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Nest Characteristic Features and Prey Selection of Mud Dauber Wasp *Sceliphron madraspatanum* "Fabricius, 1781"

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ABSTRACT

Sphecid and Carbronid wasps construct the characteristic nests with unique architectural patterns to lay their eggs and nurture their larvae. The present investigation was carried out the nest characteristic features and prey selection of mud dauber wasp from the A.V.C. College campus from January to March 2019. It deals with nest characteristic features of the active and abandoned nest of mud dauber wasp, studies indicate that Sceliphron madraspatanum nests are built on bright surfaces that are covered against water and immediate sunlight. The nests' height from the ground was less than 2 feet, nest length was less than 5 cm and cell depth or width was less than 3 cm. The mean number of orifices and cells was 6.0 and the cell length range was measured from 2.25 to 1.92 cm. Nests' shape was a maximum rectangle and a few were irregular shapes. In active nests, mean height from the ground and orifices or cells were lesser than the inactive nests. Likewise, the nest length and depth of the cells or width, weight were higher than the inactive nests. A total of 24 larvae were isolated from the 20 cells and weighed around 3.15 g. Similarly, the feed was also isolated and tally as 153 paralyzed individuals which belong to order Araneae and weighed 17.27 g. It concluded that the nest of mud dauber wasp showed species- specific architecture and it feed the spiders of an agroecosystem. From this research, the wasp might be considered a beneficial insect for the agroecosystem.

Keywords: Mud dauber wasp, Nest architecture, Nest orientation, Prey, Spider, Paralyzed.

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INTRODUCTION

Wasps are social or solitary nest builders by natural or artificial materials as a substrate. There are 35 species described in the genus *Sceliphron* worldwide [1]. A few definite groups of sphecid and crabronid wasps construct the characteristic nests with unique architectural patterns to lay their eggs and nurture their larvae. These nests are built out of mud unruffled from nearby mud puddles and hence these wasps are popularly nominated as the "mud daubers" or even the "dirt daubers". Sphecidae is a cosmopolitan family of bees with solitary or altruistic demeanors that contains digger wasps, for example, mud bees, Sceliphron madraspatanum (Fabricius), and other familiar species, all of which fall into the category of thread-waisted wasps. Nest construction of wasps is very important to protect their larvae from enemies or predators and store the chow for long life. Specific architectural ability and materials used for nest construction are species-specific in the group of wasps. Earlier, few studies have been done in various species of wasps in the aspects of nest characteristic features and prey selection [2-5].

The individual forage search profession defines a circumstance in which homogeneous individuals in a general population show dissimilarities in

food search behavior, each of which specializes in various kinds of prey. Individual expertise is widespread in animals but has not been studied in invertebrates, despite its potential effects on the food networks and population dynamics [6]. In the genus Sceliphron, females create their mud nests in various isolated and dry places, but some of them are usually related to human residential. A single cellule is first created, prepared with a spider, and sealed by a female before working on another cell. Typically, more than one cellule is created to form a cumulative nest. Cells that are not fully accumulated in a day may be temporarily sealed overnight [7, 8].

Generally, many cells of a nest are occult with a mud layer [9-12]. Halder *et al*. [2] have been observed to make around 10–13 round trips to construct each cell (2.38±0.19 cm x 0.975±0.083 cm) carrying soft mud collected mainly from frequently irrigated fields or nearby irrigation channels with their mandibles and forelegs in *S. madraspatanum*.

This study was carried out the nest architectural characteristics features and site selection for the nest construction. Moreover, the present study also deals with the prey availability in the nest cells of active nests of Mud dauber wasps.

MATERIALS AND METHODS

The nests were obtained from A.V.C. College Campus, Mannampandal, Mayiladuthurai, Tamil Nadu. The study area belongs to the vegetable agroecosystem and cultivated several vegetable crops like brinjal, bhendi, banana, etc., A total of 25 nests of *S. madraspatanum* were collected randomly during the period from January to March 2019 every week (every week two to three nests were collected and analyzed) and taken to the laboratory and put in plastic boxes (10 x 8 x 5 cm). Directly after opening the nests to analyze the cells and their structure. Bait was separated from the cells in terms of species and counted manually. The designation of spiders has been done using the thematic expertise and textbook of Indian spiders [13]. Some direct comments of nests were made at the nest site. The statistical analyses are diversity indices and correlation matrix proved the significance of the study and it was done by using IBM SPSS version 25.

