



*Rec. zool. Surv. India* : 107(Part-3) : 33-38, 2007

## **SOME ASPECTS OF WEB-BUILDING MECHANISM BY AN ARANEID SPIDER *ARGIOPE SHILLONGENSIS* SINHA FROM BORTIBEEL, NORTH 24 PARGANAS, WEST BENGAL**

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### **INTRODUCTION**

In our regular life we often observe different types of spider webs in which only the diverse varieties of spiders perform their biological activities and do not wander. They build their webs restricting themselves around it and considered as weavers. Unlike different other spiders ~~they~~ do not build webs but wanders, ambushes, commensals and hunts as non-weavers. Among the web building spiders again there are great diversities in the physical outlooks, functional, structural and environmental conditions in their webs. According to the pattern of their webs web-building spiders are recognized as true orb-web weavers and non-weavers. *Argiope shillongensis*, the spider species of present context is a true orb-web weaver.

During last 5 years while carrying out the ecological investigation on wetland environment of Bortibeel, a 13 km stretched isolated Gangetic marsh land covering about 3,00,000 bighas of cultivated land and several agricultural and fishing villages situated between 88.29–88.38 degree East and 22.8–23.0 degree North of West Bengal the authors came across the experimental spider species *Argiope shillongensis* Sinha, belonging to the family Araneidae weaving it's orb web near the paddy field of the wetland and conducted an extensive behavioral observation.

The present paper deals with the details of the sites where the spider builds it's web, the net supports for anchoring web-threads, the type of alignment, the geometrical pattern of the orb-webs, the places it stays near the web while retract, the morphological structure and measurements of web, the mesh type, the thickness of the thread, the time span it needs to build the web and orb-weaving mechanism along with the biological significance.

Information on orb-weaving behavior of araneid spiders are lacking from Bortibeel wetland area of north 24 parganas District, west Bengal. Tikader (1961) made an observation on spider

web as a protective device of spider. Tikader (1987) recorded nest-building mechanism of spider from India, Tikader (1982) made an observation of nest building behavior of araneid spiders from India. Biswas *et al.* (1995) made an observation on rice field spiders from Bangladesh, Majumder (2001) recorded some important notes on spider nest by which Odonates were caught. During last few years (since the pre-monsoon of 2001) the author while conducting the ecological studies on Bortibeel wetland have come across one araneid spider (*Argiope shillongensis* Sinha) the structural identity of its web, the interesting orb-weaving behavior near the paddy fields of the wetland.

## MATERIAL AND METHOD

**Bortibeel :** A 13 km stretch of marsh land crept up on several agricultural and fishing villages covering about 3,00,000 bighas of cultivated land situated between 22.8–23.0 degree Latitude and 88.29–88.38 degree Longitude in 5 assembly segment of Jagaddal, Khardah, Amdanga, Naihati and Barasat. The study area is situated between the 73/A bus route and Nilganj road in North-South and between NH34 and Kalyani high way in East-West. Several rail stations like Halisahar, Naihati, Kankinara, Jagaddal, Shyamnagar, Ichhapur, Palta, Barrackpur and Barasat connect the large wet area. Many villages like Ratanpur, Taraberia, Beharia, Boseganchia, Baraganchia, Kushdanga, Tapanpur and Tentulia are bordering the east while Dogachi Panpur, Mukundapur, Uchhegarh, Mahakaltala, Basudevpur, Kadamtala, UttarHansia, Dashgaria, Kaliaghata and Mathurapur, are bordering the West of the Wetland. The most important thing of this wetland is the network of several canals namely Ichhapur Khal, Pancha khal, Trimohini, khal, Koirapur khal, Basudevpur khal, Hanjana khal and Pakhimara Khal *etc.* are connecting Noai Khal (or Noai River) which was previously connecting the Vidyadhari River and also included with the riverine network of GANGA which is now almost disconnected.

**Climate :** Monsoon prevails for about four months from mid of June to mid of October with high humidity. Annual range of humidity is between 85–95%. July-August are the heavy rainfall months with precipitations as high as 400 mm. Occasional rains are also encountered through out the year. Pre-monsoon is dry and warm with thunder storms. Post-monsoon is apparently cold with negligible rainfall. Maximum temperature reaches up to 45 degree Celcius in May while the mean maximum temperature is 30 degree Celcius. observed in June. On the other hand the minimum temperature drops up to 8 degree Celcius in January and the mean minimum temperature is 20 degree Celcius.

**Agriculture :** Several paddy-fields have grown in this wetland that are accessible only in the dry season up to early monsoon till the heavy rain stops and the stagnant water have dried up considerably. Rice of different varieties, Jute, Sugarcane and vegetable of almost all varieties possible to cultivate in this type of environment (on the comparatively uplands besides the fishery ponds) are grown in this wetland.

