Mosquito Survey of the Greater Bryan/College Station, Texas Area

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Abstract: Much is known about the numerous species of mosquitos (Diptera: Culidae) and the diseases that they can transmit when the conditions for the host and pathogen are appropriate. Knowledge of the types of mosquitoes that inhabit a particular region can give entomologists and medical professionals an understanding of the kinds of arboviruses that could potentially plague that area. In this study, mosquito larvae were collected from a number of rural and urban sites within and surrounding the area of Bryan/College Station, Texas during the fall of 2016. Collections were taken from temporary and permanent bodies of water to increase the odds of catching a variety of species. The larvae were then reared to adulthood and identified in the lab. A total of 101 mosquitoes were collected over the course of the study. All of the mosquitos belonged to either the *Culex* or *Aedes* genera, most notably *Culex quinquefasciatus* and *Aedes albopictus*. The ratio of males to females was nearly even, though females are the primary concern regarding the transmittance of disease. Based on the species collected, it can be determined that the Bryan/College Station area could at some point experience an outbreak of diseases such as West Nile virus or Zika virus, both transmitted by *Culex quinquefasciatus*, or the numerous other diseases vectored by *Aedes albopictus* including dengue and chikungunya. Cases of some of these diseases a have already been recorded in Texas, so local officials should be aware of the potential of an outbreak.

Keywords: mosquito, *Aedes albopictus*, *Culex quinquefasciatus*, Bryan/College Station, disease

The information gathered in this survey is valuable to the Bryan/College Station community in that it provides an accurate account of mosquito species present in their surrounding areas. Mosquitoes are hematophagous insects that belong to the order Diptera and are considered one of the most deadly species on Earth due to their ability to vector a wide variety of diseases. With over 3,000 different species throughout the world, 176 of those species are found in the United States, and 85 species are found in Texas (Nava 2016). The presence of each of these 85 species varies in different parts of Texas, but at least one species can be found in each part of the state year-round. Mosquitoes can be found in both temporary flood water and permanent water habitats, where the females will lay their eggs, species, in either running or standing water, depending on the species. The eggs will

hatch and the mosquito will mature in this same source of water.

Due to their constant presence and ability to vector disease, mosquitoes are a serious public health concern. The feeding of human blood, which begins with penetration of the skin by the mosquito's proboscis, introduces the possibility of infection and transmission of foreign proteins (Mullens 2009). Three types of pathogens, protozoans, viruses, and filarial nematodes, are known to be transmitted by mosquitoes (Mullens 2009). Some of the mosquito borne diseases that have been found in Texas are Chikungunya, West Nile, Dengue, and, in recent cases, Zika Virus (Nava 2016). The rise in cases of West Nile Virus in 2002 in the Houston metropolitan area caused changes and improvements in mosquito surveillance and arbovirus detections (Randle 2016). West Nile virus tends to be transmitted mainly by *Culex pipiens* in the northeastern United States and is responsible for the amplification of the virus in wild bird populations (Andreadis 2012). In the north central Mid-Atlantic States, *Culex pipiens* has an increased affinity for human hosts and is a key bridge vector (Andreadis 2012). In the southwestern United States, *Culex quinquefasciatus* is the primary vector in urban regions and a secondary vector in rural areas (Andreadis 2012). The primary vectors of Chikungunya in Texas are *Aedes albopictus* and *Aedes aegypti* (Mullens 2009).

The disease transmission of both of these diseases is correlated with the time of the year, the stage that the mosquito is in, and the prevalence of the mosquitoes preferred host. Recently, there have been many reported cases of Zika virus, transmitted by *Aedes albopictus* and *Aedes aegypti*, throughout the southern United States. *Aedes aegypti* tend to inhabit highly populated areas, lay up to 200 eggs in a small amount of water, and feed during the daytime (Murray 2016). These factors make this mosquito very difficult to eradicate. Considering all the information that we know about these and other types of mosquitos, a survey of the species in a particular area could provide a potential risk assessment for arboviruses in that region. With this and similar studies to determine mosquito species in a given area, medical professionals can more accurately prepare for certain diseases that they could come across in treatment. In addition, these professionals can become more knowledgeable about certain mosquito species, their life cycles, habitats, transmission methods, the types of diseases they carry, and how they can best prevent and treat those diseases. This study was conducted to obtain accurate data of mosquito species in the areas including and surrounding Bryan and College Station, Texas in order to better prepare for possible local disease outbreaks.

Materials and Methods

Larval collection was performed at a combination of urban and rural locations in College Station, Texas and surrounding areas from the months of September 2016 to November 2016. The "dipping" method of mosquito larval collection was utilized, and larvae were allowed to mature to adulthood so each could be stored for later species identification.

