

Weather Effects on *Bombus Impatiens* monitored by the Bumble Monitor 1.4

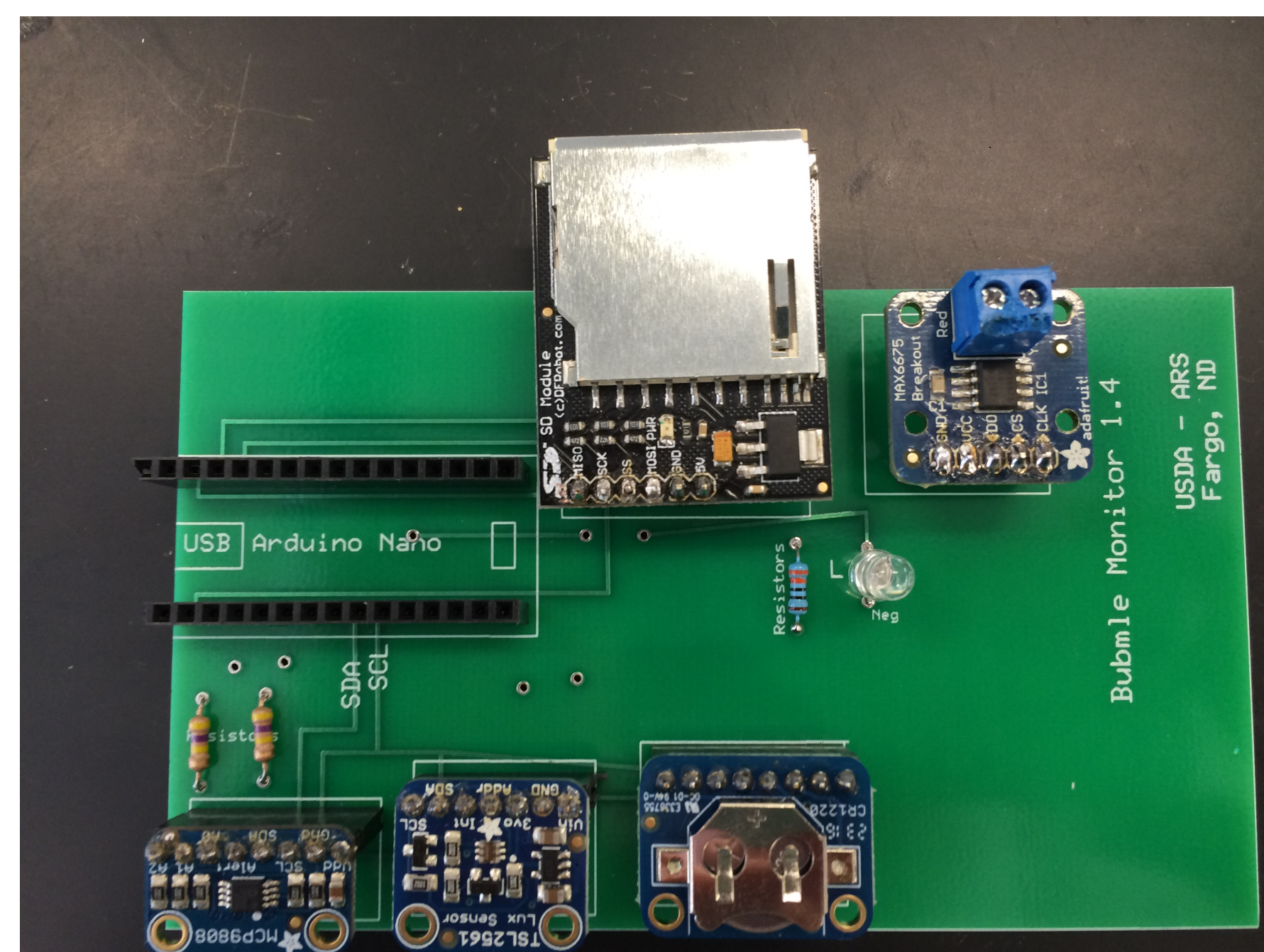
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Introduction

