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Food searching and collection by the ants *Pheidole roberti* Forel

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ABSTRACT

The ants *Pheidole roberti* Forel were offered sugar cubes each weighing 25-55mg, at 10 different sites of a human dwelling room locating in the ground floor at Garia in Kolkata, India to study the food searching and food collection behaviour. It is revealed that P. *roberti*, in course of their foraging act came in contact of the supplied sugar cubes at 10 sites within 2-753 (100.12 ± 7.82 SE) minutes (n = 220). They were unable to carry a sugar cube individually to their home and therefore they had to wait for the arrival of required number of partners to ensure the sugar cube carrying act. The sugar cubes, irrespective of the sites were carried away by the ants within 9 and 816 (mean 114.16 ± 8.82 SE) minutes after coming in contact of the same. The ants completed sugar cube collection from these spots in 1-4 spells and they needed 1-286 (mean 14.07 ± 1.87 SE) minutes to carry the sugar cubes irrespective of the sites. It is evident that food searching in ants is a matter of random process while food carrying in case of small amount of food sources is dependent on the chance of arrival of the required number partners without prior communication.

Keywords: Ants, Food Searching, Food Collection

1. INTRODUCTION

Ants are very common almost in all terrestrial niches (Bingham, 1903; Hölldobler and Wilson 1990; Tewari et al. 1998; Ghosh et al, 2005; Kharbani and Hajong, 2013). They are habituated to move here and there in search of food. Various aspects of foraging strategies of ants in respect to food resources and environmental constraints have been studied by a number of workers (Crawford and Rissing, 1983; Sudd and Sudd, 1985; Breed et al. 1987; 1996a, b; Cherix, 1987; Traniello, 1989; Biseau et al., 1992; Bonser et al., 1998; Völkl et al., 1999; Sengupta et al., 2010). Also, due attention has been paid to study the trailing behaviour and maintenance of foraging trails by different species (Pasteels et al., 1987; Nelson et al., 1991; Beckerr et al., 1992a, b, 1993; Narendra and Kumar, 2006). In human dwelling houses usually ants are thrown away time and again daily in course of cleaning of the house especially the floors. But, soon after the cleaning act they do not forget to reorient their way towards the earlier locations. As they are habituated to locate and collect food from any spot be it on the ground, floor, table, roof, tree, wall etc, it is intriguing to know whether they are equally apt to locate and collect the food irrespective of sites of food resources. To verify this, we designed the experiment by offering the similar type of food at different sites of a domestic room at Garia, a semi-urban area of greater Kolkata, India to the ants *Pheidole roberti* Forel and the findings are communicated.

2. MATERIALS AND METHODS

In Garia, Kolkata P. *roberti are* very common in trees. But, of and on they were seen to move here and there in the premises and houses near about. Accordingly, we selected ten different sites of a domestic room, 5 m in length, 4 m in width and 3 m in height, locating at the ground floor for the study. Description of the sites, distance of each site from site-1 and the height of the site from the floor of the room (where applicable) have been shown in Table 1. We offered 10 sugar cubes (25-55 mg in weight) at each site on the study day almost simultaneously with a view to note the following:

1. Time taken by the ants to come in contact with the sugar cubes after supplying the same at the site.
2. Time within which sugar cubes were carried out by the ants following the time of supply of the same at the site.
3. Number of spells required to carry out all the sugar cubes from the site.
4. Total time taken by the ants to carry out the sugar cubes after coming in contact with the sugar cubes.

It is to be mentioned here that the room was cleaned twice regularly, once in the morning, at around 07:00 hr and again in the evening between 18:00 and 18:30 hr. The cleaning was restricted mainly to remove the dust particles from the floor on way of sweeping by the help of a broom. The room was used by the residents as usual irrespective of experimental dates. During day time no electric light was required to locate any thing in the room while a flurocent lamp was used usually from 18:00 hr to 22:00 hr almost daily to carry out household works. Due attention was given not to disturb the sugar cube supplying spots of the floor. Trials were made on 30 days at different intervals depending upon the exhaustion of the sugar cubes supplied earlier. Of the 30 trials 8 trials were discarded due to the interference of black ants and displacement of sugar cubes due to stormy winds.

