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# WINTER QUARTER-INDUCED FORAGING IN ANTS

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**ABSTRACT**
Sugar cubes were offered to the ants in their natural foraging ground on the eve of winter season at Garia, Kolkata, West Bengal, India to note the foraging behaviour of the ants occurring at the said area. It is revealed that, from the five food-offered sites the ants *Paratrechina longicornis* procured all the 200 (100%) sugar cubes from the site I and *Anoplolepis gracilipes* procured all the 200 sugar cubes offered at the sites III and IV. Of the 200 sugar cubes offered at the site II , 191 (95.5%) were procured by *A. gracilipes* while only 9 (4.5%) sugar cubes were collected by *P. longicornis* only in one occasion. Likewise, at site V only in one trial all the 10 sugar cubes were procured by *A. gracilipes* though in the remaining19 trials all the sugar cubes were procured by *P. longicornis*. The ants took on average 143.25 ± 12.29 SE, 71.53 ± 5.25 SE, 58.3 ± 6.67 SE, 49.65 ± 7.26 SE and 100.16 ± 9.82 SE minutes to collect all the 10 sugar cubes from the sites I, II, III, IV and V respectively following supply of the same at the experimental spots on the eve of winter season when the atmospheric temperature was ranged from 21.2°C (minimum) to 34.4°C (maximum) and the relative humidity was ranged from 30% (minimum) to 97% (maximum).

**KEYWORDS:** Ants, foraging, winter-quarter.

## INTRODUCTION

Activities in ants are governed by a number of factors *viz*. light (Creighton 1953; Narendra *et al*., 2010 ), temperature (Briese and Macauley, 1980; Marsh 1985a,b; Porter and Tschinkel, 1987; Fellers, 1989; Heatwole and Harrington 1989; Hölldobler and Wilson 1990; Heatwole and Muri 1991; Cerada *et al*., 1998; Ruano *et al*., 2000; Cerada 2001; Pol and de Casenave 2004; Angilletta *et al*., 2010; Jayatilaka *et al*., 2011) seasons and specific time of the day (Lynch *et al*., 1980; Kotler *et al*., 2002; Kronfeld-Schor and Dayan, 2003 ). In winter ants are habituated to spend the adverse climatic conditions inside the winter-quarter (Stevenson 1985; Tschinkel 1987; Bestelmeyer 2000; Herbers and Johnson 2007). In tropical countries because of unpredictable changes in weather conditions especially with the rise of temperature, occasionally, the ants were seen to come out of their winter quarters with a view to collect food from the near about foraging grounds. It is obvious that the ants store required amount food to meet up the need of the colony members while their outing activities are ceased because of cold weather. Since they are able to sense the "approaching winter" conditions they do no mistake to reorient their behavioural activities accordingly. Thus we were stimulated in respect to our earlier findings (Naskar and Raut 2014a,b,c, 2015a, b,c, d,e,f,g) to note the changes if any, in the foraging behaviour of the ants occurring in Garia, Kolkata, West Bengal, India in view of selection of winter quarter. The experiments were carried out in the natural foraging ground of the ants and the results obtained warrant publication to enrich our knowledge on the ant's foraging behaviour furthermore.

## MATERIALS & METHODS

Usually Kolkata and its suburbs experience winter during mid-November to mid-January. During the said period atmospheric temperature reduces to a considerable degree. The maximum temperature during summer is as high as 40°C while the minimum in many occasions never comes down to 25°C. In contrast, during winter in most of the days maximum temperature hardly exceeds 30°C while the minimum temperature in several cases falls down to 10°C. Also, the relative humidity during winter remains very low, ranging between 25% (minimum) and 65% (maximum) during the period of 24 hours of a day. But, with the advent of winter atmospheric temperature declines gradually and the weather gradually becomes dry due to declining percentage of relative humidity day by day. Anticipating, as per earlier records, that the winter in Garia, Kolkata will be effective on and from mid-November we started our experiments on 18 October and continued up to 6 November 2015. We selected five sites *viz*- Site I: the floor of a domestic room in the ground floor, Site II: the south balcony of the said room, Site III: the garden adjacent to the house, Site IV: the portion of the roof of the house below the water tank, and Site V: the top of the pillar locating at the north-east corner of the roof of the house. Thus, we maintained sufficient distance from one experimental site to the other. At each of these five sites 10 sugar cubes (each 15-25 mg in weight) were offered on the ground between 07:33 h and 09:55 h daily, during the period of 20 days consecutively. Almost in all the mornings the weather was little bit chill. Due attention was paid to note the ant species involved in procuring the supplied sugar cubes. Also, data on the time required to collect all the 10 sugar cubes by the ants from each and all the sites in all the trials have been noted regularly. Data

regarding atmospheric temperature and relative humidity as recorded by the meteorological station, Government of India, Alipur, Kolkata have been taken into account to ascertain the impact of weather conditions on the foraging activity of the ants. One-way analysis of variance (ANOVA ) was applied (Campbell, 1989 ) to ascertain the effect of sites if any, on the foraging behaviour of the ant species under study.

