IDENTIFICATION OF MOSQUITO LARVAL SPECIES FOR DENGUE FREE MOMBASA, KENYA.

GLOBE INTERNATIONAL VIRTUAL SCIENCE SYMPOSIUM 2020

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Shree Swaminarayan Academy

Teach Through Expounding of Themes

SUMMARY

Mosquitoes are vectors that transmit diseases such as malaria, dengue fever, chikungunya and the zika virus. Some of these diseases such as malaria, dengue fever and zika virus can be fatal. Mombasa County is a malaria endemic region, that is prone to incidences of malaria and chikungunya.

The aim of our space challenge research was to identify mosquito larvae species within our school compound. A key factor in the project involved recognizing potential mosquito breeding sites, Sampling water from set study sites in school, Identifying mosquito taxa; differentiating between *Aedes* sp., *Anopheles* sp., and *Culex* sp. larvae, actively reducing mosquito risk- by dumping containers/pouring oil on the abandoned old tires in school compound and monitoring environment as well as learning opportunistic breeding habits used by *Aedes aegypti/albopictus* in human built environments and about vector borne disease risk to the communities along the coastal region.

The procedures involved include identifying your mosquito larvae by recognizing the gross morphological characteristics of mosquito larvae and learning the morphological features used in identifying a larva specimen. We also used the MHM protocol's four main steps; GPS locating potential breeding sites; sample & counting mosquitoes in their different life phases; identifying larvae taxa and decommissioning the breeding sites when possible. We concluded that most dominant mosquito species in Nyali area is *Aedes*. This justifies the large number of records about dengue fever and chikungunya virus in Mombasa County.

We strongly recommended that all citizens monitor their environment to look for any possible mosquito breeding habitats- which include both natural and artificial containers which can hold standing water for mosquitoes to breed in. After the research, we also organized a 1-day workshop community action with the theme christened, "Larviciding for better future" and created public awareness about the potential breeding sites of *Aedes* as well as methods of prevention amongst the local communities, beach hotel owners and public health officers in Mombasa county. The environmental club sloga aimed at destroying mosquito breeding sites… 'Flip every container on the ground!'

RESEARCH QUESTIONS

1. How many mosquito species are present in Shree Swaminarayan Academy, Nyali sub-County Kenya?
2. Which mosquito species is responsible for the spread of Dengue fever and Chukungunya viruses cases common amongst the students in our school?
3. Is Larviciding the most effective integrated mosquito vector control approach?

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INTRODUCTION

We have aimed at knowing which type of mosquito breed are found in the different corners of Shree Swaminarayan Academy such as near forest and bus park with plenty of abandoned tires and coconut shells. Over the years students have been complaining about mosquito bites especially during morning preps. This causes lots of discomfort and reduces students' concentration in their studies which may impact negatively to over academic performance and health. The same sentiments were echoed by the parents during school evening's events such as cultural nights held in the complex hall or football field. The school administration usually spend over Ksh. 400, 000 (according to records in school accounts) termly to sprays our classrooms and administration blocks in an attempt to minimize mosquito bites and related diseases. Moreover, few incidences of dengue fever have been reported amongst the student community.

The spraying of insecticides has been less effective due to increased resistance to insecticides. Mosquitoes are also adapting to control methods used inside classrooms by now feeding outside (dark corners in bus park, water tanks/flower pots and Sport complex) where it is difficult to control mosquito vector. Spraying is also very costly for our school. Moreover, this indoor residual spraying vector control method mostly targets the adult mosquito vectors and aims at reducing human-vector contact. However, integrated vector management is a key strategy recommended by World health organization (WHO), especially for African countries Kenya.

This has led to the view that successes from methods targeting adults mosquito need to be built on by targeting different mosquito stages, such as the use of larvicide. This involves the use of insecticides that kill mosquitoes in the larvae stage- before they develop into adults. According to a study conducted by De Jager and Kruger of UP Institute for Sustainable Malaria control, University of Pretoria published in News Indepth newspaper June 6th 2019, "Killing mosquito larvae promises end to malaria".

