DIVERSITY OF SPIDERS
IN KUTTANAD RICE AGROECOSYSTEM

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1. 1. Introduction

During the past decade, there has been interest in the employment of natural enemies, notably predators, for the regulation of insect pests. Despite their importance, the systematics of spiders and the role they play in pest population regulation has received little attention. Limited systematic information is available to support work in biological control including the basic need of species identification. It is, therefore, of great priority to make a systematic study of rice field spiders in various rice environments to document and characterize the spider fauna as a basis for biocontrol studies.

Spiders, which include about 39,725 described species and are estimated to number 60,000–170,000 species (Coddington & Levi, 1991; Platnick, 2007), comprise a significant portion of the terrestrial arthropod diversity. Spiders are abundant and ubiquitous, employ a remarkable diversity of predation strategies, occupy a wide array of spatial and temporal niches, are characterized by high within-habitat taxonomic diversity, exhibit taxon- and guild-specific responses to environmental change, and are relatively easy to sample and identify. They are important regulators of insect populations (Riechert & Lockley, 1984; Riechert & Bishop, 1990; Wise, 1993) and may prove to be useful indicators of the overall species richness and health of biotic communities (Kremen et al., 1993; Colwell & Coddington, 1994; Norris, 1999).

Rice is the dominant staple food in the developing world. More than 90% of the world’s rice is produced and consumed in Asia. Water is a prominent factor in the wetland rice ecosystem, making it different from other agricultural productions. The biodiversity of wetland rice ecosystem is higher than in many natural ecosystems (Schoenly et al., 1996).

The diversity and density of spiders are important in any kind of attempt for the implementation of integrated pest management system (IPM). They exhibit extremely high diversity and are the dominant insectivores in many terrestrial ecosystems. They feed exclusively on insects and are of economic value to man because of their ability to suppress pest abundance in agroecosystems. The population densities
Spiders of Kuttanad

and species abundance of spider communities in agricultural fields can be as high as in natural ecosystem (Riechert, 1981; Tanaka, 1989). In spite of this, they have not usually been treated as an important biological control agent because very little is known of the ecological role of spiders in pest control (Riechert & Lockley, 1984).

1.2. Review of Literature

Studies conducted in India:

Studies conducted in other countries:
Spiders have been mentioned as predators in rice fields by several workers. In south and south East Asia, many studies were carried out on the diversity of spiders in rice fields (Kamal et al., 1992; Song & Lee, 1994; Barrion & Litsinger, 1995; Kim, 1995; Bambaradeniya & Edirisinghe, 2001). In Korea, spiders in rice fields have been studied more extensively than any other crops (Kim et al., 1990; Lee et al., 1993; Kim, 1995; Kim & Kim, 1995; Lee et al., 1997; Yun, 1997; Yang et al., 1998; Kim, 1998; Im & Kim, 1999). Heiss & Meisch (1985) studied the spiders associated with paddy fields in Arkansas region of United States and their species composition in the fields. Bastidas & Pantoja (1993) reported that weekly sampling of Colombian rice fields with as sweep net yielded 27 species belonging to 23 genera and 11 families.
The studies of Zheu & Zheng (1984) revealed that *Lycosa pseudoannulata* was found to be one of the main components of the lycosid subcommunity in the rice fields of China. Earlier, *Larinia tabida* and *Clubiona japonicola* have been reported as dominant spiders from rice fields in the Philippines (Barrion & Litsinger, 1984). Studies of Way & Heong (1994) revealed the ecological balance between insect pests and their natural enemies like spiders. Loevinsohn (1994) studied the importance of movement of spider community between paddy fields for the establishment of population. It is also established that field densities of spiders co-vary with hopper densities (Reddy & Heong, 1991). According to Schoenly *et al.* (1996) and Pathak & Kahn (1994), the biodiversity of irrigated rice is higher than in many natural ecosystems. A previous study showed that vegetation in field bunds and other non-rice habitats surrounding paddy fields are important refuges for spiders in paddy fields (Barrion & Litsinger, 1984).

Although numerous surveys of spiders have been conducted in the rice growing regions of Asia (Barrion & Litsinger, 1995), very little is known about spiders associated with rice in the United States. Preliminary surveys have been conducted in Arkansas (Heiss & Meisch, 1985). After that, Oraze *et al.* (1988) studied the spider fauna of flooded rice fields in northern California. Bambaradeniya (2000) has discussed in detail the factors that govern the ecology of the irrigated rice field ecosystem. Previous studies on rice field ecology (Simpson & Roger, 1995; Simpson *et al.*, 1993 & 1994) have clearly revealed that agronomic practices change the physical, chemical and biological conditions in the rice ecosystem, making them less favourable for certain organisms and temporarily more favourable for others.

