Study of the spider community inside the nests of the natural Arachnidicide *Sceliphron caementarium* (mud dauber) collected from four different districts (Jalpaiguri, Hooghly, Purulia and Bankura) of West Bengal, India

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**ABSTRACT**

The nests of the *Sceliphron caementarium* were collected from four different districts of West Bengal and the scenario inside the nests were carefully studied in order to enlighten its prey apprehending behaviour and hence its survival strategy. Six different families of spiders could be spotted from the nests upon which the larvae of the *S. caementarium* survived before emerging into the non feeding pupae. Eleven species of small and attractive spiders could be identified and the maximum of nine different spider species could be recognised from Jalpaiguri district, preferably because of an ideal climatic condition and the availability of maximum number of host plants. On the other hand least species diversity of spiders was observed from the nests collected from Hooghly district. Nests from the semi arid districts of Purulia and Bankura ranked second in terms of spider diversity. Hence, as a whole the eco friendly *S. caementarium* could be considered as a beneficial insect as it provides us valuable information on the variety of spiders inhabiting a particular area and at the same time act as a natural pest controller by checking the population of the otherwise harmful spiders.

**Keywords:** Spider community, larvae, *Sceliphron caementarium*, Districts, West Bengal, Species

**INTRODUCTION**

Some sphecid and carbronid wasps construct their characteristic mud nests with unique architectural patterns to lodge their eggs and nurture their larvae. The mud accumulated from the neighbouring mud puddles are fascinatingly deposited and then designed by means of the prothoracic legs and the mandibles for the construction of the matchless “mud dauber’s” or “dirt dauber’s” nests. Three different types of mud daubers are known to rule the earth, 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*). Both the sexes of the mud daubers are known to feed on nectar as well as arthropods (like spiders) collected from a wide variety of flowers and plants respectively. Unlike the males the females play a in building their nests and foraging for the spiders to feed their growing larvae inside the nests. The mud daubers possess the stinging apparatus but are normally timid and harmless for the human population until and unless they are disturbed or pocked. It is quite a intriguing fact that the female wasps use their venomous sting to desensitize and paralyze spiders collected to feed their larvae so that they can be easily transported and stored without festering inside the nest cell until consumed by the larva.

In this investigation I have made an endeavour to study the different types of spiders collected by the black and yellow mud dauber, *Sceliphron caementarium* (potter wasp), from diverse localities of West Bengal, India. This is not a seasonal study so, it is most likely that there will be some differences in the variety of the species due to season of sample collection and vicinity of the collection site rather than the geographical location of the districts alone. Till date, a couple of reports [1 and 2] are available stating the variety of spiders found inside the mud dauber’s nests.
Despite the fact that *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 dauber’s nests collected from this part of east India. This investigation of the mud dauber’s nest will furthermore prove to be valuable in analyzing the diversity of spiders in these localities which may not have been possible manually.

**MATERIALS AND METHODS**

**a. Range of collection site**

For exploring a large and diversified study region four different districts of West Bengal have been chosen for the collection of the mud dauber’s nests all through the year. The districts comprise 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 region.(Fig. 1).

**b. Collection and investigation of the nests**

The mud dauber’s nests were collected almost from every possible place such as the furniture surfaces, edges of the walls, wooden and glass doors and windows etc, garages, basements, rooms of houses including the store rooms and bathrooms and even the flower vases were not spared. Throughout the year about 45 nests were collected from four different districts of West Bengal. The nests were carefully scraped off with the help of scalpels, the closed orifice of the mud nests were pricked and then the mud cells were carefully conked out so that no species inside was harmed.

**c. Taxonomy of the spiders**

The spiders collected from inside the nests 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 Sabbassian and Peter [6]. The adult dirt dauber (Fig. 2) and mud dauber (Fig.3) could be spotted throughout West Bengal but the nests of *Sceliphron caementarium* were collected throughout the year from four different districts of West Bengal as shown in Figure 1..