Therefore it is important for us to investigate the type of mosquito taxa and potential breeding sides in our school compound so as to adopt an effective and integrated malaria control approach.

HYPOTHESIS

1. There are different species of mosquitos in Shree Swaminarayan Academy.
2. *Aedes* mosquito is the species that would be found commonly in Shree Swaminarayan Academy due to cases of dengue fever recorded in or school.

LITERATURE REVIEW

Mosquitos, including malaria vectors, lay their eggs in water bodies. The next stage in their life cycle is larval stage where most larvae hang suspended to the water surface in order to breathe. The mosquito larvae are less mobile and feed on water microorganisms during this stage. This makes the larval stage susceptible to the use of larvicide; such as using old oil that will starve the larvae of oxygen. That causes it to suffocate, according to a study done by Institute for Sustainable Malaria control, University of Pretoria, in 2018. Another approach involves using microorganisms for the larvae to feed on, as it poisons them and they die. The larval mosquito does not pose any health risks according to Globe Observer and the Mosquito Habitat Mapping protocol. Therefore, it is suitable and safe for conducting mosquito taxa identification and effective integrated malaria control approach.

According to World Health Organization (WHO), the idea behind integrated vector management is to use a combination of different methods to reduce human-vector contact. The increase in the use of WHO approved controlled methods between 2000 - 2015 contributed to a decrease in number of malaria cases worldwide. But progress against malaria and dengue fever has stalled due to resistance to indoor spraying insecticides and outdoor breeding sites. For example, there were 219 million malaria cases reported globally in 2017 against 213 million in 2015 according to WHO. This led to the view that successes from methods targeting the adult mosquito need to be built on by targeting different mosquito stages in its life cycle.

According to biologists and scientists of Globe Observer, there are three major mosquito species which are responsible for the spread of various diseases. These are *Anopheles*, *Aedes* and *Culex* species.

Aedes aegypti and *Aedes albopictus* are container breeding mosquitoes. *Aedes aegypti* lay their eggs in water found in artificial containers- such as flowerpots and water jugs. The females lay the eggs along the edge, just above the water level. When the water level rises, it moistens the eggs and they then begin to develop.

Aedes albopictus also lay their eggs in artificial containers but, in addition, will use natural containers such as a tree hole or a coconut shell. Other species of *Aedes* mosquitoes breed in floodplains after rain events, in irrigation ditches, in woodland pools, brackish swamps and salt marshes.

RESEARCH METHODS.

Equipment and material

The following equipment and material were used in the study:

- artificial breeding site e.g 2litres of water in a dark corner / natural breeding site e.g drainage
- Dropper from Biology laboratory
- 250ml Beaker
- Magnifier lens – X60 and X100 Macro lens
- Petri Dish
- Paper towel
- Globe Observer Application using the Mosquito Habitat Mapper Protocol.
- smart phone

Step 1: Identification and location of the mosquito breeding site.

We took a tour around the school in search of the suitable mosquito breeding site, such as an artificial container or natural container like trench from the kitchen to the farm. The GPS location of the site was taken using smart phone.

Step 2: Mosquito breeding.

The 2 litres of saline water was allowed to stand in a plastic container placed in a dark corner within the bus park, undisturbed for about 1-2 weeks. The study site was visited every two days. After that the water was sampled to investigate the number of eggs, larvae, pupae and adults present as shown in figure 2.

Step 3: Identification of mosquito larvae.

A sample of water containing mosquito larvae was collected from the study site using 250ml plastic beaker and a dropper. The sampled larva was placed on a slide covered with paper towel to drain the excess water. The macro lens was attached to a smart phone camera, placed vertically/directly above the larvae sample on the slide and its light turned on (figure 3b)

The macro lens was focused on the slide, fine adjustment button turned until the larva's sharp and clear magnification was obtained at X100. The photograph of magnified larva was taken. It is important to note that different parts of body (head, thorax, abdomen, siphon/air tube, pecten and whole body) of the sampled larvae were taken one at a time. The mosquito larvae species was identified using distinctive morphological structures like pectin shape, siphonal tufts and comb scale shape as well as anal brush on the saddle as directed by the Globe Observer App (under MHM protocol) installed in the smart phone.

