2023 International Virtual Science Symposium

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School: Minas Gerais Science Club

1.TITLE

Is mosquito *Aedes Aegypti* human' new pet?

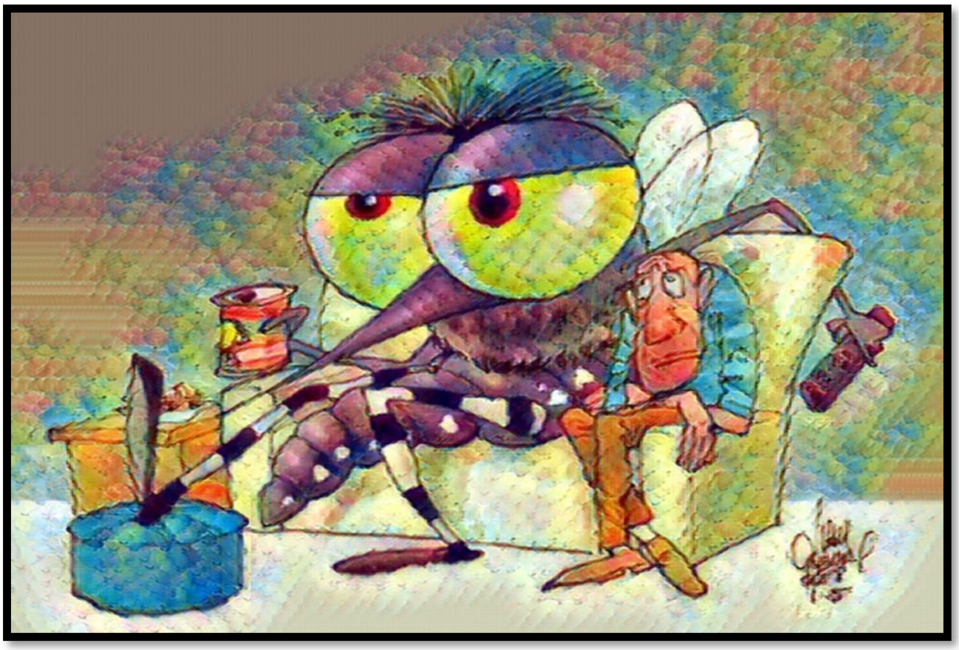

Figure 1.: *Is mosquito Aedes Aegypti human' new pet?*

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2. ABSTRACT

Arboviruses have become a major public health problem in recent decades, and it is essential to study the main breeding sites of mosquitoes, especially the species of the genus *Aedes*, specifically the *Aedes aegypti* mosquito, whose female uses domestic water containers as breeding sites for laying their eggs.

The goal of this study is to evaluate whether, in a competition of breeding sites, the mosquito, predominantly *Aedes aegypti*, prefers to spawn in domestic water deposits, which are found in human residences and surroundings, such as: catch traps, jars, clogged gutters, bottles, open waste, air conditioning trays, among others, making the mosquito the new human pet. The study analyzed the GLOBE data collected in three schools in Brazil: Rio de Janeiro, Olinda, and the Federal District.

The methodology that was applied has the bibliographic review on the genera of mosquitoes present around the three schools, the characterization of the area, data precipitation, investigation of breeding sites and the analysis of GLOBE data, copied from a period of four years, using Globe Observer mosquito habitat mapper app and Globe Observer atmosphere, and data visualization from GLOBE platform.

Our studies indicated that in 116 collection sites, larvae were found in 101 out of 119 water containers or possible breeding sites. The female mosquitoes lay eggs in different types of breeding sites, depending on the container. The types of breeding sites analyzed were classified into free artificial breeding sites (vessels/water jars, dishes, bottles, dripping pans, defrosting containers in refrigerators, discarded garbage), capture artificial breeding sites (homemade traps/mosquitérica) and natural breeding sites (bromeliads, bamboos etc.). The precipitation data at the three locations shows similarity relating to breeding sites deposits indoors and showed variation in outdoors.

Our conclusions showed that the number of mosquito larvae increases with the increase in the number of containers in all collected sites and that in a competition of containers there is a positive correlation of mosquito larvae around houses, schools, villages, and churches, in free artificial breeding sites, followed by artificial breeding sites of capture and natural breeding sites, proportionally. The precipitation influences the amount of water stored in each container and determined the possibility of a new breeding site. The *Aedes aegypti* mosquito, had the highest incidence of most larvae collected in the three investigated sites, especially in artificial breeding sites, due to its opportunistic, adaptive and anthropophilic behavior and the expressive ecological capacity to adapt to various types of containers or water reservoirs.

Keywords: *Aedes aegypti*, oviposition, traps, breeding sites, arboviruses, mosquito behavior.

3. INTRODUCTION

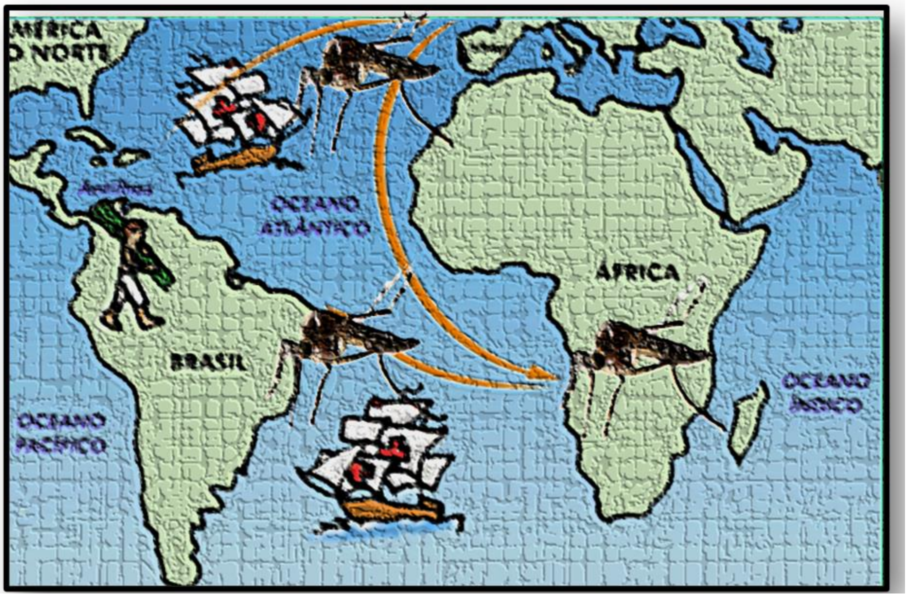


Figure 2.: *Aedes aegypti* was introduced in Brazil in the colonial period, probably during slave trade.

Arboviruses are diseases caused by viruses transmitted mainly by mosquitoes, being the female of the species *Aedes aegypti* the great villain. Arboviruses include urban yellow fever, dengue, Chikungunya, and Zika viruses, among others, and have been of great public health concern worldwide. *Aedes aegypti* was introduced in Brazil during the colonial period, probably during the **slave trade, by sea** (PAHO 1992). In Brazil, the mosquito is always associated with human domiciles (IOC/Fiocruz), although it has been found in rural areas, where they were taken in containers containing eggs or larvae, and it is considered a cosmopolitan mosquito, occurring in tropical and subtropical areas of the globe, and is not resistant to low temperatures at high altitudes. Brazil has a tropical climate with well-distributed rainfall throughout the year, moderate in winter and high in summer. The precipitation can influence the amount of water stored in water containers and create the risk of a new breeding site.

In recent years, the incidence of diseases caused by **arboviruses has shown a relevant global increase**, which is correlated to factors such as faster and more geographically extensive dispersion of viruses due to the intensive growth of global transportation systems, adaptation of vectors to increasing urbanization, inability to contain the mosquito population, and changes in environmental factors. In addition to the elements that favor the spread of diseases, Brazil represents a country with optimal environmental conditions for the permanence and dissemination of vector mosquitoes, such as *Aedes aegypti* (Gregianini et al., 2017).

Arboviroses, particularly dengue, are global threats and are spreading in urban and semi-urban areas in many countries. Controlling the spatial distribution of breeding habitats of the *Aedes aegypti* mosquito is essential for cost-effective implementation of habitat mitigation and disease control practices. In the absence of effective vaccine and specific treatment for most Arboviroses, except for yellow fever, it is important to maintain and integrate continuous entomological and epidemiological surveillance in order to direct control and prevention methods against these Arboviroses in the country.

Given this problem, the **control of these diseases** and their prevention through measures to combat the mosquito transmitters requires the participation and mobilization of the whole society. Schools, as a space for health education, are a strong instrument for disseminating information to the entire community, guiding the population on how to act in the fight against this vector.

The evaluation of the behavior of mosquitoes through the analysis of different types of breeding sites, such as the use of traps in different locations around the school and field research in the school environment, contributes to a greater impact and promotion of the importance of environmental education in the control of arbovirus vectors and their behavior in the daily lives of students.

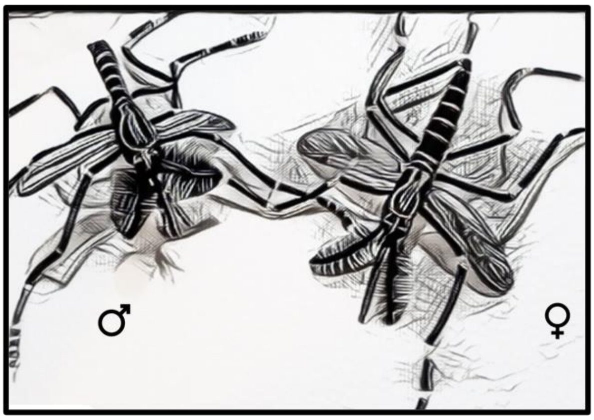


Figure 3.: *Aedes aegypti* male and female anatomies.

Smaller than common mosquitoes, the ***Aedes aegypti*** is black with scratches forming a small bowl-like design on its thorax and white stripes on its head and legs. Its wings are translucent and the noise they make is practically inaudible to humans.

The male, like those of any species, feeds exclusively on fruits. The female, however, needs blood to mature the eggs, which are laid separately on the inside walls of objects, near surfaces of clean water, where they have better survival conditions. Strategically, the female scatters eggs in different places to ensure the success of the larvae. Every four days the female collects blood through her bites. She does not need this blood to live, but only to make eggs. With this blood she produces about 100 eggs and goes out laying a little bit in each place. Other mosquitoes don't do this. This strategy of the *Aedes* is very efficient, in this sense ensuring the propagation of the offspring.

Unlike other mosquitoes, the eggs can stay dry for up to a year. The larva is ready inside the egg and waits for the next contact with clean or dirty water. As soon as there is moisture, the larva continues the evolutionary cycle. The period between the hatching of the egg and the adult stage of the mosquito takes, on average, seven to ten days. The female only flies away if she needs to. The more people she bites in her surroundings and the more places she has available to lay her eggs, the less she will fly and the longer she will live. The adult mosquito lives an average of 30 days. (www.aml.com.br)

According to Fiocruz (2019), the *Aedes aegypti* mosquito is born and reproduces in water containers, such as artificial ones, like empty cans and bottles, tires, gutters, uncovered water tanks, dishes under plant pots or any other object that can store rainwater. The mosquitoes can also seek natural breeding sites, such as bromeliads, bamboos, and holes in trees, and can also multiply in artificial breeding sites, such as home-made larva traps.

Everyday activities of residents combined with their habits and customs, produce a greater amount of urban solid waste that is composed of plastic containers, bags, bottles, cans; these when disposed in inappropriate places, facilitating the evolution of sanitary problems, this situation, together with the routine of the population, **become a condition of risk to the proliferation of mosquitoes.** These habits and customs emerge as important factors when related to epidemiology, due to the issue of the emergence of breeding sites, the occurrence of high rainfall rates and the influence of temperature favoring the development of foci and proliferation of mosquitoes, especially of o mosquito *Aedes aegypti* constituting a public health problem.

According to Soares et al (2008), A. *Aedes aegypti* is opportunistic, taking advantage of its great ecological plasticity of adaptation to artificial breeding grounds, being found in several types of containers that hold water becoming potential breeding sites, this capacity would have been a huge step towards to anthropophilic behavior.

