Free artificial Containers X Captivity Traps: What is the famous villain's favorite deposit?

Science Club: Juliana Vilela, Fábio França, Julia Pereira, Ana Júlia Cima, Gabriel Silva, Matheus Fernandes, Vitória Lavinia Lago, Samara Santos, Vanessa Macedo, Agatha dos Santos, Olga Romio.

School: Minas Gerais Public School.

Rio de Janeiro /RJ – Brazil

Teacher: Inês Mauad

E-mail: inmauad@gmail.com

30 November 2017

ABSTRACT

This study investigated the presence and the breeding sites preference of the *Aedes aegypti* mosquito in the surroundings of the Municipal School of Minas Gerais, Urca, city of Rio de Janeiro, Rio de Janeiro, Brazil.

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.

Samples for the study were obtained by collecting mosquito larvae from different containers, such as artificial breeding sites (water tanks, tanks, trash, tires, etc.) and traps, made with 2-liter transparent PET bottles, placed at four school sites and two in areas around the school in the period of six months (June to November).

The results showed that artificial deposits as breeding sites are more positive for mosquitoes, including *Aedes aegypti*. Black or dark disposal products and shady water tanks, characterized by artificial deposits, were preferred for this mosquito species.

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

INTRODUCTION (Research History)

Mosquitoes are commonly known to pose a significant threat to public health. 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. There is a major ongoing effort to eliminate mosquito breeding sites.

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. Recently, the zika virus (transmitted by *Aedes aegypti*) was associated with an increase in cases of infants with microcephaly in Brazil.

Aedes aegypti is the mosquito that transmits dengue, chikungunya and zika virus. He is a smaller mosquito than the common ones, black with white stripes on the trunk, head and legs with translucent wings. The male, as of any species, feeds exclusively on fruits. The female, however, needs blood for the maturing of her eggs, which are deposited separately on the inner walls of objects, near standing water surfaces, a place that offers them better survival conditions: heat and precipitation.

It is an urban mosquito, although it has been found in rural areas where they were transported in containers that contained eggs and larvae. It is a native to tropical and subtropical regions, does not withstand the low temperatures present at high altitudes.

The use of traps to detect the presence of *Aedes aegypti* is a technique of the time of Oswaldo Cruz (Cruz, 1909), the greatest sanitary man from Rio, who lived in the early nineteenth century. During these campaigns in Brazil, larval research has already been used to sample this mosquito's posture.

Aedes aegypti places eggs in containers such as cans and empty bottles, tires, gutters, uncovered water 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 by color and volume were preferred over transparent PET bottle traps.

1. Research Question and Hypothesis

Figure 1. Free artificial Containers *x* Captivity Traps (student drawing)

Free artificial Containers *x* Captivity Traps: which is the best breeding site, which deposit will have a higher incidence of *Aedes aegypti* mosquitoes (Figure 1)?

Annually, nearly 700 million people are afflicted with diseases transmitted by mosquitoes. The container habitats have unique properties and these habitats could be natural as trees' holes and leaves or artificial such as transparent PET bottle traps or free artificial containers such as tires, plastic cups and water tanks. But we know that *Aedes aegypti* is a mosquito with opportunistic habits. For what reason? It is a domestic mosquito that lives in or around homes or other places frequented by people, such as shops, schools or churches, for example. It has habits mainly diurnal and feeds of human blood, mainly at dawn and at dusk. But can it also bite at night? Yes. It does not let the opportunity pass, that is why the worries about the free artificial Containers, because it always there waiting the mosquito's reproduction (Institute Oswaldo Cruz – FIOCRUZ, 2017).

Recently, the problem of the reintroduction of *Aedes aegypti* into urban areas from where it had been eradicated in early XIX, created the need for permanent vigilance (Cad. Saúde Pública vol.5 n.2 Rio de Janeiro Apr./June 1989). This has sparked an interest in developing traps that can detect any introduction as quickly as possible.

In this paper, we will demonstrate that in a competition of deposits, it was possible that the higher incidence of mosquitoes in urban areas of the school environment (number

of larvae) would have a positive correlation with the type of breeding site. We will also present evidence that the free artificial breeding sites by color and volume would be chosen instead of transparent PET bottle traps.

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 June 2017 to November 2017. Observations were made using: transparent pet bottle traps for mosquitoes; Mosquito Habitat Mapper App; GLOBE collection kit for field capture; graphs of research institutions (FIOCRUZ) and graphs made by students according to GLOBE data.

