

# Survey of Larvae and Adult Mosquitoes of Medical Importance in Bryan/College Station, Texas (Diptera:Culicidae)

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Edited by Yaziri Gonzalez

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**Abstract:** Mosquitoes are potentially one of the most deadly animals in the world. They are known to vector diseases such as Yellow fever and West Nile virus. Surveying urban areas is important for identifying what species of mosquitoes are present in order to determine what potential diseases are present in the environment. The focus of this experiment was to identify what species were present in the Bryan/College Station, TX area. Mosquito larvae were captured by allowing the females to oviposit in previously placed containers and were monitored over the course of two months. By properly identifying the species of local mosquitoes, prevention methods can be taken into account in order to lower mosquito prevalence and ultimately lowering the chances of mosquito-borne diseases.

*Keywords:* Culicidae, survey, West Nile virus, disease

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Mosquitoes are notorious for pestering humans and animals, even more concerning they are known to vector many emerging diseases. By taking a blood meal on humans, they spread diseases worldwide such as Yellow fever, Dengue fever, Chikungunya virus, and malaria (Brown 2014). Locally in the College Station area, West Nile virus is a common concern associated with mosquito bites. Mosquitoes are populous in this area due to the often wet and humid climate, contributing to the optimal temperatures for mosquito breeding throughout the majority of the year. Several species of mosquitoes are common in the College Station area, but specific genera that are often found are *Anopheles*, *Culex*, *Psorophora*, and *Aedes*

(Johnsen). A few specific species that are common to the area include *Culex restuans*, *Culex quinquefasciatus*, and *Aedes albopictus* (Johnsen). With the variety of genera and species of mosquitoes in Texas and Bryan/College Station, there is a high risk for transmission of certain diseases. All three of the species mentioned are especially known to be carriers of West Nile Virus, which raises large concern for the frequency of transmission in this area. This places a high importance on surveying and collection of mosquito species in the areas that are inhabited by humans on a daily basis. This study examines the mosquito species found during a collection period in the fall and emphasizes the risk for citizens in the

College Station area for transmission of diseases by specific species

## **Materials and Methods**

Collection of mosquitoes was completed using multiple methods in different locations throughout the College Station area. Locations were chosen based on resident homes/apartments and local parks commonly inhabited with humans. During the months of September to November 2014, a variety of containers were used to collect mosquito larvae from suitable habitats where gravid water was accessible. Glass jars (Ball Corporation, Broomfield, CO) painted dark with black paint were filled with debris rainwater to manufacture a suitable mosquito habitat. They were placed in park and public locations surveyed in College Station. Clear plastic containers were used at 811 Harvey Road (30.621832, -96.312571). A large black plastic container (Sterlite, Townsend, MA) was used to collect water at 3308 Normand Dr (30.583586, -96.293574). A large 12 x 16 inch tarp (Foremost Tarp Co., Auburn, WA) was also placed outside in the backyard of 1002 Hereford St. (30.606655, -96.33158) and was allowed to collect several weeks' worth of rainwater. Locations such as parks were also surveyed for mosquito larvae habitats. Wolf Pen Creek (30.613423, -96.324933), Lick Creek Park (30.561108, -96.213706), and Brison Park (30.606655, -96.33158) were surveyed for mosquitoes. The artificial mosquito habitats were checked weekly for any mosquito larvae.

Once mosquito larvae were found, they were collected in mosquito breeders or glass jars and allowed to develop into adults. Larvae captured in jars were later transferred into mosquito breeders (BioQuip Products, Compton, CA) provided by the classroom. Mosquito breeders were kept in a temperature-controlled incubator while the larvae matured and developed into adults. A fraction of the larvae were extracted early with forceps and stored in five ml Eppendorf tubes (Fisherbrand, Pittsburgh, PA) containing 70% ethanol (Fisherbrand, Pittsburgh, PA) in order to be identified. The tubes were labeled with the date they were put into ethanol and an identification number. The larvae that remained in the breeder emerged into the adult stage and entered the top part of the breeder through the canal that had a narrow opening at the top to prevent backflow. The breeders were checked every few days for any newly-emerged adults. After herding the adult mosquitoes into the top portion of the breeder, it was taken apart and the top portion was placed in a freezer at -20.5 degrees Celsius for one minute to kill the mosquitoes without injuring their identifying features. Male mosquitoes were identified by their plumose antennae and discarded. The remaining adult female mosquitoes were collected for identification and analysis. Like the larvae, the adults were individually placed into Eppendorf tubes filled with 70% ethanol and labeled with the collection date and identification number. All larvae and adults collected were identified at a later time. The key used to identify the specimens was the Centers for

Disease Control and Prevention (CDC) mosquito key.

