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NESTING AND COLONY STRUCTURE IN THE GIANT FOREST ANT, *CAMPONOTUS GIGAS* (LATREILLE) (HYMENOPTERA: FORMICIDAE)

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ABSTRACT. - The nest of a colony of *Camponotus gigas* (Latreille) located in a hollow log was fumigated and systematically opened. 784 minor workers, 45 major workers and 2 alate males were retrieved, as well as 157 larvae and 34 eggs. Although the queen was not located the presence of eggs and young larvae strongly suggests that it was a queenright colony and the queen was lost during the opening of the nest. Several species of other organisms were found living within the nest, including isopods, crickets (Orthoptera; Gryllidae), cockroaches (Blattodea; Blattidae), an unidentified earwig (Dermaptera) and larvae of a pyralid moth (Lepidoptera; Pyralidae). During two 24 hour observation periods an average of 133 ants were seen to leave or enter the nest, mostly at night, suggesting that only a small proportion of workers are involved in foraging at any given time. Marked ants from this colony were seen to enter another nest nearby, which was probably a satellite of the first nest since activity there ceased soon after the latter was destroyed.

INTRODUCTION

The Giant Forest Ant, *Camponotus gigas* (Latreille, 1802) is virtually ubiquitous in mixed dipterocarp forest in Borneo. It is known to nest most commonly in the ground at the base of large trees and in fallen logs (Tho, 1981; Chung & Mohamed, 1993; Orr & Charles, 1994). Having located all nests in an area of about one half hectare we estimated colony size and structure for one example by fumigating and opening the nest at a time when observed activity of marked ants indicated that most workers were inside. Because of the difficulty of excavating in clay at the bases of large trees a nest in a fallen log was selected. We report the morphology of the nest, the numbers and size distributions of ants and immature stages present, and also the number and type of other arthropods inhabiting the nest.

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AREA AND METHODS

The study was carried out in primary lowland mixed dipterocarp forest near the Kuala Belalong Field Studies Centre, Temburong District, Brunei. Nests were located by presenting foraging ants with a piece of tuna, and following them back to their nests. Although *C. gigas* is known to be polydomous, a previous study (Orr & Charles, 1994) suggested that most nests (85%) in this area, which occurred at a density of 9-15 per hectare, were associated with a distinct colony as there was little exchange of marked ants between different nests. At the nest chosen for study, diel activity patterns were determined by continuously monitoring all ants entering and leaving the nest, and the extent of the terrestrial foraging territory was established by following marked ants on their foraging excursions. Subsamples of 40 and 75 ants were marked either yellow or white during the day, and night observation periods respectively. On 25/8/94 at 0800 h, a time at which activity was minimal and most colony members were expected to be inside the nest, all entrances were sealed and approximately 1l of ethyl acetate was introduced into the nest. At 1400 h the nest was opened by sawing the log into sections approximately 30cm in length using a chainsaw. Any ants which had not succumbed fully to the fumes of the ethyl acetate were sprayed with a pyrethrin based aerosol and the section with its contents was sealed in a large plastic bag. These were subsequently opened in the laboratory on a plastic sheet and all contents removed and placed in alcohol.

RESULTS AND DISCUSSION

Activity patterns. - Activity patterns were similar to those reported by Orr & Charles (1994) for other nests in the area. Up to 144 foragers emerged from the nest in the evening, versus only 29 during the day. Temporal specialization in foraging was also noted i.e. day-marked ants were subsequently observed only foraging by day and night-marked ants were observed only foraging by night. On 3 Jul. 1994 heavy rain at 1900 h completely inhibited activity. Thirty-one marked ants which had left the nest earlier in the evening did not return until the following evening, but were not observed foraging by day. It is probable that many sheltered under leaves on the forest floor, as five were located doing this, but at least in two instances, they were observed entering a second, nearby small nest at the base of a large tree. This nest probably did not contain a queenright colony, and was apparently a satellite of the nest being studied since ants marked at the main nest were observed to emerge from it, and it was completely unoccupied three weeks after the main nest was destroyed. Such satellite nests were not detected in an earlier study (Orr & Charles, 1994) and might arise temporarily to exploit a food source associated with the crown of a particular tree, while minimizing travel over the ground at night which might expose them to predation risks. As previously found by Orr & Charles (1994) only a small minority (6%) of ants returning were carrying food, mostly fragments of diverse fungal material.

