COLONY-MATE RECOGNITION IN THE WEAVER ANT

OECOPHYLLA SMARAGDINA

Thesis submitted by

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Statement on the Contribution of Others

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Abstract

Understanding recognition systems is at the heart of a range of evolutionary, biological and social processes, including the immune response, reproductive barriers, mate choice, kin selection and the evolution of parasitism. Among social insects, nestmate or colony-mate recognition may evolve as a proxy for kin recognition, as social insect colonies usually consist of a family group. I sought to advance our understanding of recognition systems by studying colony-mate recognition in the arboreal weaver ant, *Oecophylla smaragdina*. In particular, I explored the effects of spatial and temporal variation in recognition cues, and variability in the capacity of individual ants to recognise non-colonial conspecifics, on the effectiveness of recognition systems. I used a novel technique for studying colony odour: near-infrared reflectance spectroscopy (NIRS). I found that colonies of weaver ants had distinctive spectral profiles, but that there were also significant differences in the profiles of nests within colonies. Significantly, the spectral characteristics differentiating colonies from each other and nests from each other were different. The level of aggression between colonies was positively correlated with the spectral distance between colonies, especially when only those spectral characteristics that differentiated between colonies were used to calculate spectral distance. I also found that the spectral characteristics of colonies changed over time. However, the spectra of a colony and an isolated nest from that colony did not diverge significantly over time, suggesting that these spectral changes may reflect genetically programmed seasonal changes. I detected no increase in aggression over time between colonies and their corresponding isolated fragment; however, the level of trophallaxis did increase. Neither spatial nor temporal variation in colony odour appears to impair the effectiveness of colony-mate recognition in weaver ants. I also explored the effect of spatial relationships on the levels of aggression expressed by weaver ant colonies. Specifically, I tested whether weaver ants were more aggressive towards intruders from distant colonies or from neighbouring colonies. I found that weaver ants were better at identifying intruders from neighbouring colonies as non-colony-mates than intruders from distant, unfamiliar colonies. They were also significantly more aggressive towards neighbours. Thus weaver ants conform to the "nasty neighbour" model rather than the "dear enemy" model. Finally, I sought to determine whether the variability in the response of individual workers towards intruders could be attributed to the recipients or the intruders. I found that most of the variability could be attributed to differences between recipients. I further demonstrated that this variability was sometimes due to differences in the response of workers but also, in some case, due to differences in the perception of workers. I hypothesise that workers do not use the colony odour as the template against which intruders are assessed, but, rather, their individual odour prior to any mixing. This is the first study to explore colony odour using NIRS, and the first to demonstrate a behavioural response by any insect to the information contained in NIRS. This

has the potential to significantly advance social insect studies, and the study of insect behaviour in general. This is the first study to demonstrate parallel changes in odour in nests isolated from their colony of origin, contributing significantly to our understanding of how very large colonies, spread over a wide geographic area, can maintain a single colony identity. The identification of different spectral elements that differentiate between nests and colonies also contributes to this understanding, and indicates that NIR spectra carry multiple signals. Also important in this regard is the finding that differences in some aspects of spectra provoke a stronger response than others. This is also the first study to demonstrate that different individuals within a colony vary in their perceptions, and not just their response, when encountering an unknown individual. Further work remains to be done in determining how weaver ants learn to identify neighbours as a serious threat and how the behaviour of the colony is modified accordingly. Research also needs to be undertaken into the genetic basis of colony spectra, and the relationship between spectra and cuticular hydrocarbons.

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