



The chronicle pertaining to the nests of the natural Arachnidicide *Sceliphron caementarium* (mud dauber) collected from four different districts of West Bengal, India

Nilanjana Chatterjee

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ABSTRACT: The mud dauber's (*Sceliphron caementarium*) nests collected from the four different districts of West Bengal were carefully studied to gather information about the wasp's survival strategy and prey capturing habit. Their larvae were found to feed upon some eleven different species of small, brightly coloured spiders belonging to six different families. The maximum variety of spiders was observed from the nests collected from Jalpaiguri district probably because of the availability of greater variety of host plants for the spiders. Thus, the introverted *Sceliphron caementarium* can be considered as a useful wasp for human, rather than damaging since, it acts as a biological pest controller by checking the otherwise harmful spider population from in and around our locality. The *S. caementarium* also prove to be economically beneficial as well as healthful by reducing the costs and harmful side effects respectively of the chemical pest controllers.

Keywords:- Districts, Orifice, Pupa, *Sceliphron caementarium*, Spider community, venomous sting.

I. INTRODUCTION

Few definite groups of sphecid and carbrionid wasps construct characteristic nests with unique architectural patterns to lay their eggs and nurture their larvae. These nests are built out of mud collected from nearby mud puddles and hence these wasps are popularly designated as the "mud daubers" or even the "dirt daubers". The female wasps build the nests by collecting mud and molding them into place with the help of their mandibles and long prothoracic legs. There are three different types of mud daubers, the organ pipe mud dauber (*Trypoxylon politum*), the black and yellow mud dauber (*Sceliphron caementarium*) and the blue mud dauber or "dirt dauber" (*Chalybion californicum*). The male as well as the female mud daubers are known to feed on nectar collected from a wide variety of flowers and like most of the wasps they prey on other arthropods (spiders) too. The females play dual role by building their nests and foraging for the spiders to feed their growing larvae inside the nests. The mud daubers though possess the stinging apparatus are quite friendly as well as harmless until and unless they are disturbed or poked. Interestingly, the female wasps use their venomous sting to desensitize and paralyze the collected spiders so that they can be easily transported and stored without festering inside the nest cell until consumed by the larva

In this present investigation an attempt have been made to study the different types of spiders collected by the black and yellow mud dauber, *Sceliphron caementarium* (potter wasp), to feed its larvae collected from diverse localities of West Bengal, India. This study has not been conducted on a seasonal basis, so it is most likely that the number and diversity of the collected spiders will vary with respect to parameters like the month and vicinity of the collection site rather than the geographical location of the districts alone. Very few reports [1, 2] are available stating the variety of spiders found inside the mud dauber's nests. Though *S. caementarium* is a common insect noticed in different parts of West Bengal, as far as my knowledge is concerned it is going to be the first attempt to record the various spider communities likely to be found inside the mud daubers nests collected from this part of east India. This study of the mud daubers nest will also prove to be useful in analyzing the diversity of spiders in these localities which may be difficult manually.

II. MATERIALS AND METHODS

a. Selection of collection site

In order to cover a large and diversified study area four different districts of West Bengal have been selected for the collection of the mud dauber's nests round the year. The districts include Jalpaiguri [26.32°N and 88.46°E (J)] at the north of the state, Hooghly almost in the central position, [22.00°N and 88.00°E (H)] and Bankura [23.14°N and 87.07°E (B)] and Puruliya [23.20°N and 86.25°E (P)] in the western part.

b. Collection and scrutinization of the nests

The mud dauber's nests were collected mainly from the edges of the concrete walls, wooden doors and windows etc. in garages, basements, rooms of houses including the store rooms and bathrooms. About 45 nests were collected from different districts of West Bengal round the year. The nests have been carefully scraped off with the help of scalpels, the closed orifice of the mud nests were pricked and then the mud nests were broken with care so that no species inside is harmed.

c. Taxonomy of the spiders

The spiders have been identified and studied from the available catalogue [3] and checklists [4], using the taxonomic keys for our indigenous spiders proposed by Tikader [5] and Sabbasian and Peter [6].

III. RESULTS AND OBSERVATION

The nests of *Sceliphron caementarium* were collected throughout the year from four different districts of West Bengal (Fig. 1). However, the adult dirt daubers (Fig. 2) and mud daubers (Fig. 3) were observed in many parts of West Bengal.

a. The inside story of the mud dauber's (*Sceliphron caementarium*) nests

On breaking the mud nests build by the adult *S. caementarium* (Fig. 3) any of the three different situations were observed inside:

I. The deep brownish pupae occupied the individual cells of the mud nests build by the adult female *Sceliphron caementarium* (Fig. 4). (November-February)

II. The orifices of the individual cells were open and the nests were almost empty except for few moulted pupal exoskeletons (Fig. 5). (January-May)

III. The desensitized or paralyzed small and brightly coloured spiders (Fig. 6) were fully packed inside the cells of the nests. In few occasions some green, yellow/grey larvae have also been detected from the cells.

