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An investigation of Honey Bee Drone Congregation Area formation in rural and semi-rural locations in New Zealand

A thesis presented in part fulfilment of the requirement for the degree of
Master of Science in Zoology at Massey University, Manawatū, New Zealand.

David Christopher Cramp
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Abstract
Male honey bees gather in Drone Congregation Areas (DCAs), and meet with queens to mate in flight. Because they mate on the wing, investigation of these areas using current techniques is not easily facilitated in some areas, which limits research. This study investigates an improved method of studying DCAs in difficult areas; studies the landscape characteristics of DCA locations, and measures pheromone attraction between drones, and honeybee queens and workers, to ascertain any chemical contribution towards DCA formation. Using a camera equipped Unmanned Aerial Vehicle (UAV) holding an artificial honey bee queen with 9-Oxo-2-Decenoic Acid (9ODA), trials were conducted to investigate the different flight behaviours of honey bee drones on their mating flights, and the formation of DCAs. The use of the UAV was found to be successful in carrying out DCA research especially in inaccessible areas. Using this method, drone honey bee mating flight activity was investigated in several distinct areas; hill and valley areas; urban park areas, and flat agricultural areas. The data were analysed using Geographic Information System software ArcGIS 10.4.1. Different patterns of drone activity were found in the different areas suggesting that in hill and valley areas where well defined DCAs exist, landscape features played an important part in their location but that in flat areas, landscape features were not shown to play a part in DCA formation and instead, apiary-dependant DCAs dominated, and away from these apiaries, the abundance of drones flying at random in the flat areas (as opposed to being confined in a hill and valley area) would ensure mating. The results also suggest that contrary to some research, DCAs in hill and valley areas have flexible boundaries that may vary in response to other factors such as queen flight behaviour. In order to find out whether chemical influences could contribute to the formation of DCAs, a four-arm olfactometer test was carried out to investigate drone attractiveness to queens, and drone attractiveness to other drones. Contrary to my expectations, drones and queens were not attracted to other drones but rather to workers, perhaps because only sexually immature drones were available for the tests. The study overall confirms the usefulness of using a UAV in difficult areas; demonstrates a significant difference in the spatial dynamics of drone mating flight in different landscape areas, and concludes that DCA boundaries may be constructs that depend on the mating flight parameters of the queen rather than drones only. Further research, especially on the queen’s mating flight parameters is suggested.
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