Nest location and structure. - The nest (Fig. 1) was located in a fallen log 7m in length, and varying in diameter between 25 and 30cm. It lay at an inclination of 15° with the nest entrance at its lower end, thus ensuring that water could not enter the cavity. The lower part of the log was almost completely hollow with a large opening to the exterior on its ventral surface. This had been almost completely covered by a wall of mud 2-3cm in thickness with two entrance holes (6cm X 2.4cm and 2.8cm X 2.2cm respectively) on either side of the log. The main cavity of the nest, which extended back for some 1.4m, was deeply grooved with considerable quantities of decaying wood fragments and some mud. Leading off this cavity

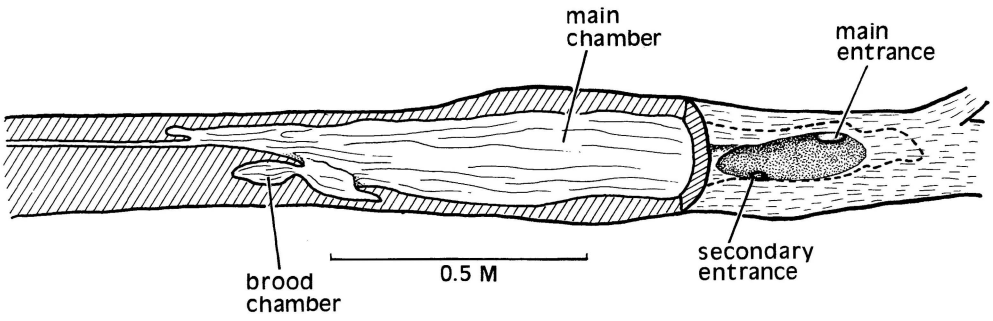

Fig. 1. Sectional view of the nest (rotated up through 30°), showing the main chamber, 'brood' chamber, other passages. The entrances indicated are located in a wall of mud sealing most of the hollow end of the log.

from its innermost recesses were two narrow tunnels, one expanding almost at once into what is presumed to be the brood chamber, judging from the number of eggs found there, (approximately 13cm X 4cm X 2.5cm), the other continuing into the heart of the log for at least another metre and ending blindly without widening. There was no evidence of fungal culture within the nest, hence fungus gathered is probably used only for immediate food requirements.

Colony composition. - Although no queen was recovered, the presence of eggs and young larvae in what was apparently a brood chamber suggests that it was a queenright colony and the queen had either escaped or had been destroyed by the chainsaw as the log was opened. A total of 834 ants were recovered from the nest, including 45 majors (5.4%). Since this count was made when most foragers had probably returned to the nest this is a good estimate of colony size excepting a few escapees and individuals which may have been stationed at a nearby satellite nest. Based on observed activity at this latter nest it is thought that it probably contained fewer than 100 ants.

As indicated by Fig. 2 the size frequency distribution of workers was bimodal, reflecting the existence of two subcastes of workers (i.e. majors and minors). However the size frequency

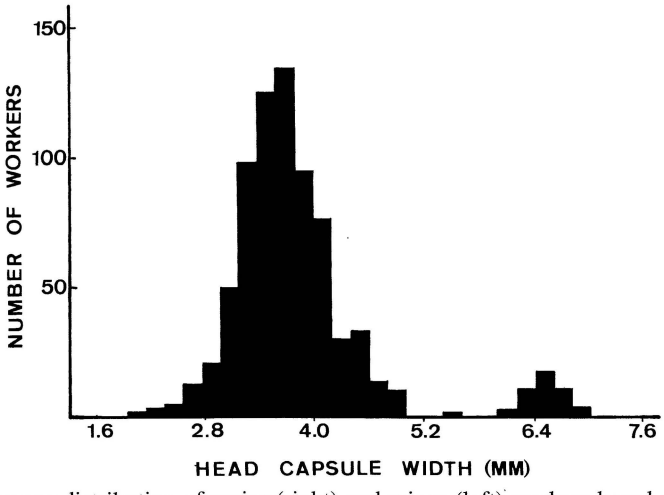

Fig. 2. Size frequency distribution of major (right) and minor (left) workers based on head capsule width.

Fig. 3. Frequency distribution of larval size classes.

distribution of each subcaste considered separately was normal, unlike the situation in many other ants in which size frequency distributions within subcastes are skewed to the left (Wilson, 1978, 1985; Porter & Tschinkel, 1985). There was no evidence for specialization in activity for ants of different sizes within the minor (or major) subcastes but this possibility requires further investigation.

Larvae appeared to fall into five clear size classes on the basis of head-capsule width (and length), probably representing separate instars. According to Hölldobler & Wilson (1990) the common number of instars in ants is four, but is five in certain species, including *Camponotus aethiops* (Dartigues & Passera, 1979). The majority of larvae were found in the inner half of the main chamber. Fig. 3 illustrates the frequency distribution of the five size classes, indicating a majority of larvae were fairly advanced in their development, although it is possible that some very small larvae were overlooked. A total of 34 eggs were found, exclusively within the recess assumed to be the brood chamber. One male was also found in this chamber. The greater numbers of advanced larvae seem to indicate that eggs are not being produced at a steady rate.

Other arthropods present.- Six other arthropod species were present in the nest. Near the entrance was a large, grey earwig (Dermaptera), which emerged from time to time apparently foraging on the log nearby. In the debris at the bottom of the main chamber were three moth larvae (Lepidoptera: Pyralidae), probably feeding on detritus. Six grylline crickets (Orthoptera: Gryllidae), 3 blattine cockroaches (Blattodea: Blattidae) and 10 isopods (Isopoda) were found generally within the main chamber. Each of these groups constituted only a single species. Examination of the mouthparts of these organisms suggests that all were probably detritovores rather than predators.

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