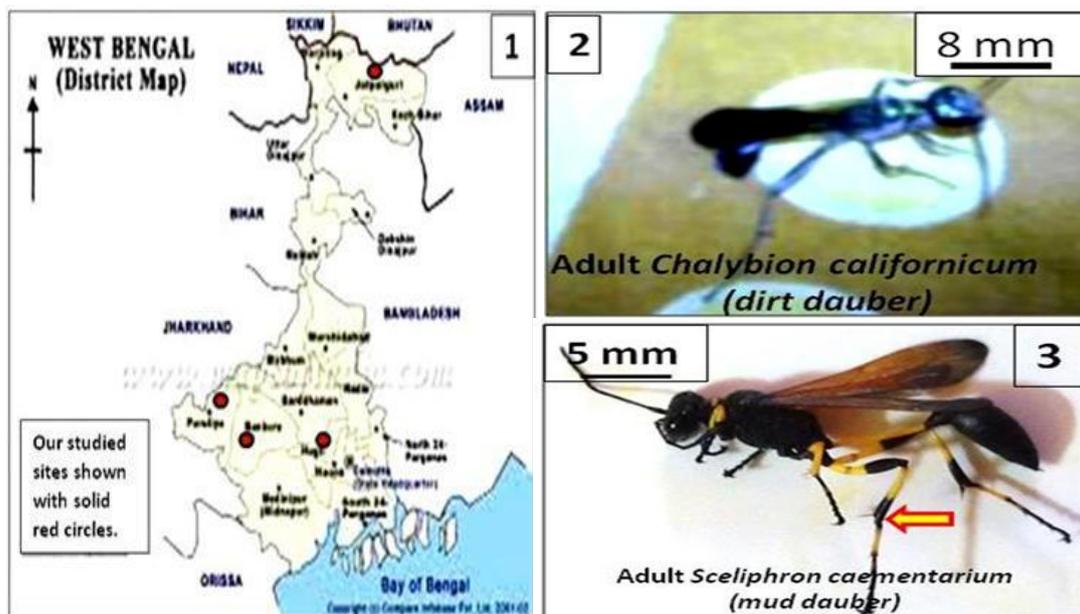


Figure 1: The district map of West Bengal showing (solid red circle) the four different districts from where the mud nests of *Sceliphron caementarium* have been collected, Figure 2: External morphology of an adult *Chalybion californicum* (dirt dauber), Figure 3: External morphology of an adult *Sceliphron caementarium* (mud dauber) showing its characteristic black and yellow striped legs (yellow arrow with red border)

