

RESEARCH ARTICLE

ANTS' FORAGING, A MYSTERY

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ABSTRACT

The ants *Pheidole roberti* were offered food at different locations in their natural foraging area on 108 days, both in day and night time at Garia, Kolkata, India to note the first contact time with the said food by them following supply of the food. It is revealed that the ants are equally apt to locate the food both in day and night times and the first contact time varied from 1 to 60 minutes, on average 7.56 ± 0.94 SE (n = 108) minutes. Statistical analysis of the data clearly revealed that there exists no significant difference in contact time in respect to locations of the food (F = 0.38, df = 9, 98, n = 107). This sort of foraging behaviour thus, uncovering the mystery of ants' foraging strategy under natural conditions.

Key Words: Ants *Pheidole roberti*, Food, Foraging, First contact, Mystery

INTRODUCTION

Ants' foraging have been the subject of study by a good number of workers (Wallis, 1964; Traniello, 1989; Beckers *et al.*, 1990; Hölldobler and Wilson, 1990; Vasconcellos, 1990; Nelson *et al.*, 1991; Beckers *et al.*, 1993; Dussutour *et al.*, 2004; Jackson *et al.*, 2004; Yamamoto and Del-Claro, 2008; Hashimoto *et al.*, 2010; Sengupta *et al.*, 2010; Jayatilaka *et al.*, 2011; Reid *et al.*, 2011; Raquel *et al.*, 2013; Hashimoto and Yamane, 2014; Naskar and Raut, 2014a,b,c). In course of studies of the foraging behaviour in ants some workers have paid due attention to draw a correlation between foraging and trade off (Raquel *et al.*, 2013) while some others (Jackson *et al.*, 2004) have opined that trail geometry gives polarity to ant foraging networks. Also, due attention have been paid to study the path efficiency of ant foraging trails in an artificial network by Vittori and coworkers (2006).

According to Lixiang and coworkers (2014) scout ants move around the nest area in a seemingly chaotic way and when one of them finds some food in the vicinity of the colony, it takes tiny piece of it to the nest, leaving a trail of scent - emanating substance called pheromones. However, there exists no report regarding foraging strategy of ants in respect to searching and collection of individual food-particles occurring here and there in the foraging area of the ants. Also, no report is in sight regarding probability of food searching of the ants in respect to the spots having acceptable food particles. Thus, in the present study an attempt has been made to ascertain the probability of the ants *Pheidole roberti* Forel to come in contact of the food materials occurring at different spots in their foraging area and the findings are worthy for publication.

MATERIALS AND METHODS

During 2010 and 2011 we offered sugar cubes, small pieces of dry fish and fragments of biscuits separately at any of the 10 different spots selected at random in the premises of a house locating at Garia, Kolkata, West Bengal, India. In each trial, of the 10 spots only one spot was selected and any one kind of food matter was left on the ground. The spot selection was also made at random and the trial was performed on different dates at different spots, at an interval of at least 10 days. Due attention was paid to offer each of these foods at an interval of at least 3 days in each spot, irrespective of day and night hours. For daytime trials, food was supplied at the spot between 06:00 and 12:00 hours, and for nighttime trials food was deposited at the spot between 18:00 and 24:00 hours. In each trial food-offering time as well as the time of first contact with the said food by *P. roberti* were noted. For calculation, contact time within 1 minute was considered as after 1 minute. It is to be mentioned here that, in any trial, if the offered food was first touched by the ants other than *P. roberti* then the said trial was discarded. Accordingly, a total of 108 trials were made to present the data. We applied analysis of variance (ANOVA) (Bailey, 1995) to ascertain whether first contact time with the food by the ants varies with the location of the foods in the foraging area.

RESULTS

The ants *P. roberti* were seen to come in contact with the supplied food after a varying length of time following supply of the said food at the selected spots. Of the 108 trials 75 were initiated in the day hours while the remaining 33 were performed during night hours. From the daytime trials it is revealed that the ants had the chance to come in contact of the supplied food for the first time within or after 1 minute in some cases, or after 2, 3, 4 or even after 35 minutes in other cases (Fig. 1).

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It is evident that, in 14 cases the ants had the chance to locate the supplied food within or after 1 minute following supply of the same at the selected spots. On the contrary, in 2 trials the ants were able to locate the offered foods after 35 minutes. Though in 21 trials *P. roborati* succeeded in locating the offered food after 2 minutes they took 3 minutes in 12 trials, 4 minutes in 8 trials and 5 minutes in 5 trials to locate the food. Interestingly, in 1 or 2 trials food contact time varied from 6 to 33 minutes (Fig.1). Of the 33 trials performed during night hours only in 2 cases the ants, on way of foraging had the chance to touch the supplied food materials just after 1 minute following supply of the same at the spots (Fig. 2). However, in other instances the ants were seen to come in contact of the offered food after 2, 3, 4, 5, 7 or 8 minutes, or even more, 60 minutes following the time of supply of the food at the spot (Fig. 2). It is evident that, in 7 trials, *P. roborati* were able to locate the food after 5 minutes while in 2 trials contact was effected just after 12 minutes or 18 minutes or 25 minutes.

