



## Frequently Asked Questions: GLOBE Observer Mosquito Habitat Mapper

### Introduction to Mosquitoes

There are 37 genera and more than 3,500 species of mosquitoes (Family Culicidae). Mosquitoes are two-winged flies (Order Diptera) and have long slender bodies, long thin legs, and narrow wings with scales on the rear margin and along the veins. Both males and females consume plant nectar. Females also require a blood meal, to provide needed vitamins and nourishment for development of their eggs. Depending on species, mosquitoes can have a preference for either humans or certain animals as the source of their blood meal. They locate their host by body odors, carbon dioxide, and heat.

There is a lot of variability in mosquito behavior between species. Most species have a preferred time they bite, such as dusk or dawn. Different species also vary in their preferred places to feed and rest; some prefer natural vegetative habitats, while others favor urban environments, and prefer to rest on walls in human dwellings.

There are four life stages: egg, larva, pupa, and winged adult. After the tiny eggs hatch, mosquito larvae (or wigglers) feed on microorganisms and very small plant and animal particles. Mosquito pupae (also called tumblers) do not feed.

Each species of mosquito has a distinctive morphological, physiological, and behavioral characteristics. These include: preferred egg laying sites, diurnal behavior patterns, flight range, and preferred host. Flight distances vary between species-- from a few hundred feet to more than 80 miles with favorable winds. Both temperature and humidity are critical for adult mosquito survival. There are temperature tolerance limits at each developmental stage in the life cycle. Overwintering by different species can be as eggs, larvae, or adults.

### Using the App:

The GLOBE Mosquito Habitat Mapper app is optimized to assist in recognition of *Aedes aegypti* and *Aedes albopictus* mosquito larvae. These two species have a global distribution and are vectors of several diseases that are contracted by humans. You will also be able to report observations of mosquitoes from the genera *Culex* and *Anopheles*. Many of the species in these two genera are harmless, but you can find out which species of these two genera are potential vectors of disease in your area. If your mosquito larva specimen does not key out to one of the 4 taxa supported by this app,



you will report “other”. Remember that finding “other” types of mosquitoes, and especially, NOT finding larvae is also important data and should be reported. Remember that “zero” is an important data observation, and just as important as finding mosquito larvae!!

## Mosquito Breeding Habitats

### Where do I collect data?

You can expect to find mosquitoes anywhere that provides a pool of water that allows the larvae to grow and develop. Different mosquitoes prefer different habitats.

The yellow fever mosquito (*Aedes aegypti*) and the Asian tiger (*Aedes albopictus*) mosquitoes are well adapted to human-built environments. Their ancestors preferred tree holes as breeding sites, but now they seek out water sources near the humans and animals where the female will find its blood meal to nourish its eggs. They now preferentially seek out manufactured containers as breeding sites- from discarded water bottles and tires to water tanks, sewers and flowerpots.

You can find a range of habitats on the GO Mosquito Habitat Mapper- take a look! You can find larvae in water sources as small as a bottle cap and as large as a cistern. Eliminating these habitats – by dumping out water or covering with a lid or net—will mean less adults will be biting near your home and school making your family and community safer from disease. These species only fly a short distance- around 100 m in their lifetime, so source reduction (dumping out and removing habitats from use) really helps!

science questions that can be explored by examining multiple data sources!

## Mosquitoes

### What type of mosquitoes are we looking for?

The app is optimized for use in identifying the Yellow fever mosquito (*Aedes aegypti*) and the Asian tiger mosquito (*Aedes albopictus*). GLOBE Observer selected these two because they are found worldwide and the adults of these species have the potential to transmit pathogens causing several human diseases. Using the app and a macrolens you can identify your specimen to genus (*Aedes*) or species (*A. albopictus*, *A. aegypti*, or *Aedes, undifferentiated*).

You can use the app to identify *Culex* and *Anopheles* genera. Some species of *Culex* are vectors for West Nile Virus. If you find *Culex* mosquitoes, you can consult a local key to see what species you have. *Anopheles* is a genera of which some species of mosquitoes that transmit the pathogens that cause malaria. The responsible species are different in different parts of the world, so once again, you will want to consult a key.



