes) and artificial captivity deposits (traps with transparent PET bottles), that in a competition for laying eggs by the mosquito female, it is positive the difference for free breeding sites in the incidence of mosquitoes in the two types of breeding sites. The Free breeding sites by the contact and volume area would be chosen to the detriment of the transparent PET bottle traps.

Free breeding sites even if they are put side by side with the artificial captive deposits (transparent PET bottle traps) full of smelling fish food would be chosen over by the female mosquito to lay their eggs.

2. Materials and Methods

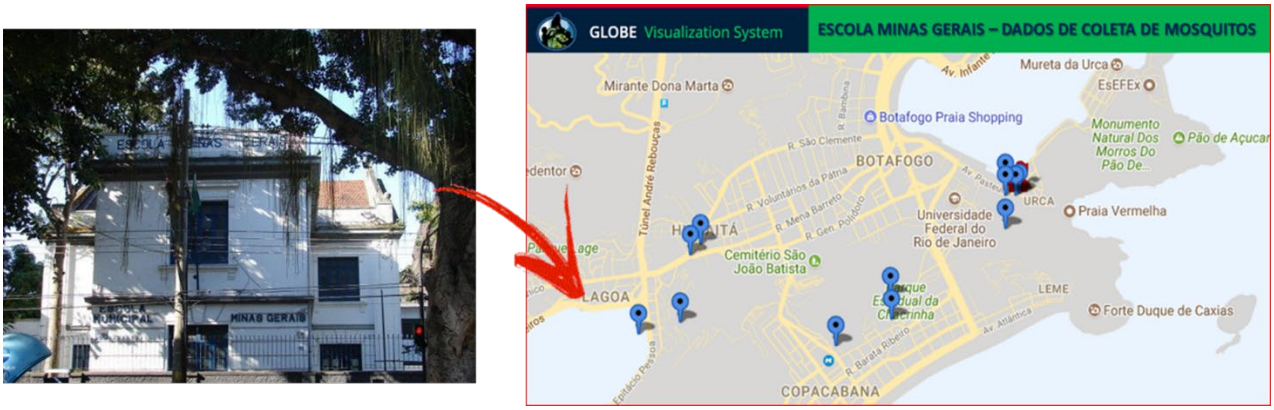


Figure 2. Location of the study site in Minas Gerais School, Urca district, Rio de Janeiro city, RJ/ Brazil.

The study site was located at Escola Municipal Minas Gerais, in Urca district, Rio de Janeiro /RJ – Brazil (22°95' S, 43°17'W, cf. Figure 2). The research was conducted from February to May 2018. Observations were made using:

Materials:

- Transparent PET bottle Traps for mosquito larvae.
- ice cream boxes used as free deposits.
- Mosquito Habitat Mapper app.
- GLOBE Collection Kit for field capture.
- Charts of Research Institutions (FIOCRUZ).
- Graphics elaborated by students according to GLOBE data.

Search Methods:

Two traps and also two free artificial breeding sites of the same dimensions (side by side) were installed to capture and collect mosquito data, mainly the *Aedes aegypti* mosquito whose female is the main transmitter of the diseases: Dengue, Chikungunya and Zika virus.

The traps were monitored weekly from February to May 2018. The Trap Network was installed to cover the entire extension of the school garden.

The breeding sites, for being of worse maintenance (risk of producing adult mosquito faster) were monitored, every 3 days, from February to May 2018.

The method applied for gathering and collecting data was the Mosquito Habitat Mapper application, from GLOBE that helped collect data, identify the larvae found and make it possible to reduce the breeding sites of mosquitoes with these deadly diseases.

Remembering that given zero is always important, being it that determines the emergence/return of the mosquito to the studied areas were sent by the application all type of data including zero.

Figure 3. Student using the GLOBE Mosquito Habitat Mapper app.

3. Data Summary and Analysis

An important part of this project was the way of storing, treating and visualizing the data, since a study like this generates a large amount of data, requiring specific tools; for this, was used the GLOBE Mosquito Habitat app, mosquito larvae hydrology protocols and GLOBE website as tools to data visualization and graphics production.

DATES, COUNT and TYPE OF BREEDING sites collected in the garden of E. M. Minas Gerais.