RESULTS AND DISCUSSION

Sceliphron madraspatanum mud nests are well lit on surfaces and covered from water and direct sunlight. Some of them were huge, with a solid base, and were challenging to separate. Mud dauber nests showed that mean height from the ground was 52.44 ± 28.86 cm and the average length and width were 4.78±1.67 and 2.35±0.44 cm respectively. The weight of the nest was also studied, the mean weight was 13.94±11.70 g. The mean number of orifices was showed 6.0±1.58 and recorded the highest 10 orifices and four orifices were least. The number of chambers in the nest was 6.0±1.58 (n=25) and the range of the chamber or cell length was 2.25 to 1.91cm. Nests' shape was maximum rectangle (96%) and few were irregular (4%) and nest substrate orientation was 40% east direction followed by 32% north and 28% west direction. The nature of nest substrate was nearly 80% were walls followed by all other materials have each 4% namely, bamboo poles, strips, cloth, switch box and tables. The nest status also noted its shows nearly 84% of the nest were inactive, with the rest of them being active and were taken further studies such as feed on the chambers.

Among the 25 nests of Mud daubers, four nests were found as active nests and it was showed the mean height from the ground was 32±14.99 cm. Likewise, the nest length and width average was noted 5.13±1.45 and 2.48±0.21 respectively. The nest varied among the four nests from 10.26 g to 42.49 g and the average was calculated as 21.94±7.50 g. The number of orifices also varied according to their size and weight, it shows four to six and a mean calculated as 5±0.41.

Active nests showed that the mean number of chambers was 5.0±0.7 and length range between 2.25 to 1.91cm. The chamber diameter range was 0.52 to 0.46cm. Active nests were opened for analyzing the prey and larvae of Mud dauber, a total of 24 larvae were isolated from the four active nests and weighed around 3.15 g. Similarly, the feed was also isolated and tally as 153 individuals which belong to order Araneae and weighed 17.27 g. Among the four active nests of Mud dauber, two nests alone have been noticed that the prey items of family Salticidae (5 genera) were showed the highest frequency as well as diversity followed by Lycosidae (1 genus) and Araneidae (1 genus) **(Table 1)**.

Table 1. Spider recorded inactive nests of *S. madraspatanum* during the study period (n=2)

Species of Spiders	Common name	Family	Nest I	Nest II
Hyllus semicupreus	Semi-coppered heavy jumper	Salticidae	20	17
Hasarius adansoni	Adanson's house jumper		1	1
Menemerus bivittatus	Grey Wall jumper		1	1
Bavia kairali	Jumping spider		41	13
Telamonia dimidiata	Two striped Jumper		9	1
Lycosa Mackenziei	Wolf spider	Lycosidae	7	3
Neoscona Nautica	Brown sailer spider	Araneidae	6	4
Un identification			19	9
Total			104	49

The diversity indices showed, there is not much variation among the two nests of Mud daubers. The species richness, dominance index, Simpson diversity index, Shannan'H index, and Evenness are quite the same and individuals vary among the nests **(Table 2)**.

The active nest shape of the mud daubers was rectangle shape and the substrate orientation of the nest shows 75% west followed by 25% east orientation. The substrate of the nest was preferred as the wall. Statically proved that the water sources positively influence the other dependent factors like nest height from the ground, nest length, number of orifices, and waste materials. The nest height from the ground positively influenced nest length alone and nest length positively influenced the nest weight. The nest length significantly influenced the number of orifices and nest weight **(Table 3)**. The correlation matrix for active nests indicated that nest height from the ground significantly influenced spider weight, number of larva in the nest, and larval weight **(Table 4)**.