Barrion & Litsinger (1994) provided a compendium on the taxonomy of the insect pests of rice and their natural enemies. According to Dale (1994) who has given a comprehensive account of the biology and ecology of insect pests of rice, over 800 species of insects damage rice plants in several ways, although the majority of them cause minor damage. The number of insect species that cause economic damage to rice varies from 20 to 30 (Pathak & Khan, 1994). Bambaradeniya (2000) recorded 130 species of phytophagous insects in rice fields, of which the majority (76 species) consisted of visitors or other insects associated with weeds. Loevinsohn (1994) has discussed various forces that determine the presence and abundance of insect pests in rice agroecosystems. Ooi & Shepard (1994) gave a comprehensive account of the natural enemies of rice insect pests. They stated that long histories of rice cultivation in many parts of the world have allowed stable relationships to evolve between rice insect pests and their natural enemies. In most instances, the species richness and abundance of predator populations may be greater than those of the pest populations, when little or no insecticides are used.
Spiders of Kuttanad

(Way & Heong, 1994). A pioneering study by Settle et al. (1996) conducted in Java demonstrated the existence of high levels of natural biological control in tropical irrigated rice systems. Abdullah et al. (1997) reported that, plant hopper populations in the Muda agroecosystem in Malaysia were probably held in check by a combination of natural arthropod predators and common insecticides. Bambaradeniya (2000) observed that more than 50% of the terrestrial arthropod species in Sri Lankan rice fields consisted of predators, with spiders being the dominant predatory group. Predatory arthropods, including insects and spiders, attack all stages of rice insects. Spiders are abundant in rice fields throughout the world. The wolf spider, *Lycosa pseudoannulata* is probably the most important predator in rice fields in Asia (Barrion & Litsinger, 1994).


Pesticides used in rice cultivation to kill rice pests and weeds can have a devastating effect on the living organisms for shorter or longer periods of time (Fernando, 1996). A number of reviews on the biocide use in rice fields and its impacts on fauna and microflora (Lim, 1992; Abdullah et al., 1997) further discuss this issue at length. The impact of biocides use in rice cultivation on vertebrates inhabiting rice fields and surrounding aquatic habitats have been investigated by researchers (Cagauan, 1995; Tejada et al., 1995). The effects of pesticides and fertilizers on specific groups of rice field organisms have been clearly documented in the study conducted by Bambaradeniya (2000).

The fauna and flora are reasonably well documented, but we do not know the manner and extent to which biodiversity has been disrupted or enhanced or changed by the replacement of natural habitats by rice ecosystems. There appear to be no comparative biodiversity studies that would yield such temporal (i.e., before – after) or spatial (rice ecosystem vs. adjoining natural ecosystem) information. Given the diversity of rice cultivation systems, their geographic and elevational spread, and the diversity of natural environments that they have replaced, there is ample scope for research into the positive and negative impacts on biodiversity of this major food production system in the world. This would, in turn, stimulate new thinking on how to maximize the biodiversity potential of the rice ecosystem.
1.3. Materials and Methods

Study area:

Kuttanad is rightly called one of the “Rice Bowls of Kerala”, contributing nearly 20% of the total rice production of the state. The region extends from 9° 17’ N to 9° 40’ N and 76° 19’ E to 76° 33’ E. It is a low lying area of coastal Kerala formed by the confluence of 4 major river systems viz., Meenachil, Manimala, Pamba and Achancoil draining into the Vembanad Lake. It measures approximately 25 km east west and 60 km north south on the west coast of Kerala (Figure 1.1.). The area encompasses 79 revenue villages lying in 2 districts. From the very early days, Kuttanad has been acknowledged as the rice bowl of Kerala. Millions of years ago, this land was a dense forest. In succeeding geological ages, the sea advanced and engulfed many places including this area. Several thousand years later, the sea receded exposing parts of midlands and coastal region. During these geological upheavals, the entire forest area was submerged far below the ground and thereafter silted up to varying levels. This area was further converted into garden lands and wet lands by the process of reclamation which now characterizes the Kuttanad. Geologically, Kuttanad is an alluvial belt formed of tertiary and quaternary sediments. The region appears as a saucer shaped basin flanked by the sand dunes in the west and low lateritic hills in the east. This deltaic alluvium is alternating layers of sand and clay of varying sizes and variable percentage of organic matter. The deltaic formations of the river systems in the basin gradually slope down to the Vembanad Lake and merge with it which is connected to the Arabian Sea by the Cochin estuary. Therefore, the flood incidence and the salinity intrusion affect variously on the different parts of the delta formation. The geographical area of Kuttanad is 874 km² in which 290 km² are garden lands rising 1-2 m above mean sea level. The remaining area is 0.6 - 2.2 m below MSL. Based on the flood incidence, salinity intrusion and other climatological parameters, Kuttanad has been divided into following 3 agroecological zones. (1) Upper Kuttanad (2) Lower Kuttanad (3) Kayal lands. During southwest monsoon, the entire area will be submerged under floodwater. The floodwater gradually drains through the watercourses and Vembanad Lake in to the sea through the Cochin gut. As the monsoon recedes, the seawater enters Vembanad Lake by tidal action and from there it spreads to other parts of Kuttanad through interconnected waterways and canals. Thus, the area is subjected to continued flood submergence during monsoon and saline water ingress during summer months. The meteorological data of the study area during the study period is furnished in Table 1.1. In Kuttanad, rice is cultivated in 53,639 hectares, which is a warm, humid region with fairly uniform temperature throughout the year ranging from 21°C to 36°C.
Humidity in general is very high all throughout the year. The average annual rainfall received is around 300 cm of which about 83% are received during monsoon months. This major rice-growing tract of Kerala state is facing the serious threat of environmental pollution due to the increased and indiscriminate use of pesticides. The pesticide consumption in Kuttanad during 2004-2005 was 485 tons.