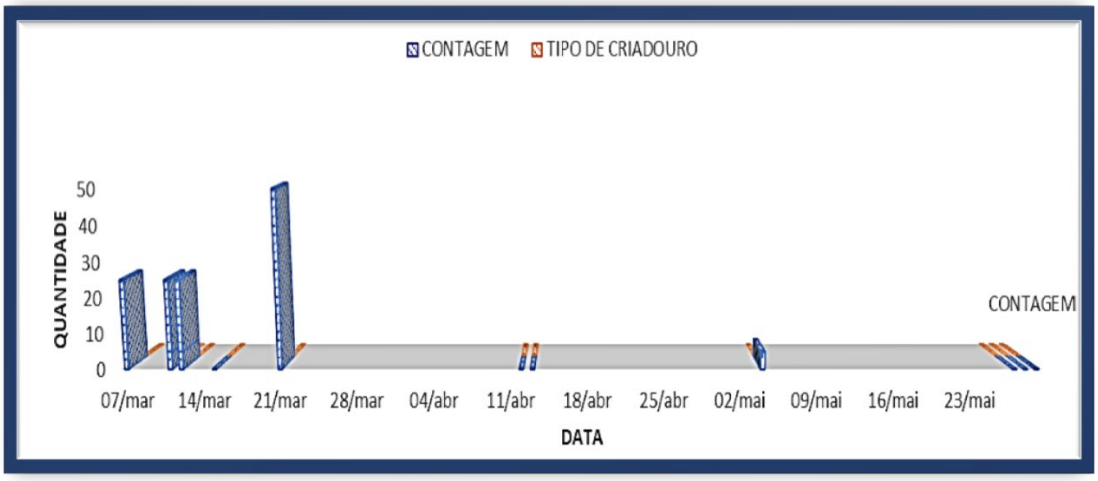
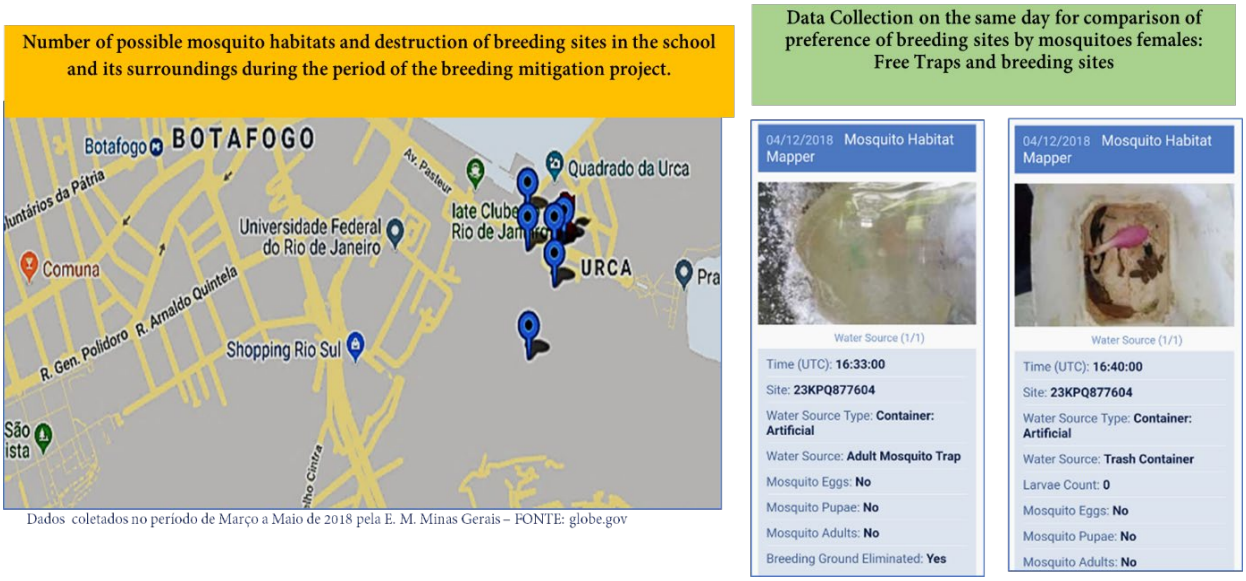


Figure 4. Data collected from breading sites – February to May 2018 using the app – SOURCE: globe.gov



Dados coletados no período de Março a Maio de 2018 pela E. M. Minas Gerais – FONTE: globe.gov

Figure 5. Data collected by school students from February to May 2018-E. M. Minas Gerais – Mosquito Habitat Mapper app