Table 2. Diversity indices of spiders inactive nest of Mud dauber (n=2)

Indices	Nest I	Nest II
Species richness	8	8
Individuals	104	49
Dominance Index	0.2413	0.2362
Simpson Diversity index	0.7587	0.7638
Shannon H' Index	1.642	1.644
Evenness	0.6456	0.6472

Table 3. Correlation matrix of variables irrespective of nests *S. madraspadnum* collected during the study period

		Water source	Nest height	Nest width	Nest length	No. of orifices	Nest weight	Waste materials
Water source	Pearson Correlation	1						
	Sig. (2-tailed)							
	N	25						
Nest height	Pearson Correlation	0.226	1					
	Sig. (2-tailed)	0.277						
	N	25	25					
Nest width	Pearson Correlation	-0.113	-0.192	1				
	Sig. (2-tailed)	0.591	0.357					
	N	25	25	25				
Nest length	Pearson Correlation	0.129	0.035	-0.247	1			
	Sig. (2-tailed)	0.538	0.869	0.234				
	N	25	25	25	25			

No of orifices	Pearson Correlation	**0.324***	-0.174	-0.089	**0.491***	1			
	Sig. (2-tailed)	0.114	0.404	0.672	0.013				
	N	25	25	25	25	25			
Nest weight	Pearson Correlation	-0.293	-0.356	0.205	**0.455***	0.082	1		
	Sig. (2-tailed)	0.155	0.081	0.326	0.022	0.697			
	N	25	25	25	25	25	25		
Waste materials	Pearson Correlation	0.192	-0.132	-0.048	0.031	0.221	-0.028	1	
	Sig. (2-tailed)	0.359	0.530	0.821	0.882	0.288	0.894		
	N	25	25	25	25	25	25	25	

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4. Correlation matrix of variables Active nests *S. madraspadnum* collected during the study period

		NHG	**WS**	**NW**	**NL**	**NO**	**NWt**	**WM**	**SW**	**No L**	**LW**	**No S**
NHG	Pearson Correlation	1										
	Sig. (1-tailed)											
	N	4										
WS	Pearson Correlation	-0.469	1									
	Sig. (1-tailed)	0.266										
	N	4	4									
NW	Pearson Correlation	0.298	-0.719	1								
	Sig. (1-tailed)	0.351	0.141									
	N	4	4	4								
NL	Pearson Correlation	**0.792***	-0.026	-0.346	1							
	Sig. (1-tailed)	0.104	0.487	0.327								
	N	4	4	4	4							
NO	Pearson Correlation	0.073	**0.846***	-0.596	0.**423***	1						
	Sig. (1-tailed)	0.464	0.077	0.202	0.289							
	N	4	4	4	4	4						
NWt	Pearson Correlation	**0.690***	-0.310	-0.306	**0.892***	0.028	1					
	Sig. (1-tailed)	0.155	0.345	0.347	0.054	0.486						
	N	4	4	4	4	4	4					
WM	Pearson Correlation	-0.601	**0.987****	-0.734	-0.143	**0.748***	-0.370	1				
	Sig. (1-tailed)	0.199	0.007	0.133	0.429	0.126	0.315					
	N	4	4	4	4	4	4	4				
SW	Pearson Correlation	**0.932***	-0.566	0.143	**0.836***	-0.095	**0.881***	-0.662	1			
	Sig. (1-tailed)	0.034	0.217	0.428	0.082	0.452	0.059	0.169				
	N	4	4	4	4	4	4	4	4			
No L	Pearson Correlation	**0.914***	-0.170	-0.114	**0.970***	**0.344***	**0.838***	-0.303	**0.902***	1		
	Sig. (1-tailed)	0.043	0.415	0.443	0.015	0.328	0.081	0.349	0.049			
	N	4	4	4	4	4	4	4	4	4		
LW	Pearson Correlation	**0.934***	-0.595	0.180	0.**815***	-0.126	**0.866***	-0.690	**0.999****	**0.888****	1	
	Sig. (1-tailed)	0.033	0.202	0.410	0.092	0.437	0.067	0.155	0.000	0.056		
	N	4	4	4	4	4	4	4	4	4	4	
No S	Pearson Correlation	0.258	-0.914	**0.913***	-0.314	-0.857	-0.093	-0.888	0.254	-0.127	0.291	1
	Sig. (1-tailed)	0.371	0.043	0.043	0.343	0.072	0.453	0.056	0.373	0.437	0.354	
	N	4	4	4	4	4	4	4	4	4	4	4

*. Correlation is significant at the 0.05 level (1-tailed).

