APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY

PP-185 [Beekeeping Technology and Quality]

Finding drone congregation areas with mechanical drones

And data collection of DCA locations

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Background

- *Apis mellifera* honey bees mate while flying in discrete leks called drone congregation areas (DCAs)
- The locations of DCAs are known to remain constant year after year[1]

Problem

- It is not fully understood how drones find these static locations, or what it is about them that leads to the creation of a DCA
- In the past, researchers have found DCAs using helium balloons or poles with pheromone lures attached, however this is limiting because areas over tree canopy, water, and tall structures are not easily accessible

Methodology

Using a mechanical drone, or unmanned aerial vehicle (UAV) to look for DCAs is a method that allows the user to survey a greater variety of areas

UAV Requirements

- Equipped with a camera that can be monitored in real time
- Must be able to tow the lightweight lure

Equipping a UAV for DCA hunting

- Lure can be either a live queen or QMP lure (TempQueen) attached to something weighing around 11g and large enough to easily spot from the UAV camera (hair roller, pill bottle with holes drilled in it, or Hopkins queen cage)
- Lure should hang ~6 meters below the UAV
- Attach lure with thin thread to allow it to break if caught
- Attach thread to thick paracord to avoid thread getting caught in propellers during takeoff
- Outfitting UAV with drop kit allows for attachment of paracord without interference with sensors

Screenshot of the Maven application showing a spiral flight path around an apiary

Where to Look for DCAs

- DCAs are found around apiaries, often within a few hundred meters[2, 3, 4]
- While some common characteristics of DCAs have been observed (landscape depressions, over creeks) looking only in those areas creates the possibility of biased results
- Flying in an outward spiral is an effective method to cover the area
- Using waypoints software, flights can be programmed to fly a route set up in advance that covers the entire area equally not just in expected places, allowing the pilot to focus on looking for drones

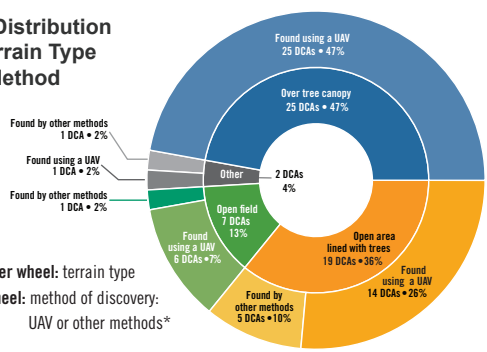
Citizen Science

- The citizen science project MapMyDCA.com is a free online tool that offers instructional information about looking for DCAs using mechanical drones
- The website's main feature is a map where users can pin DCA sites that they have located
- Anyone visiting the site can view pinned DCA locations
- All data are easily downloadable for study
- The sharing of DCA locations will help researchers gain insights about DCAs
- Since the mapmydca.com website launched in December 2019, 177 users have registered
- 53 DCAs have been pinned in 9 countries

Rolling over a pin reveals a pop up window with a button to click where more information can be found

Results and Conclusions

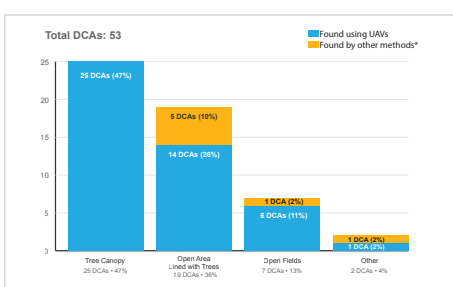
DCA Distribution by Terrain Type and Method



Inner wheel: terrain type
Outer wheel: method of discovery: UAV or other methods*

**Other methods include helium filled balloons, poles, by ear, by finding everted drones on the ground*

- An interesting finding is that 47% of the posted DCAs found occur over tree canopy, contradicting earlier research employing more limiting surveying methods stating that DCAs typically occur in an open area surrounded by a windbreak[5]
- Looking only at the DCAs found using a mechanical drone, (where it's possible to survey areas over tree canopy) 54% of DCAs were found over tree canopy



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mapmydca.com

Drone congregation area videos:

Georgia, USA | Massachusetts, USA | Connecticut, USA

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Finding DCAs with mechanical drones and data collection of DCA locations

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Background/PURPOSE:
Apis mellifera honey bees mate while flying in discrete leks called drone congregation areas (DCAs), the locations of which are known to remain constant year after year.

Problem/description
As there is no communication or intergenerational learning between male nestmates, it is not understood how drones find these static locations, or what it is about them that leads to the creation of a DCA. In the past, researchers have found DCAs using helium ballons or poles with pheromone lures attached, however this method is self-limiting as surveying area over tree canopy, water or tall structures is not easily accessible.

Methodology
Using a mechanical drone – an unmanned aerial vehicle (UAV) – to look for DCAs is a method that allows the user to survey more expansive areas. Furthermore, the sharing of DCA locations will help researchers gain insights about DCAs. The citizen science project MapMyDCA.com is a free online tool that offers instructional information about looking for DCAs using UAVs. The website's main component is a map where users can pin DCA sites that they have located, and where anyone visiting the site can view pinned DCA locations and information that the users have shared about the locations (time of day, landscape features, known apiaries in the areas). All data is easily downloadable for study.

Results and conclusion
Since the site launched in December 2019, 163 users have registered on the site and 37 DCAs have been pinned in 8 countries. One significant insight garnered is that 30 % of pinned DCAs occur over tree canopy, a contradiction from older research using more limited surveying methods.

Practical implications for beekeepers
Individuals who are queen breeders can benefit from having the ability to find locations of DCAs in their breeding areas. The further use of the project will grow this database of known DCAs that will aid in the understanding of an area of honey bee mating behavior that has been difficult to study.