

**Quantifying Attributes of Drone Congregation Areas**

**Thesis**

**Submitted in Fulfillment of the Requirements for Undergraduate  
Research with Distinction**

**By**

**Jacob A. Shuman**

**The Ohio State University**

**2021**

**Advisor**

**Reed M. Johnson**

## **ABSTRACT**

Drone Congregation Areas or (DCA's) are areas where drone honey bees from many different colonies fly and congregate in anticipation of the arrival of unmated honey bee queens. These locations are thought to be found 50 ft to 130 ft above the ground and located in an open space near a tree line or hill. While landscape factors associated with DCA's have been identified in other regions, little is known about the conditions under which DCA's form in Central Ohio.

From June to October 2020, I verified the existence of DCA's and determined the conditions under which drone bees will congregate around a virgin queen in Ross and Pickaway counties. To illustrate this behavior, a drone bee fishing net was constructed to capture the drone bees who were actively pursuing a "queen" out on her maiden flight. For the queen bee simulation, I flew a net baited with the major component in queen bee pheromone, 9-ODA. The net was suspended from a weather balloon attached to a fishing line and launched using helium gas and flown at a range of times in the afternoon. I observed drones captured from the DCA's with the net and determined the total number of drones that were collected. There was an approximate 2:1 or 3:1 ratio mature drone bees to immature drone bees that were caught each time. If a small sample size was collected, only mature drones were found. The resulting data collected included logging the time of day, temperature, wind speed, and flight time. A total of three DCA sites were found using auditory and visual cues as well as topography. The average time of day when the most drones were collected was between 3:30 PM to 4:30PM. Temperature range was between 79°F - 90°F on mostly sunny to partly cloudy afternoons. The average wind speed was less than 5 mph. The

implications of these findings support locating likely drone congregation areas in Central Ohio.

## **INTRODUCTION**

Drone Congregation Areas or (DCA's) are where drones fly and congregate after leaving their hives to mate with virgin queens. These locations are thought to be found 50 ft to 130 ft above the ground. DCA's are found usually near an open space near a tree line or hill. Drones fly to the DCA's in routes called flyways. Drones found in the DCA's come from different hives up to several km away.

## **RESEARCH AIMS**

1. Locate DCAs based on height above ground and proximity to open spaces near tree lines or hills.
2. Collect and count drones at DCAs using a drone bee fishing net to capture the drone bees that were actively pursuing a simulated queen out on her mating flight.
3. Determine whether the drones that were captured at DCAs were sexually immature vs mature.

## **MATERIALS & METHODS**

For the queen bee simulation, I used 5 drops synthetic 9-oxo-(E)-2-decanoic acid (9-ODA), the major component in Queen Mandibular Pheromone, as a bait (Figure 1). The

net was suspended by a balloon attached to a fishing line and flown at various times of the afternoon.



FIGURE 1

I observed whether drones could be caught into the net and captured so that I could determine if they were mature or immature. The drone's endophallus is equivalent to the mammalian penis. Full eversion of the mature drone bee endophallus is completed

by applying pressure on both sides of the drone bee abdomen. By squeezing the fingers together, the eversion of the endophallus is completed and the semen is exposed. I located three sites from June 7<sup>th</sup> to October 2<sup>nd</sup>, 2020 in central Ohio. An additional DCA site was found in 2019 in Wooster, OH.

The three sites found in 2020 were in Chillicothe, Frankfort, and Williamsport, Ohio

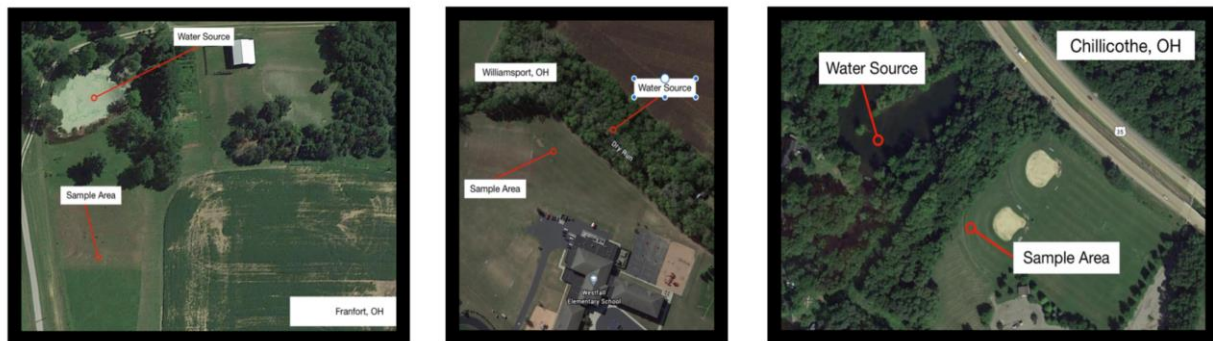


Figure 2. Aerial images of Drone collection sites in Chillicothe (left), Frankfort (Center) and Williamsport (right) Ohio.