**RESULTS**

Of the supplied 1000 sugar cubes 591 were procured by *Anoplolepis gracilipes* and 409 were collected by *Paratrechina longicornis* ants. However, the percentages of sugar cubes procured by ants from each of these five sites (I-V) varied to a considerable degree in respect to the ant species concerned (Fig.1). The ants collected the sugar cubes within 44-285 ( mean 143.25 ± 12.29 SE) minutes from site I ( Fig. 2a) ; within 29-115 ( mean 71.53 ± 5.25 SE) minutes from site II ( Fig. 2b) ; within 32-160 ( mean 58.3 ± 6.67 SE ) minutes from site III ( Fig. 2c) ; within 14-145 (mean 49.65 ± 7.26 SE) minutes from site IV (Fig. 2d); and within 60-252 ( mean 100.16 ± 9.82 SE ) minutes from site V ( Fig. 2e) ; During the study period atmospheric temperature was ranged from 28°C-34°C (absolute maximum) and 21.2°C- 26.5°C (absolute minimum), and relative humidity was ranged from 88-97% (maximum) and 30-75% (minimum) (Fig.3). Results of ANOVA tests clearly indicate that the foraging efficiency of the ants varied significantly with the sites ( $F = 2.86$, $df = 2$ , $p < 0.01$ for *A. gracilipes* ) ($F = 17.19$, $df = 1$, $p < 0.01$ for *P. longicornis* ) ( Tables 1 and 2 ).

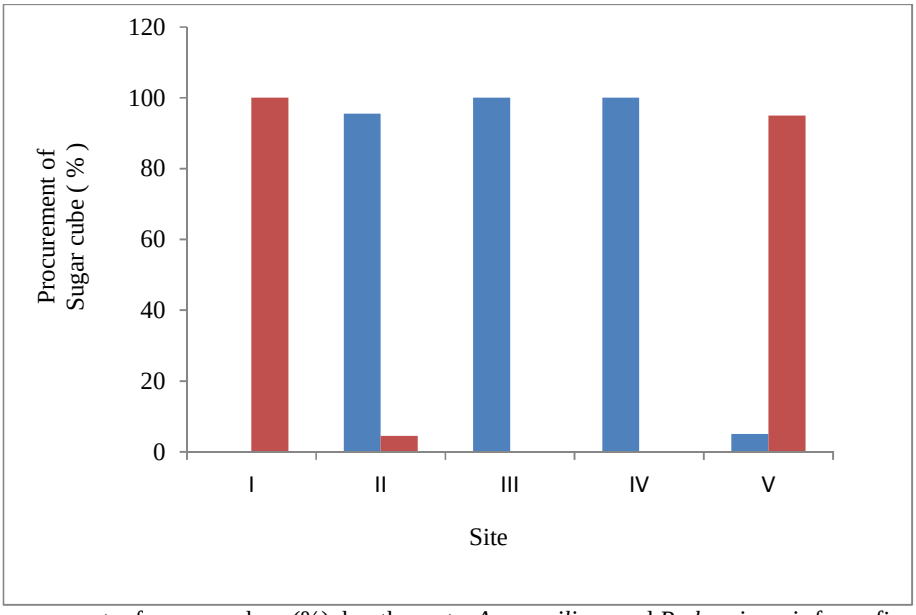


**Fig. 1.** Procurement of sugar cubes (%) by the ants *A. gracilipes* and *P. longicornis* from five different experimental sites

