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A Study of Two Ant (Hymenoptera: Formicidae) Sampling Methods in Tropical Rain Forest

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Abstract: The effectiveness of two ant sampling methods, i.e., pitfall and yellow-pan traps in three forest habitats in Sungai Lalang Forest Reserve, Malaysia were investigated. A total of nine sub-families were captured using both methods, namely Ponerinae, Myrmicinae, Dolichoderinae, Cerapachynae, Pseudomyrmicinae, Formicinae, Aenictinae, Dorylinae and Leptanilinae. More Ponerinae individuals were collected using pitfall trap while more Dolichoderiane were collected using yellow-pan trap. Pitfall trap collected higher number of individuals (31,501) than yellow-pan trap (1,963 individuals), which indicated that pitfall trap was relatively an effective method for estimating the species abundance over the yellow-pan trap. Even though less number of individuals were collected by yellow-pan trap, this method evidently caught a more diverse of ant species compared to pitfall trap. This indicated that yellow-pan trap is relatively a better method for estimating the diversity over the pitfall trap. Results indicated that none of the tested sampling methods has an advantage over the other in collecting ant. Thus, the use of all suitable sampling methods for certain habitats is still considered the best suggestion in order to get a representative sampling of ant species.

Key words: Ground ant, diversity, pitfall, yellow-pan

INTRODUCTION

The precise methods used to estimate the abundance and composition of insect in biodiversity assessment is of critical importance. Owing to the inevitable limitations of field methods, these estimation are often biased. Some species in a given habitat are either over or under represented in relative to their tree abundance. The estimates obtained from different sampling techniques or from variations in the execution of a particular technique may result in data that is biased in different ways. A number of studies has quantitatively assessed the efficacy of diverse methods of sampling ground-dwelling ants, including pitfall trap[1], winkler extraction[2] baits[3], and hand collection from quadrats[4]. However, very few studies have addressed the question of which traps is efficient to trap ants. The need of various methods in order to get better estimates of species diversity within a particular habitat was evidenced in Sulawesi, Indonesia[5]. The use of all suitable sampling methods for certain habitats per unit time is the best suggestion in order to get enough collection and a better estimation of diversity[6]. The objective of this study was to investigate the effectiveness of two sampling methods of collecting ants.

MATERIALS AND METHODS

The study was conducted at the Sungai Lalang Forest Reserve, Semenyih, Selangor from February 1999 to January 2000. The forest covers an area 729 ha and the elevation ranges from 50-800 m above sea level. The average annual temperature is 26.5°C and the total annual precipitation ranges from 432 to 514 mm. The Sungai Lalang Forest Reserve covers a number of forest types ranging from lowland to hill dipterocarp forest that is dominated by *Shorea* sp. The study was conducted in a primary forest and two selectively logged forest areas, i.e., a 10-year-old logged forest and a 5-year-old logged forest.

Pitfall trap: This trap consisted of plastic cups, 10 cm in diameter and 11 cm in height. The traps were placed in the ground with their rim leveled with the soil surface. Within each plot (ca. 10x10 cm), 5 subplots were established. In each subplot, five traps were arranged in a 3x3 m cross with 1 m between each trap as a trapping unit. A cover, at

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Table 1: Number of ant subfamilies, morphospecies and individuals collected by different sampling methods

Forest habitat	Pitfall trap			Yellow-pan trap		
	Subfamily	Morphospecies	Individual	Subfamily	Morphospecies	Individual
5- year old logged forest	9	31	7193	8	39	947
10- year old logged forest	8	34	19511	8	44	444
primary	8	33	4797	9	43	570
Total	9	52	31501	9	55	1963

least 5 cm from the ground surface was placed over the trap. Each cup was filled with water and few drops of detergent and sorbic acid. The cups were left for one week before they were collected. Specimens from the traps were emptied and preserved in bottles containing 70% ethanol. A total 75 traps were set in every forest habitat.

