

## **Population Size and Caste Composition of a Fungus-Growing Termite, *Macrotermes gilvus* (Blattodea: Termitidae)**

by

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### **Abstract**

A study of population size and caste composition in different mound sizes of a higher termite, *Macrotermes gilvus* (Hagen) was carried out in Penang, Malaysia. The mounds were measured before excavated for the estimation. We found  $37600 \pm 9300$  (n=6) individuals in each mound. Workers constituted the largest proportion (44.77%) of the total number, followed by larvae (39.09%), soldiers (15.37%), and pre-soldier (0.77%). Population parameters such as total population, total adult caste, and total immature caste were significantly correlated ( $p < 0.05$ ) with the mound parameters such as mound height and mound diameter.

**Key words:** population size, caste composition, *Macrotermes*, mound parameters

### **Introduction**

The fungus-growing termites from subfamily Macrotermitinae are abundant in Africa, South and Southeast Asia (Roonwal 1970). One of the common mound-building termite, *Macrotermes gilvus* (Hagen) (Blattodea: Termitidae) is normally found in gardens and plantation areas. However, *M. gilvus* can be a secondary pest, infesting premises after the lower termites, *Coptotermes* spp. had been eliminated by termite bait (Lee 2002, Lee et al. 2007). So far, many field studies have shown that termite baits are not effective against *M. gilvus* (Ngee et al. 2004, Lee et al. 2007). One of the hypothesis proposed was the immature castes only constitute a small proportion of the entire nest population of *M. gilvus*. Thus, when bait treatment was made, only a small fraction of the population were affected (Ngee et al. 2004).

In order to determine the reason(s) to ineffectiveness of chitin synthesis inhibitor-based bait against higher termites, we tried to resolve each hypothesis underlying the issue, and this includes the small proportion of the immature stages. In this study, we excavated 6 populations of *M. gilvus* to determine the population size and caste composition. We also investigated the relationship between population parameters and mound parameters.

### **Materials and methods**

This study was carried out in Penang Island, Malaysia. Three types of mound size were chosen: small (height: 1-20cm; diameter: 1-50cm), medium (height: 21-40cm; diameter: 51-80cm), and large

(height: 41-60cm; diameter: 81-120cm). A total of 2 of each mound size were selected in this study. Mound dimensions (height and diameter) were measured prior to excavation. To excavate the mound, we dug a trench around the base of the mound to a certain depth (30-60cm) and removed exterior section of the mounds. Mound materials, fungus combs, and termites were collected and brought back to laboratory. In some instances, returning and remaining termites were collected for several days after mound excavation until the termite numbers diminished. The termites were sorted to castes and counted manually. The relationship between population parameters (e.g., total population, total adult caste, and total immature caste) and mound parameters (i.e., mound height and mound diameter) were analyzed using Pearson correlation test (SPSS version 16.0).

### Results and discussion

Table 1 shows the population numbers of *M. gilvus* in different caste and mound size. Foraging population outside the nest was not estimated in this study (Darlington 1982). Small mound contained  $15900 \pm 600$  (n=2) termite individuals, medium mound contained  $31600 \pm 2600$  (n=2) individuals, while large mound has  $65300 \pm 3400$  (n=2) individuals respectively. The mean number of population size in *M. gilvus* is  $37600 \pm 9300$  (n=6). This value is much lower than the population size of *M. gilvus* in Indonesia where  $105900 \pm 25900$ (n=9) individuals were recorded (Subekti & Nandika 2009). Population sizes of *Macrotermes* spp. from African region were much larger compared to those registered in our study, which likely due to the difference species in both regions.

The number of major workers was always less than the number of minor workers in the population estimation. The ratio of minor workers to the major workers is 1.4: 1. This value is lower than the ratio found in *M. gilvus* colonies in Vietnam, which recorded a ratio of 2: 1 (Belyaeva & Tiunov 2010). A closely related species, *Macrotermes carbonarius* also showed less major than the minor workers (Matsumoto 1976). This variation is likely due to polyethism in Macrotermitinae. Minor workers normally serve as functional group inside the nest, while major workers forage for food (Noirot 1969). The proportion of workers to the total population is 44.77% (Fig. 1).

The major soldiers were also fewer than the minor soldiers in the population estimation. The ratio of minor soldiers to major soldiers is 5.3: 1. This result is in contrast to that reported by Subekti & Nandika (2009) who found that there were more major soldiers than the minor soldiers in *M. gilvus*, with a ratio of 3.7: 1. In overall, proportion of soldiers in total population is 15.37%.

Similar with soldier, number of major pre-soldiers was less than number of minor pre-soldiers in all of the mounds sampled. In overall, proportion of pre-soldiers in total population is only 0.77%. Proportion of larvae in total population is 39.09%. Mean proportion of larvae in *Macrotermes michaelsoni* was 43.11%, which is quite similar with larvae proportion found in this study (Darlington 1991).