- ❖ *Bombus Impatiens*, also known as a bumblebee, live in hives made up of three different roles: queen, workers, and drones.
- ❖ The sensor kits can measure weight of hive, temperature inside hive and outside hive, when to collect honey, if a hive has lost its queen, and the strength of a colony.
- ❖ Scientists/beekeepers will use sensor kits to monitor a hive so that they can take correct action if something were to go wrong.
- ❖ Measuring different variables in a hive is important because it can help scientists/beekeepers understand why colonies disappear or die.



Bumble Monitor

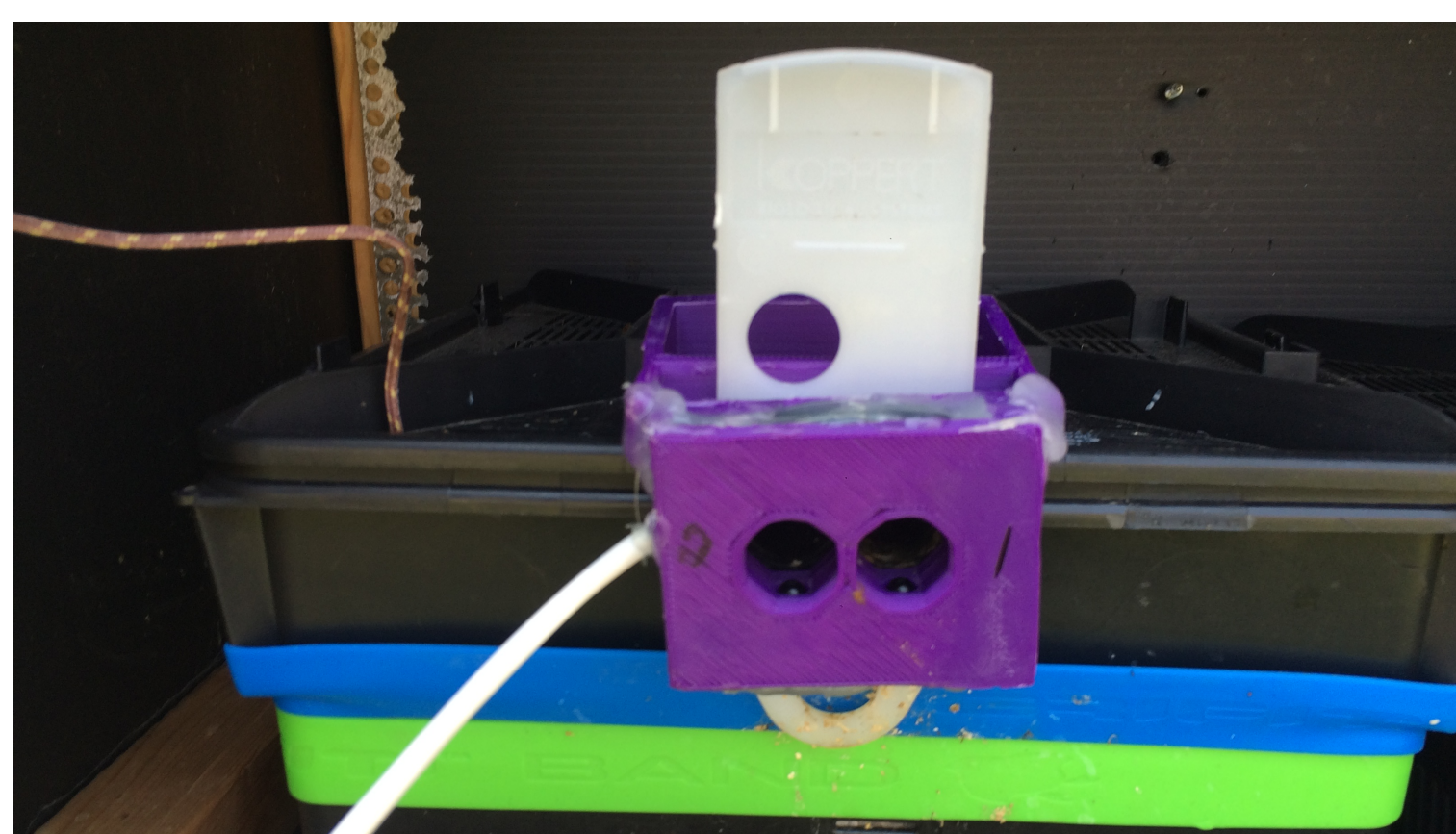
Questions