**Aquaculture :** Hundreds of reservoirs have been developed within the wetland area for the purpose of irrigation and aquaculture. Besides canal fisheries fishermen also developed the art of captive aquaculture with those man made and natural reservoirs.

**Instruments :** Collections were made by an inverted umbrella, forceps with soft-tension, small brush and with a standard hand sweeping net (129 cm in diameter). Sunca electronic emergency lamp. Taxonomic studies have been made by a Olympus dissecting type binocular microscope with ocular micrometer while behavioral observations were performed by a Samsung's field binocular (B-10x25N), an electronic stop watch. Black velvet paper and tabulated data sheets were used.

**Collections :** Spiders were collected from the study areas directly from the webs by hand picking method, by the sweeping net and by dusting the nearby bushes in to an inverted umbrella. Web threads were collected in black velvet paper piece.

**Preservation :** Collected spider specimens were anaesthetized, killed in a killing jar and finally preserved in Oudman's preservative (90 parts 70% ethanol, 5 parts glycerol and 5 parts glacial acetic acid) in glass vials.

**Identification :** Well preserved spider specimens were sorted transferred in ethyle alcohol and studied under binocular microscope in a Petri dish. The specimens were identified up to species level.

## OBSERVATIONS

Behavioral studies on araneid species were studied by random, repeated and extensive observations in different phases particularly in twilight dark as follows :

1. In Random observations, the specific behavior of the spiders were studied while came across any spider web under building process.
2. In Repeated observations, the same type of observations were noted from same and different study spots for same spider species.
3. To study the complete action of web-building, hours of continuous and extensive observation have been conducted when ever we got a chance from the beginning of the art.

In our initial observation during May, 2001 we first saw some *Argeope* spiders were busy in web-building process on the weed plants near the plaguing paddy fields. Later on September 2001 onwards we saw the same spider species was preparing its web on the paddy plants along with the folded leaf blades throughout the cultivated period. The observations were repeated continuously till the winter 2004. Every time the count of webs were increased simultaneously on the progress of flowering and reproduction of the paddy plants of the field. It is observed that they generally select their site both in dry and wet areas to build their web within the branches of low bushes or

on the small trees and in between shallow pump house and small vegetations to trap insects as their food. The highest number of orb-web of same type is observed during the early growth of paddy seeds when a particular odor, an aroma is thriving through out the field. The second highest count is observed during the flowering period. In maximum cases we saw the webs in fresh condition while watching in the morning. Even when we intentionally ruptured the snare in previous evening we saw the web is being repaired within the next very morning. The long paddy leaf blades, branches of low bushes and the walls of the pump houses in the field they took as their net support for anchoring the web vertically aligned to the ground. As we know that spider web has a particular shape and displays an engineering art of architecture in nature. It's technical morphology is totally build on the purpose of entangling insect preys for their nourishment. The web we observed made by *Argiope shillongensis* Sinha is an unique type having a circular disk-net entangled into an irregular pentagonal frame made by thick spider-silk-threads. The pentagonal frame is further entangled with the net support to hang the orb-web. The webs measured between 80.50 cm to 90.00 cm in radius for adults while 20 cm to 45 cm in case of young spiders which cover the larger population of our study materials.

The orb-web of *A. shillongensis* is commonly provided with stabilimentum, a zigzag ribbon like structure cross-mark across the hub. It consists of minute threads gather together to form a sticky band spun from the aciniform gland and aligned at the center of the web just after completion of the clockwise movement to build the web. In case of young spiders, the radial length of stabilimentum varies from 12 cm to 25 cm while in adult it is 30cm to 40cm. In two occasions near Uttar Hansia we noted the absence of such structure where in both cases the spiders were female and their measurements were 87.40 cm and 90.00 cm.

The mesh of the *A. shillongensis* is very irregular though in the outer side of the web the larger meshes are almost rectangular in shape and maximum of the meshes are quadrangles of different measuring ratios.

Unlike females, Male *A. shillongensis* perhaps does not prepare web or any nest near by their web but they watch for their prey and retreat when frightened. We saw the spider moving around the web leaving a comparatively thicker thread like dragline to be intimidated by the entangled prey on it's web. It is also observed that in maximum cases the young *A. shillongensis* watching its prey by setting itself behind a small bush or leaf near by. Females after preparing their orb-web take rest and wait in the centre of the web camouflaging with it's stabilimentum. The threads we collected on velvet paper measure under microscope with ocular micrometer. The thickness found in the range between 0.009 mm to 0.015 mm and very occasionally up to 0.025 mm.