Four traps were installed in the school to capture the *Aedes aegypti* mosquito whose female is the main transmitter of the diseases dengue, chikungunya and zika. These traps were monitored first at every 15 days. After September/2017, once a week. The trap network was installed to cover the entire length of the school.

The method used to collect data was the GLOBE Mosquito Habitat Mapper app using GLOBE protocols to collect mosquito larvae (Figure 3), wich helped identify the larvae found and make it possible to reduce the breeding sites of mosquitoes that carry these deadly diseases.

Our study, in addition to traps, also used random larvae capture data in free artificial breeding places around the school to obtain information on incidence, zero data, mosquito numbers and their diversity in urban school areas to compare their results with those of captive larvae. Remembering that given zero is always important, being it that determines the emergence/return of the mosquito to the studied areas.

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

3. Data Summary and Analysis

Aedes aegypti x domestic stilt

One is very agile, reproduces in clean water, attacks in broad daylight and is responsible for transmitting dengue in Brazil. The other prefers the dawn, puts their eggs in dirty water and rich in decomposing organic matter and torments sleep nights with their buzzing. With the arrival of summer, the reproductive and developmental cycle of the two most urban mosquitoes in the world is accelerated: *Aedes aegypti* and *Culex quinquefaciatus*, domestic leggings.

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 manufacture.

The graphic (Figure 4) shows the number of possible mosquito habitats and destruction of breeding sites in school and in areas around the school from June to October 2017 (E. M. Minas Gerais – Mosquito habitat mapper app).

Figure 4. Data collected from breading sites – June to October 2017 using the app – SOURCE: globe.gov

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

At the end of 12 months, we were able to make a study with all habitats, quantities, genus and phases of the mosquitoes found in E.M Minas Gerais school and in areas around the school. So we put all these data into a graphic.

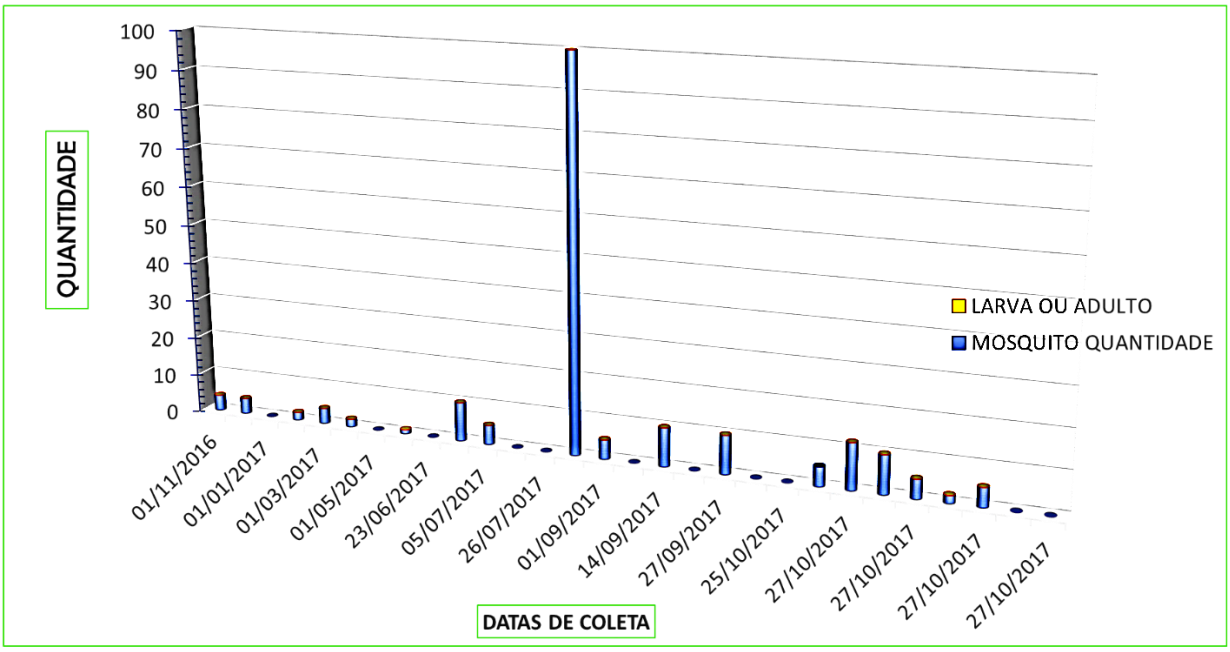

Figure 5. Data from mosquito larvae collected from Nov. 2016 to Oct. 2017 using the app and traditional collection. SOURCE: globe.gov

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.

