COLONY DYNAMICS OF THE GREEN TREE ANT (*Oecophylla smaragdina* Fab.) IN A SEASONAL TROPICAL CLIMATE.

Thesis submitted by

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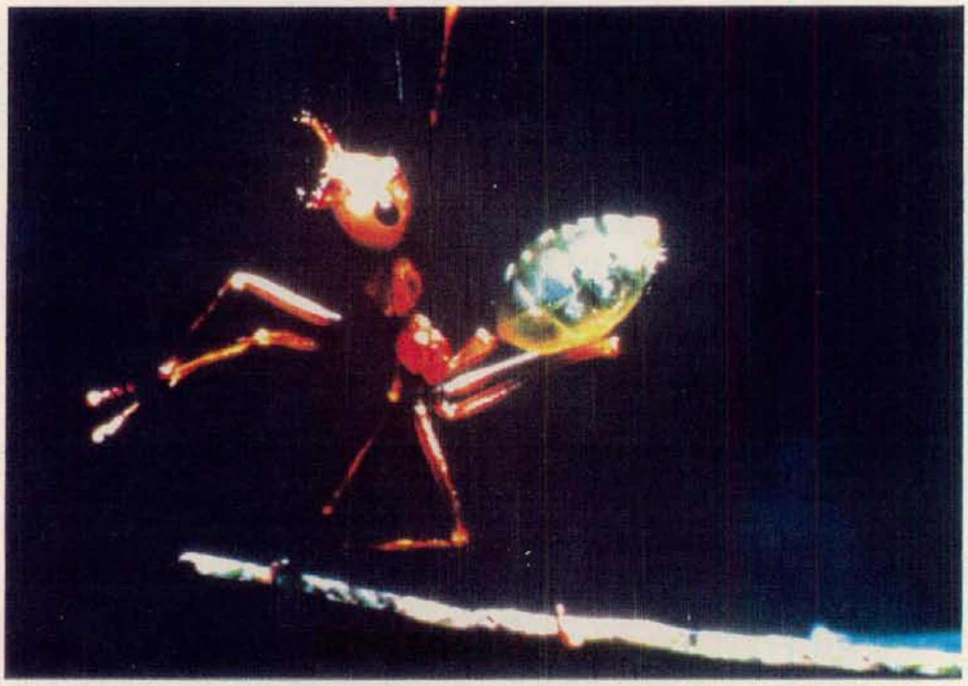
Frontispiece.

(a) Green tree ant major worker in alarm posture.

(b) Green tree ants capturing a wasp.



Abstract.

Most previous investigations of the weaver ant genus (*Oecophylla*) have been conducted in the relatively non-seasonal environment of the wet tropics (e.g. Greenslade, 1971a,b, 1972; Ledoux, 1950, 1954; Majer, 1976,a,b,c; Vanderplank, 1960; Way, 1954a,b). The present study documented substantial seasonal variation in colony structure and functioning of green tree ant (*O. smaragdina*) populations in the seasonally dry tropical climate which characterizes most of northern Australia.

The distribution of *O. smaragdina* within Australia was successfully defined by a combination of mean annual rainfall and average minimum temperature, with a curvilinear demarcation between sites with and without ants. Development and survival of ant brood was markedly reduced by low temperatures, especially the larval stage, which had a threshold temperature (when development theoretically stops) of about 17°C. In contrast, the thresholds for eggs and pupae were about 10°C and 7°C, respectively. At higher temperatures, the 2 physical variables probably indirectly limit ant distribution by controlling plant density; ants only inhabited sites with woodland or forest vegetation.

Colony extents (the numbers of trees occupied by colonies) were much larger in native vegetation than in a nearby mango plantation. This difference was probably due to the greater tree density in the native forest site. No canopy interconnections were available in the mango orchard to promote movements of ants between trees. Inter-tree migration is essential for weaver ant colonies, to disseminate brood

from the nest containing the colony's single egg-producing queen and possibly also to maintain a uniform colony recognition scent.

Levels of reproduction in green tree ant colonies were highest during the wet season and early dry season. Sexual forms were present in nests from November until March, and worker brood were most abundant from January until May. Larval and pupal brood levels rose with increasing precipitation up to monthly rainfall figures around 300 mm. Proportions of worker pupae were reduced during periods of higher rainfall, probably due to the production of sexuals at this time.

Colony extents, measured as the number of trees occupied, were smallest in native forest at the end of the dry season in November, and rose while colonies were reproducing. Most colonies reached peak extents in May, when the proportion of flowering trees was highest (and 2 months after the greatest levels of leaf flushing). After May, brood production generally decreased markedly, and colony extents in native vegetation slowly fell, with ants gradually evacuating from peripheral trees into smaller core areas of high tree density. Cycles of colony extent in the mango plantation lagged behind those in native vegetation by 2 to 4 months; maximum extents coincided with mango tree flowering from July to September. Tended homopteran levels in mango tree leaf samples were high during the flowering and fruiting period, suggesting that colony expansion may be facilitated by the increased availability of honeydew.

As colonies expanded, individual nests became smaller and the number of nests (per tree and per colony) increased. Ant distributions were thus dispersed more evenly throughout colonies during this period. This decentralization may improve foraging efficiencies, or may allow increased patrolling of territories when intrusions by other ant colonies (both intra and inter-specific) are most likely. Highest levels of prey intake and ant movement from nests did coincide with periods of greatest reproduction and dispersion; however, the causal relations between these factors are unknown.

An electronic light beam counter was developed to monitor ant activity (measured as the number of ants leaving and returning from a nest, and standardized between different nests by dividing by the total population of each nest) in native forest over a two year period. Net daily activity was greatest during the wet season months from December to March, and lowest in the dry winter period. The magnitude of these seasonal differences was remarkably high; the largest mean activity of 8.83 ants/nest individual/day (in December) was over 10 times the smallest level of 0.501 (in August). Seasonal patterns of activity correlated well with patterns of total prey weight collected by ants. Liquid food intake, measured as the average weight difference of leaving and returning ants, showed a similar, but very erratic pattern; factors such as varying forager sizes, honeydew intake inside the nest, and differing physiological conditions of inhabited trees prevented successful quantification of this food source.

A consistent circadian pattern of ant activity was observed in autumn and winter (March, May, August): activity peaked around dusk, and dropped to a minimum in the early morning before dawn. This circadian pattern was less distinct or completely absent during the spring and summer months (October, December, January). Activity was generally correlated with temperature; the fitted parabolic relationship suggested that activity was markedly reduced by low temperatures, but was less affected by higher temperatures.

Circadian patterns of activity did not correlate to patterns of food intake. Most prey was collected during the daylight hours, suggesting that *O. smaragdina* is primarily a visual predator. Honeydew intake also appeared to be greatest after dawn. Nocturnally active ants may be involved in other tasks, such as brood and young adult transport, colony scent dispersal, and territorial patrolling/guarding.

Mango trees with green tree ant populations had more tended homopterans and fewer numbers of most other arthropod groups than adjacent trees without ants. The proportions of leaves with chlorotic scars from homopterans (primarily *Phenacaspis dilata*) were greater in ant-occupied trees. The fractions of leaves with holes from chewing arthropods, and the average area of leaf missing were greater in ant-free trees.

Crop yields during the study were relatively low. However, ants appeared to augment fruit loss in trees with largest crops during the late stages of fruit development, probably by encouraging homopteran populations and so increasing sap loss. Green tree ants also appeared to reduce frugivory by fruit bats, the major predator of mango fruit.

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