Observations were made regularly and the data collected on the fate of all the 10 sugar cubes supplied at ten spots on 22 days i.e. 10 × 22=220 trials with 2200 sugar cubes, have been pooled together in respect to the sites and as a whole, to present the findings. Mean and standard error (± SE) were determined and one way analysis of variance (ANOVA) was applied (Campbell, 1989) to ascertain the effect of sites on the food searching, food carrying and the spells of food carrying activities as well as the time spend to carry out all the food materials after knowing the resource stock. The trials made on July 5, 15, 22, 25, 26, 27, 29, 30, August 2, 3, 4, 5, 9, 10, 11, 12, 13, 14, 15, 16, 17 and 18, 2011 were considered for analysis of the data. Sugar cubes were offered between 07:17 and 09:32 hr in these sites on the trial dates mentioned and observations were continued until all the sugar cubes were carried out by the ants *P. roberti* from the sites.

3. RESULTS

The ants P. *roberti* irrespective of sites were seen to locate the sugar cubes within 2-753 (mean 100.12 ± 7.82) minutes though the mean time required to come in contact with the sugar cubes varied with the sites from 14.32 ± 3.58 (Site 1) to 153.77 ± 24.76 (Site 10) minutes (Figure 1). Results of ANOVA tests clearly revealed that the site of food source had significant effect ($F = 8.13$, $df = 9$ $p < 0.001$) on the time of food searching. The ants after coming in contact with the sugar cubes were seen to test the sugar cubes until required number individuals assembled there to carry away a sugar cube to home. Thus the sugar cubes were taken to home within 9 and 816 (mean 114.16 ± 8.82) minutes. Variations in respect to the time required to take away the sugar cubes are well marked with the sites (Figure 2) selected for experimentation. Such variations are statistically significant ($F = 10.29$, $df = 9$, $P < 0.001$). In all cases an ant was unable to carry out a sugar cube individually. Therefore, to carry the same pull and push mechanisms were effected by active participation of several ant individuals , usually 4-6. Thereby, they were seen to carry away the ten sugar cubes from the food-offered sites in several spells (Figure 3).

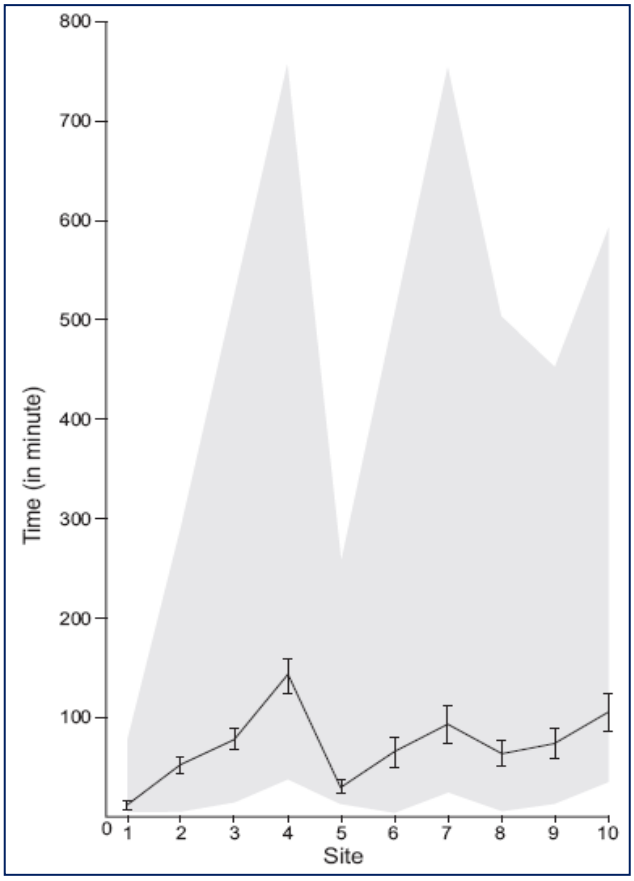

Figure 1

Time taken (range, mean ± SE) by the ants P. *roberti* to come in contact with the food (sugar cubes) supplied at different sites inside a human dwelling room (See text for site specification)