The opportunistic habit of the mosquito (IOC/Fiocruz) of living where there are good conditions for food and reproduction, its great ease in adapting to the environment, biting people at any time of the day, **made the *Aedes aegypti* a new 'pet'.** (Assessoria AML) The females prefer human blood as a source of protein to that of any other vertebrate animal. They attack in the early morning or at dusk. Their saliva contains an anesthetic substance, which makes the bite almost painless. Both females and males take shelter inside houses or in the surrounding neighborhood.

We **propose in our research** that, due to its opportunistic, domestic, and urban behavior (IOC/Fiocruz), in a competition of breeding sites, the female mosquito, the *Aedes aegypti*, prefers to spawn in water deposits that are in its surroundings, such as: plant pots, clogged gutters, bottles, open garbage, air-conditioning trays, among others, that is, free artificial breeding sites.

The present study aimed to evaluate the behavior of mosquitoes, focusing on the specie *Aedes aegypti*, in different breeding sites, proving their opportunistic and domestic habits and, thus, having significant elements to generate a risk map, monitor Arboviroses and perform positive actions to prevent mosquito-borne diseases. To this end, an assessment was made of GLOBE data collected in schools in three locations in Brazil: Rio de Janeiro, Olinda, and the Federal District.

The study chose to analyze data collected using the mosquito hydrology protocol of the Globe Observer - Mosquito Habitat Mapper app and Globe Observer atmosphere visualization from GLOBE platform.

Figure 4.: Mosquito identification using GLOBE Mosquito Habitat mapper and magnifying glass.

4. RESEARCH QUESTION AND HYPOTHESIS

QUESTION

In a breeding competition, the behavior of the mosquito determines the type of container chosen for ovoposition, especially for the *Aedes aegypti* species?

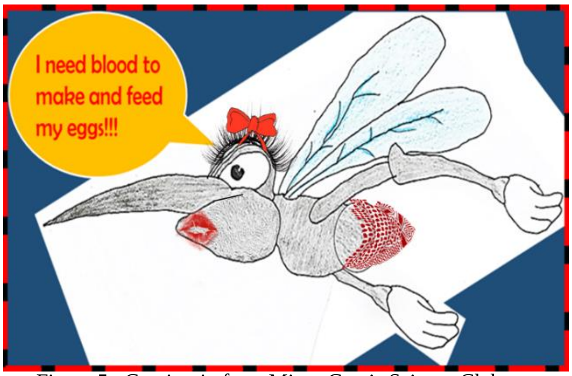


Figure 5.: Comic trip from Minas Gerais Science Club

HYPOTHESIS

Because it has opportunistic, domestic, and urban behavior (IOC/Fiocruz), in a competition of containers for breeding sites, the *Aedes aegypti*, prefers to spawn in water deposits that are in its surroundings, such as: pots of plants, clogged gutters, bottles, open waste, air conditioning trays, capture traps, among others.

5. MATERIALS AND METHODS

DATA COLLECTION

An important part of this research was the way to store, treat and visualize the data, since a study like this generates a large amount of data, requiring specific tools. For this we used data collected in Globe Mosquito Habitat app, mosquito larvae hydrology protocol, and atmosphere (precipitation and air temperature) data stored in GLOBE platform.

The mosquito larvae analysis was carried out based on GLOBE data collected in schools in three Brazilian cities: Rio de Janeiro, Olinda and Sobradinho, located in the respective geographic coordinates 22°57' S, 43°11' W; 8°073' S; 34°88' W; 15°63' S, 47°82' W, in the period from 2018 to 2022.

The schools were chosen because they had the three types of breeding sites intended in the research (Table 1) and similarity in the precipitation data at time chosen (Diagram G; H). A total of 116 data collections of data stored on the GLOBE platform.

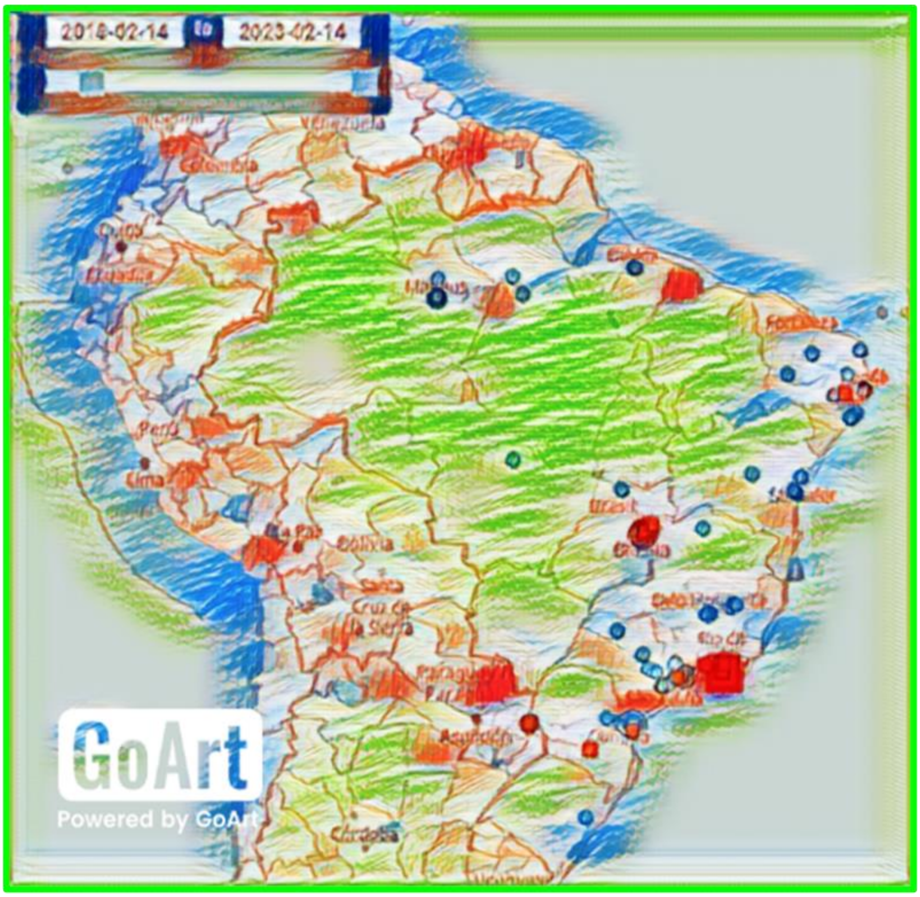


Figure 6: GLOBE map of the study with the mosquito data collected in the three cities analyzed.

ENTOMOLOGICAL STUDIES

Data analysis was performed on mosquito larvae from free artificial breeding sites (Vessels / jars with water, dish, bottles, drip pan, defrosting containers in refrigerators, discarded garbage), artificial capture sites (traps / mosquitoes) and natural breeding sites, to monitor the opportunistic behavior through oviposition of the female mosquito, in particular, *Aedes aegypti*, the main transmitter of Arboviroses: Dengue, Chikungunya, Urban Yellow Fever and Zika.

STUDY SITES

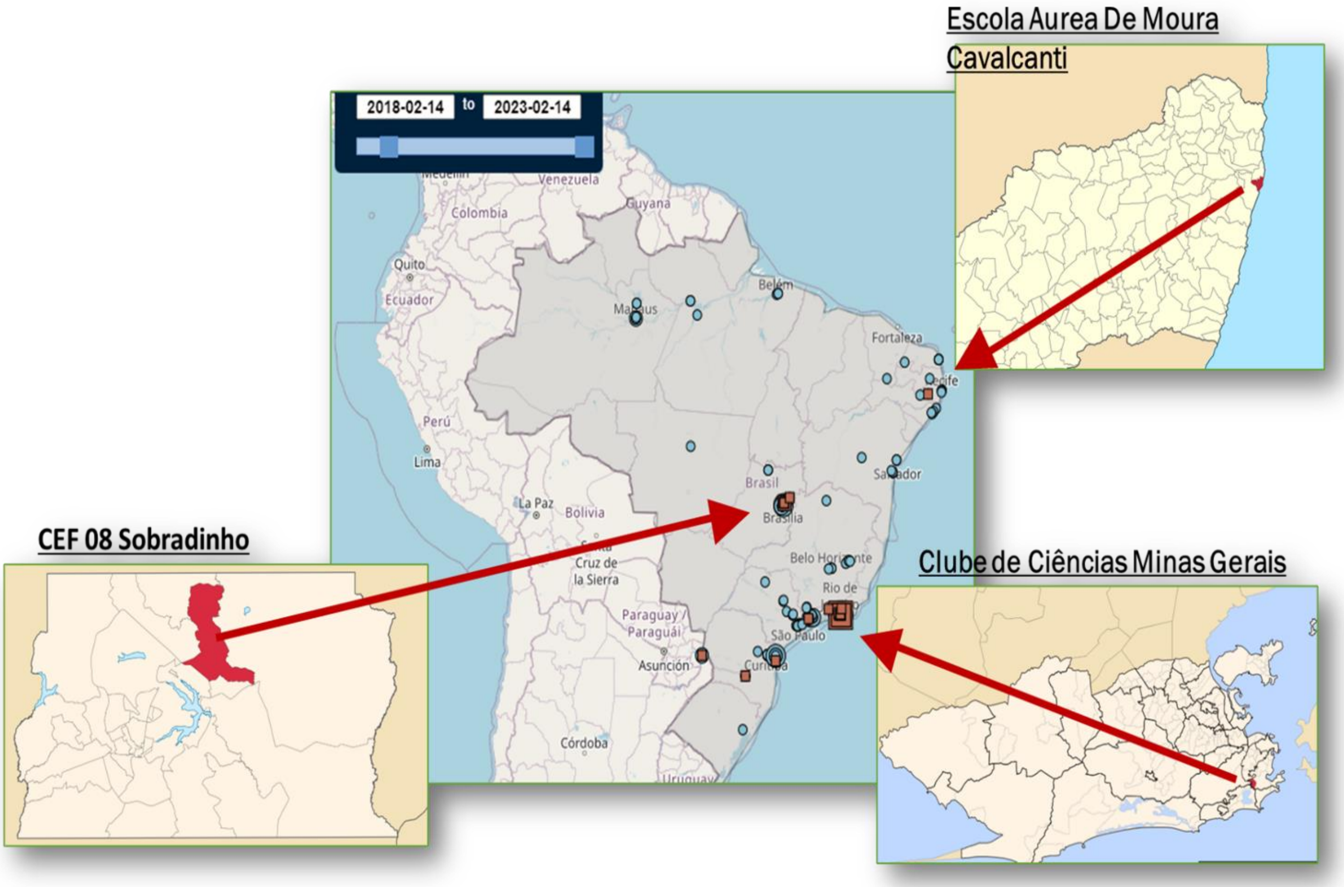


Table 1. GLOBE map of the study with the mosquito data collected in the three cities analyzed.

DATA COLLECTION USING GLOBE PROTOCOLS FROM THE THREE STUDY SITES

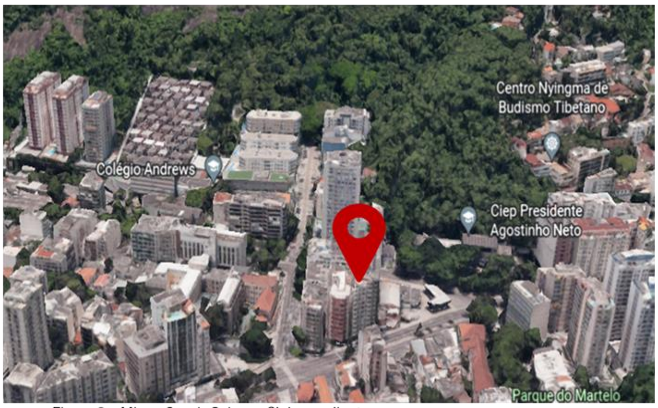
Study site 1

Minas Gerais Science Club, Rio de Janeiro located in Humaitá district, Rio de Janeiro /RJ – Brazil (22°57' S, 43°11'W). The research collected data from February 2018 to November 2022.