### **What if the larva I see is not one of the three genera identified in the app?**

Remember that most mosquitoes you find will not be from these three types-there are more than 3,500 species of mosquitoes! Most mosquitoes do not transmit disease- instead, they play an important role in the ecosystem, as pollinators and as food for bats, birds and aquatic organisms. You can select “other” as your species, and then mitigate the habitat as you would for one of our three genera.

### **What if I don't see the features I need to determine the kind of mosquito?**

Not all specimens can be identified! A specimen might be damaged- such damaged can occur if the larva is caught in a net, for example. Other specimens do not have clear features that you can use to identify: maybe your specimen is from the 1<sup>st</sup>-3<sup>rd</sup> instar and the features are not fully mature so you can't use them to determine your genera or species. Sometimes, the larva is lying in such a way you can't see the features. Before you give up, use a toothpick to gently move the mosquito so that the features are all in full view. The app shows an image of how the mosquito should be positioned for identification. You may want to look at 2 or 3 mosquito larvae in your sample before you make a final determination.

### **Do you find only one species of mosquito in a sample?**

Not always! It is common to find only one species in a sample, but it's good to check a few specimens just to be sure.

### **What is the mosquito life cycle?**

It is variable, based on environmental conditions- so this is approximate!

Adult  eggs (2 -3 days)  larvae (4 -5 days)  pupae (1- 2 days)  Adult

The time table varies somewhat by species, as well as environmental conditions-including water availability, nutrient status and temperature. Some species, such as *Aedes aegypti* and *Aedes albopictus*, lay their eggs on the side of the container, above the water line. When there is a recent rain, the water rises up, submerging the eggs. The eggs can lay dormant for months until there is enough water for them to complete their aquatic development stages.

Mosquitoes are cold-blooded, so their metabolism speeds up as temperatures warm. Higher temperatures will reduce the time it takes to progress through each stage in the life cycle. If nutrients are sparse, or temperatures are lower, the mosquito will take longer to develop. This is an interesting question to research using GLOBE data! But be sure to conduct any observation activities using a mosquito trap, so that adults have no chance to escape!

### **What do the male mosquitoes feed on?**

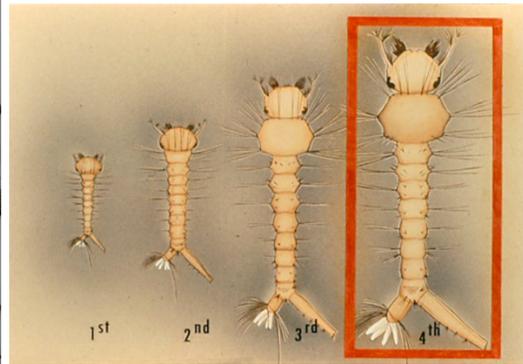
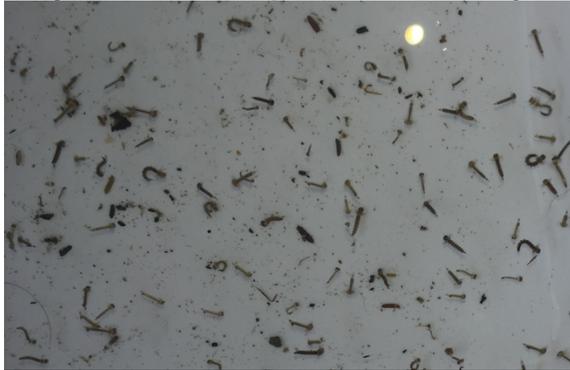
Male mosquitoes feed on any sugar source, including flowers, fruit, nectar and other insects. Some mosquitoes are important pollinators, like bees!



### Can you identify *Anopheles*, *Aedes* or *Culex* larvae with the unaided eye?

We can see the characteristics of mosquito larvae: If you see larvae resting parallel with the water surface, you can be sure you have *Anopheles*- it is the only genera that has this characteristic. On the other hand, *Aedes* and *Culex* larvae cling at an angle of 45° with the side of the container. *Aedes* larvae have shorter, spindle shaped siphons, *Culex* larvae tend to have longer, cylindrical siphons. However, there are 3,500 species of mosquitoes, so you should consult a key for your area to be sure.