Generally we saw *A. shillongensis* to build its orb-web during our returning time from the field at evening and very occasionally in day time. To emphasize the studies on nest building habit of the spider we kept our evening observations in 5 nearby spots of little different habitats of

Basudevpur like (1) in the paddy field, (2) in between paddy field and nearby bushes, (3) in between two paddy fields, (4) in between two paddy fields separated by a small stream and (5) between the wall of pump house and leaf blades of paddy plants where we visited in short intervals of times. It is observed that adult spider took about 40–55 minutes to finish the web while the young one take only 30–40 minutes. In the other hand they could repair their webs very quickly. One major damaged web took only 10 minutes to repair, which looks like a new one by an adult. Young one never observed in repairing job.

### **Orb weaving mechanism of *Argiope shillongensis***

Female spiders of this group spinned the weaves. The threads are first formed from the spinnerets and holds the threads by the claw of one of her hind legs and attaches it at the first anchoring point A at any net support item. From the initial point she drops herself with the threads until she reaches another point B of other net support then she moves further to two other points C, D, & E and finally she reaches to the point A thus a pentagonal outer frame work of the weave is formed. It took about 4–5 minutes. In the next step we observed her to move through the horizontal strand up to half of it's length and drops down to a point on the pentagonal frame to build a connecting thread line. She then again scroll up through the thread line up to it's middle, the ultimate centre of the web. From the centre the spider starts to construct the radial threads, thus the centre or hub of the web formed within another 10–15 minutes. From the centre she builds the circular less-viscid threads in anticlockwise direction up to the periphery. Later on she reverses its direction, rolls up the old threads and puts down the new thread which is finer and more closely intercepted sticky-silks. The clockwise spreaded threads ware comparatively more elastic and stickier. In both the movements took same time *i.e.*, about 20–35 minutes but not with uniform speeds. The speed in case of the clockwise movement is almost double to cover almost double the length of anticlockwise circled threads.

## **DISCUSSION WITH BIOLOGICAL SIGNIFICANCE**

From our studies it is revealed that both young and adult *Argiope* build their orb-web within a day ranging an average time span from 30 to 55 minutes and at a stress or with considerable intervals in and around the paddy field. As we observed that population of the spider as well as their webs are higher in number during flowering and early seed bearing seasons like the pathogenic insects. Hence it is suggested that *Argiope* might have gathered in anticipation with the availability of sufficient prey for it's nourishment.

Whole the environmental condition along with the addicting aroma of mature paddy flower throughout the field together might have a key role on their gathering and web-building in a particular season. The number of smaller size web in larger count and larger size webs in lesser count may suggest the balance trophic level and size compatibility among the preys and predator.

In the measurement of threads unlike common threads we got some thicker threads measuring about 0.025 mm which might have been fused double, triple or tetrad thinner threads. In maximum occasions we observed the spider building its web in evening onwards. It might be due to their busy activities in daytime with capturing insect preys that are also diurnally active. We never saw a single young spider repairing its web might be due to their smaller webs which can easily be prepared instead of repairing it. The web building mechanism of *A. shillongensis* shows so sophistications and precisions that easily trap to capture prey for nourishment of spider thus demand immense biological significance towards the study of paddy pest population. The web-building habit by *A. shillongensis* near and in the paddy field traps different insects belonging to the orders Orthoptera, Lepidoptera, Coleoptera, Hemiptera Diptera, Hymenoptera etc. Lot of species from those insect families are hazardous to paddy plants and controlled naturally by the web building and feeding habits of the spider also have tremendous ecological impact and biologically significant. Thus the potential impact of *A. shillongensis* in insect pest management possesses great significance.

#### ACKNOWLEDGEMENTS

The authors are grateful to Dr. J.R.B. Alfred Director and Dr. R.A. Khan, Additional Director, Zoological Survey of India for kind permission to carry out the work.

#### REFERENCES

- Biswas, V., Kamal, N.Q. and Begum, A. 1995. Orb-weaving behavior of some rice field spiders, *Bangladesh J. Zool.*, **23**(2) : 147-152.
- Chawdhury, S.H. and Nagari, S. 1981. Rice field spiders from Chittagong, *Proc. Zool. Soc. Bangladesh* : 53-72.
- Majumder, S.C. 2001. Observation on predation of Damselflies by spiders in the Sundarban, West Bengal, *Bionotes*, **3**(3) : 65.
- Tikader, B.K. 1961. Protective devices of some web-weaving spider from India. *J. Bombay nat. His. Soc.*, : 827-830.
- Tikader, B.K. 1982. *Fauna of India*, Spiders : Araneae, **2**(2) : 259-446.
- Tikader, B.K. 1987. Handbook of Indian Spiders. *Zool. Surv. India* : 1-251.