

Incidence of aggressive territoriality between two ant species: *Camponotus compressus* Fab. and *Oecophylla smaragdina* Fab. (Hymenoptera: Formicidae)

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Interspecific rivalry among higher animals is not uncommon. However, it is less noticed among invertebrates, which function at micro ecological levels. One such incident was encountered by the authors in an old, neglected mango orchard on the outskirts of Bengaluru, India, between two species of ants, *Camponotus compressus* Fabricius and *Oecophylla smaragdina* Fabricius. While these two spatially co-existed and foraged in the orchard, rivalry was found on three trees which harboured arboreal *O. smaragdina* nests, where *C. compressus* (a ground nester) also began nesting at the base of the tree.

Foragers of *O. smaragdina* while descending the tree trunks found *C. compressus* at the base of the tree an intrusion (or vice versa?) and interspecific rivalry ensued for nearly seven weeks leading to mortality in both species. Overall, *O. smaragdina* suffered six times more loss in terms of number and biomass, but prevailed over *C. compressus*. The latter was forced to abandon nesting. It is important to record such interspecific processes, in insects at a micro ecological level.

Keywords: Aggressive territoriality, ants, interspecific rivalry, micro ecological levels.

COMPETITION, exclusion and territoriality are well documented in higher animals, but less noticed in invertebrates, especially insects. However, interspecific associations have been a subject of study in insects, especially among ant, predator and prey¹. We report here an interspecific interaction between two species of ants, *Camponotus compressus* Fab. and *Oecophylla smaragdina* Fab. It is known that *O. smaragdina* is predatory and tree-nesting². Aggressiveness allows it to maintain territories that exclude other ant species³. *C. compressus* nests on the ground, and forages on the ground and the trees⁴.

Competition for a resource shapes spatially and/or temporally the foraging and distribution of ant colonies⁵.

So, while on a faunistic study of Formicidae, it was interesting to see rivalry between two ant species *O. smaragdina* and *C. compressus* in an old, undisturbed mango orchard near Bengaluru, India. On careful examination, several dead ants of both the species that resulted from the rivalry were found. This led us to collect systematic data on these two species and to study the interspecific rivalry, especially on trees where their foraging and nesting ranges overlapped.

The study area was a 75-year-old mango orchard consisting of 24 fruiting trees of mixed varieties. The orchard was being conserved for its ecological value in the peri-urban outskirts of Bengaluru (12°57'N and 77°35'E), and thus was not subjected to any practices like fertilizer application or pesticidal sprays, except for harvesting the fruits once a year. The observation began in February 2013 and continued up to August 2013. Ants were sampled by taking the visual presence-absence of all species every alternate day. We observed interspecific rivalry at the base of three trees leading to mortality in both species. Mortality of the ants was recorded from the base of these three trees. *O. smaragdina* nests were well established on these trees, whereas *C. compressus* was seen beginning to establish its ground nests at the base of the trees. Each tree trunk up to a height of 5 ft from the ground was visually searched using a ground lens by going round the tree once. The side branches within 5 ft were also searched. Five random quadrants of 12 × 12 inches each at the immediate base of the trees were marked. Dead ants were counted and collected in a polythene bag to be taken to the laboratory. These were cleaned and dried in a hot-air oven at 40°C for 8 h and weighed for their dry biomass⁶. The ratio of *C. compressus* to *O. smaragdina* (numerically more dead) was taken as a criterion for species dominance in time, as suggested by Robinson⁷. To study the association between the two species, a 2 × 2 contingency table as suggested by Southwood⁸, was prepared with χ^2 at $P = 0.05$ as the test criterion. Correlation and regression were run to observe the trend and variability between the two species of ants with correlation coefficient r at $P = 0.05$ and R^2 (coefficient of determination) as test criteria⁹.

Among the 15 species of ants recorded, *O. smaragdina* (25.2%) and *C. compressus* (21.1%) were the most frequent. Initially, in the last week of February, the mean numerical ratio of dead *C. compressus* and *O. smaragdina* ($n = 3$ trees) was 1 : 1.7 ants. The corresponding biomass ratio of dead *C. compressus* and *O. smaragdina* was 1 : 1.5. *O. smaragdina* had higher mortality and higher loss of biomass compared to *C. compressus*.

On 30 March and 1 April 2013, a large number of dead ants of both species was seen at the site (Figures 1 and 2). Mean mortality ratio of *C. compressus* to *O. smaragdina* increased to 1 : 6.75. The corresponding biomass ratio was 1 : 6.5. It was interesting to note that numbers and biomass loss ratios were similar. The competition by

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aggression to occupy their respective nesting niches was six times more than the initial ratio. The *C. compressus* soldier ants were larger in size, whereas the *O. smaragdina* were larger in numbers. Along with the 642 larger soldier ants, 76 forager ants of *C. compressus* were also observed dead, which is unusual, as in social insects it is assumed that soldiers in the division of labour defend and die. In the case of *O. smaragdina* only the larger workers were dead as the smaller-sized ants were involved in brood care and this seemed best for colony survival^{10,11}. Since the nest of *O. smaragdina* was well established unlike that of *C. compressus*, the former seemed to have enough number of larger workers for defence^{12,13}.

Figure 3 shows that, when the encounters of *O. smaragdina* were zero, the sightings of *C. compressus* were high at a mean of 42.42 encounters and in the absence of *C. compressus*, the average encounter of *O. smaragdina* was 37.66. The two ant species seemed to be excluding each other in time, a sure way of avoiding competition (Figure 3). This was confirmed by negative significant correlation $r = -0.44$ (at $P = 0.05$) between temporal variations in the encounters between the two

species. A linear model showed that the variability in the encounter of *C. compressus* was accounted to the extent of 54% ($R = 0.54$) by the variability in the encounter of *O. smaragdina* (Figure 4).