### Why are the mosquito larvae in my sample different sizes?



Answer: The sample has only one species of mosquito, but they are at different stages of development:

After hatching from its egg, the larva is in its first **instar** (stage between molts). It eventually outgrows its exoskeleton and molts (loses its outer covering) to become a second instar. The larva goes through two more molts to reach the fourth instar. The fourth instar is the larval stage that is most visible, reaching a length of nearly 1 cm. The features used to identify your specimen are seen on the **4<sup>th</sup> instar larva**- so look for the biggest larvae in your sample.

If you can't distinguish any features, it is possible that the larvae are still in an earlier instar stages. If that is the case, you can count your larvae, but you will not be able to identify features. The 4<sup>th</sup> instar will molt to become a pupa, another stage in the lifecycle of a mosquito. Pupa are distinguished by their appearance- they look like a comma. You may find pupae in your sample.



Do you see the pupa? It's the dark "comma" on the right of the screen.



### How long can you keep larvae samples?

Depending on the temperature and nutrients, larvae develop into pupae after a few days- week. A pupa will usually develop into an adult within a day.

If you want to collect larvae and identify a day or two later, it's a good idea to put the larvae in ethanol alcohol. You can also refrigerate live specimens to slow down their development. Use ethanol to save specimens for reference for longer periods.

### What do you do if adults emerge in your sample?

You don't want to get bitten by the adults, so gently shake or turn the sample over and drown the adults. Do not open a container or bag that contains live flying adults.

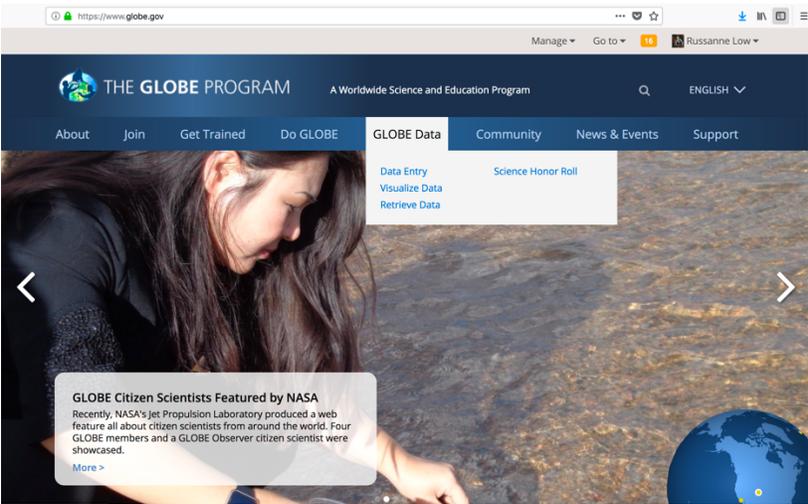
### How do you dispose of your mosquito sample?

Mosquito larvae are harmless, you can throw out the water sample on the ground or in the grass. They will die if they are not in a water source.

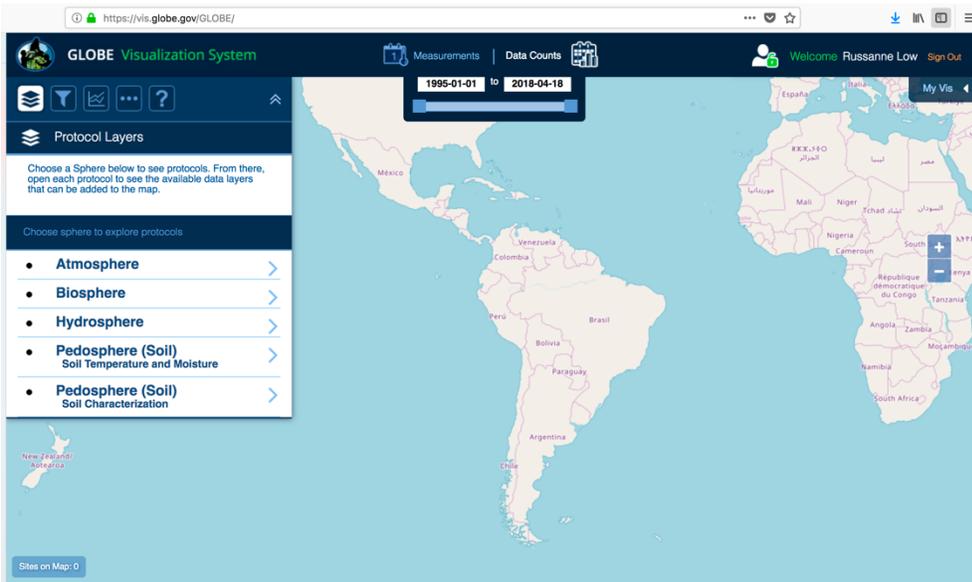
### How can I visualize my data?