Does higher temperatures, light, and humidity increase the number of trips bumblebees make from their hive? To test this, three questions were asked:

1. Does temperature throughout the day affect the activity of bees?
2. Does the amount of sunlight affect the activity of the bees?
3. Does average temperature of the day affect the total activity of the bees for that day?

Methods

Two hives were placed outside the USDA-ARS building on the NDSU campus. The hives were located close to a diverse flower population.



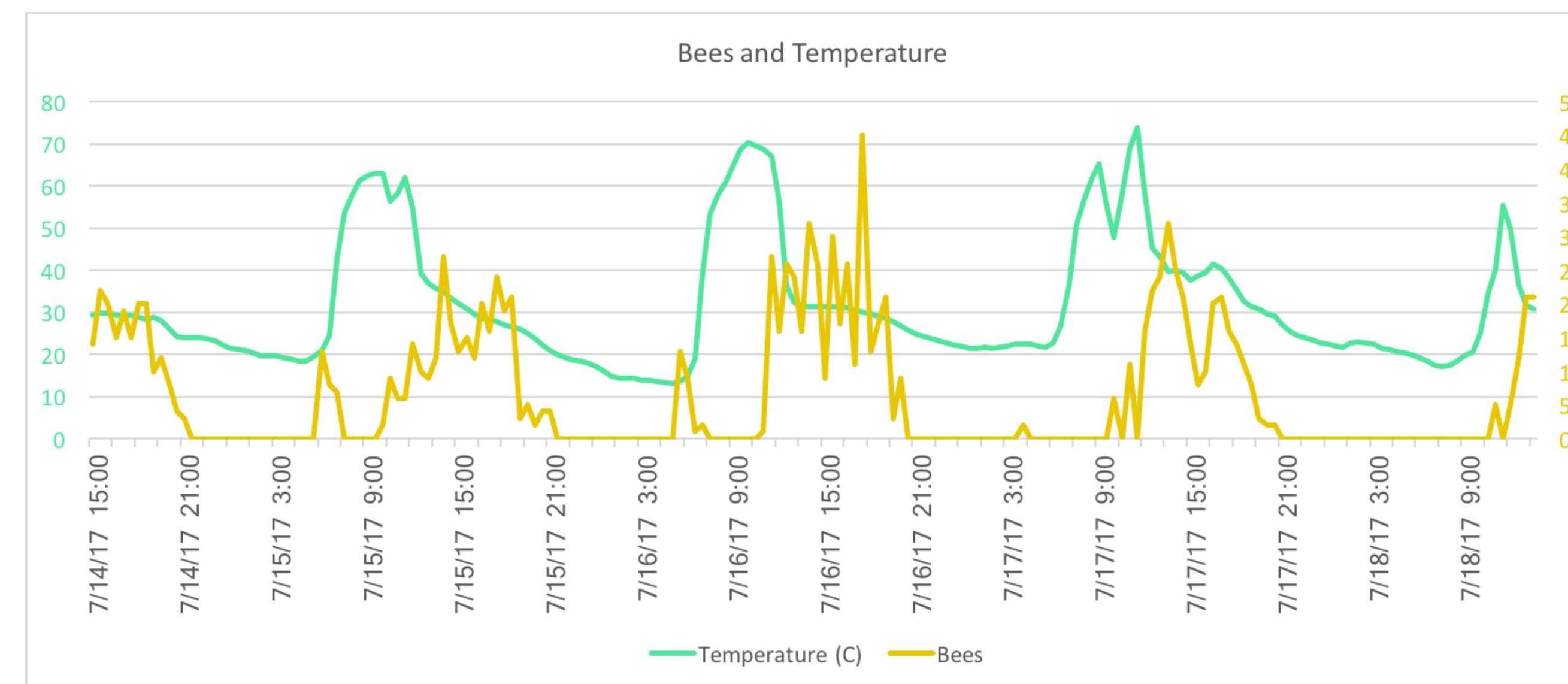
Bumble Monitor's inferred sensors are used to detect entrances and exits

