

Foraging Interactions between the Reddish Brown Ants *Pheidole Roberti* and the Black Ants *Paratrechina Longicornis*

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Abstract: *The reddish brown ants Pheidole roberti* Forel and the black ants *Paratrechina longicornis* (Latreille) forage in the same area in Garia, Kolkata, West Bengal, India. The food habit is almost same in both the ant species. Therefore, to study the foraging interactions between these two species we offered sugar cubes to these insects at different locations in their foraging area, in the premises of a domestic house. It is revealed that *Paratrechina longicornis* is much aggressive and furious than *Pheidole roberti*. In course of competition *Paratrechina longicornis* attacked and killed some *Pheidole roberti* foragers to procure the supplied sugar cubes from the sites. It is noted that ,of the 900 supplied sugar cubes *Paratrechina longicornis* procured 769 (85.44 %) while *Pheidole roberti* was somehow able to manage 131(14.56 %) of course, at the cost of injury and life of some foragers. Perhaps to avoid such risk *Pheidole roberti* have developed individual foraging strategy in a more befitting manner.

Keywords: *Ants, Pheidole roberti, Paratrechina longicornis, foraging interaction*

1. INTRODUCTION

Ants' foraging and behaviour of forager ants have drawn the attention of various workers (Carroll and Janzen, 1973; Markin *et al.*,1975; Wehner *et al.*,1983; Goss *et al.*, 1989; Traniello, 1989; Nelson *et al.*, 1991; Beckers *et al.*, 1993; de Biseau and Pasteels, 1994; Orr *et al.*, 1997; Holway, 1999; Mailleux *et al.*, 2000; Portha *et al.*, 2002; Sengupta *et al.*, 2010; Prabhakar *et al.*,2012; Loreto *et al.*, 2013; Hashimoto and Yamane, 2014; Westermann *et al.*, 2014; Li *et al.*,2014; Naskar and Raut, 2014 a, b, c, 2015). It is obvious that more than one ant species use the same foraging area to maintain the nutritional status of their colony. Therefore, competition for the collection of food is mandatory. It is really intriguing to know the actual strategy developed by the competing species to procure food from the source in presence of rival group.

In course of studies of foraging behaviour in the reddish brown ants *Pheidole roberti* Forel we had to discard a number of trial due to interference of the black ants *Pratrechina longicornis* (Latreille,1802) off and on (Naskar and Raut, 2014 a, b, c,2015). Therefore we became interested to study the foraging interactions between these two ant species occurring in and around Garia, Kolkata, West Bengal, India. Accordingly, we offered sugar cubes at certain spots in the foraging area confined to the premises of a domestic house locating at Garia. Data, irrespective of trials have been collected in respect to first contact of the sugar cubes, fighting and or other kind of interactions between the foragers of two ant species and the number of sugar cubes procured by the foragers of each species, from the source. Since both the ant species depend on the same foraging area for their food resource information collected in the present study programme would enlighten the future workers regarding survival strategy developed by the competing ants furthermore.

2. MATERIALS AND METHODS

The reddish brown ants *Pheidole roberti* and the black or crazy ants *Paratrechina longicornis* are invariably found in close association in and around human dwelling houses and house premises at Garia, Kolkata (Naskar and Raut, 2014a, b, c). Accordingly, we selected the premises of a house where ants were seen to forage almost regularly. Ignoring the nest-locations of the foraging ants we selected food-offering spots at random but the same spot was never

used for the second time. We offered sugar cubes, 15-55 mg each, in the following specifications in twelve trials.

Trial I: 20 sugar cubes were deposited at the site at 06 : 40 h

Trial II: 30 sugar cubes were deposited at the site at 07: 40 h

Trial III: 40 sugar cubes were deposited at the site at 11:08 h

Trial IV : 50 sugar cubes were deposited at the site at 11: 40 h

Trial V: 60 sugar cubes were deposited at the site at 09:00 h

Trial VI : 70 sugar cubes were deposited at the site at 08 :36 h

Trial VII: 80 sugar cubes were deposited at the site at 09:05 h

Trial VIII: 90 sugar cubes were deposited at the site at 08:00 h

Trial IX: 100 sugar cubes were deposited at the site at 07:55 h

Trial X: 110 sugar cubes were deposited at the site at 07:58 h

Trial XI: 120 sugar cubes were deposited at the site at 07:47 h

Trial XII: 130 sugar cubes were deposited at the site at 08:05 h

All the trials were performed on sunny days during 2010. In each trial due attention was paid to note the time of first contact of the ants with the sugar cubes, and the subsequent events in respect to procurement of the sugar cubes from the offered site to the nest.

