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# **COLONY-MATE RECOGNITION IN THE WEAVER ANT**



## ***OECOPHYLLA SMARAGDINA***

Thesis submitted by

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for the degree of Doctor of Philosophy

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## **Statement on the Contribution of Others**

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In the jointly authored papers that constitute several chapters of this thesis, Prof. Ross Crozier and Assoc. Prof. Simon Robson contributed to experimental design and interpretation of results, as well as to the writing of the papers, particularly with a view to presenting the papers in a style suitable for the chosen publication.

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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.

## Table of Contents

<b>Statement of Access .....</b>	<b>ii</b>
<b>Statement of Sources .....</b>	<b>iii</b>
<b>Statement on the Contribution of Others .....</b>	<b>iv</b>
<b>Acknowledgements .....</b>	<b>v</b>
<b>Abstract.....</b>	<b>vi</b>
<b>List of Tables .....</b>	<b>xiii</b>
<b>List of Figures .....</b>	<b>xiv</b>
<b>1 Introduction .....</b>	<b>1</b>
1.1 Recognition Systems .....	1
1.2 Study Species .....	3
1.3 Thesis Structure .....	4
1.4 Note on Methods.....	4
1.5 Note on Publications .....	6
<b>2 Colony-mate recognition in ants .....</b>	<b>7</b>
2.1 Colony Odour .....	7
2.2 Recognition Template .....	9
2.3 Recognition Errors .....	10
2.4 Dear Enemy .....	11
2.5 Conclusion .....	12
<b>3 NIRS as a tool in ecology and evolutionary biology .....</b>	<b>13</b>
Abstract .....	13
3.1 Introduction.....	14
3.2 Chemical Analysis .....	15
3.2.1 Organic compounds .....	17

3.2.2	Inorganic compounds .....	18
3.3	Holistic Analysis .....	19
3.3.1	Resolving complex mixtures .....	20
3.3.2	Other holistic characteristics .....	22
3.4	Discrimination and Classification .....	24
3.5	Future Directions .....	26
3.5.1	Behavioural studies .....	26
3.5.2	Species identification .....	27
3.6	Advantages and Disadvantages of NIRS .....	27
3.7	Conclusion .....	29
<b>4</b>	<b>NIRS identifies the colony and nest of origin of weaver ants .....</b>	<b>30</b>
	Abstract .....	30
4.1	Introduction.....	31
4.2	Methods .....	31
4.3	Results .....	33
4.3.1	Colony allocation.....	33
4.3.2	Nest allocation .....	35
4.4	Discussion.....	37
<b>5</b>	<b>Aggression in weaver ants reflects differences in near-infrared spectra .....</b>	<b>39</b>
	Abstract .....	39
5.1	Introduction.....	40
5.2	Methods .....	41
5.2.1	Colony Spectra.....	41
5.2.2	Aggression Bioassay .....	41
5.3	Results .....	43

5.4	Discussion.....	45
<b>6</b>	<b>Nest and colony specific spectra in the weaver ant .....</b>	<b>49</b>
	Abstract .....	49
6.1	Introduction.....	50
6.2	Methods .....	50
	6.2.1 Colony and nest spectra .....	50
	6.2.2 Aggression and colony spectra .....	52
6.3	Results .....	52
	6.3.1 Colony and nest spectra .....	52
	6.3.2 Aggression and colony spectra .....	54
6.4	Discussion.....	55
<b>7</b>	<b>Temporal variation in recognition cues: implications for the social life of weaver ants. ....</b>	<b>60</b>
	Abstract .....	60
7.1	Introduction.....	61
7.2	Methods .....	62
	7.2.1 Colony Spectra.....	62
	7.2.2 Behavioural Bioassays .....	63
	7.2.3 Statistics.....	64
7.3	Results .....	64
	7.3.1 Colony Spectra.....	64
	7.3.1.1Change over Time .....	64
	7.3.1.2Divergence between Original Colonies and Colony Isolates .....	67
	7.3.2 Behaviour .....	68
	7.3.3 Spectra and Behaviour .....	69