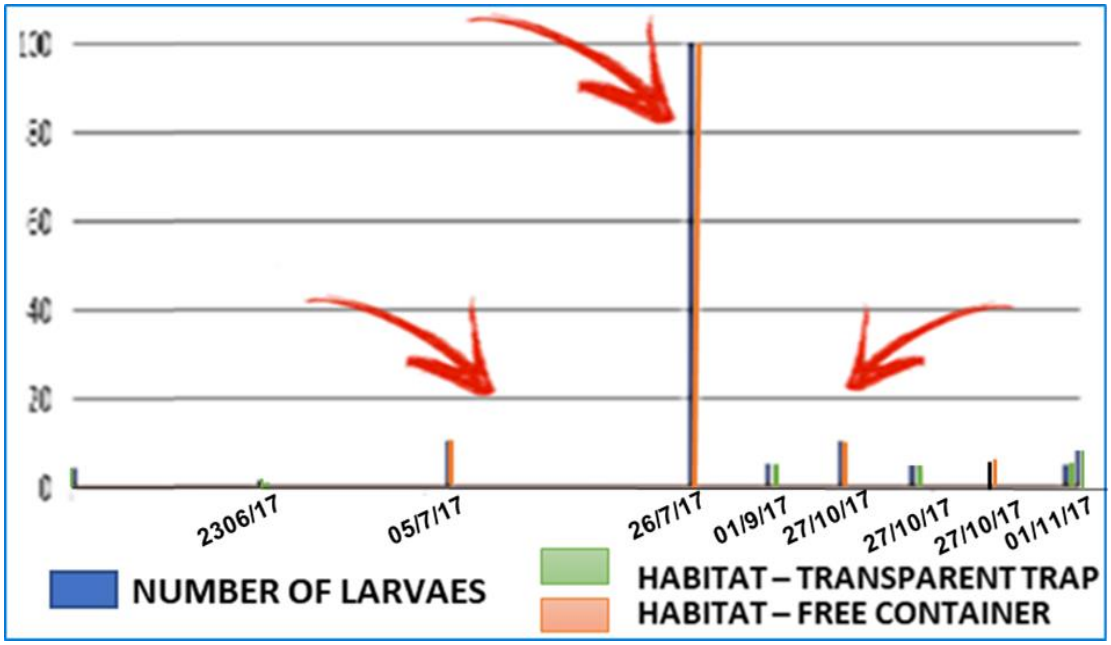

Figure 6. Data collected from June to October 2017 using the app – SOURCE: Student's graphic

In the data collected by the GLOBE Mosquito Habitat Mapper app, the larval identification of the mosquitoes of the urban areas around the school (number of larvae) in the free artificial breeding sites, such as: tires, bottles and cans, material of abandoned paint and garbage.

In the graph from figure 4, an increase in the incidence of mosquitoes in sample collections, on July 26th and October 27th , is shown in free artificial breeding places around the school, that is, areas without traps.

The sample of the 26/07, despite the great amount of mosquito larvae found, did not present great diversity of mosquitoes, being all the genus Culex. The same situation was observed in the 27/10 sample.

Remembering that given zero is always important, being it that determines the emergence/return of the *Aedes aegypti* mosquito to the studied areas of the school environment.

4. Results, Conclusions, Discussion

Results

Mosquito species, breeding site and Container

In Minas Gerais school, we found two different types of mosquito larvae (*Aedes aegypti* and *Culex*). Breeding sites and container types did effect mosquito larvae number but not species (Figure 5). Perimeter, area of observation site, container color effects show effects in the numbers of mosquito, but not at species (Figure 5).

Our results have made us support our hypothesis

The comparative analysis of mosquito incidence, increase and proliferation data between captive larvae and free artificial reservoirs in the school environment showed that, in a competition of deposits, there is a higher incidence of mosquitoes in the areas of urban environments in the school environment. Thus, we can affirm that they present a positive correlation with the type of breeding place (Figure 6).

Free artificial breeding sites by color and volume (tires, bottles and cans, abandoned paint and trash materials) are chosen instead of transparent PET bottle traps. The data collected do not show great diversity of mosquitoes in the two types of containers (breeding sites) surveyed (Figure 5).

Discussion

We observed that breeding site, container types, perimeter, area of observation site affect the number of the mosquito larvae but did not affect the type of the specie. It was important to verify the larval incidence in our school and surroundings area in this study to monitoring and control of mosquitoes transmitting dengue, chikungunya and zika virus diseases.

Our research, in addition to traps, also used free and random larvae capture data in urban areas around the school (in free artificial containers such as water tanks, tires and others).