3. RESULTS

The ants *Pheidole roberti* and *Paratrechina longicornis* exhibited different kinds of behaviour in different trials as could be revealed from the following descriptions.

Trial I: After 7 minute's i.e. at 06:47 h two medium sized *Pheidole roberti* were seen to come in contact with the sugar cubes. Each ant started checking a sugar cube individually. Immediately, one of them moved to another sugar cube to verify the same. After that it moved away in a zigzag manner. At 06:50 h another medium sized *Pheidole roberti* appeared at the site and tasted a sugar cube. At 07:04 h it checked another two sugar cubes rapidly and moved a little bit in a diamond shaped pathway. Thereafter, it came back to the site again. At 07:08h one *Pheidole roberti* was seen to carry away a sugar cube. All on a sudden, another *Pheidole roberti* forager was seen to come forward to help the partner in the food-carrying process. Both the ants carried away the said sugar cube. At 07:13 h a lot of medium sized *Pheidole roberti* and many *Paratrechina longicornis* were assembled in close contact of the sugar cubes. They started fighting. *Paratrechina longicornis* were much aggressive. In the mean time (at 07:15 h) three *Pheidole roberti* individuals took the liberty to check a sugar cube. At 07:23 h one sugar cube was taken away by a *Pheidole roberti*. At 07:24 h the site was completely free from *Pheidole roberti*. At 07:25 h the ants *Paratrechina longicornis* were seen engaged in licking the sugar cubes, in group, 2-5 individuals encircling a sugar cube. At 08:30h the number of aggregated *Paratrechina longicornis* increased to 10-12 per sugar cube. At 09:45 h eight *Paratrechina longicornis* were seen to carry away a big sugar cube jointly. Of the eight, four were pushing and the other four were pulling the sugar cube. Another sugar cube was taken away by the said ant species at 09:48 h. In the mean time many more *Paratrechina longicornis* appeared at the site and all the sugar cubes, each one by at least two individuals, were carried to the nest within 10:44 h. In each case one ant was pushing and the other one was pulling the sugar cube. Of the 20 sugar cubes 17 were carried by *Paratrechina longicornis* and 3 were procured by *Pheidole roberti* (Fig.1).

Trial II : A medium sized *Pheidole roberti* appeared at the site after 3 minutes (at 07:43 h) of supply of sugar cubes. It checked four sugar cubes and picked up one big sugar cube to pull the same towards the nest. At 07:46 h another *Pheidole roberti* forager joined with the said food-carrying ant individual, perhaps to make the carrying process easier. At 07:50 h another sugar cube was taken away by *Pheidole roberti*. Surprisingly, at 07:57 h a row of *Paratrechina longicornis* became pronounced. Then and then six sugar cubes were taken away by eighteen

Paratrechina longicornis. Each sugar cube was pushing by two ants and pulling by one ant. Suddenly, a big sized *Pheidole roberti* appeared at the site. Also, simultaneously (at 08:00 h) many *Paratrechina longicornis* assembled encircling the sugar cubes. At 08:02 h five sugar cubes, each one being carried by two ant individuals, were taken to home by *Paratrechina longicornis*. Again, at 08:04 h two larger *Pheidole roberti* along with some small sized foragers reached at the vicinity of sugar cube supplied site. Just in the next minute (at 08:05 h) a row of *Paratrechina longicornis* was seen to establish a connection with the sugar cube supplied site. There was no fight between the members of two ant species. The sugar cubes were captured by the black ants and all the sugar cubes were procured by *Paratrechina longicornis* within eight minutes. The carrying act was almost same, one in pushing act and other one in pulling act. Thus, of the 30 sugar cubes 2 were procured by *Pheidole roberti* and 28 were collected by *Paratrechina longicornis* (Fig. 1).