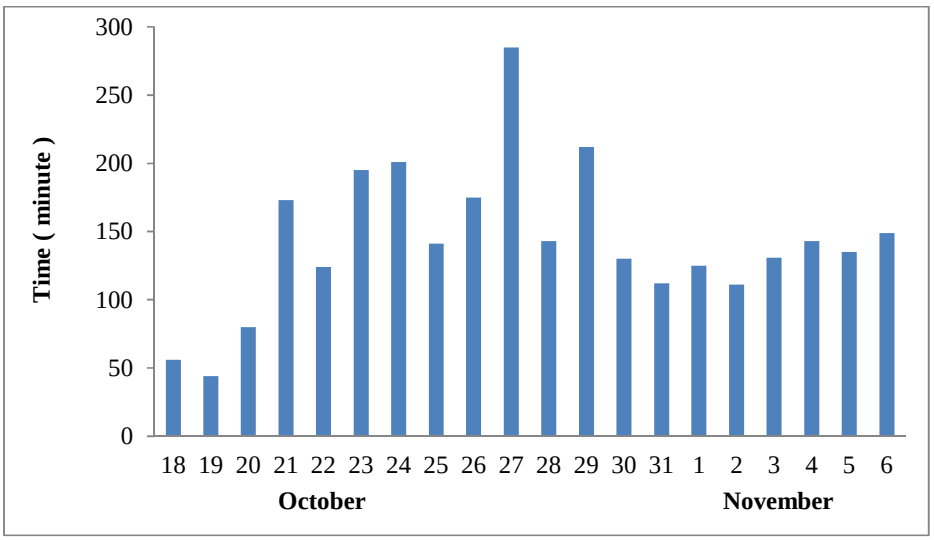


**Fig.** 2a. Time (mean) taken by the ants to procure the supplied 10 sugar cubes from the site I.

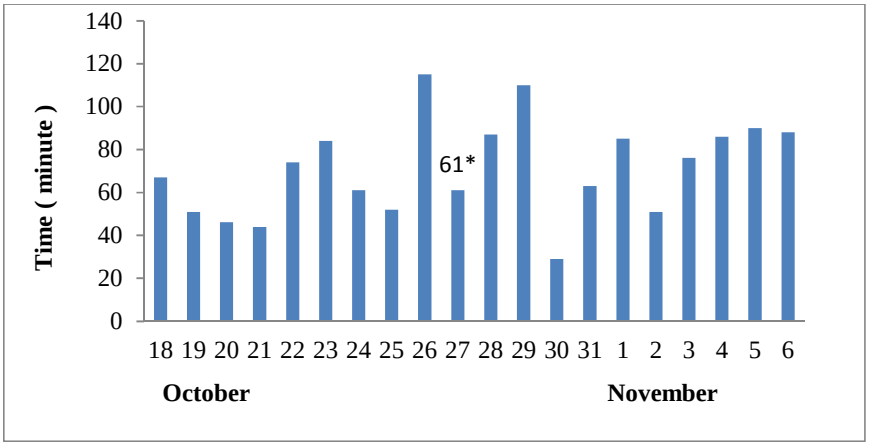


**Fig.** 2b. Time (mean) taken by the ants to procure the supplied 10 sugar cubes from the site II. (*Total 61 minutes required; *P. longicornis* carried 9 sugar cubes in 58 minutes and *A. gracilipes* carried 1 sugar cube in 3 minutes)