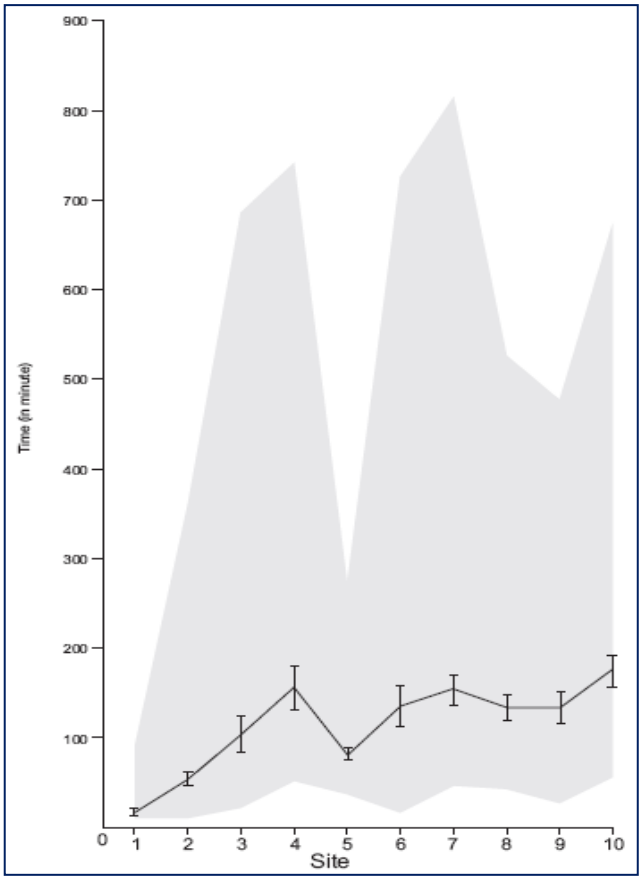

Figure 2

Time taken (range, mean ± SE) by the ants *P. roberti* to carry out all the 10 supplied sugar cubes from 10 different sides of a human dwelling room, after coming in contact of the said food at each site.

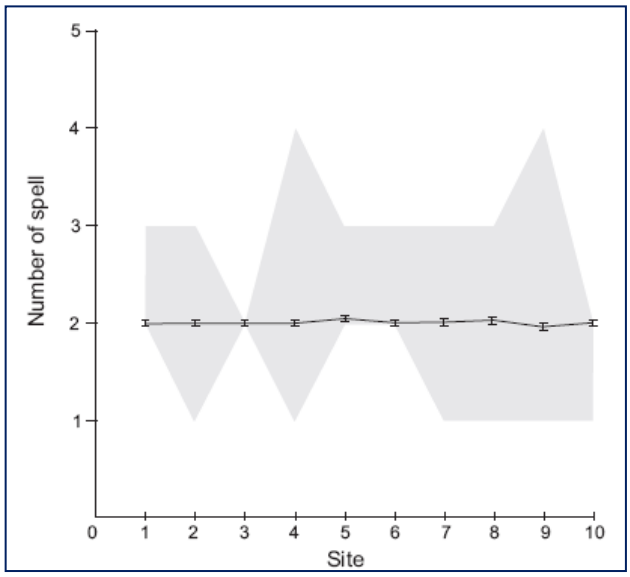

Figure 3

Spells (range, number, mean ± SE) required by the ants P. *roberti* to collect all the 10 sugar cubes from the supplied sites