Figure 1. 1. Map of the study area
Table 1.1. Climatological parameters during the study period

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Temperature (°C)</th>
<th>Relative Humidity (%)</th>
<th>Rain fall (mm)</th>
<th>Rain days</th>
<th>Wind velocity</th>
</tr>
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<td>32.88</td>
<td>76.89</td>
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Study time:
The investigation was carried out for a period of 3 years from November 2001 to February 2004. Sampling was conducted during five seasons; Kharif 1 (Winter crop) (November 2001 – February 2002), Rabi 1 (Monsoon crop) (June 2002 – September 2002), Kharif 2 (November 2002 – February 2003), Rabi 2 (June 2003 - September 2003) and Kharif 3, (November 2003 – February 2004). The Rabi season is characterized by heavy rain (South-West Monsoon) and high humidity. More than 80%
of the total annual rainfall is received during this season. The Kharif season is characterized by low rainfall and dry weather (Menon et al., 2000). The following eight sites were selected for the study: Chambakulam, Edathua, Krishnapuram, Moncompu, Nedumudy, Pallathuruthy, Pallikoottuma and Vellisrakka (Plate 1.1 - 1.8).
Sampling:

The sampling was done fortnightly. Each crop season included seven stages of samplings according to the growth of the plant. A total of 28 quadrates were studied each season per site by collecting from 4 quadrates. Thus during each season specimens from 224 quadrates were collected. During the entire study, a total of 1120 quadrates were sampled.

Quadrate method: Spiders were collected from quadrates (1 m × 1 m). Four quadrates were placed at four corners of 10m×10m area. Sufficient core area was left to avoid edge effect. The area around each plant was searched for possible webs and the plants were thoroughly examined from the bottom to the top and on leaves and flowers for spiders and pests. All 4 quadrates were searched for a total of one hour. Spiders were collected by leading them into glass tube (5.2 cm × 2.0 cm) from the ground stratum and from the terminals of plants by beating them with a rod and the falling spiders were collected in glass tubes. Specimens from each quadrate were preserved in 70% ethyl alcohol in the field and counted under a stereo-zoom microscope (Leica - MS5). Spiders of all life stages, including egg cases were also collected during the sampling.

Sampling technique:

To measure the density of predatory spiders and major insect pests and their frequency and abundance during various seasons and at different places, following methods were used.

Hand picking: Hand picking method was used to collect the spiders from the leaf blades, flowers, dry leafs and from ground stratum. The areas around each plant were thoroughly examined from the top to bottom on leaf blades, flowers and dry leafs for spiders and insect pests. The ground area near the plants was also searched. According to the collection, the location where the spiders were found was also noted. Spiders were easily collected by leading them into glass vials (5.2 cm x 2.0 cm) from the ground stratum and from the terminals of the plants. All the collected specimens were preserved in 70% ethyl alcohol with proper labeling of locality, date, crop stage and other notes of importance. Field record was maintained throughout the study period. The field collection data also used to calculate the species richness, species diversity and relative abundance of dominant spiders present in different location and season.
Sweeping: Standard sweeping method was also used to collect spiders from the field. A sweep net made by attaching a mosquito net to a 0.38 m diameter iron frame fitted on a wooden pole was used for sweeping. Ten sweeps were performed lengthways along a row (approximately 10 m) in every fortnight. The contents of these ten sweeps were transferred to a collection bottle and preserved in 70% ethyl alcohol with proper labeling of locality, date, crop stage and other notes of importance and later identified in the laboratory.

Identification of spiders:
The collected spiders were identified up to the species with the help of available literature (Tikader, 1987; Barrion & Litsinger, 1995). Monthly data were prepared for each crop with detailed information on the occurrence of mature male, female and juvenile spiders. These data were used to deduce the seasonal abundance and breeding period of dominant spiders. These data were also used to study the phenology and understand certain stages in the life history of important spiders in field condition. Adult males and females collected from the fields were identified up to the species level. The masses of immature spiders were identified up to the generic level and used the following criteria for their identification up to the species level.
1. When adults of single species of a genus was represented from an area, all immature stages collected from that area of that genus were identified as that species.
2. When two or more species of adult specimens were found of one genus, the immature stages collected were reared up to maturity to confirm their species and also tried to identify with the help of colour and size differences even before attaining maturity.
The immature stages of certain families or genera which were found to be rare and the very few numbers collected were identified only to the generic level.