FIGURE 2

# RESULTS

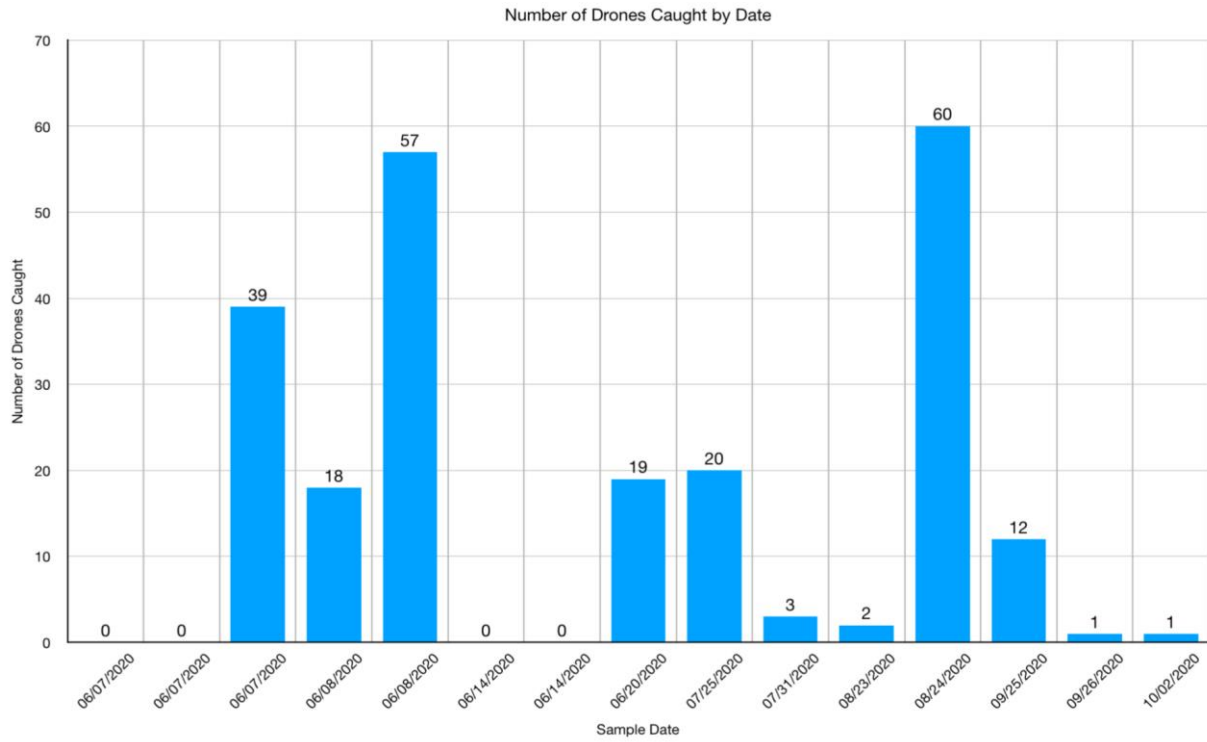


Figure 3. Number of drones caught at all locations throughout the sampling period.