Bumble Monitor

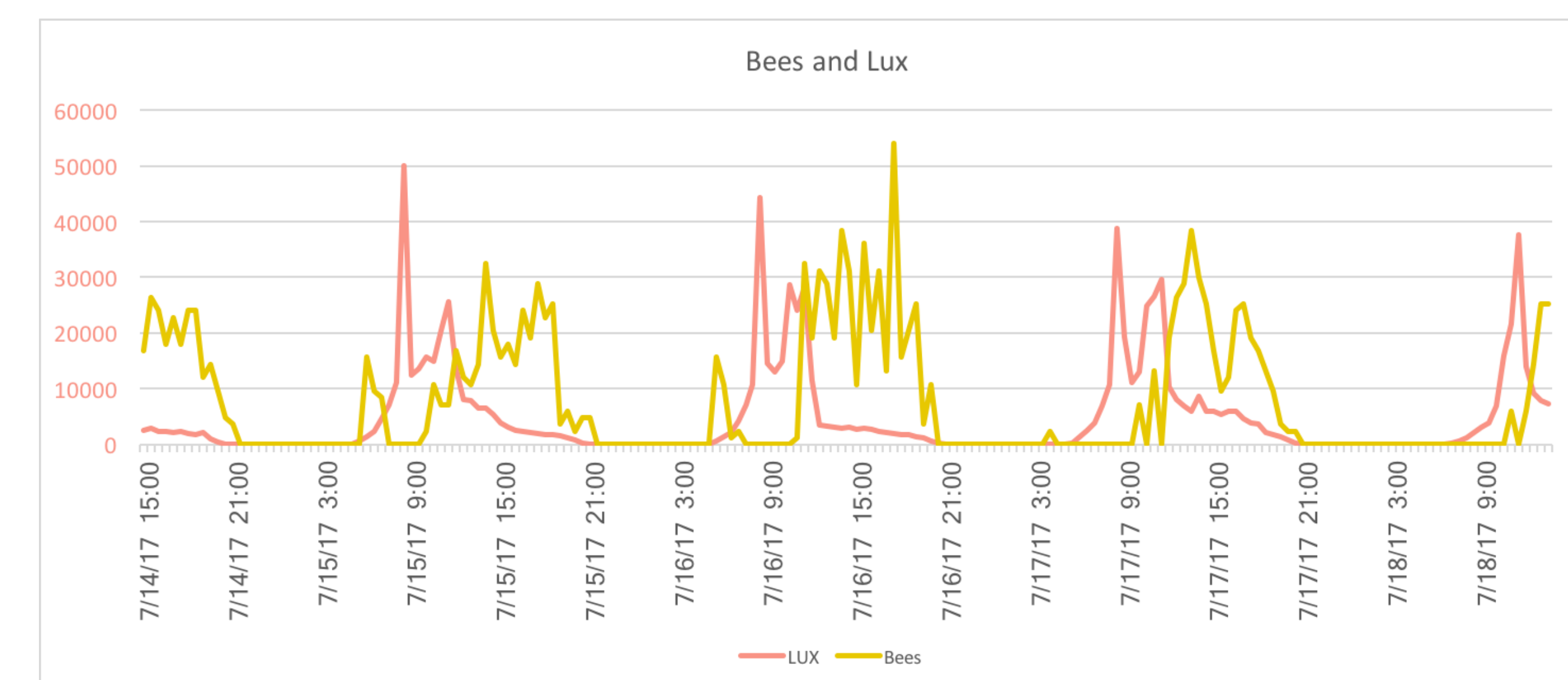
The Bumble Monitor uses an Arduino Nano to control when to record data and when to write that data to an SD card. It also receives data from two inferred sensors to determine when a bee is entering or exiting the hive. The Bumble Monitor is also used to monitor different variables associated with each hive, including:

1. Temperature outside the hive (this sensor was located on the top of the box)
2. Temperature inside the hive
3. The amount of sunlight hitting the box
4. When a bee enters/exits the hive and the time it takes to enter/exit

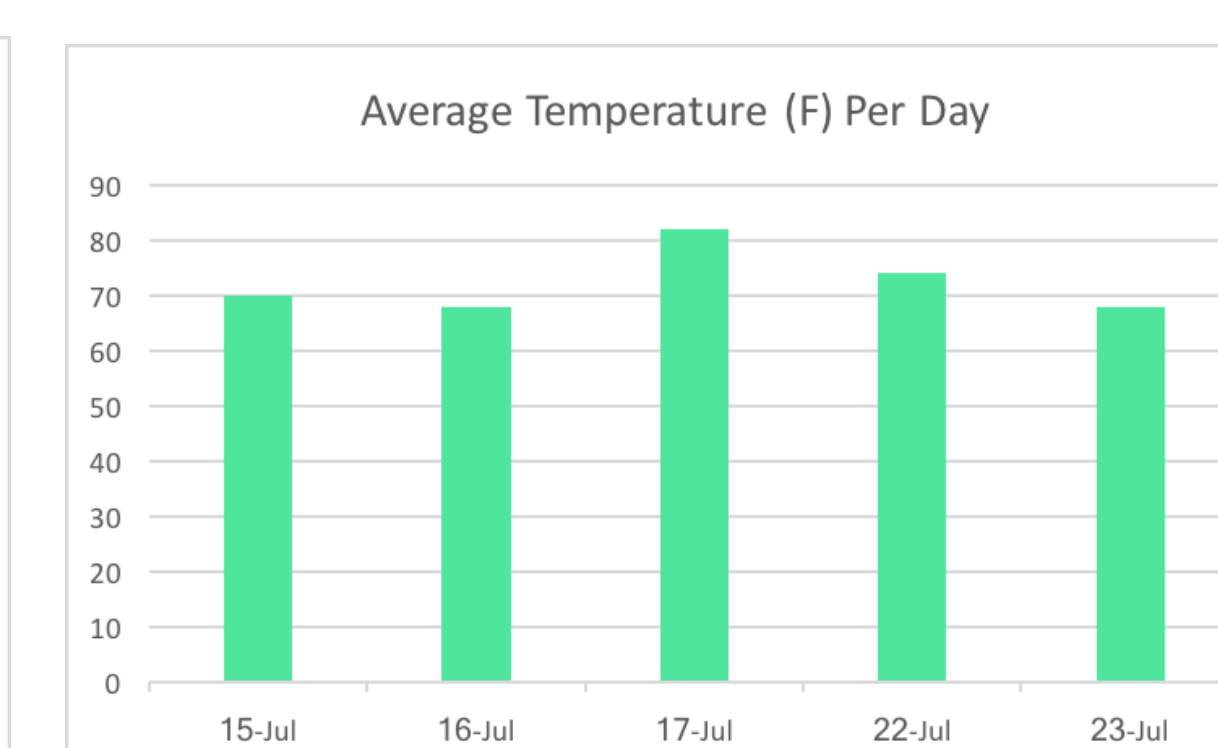
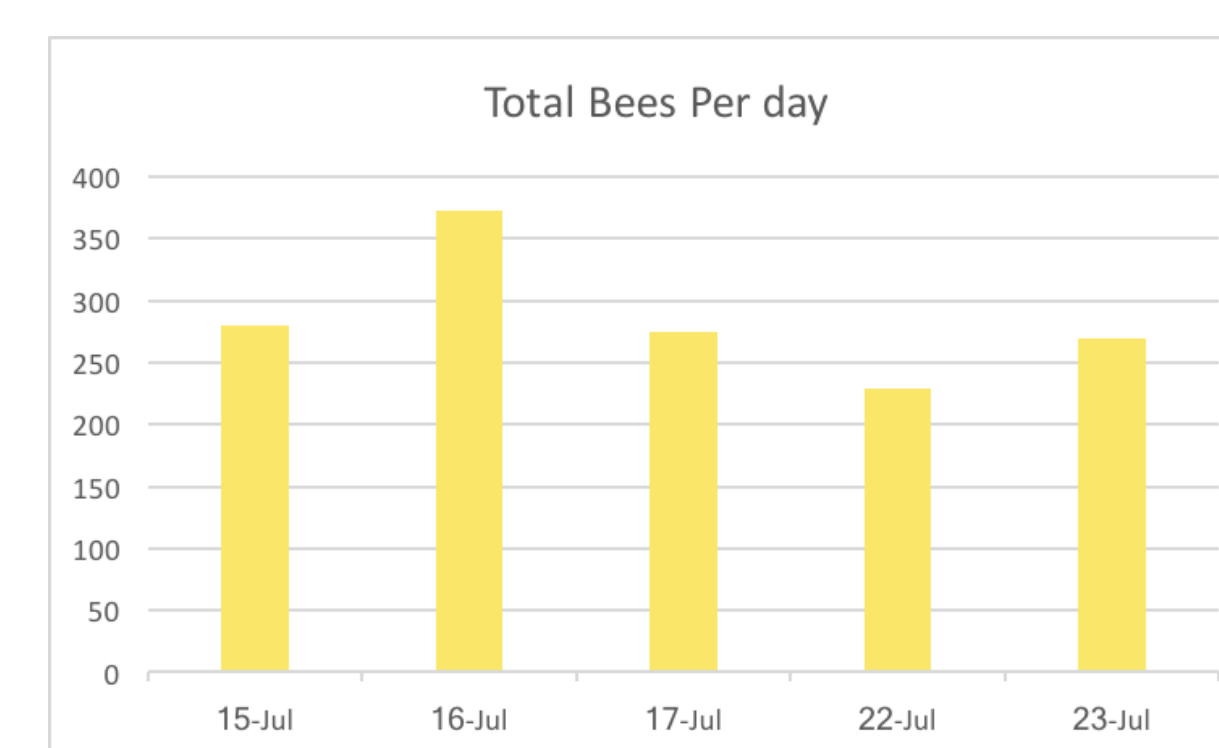
Results