Diversity indices:
The diversity, richness, and evenness indices of spider communities were calculated using the SPDIVERS.BAS programme of Ludwig & Reynolds (1988). Diversity analysis determine the significance of observed differences in community structure between different crop growth stages and two seasons based on the species abundance distributions (Solow, 1993). Two diversity indices used are the Shannon-Wiener index, which is sensitive to changes in the abundance of rare species in a community, and the Simpson index, which is sensitive to changes in the most abundant species in a community (Solow, 1993). Shannon – Wiener index, which increases with the
number of species in the community, is an ordinal scale. A diversity index incorporates both species richness (the total number of species) and evenness (how equally abundant the species are), in a single value (Magurran, 1988). Species richness (S) examines the number of species occurring in a habitat. Overall species richness is the most widely adopted diversity measure. The values for Simpson’s index vary between 0 (for a sample with high diversity) and 1 (for a sample dominated by a few species).

Shannon index is defined as: \( H' = -\sum_i p_i \log p_i \)
Where: \( p_i = \) the observed relative abundance of a particular species.

Simpson index is defined as: \( \lambda = \sum ni (ni-1)/ [N (N-1)] \)
Where: \( ni = \) the number of individuals of species \( i \) and \( N = \sum ni \)

However, shifts towards incorporating species abundance have lead to widespread use of Shannon’s index (H’). A diversity index allows comparisons to be made between two conditions. This index is more easily interpreted than other diversity indices (Ludwig & Reynolds, 1988). If values for diversity indices are often difficult to interpret, species richness and evenness are often presented as separate values. In this form, they provide important insights into the ecological changes that occur over time or the differences between ecological communities (Bisby, 1995).

It would appear that an unambiguous and straightforward index of species richness would be S, the total number of species in a community. However, since S depends on the sample size, it is limited as a comparative index. Hence, a number of indices have been proposed to measure species richness that is independent of the sample size. They are based on the relationship between S and total number of individuals observed, \( n \), which increases with increasing sample size. The Margalef index, \( R = S-1/\ln (n) \).

When all species in a sample are equally abundant an evenness index will be at its maximum, decreasing towards zero as the relative abundance of the species diverges away from evenness. Probably the most common evenness index used by ecologists is \( E = \ln (N1)/\ln (N0) \). An evenness index should be independent of the number of species in the sample. Intuitively, it would seem reasonable that regardless of the number of species present, an evenness index should not change. It has shown that the addition of a rare species to a sample that contains only a few species greatly change the value of E (Ludwig & Reynolds, 1988). Two tailed ANOVA tests were used to test the hypothesis that the crop growth stages and seasons collect different abundance and composition of spider assemblages.
Vertical stratification:
Spiders collected from the field were classified into five main functional groups based on their distribution on the different strata. These strata based on the relative distance in the crop itself that exhibit limitations on spiders set by both physical conditions and biological factors. Describing the spider diversity in terms of these groups allows greater insights into how habitat differences may be reflected in the foraging strategies. In the present study, 5 main functional groups were recognized, namely <20cm from water /soil surface, 20 – 40 cm, 40 – 60 cm, 60 – 80 cm and >80 cm.

Guild structure:
Ecological characteristics relating to foraging manner, nature of web, prey species, microhabitat use, site tenacity and daily activity were subjected to guild classification. Output of the analysis was organized into tabular form. The spider guild classification was composed according to the families collected during the study. Designation of spider guild was based on the ecological characteristic known for the family (Young & Edwards, 1990).

1. 4.  Results

1. 4.1.  Taxonomy
A total of 17717 individuals belonging to 99 species, 66 genera and 20 families were sampled in Kuttanad during the study period (Table 1. 2.). The spiders collected from the various sites were identified with the help of literature. The key to the families and separate keys to genera and species for the specimens dealt with in this work are provided.
Diversity of spiders

