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ANTS FORAGE HAPHAZARDLY: A CASE STUDY WITH *PHEIDOLE ROBERTI*

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ABSTRACT
The ants *Pheidole roberti* were offered 10 sugar cubes, each weighing 25-55mg at 10 different sites, in a domestic house locating at Garia, Kolkata, India to note the foraging habit of the said ant species in respect to collection of these sugar cubes by them. It is revealed that the ants in certain trials succeeded to come in contact of the sugar cubes within 1-8 minutes while in other cases 11 - 653 minutes were needed to locate the offered food source. As it was not possible for an ant individual to carry a sugar cube alone to the nest it had no alternative but to wait for the arrival of the fellow members to the concerned sites so as to enable them to carry a sugar cube jointly through pull and push mechanism. In some trials procurement of the last sugar cube was possible after 734 minutes of the offering time, on arrival of the last ant individual to join the group. As the ants, after coming in contact of these sugar cubes took 2-211 minutes to take away all the sugar cubes from a site it is sure that the contact of the sugar cubes by *P. roberti* was a matter of chance in course of foraging because of haphazard movement.

KEYWORDS: Ants, *Pheidole roberti*, food searching, haphazard movement.

INTRODUCTION

Foraging in ants is a spectacular event. It may be an individual effort or a joint effort by a number of individuals. As ants can move in any direction it is obvious that they are apt to search and carry the food from almost all possible niches to their nest. Since at any time individuals of an ant species are seen to move here and there in search of food it is intriguing to know whether they are at a position at any location to recognize and collect the food instantly in respect to time of occurrence of the food materials or the chance of coming in contact of food is a matter of coincidence in respect to movement. Also, the aspect of foraging is to carry the food matters to the nest. Since an ant individual as regards to species has limitation to carry a food particle beyond a certain weight, individually it has no alternative under such a situation but to wait for the arrival of other fellow members so as to enable them to house the said food particle jointly. Thus, it appears that searching of food and carrying the said food to the nest are the events of foraging. Keeping this view in mind we offered 10 sugar cubes to the ants *Pheidole roberti* at 10 different sites of a domestic room at Garia, Kolkata, West Bengal, India to note the foraging behaviour, whether in predictable patterns or haphazardly, which is in practice. Though ample information on foraging activity of ants is available from the studies of Wilson (1962), Hantgartner (1970), Pasteels *et al.* (1987), Traniello (1989), Nelson *et al.* (1991), Crist and Mcmahon (1991), Beckers *et al.* (1993), Breed *et al.* (1996), Jackson *et al.* (2004), Vittori *et al.* (2006), Yamamoto and Del-Claro (2008), Sengupta *et al.* (2010), Jayatilaka *et al.* (2011), Raquel *et al.* (2013) and Naskar and Raut (2014a,b) report on the nature of foraging movement is still wanting. However, Hsu (2009) opined that the ants forage haphazardly. Thus to verify the actual nature of foraging movement of ants experiments were carried out with the ants *P. roberti* under natural conditions.

MATERIALS & METHODS

The ants, *P. roberti* are habituated to forage almost everywhere *i.e.* in the houses, premises trees and grasslands in and around their habitat at Garia, Kolkata. We selected a room in the ground floor of a domestic house for experimentations. Ten sites of the said room were selected at random (Table 1) for the supply of the sugar cubes as food for the ants. In each site 10 sugar cubes each 25-55 mg in weight were left almost at the same time to note the time of arrival of the ants to the sugar cubes supplied sites and to record the time to carry away the sugar cubes from the supplied sites. We applied X^2 (Chi square) to justify whether the foraging act was random or not. To test the hypothesis we denoted t_1 = first contact time, t_2 = second contact time t_3 = third contact time and t_4 = fourth contact time of the ants with the sugar cubes in respect to carrying act of the same from the sites. For calculation the time of supply of the sugar cubes was considered as '0' (zero) minute while k was denoted as the final time point of carrying the sugar cubes from the same supplied site by the ants. Thus, the calculation was made by using the formula $(x_1 - y_1 / y_1)$ where x_1 = observed value and y_1 = expected value. The expected value was estimated by using the formula $t_1/k \times 10$ for y_1 where 10 stands for the number of sugar cubes offered ; for y_2 the $t_2 - t_1/k \times 10$ was applied, and $t_3 - t_2/k \times 10$ was applied for y_3, and so on. Also, one way analysis of

variance (ANOVA) was applied (Campbell, 1989) to justify the effect of sites on the foraging behaviour of the ants, if any.