**. Correlation is significant at the 0.01 level (1-tailed).

NHG- Nest height from the ground; WS- Water source; NW- Nest width; NL- Nest length; NO- No. of orifices; NWt- Nest weight; WM- Waste materials; SW- Spider weight; No L- No of larva; LW- Larval weight; No S- No of spider

Investigating nest of any fauna will give more knowledge on natural history [14-16]. Studies indicate that Sceliphron madraspatanum is made on bright surfaces (walls, under tables, etc.) covered from water and direct sunlight. Also, Naumann [17] stated that Sceliphron laetum nests are commonly discovered in indistinctly light sites or shady, covered from water and direct sunlight. He also reported Syzygium formosum nests on walls covered from rain, but well. Callan [11] regarded that Syzygium formosum nests were also in a sheltered and

luminous condition. Nests' height from the ground was less than 2 feet observed and it may be due to the availability of collection points, maintenance, and short duration for construction [3]. The present investigation studied the length of the nest was less than 5 cm and cell depth or width of the nest was less than 3 cm. The mean number of orifices and cells was 6.0 and the length range was measured from 2.25 to 1.92 cm. Similar results were observed by the previous studies in *Anoplius infuscatus* and *Episyron sp*. [18]. Camillo [7] also studied *Sceliphron fistularium* nest characteristics and notice the cells numbers in each nest ranging from 1 to 54, their length ranging from 20.8 to 29.7 mm, and their diameter ranging from 7.6 to 11.7 mm. Nests' shape was a maximum rectangle and a few were irregular shapes. The mud nest of *Sceliphron madraspatanum* is similar to that of *Sceliphron assimile*; all members of the genus *Sceliphron* build rectangular mud nests made up of cells [9]. Nest substrate orientation is important for protection from the abiotic (sunlight, wind, water, etc.,) and biotic factors (Gecko, Dragonflies, Spider, etc.,). This study found the east orientation was high followed by north and south. The nest orientation is used for flight orientation of the wasp surrounding nest to capture prey [19]. The condition of the nest also indicated that about 84% of the nest was inactive and the rest was active, and further studies such as feeding in the chambers were performed.

Inactive nests, mean height from the ground, and orifices or cells were lesser than the inactive nests. Likewise, the nest length and depth of the cells or width, weight were higher than the inactive nests. A total of 24 larvae was isolated from the 20 cells and weighed around 3.15 g. Similarly, the feed also isolated and tally as 153 paralyzed individuals which belonged to order Araneae and weighed 17.27 g. Among the four active nests of Mud dauber, two nests alone have been noticed the prey items and family Salticidae were showed the highest frequency as well as diversity followed by Lycosidae and Araneidae. *Sceliphron* wasps have been the subject of many studies in the past about prey selection. Halder *et al*. [2] and Gonzaga and Vasconcellos Neto [20] have been studied the same species and revealed that spiders collected from the mud wasp nests could be identified as *Neoscona odites* (Simon) (Araneidae) commonly known as orb-weaver spiders; *Lycosa* spp. (Lycosidae) or wolf spiders; and *Marpissa* spp. (Salticidae) or jumping spiders all of which were found abundantly in the vegetable ecosystem.

Most species appear to predominate over orb-web spiders (such as Araneidae) [21-23], however, terricolous spiders are selected in some cases, such as Sceliphron formosum (Smith), which predominantly over Salticidae [11]. Size appears to be a significant element in bait selection [24]. The active nest shape of the mud daubers was rectangle shape and substrate orientation of the nest shows 75% west followed by 25% east orientation the substrate of the nest was preferred as the wall for the long life of the larval as well as the wasp. Previously there is no study about diversity indices of spiders in a wasp nest so the present explained diversity indices of a spider. There was not much variation among the two nests of Mud daubers. The species richness, dominance index, Simpson diversity index, Shannan'H index, and Evenness are quite the same and individuals vary among the nests. The literature indicates that few insects greedily eat spiders to survive. To date, predatory mites, flies (Acroceridae), harvestman (Pholcus phalangioides) in the rice ecosystem [25], and spiders wasp (Pompilidae) feed on spiders, as been reported. However, the current study finalized that the mud dauber wasp, S. madraspatanum, is a spider hunter for juvenile survival.

CONCLUSION

Investigating natural history and related trophic connections were the initial inspiration for nest research and still feature in most studies. Almost every nest study donates to natural history knowledge. This trend likely reflects the general shift from primarily explanatory approaches to more comparative and hypothesis-driven research going beyond the detailed study of life history that is seen across biology and ecology. Likewise the present study revealed the natural history of nest of mud-dauber wasp. It illustrate the structure and other features of the nest.

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