**RESULTS**

**Figure 1-** The district map of West Bengal indicating (yellow triangle) the four different districts from where the mud nests of *Sceliphron caementarium* have been collected.
Glimpses inside the mud dauber’s (Sceliphron caementarium) nests
On carefully breaking the nest’s built by the adult Sceliphron caementarium, any one of the following situations could be noticed:-

i) The individual cells of the nest were entirely occupied by the deep brownish pupae of Sceliphron caementarium (Fig.4). (November-February).

ii) The opening of the individual cells i.e., the orifice were free and the nests were almost empty except for few moulted pupal exoskeletons. (Fig.5). (January-May).

iii) Small and brightly coloured desensitized and paralysed spiders (Fig. 6) were fully packed inside the cells of the nests. In some instances few green, yellow/grey larvae have also been detected from the cells.

Figure 4 - A compound mud dauber’s 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 cocked 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.

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The number of cells in a single nest has been found from our observation to vary between one to as many as twelve. The cells are usually constructed vertically (Fig. 7, 8 and 9). However, horizontal and angular cells have also been found in few cases (Fig 10 and 11 respectively). Interestingly, the cells are all independent units and are not interconnected. (Fig.12). 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. 11) 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.

Figure 7- A mud dauber’s (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.
Figure 9- An uneven deceiving mud dauber’s (*Sceliphron caementarium*), nest build on the surface of a wall (collected from Hooghly district) close to a wooden window. The junction of the window and the wall is shown with a black arrow.

Figure 10- A horizontally built *S. caementarium’s* nest (Mn) hanging at the junction of a window frame and a wall showing an open orifice (black arrow with red border). The black arrow indicates the horizontal direction.

Figure 11- 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 12-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).

The various species of spiders that have been isolated and identified from the nests of *Sceliphron caementarium* are tabulated below.

Table 1 Classification of spider community inside the mud dauber’s nests as observed from four different districts of West Bengal, India

<table>
<thead>
<tr>
<th>Serial Number</th>
<th>Scientific name of the spider</th>
<th>Family</th>
<th>Characteristics</th>
<th>Region of collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Agelenopsis sp.</em>&lt;br&gt;Common name- Grass spider</td>
<td>Agelenidae</td>
<td>Size-8-10 mm&lt;br&gt;Medium brown in colour with two light brown lines on the cephalothorax.&lt;br&gt;Abdomen containing lengthwise concentric areas of lighter pattern.&lt;br&gt;Long spinneret extending beyond the length of the abdomen.</td>
<td>P B J</td>
</tr>
<tr>
<td>2</td>
<td><em>Menemerus bivittatus</em>&lt;br&gt;(Dufour, 1831)</td>
<td>Salticidae</td>
<td>Size- 8-11 mm&lt;br&gt;Carapace is deep brown with white bands in the lateral edges.&lt;br&gt;Eyes are black.&lt;br&gt;Legs with white and brown rings.&lt;br&gt;Abdomen is whitish brown with a broad dark brown median band along the entire length.</td>
<td>B P J</td>
</tr>
<tr>
<td>3</td>
<td><em>Olios millet</em>&lt;br&gt;(Pocock, 1901)</td>
<td>Sparassidae</td>
<td>Size- 12-15 mm&lt;br&gt;Body and legs green in colour.&lt;br&gt;Anterior thoracic portion is comparatively deep in colour.&lt;br&gt;An hour glass-shaped red mask n the ventral side of the abdomen.</td>
<td>J H</td>
</tr>
<tr>
<td>4</td>
<td><em>Pardosa sp.</em>&lt;br&gt;Common name-Thinlegged wolf spider</td>
<td>Lycosidae</td>
<td>Size-6-10 mm&lt;br&gt;Uniformly coloured dark brown to black.&lt;br&gt;Legs with black and brown stripes.</td>
<td>H J P</td>
</tr>
<tr>
<td>5</td>
<td><em>Plexippus paykulli</em>&lt;br&gt;(Savigny and Audouin, 1825)</td>
<td>Salticidae</td>
<td>Size-7-10 mm&lt;br&gt;Female is dull brown coloured with two white spots on the abdomen.</td>
<td>J P B</td>
</tr>
</tbody>
</table>

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Male with median white band on the cephalothorax and abdomen, bordered by black lateral bands.