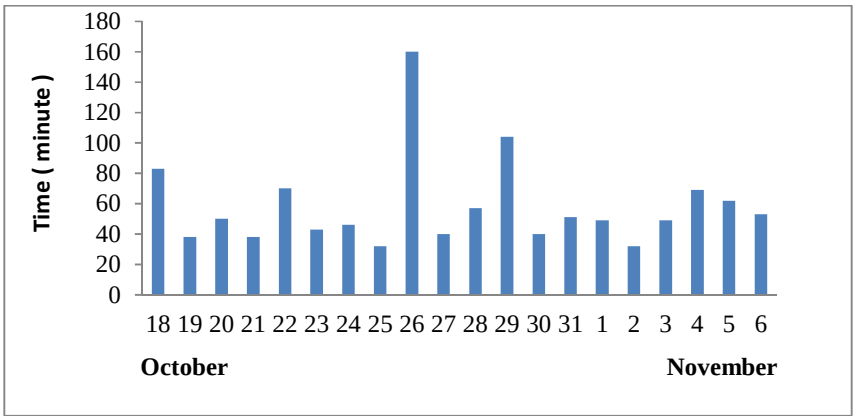


**Fig.** 2c. Time (mean) taken by the ants to procure the supplied 10 sugar cubes from the site III.

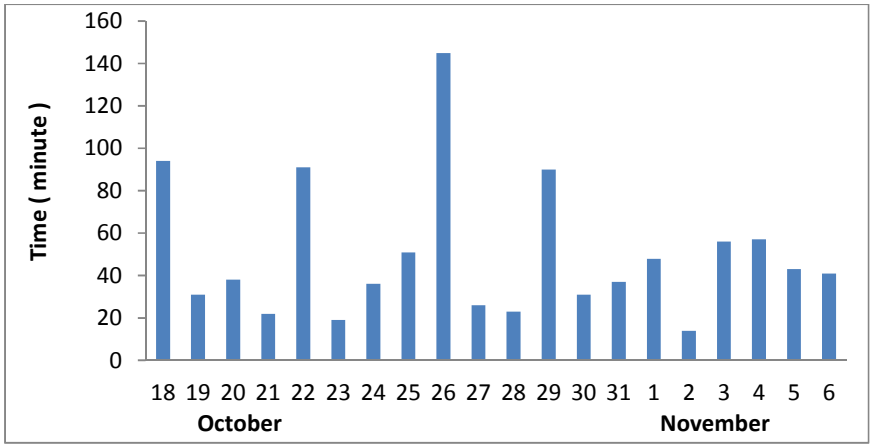


**Fig.** 2d. Time ( mean ) taken by the ants to procure the supplied 10 sugar cubes from the site IV.

**TABLE 1**. Results of ANOVA tests justifying the effect of sites on the foraging activity of the ants *A. gracilipes*

| Source of variation | Sum of Squares (ss) | Degree of Freedom (df ) | Mean squares (MS) | Variance ratio ( F ) |
|---|---|---|---|---|
| Between foods | 4716.31 | 2 | 2358.155 | 2.85 |
| Residual | 46371.49 | 56 | 828.06 | |
| Total | 51087.8 | 58 | | |

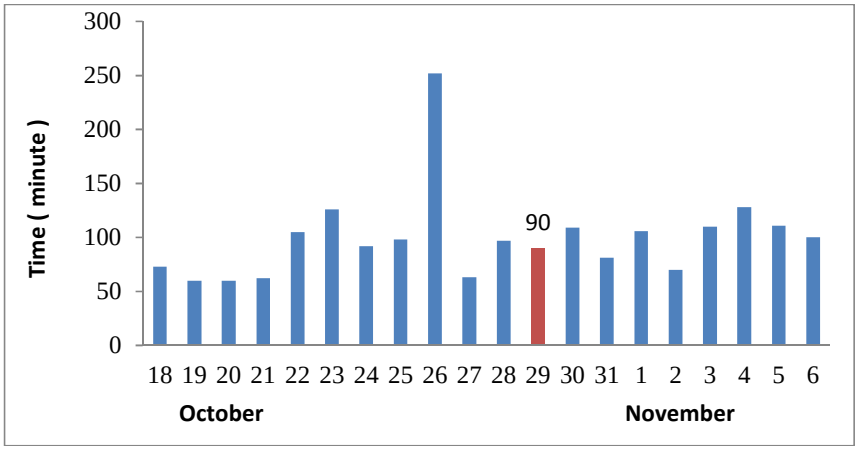


**Fig.** 2e. Time (mean) taken by the ants to procure the supplied 10 sugar cubes from the site V.

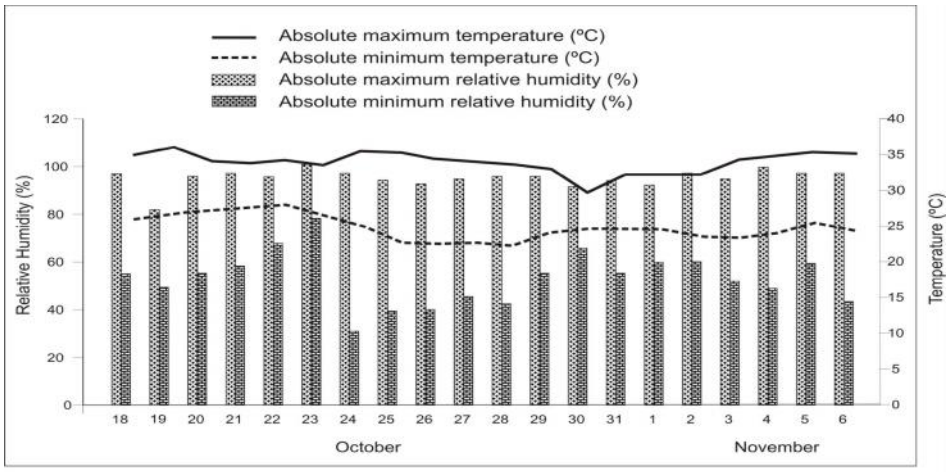


Figure 3. Ranges of atmospheric temperature (°C) and relative humidity during the study period 18 October – 6 November 2015 at Garia, Kolkata, West Bengal, India.