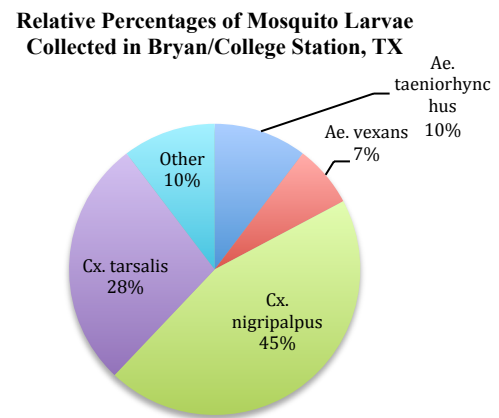
No inferential statistical analyses were conducted in this survey; however, descriptive statistics were used to describe the distribution of samples that were collected.

## Results

Mosquito larvae were successfully collected from three locations: 3308 Normand Dr. (30.583586, -96.293574), 811 Harvey Road (30.621832, -96.312571), and 500 West Dexter (30.606194, -96.332719). A dark plastic container was used at the Normand Dr. location; three clear plastic containers were placed at the Harvey Rd. location; and mosquito larvae were directly collected with the mosquito breeder from a hole in the ground at the West Dexter location. The Harvey Road location had three plastic containers, but only one container yielded any mosquito larvae. The two other containers were tipped and empty upon re-collecting them.

Surveying Brison Park resulted in no larvae found in the park area, including puddles in the grass and a large ditch that collected water run-off. The area surrounding the park contained potholes formed in the grass near a driveway at 500 West Dexter, resulting from tires leaving imprints in a muddy area and leaving behind a hole filled with rainwater that was a suitable habitat for mosquito larvae. A large amount of larvae were found and collected with a variety of glass jars and mosquito breeders.

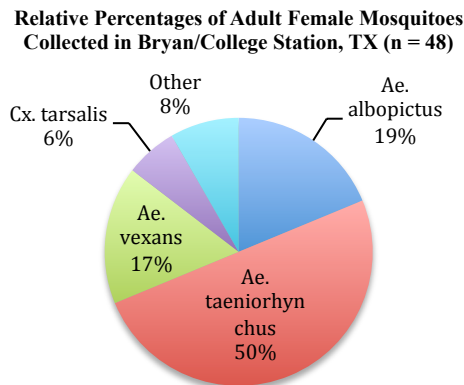
Gravid water in dark glass jars and dark plastic containers were also placed around Texas A&M University (Heep building), Wolf Pen Creek, and Lick Creek Park and a tarp and a variety of containers were used at 1002 Hereford St., however, these locations did not yield any mosquito larvae. Furthermore, the containers at these locations were found empty of gravid water or toppled down.



**Figure 1.** The relative percentages of mosquito larvae collected throughout Bryan and College

A total of 27 mosquito larvae and 48 adult female mosquitoes were collected over a period of approximately four weeks (October 10, 2014-November 4, 2014). Seven species of mosquito larvae and eight species of adult mosquitoes were identified using the CDC Mosquito Key. The mosquito larvae identified included: *Aedes vexans*, *Aedes taeniorhynchus*, *Culex nigripalpus*, *Culex quinquefasciatus*, *Culex restuans*, *Culex tarsalis*, and *Toxorhynchites rutilus*. The following adult mosquitoes were identified: *Aedes albopictus*, *Aedes sollicitans*, *Aedes taeniorhynchus*, *Aedes vexans*, *Culex. quinquefasciatus*, *Culex.*

*salinarius*, and *Culex. tarsalis*. The majority of *Culex* mosquito larvae were collected from the West Dexter location. However, the majority of adults from this location were *Aedes. taeniorhynchus*.



**Figure 2.** The relative percentages of adult female mosquitoes collected throughout Bryan and College Station, TX.

In the collection, 45% of the larvae were identified as *Cx. nigripalpus* (Figure 1). Approximately half of the adult female mosquitoes collected were identified as *Ae. taeniorhynchus* (Figure 2).

## Discussion

### Collection Technique Evaluation

Surveying Brison Park resulted in no larvae found in the park area, including a large ditch running through the park. This ditch was a habitat for small fish that may prey on mosquito larvae. This might be a possible reason for the lack of mosquito larvae. Alternatively, the 500 West Dexter site was located across the street from the park, but contained the greatest number of larvae and adult mosquitoes found in this project. This particular site was an incidental find, as no

traps were placed. The 500 West Dexter site was an address to a resident house. The driveway had a hole in the grass, presumably from tire tracks repeatedly running along the site during the rainfall that occurred 2-4 days prior to collection (October 17, 2014). The rainfall collected in the hole, and as temperatures increased over the course of the week, mosquitoes were able to lay their eggs in the hole or the eggs that were already in the hole were able to hatch. This resulted in a large number of larvae and pupae collected at the 500 West Dexter site.