7.4	Discussion.....	69
<b>8</b>	<b>Weaver ants <i>Oecophylla smaragdina</i> encounter nasty neighbours rather than dear enemies.....</b>	<b>75</b>
	Abstract. ....	75
8.1	Introduction.....	76
8.2	Methods .....	78
	8.2.1 Experiment 1: field nests.....	78
	8.2.2 Experiment 2: manipulated nests.....	79
	8.2.3 Statistical analysis.....	80
8.3	Results .....	80
	8.3.1 Experiment 1: field nests.....	80
	8.3.2 Experiment 2: manipulated nests.....	81
8.4	Discussion.....	83
<b>9</b>	<b>Know thine enemy: Why some weaver ants do but others don't .....</b>	<b>87</b>
	Abstract .....	87
9.1	Introduction.....	88
9.2	Methods .....	89
	9.2.1 Experiment 1.....	89
	9.2.2 Experiment 2.....	91
9.3	Results .....	92
	9.3.1 Experiment 1.....	92
	9.3.2 Experiment 2.....	94
9.4	Discussion.....	94
<b>10</b>	<b>General discussion .....</b>	<b>98</b>
10.1	Near-infrared spectroscopy .....	98
10.2	Spatial and tempoaral variation in potential recognition cues .....	100

10.3	Individual variation in recognition skills .....	101
10.4	Other significant findings: Know thine enemy .....	102
10.5	General conclusion.....	103
<b>References.....</b>		<b>105</b>
<b>Appendix A .....</b>		<b>125</b>
A.1	Comparison of means.....	125
A.2	Bootstrapped confidence intervals.....	130
A.3	Nested ANOVA .....	131
A.4	Two-way ANOVA with interaction.....	135

## List of Tables

Table 3-1: Selected studies using NIRS to predict chemical content.....	16
Table 3-2: Selected studies using NIRS to predict holistic characteristics. ....	20
Table 3-3: Selected studies using NIRS to classify samples into groups. ....	25
Table 4-1: Allocation of ants to colonies using multinomial logistic regression. The shaded cells indicate the individuals assigned to the correct colony. ....	34
Table 4-2: Allocation of ants to nests within colonies using logistic regression. The shaded cells indicate the individuals assigned to the correct nest. ....	36
Table 6-1: Main peaks identified using NIRS: mean location $\pm$ SD. The chemical bonds most likely associated with those peaks are listed.....	51
Table 6-2: Variation in peak location (wavenumber per cm), obtained using NIRS, between colonies and between nests within colonies. ....	53
Table 6-3: Variation in peak amplitude (absorbance units), obtained using NIRS, between colonies and between nests within colonies. ....	55
Table 6-4: Variation in peak width, obtained using NIRS, between colonies and between nests within colonies. ....	56
Table 9-1: Observed behaviours and associated score ( <i>s</i> ).....	90

## List of Figures

- Figure 4-1: An example of a near infrared spectrum, after baseline correction and smoothing.  
The six peaks used in the multinomial logistic regression are indicated above the spectrum. .... 34
- Figure 4-2: The mean similarity (with 95% confidence intervals) of weaver ants within a colony to each other (Self), and to ants from other colonies..... 35
- Figure 4-3: The mean similarity (with 95% confidence intervals) of weaver ants within each nest in a colony (*aa*, *bb*) compared with the similarity between the two nests (*ab*). .. 37
- Figure 5-1: Relationship between the mean aggression index (*A*) of *O. smaragdina* colonies and the mean spectral distance ( $D_o$ ) between individuals from the recipient colony and the intruder colony. .... 43
- Figure 5-2: Relationship between the mean aggression index (*A*) of *O. smaragdina* colonies and the mean spectral distance between individuals from the recipient colony and the intruder colony along two axes, F4 (▼) and F5 (■)..... 44
- Figure 5-3: Relationship between the standard deviation in aggression ( $A_{SD}$ ) shown by *O. smaragdina* colonies towards intruders and the mean spectral distance ( $D_s$ ) between individuals from the recipient colony..... 45
- Figure 6-1: The mean position (wavenumber per cm) of (a) P1, (b) P2 and (c) P5 in colonies C1 to C5. Post-hoc comparisons were performed by permutation using Tukeys HSD test, with different letters indicating peak positions that were significantly different from each other ( $\alpha = 0.05$ ). The error bars represent the 95% confidence intervals around the mean. .... 54
- Figure 6-2: (a)–(g) The mean width (wavenumber  $\text{cm}^{-1}$ ) of P1 – P7 respectively in colonies C1 to C5. Post-hoc comparisons were performed by permutation using Tukeys HSD test, with different letters indicating peak positions that were significantly different from each other ( $\alpha = 0.05$ ). The error bars represent the 95% confidence intervals around the mean. .... 57
- Figure 6-3: (a) The relationship between the mean aggression index *A* and the distance  $D_1$  between colonies, calculated using only those spectral parameters that differed between colonies but not between nests within colonies; (b) the relationship between the mean aggression index *A* and the distance  $D_2$  between colonies, calculated using the remaining spectral parameters..... 58
- Figure 7-1: The mean spectral distance between the original colonies (▼, —) and the colony isolates (■, ----) and the original colony spectra at T1, measured over four time intervals, T1 to T4. The distance at T1 is the mean distance between two randomly selected samples from each colony. The error bars represent the standard deviation

