

Mosquito Surveillance in the Lower Rio Grande Valley



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Abstract

Mosquito surveillance is a critical component of an effective early-warning system for many mosquito-borne diseases due to the lack of sentinels or other systems prior to an increase in human cases. Our efforts to assist surveillance for prominent mosquito-borne diseases in the Lower Rio Grande have been active for the past four years. Working with local partners including local health departments, city animal and vector control officers, and county health offices, we receive mosquito samples they have collected. The mosquitoes are identified to species and then tested for disease. While the 2020 season was disrupted in March 2020 with SARS-COV2 concerns, surveillance activities have resumed in September 2020. During 2019 and 2020, we received a total of 80,150 mosquitoes from local partners and identified a total of 28 species. Throughout the year the most prevalent mosquito species collected in South Texas were *Culex quinquefasciatus*, *Aedes aegypti*, and *Psorophora columbiae*. *Culex* species, *Ae. aegypti* and *Ae. albopictus* were tested for relevant diseases (West Nile virus as well as dengue, chikungunya, and Zika virus). To date, all mosquitoes tested have been negative. While the disruption in 2020 has limited our ability to identify long term patterns in mosquitoes, we discuss some of the patterns that have been determined to date.

Introduction

The Rio Grande Valley, a region located at the southern tip of Texas and the US-Mexico border, is susceptible to mosquito-borne disease (Martin, et al., 2019). The region's warm, yearlong climate creates a suitable environment for mosquito breeding. Additionally, the high presence of mosquito vector species across the Rio Grande Valley increases the risk for mosquito-borne disease cases and transmission (Garcia-Luna et al., 2019). Cases of vector-borne diseases have been reported across counties in the Rio Grande Valley (Martin, et al., 2019). In 2020, cases of West Nile Virus and Dengue virus were detected in the Rio Grande Valley (The County of Hidalgo Texas, 2020). Moreover, mosquito surveillance is essential to properly identify a local outbreak, as well as aid local health departments in containing an outbreak (Gu et al., 2008). We have assisted the Rio Grande Valley for the past four years by, 1) studying mosquito distribution and patterns throughout the lower Rio Grande Valley, 2) assisting local health departments in surveillance efforts, and 3) performing surveillance across the lower Rio Grande Valley by testing mosquito vectors for Zika, Dengue, Chikungunya, and West Nile Virus.

Methods

The testing process for the mosquitoes collected in the lower Rio Grande Valley consists of mosquito collection, identification, homogenization, RNA extraction, and a Real-Time PCR test. Mosquitoes are collected with a variety of mosquito traps and submitted by local health departments. The three participating public health departments in mosquito collection were the City of Brownsville Public Health Department, City of McAllen Health and Code Enforcement Department, and Hidalgo County Health Department. Using the Identification and Geographical Distribution of Mosquitoes of North America, North Mexico dichotomous key, mosquitoes are identified. Female mosquito vectors such as *Culex* species, *Ae. aegypti*, and *Ae. albopictus* are grouped into their respective super pools. The rest of the mosquitoes collected are discarded. A maximum of 50 mosquitoes of the same species are placed into one super pool. Two steel beads and sterile PBS are added into each super pool for homogenization with the use of TissueLyser II. The QIAamp Viral RNA Mini Kit is utilized to extract RNA from each super pool. Once RNA has been extracted, each super pool undergoes a Real Time PCR. *Ae. aegypti* and *Ae. albopictus* are tested with a ZIKV/DENV/CHKV Triplex. On the other hand, *Culex* species are tested with a WNV singleplex.