TABLE 1: Location of the ten sites and relevant information of the same selected to offer food (sugar cubes) to the ants *P. roberti*

Site No	Description of the Site	Distance (m) from site No. 1	Height (Cm)
1	Floor of the room (north east corner side)	0	0
2	Floor close to the centre of the room	1.90	0
3	In front of the printer at the center of the floor of the room	2.40	0
4	At the base of east facing window	2.97	76
5	On the table	3.40	76
6	At the base of south facing window	5.20	76
7	At the ralling of west side	5.90	76
8	On the floor of west side	5.90	0
9	At the ralling of north side	5.16	76
10	At the base of door	2.40	0

A total of 10 trials, one at each site, have been made at each occasion, daily. The trial dates were July 5, 25-27, 29, 30, August 2-5, 9-28, 2011. Thus a total of 300 trials, 30 trials at each of the 10 sites were performed in a 30 day period. In all cases subsequent trials were made only after the exhaustion of sugar cubes supplied in the previous trial. In cases when sugar cubes were left unnoticed by the ants at any site even after 48 hours of supply the said trial was not taken into account in the present study. In all cases mean and standard error (SE) have been calculated to present the data.

RESULTS

Of the 300 trials performed the ants *P. roberti* collected all the 10 sugar cubes instantly in 7 trials, irrespective of sites, in a group while in the remaining 293 trials they were seen, in course of foraging, to come in contact with the supplied sugar cubes for the first time, within 1- 653 (average 77.41 ±11.85) minutes though the said time varied to a great extent in respect to the sites selected and trials performed (Fig.1). Results of ANOVA tests clearly indicate that the site had significant effect on the time of arrival of the foraging ants in contact of the sugar cubes ($F = 8.49$, $df = 9$, $P < 0.001$). As it was not possible to carry a sugar cube individually by an ant there were no alternative but the first comer had to wait for the arrival of the subsequent fellow members so as to enable them to ensure the sugar-cube carrying operation. Thus arrival of fellow members at the sites up to the time 9 -734 (average 87.2 ± 12.55) minutes following supply of the sugar cubes was proved effective in achieving foraging success in respect to supplied sugar cubes.

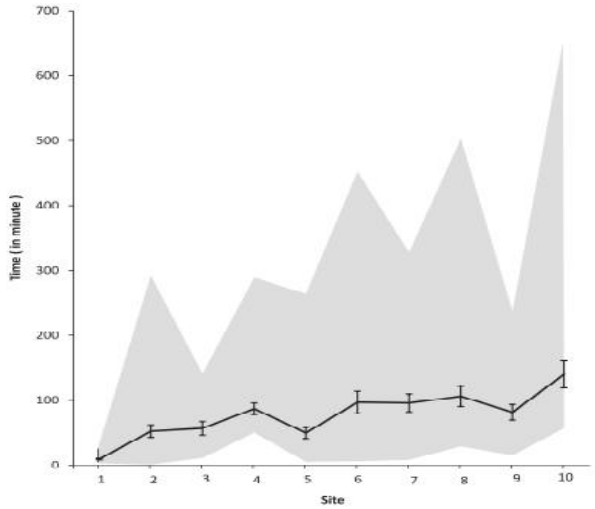

FIGURE 1: Time (range, mean ± SE in minute) for first contact to the sugar cubes by the ant *P. roberti* following supply of the same at 10 different sites

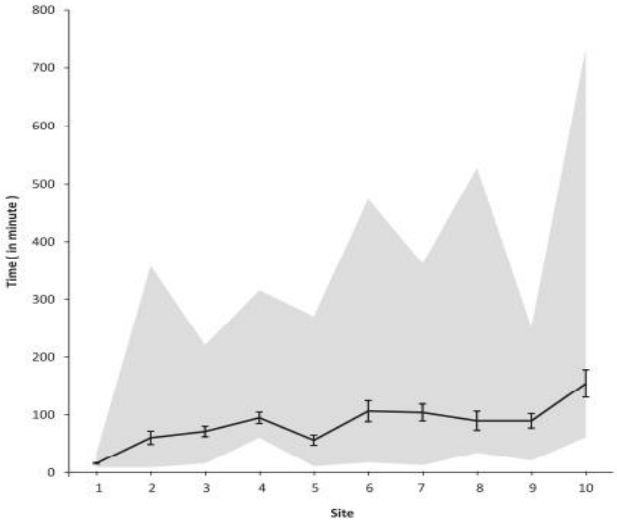

FIGURE 2: Time (range, mean ± SE in minute) for arrival of ant *P. roberti* to the sugar cubes to the nest

Fig.2 presents the time of arrival of the last individual (s) at the respective sites to exhaust the sugar cubes. Also in this case results of ANOVA tests indicate that the sites had significant impact in deciding the contact time of ants

with the sugar cubes occurring at the supplied sites (F = 7.17 , df = 9, P < 0.001). It is evident that a varying length of time was needed by the ants to procure all the ten sugar cubes from a site, after coming in contact with the sugar cube. In some cases the 10 sugar cubes were taken away within 2 minutes while in other instance 211 minutes were needed for the same (Fig. 3). Irrespective of sites and the trials performed all the ten sugar cubes were taken away from the sites by *P. roberti* within 10.47 ± 0.9 minutes. However, variations noted in the required amount of time to carry all the sugar cubes from the supplied sites are, as per results of ANOVA tests, not significant (F = 0.96, df = 9) from statistical view points. X^2 value obtained is excessively high. This indicates that the foraging movement of *P. roberti* is haphazard.