<table>
<thead>
<tr>
<th>#</th>
<th>Common Name</th>
<th>Family</th>
<th>Size (mm)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td><em>Plexippus petersi</em> (Karsch, 1878)</td>
<td>Salticidae</td>
<td>6-9</td>
<td>Male: is dull brown in colour with two white spots in the abdomen. Male: incomplete white bands on the cephalothorax and abdomen.</td>
</tr>
<tr>
<td>7</td>
<td><em>Tegenaria domestica</em> (Clerk, 1757)</td>
<td>Agelenidae</td>
<td>7-11</td>
<td>Female: dull brown in colour with two white spots in the abdomen. Male: incomplete white bands on the cephalothorax and abdomen.</td>
</tr>
<tr>
<td>8</td>
<td><em>Thiania bhamoensis</em> (Thorell, 1887)</td>
<td>Salticidae</td>
<td>6-8</td>
<td>Male: elongated and longer black or dark coloured cephalothorax. Female: dull orange to brown or grayish in colour. Legs are striped or annulated. Cephalothorax: has two dull, longitudinal stripes.</td>
</tr>
<tr>
<td>9</td>
<td><em>Thomiscus sp.</em></td>
<td>Thomisidae</td>
<td>8-12</td>
<td>Size: 6-12 mm. Male: 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.</td>
</tr>
<tr>
<td>10</td>
<td><em>Xysticus bharatee</em> (Gajbe and Gajbe, 1999)</td>
<td>Thomisidae (crab spider)</td>
<td>6-9</td>
<td>The front pair of legs are larger and stronger than the other six. Two big and prominent front eyes.</td>
</tr>
<tr>
<td>11</td>
<td><em>Zosis geniculatus</em> (Oliver, 1789)</td>
<td>Uloboridae</td>
<td>5-8</td>
<td>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.</td>
</tr>
</tbody>
</table>

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

It has been shown in Figure 13, that the percentage occurrence of the spider families differs within the state for different districts.

![Figure 13 - Pie Charts showing the percentage of spider family diversity in the districts of (a) Jalpaiguri, (b) Bankura, (c) Purulia and (d) Hooghly.](http://www.journalzbr.com/issues.html)
d. 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). 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).

The lengths of the spiders are measured using simple geometry box scales, whose lowest precision limits are marked in millimeter (mm).

DISCUSSION

The *Sceliphron caementarium* are solitary insects that perform dual roles in nature i.e., they build the nests for their newly hatched larvae as well as forage for collecting their prey to feed their young ones, and show marked parental care or more specifically “maternal care”. They preferably select dry, shady and elevated locations for building their nests so that their tender nests do not get wet or are not washed away with downpour. After the nest cells are build and before the eggs are laid inside the cell, the mud dauber has to selectively collect the small spiders and stuff the cells with many spiders and then lay the egg preferably upon the back of a desensitized spider. Immediately after laying the egg, the orifices of the cells are closed with strong substances such as mud or even calcium carbonate. Inside the closed cells there may be one or more fresher but desensitized spider species upon which the newly hatched larvae feeds before transforming into the non feeding dormant pupae. The paralysed spider remain motionless and do not feed inside the cell.

The paralyzed spider *Phidippus sp* was brought out from a mud cell by Dennys [7] and kept inside a vial which after two months was found to be still alive. The spider when fed with flies and water managed to survive for another one and half years. This was due to the fact that the venom of such wasps acts as momentary tranquilizer whose effect ceases after definite time period. This is an excellent strategic adaptation of the mud dauber to feed the larvae with fresh and unrotten food till it pupates.

As far as the architecture of the nests is concerned, the mud dauber builds separate independent cells probably in order to avoid the possibility of inter-specific struggle within its larvae for food and shelter. Further, the insect pts some extra mud upon the cell 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 away the predators, like the insectivorous birds that would otherwise discover the resourceful nests and meal on the stocked assets. 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 and 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, spraying 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 vicinity. 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 tinted houses and gardens. At the same time, it would save our money as well as heath 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.

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CONCLUSION

The diverse community of spiders identified from the nest’s of the mud dauber, Sceliphron caementarium suggests that the mud daubers play a very important as well as beneficial role by collecting and controlling the otherwise harmful spiders. The spiders act as plant pests and often cause household nuisance by weaving disturbing webs. The Sceliphron caementarium play a major role as biological pest controller in an ecofriendly and inestimable approach. They act as the natural arachnidicides. In addition, the spider community inside the mud dauber’s nest may also prove to be useful for the entomologists as they represent species which sometimes go unnoticed due to difficulty in their collection manually.

Acknowledgement
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REFERENCES


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