Figure 7:. Minas Gerais Science Club map with mosquito data collected from the GLOBE platform from 2018 to 2022.

Rio de Janeiro, the city where Minas Gerais Science Club is located has a latitude of 22°57'S, and a longitude of 43°11'W. The capital of the state has an estimated population of 6.748 million inhabitants, and is considered a megalopolis, a city primarily for housing, commerce and tourism, and is located between the mountains and the Atlantic Ocean.

Rio de Janeiro is part of the Southeast Region of Brazil, inserted in the Atlantic Forest biome, which is the most endangered forest in the country, with only 12.5% of its area preserved. The climate of the city is predominantly humid tropical, influenced by the moist air masses coming from the Atlantic Ocean. Its average temperatures and air humidity are high throughout the year and the rains are regular and well distributed.



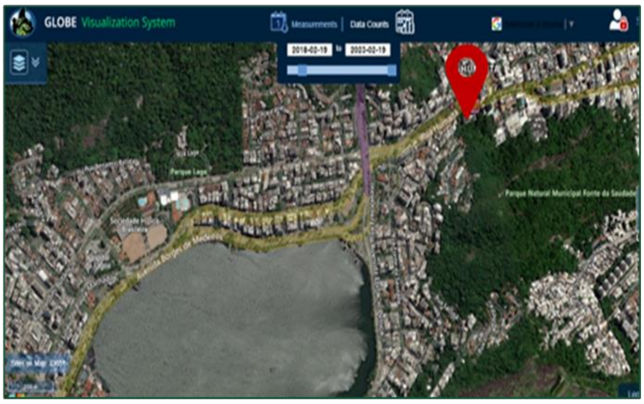


Figure 8:. Minas Gerais Science Club coordinates.

97 data collections – 77 larvae

- ✓ 10 free artificial containers with 7 larvae
- ✓ 85 artificial capture containers with 69 larvae
- ✓ 2 natural container - 1 larvae

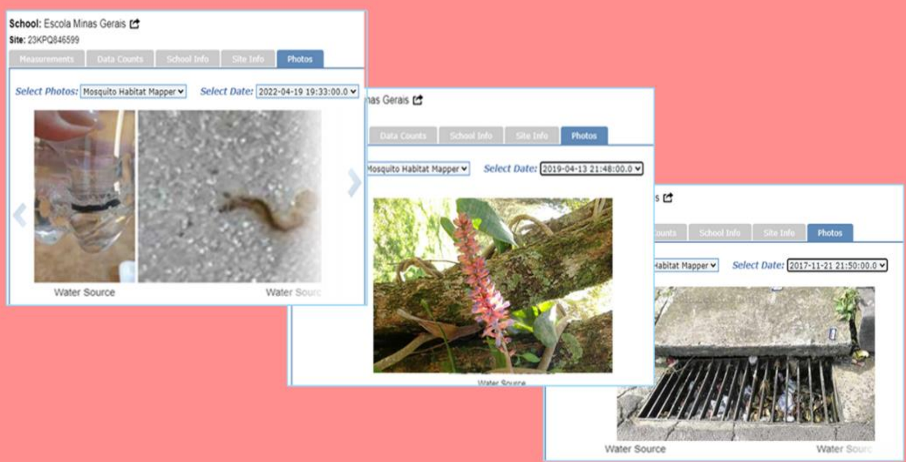


Figure 9:. Minas Gerais Science Club' mosquito data free artificial containers using MHM (2018-2022).
Figure 10:. Minas Gerais Science Club' mosquito data from capture containers using MHM (2018-2022).
Figure 11:. Minas Gerais Science Club' mosquito data from natural containers using MHM (2018-2022).

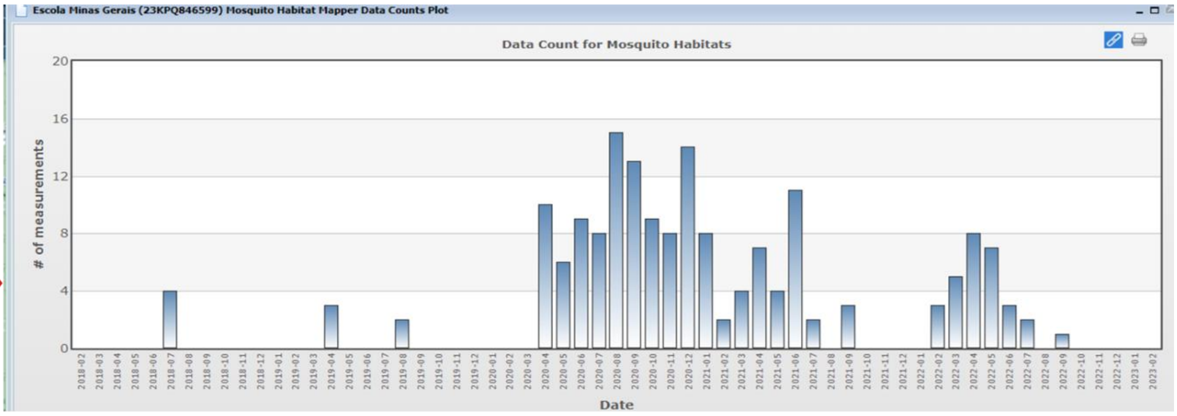
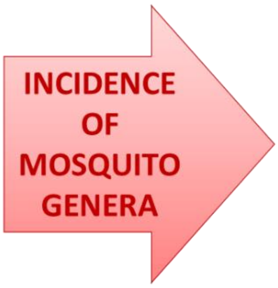


Table 2.A E 3.B- Data collected – mosquito data from 2018 - 2022. Minas Gerais Science Club - SOURCE:



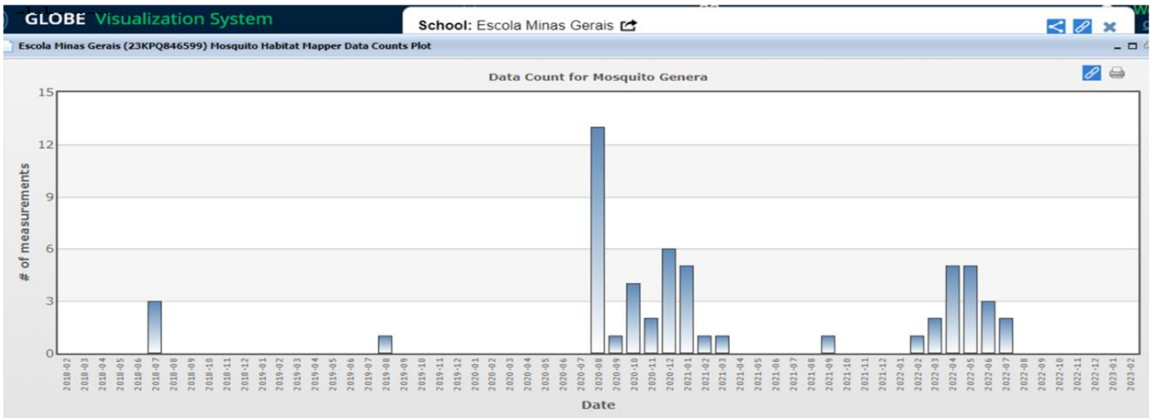
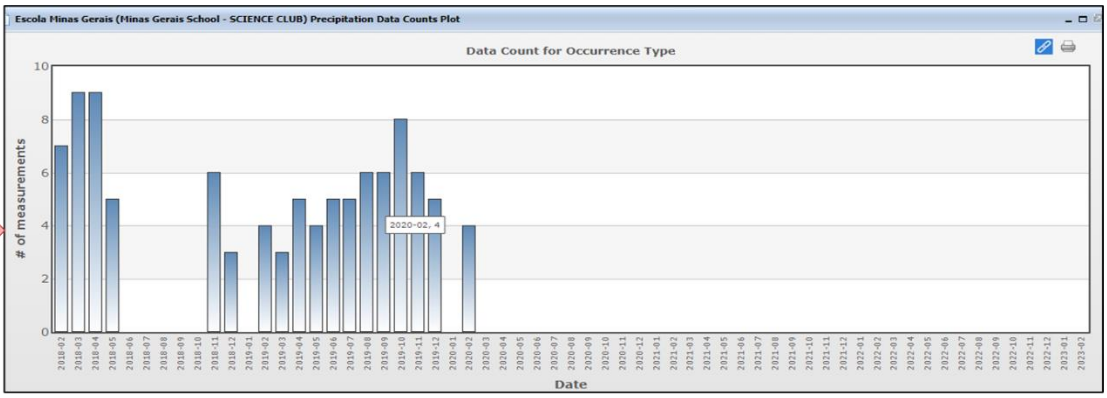
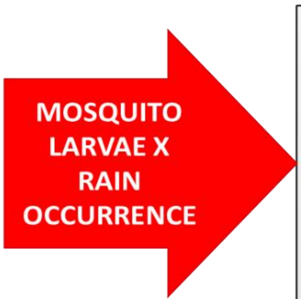
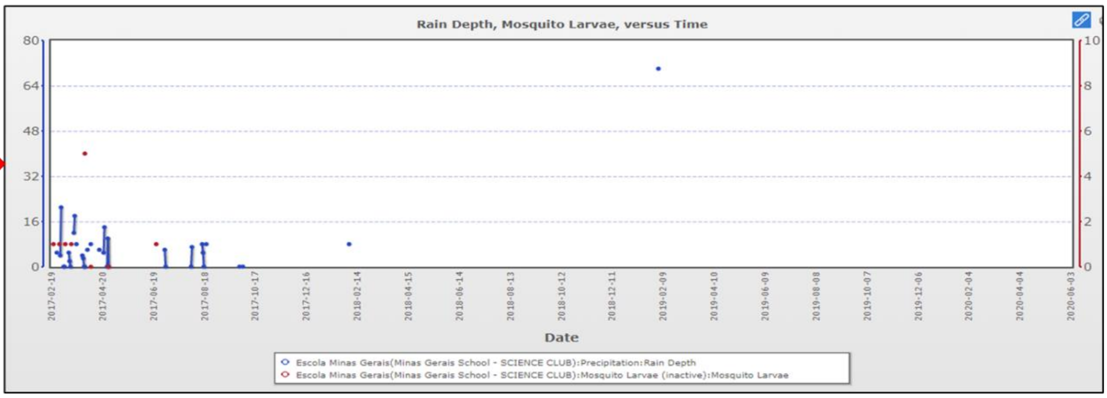


Table 3.A e 4.B- Precipitation data and comparison rain occurrence and larvae incidence from 2018 - 2022. Minas Gerais Science Club - SOURCE: globe.gov







AVERAGE AIR TEMPERATURE AND PRECIPITATION OF RIO DE JANEIRO IN A YEAR

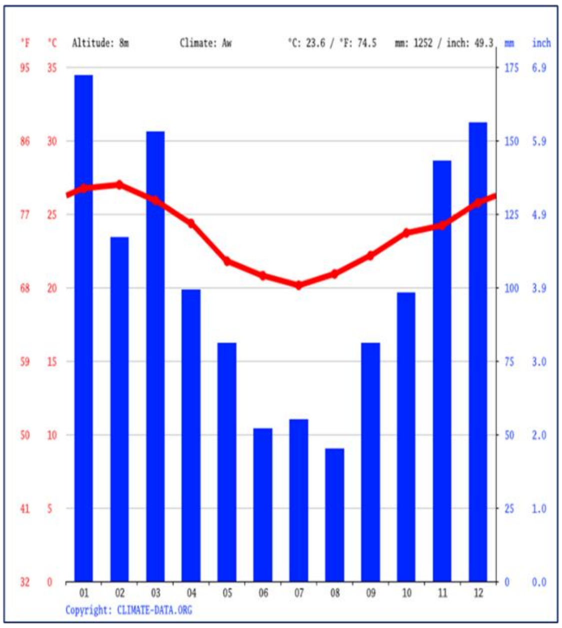
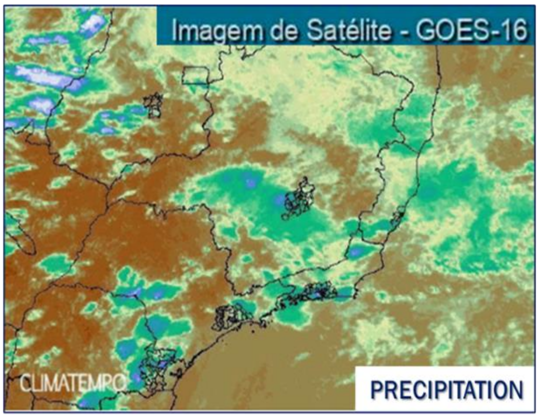


Diagram A. Average air temperature and precipitation of Rio de Janeiro in a year.