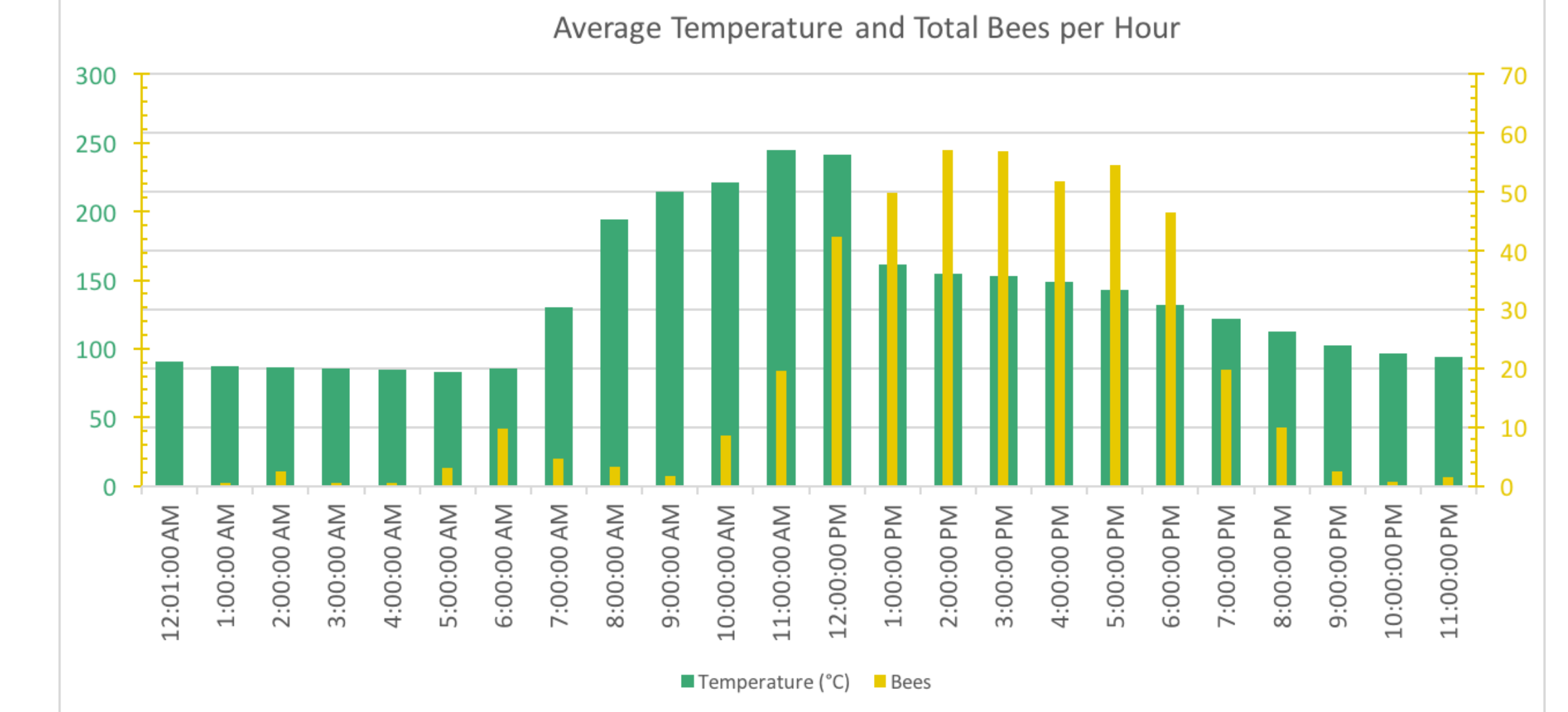
The green line represents the average temperature over a 15 minute interval. The yellow line represents the total number of bees that entered/exited the hive over a 15 minute interval.