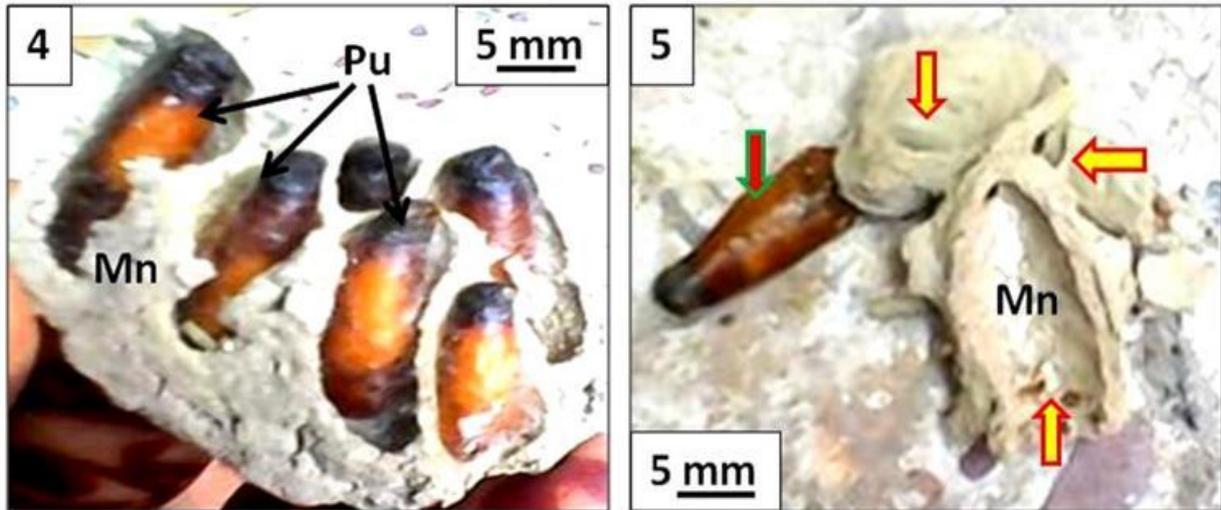


Figure 4: A compound mud daubers nest containing as many as eight (six are visible here) parallel cells which are fully occupied by the dormant non feeding pupa situated within the transparent cocoon. [Mn- Mud nest; Pu- Pupa], Figure 5: A nest of *S. caementarium*, collected from Hooghly district has been conked out to show the interior architecture of the cells (shown with red outlined yellow arrows) along with the remains of a chitinous cocoon (green outlined red arrow) from where the adult has already emerged

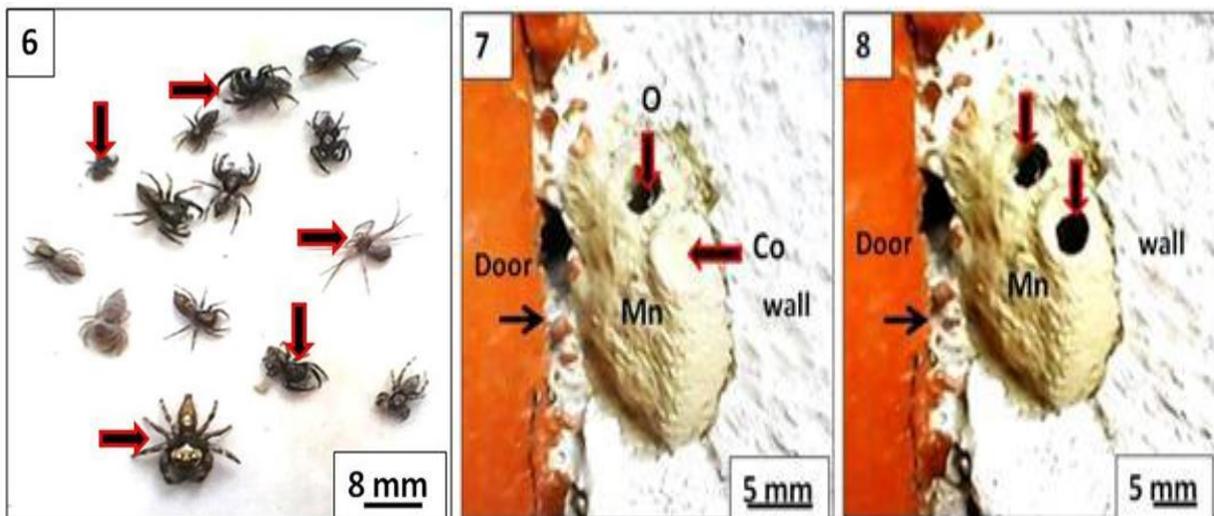


Figure 6: A spider (black arrow with red border) community present inside a single mud dauber's nest collected from Jalpaiguri district, Figure 7: A mud daubers (*Sceliphron caementarium*), nest build on the surface of a wall (collected from Jalpaiguri district) next to a wooden door. The junction of the door and the wall is shown with a black arrow. One of the cell orifices is closed with mud (Co), while the other is open (O), Figure 8: The same old nest (Fig. 7 after 6 days), with both the orifices (black arrows with red border) open indicating the emergence of the adult insects after metamorphosis

The number of cells in a single nest has been found from our observation to vary between one to as many as fourteen. The cells are usually constructed vertically (Fig. 7, 8 and 9). However, horizontal and angular cells have also been found in few cases (Fig 12 and 13 respectively). Interestingly, the cells are all independent units and are not interconnected. (Fig.14). After building the first cell, the mud dauber lays a single egg on one of the desensitized but fresh spiders and then seals the cell with a cap preferably with the same kind of mud. It has been noticed that sometimes the mud daubers seal its nest with substance such as calcium carbonate (Fig. 13) rather than mud, however the reason is perhaps, the mud dauber just picks up anything it gets with the help of its mandible and long legs to build and protect its nest. The next cell is built immediately adjacent to the first one and the process continues. After the nests are built the mud dauber puts additional amount of mud on their nests (Fig. 9, 10, 11) till it looks untidy. Sometimes the nests go unnoticed and are often mistaken as casual clay lumps. The pupae inside the brown cuticle looks creamy white (Fig. 15).