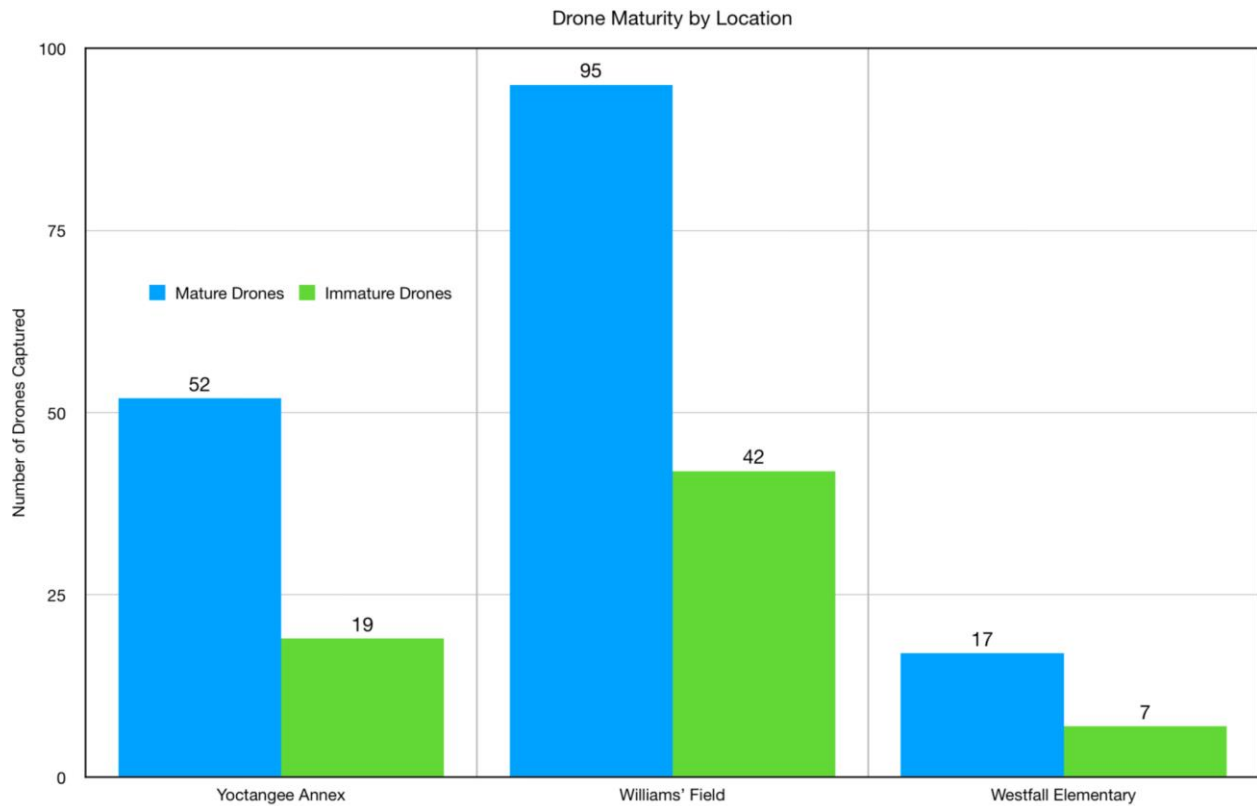


Figure 4. Number of mature and immature drones caught at each location.

Weather: The days were sunny to partly cloudy with temperatures between 79o F to 90o F. The humidity was less than 50%. The average wind speed was less than 5 mph.

Sampling Times: The average time of day was 3:30pm to 4:30pm. The months when sampling was conducted were June to October 2020.

Geography/Terrain: The drones were caught in an open field near a tree line. Drones had a clear line of sight to the net. Nearby stagnant pond water sources were found 200 ft to 400 ft. away.

Observed Drone Characteristics: Fewer drones were caught during the dearth in blooming flowers providing pollen and nectar that occurred in late July and early August. There was an approximate 2:1 to 3:1 ratio of mature drone bees to immature drone bees. On occasions when few drones were collected, only mature drones were found. The drone bees in a DCA were always heard before they could be spotted visually. They were observed competing and were flying into the breeze at the net. There was a distinct drone comet shape to their flight pattern.

## **CONCLUSION**

A total of three DCA sites were found using auditory and visual cues as well as topography. These findings will be useful for future researchers or beekeepers aiming to locate likely drone congregation areas in central Ohio. Identifying open fields near tree lines with a stagnant water source about 200 to 400 feet away are likely host DCA's. While landscape factors associated with DCA's have been identified in other regions, little was known prior to this investigation about the conditions under which DCA's form in central Ohio.

The importance of knowing the attributes of DCAs located near queen production apiaries is beneficial especially to commercial beekeeping. Specifically, knowing the optimum mating flight times, DCA locations, and what the favorable weather conditions typically are for mating flights allows for better queen fertilization. The traits of the queen bee depend on the ability to mate with as many suitors during her mating flights. Failure to mate with 12-20 mature drones during these flights could result in insufficient sperm



collection. If the sperm is exhausted, then the queen can only produce drones and the future survivability of the hive offspring is severely compromised. (Koeniger et al 2014).

## REFERENCES

Finding DCA's. (2018, July 18). Retrieved March 15, 2020, from

<https://www.beeculture.com/finding-dcas/>

Galindo-Cardona, A., Monmany, A. C., Moreno-Jackson, R., Rivera-Rivera, C., Huertas-Dones, C., Caicedo-Quiroga, L., & Giray, T. (2012). Landscape analysis of drone CONGREGATION areas of the Honey Bee, *Apis mellifera*. *Journal of Insect Science*, 12(122), 1-15. doi:10.1673/031.012.12201

Koeniger, G., Koeniger, N., Ellis, J., & Connor, L. J. (2014). *Mating biology of honey bees (Apis mellifera)*. Herten: Buschhausen.

Koeniger, N., Koeniger, G., & Pechhacker, H. (2005). The nearer the better? Drones (*APIS mellifera*) prefer nearer drone congregation areas. *Insectes Sociaux*, 52(1), 31-35. doi:10.1007/s00040-004-0763-z

Rangel, J., & Fisher, A. (2019). Factors affecting the reproductive health of honey bee (*APIS MELLIFERA*) Drones—a review. *Apidologie*, 50(6), 759-778. doi:10.1007/s13592-019-00684-x

## **ACKNOWLEDGEMENTS**

I would like to thank Dan Williams of Williams Honey Bees for site access to his family farm. Thanks to Jo Shuman and Joe Shuman for assistance with data documentation, hauling sampling equipment to sampling locations, and financial support needed for this project.