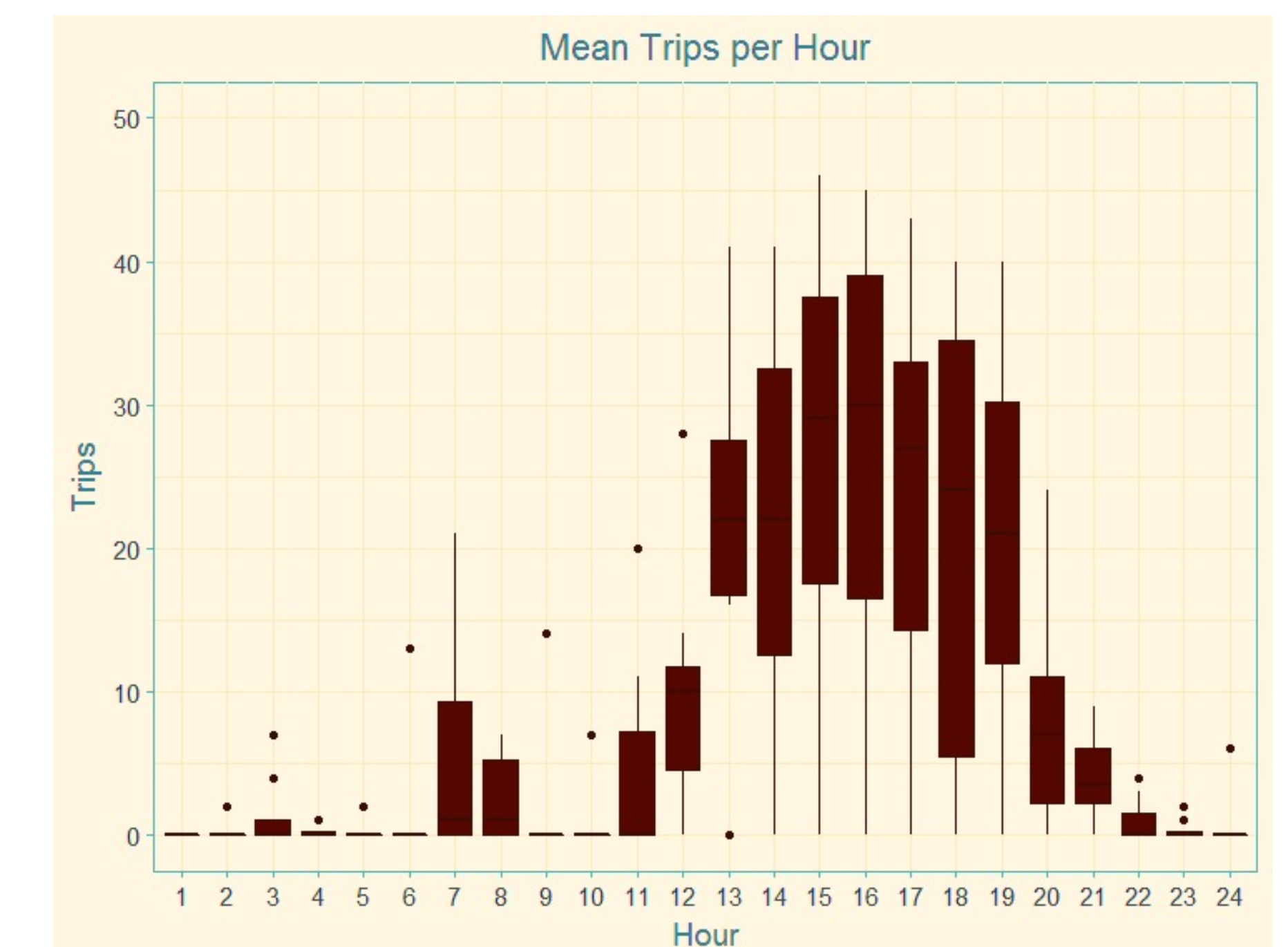
The red line represents the average LUX (amount of light in a square meter) in 15 minute intervals. The yellow line represents the total number of bees that entered/exited the hive over a 15 minute interval.



The chart on the left represents the total number of trips that the bees made out of one hive on each day. The chart on the right represents the average temperature (°C) of each day. Note: Temperature data was taken from Fargo Hector International Airport Climatological Data Station



This graph represents the total number of bees entering/exiting the hive grouped by the hour along with the average temperature at each hour



Conclusions

- ❖ The bees were more active at times where the temperature was between 30 °C and 40 °C
- ❖ The bees were more active at times where their hive was in shade versus being in direct sunlight
- ❖ The bees were more active on the days where the average temperature was below 70 °F
- ❖ The bees seemed to prefer times later in the day when the sun is not on the hive and the temperatures have started to cool down

Future Directions

- ❖ We would measure weight to determine the different colony sizes. A very accurate scale would allow us to allow use to determine if the bee is entering the hive or leaving
- ❖ We would use data streaming to monitor hive to determine if the equipment has stopped working and/or the hive is having problems
- ❖ More hives would be used in future experiment to get a wide range of data

Acknowledgments

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