Table 1.2. Checklist of spiders collected from Kuttanad rice agroecosystem

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Family/Genus/Species</th>
<th>No. of specimens collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>FAMILY AMAUROBIIDAE</strong> Thorell, 1870</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td><em>Amaurobius</em> sp.</td>
<td>5</td>
</tr>
<tr>
<td>II</td>
<td><strong>FAMILY ARANEIDAE</strong> Simon, 1895</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td><em>Araeneus ellipticus</em> (Tikader &amp; Bal, 1981)</td>
<td>932</td>
</tr>
<tr>
<td>3</td>
<td><em>A. insutus</em> (Koch, 1871)</td>
<td>154</td>
</tr>
<tr>
<td>4</td>
<td><em>A. nympha</em> (Simon, 1889)</td>
<td>324</td>
</tr>
<tr>
<td>5</td>
<td><em>Argiope aemula</em> (Walckenaer, 1842)</td>
<td>107</td>
</tr>
<tr>
<td>6</td>
<td><em>A. catenulata</em> (Doleschall, 1859)</td>
<td>38</td>
</tr>
<tr>
<td>7</td>
<td><em>A. pulchella</em> Thorell, 1881</td>
<td>21</td>
</tr>
<tr>
<td>8</td>
<td><em>Cyclosa confraga</em> (Thorell, 1892)</td>
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</tr>
<tr>
<td>9</td>
<td><em>C. fissicauda</em> Simon, 1889</td>
<td>11</td>
</tr>
<tr>
<td>10</td>
<td><em>Cyrtophora citricola</em> (Forskal, 1775)</td>
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<td><em>Nesocona vigilans</em> (Blackwall, 1865)</td>
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<td><strong>FAMILY CLUBIONIDAE</strong> Wagner, 1887</td>
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<td>12</td>
<td><em>Clubiona drassodes</em> Cambridge, 1874</td>
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<td>13</td>
<td><em>Clubiona</em> sp.</td>
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<td><strong>FAMILY CORINNIDAE</strong> Karsch, 1880</td>
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<td>14</td>
<td><em>Castianeira zetes</em> Simon, 1897</td>
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<td><strong>FAMILY GNAPHOSIDAE</strong> Pocock, 1898</td>
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<td>15</td>
<td><em>Gnaphosa</em> sp.</td>
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<td><strong>FAMILY HERSIILIDAE</strong> Thorell, 1870</td>
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<td>16</td>
<td><em>Hersilia</em> sp.</td>
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<td>VII</td>
<td><strong>FAMILY LINYPHIIDAE</strong> Blackwall, 1859</td>
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<td><em>Atypena adelinae</em> Barrion &amp; Litsinger, 1995</td>
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<td><em>A. thailandica</em> Barrion &amp; Litsinger, 1995</td>
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<td><em>Atypena</em> sp.</td>
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<td><em>Erigone bifurca</em> Locket, 1982</td>
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<td><strong>FAMILY LYCOSIDAE</strong> Sundevall, 1833</td>
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<td><em>Arctosa khudiensis</em> (Sinha, 1951)</td>
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<td><em>Lycosa mackenziei</em> Gravely, 1924</td>
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<td><em>L. poonaensis</em> Tikader &amp; Malhotra, 1980</td>
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<td><em>L. tista</em> Tikader, 1970</td>
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<td><em>Pardosa amkhasensis</em> Tikader &amp; Malhotra, 1976</td>
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<td><em>P. pseudoamnulata</em> (Bosenberg &amp; Strand, 1906)</td>
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<td><em>P. shyamalae</em> (Tikader, 1970)</td>
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<td><em>P. sumatraana</em> (Thorell, 1890)</td>
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<td><em>Trochosa punctipes</em> (Gravely, 1924)</td>
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<td><strong>FAMILY MITURGIDAE</strong> Simon, 1885</td>
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<td><strong>FAMILY OXYOPIDAE</strong> Thorell, 1870</td>
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<td><em>Oxyopes ashae</em> Gajbe, 1999</td>
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<td><em>O. bharatae</em> Gajbe, 1999</td>
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<td><em>O. javanus</em> Thorell, 1887</td>
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<td><em>O. sakuntalae</em> Tikader, 1970</td>
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<td><em>O. shweta</em> Tikader, 1970</td>
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<td><em>O. sunandae</em> Tikader, 1970</td>
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<td>37</td>
<td><em>Oxyopes</em> sp.</td>
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<td><em>Peucetia viridana</em> (Stoliczka, 1869)</td>
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<td><strong>FAMILY PHILODROMIDAE</strong> Thorell, 1870</td>
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<td>39</td>
<td><em>Philodromus</em> sp.</td>
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<td><em>Thanatus parangvulgaris</em> Barrion &amp; Litsinger, 1995</td>
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<td><strong>FAMILY PHOLCIDAE</strong> Koch, 1851</td>
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<td>41</td>
<td><em>Artema</em> sp.</td>
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<td>42</td>
<td><em>Crossopriza</em> sp.</td>
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<td>43</td>
<td><em>Pholcus</em> sp.</td>
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<tr>
<td>44</td>
<td><em>Uthina</em> sp.</td>
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<td>XIII</td>
<td><strong>FAMILY PISAURIDAE</strong> Simon, 1890</td>
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<tr>
<td>45</td>
<td><em>Perenethis</em> sp.</td>
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<tr>
<td>46</td>
<td><em>Pisaura</em> sp.</td>
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<td><strong>FAMILY SALTCIDAE</strong> Blackwall, 1841</td>
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<td>47</td>
<td><em>Asemonea</em> sp.</td>
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<td>48</td>
<td><em>Bavia</em> sp.</td>
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<tr>
<td>49</td>
<td><em>Bianor</em> sp.</td>
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<td>50</td>
<td><em>Brettus</em> sp.</td>
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<td><em>Carrhotus viduus</em> (Koch, 1846)</td>
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<td><em>Harmochirus</em> sp.</td>
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<td><em>Hasarius adansoni</em> (Audouin, 1826)</td>
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<td><em>Hyllus semicupreus</em> (Simon, 1885)</td>
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<td>55</td>
<td><em>Menemerus</em> sp.</td>
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<td><em>Myrmarachne orientales</em> Tikader, 1973</td>
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<td><em>M. platateoides</em> (Cambridge, 1869)</td>
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<td><em>Phintella vittata</em> (Koch, 1846)</td>
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<td><em>Plexippus paykulli</em> (Audouin, 1826)</td>
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<td>60</td>
<td><em>P. petersi</em> (Karsch, 1878)</td>
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<tr>
<td>61</td>
<td><em>Plexippus</em> sp.</td>
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<td><em>Rhene danieli</em> Tikader, 1973</td>
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<td>63</td>
<td><em>Rhene flavigera</em> (Koch, 1848)</td>
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<tr>
<td>64</td>
<td><em>Siler</em> sp.</td>
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<td>Species</td>
<td>Origin</td>
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<td><em>Telamonia dimidiata</em> (Simon, 1899)</td>
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<td><strong>FAMILY SCYTODIDAE</strong> Blackwall, 1864</td>
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<td><em>Scytodes fusca</em> Walckenaer, 1837</td>
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<td><em>S. thoracica</em> (Latreille, 1802)</td>
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<td><strong>FAMILY SPARASSIDAE</strong> Bertkau, 1872</td>
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<td><em>Heteropoda venatoria</em> (Linnaeus, 1767)</td>
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<td>69</td>
<td><em>Olios</em> sp.</td>
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<td><em>Theleticopis</em> sp.</td>
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<td><strong>FAMILY TETRAGNATHIDAE</strong> Menge, 1866</td>
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<td><em>Dyschiriognatha dentata</em> Zhu &amp; Wen, 1978</td>
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<td><em>Leucauge decorata</em> (Blackwall, 1864)</td>
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<td><em>L. pondae</em> Tikader, 1970</td>
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<td>74</td>
<td><em>Orsinome</em> sp.</td>
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<td><em>Tetragnatha andamanensis</em> Tikader, 1977</td>
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<td><em>T. javana</em> (Thorell, 1890)</td>
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<td><em>T. cochinensis</em> Gravely, 1921</td>
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<td><em>T. fletcheri</em> Gravely, 1921</td>
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<td><em>T. mandibulata</em> Walckenaer, 1842</td>
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<td><em>T. maxillosa</em> Thorell, 1895</td>
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<td><em>Tylorida</em> sp.</td>
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<td><strong>FAMILY THERIDIIDAE</strong> Sundevall, 1833</td>
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<td><em>Achaearanea</em> sp.</td>
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<td><em>Argyrodes andamanensis</em> Tikader, 1977</td>
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<td><em>Chryso argyrodiformis</em> (Yaginuma, 1952)</td>
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<td><em>Phycosoma martinae</em> (Roberts, 1983)</td>
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<td><em>Theridion lunabani</em> Barrion &amp; Litsinger, 1995</td>
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<td>89</td>
<td><em>Theridion</em> sp.</td>
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<td><strong>FAMILY THOMISIDAE</strong> Sundevall, 1833</td>
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<td><em>Misumenops maygitgitus</em> Barrion &amp; Litsinger, 1995</td>
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<td><em>Oxytate virens</em> (Thorell, 1891)</td>
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<td>92</td>
<td><em>Ozyptila</em> sp.</td>
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<td><em>Runcinia</em> sp.</td>
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<td><em>Thomisus pugilis</em> Stoliczka, 1869</td>
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<td>95</td>
<td><em>Xysticus</em> sp.</td>
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<td><strong>FAMILY ULOBORIDAE</strong> Thorell, 1869</td>
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<tr>
<td>96</td>
<td><em>Miagrammopes</em> sp.</td>
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<td><em>Uloborus danolius</em> Tikader, 1969</td>
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<td><em>U. krishnae</em> Tikader, 1970</td>
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<td>99</td>
<td><em>Zosis</em> sp.</td>
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KEY TO THE SPIDER FAMILIES COLLECTED FROM KUTTANAD RICE AGROECOSYSTEM