χ^2 showed significant association between the two ant species at $P = 0.05$. As the products of $a \times d$ and $b \times c$ in the 2×2 contingency table showed that $ad < bc$ the association was negative¹, substantiating our results of exclusion and explained the interspecific rivalry. However, when they extended to occupy the same tree for nesting, there was overlap in foraging ranges. Though nests are vertically separated with one species being arboreal (*O. smaragdina*) and the other sub-terrestrial (*C. compressus*), *O. smaragdina* descends the tree to forage, intruding perforce around the nest sites of *C. compressus* if it is at the base of the same tree. The nest pheromone is always released at the nest entrance and diffuses through it¹⁴. Ant nest pheromones are specific to the colony and hence the workers are aroused to aggression at alien odours. In any case, ants recognize their nest-mates from their nest-odours and distinguish them from alien ants. When intruders are encountered, they are attacked and eventually killed¹⁵. The odours of *O. smaragdina* foragers promote *C. compressus* to attack. Why they tend to occupy a same tree is difficult to reason. Perhaps for these two species, the trees became a limiting factor or even by pure chance – ‘a mistake’ probably due to selection of the



Figure 1. Dead worker ants of *Camponotus compressus* (polymorphic) and *Oecophylla smaragdina* (monomorphic) at the base of the tree (orangish-brown – *O. smaragdina*, black – *C. compressus*).



Figure 2. An *O. smaragdina* worker ant dead after attacking a major worker of *C. compressus* almost three times its size.

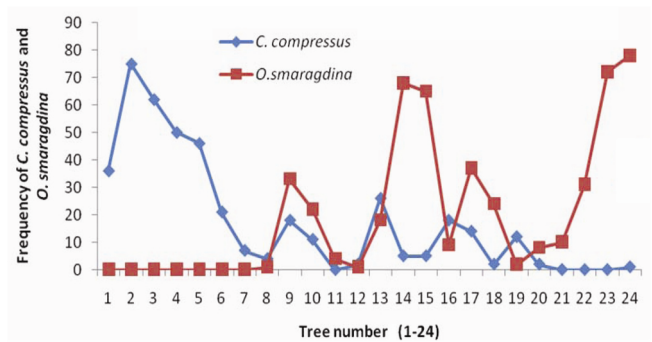


Figure 3. Frequency of *C. compressus* and *O. smaragdina* on the 24 trees in the mango orchard.

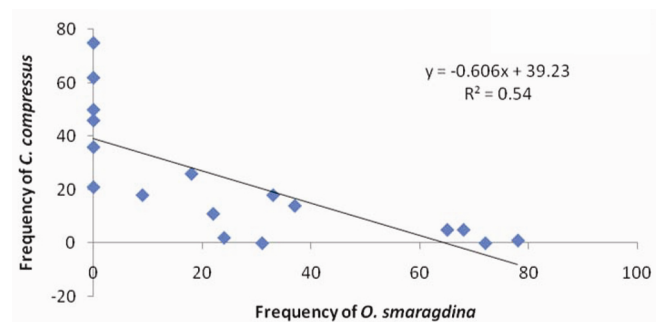


Figure 4. Models showing influence of *O. smaragdina* on *C. compressus* in the mango orchard.

same site. Co-occurrence of nesting affects the survival of both the species. However, in 24 trees, the probability of co-occurrence of nesting was 0.27.

Over time, two competing species can either coexist, through niche differentiation or resource partitioning, or compete until one species becomes locally extinct¹⁶. On the 11 trees where both the species were recorded only for foraging, but not nesting, no signs of visible aggressiveness or competition were observed. Both species of ants were seen foraging up and down the trunk freely. The *C. compressus* nest at the base of the tree limited the foraging activity of *O. smaragdina*. This restricted foraging curbed the resources and also caused a niche overlap. So when niche (here the tree and foraging area) overlap occurred for food and nesting, competition arose. The mortality of fighting ants of both the species for the survival of their respective colonies can perhaps be interpreted as altruism. This study is in agreement with the Hutchinsonian¹⁷ view, where the presence of one species constrains the presence of another species by interspecific competition, modifying the position of species' niche within the multidimensional space.

According to Cornel⁴, the distribution of *O. smaragdina* is restricted due to the influence of foraging terrestrial ants, which is in agreement with the present study. However, in this study, we found that *C. compressus* was restricted by *O. smaragdina* as also supported by a linear model in which variability in *C. compressus* encounters was explained to the extent of 54% ($R^2 = 0.54$) by the variability in encounter of *O. smaragdina*.

In time, the territorial rivalry caused evacuation of *C. compressus* that was just beginning to establish at the base of the trees where *O. smaragdina* was already established. They were not recorded on or around the three trees after mid-April till the end of the study period in August. The conflict for nest establishment and niche was won by *O. smaragdina* at the cost of its individual workers. *O. smaragdina* nests and its satellite nests continued to exist on the three trees till the end of the study period, probably establishing an advantage for arboreal nesters over their sub-terrestrial counterparts, irrespective of size and number. Such observations at a micro-ecological level will throw open many more dimensions that are of ecological value, parallel to territorialism at macro-ecological levels, which is more frequently observed and reported. As some insects are serious agricultural and horticultural pests, research is skewed in that direction. Studies on interspecific competition between ants in relation to their management are also important^{18,19}. Thus fundamental research on insect ecology in the field at a micro level can unearth many interesting facets and functions of ecological value.

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