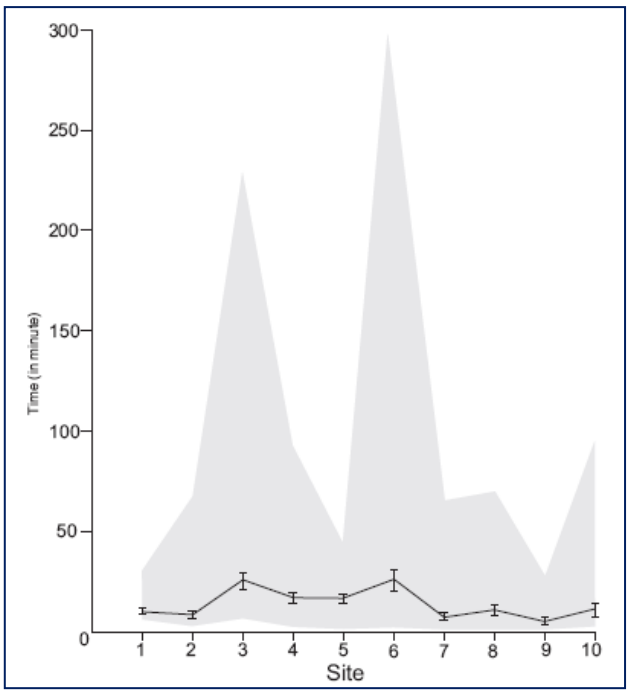

Figure 4

Total time (range, mean ± SE) spent by the ants P. *roberti* to carry out the supplied sugar cube from the 10 different sites

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	On the floor of the room	0	0
2	In front of the site no - 3	1.90	0
3	In front of the printer	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.	2.20	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 the door	2.40	0

That the sites of food source had significant impact on the variations of spells of food collection could be revealed from the results of ANOVA tests ($F = 4.3$, $df = 9$, $P < 0.001$). Though food searching was a random process in *P. roberti* the total time required by the ants to carry away the sugar cubes after locating the same at different sites varied to a great extent, 1-286 (mean 14.07 ± 1.87) minutes the mean time needed to finish the food carrying operation varied with the sites, 8.36 ± 1.14 to 23.82 ± 12.27 minutes (Figure 4) but the said variations were statistically insignificant.

The ants, of the 220 trials, carried food only in one spell in eight cases while they needed two spells in 198 cases, three spells in 12 cases and four spells in 2 cases to carry out the supplied ten sugar cubes from the specified sites. Operation of second spell food carrying was started after 1-1055 (mean 19.12 ± 7.12) minutes of the first spell. The time of second spell food carrying operation following first spell food carrying action and the number of cases noted among the 212 trials have been shown in Table 2. Of the total trials performed, in 14 cases the ants were seen to carry the food in the third spell after 2-37 minutes of the second spell (Table 3). Only in two cases the ants needed the fourth spell to deposit the sugar cubes in their storage site from the collection site. They performed the said activity after 6 minutes in one case and 26 minutes in other case after completion of the third spell. However, there exists no parity as regards to performance of second and subsequent spells for food collection in respect to time the ants performed the food carrying duty after the first or second or third spells (Table 3) with a view to home all the sugar cubes which were offered at ten sites.