To collect and gather information on the incidence, quantity and diversity of mosquitoes in urban school areas in order to compare their results with those of captive larvae (transparent PET bottle traps).

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 6) shows that the number of larvae collected increases considerably in free artificial breeding sites (tires, bottles and cans, abandoned paint and garbage) compared to artificial PET bottle traps.

It was verified, in our research, that there is no greater variety of mosquitoes in the artificial deposits.

Conclusion

The biodiversity of mosquitoes is very evident, with many genera having worldwide distribution and some general with limited or endemic distribution. More recently, the increase of the diseases (dengue, chikungunya and zika) transmitted by the mosquito *Aedes aegypti* has created the need for permanent surveillance at the land, sea and air terminals. This has sparked interest in the development of traps capable of detecting any introduction of *Aedes aegypti* as soon as possible.

Figure 7. Index of infestation and proliferation of *Aedes aegypti* in the districts of Rio de Janeiro in 2016/2017. SOURCE: https://oglobo.globo.com/rio/casos-de-dengue-aumentam-442-no-municipio-do-rio-18819188

Área Programática, Regiões Administrativas e Bairros	População Censo 2010	Jan	Fev	Mar	Abr	Mai	Jun	Jul	Ago	Set	Out	Nov	Dez	Total
Total	6.320.446	795	620	532	385	263	125	124	104	126	185	148	88	3.495
IV Botafogo	239.729	11	14	17	12	2	3	5	6	5	5	2	8	90
Flamengo	50.043	2	1	4	0	1	0	1	1	1	1	0	1	13
Glória	9.661	1	3	2	1	0	1	0	1	0	0	0	0	9
Laranjeiras	45.554	0	2	1	0	0	0	0	0	0	2	1	1	7
Catete	24.057	2	1	2	0	1	0	0	1	1	1	0	4	13
Cosme Velho	7.178	0	1	3	0	0	0	0	0	0	0	0	0	4
Botafogo	82.890	6	4	2	9	0	2	2	3	2	1	1	2	34
Humaitá	13.285	0	1	3	2	0	0	1	0	0	0	0	0	7
Urca	7.061	0	1	0	0	0	0	1	0	1	0	0	0	3

Figure 8. Number of dengue cases per month, Administrative Regions and districts of Rio de Janeiro City – 2017

Our research, in addition to traps, also used data from free artificial containers, that is, free and random larvae catches around the school and thus obtain information on the incidence, quantity and proliferation of mosquitoes from school urban areas in order to compare their results with those of captive larvae.

The results show that in a deposit competition, artificial breeding sites free by color and volume are more attractive to mosquitoes than transparent PET bottle traps.

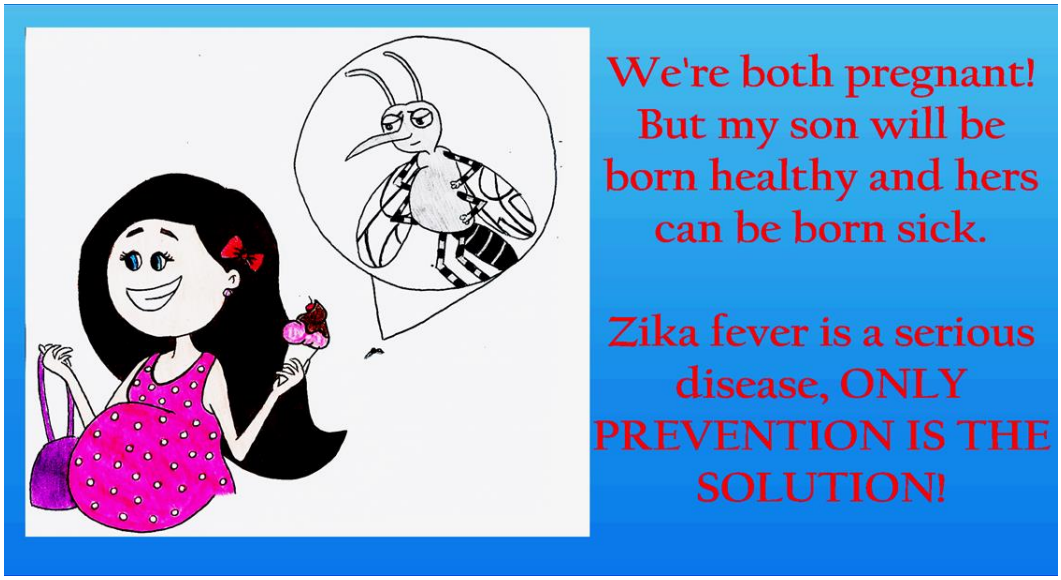

Figure 9. Student Charge – Vanessa Macedo, talking about the severity of the disease for mothers.