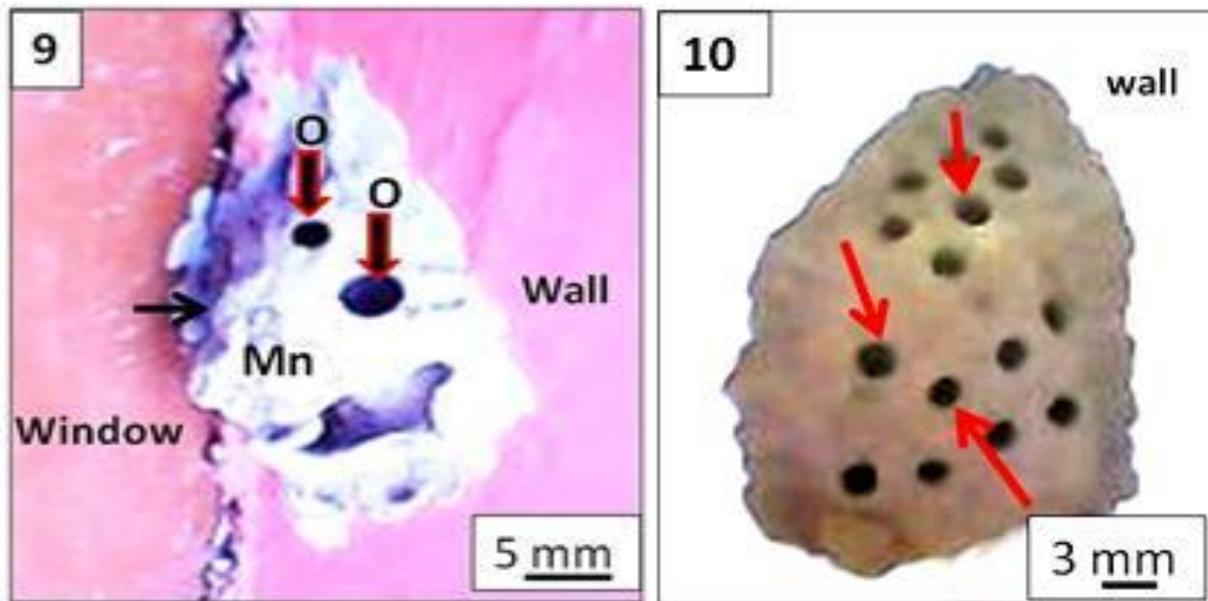
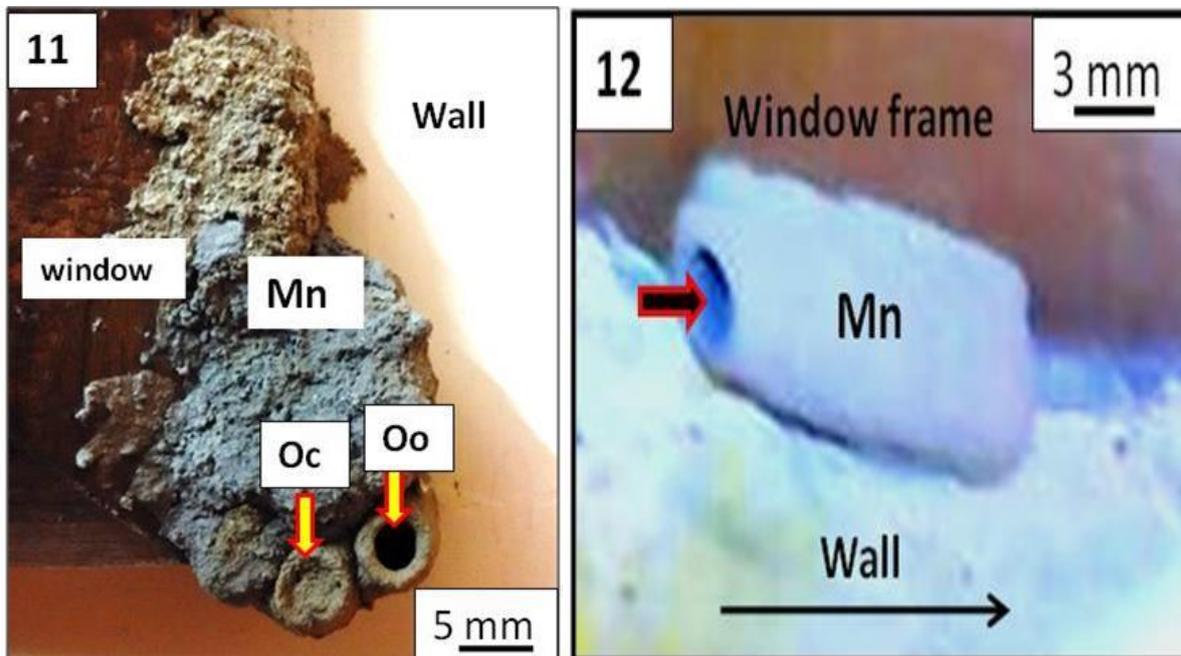