1a. Araneomorphae with cribellum and calamistrum (Section Cribellate)………………………………………………………………………………….. 2

1b. Araneomorphae without cribellum and calamistrum (Section Ecribellate)………………………………………………………………………………….. 3

2a. Femora with rows of long trichobothria, metatarsi IV compressed and curved under the line of the calamistrum, first pair of legs clearly longer than the second pair………………………………………………………………………………………….. ULOBORIDAE

2b. Cribellum undivided, both tarsal claws of similar size, linear calamistrum with one row of setae only and located at base of metatarsus IV, carapace longer than wide, male palpal tibia with retrolateral apophysis…………………………………………….. AMAUROBIIDAE

3a. With less than eight eyes………………………………………………… 4

3b. With eight eyes…………………………………………………………….. 5

4a. Eyes in two well separated triads………. PHOLCIDAE (in part)

4b. Six small eyes arranged in three well separated contiguous diads, cheliceral promargin with fewer teeth, metatarsi longer than tarsi, carapace domed towards thoracic region, female epigastric region with anchoring holes ………………………………… SCYTODIDAE

5a. Tarsus with two claws…………………………………………………. 6

5b. Tarsus with three claws…………………………………………………. 13

6a. Eyes in three rows (4.2.2), rarely (2.2.2.2), anterior median eyes very large, jumping spiders………………………………… SALTICIDAE

6b. Eyes arranged differently………………………………………………… 7

7a. Legs laterigrade, directed towards side or forwards………………… 8

7b. Legs prograde, I and II directed forwards, III and IV backwards…………………………………………………………………………………………….. 10

8a. Tarsi and metatarsi without scopulae, legs I and II usually much longer than legs III and IV …………………….. THOMISIDAE