CLIMATOLOGICAL DATA FOR RIO DE JANEIRO 2018/2022

	Janeiro	Fevereiro	Março	Abril	Maio	Junho	Julho	Agosto	Setembro	Outubro	Novem-bro	Dezembro
Temperatura média (°C)	26.7	27	25.9	24.3	21.8	20.8	20.1	20.9	22.2	23.7	24.2	25.8
Temperatura mínima (°C)	23.3	23.3	22.7	21.1	18.2	16.8	16	16.5	18.1	20	21	22.4
Temperatura máxima (°C)	31.2	31.7	30.2	28.5	26.2	25.8	25.4	26.5	27.5	28.6	28.5	30.1
Chuva (mm)	172	117	153	99	81	52	55	45	81	98	143	156
Umidade(%)	79%	78%	81%	81%	81%	80%	79%	78%	75%	78%	80%	80%
Dias chuvosos (d)	12	10	12	10	9	6	6	6	8	9	12	12
Horas de sol (h)	9.8	10.0	8.8	7.9	7.2	7.0	6.9	7.3	7.2	7.4	7.7	8.8

Diagram B. Climatological data for Rio de Janeiro 2018/2022

Study site 2

Escola Aurea de Moura Cavalcanti, Pernambuco, located in Olinda /PE– Brazil (8°073’ S, 34°88’. The research collected data from February 2018 to November 2022.

Olinda, the city where the Aurea de Moura Cavalcanti School is located, has a latitude of 8°073'S, and a longitude of 34°88'W. A Brazilian municipality in the state of Pernambuco, it has an estimated population of 393,734 inhabitants in an area of 41.3 km². Olinda is an essentially residential, commercial, and tourist town, located in the Metropolitan Region of Recife, on the coast of the state of Pernambuco, six kilometers from the capital, bordering the Atlantic Ocean to the east.

Olinda is part of the Northeast Region of Brazil, inserted in the Atlantic Forest biome, which is the most threatened forest in the country, with only 12.5% of its area preserved. The climate of the city is humid tropical, typical of the northeastern east coast, with average monthly temperatures of 25 °C. and "the highs can exceed 30 °C.

Figure 12:. Aurea de Moura Cavalcanti School map with mosquito data collected from the GLOBE platform from 2018 to 2022.

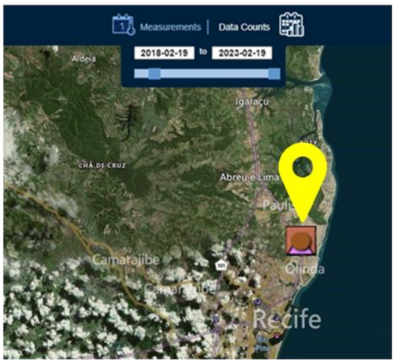


Figure 13:. Aurea de Moura Cavalcanti School location in Olinda city.

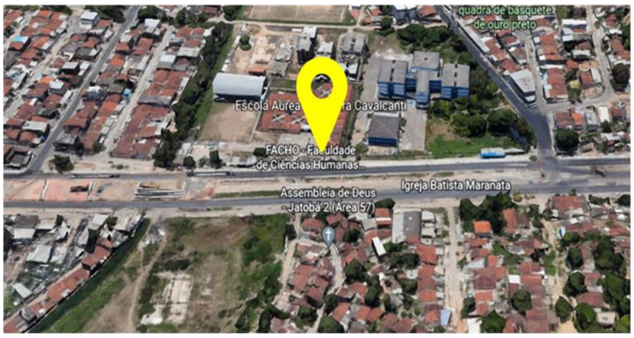


Figure 14:. Aurea de Moura Cavalcanti School coordinates.

5 data collections –
4 larvae

- ✓ 4 free artificial containers with 2 larvae
- ✓ 3 artificial capture containers with 2 larvae
- ✓ 1 natural container - 0 larvae

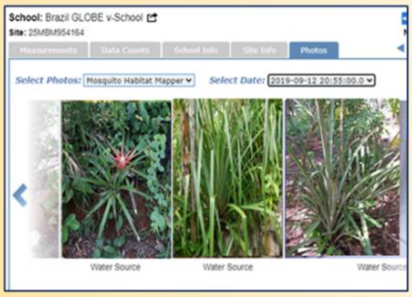
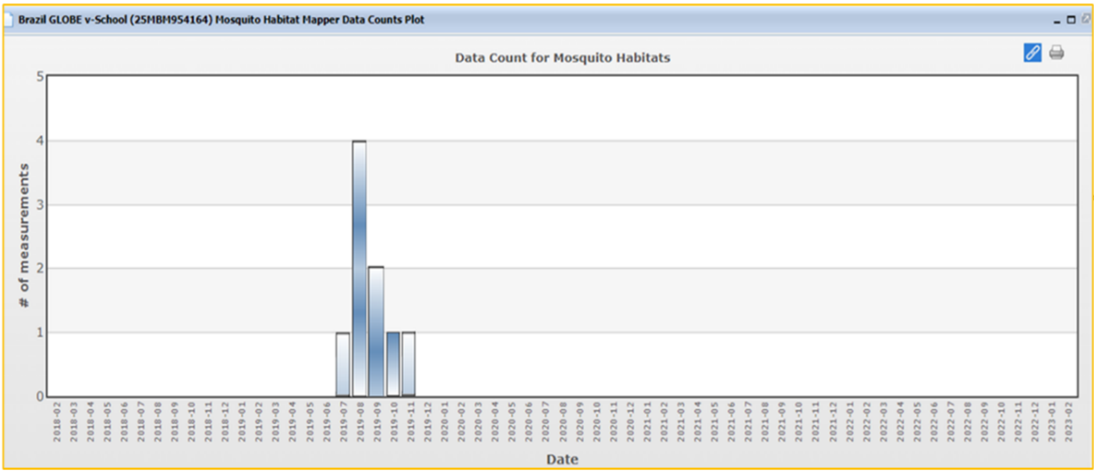


Figure 15:. Aurea de Moura Cavalcanti School ' mosquito data from three kinds of containers using MHM (2018-2022).



INCIDENCE OF MOSQUITO BREEDING SITES

Table 4. Data collected – mosquito habitat from 2018 - 2022. Aurea de Moura Cavalcanti School - SOURCE: globe.gov

INCIDENCE OF MOSQUITO GENERA

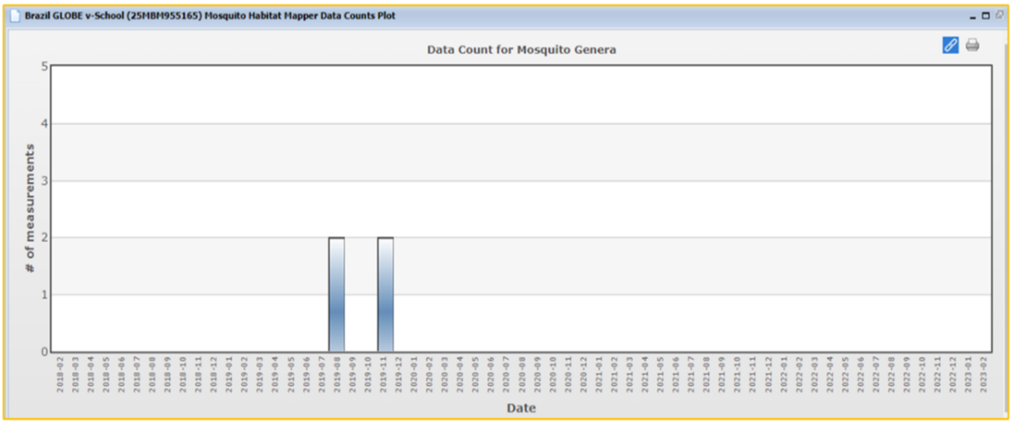


Table 5. Data collected – mosquito genera from 2018 - 2022. Aurea de Moura Cavalcanti School - SOURCE: globe.gov

AVERAGE AIR TEMPERATURE AND PRECIPITATION OF OLINDA IN A YEAR

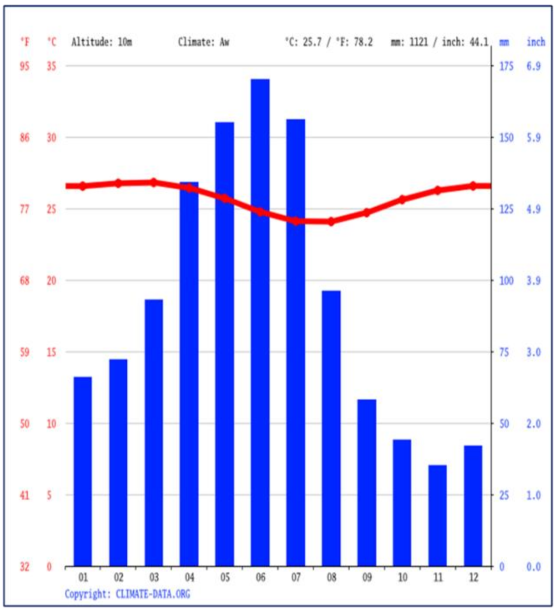
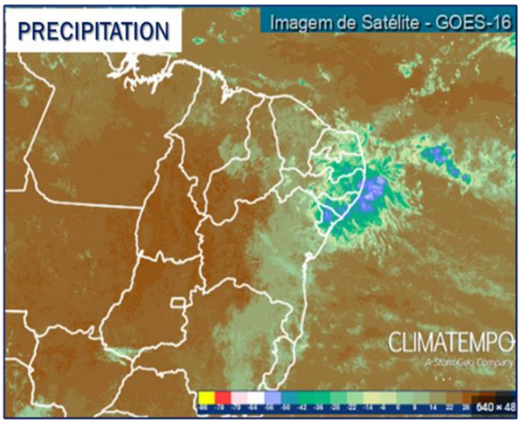


Diagram C. Average air temperature and precipitation of Olinda in a year.



CLIMATOLOGICAL DATA FOR OLINDA 2018/2022

	Janeiro	Fevereiro	Março	Abril	Maio	Junho	Julho	Agosto	Setembro	Outubro	Novem-bro	Dezembro
Temperatura média (°C)	26.6	26.7	26.8	26.4	25.7	24.8	24.1	24.1	24.7	25.6	26.3	26.6
Temperatura mínima (°C)	24.3	24.5	24.5	24.3	23.7	23	22.3	22.1	22.6	23.4	23.9	24.3
Temperatura máxima (°C)	29.6	29.7	29.8	29.2	28.3	27.2	26.5	26.7	27.5	28.6	29.4	29.6
Chuva (mm)	66	72	93	134	155	170	156	96	58	44	35	42
Umidade(%)	76%	76%	77%	80%	82%	83%	81%	78%	76%	74%	72%	74%
Dias chuvosos (d)	14	13	15	17	18	18	19	17	13	11	10	11
Horas de sol (h)	7.9	7.9	7.8	7.5	7.1	7.1	7.1	7.2	7.2	7.3	7.7	8.0

Diagram D. Climatological data for Olinda 2018/2022

Study site 3

CEF 08 Sobradinho, located in Cidade Satellite Sobradinho /DF – Brazil (15°63’ S, 47°82’W. The research collected data from February 2018 to November 2022.

Figure 16:. CEF 08 Sobradinho map with mosquito data collected from the GLOBE platform from 2018 to 2022.