**TABLE 2.** Results of ANOVA tests justifying the effect of sites on the foraging activity of the ants *P. longicornis*

| Source of variation | Sum of squares ( ss ) | Degree of Freedom (df ) | Mean squares (MS) | Variance ratio ( F ) |
|---|---|---|---|---|
| Between foods | 18093.16 | 1 | 18093.16 | 17.19 |
| Residual | 38947.28 | 37 | 1052.63 | |
| Total | 57040.44 | 38 | | |

## DISCUSSION

From the results it is evident that foraging in ants, just prior to onset of winter, is completely different in respect to foraging behaviour they exhibit in other seasons in Garia, Kolkata (Naskar and Raut 2014a, b, 2015a, b). It is on record that, in other seasons, in most cases, more than one ant species were seen to collect food from the same source through competition even on way of fighting (Naskar and Raut 2014c, 2015a,b). But the results of present investigation clearly indicate that the foraging is confined to a single species from a food source. Almost there exists no competition for collection of food *i.e.* sugar cubes by the members of different ant species except the lone incident of procurement of 4.5% sugar cubes by *P. longicornis* from site II and 5% sugar cubes by *A. gracilipes* from site V. This suggests that, during this period of the year, ants are habituated to forage in the vicinity of their shelter. They, most probably, select their winter-quarter at distant locations from each other in respect to the groups of the same ant species or of different species. Otherwise, how it was possible for one ant species to procure all the supplied sugar cubes regularly, for 20 days without interference by the members belonging to other ant species ? This could be substantiated from the fact of availability of sugar cubes for a period of 4 hours 45 minutes in the foraging ground. This phenomenon could be explained from the fact of variations in acclimatization pattern of the individual ant concerned. Because, it is an established fact that the ants *Myrmecia crosslandi*, *Messor pergandei*, *Pogonomyrmex occidentalis*, *Ocymyrmix barbiger* are habituated to regulate their walking speed in respect to rise and fall of tolerable temperature ranges of the environment to perform above-ground activity (Creighton 1953; Taylor 1977; Marsh 1985a, Heatwole 1996; Jayatilaka *et al.* 2011). Therefore, it is granted that foraging in ants centering the winter-quarter is effective within a close circle and thus, the probability of interference in foraging

act by other ant species is practically absent. However, each ant species is opportunistic and is apt to forage amidst the fluctuating pre-winter weather conditions so as to enable them to procure food if occurring close to their shelter, to ensure their food-reserve for winter months. Customarily, ants are habituated to inform the colony members regarding food sources as and when they come across the same in their foraging ground ( Detrain *et al*., 1999; Camazine *et al*., 2001; Portha *et al*., 2002; Detrain and Deneubourg 2008; Jeanson *et al*., 2012; Arganda *et al*., 2014). Therefore, the colony members act promptly to carry the food matters to the nest. Our earlier observations indicate that, during summer the ants, irrespective of species are able to collect the offered 10 sugar cubes of almost same specifications as have been mentioned in the present study programme, within a short time after coming in contact with the supplied sugar cubes. Therefore, requirement of more time to collect the same number of sugar cubes from the foraging ground during pre-winter period seems to be the impact of weather conditions of the study period concerned. It is most likely that, under this sort of changing weather conditions only selective foragers or workers are recruited to procure the foods. Otherwise, there would have been the probability of contact with the sugar cubes by many more ant individuals much earlier. As ants fond of sugar cubes there exists no possibility to refuse the same by an ant individual after coming in contact of the same. Thus, it seems that, just prior to onset of winter only stronger hardy foragers are recruited for foraging. However, in this regard we cannot rule out the idea proposed by Prabhakar and co-workers (2012) that the foraging behaviour in ants is regulated in response to current food availability throughout the colony's foraging area. This indicates that the ants are cautious in executing foraging programme especially in respect to chilling sensation with the approach of winter. As the experimental sites were of varying nature and two ant species are involved in the studies the chilling sensation would be of different nature. At the same time foragers or workers would be of varying nature and number in respect to the sites. Therefore, variation in foraging activity in respect to the sites is inevitable as is justified from the results of ANOVA tests. In Garia, Kolkata during spring and summer atmospheric temperature usually remains very high (maximum up to 42°C and minimum 25°C). Also, the relative humidity prevails between 60% and 100% during the said period (Raut and Ghosh 1984). Therefore, fall of temperature to 21.2°C and the relative humidity to 30-75% would enable the ants to sense the change in weather condition to prepare themselves for spending winter months in winter quarter safely.

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