Trial III: After 3 minutes (at 23:11 h) a medium sized *Pheidole roberti* came in contact of the supplied sugar cubes. Quickly it checked six sugar cubes. Within next 3 minutes ten more *Pheidole roberti* foragers assembled at the site. Two sugar cubes were taken away by five *Pheidole roberti* foragers. In one instance the sugar cube was pushing by two ants and pulling by one ant while in other instance one was pushing and the other one was pulling. Another forager of the said species appeared at 23:33 h and took away a sugar cube. Also another *Pheidole roberti* forager was seen to procure a sugar cube at 23:45 h from the supplied site. At 23:47 h a *Paratrechina longicornis* forager came across the sugar cubes. It checked seven sugar cubes quickly. Then it gone away. At 23:52 h many black ants *Paratrechina longicornis* arrived at the site. They checked the sugar cubes and carried all the sugar cubes (Fig. 1) through pushing and pulling mechanism within next 19 minutes i.e. from 23:56 h to 24:15 h.

Trial IV: Of the 50 sugar cubes supplied at the site one was taken away by a *Pheidole roberti* forager after 2 minutes i.e. at 11:42 h. At 11:47 h 17 black ants *Paratrechina longicornis* reached at the site and examined the sugar cubes. Immediately one sugar cube was taken away by a black ant forager. Suddenly a few forager of *Pheidole roberti* foragers took their position at the site at 11:51h. Within three minutes black ants attacked the reddish brown ants and fighting was continued for 27 minutes. *Paratrechina longicornis* were furiously aggressive and were effectively killing and/or injuring the *Pheidole roberti* through a strong bite at the thorax region of the rival. Thereby, the red ants scurried away. At 12:18 h one red ant came at the site and tried to pull a sugar cube. Instantly, one black ant intercepted the red ant. The ant *Pheidole roberti* left that sugar cube but hurriedly took another one and moved away. At 12:19 h four sugar cubes were carried away by four *Paratrechina longicornis*. Thereafter, at 12:22 h 22 black ants appeared at the site. They were seen to check the sugar cubes. Then, they were seen to carry the sugar cubes lot by lot, i. e. 6, 5, 2 and 4. A group of 32 *Paratrechina longicornis* appeared at the site at 12:33 h. Following examinations of the sugar cubes they took away 2, 6, 3, 5, 6 and 4 sugar cubes successively through pulling and pushing mechanisms. The number of sugar cubes procured by each ant species could be visualized from Fig.1.

Trial V : Following deposition of 60 sugar cubes at the site at 09:00 h a *Pheidole roberti* forager took away a sugar cube instantly. Thereafter, within 09:34 h three *Pheidole roberti* came to the site individually and took away three sugar cubes. At 09:35 h four *Paratrechina longicornis* and one *Pheidole roberti* were busy in examining the sugar cubes. A black ant arrived at the site at 09:40 h and took away a sugar cube. These four black ants procured three sugar cubes at 09:48 h. Another sugar cube was taken away by a reddish brown ant at 09:54 h. Since then *Pheidole roberti* foragers were seen to come to the site at different numbers and took away the sugar cubes in several spells. At 10:58 h the site was free from the supplied sugar cubes. Thus, *Pheidole roberti* procured 56 sugar cubes from the supplied source. (Fig.1).

Trial VI: At the time of supply of sugar cubes one *Pheidole roberti* took away a sugar cube then and then. After six minutes another *Pheidole roberti* forager appeared at the site, checked the sugar cubes and then left the spot. At 08:53 h seven *Paratrechina longicornis* forager came in contact of the sugar cubes. One of them returned to the nest. At 09:00 h a lot of *Paratrechina longicornis* foragers invaded the spot in a row. At 09:05 h and onwards these black ants were seen

to carry the sugar cubes in several spells, 1-8 cubes in each spell. The site was free from supplied sugar cubes at 09:34 h. All the sugar cubes were collected by *Paratrechina longicornis* (Fig.1).