Though the first contact with the food was effected after 2 minutes in 3 trials, or 3 minutes in 3 trials, or 4 minutes in 3 trials, it took 60 minutes in 1 trial to locate the offered food by the ants *P. roborati* (Fig. 2). Irrespective of trials made during day or night hours it is evident that *P. roborati* was able to come in contact with the supplied food after 1 minute in 16 trials, 2 minutes in 24 trials, 3 minutes in 15 trials, 4 minutes in 11 trials, 5 minutes in 12 trials, 6 minutes in 3 trials, and 12 minutes in 4 trials. In the remaining trials first contact with the supplied food was effected after 7, 15, 16, 18, 20 and 35 minutes in 2 trials of each case. In the remaining trials contact with the food was effected after a long time, even after 60 minutes (Fig. 3). Though the contact time was ranged from 1-60 minutes the ants on average touched the supplied food after 7.56 ± 0.94 SE minutes. Results of ANOVA tests clearly indicate (Table 1) that, there exists no significant difference ($F = 0.38$, $df = 9, 98$, $n = 108$) in contact time with the food by the ants *P. roborati* in respect to locations of the food.

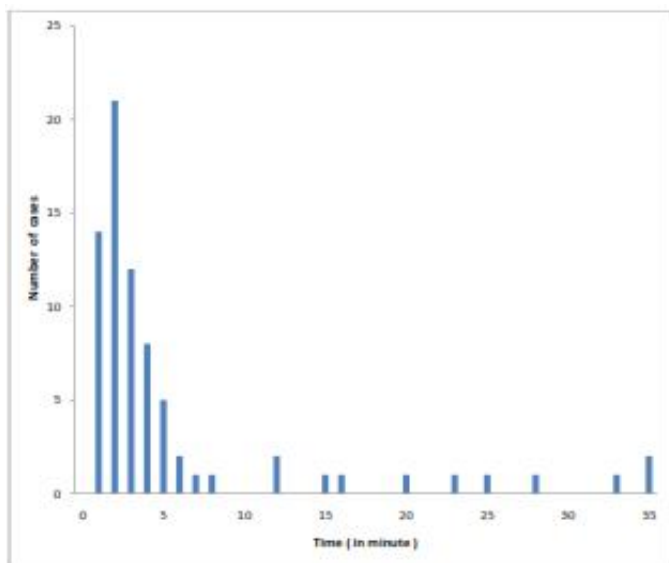


Fig.1. First food contact time by the foraging ant *P. roborati* during daytime following supply of foods at 10 different locations in the foraging area

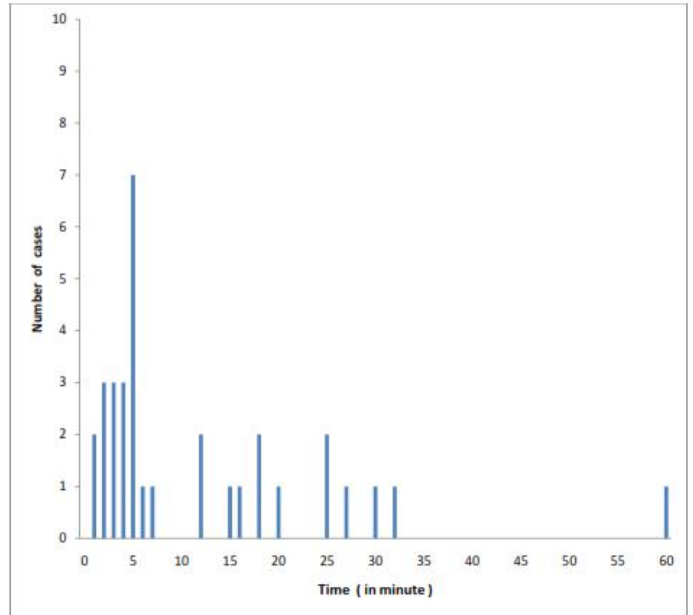


Fig.2. First food contact time by the foraging ant *P. roborati* during night time following supply of foods at 10 different locations in the foraging area

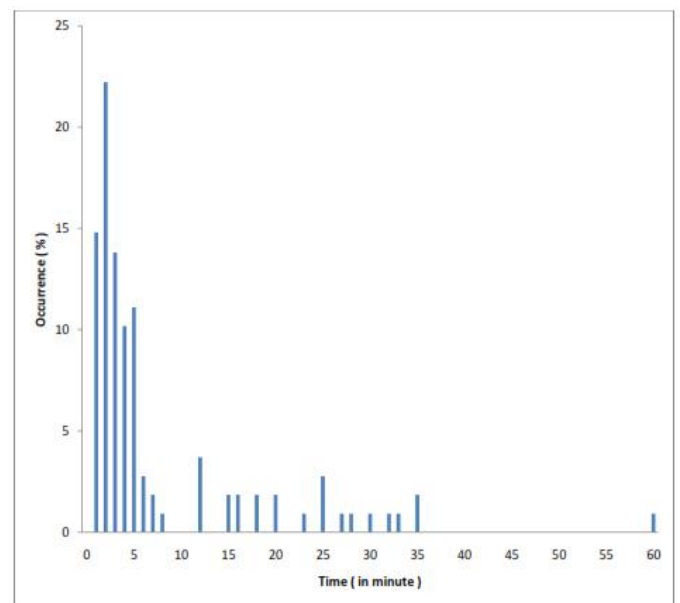


Fig.3. First food contact time by the foraging ant *P. roborati* during the period of 24 hours of a day following supply of foods at 10 different locations in the foraging area

Table 1. Results of ANOVA tests to justify the influence of location of food materials on the first contact time of the ants *P. roborati*.