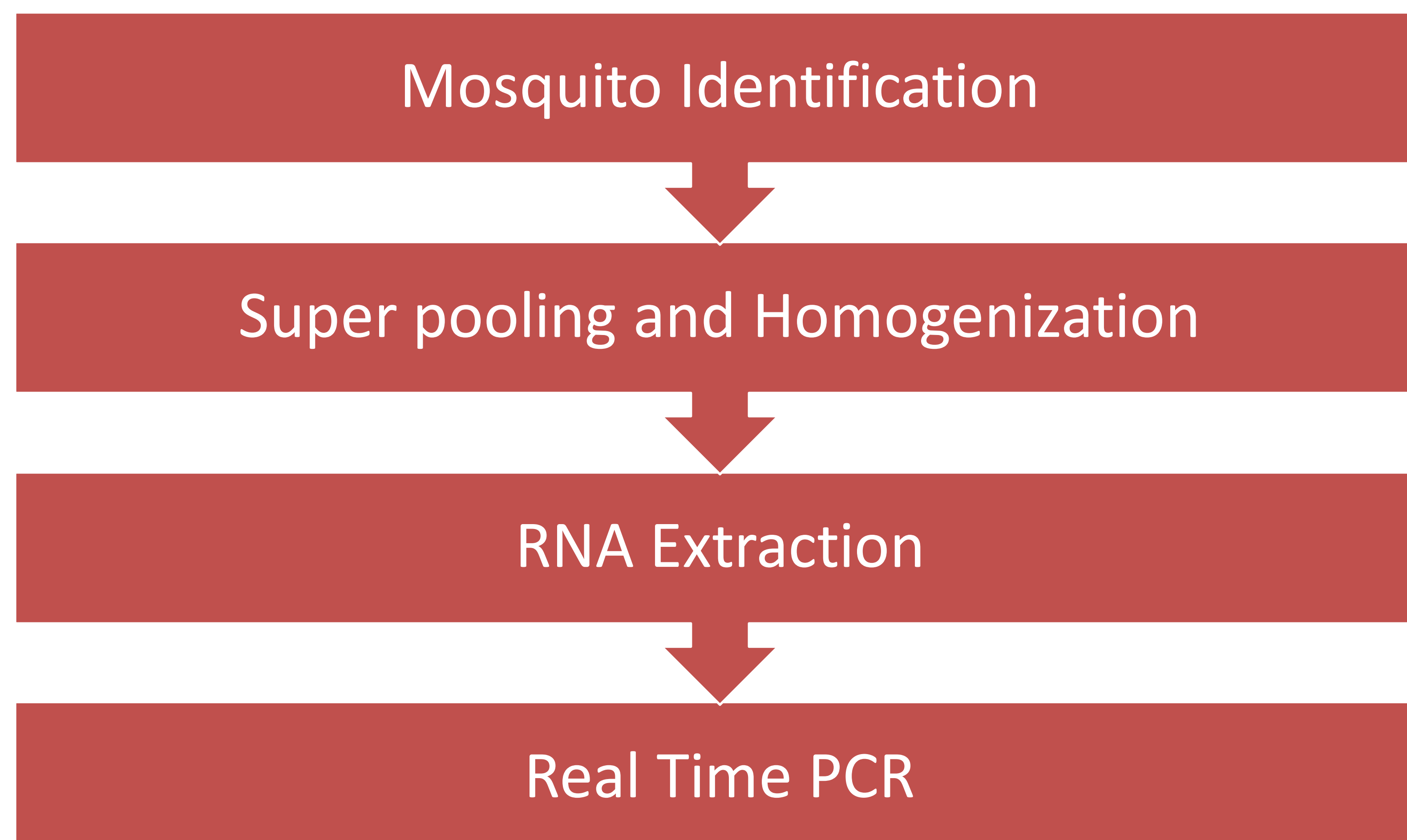


Figure 1: Process for mosquito testing

Results

Total Mosquito Collection 2019-2020		
	Cameron County	Hidalgo County
2019	35,438	33,838
2020	9,147	1,727

Figure 2: Total amount of mosquitoes collected during 2019-2020 in Cameron County and Hidalgo County

Total Mosquito Vector Tested 2019-2020			
	<i>Aedes aegypti</i>	<i>Aedes albopictus</i>	<i>Culex quinquefasciatus</i>
Cameron County	7,420	672	20,735
Hidalgo County	2,089	74	2,873

Figure 3: Total amount of mosquito vectors collected and tested during 2019-2020 in Cameron County and Hidalgo County