Trial VII: A *Paratrechina longicornis* forager came in contact of the sugar cubes at 09:06 h. It checked a number of sugar cubes and moved away. Within next 5 minutes seven *Paratrechina longicornis* were seen to examine the sugar cubes. At 09:16 h there assembled 14 black ants. In the mean time, a *Pheidole roberti* was moving away with a sugar cube. But instantly a *Paratrechina longicornis* rushed to her and started fighting with the said *Pheidole roberti*. After a minute each one moved in a different direction. The said red ant then picked up the sugar cube crawled towards the nest. The said black ant left the site hurriedly biting a sugar cube by 09:34 h. A *Pheidole roberti* forager was checking a sugar cube which was taken to the nest by 10:55 h. At 11:00 h a good number of *Paratrechina longicornis* were seen to examine the sugar cubes. They started to carry the sugar cubes by 11:03 h lot by lot up to 11:37 h to exhaust the sugar cubes. The red ants carried the sugar cubes mostly in pushing act and the number of sugar cubes carried in each occasion was ranged from 4 – 8. In fact, *Pheidole roberti* was able to procure only 2 sugar cubes out of 80 supplied at the site (Fig.1).

Trial VIII: At 08:02 h a *Paratrechina longicornis* appeared at the site and checked three sugar cubes. It moved towards the nest. On way to nest it came across with seven foragers perhaps of its own nest. At 08:05 h a row of *Paratrechina longicornis* reached at the site. Many of them were seen to examine the sugar cubes. Suddenly, a lot of *Pheidole roberti* appeared at the site and fighting with *Paratrechina longicornis* was initiated at 08:12 h. While some black ants were engaged in fighting others were seen to carry thirteen sugar cubes to the nest. Thereafter, all the remaining sugar cubes were carried to the nest by the *Paratrechina longicornis* in several spells, 2 to 13 cubes in each spell within 09:38 h. The carrying mechanism was effected mostly by pushing mechanism. Practically *Pheidole roberti* failed to procure a single sugar cube from the offered site (Fig.1).

Trial IX: A *Pheidole roberti* appeared at the site just after one minute and examined few sugar cubes. After 25 minutes another three *Pheidole roberti* foragers joined with the earlier one to examine the sugar cubes. At 08:22 h two *Paratrechina longicornis* foragers were seen to taste the sugar cubes. By the next minute another black ant joined with them. The sugar cubes were almost captured by innumerable *Paratrechina longicornis* within 08:45 h. However, by the next three minutes four sugar cubes were taken away by *Pheidole roberti*. At 08:49 h a row of black ants touched the sugar cube supplied site. Thereafter, they were seen to carry the sugar cubes in eleven spells, having 4 - 17 sugar cubes in each spell. The first spell was initiated at 08:50 h while the last spell was effected at 09:13 h. Thus, a total of 96 sugar cubes were procured by *Paratrechina longicornis* from the supplied source (Fig.1).

Trial X: Just after one minute two *Paratrechina longicornis* foragers appeared at the sugar cube supplied spot. While they were examining the sugar cubes many more ants of the said species were seen approaching the site. They carried 45 sugar cubes within 09:05 h, in several spells. At 09:06 h a few *Pheidole roberti* foragers appeared at the site. They checked the sugar cubes and left the spot. At 09:08 h 6 sugar cubes, at 09:10 h 3 sugar cubes and at 09:12 h 2 sugar cubes were procured by the *Paratrechina longicornis* foragers. Suddenly a good number of *Pheidole roberti* were seen marching towards the sugar cube supplied spot in a row. Within next few minutes few more *Pheidole roberti* assembled at the site. They were tasting the sugar cubes and some of them were seen to carry sugar cubes to the nest. This act was continued for a long time and the site became free from the supplied sugar cubes by 18:00 h. Both the ant species procured a considerable number of sugar cubes from the supplied site (Fig.1).