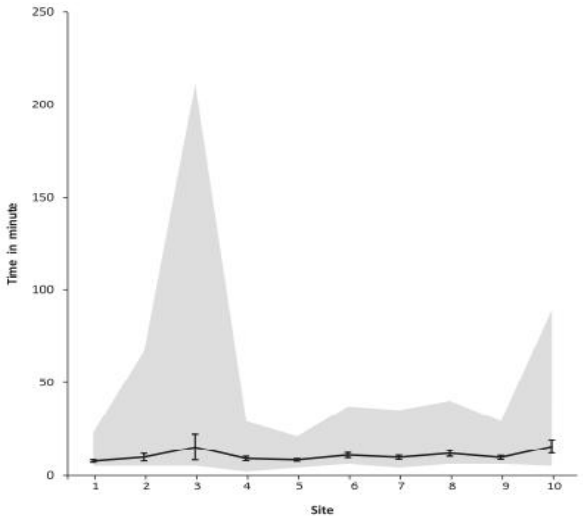

FIGURE 3: Time (range, mean ± SE in minute) needed by ant *P. roberti* to carry away all the sugar from the 10 sites after coming in contact with these sugar cubes

DISCUSSION

From the studies it is evident that the ants *P. roberti* forage individually here and there in search of food. But it is not clear whether they move in respect to a clue to get the food or the moving act is simply a phenomenon of searching the food source at random in all possible spaces. Though numerous studies have investigated how chemical composition of food sources influences individuals to develop the trail (Verhäghe, 1982; Beckers *et al*., 1993; de Biseau and Pasteels, 1994; Mailleux, 2000) it is not known whether the ants initially start moving in quest of food without any clue. Also, it is not on record which chemical clue is sensible to ants at what distance. Therefore, we are still in darkness whether *P. roberti* were able to guess the presence of sugar cubes at the supplied sites from a distance on way of their foraging movement or the phenomenon of contact with the sugar cubes is a chance factor as a result of haphazard crawling.

Results of the present experiments clearly indicate that *P. roberti* are habituated in searching of food almost through the day and night hours. Because, they were assembled at the sugar cube supplied sites within one or two minutes though in some cases contact with the sugar cubes became effective after 653 minutes. It is very difficult to assume that there were no ant individuals around the ten sites selected for studies within the effective range of chemoreception of *P. roberti* with a view to guess the presence of sugar cubes at a close distance. If the ants would have that kind of receptor mechanism then they would have not been allowed the sugar cubes untouched, unnecessarily, for 28, 141, 237, 264, 289, 292, 328, 452, 503, and 653 minutes respectively at sites 1 to 10 in some trials. Moreover, this was happened even after knowing the fact that sugar cubes are available at these sites. Because, the trials were made at the same sites in one instance (August 9 - 28) consecutively for 20 days. This indicates that the ants are adapted more for haphazard searching then selective searching except the cases of trail-bound food collection (Pasteels *et al*., 1987; Beckers *et al*., 1990, 1993) system. The habit of haphazard movement for food searching is also pronounced by the fact of arrival of ant individual at the site at different time point during a length of time period ranging from 9- 734 minutes after supplying the sugar cubes at the sites. That is, the ants took the liberty to carry a sugar cube when sufficient number of individuals was assembled at the site so as to enable them to carry a sugar cube to the nest. It is sure that the assemblage of ants at the site prior to carry a sugar cube to the nest was undoubtedly, happened, because of coincidence of contacts of ants with the sugar cube on way of haphazard movement. Another interesting aspect of this study is associated with the total time the ants needed to carry all the sugar cubes to the nest. In seven trials the ants carried all the ten sugar cubes almost instantly from the supplied sites while in the remaining 293 trials the sugar cubes were taken away from the sites within 2-89 minutes though on average such operation was completed within 10.47 minutes after the ants coming in contact of the sugar cubes. Thus, it indicates that the ants may come in contact of the available foods in their foraging area at any time, on way of food searching but they must do the needful to collect the available foods at the earliest opportunity. As in the present case, it was not possible to carry a sugar cube by an ant individually they applied joint effort to ensure the foraging success through the effective actions of pull and push mechanisms. Since the ants

ensured collection of sugar cubes within around a mean time of 10 minutes the role of pheromone in inviting the fellow members to the site of food resource could not be ruled out. In this case, it is most likely that the ants carrying a sugar cube deposited the pheromone on the way so that fellow members moving haphazardly would have the chance to reach the food source accurately. Possibly, these strategies have enabled *P. roberti* to procure all the 10 sugar cubes from the sites within a short time. Otherwise, it would have not been possible for the ants to collect the sugar cubes within a short time span. However, there exists no assurance that the ants would be able to collect all the sugar cubes at earliest opportunity because of their habit of haphazard foraging movement. This is justified from the fact of statistically insignificant result obtained regarding observed and expected time span of the ants for collection of the sugar cubes from the sites. Because, in certain trials sugar cubes were left untouched for 653 minutes at the supplied site. Since sugar cubes are preferred food item of *P. roberti* (Naskar and Raut, 2014b) this phenomenon could only be explained from the habit of haphazard movement of the ants *P. roberti* during foraging.

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