Figure 9: An uneven deceiving mud daubers (*Sceliphron caementarium*), nest build on the surface of a wall (collected from Hooghly district) next to a wooden window. The junction of the window and the wall is shown with a black arrow, Figure 10: A deceiving composite nest of the mud daubers (*Sceliphron caementarium*) that initially looked like the lump of mud and could be discovered only after the adults emerged out making distinct orifices (red arrow).

Figure 11: An untidy nest of the mud daubers (*Sceliphron caementarium*) with one of the orifices closed (Oc)



and the other open (Oo) collected from Puruliya district, Figure 12: A horizontally built *S. caementarium*'s nest (Mn) hanging at the junction of a window frame and wall showing an open orifice (black arrow with red border).the black arrow indicates the horizontal direction.

The different species of spiders isolated and identified from the collected mud daubers nests along with their families and place of occurrence are tabulated below (TABLE 1). It has been shown in figure 16, that the percentage occurrence of the spider families differs within the state for different districts.

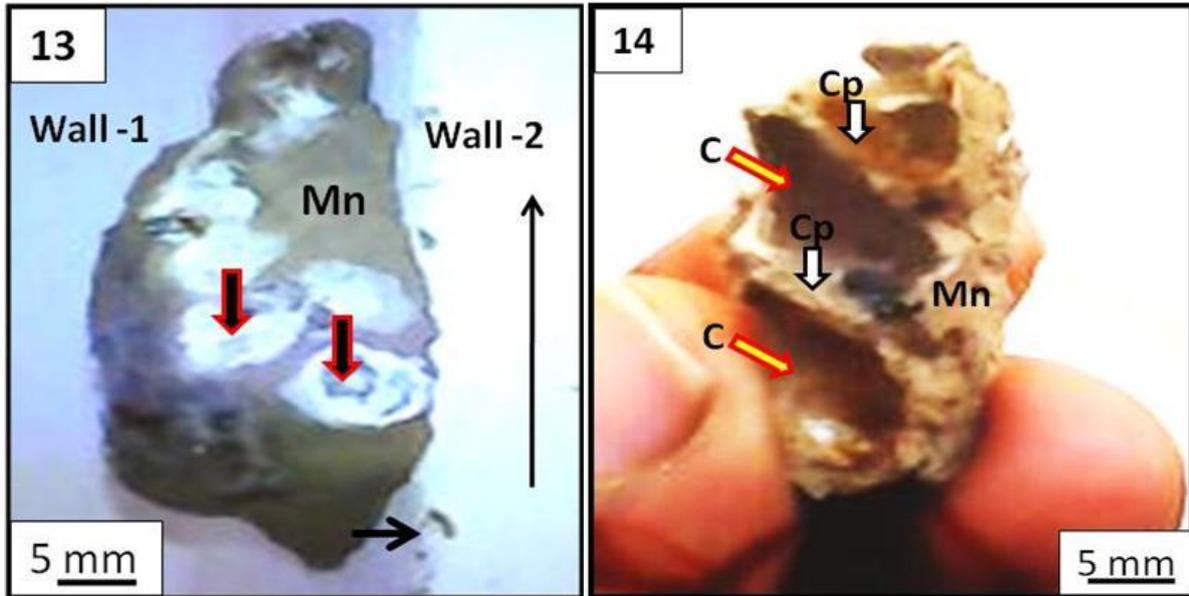


Figure 13: A *S. caementarium*'s nest (Mn) built at an angle with the vertical walls 1 and 2 (the vertical direction is indicated with a black arrow). The orifices of the cells are sealed with white calcium carbonate (black arrow with red border), Figure 14: A conked out mud dauber's (*Sceliphron caementarium*) nest showing the concave surfaces of the cells (red and yellow arrow) and the intra-cellular partitions (cp).