Table 3
Third spell food carrying by the ants P. *roberti*

Time (in minute) of third spell food carrying after the second spell	Number of Cases
2	1
3	1
4	3
5	2
8	1
11	1
14	1
22	1
25	2
37	1

4. DISCUSSION

From the results it appears that the ants P. roberti are able to locate the food (sugar cubes) from all the sites selected for experimental studies. But, the time they needed to locate these sugar cubes varied to a great extent 2-753 minutes. As such variations are statistically significant it can safely be concluded that the ants P. roberti move at random from place to place in search of food, and the contact with the food is a mere coincidence in course of foraging. This finding may be considered as a proof of William Baxter's idea that the ants don't march in predictable patterns to search for crumbs, instead, they roam randomly (Live Science, 2009). It is really interesting to know how long the ants would allow the food materials at the spot unattended after coming in contact with the same ? Mailleux et al. (2000) stated that the scouts of Lasius Niger are able to assess the amount of food available as well as the rules governing its decision to lay a recruitment trail. In the present study the food was limited to only ten sugar cubes and these were carried jointly by 4-6 P. roberti. It is most likely that the initial and subsequent visitors had to wait to have required number worker to carry sugar cube to home through pulling and pushing mechanism. As these ants did not lay the trail to carry the ten sugar cubes from any of the ten spots it is certain that P. roberti is equally intelligent to assess the food volume like that of L. niger (Mailleux et. al. , 2000). As P. roberti had no ability to carry a sugar cube individually and the volume of food was not enough to move for laying trail it had developed the strategy to spent time on way of eating sugar cubes at the receiving site until required number workers assembled at the spot to carry a sugar cube to home. Accordingly, in the same way with the arrival of some other but required number individuals another sugar cube is carried to home. This is why the sugar cubes are carried by the ants in several spells from different sites.

It is an established fact that the ants use pheromone to mark the path between the food source and the home (Hantgartner, 1970 ; Nelson et al., 1991 ; Beckerr et al. , 1993; Mailleux et al., 2000). But the use of pheromone is regulated by the volume of food occurring at the source. As the deposited pheromone decreased with the time due to evaporation (Beckerr et al. , 1993) and in the present study, if the same was ever deposited by P. roberti was faded because of cleaning activity and human's movements on the floor of the room. Therefore, scout's communication had less effective to direct the movement of the recruited workers to the food

source. Thus the foraging was at random and almost each and all the sugar cubes were carried to the nest by the 4-6 P. roberti individuals as a result of coincidence of assemblage at the food source in course of random food searching.

Table 2
Second spell food carrying by the ants P. *roberti*

Time (in minute) of second spell food carrying after the first spell	Number of Cases
1	3
2	7
3	6
4	35
5	46
6	33
7	8
8	15
9	13
10	8
11	5
12	6
13	1
14	6
15	3
17	4
19	2
20	2
21	2
22	1
23	1
24	1
25	1
26	1
27	1
29	2
32	1
33	2
34	1
39	1
40	1
87	1
1035	1
1055	1

The present findings thus, indicate that the ants (P. roberti) forage regularly at random and collect the heavier food particles from the source, even from the known source, depending upon their coincidence of aggregation at the food source independently, without communication and / or establishment of chemical induced path as involved with the food collection from the voluminous food source (Pasteels et al., 1987; Beckerr et al, 1990; 1992a; Mailleux et al. , 2000; Roulston and Silverman, 2002). But in this context it is to be mentioned here that searching ants moved in a manner consistent with a correlated random walk as has been pointed out by Crist and MacMahon, (1991) in case of harvester ant, Pogonomyrmex occidentalis. Therefore, the time needed to reach at the food source, the length of time the sugar cubes were left unattained at the certain sites, the number of spells required to collect the supplied sugar cubes and the time gaps noted between the first and second spells, second and third spells, and third and fourth spells are nothing but reflection of random foraging behaviour of P. roberti. Since common behaviour of ants could not be altered in captivity (Karmakar et al., 2012) and the present observations though have been made on the supplied foods at certain sites P. roberti would exhibit similar behaviour in collecting foods from the natural but limited source of food if their foraging area is interfered by humans of and on. Therefore, it is concluded that the ants P . roberti are apt to locate and collect food from any sites on way of random foraging. However, the probability of locating food resources varies with the sites and thereby utilization of available foods in the foraging area sometimes, a time consuming process.

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