Trial XI: At 08:03 h a *Paratrechina longicornis* came across the supplied sugar cubes. At 08:06 h a *Pheidole roberti* forager also appeared at the site. They were checking the sugar cubes. By 08:22 h many black ants assembled at the site and examined the sugar cubes. The said *Pheidole roberti* forager left the site at 08:23 h. At 08:24 h six sugar cubes and at 08:26 h eight sugar cubes were taken away by *Paratrechina longicornis*. Thereafter at 08:28 h many more *Paratrechina longicornis* were seen encircling the sugar cubes. They carried the sugar cubes in eleven spells, having 3-17 sugar cubes in each spell. Almost in all cases one sugar cube was carried by one ant by pushing the same towards the destination. Thus, *Paratrechina longicornis* procured all the sugar cubes from the site (Fig.1).

Trial XII: A *Pheidole roberti* forager appeared at the site within a minute of deposition of sugar cubes at the site. Another *Pheidole roberti* forager reached at the spot just after five minutes (at 08:10 h) following deposition of sugar cubes. By 08:12 h 33 *Pheidole roberti* assembled at the site. They examined the sugar cubes. At 08:15 h one sugar cube and at 08:16 h three sugar cubes were taken away by the ants. In most cases one was pulling and the other was pushing the sugar cube. At 08:23 h one *Paratrechina longicornis* forager came across the sugar cubes. By the next minute many foragers of the said ant species were seen to reach at the site in a row. Within a minute the sugar cubes were captured by these black ants. Fighting started and one *Pheidole* forager was attacked by a *Paratrechina* forager. *Pheidole* forager was seriously injured. Another *Pheidole* forager was seen to carry the injured one to the nest. Fighting continued for 13 minutes (from 08:26 - 08:39 h) and finally *Pheidole roberti* failed to stay at the sugar-cubes supplied site. *Paratrechina longicornis* foragers thereafter, carried the sugar cubes to the nest in eleven spells, within 09:26 h. At 09:27 h many more *Paratrechina longicornis* arrived at the site and the remaining sugar cubes were taken to the nest within 11:17 h (Fig.1).

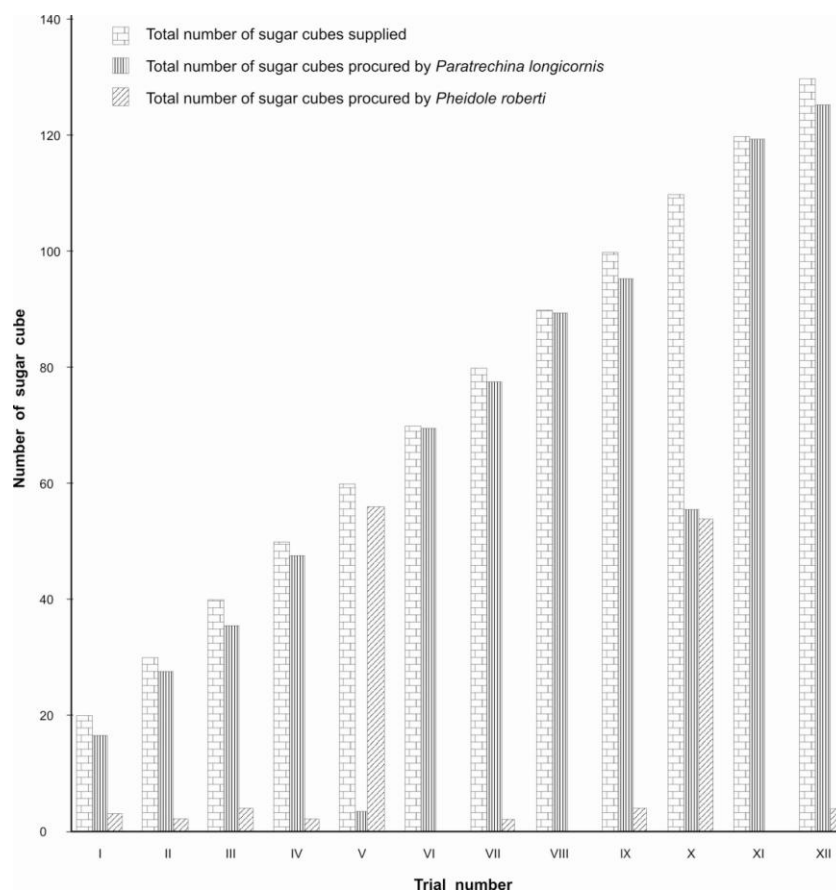


Fig1. A comparative account of sugar-cube procurement by the ants *Pheidole roberti* and *Paratrechina longicornis* from the supplied food source in the foraging area.