8b. Tarsi and sometimes metatarsi with scopulae, legs different…. 9

9a. Small to medium-sized spiders, chelicerae without teeth or at most one on retromargin, tarsus-metatarsus joint allowing movement in one plane only…………….. PHILODROMIDAE
9b. Medium to large sized spiders, chelicerae with at least two teeth (rarely one) on retromargin, membranous connection to metatarsus permits free movement of tarsus. **SPARASSIDAE**

10a. Posterior median eyes flat and round, without dome-shaped lens, maxillae obliquely depressed, anterior spinnerets conical, not widely separated, without long setae on spigots, anterior lateral spinnerets one segment with enlarged piriform gland spigots, sometimes spinnerets long and cylindrical, far apart

10b. Posterior median eyes with dome-shaped lens, maxillae usually not obliquely depressed, tarsi without auxiliary claws, sternum mostly longer than wide, eyes in two rows (4:4)...........11

11a. Posterior spinnerets clearly two-segmented with distal segment distinctly conical..........................**MITURGIDAE** (in part)

11b. Posterior spinnerets with one segment only or if two-segmented, distal segment rounded........................................12

12a. Male palp pear-shaped with short distal embolus, without median apophysis, females with square-shaped epigyne with spherical spermathecae and entrance ducts shining through integument, median spinnerets of female with three, posterior spinneret with two large cylindrical gland spigots .................................................................................................................**CORINNIDAE**

12b. Genitalia differently shaped, median and posterior spinnerets of female without such spigot, median spinnerets of females not flattened, without rows of large spigots.........**CLUBIONIDAE**

13a. Tarsi with trichobothria, often in a row...........................14

13b. Tarsi without trichobothria, legs without prolateral scopulae....19

14a. Eyes either in three to four rows or in three groups..............15

14b. Eyes in two rows, posterior spinnerets not particularly long or with one segment only, trochanters often notched....................18

15a. Eyes in three groups 4.2.2, carapace broad, raised towards the back..........................................................**PISAURIDAE** (in part)

15b. Eyes in three or four rows: 2:2:2:2, 4:2:2 or 2:4:2, posterior eyes not much larger than anterior ones, trochanters notched ...........................................................16

16a. Clypeus very high, posterior eyes and anterior lateral eyes forming a hexagonal group in front of small anterior median
Spiders of Kuttanad

eyes, numerous long spines on tibiae and metatarsi...........................................OXYOPIDAE

16b. Clypeus not as high, eye position and setae on legs different... 17

17a. Eyes sessile, not on tubercles, abdomen oval, smoothly rounded posteriorly, male palpal tibiae without retrolateral apophysis, cocoon attached to spinnerets, anal tubercle with one segment
.......................................................................................................................LYCOSIDAE

17b. At least one pair of eyes on shallow tubercles, abdomen almost always elongate, tapered to back, male palpal tibia with retrolateral apophysis, anal tubercle biarticulate, labium hardly longer than wide, anterior lateral eyes normal, egg cocoon carried between chelicerae and palp
.......................................................................................................................PISAURIDAE (in part)

18a. Posterior leg pairs often with paired claws only, labium longer than wide and with distal margin notched, trochanters notched, males with obvious crack at the base of tibiae............................................MITURGIDAE (in part)

18b. All leg pairs with three claws, labium rarely longer than wide but distal margin not concave, trochanters may be unnotched, males without crack at base of tibiae, anterior spinnerets either with one segment or distal segment shaped differently, trochanters may be notched, posterior eye row recurved, some eyes on tubercles, anterior and posterior spinnerets not obviously different in length, abdomen usually widest near front, tapering towards back, male palpal tibia without ventrodistant refolded rim.................................................PISAURIDAE (in part)

19a. Posterior spinnerets very long, last segment at least three times longer than wide, posterior spinnerets with a median row of spigots ...............................................................HERSILIIDAE

19b. Posterior spinnerets not unusually long................................. 20

20a. Eyes in three groups, anterior median eyes apart, remainder in two triads, legs thin and long, tarsi pseudosegmented...............................PHOLCIDAE (in part)

20b. Eye pattern and legs different, less hairy spiders .................... 21

21a. Paracymbium is a separate sclerite, tarsi usually cylindrical or sometimes fusiform, chelicerae often with stridulating file, small spiders without dentate process on male palpal cymbium..................................................LINYPHIIDAE
21b. Paracymbium fused to cymbium or rudimentary, no cheliceral stridulating file, tarsi variable……………………………………22

22a. Tarsi IV with ventral comb of serrated hairs, brownish rings around the eyes, femora without spines, paracymbium a small hook at the distal promargin of the cymbium, labium not rebordered, male palpal tibia broadened towards the extremity with typical fan of widely spaced setae …………………………………………………….. THERIDIIDAE

22b. Tarsi without ventral comb of serrated hairs, eyes without brownish rings, teeth on paired claws in the longitudinal axis, chelicerae usually with more teeth, tracheal spiracle much narrower than spinneret area, tarsi as thick at tip as at base, orb webs builders ……………………………………………………..23

23a. Male palp fairly simple without median apophysis but with conductor wrapping the embolus, paracymbium elongate or short, chelicerae usually long or swollen, modified for courtship in males, epigyne usually indistinct……TETRAGNATHIDAE