Sobradinho is an administrative region of the Brazilian Federal District latitude 15°63' S, and longitude 47°82'W. It is located 22 kilometers from Brasilia, the capital of the country, today has about 85,491 inhabitants (PDAD 2010/2011) Sobradinho is part of the Center-West Region of Brazil, is entirely occupied by Cerrado, the second largest biome in South America. Sobradinho has a tropical climate, with an average temperature of 22 °C and variations ranging from 13 °C to 28 °C throughout the year. The period with more rain, generally strong and of short duration, is between the end of spring and the end of summer and makes the city greener.

Figure 17:. CEF 08 Sobradinho coordinates.

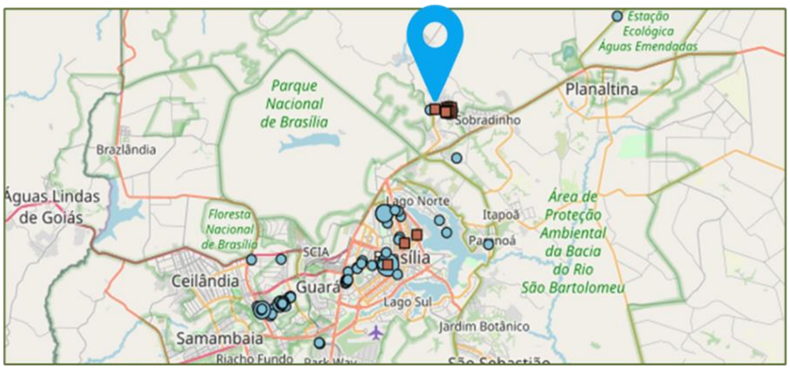


Figure 18:. CEF 08 Sobradinho location Sobradinho-, Distrito Federal.

14 data collections – 17 larvae

- ✓ 10 free artificial containers with 14 larvae
- ✓ 2 artificial capture containers with 1 larvae
- ✓ 2 natural container - 2 larvae

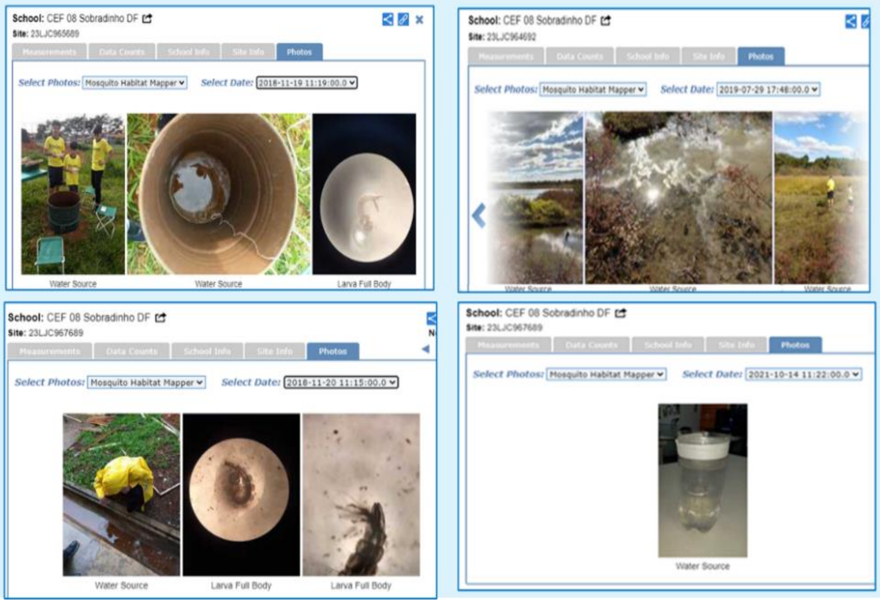
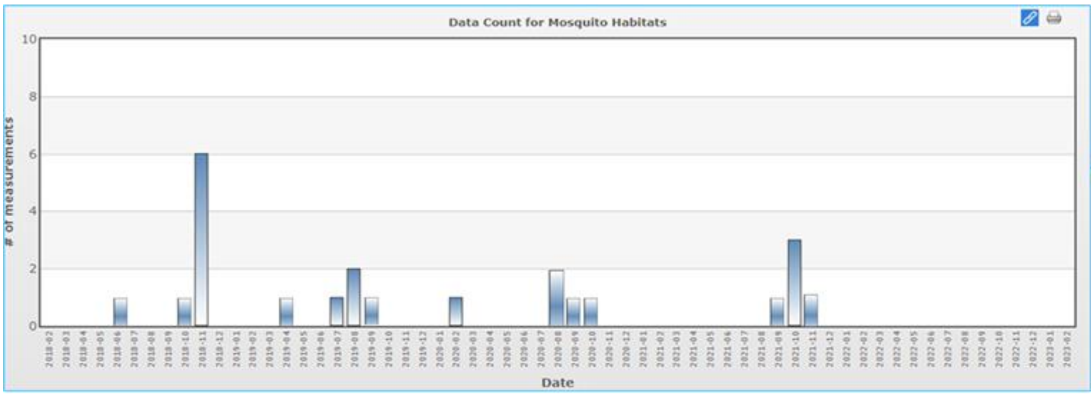


Figure 19. CEF 08 Sobradinho' mosquito data from three kinds of containers using MHM (2018-2022).



INCIDENCE OF MOSQUITO BREEDING SITES

Table 6. Data collected – mosquito habitat from 2018 - 2022. CEF 08 Sobradinho - SOURCE: globe.gov

INCIDENCE OF MOSQUITO GENERA

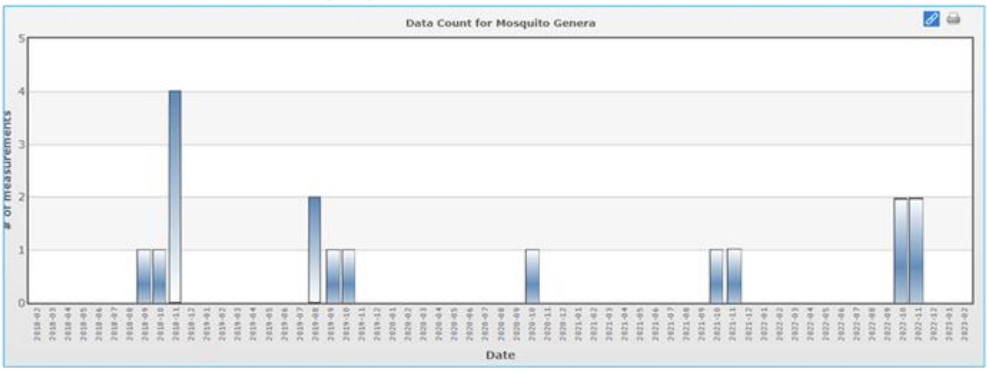


Table 6. Data collected – mosquito genera from 2018 - 2022. CEF 08 Sobradinho - SOURCE: globe.gov

AVERAGE AIR TEMPERATURE AND PRECIPITATION OF SOBRADINHO IN A YEAR

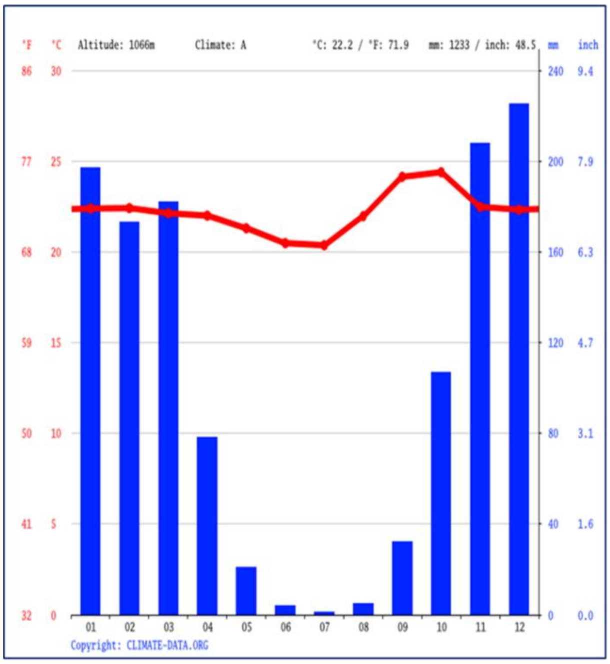
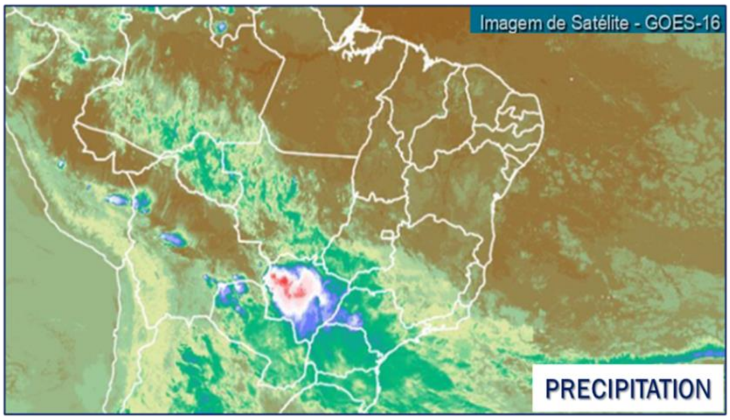


Diagram E. Average air temperature and precipitation of Sobradinho in a year.



CLIMATOLOGICAL DATA FOR SOBRADINHO 2018/2022

	Janeiro	Fevereiro	Março	Abril	Maio	Junho	Julho	Agosto	Setembro	Outubro	Novem-bro	Dezembro
Temperatura média (°C)	22.4	22.4	22.1	22	21.3	20.5	20.4	22	24.1	24.4	22.5	22.3
Temperatura mínima (°C)	18.8	18.7	18.6	18	16.7	15.6	15.2	16.4	18.7	19.6	18.9	18.9
Temperatura máxima (°C)	26.7	26.8	26.6	26.6	26.4	25.8	25.9	27.8	29.9	29.7	27	26.7
Chuva (mm)	197	173	182	78	21	4	1	5	32	107	208	225
Umidade(%)	77%	76%	78%	72%	62%	56%	50%	42%	42%	53%	74%	77%
Dias chuvosos (d)	15	14	15	9	3	0	0	1	4	10	16	16
Horas de sol (h)	8.9	8.9	8.3	8.6	8.9	9.2	9.6	10.2	10.4	9.9	8.8	8.9