The 3308 Normand Dr. collection site also resulted in a large number of larvae captured. A few larvae were captured and preserved in ethanol. The majority of the larvae from this site were left to pupate and emerge as adults. The adults that emerged contributed a significant amount to the total number of adult mosquitoes. Unlike the 500 West Dexter location, this site was an intentional collection site. A large black plastic bin was in the backyard of this home and contained gravid water from the collection of rainwater, grass, dirt, and other organic material. According to Maryland's Department of Agriculture (2014), some mosquito species such as *Ae. aegypti* prefer containers in the shade or dark-stained containers. This technique worked well for this site. As expected, the majority of the adult female mosquitoes found in this artificial container was from the *Aedes* genus.

The 811 Harvey Rd. location yielded subpar results. Three clear plastic containers filled

with gravid water were used to attract mosquitoes. This site yielded far less larvae than the dark container, suggesting that mosquitoes might prefer darker containers versus clear containers (Maryland Department of Agriculture, 2014). While one of the containers yielded some larvae and adults, the two remaining containers were found empty and tipped on their sides. The presence of stray cats could explain these results, as they may have considered the containers as a source of water. The larvae collected were from the *Culex* genus and the adults that emerged included one *Cx. tarsalis* and five *Ae. albopictus*. The *Ae. albopictus* adults were expected even though the containers were clear; however, the plastic bowls were placed in the shade.

Other locations did not yield such successful results. This could have been due to disturbances of the containers/tarp; lack of rain in the tarp; and lower than expected temperatures during the collection period.

#### *Genera Collected and Species of Interest*

The majority of the mosquitoes (larvae and adults) that were collected belonged to the *Aedes* and *Culex* genera. Two *Toxorhynchites* larvae and adults were also collected. According to the sample, these three groups were the major genera that were represented in Bryan/College Station, TX.

An interesting finding was the presence of *Ae. taeniorhynchus* larvae and adult mosquitoes from the 500 West Dexter collection site. *Aedes taeniorhynchus*, also

known as the Black Marsh mosquito, is commonly found in the southern United States. In particular, this mosquito species is found along the coast of the Gulf of Mexico in Texas. Major counties afflicted with this mosquito include Harris, Galveston, and Fort Bend (Johnsen). Previously, this mosquito was not found in Brazos County due to the lack of high tides and marshes (Apperson, 1991, Galveston County Mosquito Control). *Aedes taeniorhynchus* does have a rather long flight range, approximately 20-40 miles (Jackman and Olson, Galveston County Mosquito Control). These findings might suggest that this particular species of mosquitoes could be migrating throughout Texas. Further surveillance of *Ae. taeniorhynchus* will be needed to monitor the migration of this mosquito.

Another surprising result was the presence of *Culex nigripalpus* larvae collected from the 500 West Dexter location. *Culex nigripalpus* is a common mosquito in Florida (University of Florida Medical Entomology Laboratory). On the other hand, this species is not commonly found throughout Texas, but has been identified in a few counties scattered around Texas (Johnsen). Like *Ae. taeniorhynchus*, *Cx. nigripalpus* has not been found in College Station previously. The presence of *Cx. nigripalpus* larvae could mean the species is migrating to new territory and further surveillance of this species would be prudent to examine the migration patterns and possible need for control of this species.

#### *Possible Risk to the Public*

With the worldwide trade system, there is a high possibility for an infected mosquito to be transported to North America or for an infected human to carry any of the pathogens to the United States. Specifically in Bryan/College Station, TX, there is a greater risk of disease transmission by mosquitoes commonly found in the area. In this specific study, the most common larvae and adult mosquitoes captured were *Cx. nigripalpus* and *Ae. taeniorhynchus*, respectively. From the results in this study, residents of Bryan and College Station may be at greatest risk for Eastern Equine encephalitis, Saint Louis encephalitis, and West Nile virus. The greatest risk for disease transmission lies with individuals who work outdoors for long periods of time and those who are outdoors recreationally. With the presence of *Ae. albopictus*, which can transmit a variety of human and animal diseases, it will be important for residents in College Station to take precautions to prevent mosquito bites and thusly, transmission of mosquito-borne diseases.

#### *Recommendations and Future Studies*

Surveys and collection studies are important first steps in determining the risk of disease and developing plans on how to control vector-borne diseases. Surveillance studies should continue to monitor these mosquito species, particularly *Cx. nigripalpus* and *Ae. taeniorhynchus* as these were not previously described in Bryan and College Station. Given their ability to travel far distances, it is possible for these mosquito species to migrate to other parts of the United States. Texas is especially prone to high mosquito populations because of the humid and warm weather during the summer, which provides ideal conditions for mosquito breeding. Furthermore, mosquitoes should be tested to detect WNV and other encephalitis viruses that could pose a risk to Texas. By conducting surveillance studies and performing molecular testing, public health professionals may have the ability to prevent or control emerging diseases such as Rift Valley Fever and Chikungunya.

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