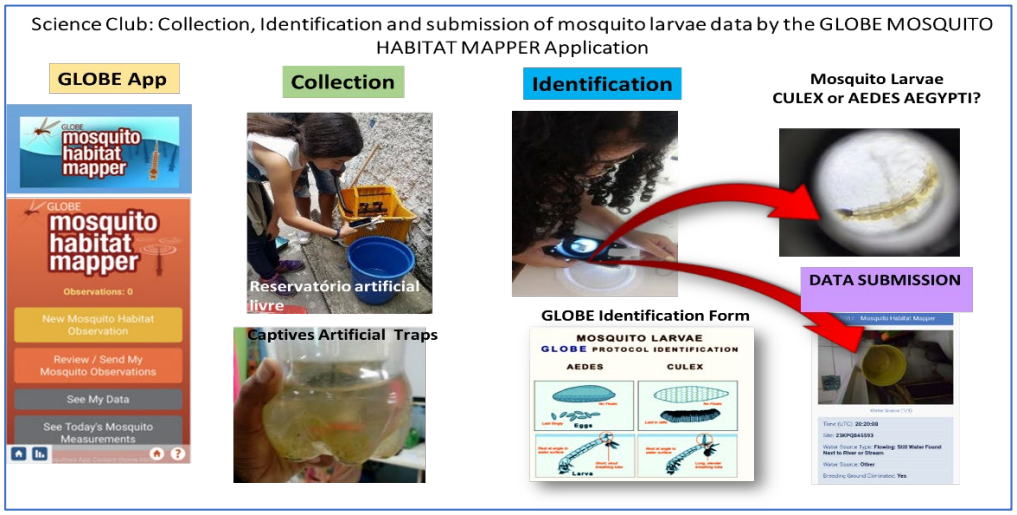


Figure 6. Minas Gerais school mosquito research from Nov. 2016 to Feb. 2019 using the app. SOURCE: globe.gov

4. Results, Conclusions, Discussion

Results

In the data collected by the GLOBE Mosquito Habitat Mapper application, mosquito positivity (number of larvae), that is, preference for egg laying by the mosquito female, was observed in the free artificial breeding sites - wasted ice cream boxes - in detriment to the captive artificial traps of transparent PET bottle with smelling fish food placed side by side to them.

The graphic of figure 4, there is an increase in the incidence of mosquitoes in samples collection, on days 07/03, 14/03 and 21/03, in free breeding sites, placed side by side with captive artificial traps in the school garden.

The samples of the observed days with higher incidence of larvae showed a diversity of mosquitoes, with specimens of the genera Aedes and Culex.

After which data observation, we performed the analysis and interpretation of the results found through comparative graphics, spreadsheets, research on sites FIOCRUZ, NASA and reports of incidence of diseases in the Municipal Health Department.

In Brazil, *Aedes aegypti* larvae research is used to calculate the level of mosquito infestation and, therefore, to estimate the risk of epidemics of diseases, as recommended by the World Health Organization. For this, traps are used to develop larvae of *Aedes aegypti* mosquitoes, in the monitoring and control of mosquitoes that transmit dengue, chikungunya and Zika Virus.

Our results have made us support our hypothesis

The Comparative analysis when we cross the data collected from incidence, increase and proliferation of mosquitoes, that is, preference for laying eggs by the female mosquito, among the data of larvae in artificial deposits of captivity-bottle traps Transparent PET with smellinf fish food– and free breeding sites – ice cream boxes wasted – in the school gardens, showed that, in a deposit competition, there is a higher incidence of mosquitoes in free breeding sites – ice cream boxes wasted –. (Figure 5) The collected data show a great diversity of mosquitoes in the two types of containers (breeding sites) surveyed.

Figure 7. Minas Gerais school mosquito larvae identification specie and genus from mosquito using the app.

Discussion

Our study in addition to captive breeding sites with smelling fish food (transparent PET bottle traps) used data from free artificial breeding sites – (ice cream boxes wasted) placed side by side with traps, in two places in the school gardens and thus obtaining information on the

incidence, quantity and proliferation of mosquitoes in order to compare their results with those of the captive larvae and conclude the best place of preference for laying eggs by the mosquito female.

The results show that in a deposit competition, the free artificial breeding sites – ice cream boxes wasted – by the contact and volume area are more attractive to mosquito females than the transparent PET bottle traps, even if the traps are full of smelling fish food.

We Think it would be important to highlight, to the researchers of the Mosquito *Aedes aegypti* and his diseases - Dengue, Chikungunya and Zika virus - , and also to the Public Health Institutions, as well as other students, the importance of use, as traps, of deposits simulating the free artificial containers; such as, ice cream boxes wasted, tires and water reservoirs: the favorites of mosquitoes.