Diagram F. Climatological data for Sobradinho 2018/2022

DATA ANALYSIS

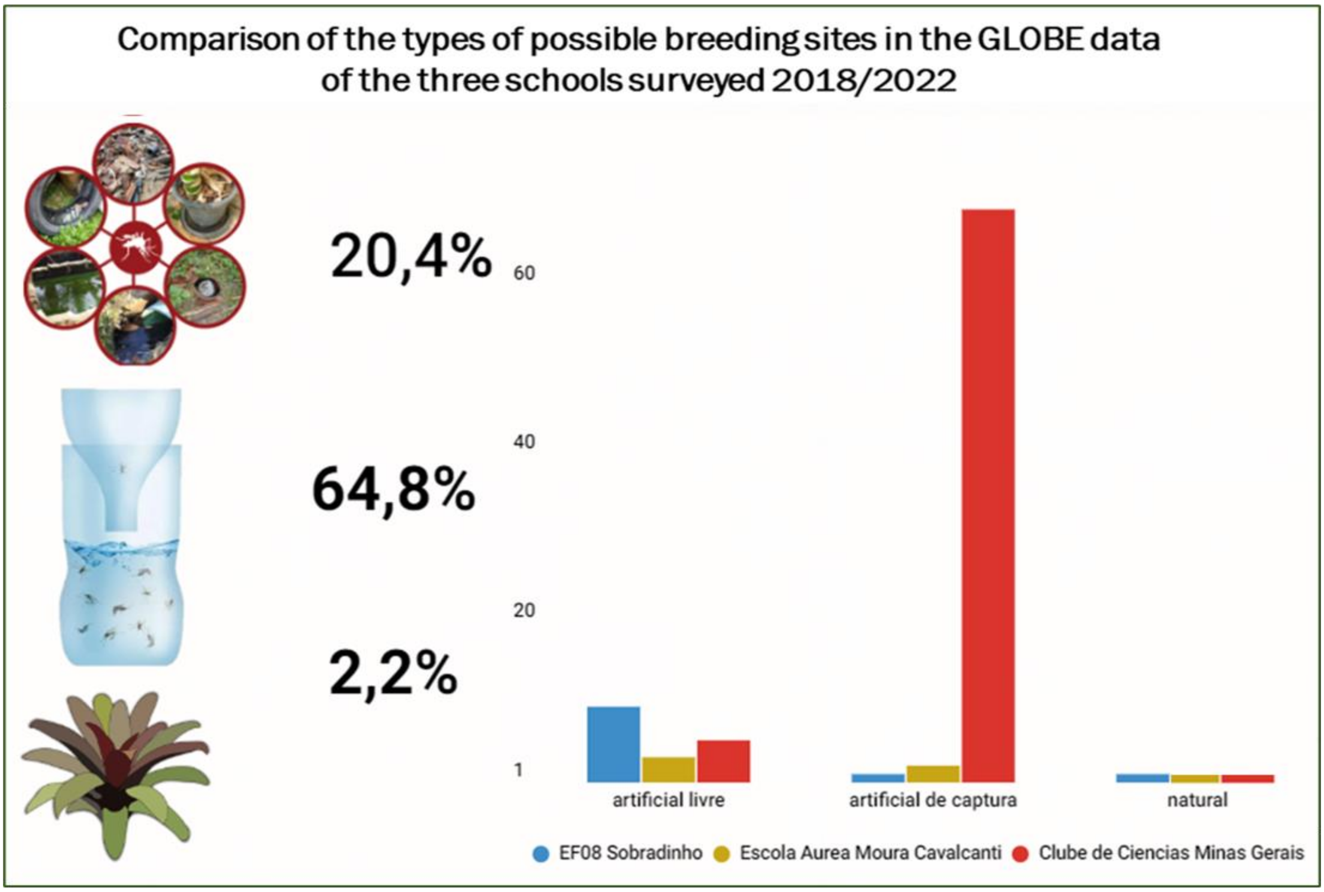


Table 9. Data collected from GLOBE Platform using MHM – mosquito habitat from 2018 - 2022. SOURCE: globe.gov

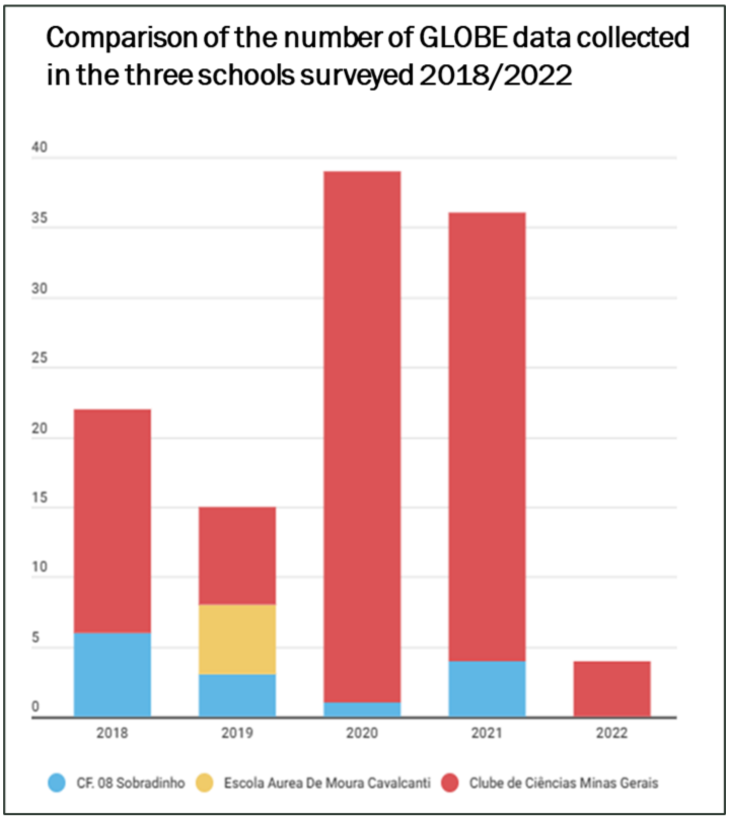


Table 8. Data collected from GLOBE Platform using MHM – mosquito habitat from 2018 - 2022. SOURCE: globe.gov

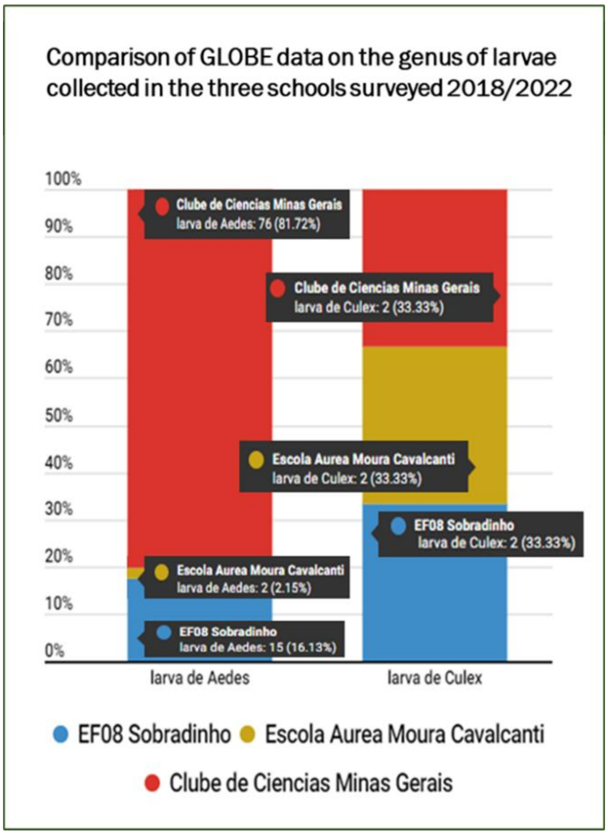


Table 10. Data collected from GLOBE Platform using MHM – mosquito habitat from 2018 - 2022. SOURCE: globe.gov

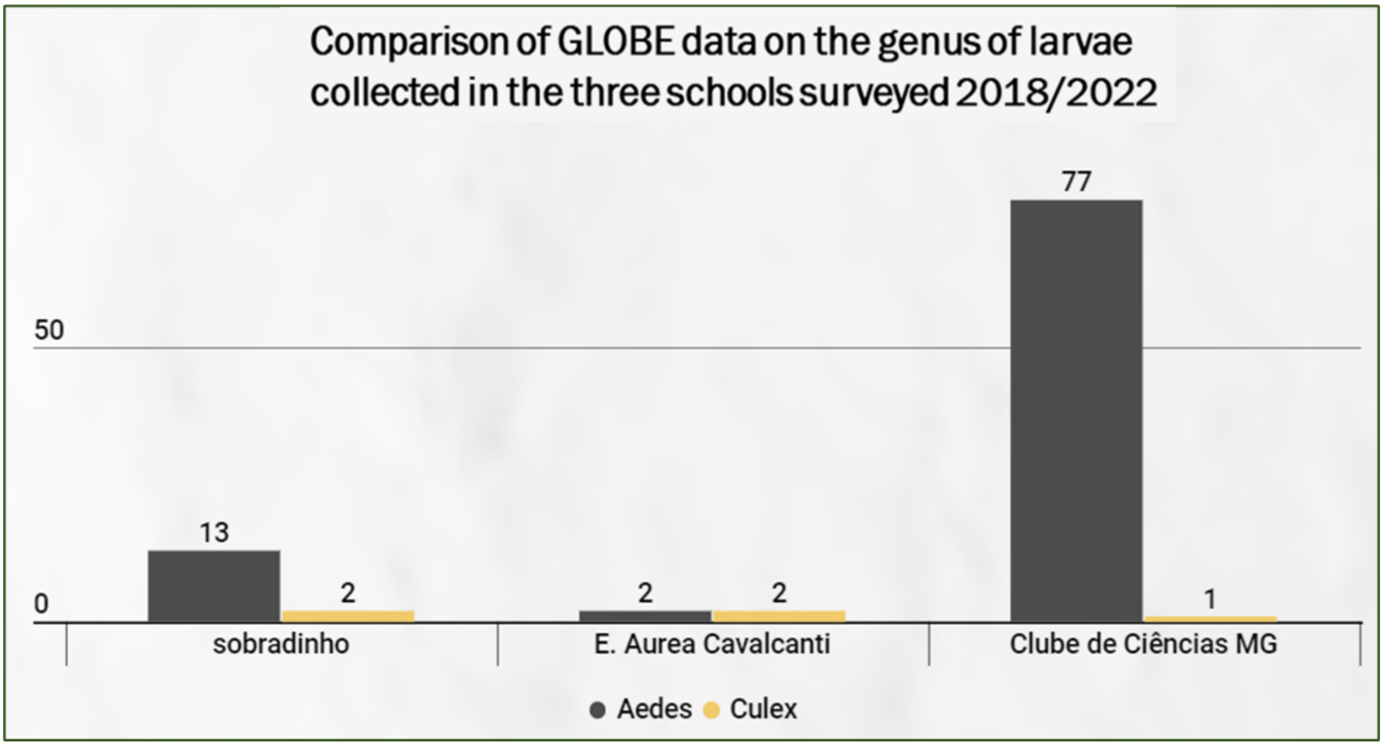


Table 11. Data collected from GLOBE Platform using MHM – mosquito habitat from 2018 - 2022. SOURCE: globe.gov

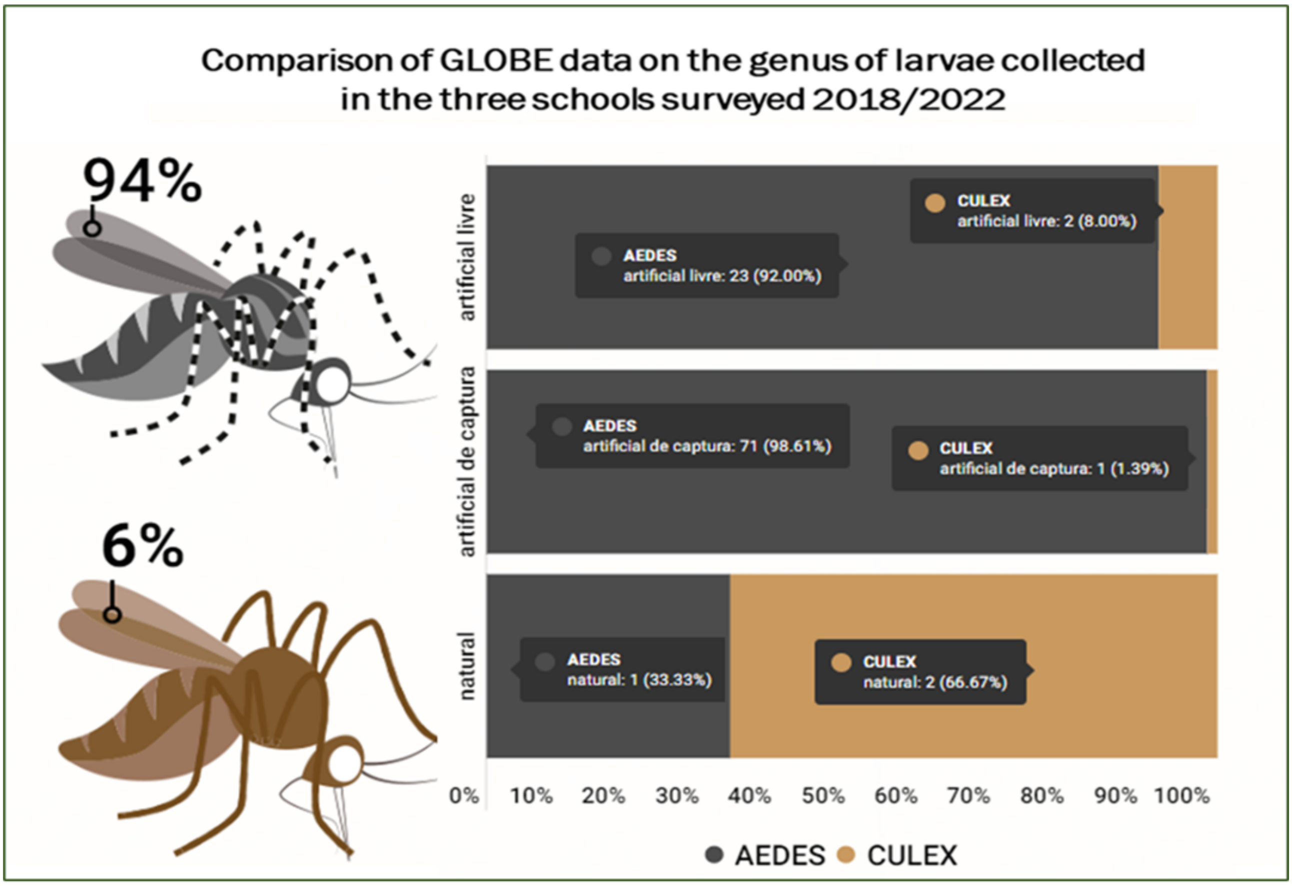


Table 12. Data collected from GLOBE Platform using MHM – mosquito habitat from 2018 - 2022. SOURCE: globe.gov