Step 4: Elimination of breeding site.

After the successful identification of the larvae, the breeding was eliminated using the Mosquito vector control methods of pouring out the water (when possible). For natural breeding sites, like the drainage, we informed the school administration that it creates a potential breeding ground for mosquitoes. The busy vegetation was cleared by the workers. It was also dredged to allow water to flow.

RESULTS

Result 1: Identification and location of the mosquito breeding site.

An artificial breeding site; plastic container filled with 2 litres of water was placed in a dark corner in school bus park area. We set up one study site within the school for easy monitoring. Figure 1b below shows the study site location/mosquito breeding site generated using the Globe Observer App.

Figure 1a: Team members setting up a mosquito breeding site

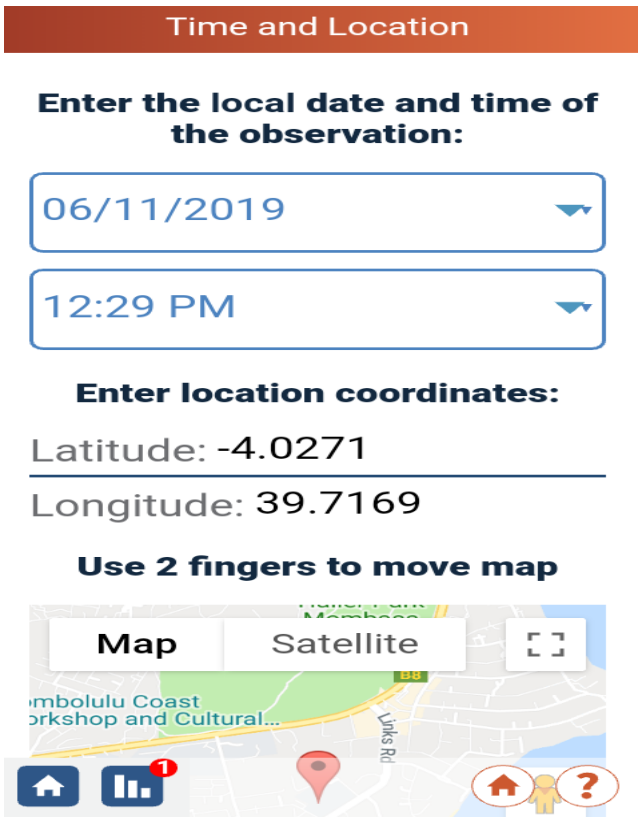
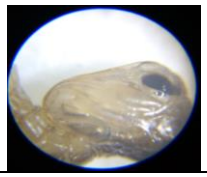


Figure 1b: Study site location smart phone's screenshot

Result 2: Mosquito breeding.

The water was left for about 2 weeks. The site was visited after every two days during lunch hour or clubs' time and observations recorded using the Mosquito Habitat Mapper. The following were observed to be present at the breeding site after water was left to stand undisturbed for 1-2 weeks. There were no any sign of mosquito larvae or egg in the first one week particularly before the rains started. However, the number of each stage of mosquito increased during rainy season since the area became moister as recorded below (Figure 2).

Sample as at June 11th 2019	Number	Images observed	
Eggs 	40 Dark eggs		
Larvae 	30 needle-like larvae		
Pupa 	4comma-like pupa		
Adult	3		
Figure 2: Observations on mosquito breeding			

<u>Result 3: Identification of mosquito larvae.</u>

Using the macro lens attached to a smart phone different morphological features of the larvae were identified. With the help of Globe Observer App under Mosquito Mapping Protocol the following differentiating key features were observed; cylindrical siphon, presence of pecten, single pair of siphonal tufts, anal brush at the posterior of the saddle, pitchfork shaped comb scales, no tufts between the pecten and strong dark hook on the thorax setae(hair). The *Aedes aegypti* larvae was successfully identified.

Water samples from the breeding site were collected and taken to the laboratory for identification as shown in Figure 3 below.