You can visualize your data on the GLOBE visualization site. It provides a map-based interface to see the data. To find mosquito habitat data, find the drop-down menu and select hydrosphere. Then select what you want to see- habitats, species, or mitigated/destroyed sites. Choose the date you want, or the range of dates. The map will load. You can then click on any data point to find metadata about that site. You can also click on the first tab and download the data as a .csv or .tmz file for your own analysis.

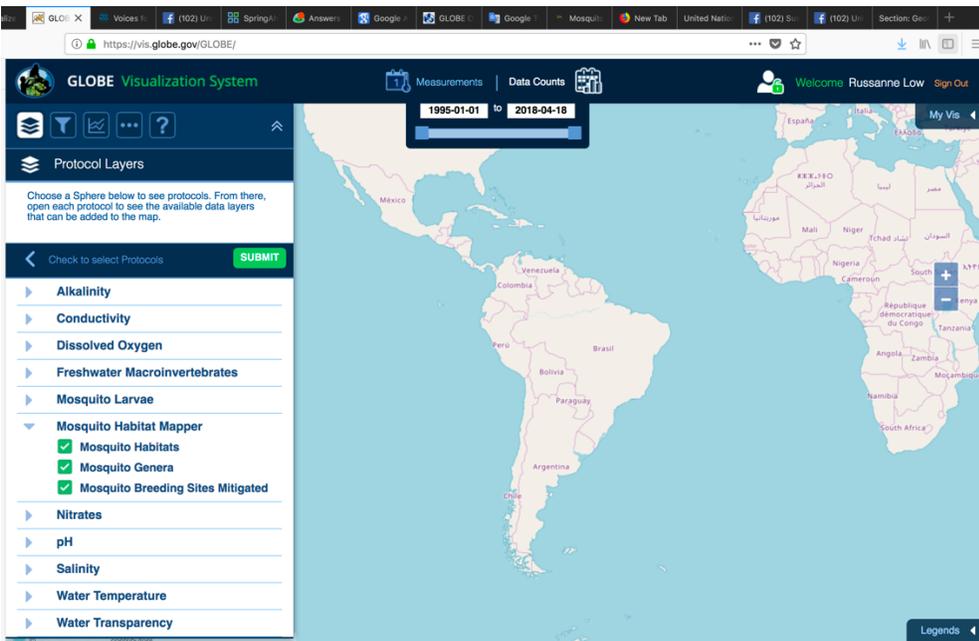
1. Go to [globe.gov](https://www.globe.gov) and on the menu, select GLOBE data and click on "visualize data"