Collection Sites:

A variety of sites were selected in order to analyze larval populations in both urban and rural settings. Rural sites included Lick Creek Park (College Station, TX~ 30.562450, -96.214465), a ranch in Grimes County (Iola, TX~ 30.721, -96.107857), a ranch in Washington County (Burton, TX ~ 30.182160, -96.595528). Urban sites

included a house in the South Garden Acres neighborhood (Bryan, TX ~ 30.635068, -96.339844), and from a location in the middle of another small neighborhood, Woodland Court (Bryan, TX ~ 30.630867, -96.374356).

Collection:

Upon identification of a potential site for mosquito larval collection, initial observation of the habitat was performed and described using the Habitat Collection Form (see appendix A). A plastic one-cup measuring cup (236.59 milliliters, 8 fluid ounces) was then used to scoop samples of water. A minimum of two scoops (16 total ounces) were collected from each location. To avoid disturbing and scattering larvae, the collector was carefully placed in the water to avoid casting a shadow on the surface of the water. The measuring cup was dipped below the surface away from the larvae, moved underneath larvae, and brought up towards the surface to collect larvae in the cup. The collector would then inspect the cup for the presence of larvae. After collection was complete, the Habitat Collection Form was completed and details of the collection procedure were described. Larvae were then placed in BioQuip mosquito breeding containers, and were fed fish food daily if necessary (some samples included enough organic material from the habitat that supplementation with fish food was not needed). Tape and a permanent marker were used to label each container with the date of collection, collection site, and initial number of larvae.

Data Analysis:

After maturation to adulthood, adult mosquitoes were removed from larval containers and stored in a freezer for later species identification. Species identification was performed using the Centers for Disease Control and Prevention pictorial key for adult mosquito identification. Data from the Habitat Collection Forms and the results of species identification of collected mosquitoes was graphically depicted. The overall number of each mosquito species collected was categorized according to location of collection and type of habitat.

Results

In total, 101 mosquitoes were collected from Bryan/College Station and surrounding areas, of which 47 were male and 54 were female. The areas used for sampling were College Station, Bryan, Iola, and Burton. Specifically, larvae were collected from Lick Creek Park in College Station, a bucket of stagnant water in Iola, puddles near a paved road in Bryan, and a water trough in Burton. Larval Collection Forms, which were completed for every sample, indicated that larvae were most often collected from slightly turbid water, which was consistent among temporary and permanent sites. As shown in detail in Figure 1, the adult mosquitoes collected were identified to be of the species *Culex quinquefasciatus, Aedes albopictus, Aedes epactius* and *Aedes vexans*. Also, found along with the mosquitoes in Burton were 2 midge flies.

Location	Species	# Males	# Females	Area type
Burton, TX	*Culex quinquefasciatus*	22	18	rural
Iola, TX	*Aedes albopictus*	3	4	rural
Iola, TX	*Aedes vexans*	0	1	rural
Lick Creek Park, College Station, TX	*Aedes vexans*	0	4	rural
South Garden Acres, Bryan, TX	*Aedes albopictus*	14	20	urban
Woodland Court Bryan, TX	*Aedes epactius*	8	7	urban

Figure 1: A record of mosquito species collected in rural and urban areas surrounding the Bryan/College Station areas.

Discussion

Mosquitoes were gathered from urban and rural sites in Brazos County, TX and surrounding areas. With the small sample size of this survey, it cannot be determined whether the distribution of mosquitoes varies significantly depending on if they were found in a rural or urban collection site. However, it is pertinent to note that among the mosquitoes collected, many were vectors of medical significance. The presence of these medically relevant species in the collection indicates that there are established population of these species living in the Brazos County area. *Aedes albopictus* mosquitoes were found in both the urban and rural samples collected. This particular species has been found to competently vector a number of diseases, including dengue fever in which cases have been found in Texas as recently as 2013 (Gratz 2004, Thomas et al. 2016). *Aedes albopictus* also vectors Chikungunya, which the Texas Department of State Health Services began tracking in 2014, during which 114 cases of fever were recorded in Texas ("Annual Summaries" 2015). No cases of Chikungunya have been reported in Brazos County in 2016, but a travel-related case could be transmitted using the local populations of *Aedes albopictus* ("Communicable Diseases" 2016).

Culex quinquefasciatus specimens were also found in this survey in a rural environment. *Culex quinquefasciatus* is a vector of medical importance, as it has been found to be responsible for the transference of West Nile Virus. The Texas Department of State Health Services released reports for 2012, 2013, and 2014 on the cases of arboviruses reported throughout Texas

which state that 1,868 human cases of West Nile Virus were found in 2012, 183 cases in 2013, and 379 cases in 2014 (“Annual Summaries” 2015). These reports indicate that West Nile Virus has a consistent presence in Texas and will cause human cases of West Nile Virus. As such, the virus’s distribution must be monitored, as well as the vector *Culex quinquefasciatus.* In the Brazos County area, an established population of this vector is a risk factor for outbreak of West Nile Virus locally. However, according to the Brazos County Health Department, no West Nile Virus cases have been recorded so far this year in Brazos County (“Communicable Diseases” 2016).