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, the use of

traps simulating containers artificial free, like tires and tanks of water, are the favorites of the mosquitoes, that is, the villain (Figures 7,8 and 9)!

5. Acknowledgements

We thank Minas Gerais, Principal Regina Paschoa and School Coordinator Tania Campos, FIOCRUZ (Elimina dengue Project), Go Mosquito Community, Dr. Russanne Low and Renee Codsi from Institute for Global Environmental Strategies.

6. Bibliography and References

1. BEM ESTAR magazine, <http://g1.globo.com/bemestar/noticia/2016/01/e-se-eliminassemos-todos-os-mosquitos-transmissores-de-doencas.html> Acess:10/05/2017.

2. BILL GATES BLOG. <https://www.gatesnotes.com/Health/Most-Lethal-Animal-Mosquito-Week >Acess:14/05/2017.

3. BUREAU OF EPIDEMIOLOGY, DEPARTMENT OF DISEASE CONTROL, the Ministry of Health, Brazil. *CADERNOS DE SAÚDE PÚBLICA* vol.5 n.2 Rio de Janeiro Apr./June 1989.

4. FIOCRUZ, Instituto Oswaldo Cruz, *Aedes X Pernilongo comum,* <http://www.ioc.fiocruz.br/dengue/textos/aedexculex.html>. Acess:10/05/2017.

- Graphs of Research Institutions (FIOCRUZ)

5. GLOBE. GOV. Graphs made by students according to GLOBE data. <https://vis.globe.gov/GLOBE/> Acess:10/08/2017.

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

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

7.GO MOSQUITO Community – <https://mosquito.strategies.org/index.php/en/>. Acess:10/10/2017.

8. GOOGLE EARTH photos. < https://earth.google.com/web > Acess:10/08/2017.

9. MUNICIPAL Health Department, <http://www.rio.rj.gov.br/web/sms/dengue> Acess:11/15/2017.

10.RUEDA, Leopoldo. Freshwater Animal Diversity Assessment <citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.554.9727&rep=rep1&type=pdf>

Acess:10/05/2017.

11. SOUZA-SANTOS R. *Fatores associados à ocorrência de formas imaturas de Aedes aegypti na Ilha do Governador*, Rio de Janeiro, Brasil. Rev. Soc. Bras. Med. Trop 1999;32:373-82.

12. THETE KD, Shinde *LV. Biol Forum-An Int* J**.** 2013, pag. 124**.**

7. Globe Badges

B1. 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 Vilela, Fábio França, Vitória Lavinia Lago, Olga Romio: data collect, project summary, video elaboration, theoretical part and research on the subject.
- Gabriel Silva, Matheus Fernandes, Agatha Santos: collection and production of exploitable data.
- Julia Pereira, Samara Santos, Vanessa Macedo: art and preparation of the poster.
- Juliana Vilela, Fábio França, Ana Júlia Cima, Vitória Lavinia Lago: drafting of the project.

B2. Community impact

Use of local data from the GLOBE Mosquito Habitat Mapper app and Globe site data collect from Urca district makes it possible to characterize the number of the breading sites and 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 and the importance of data zero to contain mosquito development in the district.

B6. 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 villains in support of our battle to combat mosquitoes of diseases such as dengue fever, yellow fever, chikungunya and the Zika virus.

8. GLOBE Learning Expedition (GLE)

Environmental Problems and Solutions

"What would you say is the most dangerous animal on Earth? Sharks? Snakes? Humans? What makes mosquitoes so dangerous? Despite their innocuous-sounding name—Spanish for "little fly"—they carry devastating diseases." (gatesnotes.com) The mosquito is the most dangerous animal in the world, it threatens half of the world's population and causes billions of dollars in lost productivity annually. They transmit illnesses that kill one million people a year, more than a hundred species of mosquitoes can transmit various diseases to humans and other animals.

Our 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 *Aedes aegypti* and therefore are the most hazardous waste.

The use of local data from the GLOBE Mosquito Habitat Mapper app and Globe site data collect from Urca district makes it possible to characterize the number of the breading sites and their mitigation. The data collection makes possible to contain mosquito development in the district.

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 also to the Public Health, as well as other students, the use of traps simulating containers artificial free; like tires and water tanks: are the favorites of the mosquitoes, that is, of the lady villains!