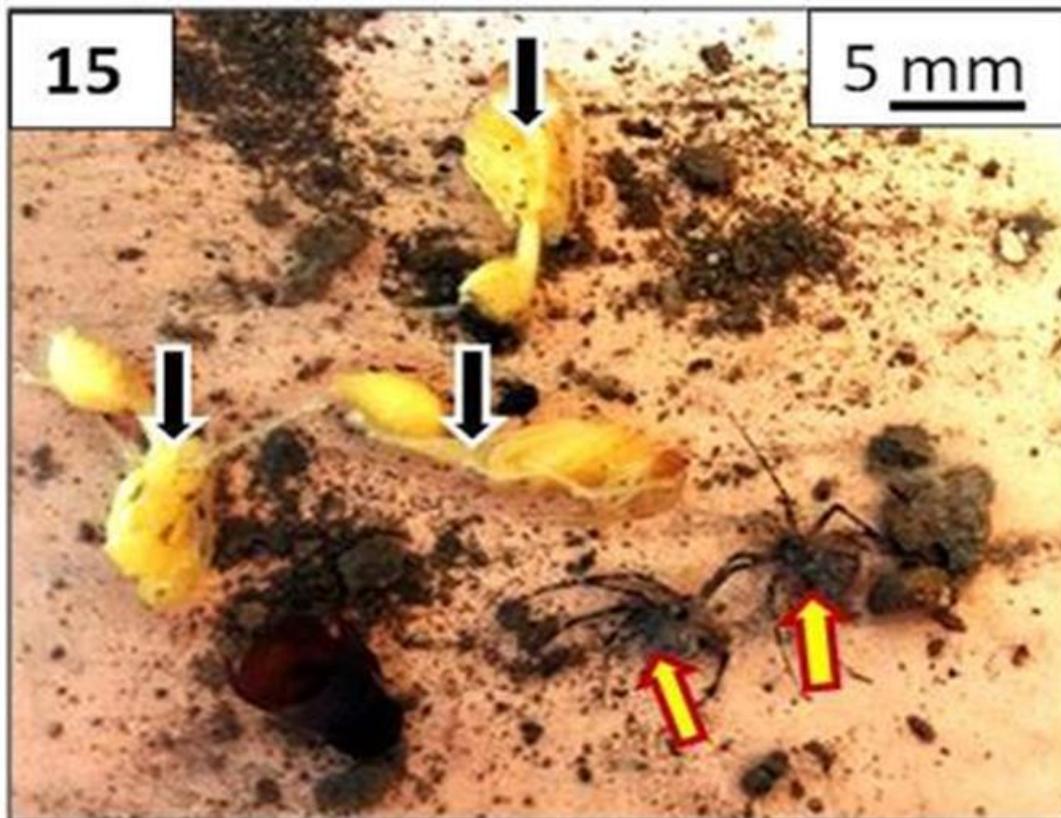


Figure 15: The creamy white coloured metamorphosing mud daubers (black arrow with white border) found inside the pupal case (yellow arrow with red border) collected from a nest in Puruliya. Some desensitized spiders (Sp) are found to lie in the remnants of the broken mud dauber's nest.

Table 1 The different species of spiders isolated and identified from the collected mud Daubers nests along with their families and place of occurrence

Serial Number	Scientific name of the spider	Family	Characteristics	Region of collection
1	<i>Tegenaria domestica</i> (Clerk, 1757)	Agelenidae	Size- 7-11 mm (females) 6-9 mm (males) Dark orange to brown or grayish in colour. Legs are striped or annulated. Cephalothorax with two dull, longitudinal stripes.	P B
2	<i>Agelenopsis sp.</i> Common name- Grass spider	Agelenidae	Size-8-10 mm Medium brown in colour with two light brown lines on the cephalothorax. Abdomen containing lengthwise concentric areas of lighter pattern. Long spinneret extending beyond the length of the abdomen.	P B J
3	<i>Pardosa sp.</i> Common name- Thin legged wolf spider	Lycosidae	Size-6-10 mm Uniformly coloured dark brown to black. Legs with black and brown stripes.	H J P
4	<i>Plexippus petersi</i> (Karsch, 1878)	Salticidae	Size-6-9 mm Female is dull brown in colour with two white spots in the abdomen. Male with incomplete white bands on the cephalothorax and abdomen.	J
5	<i>Plexippus paykulli</i> (Savigny and Audouin, 1825)	Salticidae	Size-7-10 mm Female is dull brown coloured with two white spots on the abdomen. Male with median white band on the cephalothorax and abdomen, bordered by black lateral bands.	J P B H
6	<i>Olios millet</i> (Pocock, 1901)	Sparassidae	Size- 12-15 mm Body and legs green in colour. Anterior thoracic portion is comparatively deep in colour. An hour glass-shaped red mask on the ventral side of the abdomen.	J H
7	<i>Zosis geniculatus</i> (Oliver, 1789)	Uloboridae	Size- 5-8 mm Hump on the abdomen. Cephalothorax wide. Legs are annulated with bright stripes of dark brown and white. Abdomen is light coloured.	B
8	<i>Menemerus bivittatus</i> (Dufour, 1831)	Salticidae	Size- 8-11 mm Carapace is deep brown with white bands in the lateral edges. Eyes are black. Legs with white and brown rings. Abdomen is whitish brown with a broad dark brown median band along the entire length.	B P J

