Proposed Title

Investigating the correlation between the size of the olfactory centre in the brains of bumble bees and their choice of flower based on different scents and colours.

Keywords

Dimorphism, Olfactory, Pollinators, Visual, Volatile

Motivation Behind the Project

Currently, there are only a few bee species available to be introduced as a pollinator but there is a large disparity between different bees and how they are attracted to different plants. By investigating the difference between bumble bee species, observations can be made on how effective it could be to increase the range of bees available to be pollinators.

Background

Bumble bee species, such as B.*terrestris,* have a correlation between the size of the head to the number of sensory neurons. Therefore, some species have a higher sensitivity to smell and the ability to distinguish between different chemicals 1. Additionally, there is a dimorphism between female and male bees. Females have larger brains, while males have longer antennae. This is due to the different species-specific selection placed on bees where the females are responsible for finding food while males are responsible for looking for mates 2. Using the olfactory centre, bees can learn from previous experience with food sources from a plant and the associated volatiles, to enable them to find other sources where they will get a reward 3. Previous studies have also found that bees display a preference for plants based on their colours, and their trichromatic visual system can only sense violet, blue and green hues, with the latter mainly used as a contrasting background 4. As there are large disparities between the physiology of bumble bee species, including the 8 native to Durham, it is unclear how the two systems being investigated work together and if one dominates over the other.

Introduction

My project aims to investigate if there is a link between the olfactory centres, including the size and number of lobes, to the preference that bees show towards certain plants. One hypothesis is that the larger the olfactory centre, then the more likely a bee is to choose a flower based solely on the scent. This would be because they have a better ability to detect and process chemicals than species with smaller olfactory centres. The bees with smaller olfactory centres are more likely to remain drawn to the natural plant state as they have a lower ability to detect chemicals and are more drawn to the colour of the flower. By finding a connection between the olfactory centre of a species of bee and the volatiles and colours of a plant, there will be more evidence to support the introduction of new bee species in certain areas based on the local flora or agriculture. This has the potential to contribute to improvements in biodiversity and improve crop yield in different areas if a bee with different physiology is more suited to the crops or local flora.

Proposed Methods

The experiments will involve using the database from the Insect Neuro Lab that contains the data on the chemical composition of flowers. I will select the most prevalent chemicals to produce a mixture of volatiles that bees are attracted to in vials. These will be placed on a 3D-printed flower, in a white or green colour, and then within a group of flowers that bees are

naturally attracted to, such as Lavendera spp 5 and Chamaenerion *angustifolium 6*. The concentration of chemicals will be changed from similar to the natural plant and then higher and lower. This will allow me to compare which bee species and sex prefer the plant at different concentrations. The bees will be captured, and their brains dissected and imaged, to see the size of their olfactory centre and the number of lobes. Hypothetically, the bees with the larger numbers of lobes will be more likely to be attracted to artificial flowers than the species with smaller lobes as they will be able to sense the chemicals and not rely on the visuals of plants. The bees with the smaller lobes will hypothetically be attracted to the natural plant as they will be less able to sense the chemicals and will mainly be attracted to the blue and violet hues of the natural plant.

Summary

This project aims to add to the current work of the Durham Insect Neuro Lab and the wider field of chemical ecology by providing information on the different ways that bees choose flowers. This will allow for more justified decisions to increase the range of bees introduced as pollinators, based on the type of plant that is being grown.

References

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