The mound height was significantly correlated ( $p < 0.05$ ) with the population number, total number of adult caste, and the total number of immature caste. The correlations were highly significant

Table 1. Population numbers of different caste in different size of mound in *Macrotermes gilvus*

Mound Size	No.	Adult caste population				Immature caste population			Total Population
		Major Soldier	Minor Soldier	Major Worker	Minor Worker	Major Presoldier	Minor Presoldier	Larvae	
Small Mound	1	577 (3.51%)	2539 (15.42%)	3085 (18.74%)	5099 (30.97%)	3 (0.02%)	164 (1%)	4995 (30.34%)	16462
	2	386 (2.53%)	906 (5.94%)	2954 (19.38%)	3885 (25.48%)	3 (0.02%)	144 (0.94%)	6968 (45.70%)	15246
	Mean	482 (3.02%)	1723 (10.68%)	3020 (19.06%)	4492 (28.23%)	3 (0.02%)	154 (0.97%)	5982 (38.02%)	15900 ± 600
Medium Mound	3	297 (0.87%)	2628 (7.70%)	6639 (19.45%)	7460 (21.85%)	5 (0.01%)	144 (0.42%)	16965 (49.70%)	34138
	4	820 (2.83%)	2331 (8.04%)	4989 (17.20%)	6028 (20.78%)	6 (0.02%)	192 (0.66%)	14638 (50.47%)	29004
	Mean	559 (1.56%)	2480 (8.70%)	5814 (19.33%)	6744 (20.50%)	6 (0.03%)	168 (0.62%)	15802 (49.25%)	31600 ± 2600
Large Mound	5	1780 (2.59%)	12355 (17.98%)	12565 (18.29%)	19604 (28.53%)	70 (0.1%)	609 (0.89%)	21720 (31.61%)	68703
	6	1610 (2.60%)	8410 (13.57%)	11540 (18.62%)	17126 (27.64%)	20 (0.03%)	375 (0.61%)	22880 (36.93%)	61961
	Mean	1695 (2.60%)	10383 (15.76%)	12053 (18.46%)	18365 (28.09%)	45 (0.07%)	492 (0.75%)	22300 (34.27%)	65300 ± 3400
Mean ± S.E. of all mound type		912 ± 259 (2.43%)	4862 ± 1836 (12.94%)	6962 ± 1707 (18.52%)	9867 ± 2748 (26.25%)	18 ± 11 (0.05%)	271 ± 76 (0.72%)	14694 ± 3029 (39.09%)	37600 ± 9300

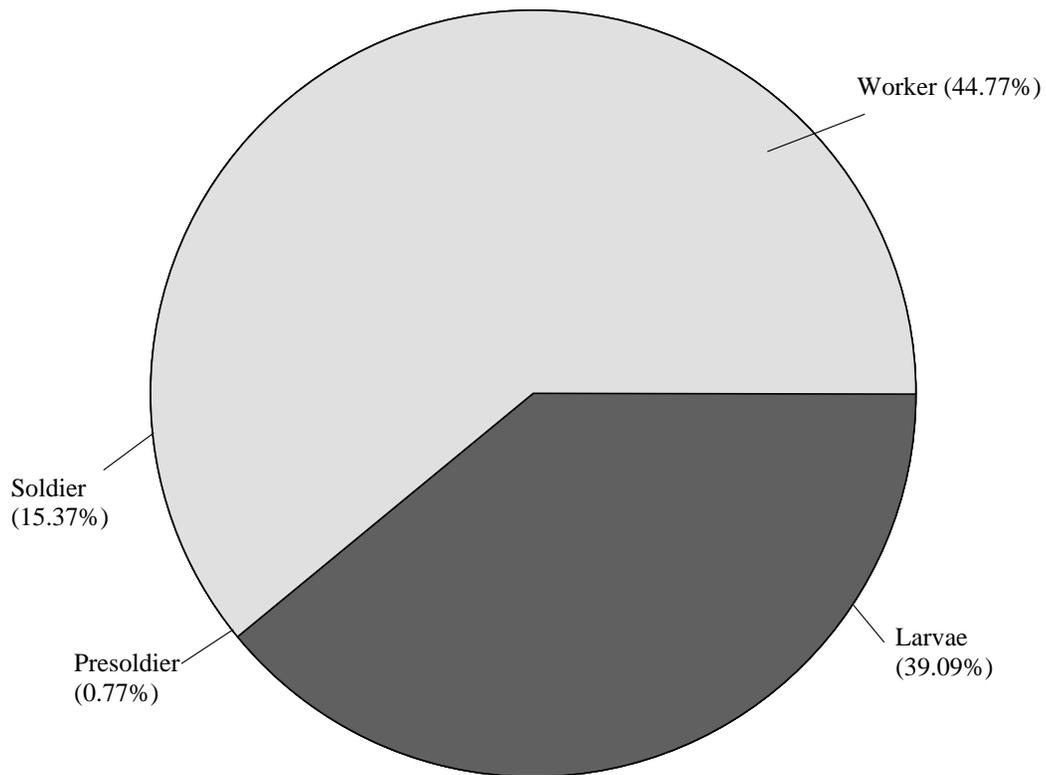


Fig. 1: Proportion of caste in *Macrotermes gilvus*

with correlation coefficient in the range  $0.924 \leq r \leq 0.967$ ,  $p < 0.01$ . The mound diameter was also significantly correlated with all population parameters. The correlations were highly significant with correlation coefficient in the range  $0.941 \leq r \leq 0.975$ ,  $p < 0.01$ . In other study on *Macrotermes natalensis* (Haviland), termite numbers were significantly correlated with the mound height, but not with the mound diameter (Meyer et al. 2000).

### Conclusions

In conclusion, the immature castes constituted ~40% in the total population of *M. gilvus*. Both mound height and mound diameter were significantly correlated with all population parameters. The mound parameters can possibly be used to estimate termite population in *M. gilvus* colonies.

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