9	<i>Thiania bhamoensis</i> (Thorell, 1887).	Salticidae	Size- 6-8 mm Elongated and longer black or dark coloured cephalothorax. Elongated abdomen, rounded at the front and converging at the end. Eyes are protruded out. Cephalothorax has a broad, crescent-shaped, hairy, bronze coloured band. The first pair of legs are slightly swollen and larger than the others.	P H B J
10	<i>Thomisus sp.</i>	Thomisidae	Size- 8-12 mm Bright green in colour. The thorax is broad and wide, anterior margin bear horns. The abdomen is pentagonal in shape, The first two pairs of legs are robust and bear spines.	J B P
11	<i>Xysticus bharatee</i> (Gajbe and Gajbe, 1999)	Thomisidae (crab spider)	Size- 6-9 mm The front pair of legs is larger and stronger than the other six. Two big and prominent front eyes.	J H P B

Note: many spider species show marked sexual dimorphism and the male and female of the same species greatly vary in size and colouration.

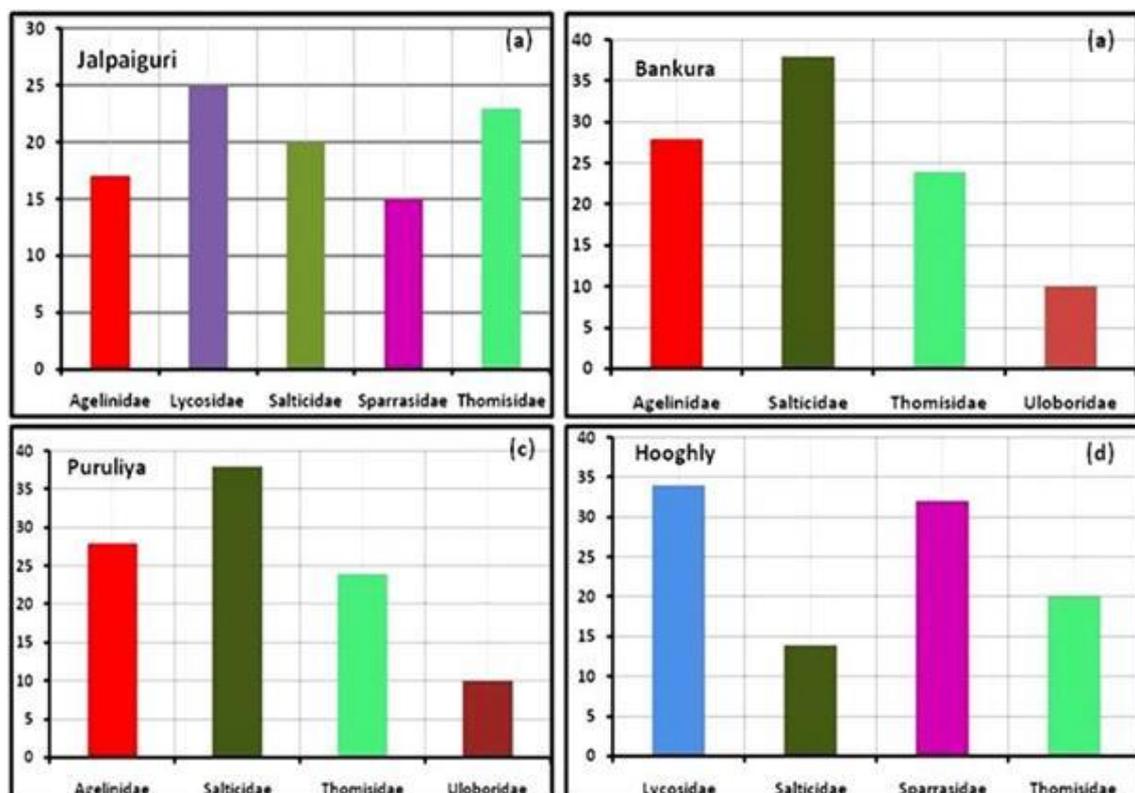


Figure 16 - Bar diagrams showing the percentage of different families of spiders collected from (a) Jalpaiguri, (b) Bankura, (c) Puruliya and (d) Hooghly districts

IV. MEASUREMENTS

Adult mud dauber is characterized by its black slender body and yellow stocking legs with an ultra slim waist (Fig 2 and 3). It measures about 20-30 mm in length. The dormant pupae or cocoon measures about 16-20

mm and are tightly set inside the cells of the nests (Fig.4). Vertically the mud daubers cells measures up to 40 mm in length and 20 mm in diameter. Several cells or compartments are cemented laterally with mud or hard cementing substance such as calcium carbonate to constitute a composite nest (Fig. 8, 13). The orifice of the cells from a single nest differs markedly in size ranging from (3-6 mm).The nests are again covered with additional mud from outside (Fig. 9, 10, 11).The lengths of the spiders are measured using simple geometry box scales, whose lowest precision limits are marked in millimeter (mm).