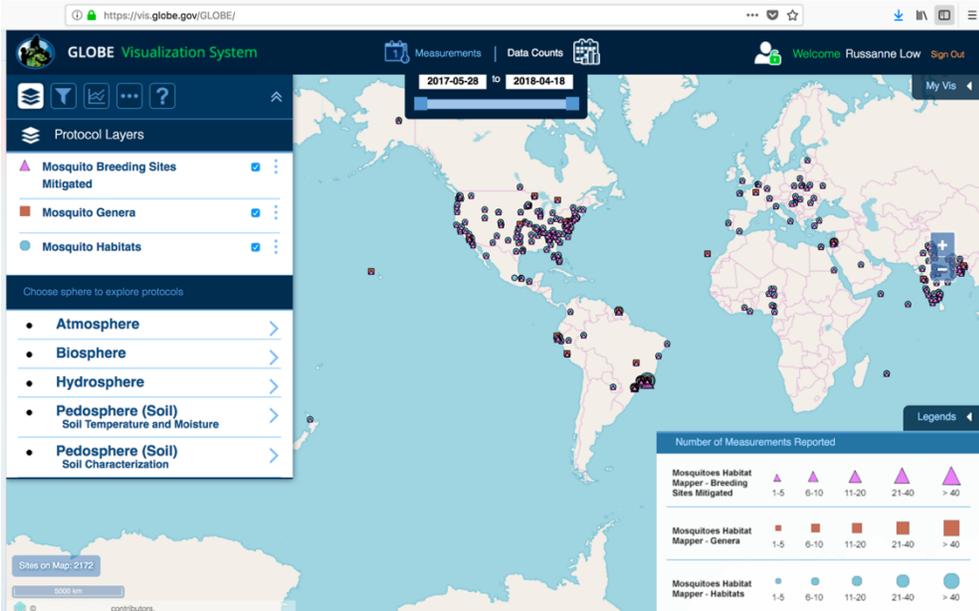
2. Select the data layer icon, and you will see the protocol layers. Select Hydrosphere.
3. Select data counts if you want to see all the data available within a range, or select a single day.



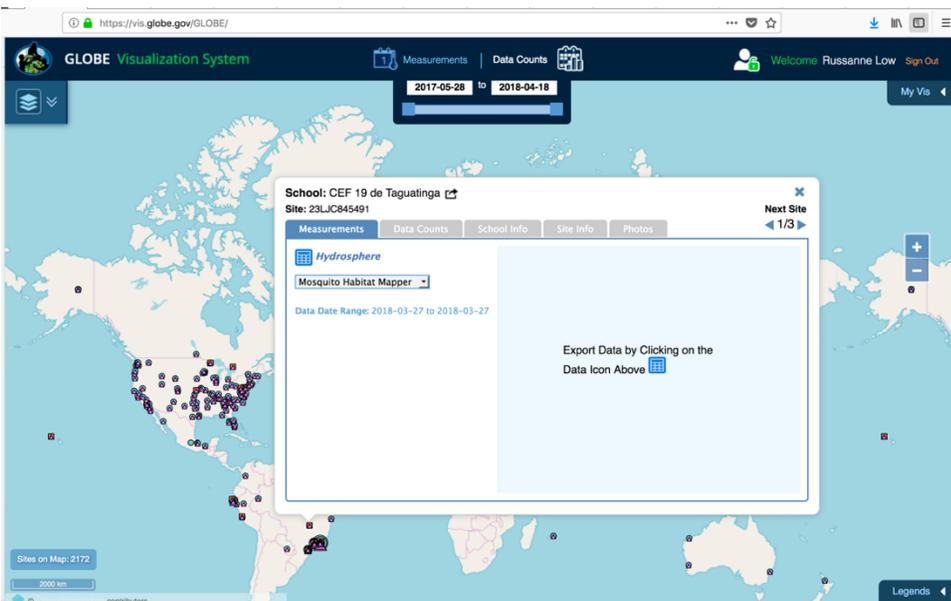
4. In Hydrosphere, select Mosquito Habitat Mapper and the fields you want to examine.



- The data will populate the map. You can see the legend by clicking on the pull-out legend, lower right. You can zoom in and see on which street the data was found!



- You can download data as a .csv file by clicking on a data point and choosing the "Measurements" tab. Follow instructions to download.





### **How long does it take for my data to be viewed on the GLOBE Vis system?**

Your data will be visible on the website within a few hours, usually less than 5 hours. Your photos will not be visible until they have been approved by the system, and this may take somewhat longer, depending on the rate of submissions by citizen scientists using the GLOBE Observer app. This delay is a safety procedure to make sure no inappropriate images are uploaded to the GLOBE Vis.