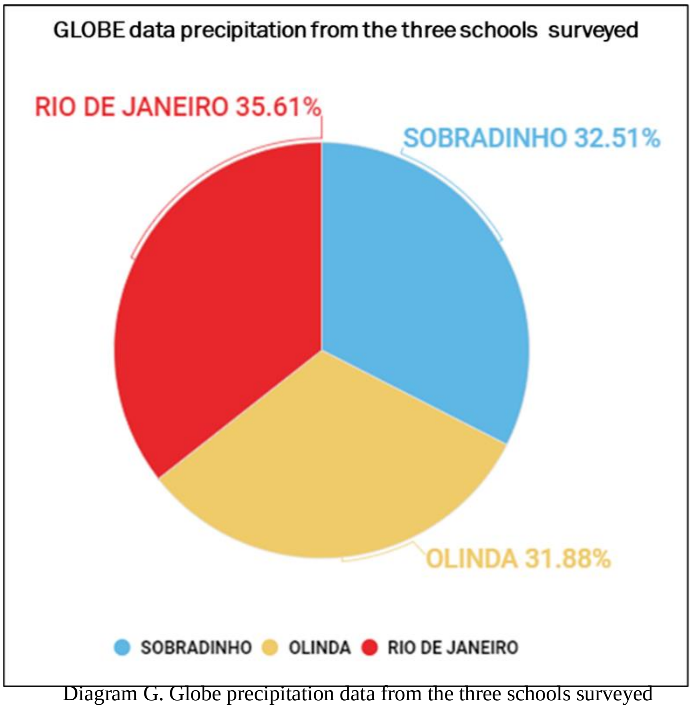


Diagram G. Globe precipitation data from the three schools surveyed 2018/2022.

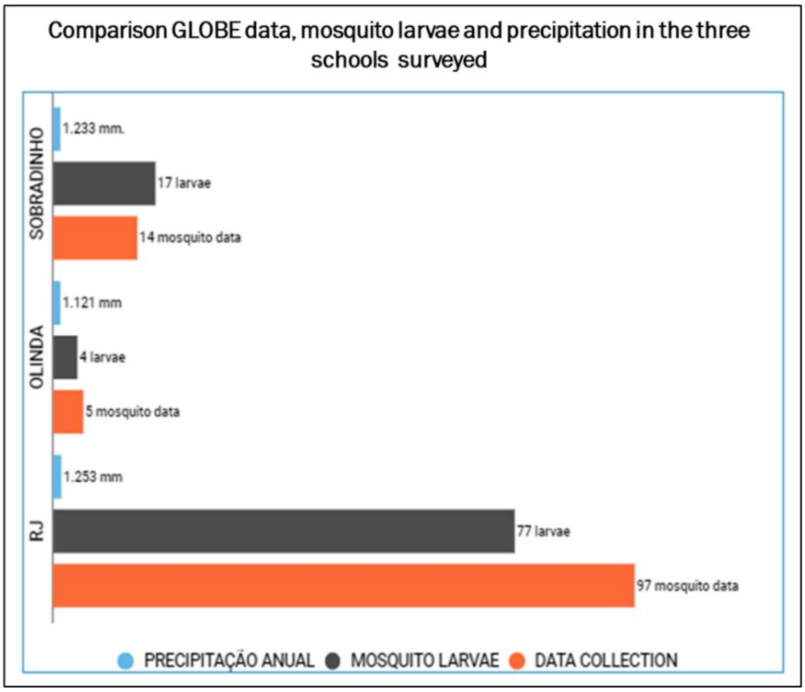


Diagram H. comparison precipitation, mosquito larvae, mosquito data from the three schools surveyed 2018/2022.

6. RESULTS

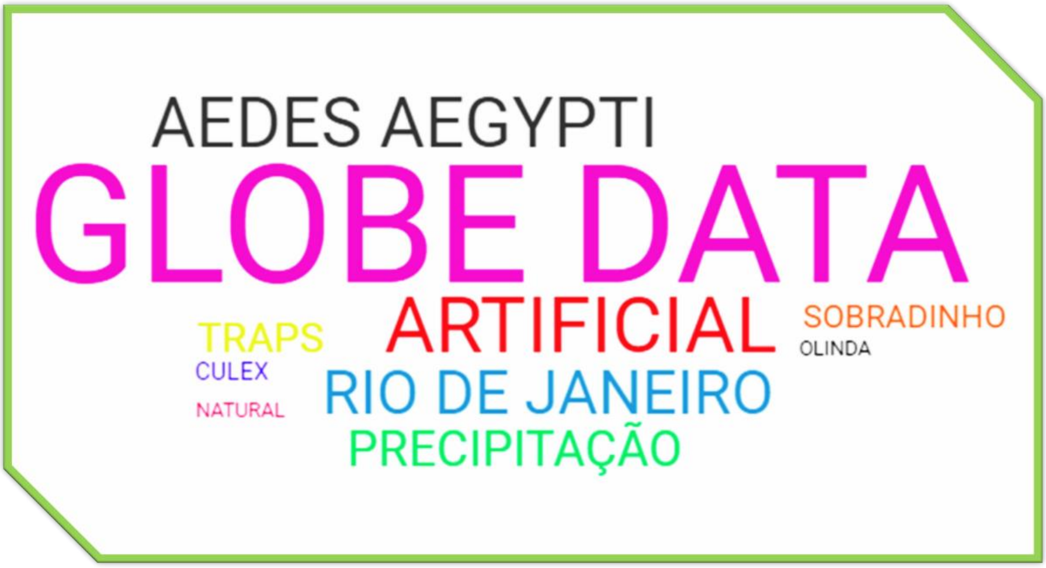


Figure 20. Word cloud from the study analysis

TYPES OF WATER CONTAINER IN THE THREE SITES ANALYZED

The types and number of water deposits, possible breeding sites of mosquitoes, were significantly different among the collected data. The number of data collected was higher in the Minas Gerais Science Club (Tables 1 and 2) than in the other two schools. (Table 8).

The school CF 08 Sobradinho (Tables 6 e7) had the most varied number of breeding sites, mainly in an artificial container of free living, the Science Club of Rio de Janeiro presented the largest amount of data in artificial capture container. On the other hand, the lowest number of data collection in the analyzed period was that of the Aurea Cavalcanti School (Tables 4 and 5), almost not varying the mosquito genus as to the type of breeding site. (Table 9).

PRECIPITATION IN THE THREE SITES ANALYZED

Brazil has a tropical climate with well-distributed rainfall throughout the year, moderate in winter and high in summer (Diagram A to F). Precipitation is a principle that favors the density of breeding sites due to the increase in artificial containers with accumulation of water outside the home (GLUBER, 1998), favoring the development and proliferation of mosquitoes, especially *Aedes aegypti*, creating the risk of a new outbreak diseases transmitted by mosquitoes - arboviruses(Diagram G;H).

Globe data from Minas Gerais science club shows a marked increase in mosquitoes in free artificial containers and outdoor traps when there is more rainfall (Table 3A and 3B).

TOTAL MOSQUITO LARVAE IN THE THREE SITES ANALYZED

The data collected does not show a great diversity of mosquitoes in the measured breeding sites. The vast majority are composed of mosquitoes of the genus *Aedes*. The samples of the observed days with higher incidence of larvae showed mosquitoes, with specimens of the genera *Aedes* and *Culex*.

The 116 collection sites analyzed, larvae were found in 101 out of 119 water containers near residences, churches, villages, and schools. (Table 12). The number of larvae of the genus *Aedes*, especially *Aedes aegypti*, and *Culex* varied between the types of containers (Table 11 and 12).

Our results have made us support our hypothesis.

Our results showed that in a container competition there was a positive correlation of mosquito larvae proportionally in free artificial breeding sites, followed by artificial capture breeding sites and natural breeding sites. The mosquito of the genus *Aedes,* species *Aedes aegypti*, had a higher incidence in most larvae collected in the three sites surveyed due to the expressive ecological capacity of adaptation to the various types of containers or water reservoirs. (Table 9, 12). The occurrence of rains affected the data in external collection areas (Diagram H). After data collection from the three schools, the analysis results found were performed through comparative graphs, spreadsheets, research on sites such as FIOCRUZ, NASA, GLOBE Platform and disease incidence reports at the State Health Department.

7. DISCUSSION

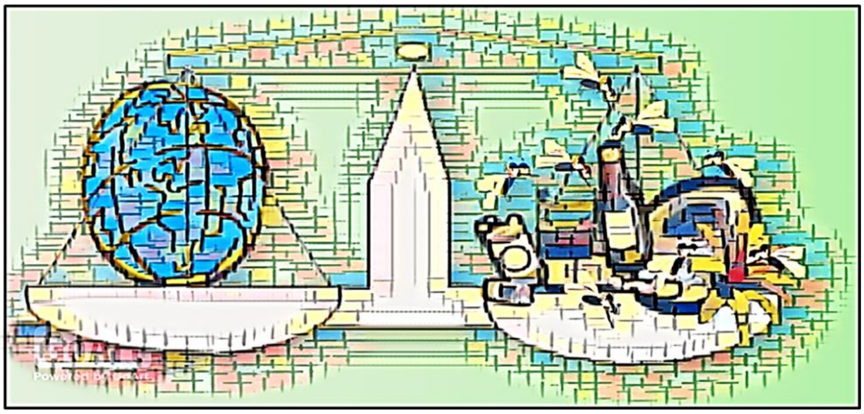


Figure 21. Who will win the battle: Humans x environment.

The analysis of data collection of the three schools in the cities of Sobradinho, in the Federal District, Midwest Region; Olinda, Northeast Region; Rio de Janeiro, Southeast Region, it was observed that the number and types of containers varied in the three sites. In addition, we observed that the number of mosquito larvae increased with the increase in the number of water containers offered in all collected sites, suggesting that where there is free supply of water reservoirs, mosquitoes reproduce more.

The analysis of data collection from the three schools in the cities of Sobradinho, Federal District, Midwest Region; Olinda, Northeast Region; Rio de Janeiro, Southeast Region, showed that the number and types of containers varied in the three locations. In addition, it was observed that the number of mosquito larvae increases with the increase in the number of water containers offered, suggesting that where there is a free supply of water to fill the containers, such as rainfall, (Diagram G; I) watering cans and sprinkler, mosquitoes breed more.

The results of our study show that the number and type of water containers affect the number of larvae in the three regions analyzed, on the other hand, the supply of water and blood is a determining factor in the creation of mosquito breeding sites in the studied locations. It was also observed that *Aedes aegypti* prefers to make their breeding sites in artificial containers, with no specific preference between traps and outdoor containers, in other hand *Culex* preferred outdoor and natural containers. (Tables 11 and 12).