Yellow pan trap: Yellow pan traps were placed on the forest floor. They consisted of yellow trays measuring about 24x20x6 cm. Five traps, spaced at 5 m apart, were set in each plot. Each trap was filled with water containing a little detergent to break the surface tension and sorbic acid as preservative agent. The traps were emptied after 1 week and the insects were stored in 70% ethanol.

All ants collected from each trap were initially sorted to the level of morphospecies and then identified to genus using Bolton[7]. The Williams' index (∝) of diversity was used to compare the diversity of samples in relation to sampling method. This index is very convenient since it only requires that the sample size (n) and number of species (S) in a sample are known. T-test was used to assess the difference ant numbers between pitfall and yellow-pan traps.

RESULTS AND DISCUSSION

The number of individuals collected per trap was significantly different between traps (t-value 4.577, $p<0.01$). The number of ants collected using pitfall trap (31501) was relatively higher than that collected using yellow-pan trap (1963) (Table 1). In contrast, there were 55 morphospecies collected trap against 52 morphospecies collected by pitfall trap. This indicated that yellow-pan trap collected less number of individuals but more in morphospecies. Both type of traps collected 9 subfamilies but the ranking of domination was different (Table 2). Subfamily Ponerinae, Myrmicinae and Dolichoderinae dominated the sample collected using pitfall and yellow-pan trap.

Species from Ponerinae generally are found in all forest habitats and more active foraging food outside compared to others subfamilies. Even though in the world, Myrmicinae is the largest ant group, which contain 68 genera. They are cosmopolitan distribution with generalized nesting and dietary requirement habits[8].

Table 2: Total number of ants collected using pitfall trap and yellow-pan trap

Subfamily	Pitfall trap	Yellow-pan trap
Ponerinae	13989	590
Myrmicinae	7959	498
Dolichoderinae	3144	626
Cerapachynae	2636	29
Pseudomyrmicinae	2468	29
Formicinae	641	92
Aenictinae	428	8
Dorylinae	230	10
Leptanilinae	6	81
Total	31501	1963

Table 3: Diversity index (∝) for ant morphospecies collected using two sampling methods

Forest habitat	Pifall trap	Yellow-pan trap
5-year old logged forest	4.15	08.31
10-year old logged forest	4.01	12.55
Primary forest	4.77	12.11
Total	4.95	12.78

Most species of Dolichoderinae are general predators scavengers. They can be found in most regions of the world and in all major habitats[9].

In all habitats, the alpha diversity index (∝) for ant morphospecies was higher for yellow-pan trap than pitfall trap (Table 3). This indicated that yellow-pan trap may be a better method for sampling than the pitfall trap. The results from this study evidently do not corroborate with finding from previous studies. Therefore yellow-pan trap should be added as a technique for study on ground-dwelling ants. Samples of Ichneumonidae (Hymenoptra) collected in the yellow-pan trap appear to be the most diverse[5].

Previous studies have been done by Anderson[10] Samways *et al.*[11] showed that pitfall trap was the better sampling method for collecting ants. According to Agosti *et al.*[12] the pitfall trap was also effective method for collecting ants. These contradicting results indicate that more than one sampling methods are necessary to get better ant representation and diversity estimation in a particular habitat.

Evaluation of trap precision is done by using Relative Variation value (RV). Pitfall trap gives a lower RV (6.66) compared to yellow-pan trap (9.27). The lower value indicated more precision. Precision of trap would show the amount of accepted error. For research, 10% of mean should be accepted[13]. Consistent with other studies[12], results indicated that pitfall traps is the most effective method in the survey of ants and its effectiveness in sampling ant species is proven in this study. The success of using pitfall traps for ground-dwelling ants[11] was supported here. Besides that, pitfall traps are usually recommended in insect sampling, especially for ground beetles and staphyliniid beetles[14,15]. Thus, the relatively diverse of ant species caught with yellow-pan trap indicated that this trap should be added to obtain a comprehensive result. In conclusion, every method undoubtedly has at least one advantage over another.

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