We conclude that in a competition of deposits, there is a greater positivity of mosquitoes of urban areas in the school environment (number of larvae) and these show a positive correlation with the type of breeding place.

The graph (Figure 8) shows that the number of larvae collected increases considerably in free artificial breeding sites (boxes of ice cream wasted) compared to captive artificial breeding sites (PET bottle traps) even if they are put side by side with traps full of smelling fish food.

Conclusion

Our study used free breeding sites (wasted ice cream boxes) and artificial captive deposits with smelling food (traps) placed side by side in the school gardens to collect information on the incidence, quantity and diversity of mosquitoes in order to compare their results and to distinguish the location of breeding preference of the female mosquito.

We conclude that in a competition of deposits, there is a greater positivity of mosquitoes in the school gardens (number of larvae) in relation to their type of breeding place.

The graph (figure 8) shows that the number of collected larvae increases in free artificial breeding sites - wasted ice cream boxes (blue) - compared to the artificial PET bottle traps (red) placed side by side to them.

It was verified, in our research, that there is a greater variety of mosquitoes in free breeding sites - ice cream boxes, thus being the preferred place for laying eggs by the female mosquito.

Free breeding by contact area and volume would be chosen over artificial captive deposits (the transparent PET bottle traps) by the mosquito female to lay their eggs, even though the traps were full of smelling fish food that was used to attractive the female mosquito.

The graph shows that in the period observed the highest incidence of larvae occurred in free artificial containers (wasted ice cream boxes) found in the school gardens.

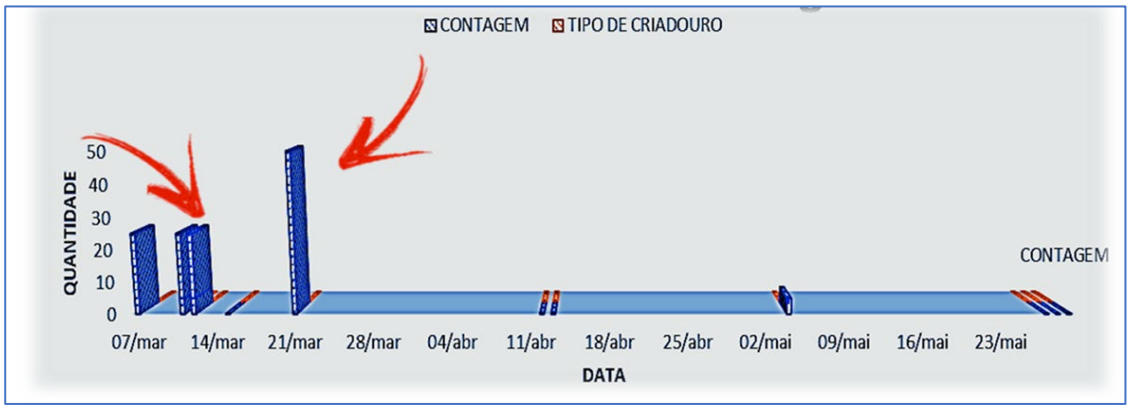


Figure 8 - Data of mosquito larvae collected from February to May 2018 by E. M. Minas Gerais – SOURCE: globe.gov

Mosquitoes are one of the deadliest animals in the world. Their ability to carry and spread disease to humans causes millions of deaths every year. In 2015 malaria alone caused 438. 000 deaths. The worldwide incidence of dengue has risen 30-fold in the past 30 years, and more countries are reporting their first outbreaks of the disease. Zika, dengue, chikungunya, and yellow fever are all transmitted to humans by the *Aedes aegypti* mosquito. More than half of the world's population live in areas where this mosquito species is present. Sustained mosquito control efforts are important to prevent outbreaks from these diseases. There are several different types of mosquitoes and some have the ability to carry many different diseases.