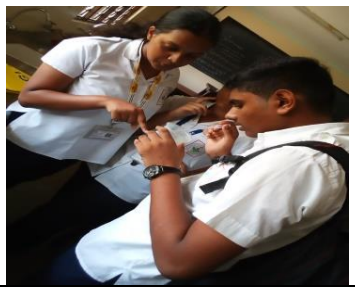


Figure 3a: Collection of water sample from breeding site

Figure 3b: Identification of larvae species in the laboratory

Morphological features were observed and recorded using the Globe Observer App – Mosquito Habitat Mapper protocol in order to identify the larval species from the water samples.

Morphological feature	Observation	Shape description	*Aedes genus*
Presence of Siphon	Yes	Cylindrical or spindle Siphon forms 'Y' shape with anal segment	
Pecten presence	Yes		
Siphon hair	Yes	Single tuft, single hair	
Saddle	Yes	Partially covers the anal segment	
Comb scale shape	Yes	pitchfork	
Tufts	No	No tuffs between pecten	***Aedes aegypti sp.***
Anal brush	Yes	Anal brush presence in front of the saddle	
Hooks on the Thorax	Yes	Strong dark hooks present.	

Result 4: Elimination of breeding sites.

The artificial breeding site was eliminated by pouring the water and larvae out. The larvae and pupae cannot survive without water, so this successfully eliminates them as a potential risk.

The summary of result of study findings is presented in Figure 5 below.