around the mean. *Indicates that the distance at that time was greater than the distance at T1. ....	65
Figure 7-2: The mean spectral distance between the original colonies (↓, —) and colony isolates (■, ----) and the original colony spectra at T1, measured along each axis (F1 to F6), at four time intervals, T1 to T4. The distance at T1 is the mean distance between two randomly selected samples from each colony. The error bars represent the standard deviation around the mean. *Indicates that the distance at that time was greater than the distance at T1. ....	66
Figure 7-3: The mean spectral distance between the original colonies and colony isolates at four time intervals, T1 to T4. The error bars represent the standard deviation around the mean. ....	67
Figure 7-4: The mean frequency of antennation (a), grooming (b) and trophallaxis (d), and the mean level of aggression (c), between recipients from the original colonies and intruders from the original colonies (↓, —) and colony isolates (■, ----), at four time intervals, T1 to T4. The error bars represent the standard deviation around the mean. * indicates a significant difference at that time. ....	68
Figure 7-5: The mean frequency of trophallaxis plotted against (a) the mean Euclidean distance and (b) the distance along axis F3, between the original colony (recipient) and the colony isolate (intruder). The regression line and equation are shown. ....	70
Figure 8-1: The mean aggression index <i>A</i> plotted against the spectral distance between colonies of weaver ants. ....	81
Figure 8-2: The mean aggression index <i>A</i> towards intruders from neighbouring colonies (N) and distant colonies (D), (a) with all intruders included and (b) with only those included that were correctly identified as alien conspecifics. The error bars indicate the 95% CI around the mean. ....	82
Figure 8-3: The mean maximum level of aggression shown towards intruders from neighbouring colonies (N) and distant colonies (D). The error bars indicate the 95% CI around the mean. ....	83
Figure 8-4: The mean proportion (arcsine-square root transformed) of intruders from neighbouring colonies (N) and distant colonies (D) correctly identified by recipient colonies as alien conspecifics. The error bars indicate the 95% CI around the mean. ....	84
Figure 8-5: The mean proportion (arcsine-square root transformed) of grooming and trophallaxis shown towards intruders from neighbouring colonies (N) and distant colonies (D). The error bars indicate the 95% CI around the mean. ....	85
Figure 9-1: The mean Bray-Curtis Index (BCI) for each colony for one intruder facing several recipients (Treatment 1) and one recipient facing several intruders (Treatment 2). ...	92

Figure 9-2: The mean coefficient of variation (CV) of the response index (RI) for each colony for one intruder facing several recipients (Treatment 1) and one recipient facing several intruders (Treatment 2). ..... 93

Figure 9-3: The mean response index (RI) of recipients facing intruders from two different colonies. Parts (a) – (f) show the results for recipient colonies 1 – 6 respectively. Hollow circles and solid circles represent the two individuals from each recipient colony, and \* indicates a significant interaction between the responses of the two recipients to intruders from different colonies. The error bars represent the 95% confidence intervals around the mean. .... 95