This study showed that *Aedes aegypti* has a higher incidence in urban areas, in artificial capture reservoirs and free (94%) confirming its anthropophilic character. This analysis corroborates with Natal (2002), stating that the invasion and permanence of *Aedes aegypti* in the urban environment is due to the decharacterization of the natural habitat of this mosquito, caused by human pressures when deforestation caused a genetic variety of this mosquito to be selected by the altered environment. Its opportunistic behavior, taking advantage of its great ecological plasticity in adapting to artificial breeding grounds, found in various containers that retain water and making them potential breeding grounds, has been a big step towards the anthropophilic behavior of the mosquito as stated by Soares. (2008)

8. CONCLUSION

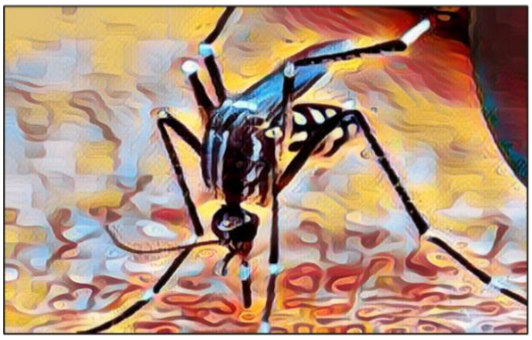


Figure 11. Mosquito behavior

Figure 12. Educational Campaigns

In our project analysis of the data collection from the three schools in the cities of Sobradinho, Olinda, and Rio de Janeiro, it was observed that the number and types of containers varied in the three sites. Furthermore, we observed that the number of mosquito larvae increased with the increase in the number of containers in all the sites collected and that the *Aedes aegypti* mosquito appears in greater numbers in the three breeding sites analyzed.

Therefore, it is important to know more about the origin of this vector that causes so many diseases and deaths in Brazil and in the world.

We think it is important to point out that we carried out a campaign to show how the mosquito came from Africa to Brazil on slave ships. We posted our “history" on Facebook to let people know more about the origin of the mosquito and also to call attention and awareness that the mosquito can be our new pet if we don't take responsibility to mitigate this Arboviroses main' vector.

Let's learn about the mosquito's domestic behavior to prevent it from becoming our newest pet

Aedes aegypti is much more active during the day, especially in the early morning and late afternoon, feeding on blood, usually low body arts such as feet and shins. It is an essentially daytime mosquito, but it is good to make it clear that this does not mean that it does not feed at night. It is an opportunistic mosquito: if the resident leaves an exposed leg or arm near the shelter of *Aedes aegypti*, it will probably be bitten even at night. *Aedes aegypti* is a discrete mosquito, rarely noticed when feeding on blood, and very alert, escaping with any more sudden movement. The Culex mosquito comes in making noise near the ear and is not as difficult to catch as the other. Inside the residences the two coexist well and are usually found in the same shelters: under tables, behind furniture, between curtains and in niche of books, for example.

Why do we need to know mosquito behavior?

Knowledge of mosquito behavior contributes to the development of educational campaigns in the elimination of breeding sites found with water in buildings, discarded waste and natural environments, which could become potential foci, preventing, and controlling vectors.

10. REFERENCES

1. ASSOCIAÇÃO MÉDICA DE LONDRINA (2020) <https://www.aml.com.br/como-o-aedes-o-mosquito-oportunista-se-tornou-um-novo-bicho-de-estimacao/> Access: 18/02/2023.

2. BRAZILIAN JOURNAL OF HEALTH RESEARCH (2008), Vol. 10. Access: 20/02/2023.

3. FIOCRUZ, Instituto Oswaldo Cruz, *Conheça o comportamento do mosquito Aedes aegypti e entenda a razão que leva este pequeno inseto a ser taxado desta forma*

<http://www.ioc.fiocruz.br/dengue/textos/aedexculex.html>. Acess: 10/02/2023.

- Graphs of Research Institutions (FIOCRUZ).
- Portal ENSP - Projeto ZDC/ Escola Nacional Sergio Arouca – Fiocruz

4. GLOBE. GOV. Graphs made by students according to GLOBE data.
<https://vis.globe.gov/GLOBE/> Acess:22/02/2023.

- GLOBE Science Protocols – Atmosphere » air temperature, precipitation.
- Hydrosphere » Mosquito Larvae.

5. GLOBE Mosquito Habitat Mapper App to Locate Mosquito Larvae.
<https://mosquito.strategies.org/index.php/pt/pagina-inicial/app-brasil/>

6. GO MOSQUITO Community – <https://mosquito.strategies.org/index.php/en/>. Acess: 20/02/2023.

7. GREGIANINI T.S. et al. Emerging arboviruses in Rio Grande do Sul, Brazil: Chikungunya and Zika outbreaks, 2014-2016. Rev Med Virol. 017;(August):1-10.

8. GUBLER, D. J. Dengue and dengue hemorrhagic fever. Clinical Microbiology Reviews, v. 11, n.03, p. 480- 496, jul.1998.

9. MEMÓRIAS DO Inst. Oswaldo Cruz vol.108 no.8 Rio de Janeiro Dec. 2013 Epub Nov 28, 2013. < https://doi.org/10.1590/0074-0276130128> Access:24/02/2023.

10. NATAL, D. et. al. Encontro de Aedes (Stegomyia) albopictus (Skuse) em Bromeliaceae na periferia de São Paulo, SP, Brasil. Revista de Saúde Pública, São Paulo. p. 31:517, 518, 2002.

11. PAHO Library Cataloguing-in-Publication Data. Pan American Health Organization. Health in the Americas: 2002 < https://www.paho.org/salud-en-las-americas-2012/dmdocuments/health-americas-2002-vol-1.pdf> Access:26/02/2023.

12. SILVA, A. A. et al. Fatores sociais e ambientais que podem ter contribuído para a proliferação da dengue. (2003). - DOI: 10.4025/actascihealthsci.v25i1.2305 Acess: 26/02/202.

13. SOARES, V. A. R. C.; RODRIGUES, W. C.; CABRAL, M. M. O. Estudos de áreas e depósitos preferenciais
de Aedes albopictus (Skuse, 1894) e Aedes A. aegypti (LinnA.us, 1762) no município de Paracambi, Rio de Janeiro, Brasil. Revista EntomoBrasilis, Vassouras, v. 01, n. 03, p. 63-68, dez. 2008.

14. WHO - World Health Organization 2012. Acess: 22/02/2023.

11. OPTIONAL BADGES FOR SCIENTIST SKILL

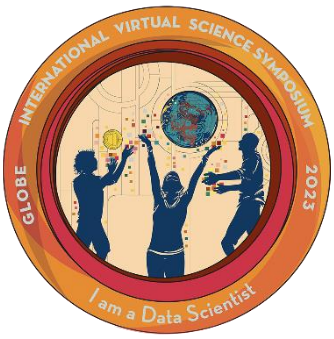
Figure 24 – Student drawing

A. 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, and Andreia Silva: data collect research, project summary, video elaboration, theoretical part, and research on the subject.
- Camille Santos and Luis Eduardo Freitas: collection and production of exploitable data.
- Luiz Eduardo Freitas and Juliana Vilela: art and video record.
- Juliana Vilela, Andreia Silva, Camille Santos: drafting of the project.
- All group: Video Presentation.

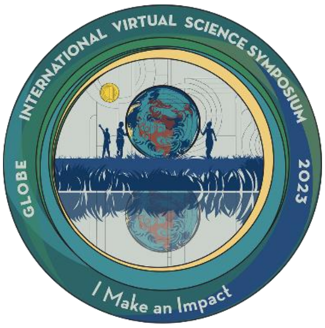
B. Data Scientist



The project used data from three schools in Brazil stored which was collected by the students using GLOBE Mosquito Habitat Mapper and data research in GLOBE platform and official Brazilian data. MHM app shows 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 - and subsequent analysis helps students and scientists to investigate the proliferation of mosquitoes, supporting our battle to combat disease mosquitoes such as dengue, yellow fever, chikungunya, and the Zika virus more effectively and promptly.

As you can see in this project data analysis from Globe Platform: In all sites collected, in a competition of containers, there is a positive correlation of mosquito larvae in artificial breeding sites followed by natural breeding sites. The mosquito of the genus *Aedes*, species *Aedes aegypti*, had the highest incidence in most of the larvae collected in the three sites surveyed due to the expressive ecological capacity of adaptation to various types of water containers.

C. Community Impact



The analysis of data from the Globe platform of three schools in different regions of Brazil, collected using the GLOBE Mosquito Habitat Mapper application, makes it possible to know the type of breeding site chosen by the opportunistic behavior of the *Aedes aegypti* mosquito. This knowledge contributes to the development of assertive actions and educational campaigns to eliminate containers with water, which could become potential breeding sites, in school areas and their surroundings, thus preventing and controlling the vectors and the need for their mitigation. The use of GLOBE data from other locations in Brazil and data from the Municipal Health Department makes it possible to show and compare breeding sites of *Aedes aegypti* and its density is higher in artificial containers - ovoposition preference of mosquito females - and the importance of zero data to contain the development of mosquitoes in schools and surroundings.

D. STEM Storyteller

In the analysis of data collection from the three schools in the cities of Sobradinho, in the Federal District, Midwest Region; Olinda, Northeast Region; and Rio de Janeiro, Southeast Region, it was observed that the number and types of containers varied in the three sites. In addition, we observed that the number of mosquito larvae increased with the increase in the number of containers in all collected sites and that the *Aedes aegypti* mosquito appears in greater numbers in the three breeding sites analyzed. That is why it is so important to better understand the origin of this vector that causes so many diseases and deaths in Brazil and worldwide.

We think it is important to point out that we carried out a campaign to show how the mosquito came from Africa to Brazil on slave ships. The guiding line was the way the mosquito first arrived in Brazil, in Rio de Janeiro, and how the city was invented by the yellow fever disease in the early 1900s. a little more about the history of the mosquito and to be aware that, if we do nothing, history will repeat itself, changing the disease or not. We also call attention for students and all people to know that the mosquito could be our new pet if we don't assume the responsibility of combating this main vector of arboviruses.

The AEDES AEGYPTI history in Brazil, when all begins...

THE ENEMY ARRIVED WITH THE SLAVE SHIPS...

The Aedes aegypti mosquito is part of the history and has been spreading throughout the world since the colonization period.

The mosquito originates in Egypt, Africa, and has been spreading throughout the tropical and subtropical regions of the planet since the 16th century, the period of the Great Navigations.

He arrived in Brazil along with the slave ships, after a long journey of his eggs inside the water reservoirs of the boats.

THE OUTBREAK – THE UNKNOW ENEMY!!

In the nineteenth century a great epidemic that devastated almost all of Brazil, and one of the most attacked cities was Rio de Janeiro. And this outbreak caused the Empire to act taking measures that could be considered public health, after all the government of that time , by means of a decree, tried to clean the cities purifying the air. But even so, yellow fever continued to attack and it was not yet imagined that the cause of the disease was a mosquito and from the year 1850 it became endemic in Rio de Janeiro. The city of Rio de Janeiro was very ill. It was an very dangerous outbreak.

THE ENEMY WAS A MOSQUITO VILAN!

Only in nineteenth century that the solution to yellow fever emerged, after all, until that time theories about the disease were innumerable. Many here in Brazil believed that climate, soil, and air could be conducive to its emergence; so that idea of cleaning the air. And it was when Oswaldo Cruz – the most famous Brazilian scientist – aware that the Cuban scientist discovered that the yellow fever was transmitted by the mosquito **Aedes aegypti** - started his fight to end the yellow fever in the city of Rio de Janeiro, received ample support from President, who had lost one of his children because of this disease.

BACK AND FORWARD – IN ALL COUNTRY!

In 1955, Brazil eradicated Aedes aegypti as a result of measures to control **yellow fever**. But in the late 1960s, the relaxation of the measures adopted led to the reintroduction of the vector in national territory.

The fact is that today, after a rapid survey of the public health indexes for **Aedes aegypti** - based on data from the summer of 2018 - show a total of 199 Brazilian municipalities at risk of dengue outbreak, chikungunya and virus Zika due to the significant presence of Aedes aegypti.

Today, the mosquito AEDES AEGYPTI is found in all Brazilian states transmitting dengue, zika and chikungunya!

http://agenciabrasil.ebc.com.br
http://www.aprendebrasil.com.br

Figure 25 – Science club news – The *Aedes aegypti'* origin.