Source of variation	Sum of squares	Degree of freedom	Mean square	Variance ratio
Between locations	366.05	9	40.672	0.38 ^a
Within locations	10449.39	98	106.63	--
Total	10815.44	107	--	--

^aInsignificant

DISCUSSION

From the results it is evident that *P. roberti* is equally apt for foraging both during day and night time. It is also clear that the foraging act is almost a continuous process. This is well evident from the fact of presence of scouts or foragers almost round the clock in the foraging area. Thus, it was possible for some of the foragers to come in contact of the food within or after 1 minute following supply of the food at the spots. As the ants were successful in locating the foods supplied at any and all the 10 spots on 108 different dates after different lengths of time following supply of the said food, it is most likely that *P. roberti* is habituated in searching food from all possible niches and the searching operation seems to be independent of any kind of influence and/or clue. This is justified from the fact of records of first contact time, 1 to 60 minutes after the time of supply of the food at the selected spots. However, reports on the influence of chemical composition of food sources on individual trail-laying behaviour in ants are on record (Verhäghe, 1982, Beckers *et al.*, 1993, de Biseau and Pasteels, 1994). Since, of the 108 trials, 78 (72.22 %) contacts with the food became effective within 5 minutes after the time of supply of the said food it is inferred that the ant's efficiency in searching the food-locating sites is confined to the sites more or less around 72 %, within a period of five minutes. On the other hand, their searching ability for 28 % food-locating sites became effective only after 6 to 60 minutes.

However, irrespective of sites and the hours of the 24 hours period of a day *P. roberti* were successful in locating the supplied food (100 %) after a mean time 7.56 ± 0.94 SE minutes following supply of the food in 108 trials made on different dates. As, in nature, occurrence of food at any spot is a chance factor and searching for the same by the ants is comparable with the event of begging on way of touching the new spots in course of foraging. Since there exists no certainty of getting alms from all persons whom the begger approached, foraging of *P. roberti* are also not adapted to search and collect food from all niches within a definite length of time. However, they never spare these foods.

Because, as and when their foraging path coincides with the spots having foods the same are collected by them. Thus, it appears that food searching is an event performed by the animals with a view to collect food from almost all sources at the first hand but in reality there exists every probability of escaping of some food-bearing spots in course of foraging. Perhaps, this sort of foraging-behavioural lacuna has paved the foundation of sheltering spots for the prey animals with a view to escape the sight of their predators. As each and all prey individuals are susceptible to attack by their predators sooner or later, they are expected to be victimized as could be the case of collection of supplied food by the ants *P. roberti* from a spot even after an hour or later time period on way of haphazard movement (Naskar and Raut, 2014c). As opined by Lixiang *et al.* (2014) that the foraging in ants is done by deterministic walks in a random environment it is very hard to assume that the ants *P. roberti* were in

need of at least 60 minutes to come in contact with the food through deterministic walks. Thus, from the present study it appears that ants search food haphazardly but the probability of coming in contact with the food is a matter of coincidence and, of course, independent of the location of nest (home), quality of the food and the colony's current nutritional status. Thus, the results of the present studies are in contradiction with the opinion expressed by Traniello (1989), Portha *et al.* (2002) and Lixiang *et al.* (2014) at least, in case of foraging for scattered food particles in the foraging area. This could be substantiated from the value of *F* obtained in the ANOVA test. The calculated value (0.38) is insignificant both at 5% and 1% level of significance. Hence, it is concluded that there exists no significant difference in contact time with the food among locations. The most interesting aspect of ants' foraging lies with the protocol perhaps, in an organizational instruction regarding the trend and direction of foraging movement. Otherwise, it would have not been possible by the ants *P. roberti* to come in contact of the food materials within a mean period of 8 minutes, on 108 days, irrespective of the type of food and the supplied spots. Since, from the statistical view point there exists no impact of locations in ensuring contact with the food by *P. roberti* it is really a mystery to be uncovered to strengthen our knowledge regarding instructions to the movement of foragers in respect to locations of the foods in the foraging area concerned. Such findings would enable us in posting soldiers in the war-belt leaving no opportunity for the enemy to have the hiding space and/or to obstruct the enemy on way of sudden attack through the use of such untraceable spots.

Conclusion

The ants *P. roberti* are apt to locate food in all accessible niches both in day and night hours in their foraging area. Though individual ant needs a different length of time to locate the food source, in fact, there exists no significant difference in time of contact with the food available in the foraging belt. It is well established that the food searching strategy in ants especially in *P. roberti* is technically superb and effective in securing the food.

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