### **How do I find my observations?**

If you have completed the GLOBE Mosquito eTraining, you will have a GLOBE account, which makes it possible to easily find your observations in the database.

To find your user id:

1. Log in to GLOBE (main site or from the GLOBE Observer page - doesn't matter)
2. Click on your name in the upper right and select My Account from the dropdown menu
3. Your user id will appear in the middle of the screen under your profile picture.

Here's the format: [https://www.globe.gov/apps/my-observations/\[userid\]](https://www.globe.gov/apps/my-observations/[userid])

For example, here is the link to my observations: <https://www.globe.gov/apps/my-observations/2952065>

## **Conducting Research**

### **How can I use my data to better understand mosquitoes in my area?**

This is a good question. It helps to start with a question or hypothesis: what do you want to know? Do you want to know when you have the highest danger of mosquito bites? Do you want to know what are the preferred breeding sites in your area? Do mosquitoes in your area prefer clear or dirty water? What nutrients work best to attract mosquito moms to lay eggs in your mosquito trap? Once you have a question, you can always contact GLOBE scientists to help you refine your research design.

### **How can I investigate mosquitoes with other GLOBE protocols? I.e. Temperature, precipitation, land cover, water quality, soil moisture...**

Scientists researching and predicting future mosquito borne disease epidemics use temperature, precipitation, and land cover data from satellites in their models. These data collected on the ground using GLOBE protocols are extremely useful. There is still a lot that is not known about mosquito ecology and microhabitats- and one reason why is that mosquitoes are constantly adapting to new conditions. Some mosquitoes that always favored clean clear water a decade ago are now found in sewers. There are a



lot of rudimentary mosquito ecology research that you can conduct using GO MHM and GLOBE Protocol data.

### **At what seasons of the year are greater percentages of mosquito larvae found?**

Most often they are found in the rainy season or shortly after the end of the rainy season, but in some regions, mosquitoes are found year round. . A great question for you to explore using GLOBE data from your region!

### **How can I use NASA satellite images and resources to better understand mosquitoes in my area?**

There are a number of NASA data portals you can use to explore satellite data and examine it in conjunction with your field data. A good start is found in The Educator's Guide to NASA Earth Science Images and Data, [https://www.strategies.org/wp-content/uploads/2015/09/EducGuide\\_508Fin.pdf](https://www.strategies.org/wp-content/uploads/2015/09/EducGuide_508Fin.pdf) You can also browse other sources of data in NASA Wavelength, NASA's Earth and Space Science Education Library. <http://nasawavelength.org/data-and-images>

There are tutorials online to learn how to access data from these sources. You can also ask GLOBE scientists (GISN) to help you.

### **How can we use this data to make a difference in my community? (action grants, policy, education, etc.)**

Many parts of the world do not have municipal mosquito monitoring or control programs. Incidentally, this includes half of the United States! For this reason, surveillance, reporting and taking breeding sites out of commission and use (especially sites in built human environments) is critical. For diseases such as dengue, Zika, chikungunya and other arboviruses for which there is no vaccine, there are only three lines of defense-surveillance, mitigation and education. GLOBE Observer Mosquito Habitat Mapper does all three!

If you are part of a local effort to map and report breeding sites in your community, let the municipal government know. The public health department, mosquito control agency, or local government may be interested in partnering with you. In many parts of the world, including most of the U.S., the mosquito surveillance infrastructure is inadequate in the face of emerging disease threats from invasive mosquitoes, so your work will be welcomed~

## **Safety questions**

Larvae do not bite and cannot transmit pathogens into your blood. Also, adult mosquitoes are not found in larger numbers near the breeding sites, so there is no additional danger in collecting larvae. However, it's important to always take precautions from getting mosquito bites. Protect yourself by wearing light colors, long sleeves and pants, socks and shoes, and use a mosquito repellent on exposed skin. DEET compounds are the most effective.



While the larvae are not hazardous, you should take precautions in case the water that they are in is polluted. It is a good practice to use disposable gloves when handling water samples, and eye protection in case of splashes. Consult your teacher to see what the school procedures are.