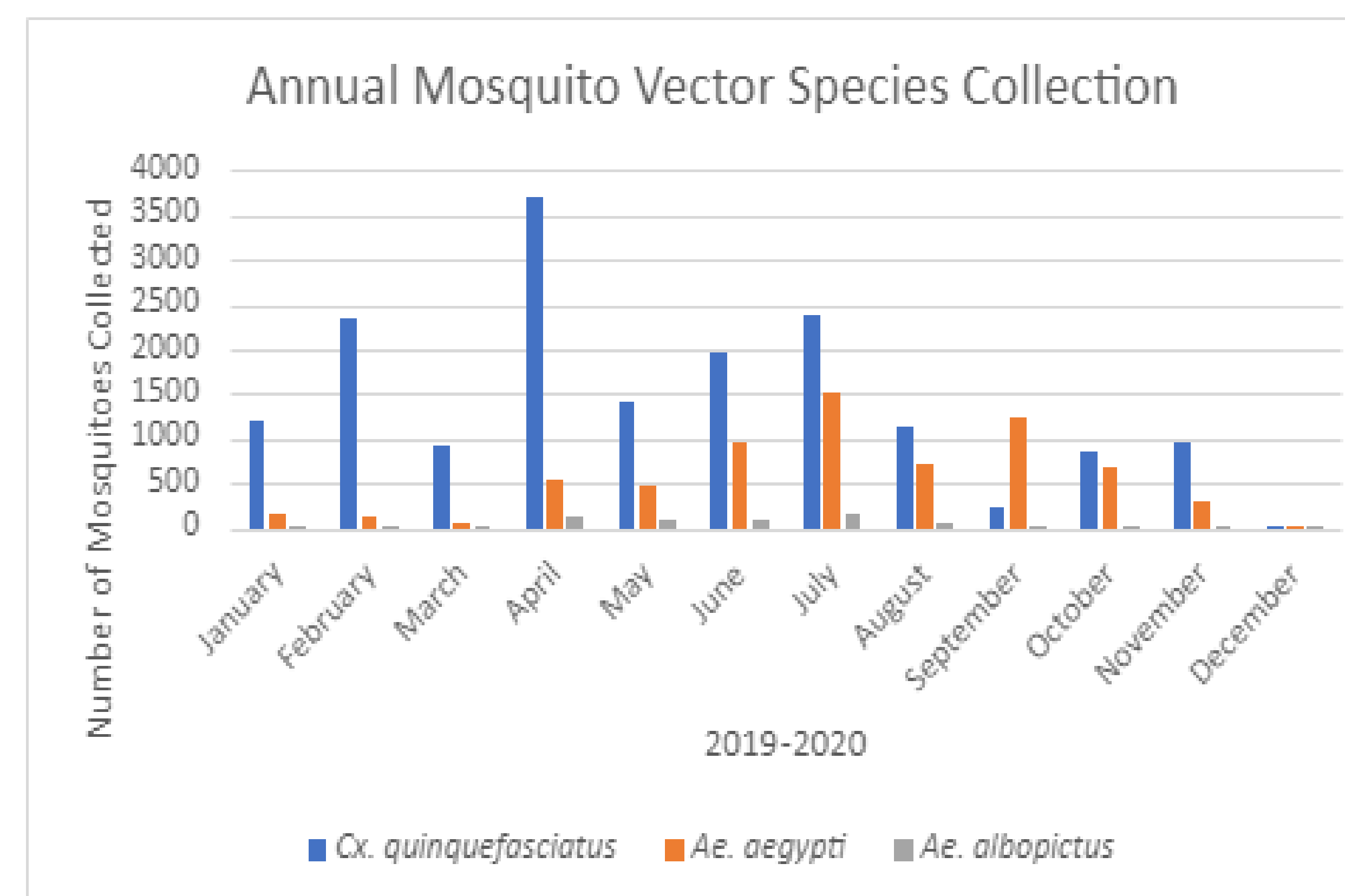


Figure 4: *Ae. aegypti*, *Ae. albopictus*, and *Cx. quinquefasciatus* annual collection pattern throughout 2019 and 2020 in Hidalgo and Cameron County

Prevalent Female Mosquito Species	Number of Mosquitoes
<i>Cx. quinquefasciatus</i>	23,608
<i>Ps. columbiae</i>	17,624
<i>Ae. aegypti</i>	9,509
<i>Ps. cyanescens</i>	3,121
<i>Oc. thelcter</i>	5,323
<i>Ae. vexans</i>	2,426
<i>Cx. nigripalpus</i>	992
<i>Oc. taeniorhynchus</i>	925
<i>Ae. albopictus</i>	746
<i>Cx. erraticus</i>	605
<i>An. quadrimaculatus</i>	573

Figure 5. The most common species collected during 2019-2020 in Hidalgo and Cameron County

Discussion

During 2019-2020 a total of 80,150 mosquitoes were collected and identified from Hidalgo and Cameron County. 83.5% of the mosquitoes collected were female. The most common species collected in Hidalgo County and Cameron County were *Ae. aegypti*, *Cx. quinquefasciatus*, and *Ps. columbiae*. 29.5% of the collected mosquitoes were *Cx. quinquefasciatus* making it the most prevalent mosquito species collected. *Ae. aegypti* was the third most prevalent mosquito collected, and *Ae. albopictus* was the ninth most common species. A large amount of *Ps. columbiae* was collected during periods of high precipitation and flooding. The collection data demonstrated that relevant mosquito vector species: *Ae. aegypti* and *Cx. quinquefasciatus* are present yearlong across Cameron and Hidalgo County. Only the female mosquito vector species capable of transmitting vector borne diseases were tested. Surveillance limitations arose due to the COVID-19 outbreak. As a result, mosquito collection and testing were brought to a halt in March 2020 and resumed in September 2020. Out of the total mosquito collection 33,863 mosquitos were tested. All *Ae. aegypti* and *Ae. albopictus* mosquitoes tested were negative for Zika, Dengue, and Chikungunya virus. All *Culex* species tested were negative for West Nile Virus. Mosquito surveillance continues to be highly essential in the Lower Rio Grande Valley. It is important to establish a long-term surveillance system to properly understand long term distribution patterns for vector mosquito species and identify the presence of mosquito borne diseases at an early stage.

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