Culex quinquefasciatus is also a known vector of the Zika virus, along with *Aedes albopictus*. In 2016 alone, 4 travel-related cases of Zika have been detected in Brazos County according to the Brazos County Health Department (“Communicable Diseases” 2016). The populations of *Culex quinquefasciatus* and *Aedes albopictus* could cause these travel-related cases to transmit locally to other citizens of Brazos county.

Experiments conducted in the future on this topic could include a greater number of surveys, collectively from which more conclusive data about the mosquito populations in Brazos County could be analyzed. If resources permitted, it would be most preferable to test the mosquitoes collected for the presence of the diseases which they vector to determine if the diseases were present locally.

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Sources

Andreadis, Theodore G. 2012. The Contribution of *Culex pipiens* Complex Mosquitoes to Transmission and Persistence of West Nile Virus in North America. Journal of the American Mosquito Control Association. 28: 137-146. http://search.proquest.com.ezproxy.library.tamu.edu/docview/1440824739?accountid=7082

"Annual Summaries for West Nile Virus in Texas." *Texas Department of State Health Services*. Texas Department of State Health Services, 14 Aug. 2015. Web. 30 Nov. 2016. <https://www.dshs.texas.gov/idcu/disease/arboviral/westnile/summaries/>.

"Communicable Diseases Tracker." *Brazos Health Department*. Brazos County Health Department, 18 Oct. 2016. Web. 30 Nov. 2016. <http://brazoshealth.org/articles/1-90>.

Gratz, N. G. 2004. Critical review of the vector status of *Aedes albopictus*. Medical and Veterinary Entomology, 18: 215–227. doi:10.1111/j.0269-283X.2004.00513.x

Mendoza, F., Ibáñez-Bernal, S. and Cabrero-Sañudo, F.J. 2008. 'A standardized sampling method to estimate mosquito richness and abundance for research and public health surveillance programmes', Bulletin of Entomological Research, 98(4), pp. 323–332. doi: 10.1017/S0007485308005701.

Mullen, Gary R., Durden, Lance A. 2009. Chapter 14: Mosquitoes (Culicidae), pp. 10239-11436. Medical and Veterinary Entomology. 2nd Edition. Elsevier Inc., Oxford, UK.

Murray, John S. 2016. Understanding Zika Virus. Journal for Specialists in Pediatrics. http://onlinelibrary.wiley.com.ezproxy.library.tamu.edu/doi/10.1111/jspn.12164/full

Nava, Martin Reyna, et al. 2016. Journal of Vector Ecology. A taxonomic checklist of the mosquitoes of Harris County, Texas. 41.1: 190-194. http://search.proquest.com.ezproxy.library.tamu.edu/docview/1802725404?accountid=7082

Randle, Yvonne H., et al. 2016. U.S. Army Medical Department Journal. 2014: A Record-Breaking Year for West Nile Virus Positive Mosquito Pools in Harris County and City of Houston, Texas. 1-8. http://web.b.ebscohost.com.ezproxy.library.tamu.edu/ehost/pdfviewer/pdfviewer?vid=2&sid=66bc04b2-1d4a-45df-8991-ab0e55b4e3d1%40sessionmgr1

Thomas DL, Santiago GA, Abeyta R, Hinojosa S, Torres-Velasquez B, Adam JK, et al. 2016. "Reemergence of Dengue in Southern Texas, 2013." *Emerging Infectious Diseases* 22.6: n. pag. *Centers for Disease Control and Prevention*. Centers for Disease Control and Prevention, 16 May 2016. Web. 30 Nov. 2016. http://dx.doi.org/10.3201/eid2206.152000.

Appendix A:

Larval Habitat Collection Form

Name of Collector:_____

Date/Time of Collection:_____

Site Location: _____

Habitat Type: ___Temporary ___Permanent

Site Description:

_____

_____

_____

Approximate site dimensions:_____ **x** _____

Water Levels:	**Turbidity:**	**Problems:**
_____ Dry	_____ Clear	_____ Water depth
_____ Dry between pools	_____ Slightly	_____ Soft Bottom
_____ Low	_____ Turbid	_____ Visibility
_____ Normal		_____ Instream vegetation
_____ High		_____ Brush on banks
_____ Flooding		_____ Current
		_____ Equipment
		_____ Other
		_____ None

If collection was complicated by any of the above problems, please describe:

_____

Amount of water collected:_____ **oz.**

Total number of dips:_____ **Number of larvae:**_____