V. DISCUSSION

The solitary mud daubers like most other wasps are predators and the female prefers to build their nests or brood chambers on the edges of rough surfaces so that they can tightly place the mud nest and the nest remains strongly attached to the surfaces. The *S. caementarium*, selects dry places to build their nests so that the nests do not get wet and washed away with water. Being a solitary insect, a single female adult has to build its nest as well as forage for prey before laying its eggs. It has been observed in the present study that a single egg is laid on each cell, preferably on the back of a paralyzed spider and then the orifice of the cells are sealed with mud caps or white powders of calcium carbonate. Each cell is stuffed with more than one spider belonging to the same or different genera so that the newly hatched larvae can feed on the fresh and living spiders before they transform into the non feeding pupal stage. The paralyzed spider cannot feed and can neither move inside the cell. Dennys [7] brought out the paralyzed *Phidippus* sp. spider from the mud cell and kept it inside a vial and after two months it was found to be still alive. On feeding the spider with flies and water it managed to survive for another one and half years. So, the venom of such wasps acts as momentary tranquilizer whose effect ceases after definite time period. This is an excellent strategy to feed the larvae with fresh and unrotten food till it pupates. The mud dauber in many places has been found to put some extra mud after constructing the general cells. This is probably for two vital reasons, Firstly, an extra mud layer acts as strong insulating material and hence helps in maintaining a constant temperature inside the mud nest and secondly, an untidy nest plays a deceiving role for its enemies and helps in keeping the predators, like the insectivorous birds that would otherwise discover the resourceful nests and meal on the stocked assets, away from the nests. Each independently constructed cell in the nest for single larvae to be hatched is probably a strategy of the mother to protect its young ones from the intra-specific struggle likely to be experienced by the larvae for food as well as shelter inside the common cells.

The young ones stay inside the cells to avoid the extreme cold of the winter months. The spiders collected from different areas depict that these are small in size usually not exceeding 12 mm of length. The data collected from the four different districts of West Bengal shows that nests from Jalpaiguri district harbor the maximum species variety (9 in our study) included in 6 different families, probably because of the presence of a diversified plant species and house hold conditions in the foot hills of the Himalayas. Rosenzweig [8] have shown that several environmental factors are responsible for the diversity of species. Moreover, unlike the districts of Puruliya and Bankura, in Jalpaiguri district the summers are not so arid and the places do not experience long moisture less summer months with most number of barren trees and grass less fields that usually harbor the spiders. However, spaying of pesticides in the crop fields may also be considered for the lack of spider species diversity in the mud daubers nests. Similar investigations on the mud daubers nests were made in the twentieth century by Muma [1] and Doris [2] in other corners of the globe.

Mud daubers unlike the other wasps may be considered to be a beneficial insect as they rarely sting or attack the human population and they help in pest controlling by picking the unwanted and harmful spiders from different sites in our houses and gardens or forests. This mud dauber can easily be launched to act as a biological pest control mechanism so that we can get rid of the disturbing small spiders particularly from our well decorated houses and gardens. At the same time, it would save our money as well as health by reducing the use of harmful chemical pesticides in the garden and in our houses. So, we should think several times before destroying any mud dauber's nest in our garages or out houses as they are more eco friendly pest eliminating agents than other pest controlling elements such as fumigants, chemical sprays, etc.

VI. CONCLUSION

It is clear from this study that the mud daubers are not at all aggressive or dangerous to the human population; rather they are friendly, since they help in controlling the otherwise harmful spider population in an eco friendly and priceless manner. They are the natural arachnidicides and they should to be allowed to build their uniquely designed nests in the outskirts of the houses and comparatively undisturbed areas so that they can continue with their pest controlling habit and save our lives from the effects of the harmful chemical pest controllers. Their nests should not be unnecessarily destroyed as they also act as efficient spider catchers and help the entomologists in providing a sketch of the small sized spider diversity in an area and spot some of the spiders which are otherwise difficult to collect and study.

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