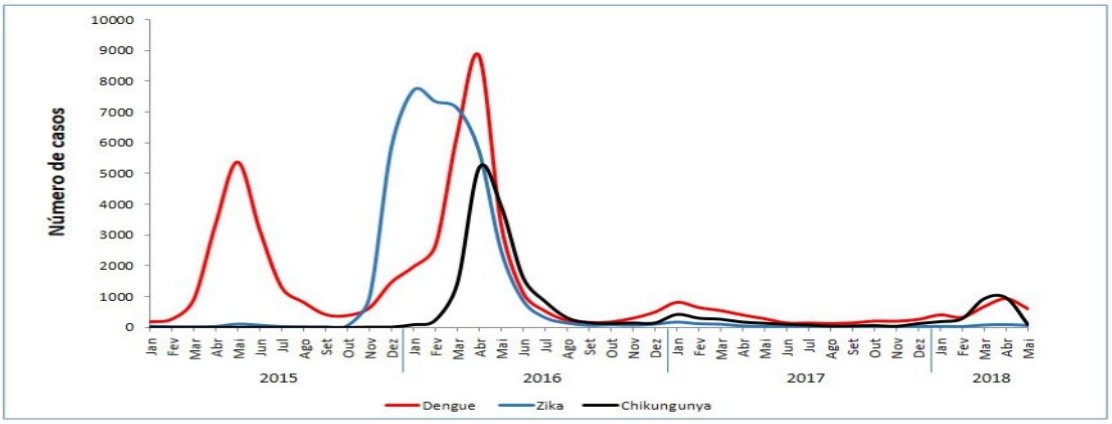


Figure 8 - Data from disease mosquito transmitted collected from 2015 to 2018 in Rio de Janeiro– Brazil. SOURCE: Portal ENSP - Projeto ZDC/ Escola Nacional de Saúde Pública Sergio Arouca - Fiocruz

Why do we need mosquito data?

We think it would be important to point out to the researchers of the *Aedes aegypti* mosquito and the diseases transmitted by it – dengue, chikungunya and zika – and to the Public Health Offices, as well as other students and the general population. Globally, there is a major effort to

use satellite data to predict the onset, decline, and spread of vector-borne diseases. Reliable soil-based data are useful for the development of realistic computational models based on satellite data.

In most parts of the world, soil verification data are simply not available - so GLOBE observations are extremely important in tracking and controlling disease. These satellites cannot distinguish between the places in your community - we need the "eyes in the sky", but also the "boots on the ground"! And the use of traps simulating containers artificial free, like tires and tanks of water, are the favorites of the mosquitoes and therefore can be safety use to know he data in regions and places that they are not available to collect directly from the free mosquito breeding sites. (CODSI, RENEE)

We from the Minas Gerais Science School Club believe that climate change is real, and its phenomena are already affecting the dynamics of water and temperature and so it is also changing the area of distribution of mosquitoes on the planet. Our only solution is prevention. Work of an ant, but that gains results!! Prevention is our only and last chance!!

5. Acknowledgements

We thank Minas Gerais, Principal Deinze Marzal and School Coordinator Tania Campos, FIOCRUZ (Elimina dengue Project), Go Mosquito Community, GLOBE Mission Mosquito, Dr. Russanne Low and Renee Codsi from Institute for Global Environmental Strategies, AEB Brazilian Space Agency, Nadia Sacenco.

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7. Optional Badges for Scientist Skills

Collaboration

All the students worked together to provide a good work. During the development of the project, each of the student could stand out in their best performance. Therefore, they were able to show their specials skills.

- Juliana Villela, Fábio França, Barbara Mol: data collect, project summary, video elaboration, theoretical part and research on the subject.
- Gabriel Moraes, Tayná Santos, Camille Santos collection and production of exploitable data.
- Tayná Santos, Beatriz Lima, Sara Penna, Ana Sophia Pereira da Silva: art and preparation of the poster.

- Ana Sophia Pereira da Silva, Lucas Trindade, Camille Santos, Bárbara Lima Mol: drafting of the project.
- Juliana Villela: Video Presentation.

Community impact

Use of local data from the GLOBE Mosquito Habitat Mapper app and Globe site data collect from our school district makes it possible to characterize that the free breading sites are preferred from mosquito female to lay their eggs, and therefore, the extremally need to their mitigation. The use of GLOBE data from others site in Brazil and data from Municipal Health Department makes possible to show and compare that the Urca is a district that has *Aedes aegypti* and their density is higher in free artificial containers, - the female mosquito preference - and the importance of data zero to contain mosquito development in the schools and all the district.

Exploring STEM Careers

The GLOBE Mosquito Habitat Mapper was the application used in the Project. It is high performance that allows the visualization of geographic information as well as performing data collection in the field and uses the GPS functionality of the mobile terminals to provide localization intelligence in mapping projects. The data collected and recorded as well as all field documentation of possible habitat, genus identification and mosquito species, destruction of breeding sites - help students and scientists to investigate more effectively and more promptly the proliferation of enemies in support of our battle to combat mosquitoes of diseases such as dengue fever, yellow fever, chikungunya and the Zika virus.