4. DISCUSSION AND CONCLUSION

From the results of twelve experimental trials it is well evident that the ants *Pheidole roberti* and *Paratrechina longicornis* are habituated to forage almost throughout the period of 24 hours of a day. Because, irrespective of trials they came in contact of the supplied sugar cubes within a few minutes. But, in most cases foragers of *Pheidole roberti* touched the offered sugar cubes first. This indicates that the foragers of *Pheidole roberti* are more common irrespective of spots in the foraging ground than those of *Paratrechina longicornis*. A detailed analysis on the contact time with the offered food by *Pheidole roberti* have already been made by Naskar and Raut (2014a). In the present trials almost in all cases *Pheidole roberti* tried to carry the sugar cubes at the very first contact while *Paratrechina longicornis* have developed the strategy of communication to the nest-mates, following estimation of the amount of the food available at the site. Thus, they ensure scout recruitment to achieve foraging success. However, foraging success in *Paratrechina longicornis* is, in most cases effective only after a battle with the *Pheidole roberti* foragers.

Chasing, physical attack and injury on way of biting by *Paratrechina longicornis* to the foragers of *Pheidole roberti* are proved effective to drive away these competitors and to achieve the foraging success. As fighting and collection of the food are very much involved with the amount of food to be procured by the ants *Paratrechina longicornis* it is mandatory, at the first contact with the food, to estimate the volume of the food occurring at the site. This is very much related with the cost-benefit effect of foraging. This is why in most cases *Paratrechina longicornis*, after coming in contact of the sugar cubes moved from one sugar cube to the other. It is evident that, like *Lasius niger* (Mailleux et al. 2000) *Paratrechina longicornis* is able to estimate the food volume. However, ants are cautious regarding energy budget. Because, *Paratrechina longicornis* foragers considered it fit to recruit the scouts only when the number of supplied sugar cubes was more. This could be justified from the fact of collection of sugar cubes by them in cases of first two trials. It is also clear that *Paratrechina longicornis* are strategically decisive regarding foraging. That is, if they have taken the decision to procure food from a source then they would left no option to achieve success. This is justified from the fact of engagement of some foragers in fighting with the competitors while others remained busy to carry the sugar cubes to the nest.

As in the present study *Pheidole roberti* failed to procure more than 14.56% (131 out of 900) sugar cubes from twelve different trials it is apparent that foraging success of these ants at least amongst the foragers of *Paratrechina longicornis* depends largely on the chance. This could be explained clearly from the number of sugar cubes collected by them in each trial. That is, of the twelve trials, *Pheidole roberti* failed to collect a single sugar cube in three trials (VI, VIII, IX) while they were somehow able to collect 2, 2, 2, 3, 4, 4 and 4 sugar cubes in trials II, IV, VII, I, III, IX, and XII respectively. Surprisingly, in trials V and X *Pheidole roberti* succeeded in procuring 56 (out of 60) and 54 (out of 110) sugar cubes respectively from the site. This indicates that *Pheidole roberti* foragers have developed the strategy of foraging all along, everywhere and to collect the food whatever be the amount, at the first moment prior to development of any kind of confrontation with the rival group. In cases when any food source is beyond the knowledge of the competitors or competitors are reluctant to collect such kind of food much more in respect to need of other kinds of food for the colony (Portha et al. , 2002 ; Sengupta et al. 2010) *Pheidole roberti* would enjoy the benefit of foraging success under such circumstances. Perhaps, to avoid such competition *Pheidole roberti* have developed individual foraging strategy in a more effective way than the group foraging.

The crazy ants *Paratrechina longicornis* are aggressive in nature. They are habituated to fight with competing ants *Pheidole roberti* in course of foraging with a view to collect all the foods from the source. Under competitive situation availability of food for *Pheidole roberti* depends on the reluctance of *Paratrechina longicornis* for having such foods.

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