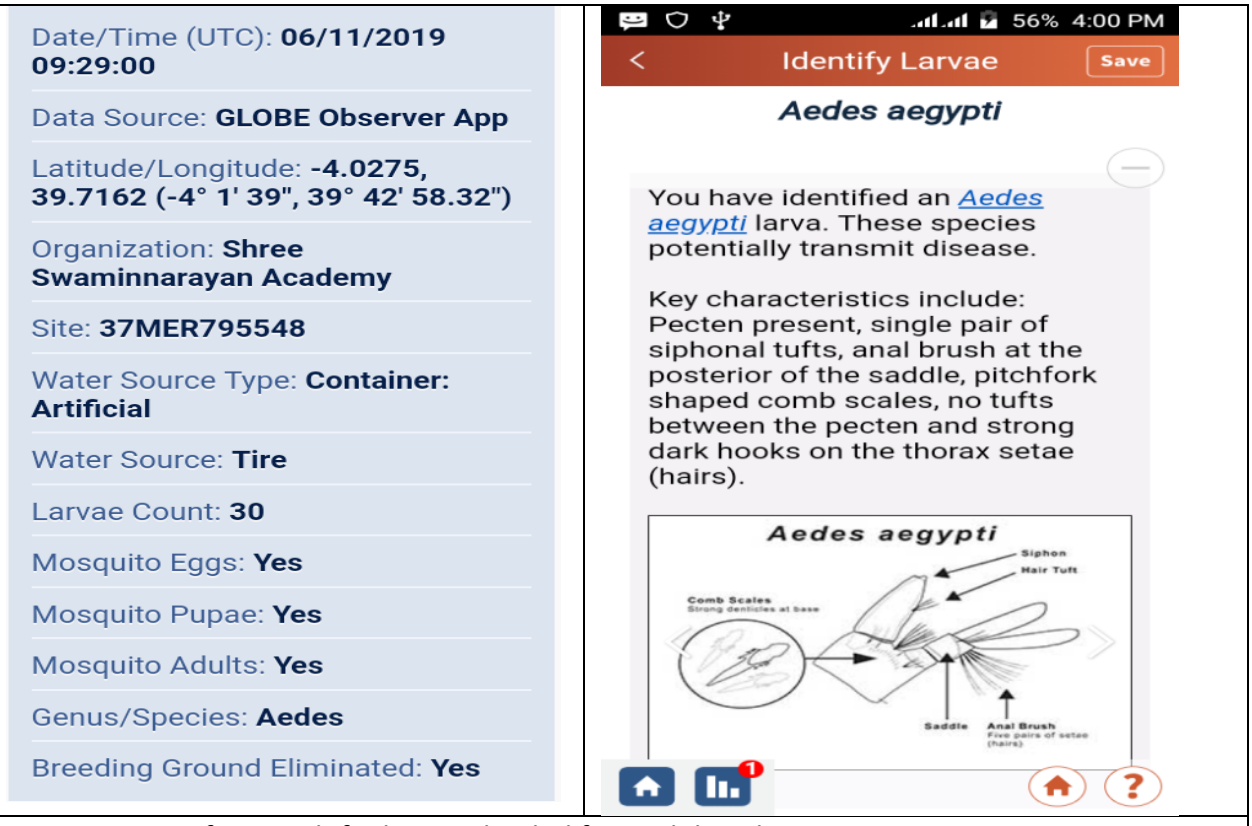


Figure 5: Summary of research findings uploaded from Globe Observer App

DISCUSSION

Most of the larval species found around our school compound belonged to the *Aedes* species. This may explain the lower incidences of malaria in Nyali area compared to the rest of Mombasa County. *Aedes* species are known to transmit dengue fever and chikungunya.

We concluded that most dominant mosquito species in Nyali area is *Aedes*. This justifies the large number of records about dengue fever and chikungunya virus in Mombasa county.

By identifying potential breeding sites for mosquitoes and by using optional equipment (*such as smartphone camera lenses – which will be provided*) to examine, photograph and identify the mosquito species, you will be able to know which mosquito-borne diseases can afflict our community. In addition, *public health authorities* can use your observations to inform where, when, and how to intervene in their communities to reduce disease risk.

CONCLUSION

Most species found in our school is *Aedes.*

Do not leave places in conditions of which any of the breads of mosquitoes will be able to mature and spread e.g. still water be it in artificial or natural places.

By doing so you prevent spread of diseases that include; zika virus, dengue fever, malaria, chikungunya etc.

If a mosquito breeding site is discovered in your locality, do report it to the health departments in the respective area.

Our Environmental Club in collaboration with the *Kenya Space Agency's GLOBE Program* organized a **1-day workshop** on identification of different species of mosquitoes and monitoring their potential breeding sites in our homes, hotels, offices and surrounding environment. The workshop targeted County officials, Public Health Workers (promoters, coordinators), Public Health Officials, Beach Hotel Owners, Teachers, Students (primary & secondary) and Community members.

The workshop achieved the following objectives: Nurtured students' social responsibility to other people and the environment, Created awareness of mosquito species and potential breeding sites, Supported the community to develop and implement an effective integrated mosquito vector borne diseases control approach, equipped the participants and citizen scientists with skills on Mosquito larvae identification using GLOBE Observer Mosquito Habitat Mapper (GO MHM) App.

And most importantly, we communicated our research findings – "dissemination" of information to the community and guests through recitation of a poem dabbed, "The fight" during Academy's Annual Prize Giving Day. (see Appendix 3).

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APPENDIXES

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IDENTIFICATION OF DIFFERENT SPECIES OF MOSQUITOES AND MONITORING THEIR POTENTIAL BREEDING SITES IN OUR SURROUNDING ENVIRONMENT, SENSITIZING THE COMMUNITY ON LARVICIDING.

Report on Shree Swaminarayan Academy Globe program Community Action

Date: 4th October, 2019.

Venue: Shree Swaminarayan Academy, Nyali Links Rd, Mombasa.

GLOBE COMMUNITY ACTION POEM

THE FIGHT (By Ken Wago)

You whistle at night,
Biting transmitting germ in the light,
The vector hitting again and again,
Malaria, the emotional drain.
Flip every empty container on the ground,

Mosquito the small size of grain,
Affecting human health to the brain,
The body gets weak
The cells swell and bleak.
Flip every empty container on the ground,

Aedes! Culex!
Less harmless and immobile at larvae,,
To finish Dengu, Chikungunya, Zika and
Malaria around.
Flip every empty container on the ground.

Oh! Mosquito
Anopheles, the name,
The insect to blame
In the malaria game,
It has come to fame,
The master to tame,
To finish the malaria the same.
Flip every empty container on the ground.

Anopheles!
Flip every empty container on the ground.