23b. Male palp complex, with median apophysis, embolus not wrapped by conductor, paracymbium often hook-shaped, chelicerae often swollen but not modified for courtship, epigyne often with scape……………………………… ARANEIDAE

1. FAMILY AMAUROBIIDAE Thorell, 1870 (Hackled mesh web weavers) (Plate 1. 9)

Identification features: Cephalothorax longer than wide, cephalic region slightly elevated, fovea varies from longitudinal to simple depression. Pale coloured eight eyes in two rows. Sternum oval to heart shaped, margin usually sinuous with blunt apex. Labium square to rectangular. Maxilla rectangular with serrula almost parallel. Chelicerae in males longer and more slender than in
females, both pro and retromargin with teeth. Legs long, three clawed with a single row of trichobothria on tarsi; trochanters are unnotched. Some species with dark annulations in leg. Abdomen oval with a dense layer of fine setae. Generally dark brown or grey with ill defined pattern. Six spinnerets, anterior and posterior two segmented. Cribellum entire or weakly-to-strongly divided. Calamistrum present median to basal position of fourth metatarsus. Epigyne complex, usually with posterior median lobe separated from lateral lobes by sutures. Male palp with simple, sclerotized retrolateral and dorsal tibial apophysis.

Typically ground-dwelling, cryptic spiders inhabiting damp and dark places. They are nocturnal hunters, hiding beneath logs and stones or in holes of trees. They construct irregular, tangled funnel like webs of bluish cribellate sticky silk at the bottom level of the plants that are usually extended to the crevices of the soil. The spider rests in one corner of the web, somewhere down in the crevices or in the folded leaves. The silk threads radiate from the retreat onto the substrate. The cocoons are spherical and are fastened with the webs where the female rests.

*Genus I Amaurobius* Koch, 1837

These cribellate spiders prepare irregular webs at the bottom level of the plants and are usually extended to the crevices of the soil. The webs are more sticky and the spider rests in one corner of the web, somewhere down in the crevices or in the folded leaves. They are dark in colour and clothed with hairs. Legs are heavily spined and calamistrum is present on the fourth metatarsus. The cocoons are spherical and are fastened with the webs where the female rests.

Specimens examined:
1. *Amaurobius* sp.

2. FAMILY ARANEIDAE Simon, 1895 (Orb web spiders) (Plate 1. 10)

**Identification features:** Cephalothorax frequently flat, variable; cephalic region usually separated from the thoracic region by an oblique depression, fovea distinct to absent. Eight eyes in two rows, less variable in size in different genera; laterals widely separated from medians, medians forms a quadrangle either a square or a trapezium; laterals usually close and often projecting on angular tubercles. Sternum heart shaped or triangular and narrowing behind, thus coxae IV nearly contiguous. Labium wider than long, with swollen distal edge (rebordered). Maxillae widest distally and generally not longer than wide. Chelicerae strong, vertical and not divergent, provided with lateral condyle (boss) on each, fang furrow armed with two rows of strong teeth.
Legs long and strong, clothed with hairs and spines, three tarsal claws and auxiliary foot claws, trichobothria present on all leg segments except tarsi. Abdomen variable in size and shape, usually globose, overhanging cephalothorax, dorsum frequently with distinct pattern and humps, covered with serrated setae. Six simple spinnerets with aggregate silk gland spigots and colulus. Epigyne complex, completely or partially sclerotized, frequently with scapus, epigynal plate with a transverse furrow. Pedipalp with single claw in female; male palp complex, paracymbium usually has a sclerotized hook, paracymbium attached to proximal end of cymbium, median apophysis present, bulbus rotated within cymbium.

Many species of this family are commonly present in paddy fields and most of them construct perfect orb webs for prey capture. They use the “spin-wrap-attack” method to subdue their prey. Spiders hang in the web head down position and are sit-and-wait predators and the web can be considered as the spider’s home territory. The general shape, number of radii, spirals, shape of hub and decorations of the web vary between genera and subfamilies. Some spiders decorate the web with stabilimentum. Both the size and the weight of the spider as well as the web’s site can influence web design.

Key to the genera of the family Araneidae:

1a. Posterior row of eyes strongly procurved; anterior lateral eyes smaller than posterior laterals………………………………….2
1b. Posterior row of eyes nearly straight or recurved, lateral eyes subequal in size………………………………………………3

2a. Abdomen pentagonal, broadest posteriorly; dorsum with transverse brown bands; without humps………………….Argiope
2b. Abdomen not pentagonal, dorsum provided with at least one pair of shoulder humps. \textit{Cyrtophora}

3a. Posterior median eyes very close; carapace provided with a “U” shaped junction between cephalic and thoracic region. \textit{Cyclosa}

3b. Posterior median eyes not very close; carapace not having any ‘U’ shaped junction between cephalic and thoracic region.

4a. Thoracic groove transverse; epigyne with distinct scape, often wrinkled, not provided with any lateral lobes. \textit{Araneus}

4b. Thoracic groove transverse; epigyne with wrinkled scape and provided with one or two pairs of lateral lobes. \textit{Neoscona}

\textbf{Genus II} \textit{Araneus} Clerck, 1757

Carapace moderately convex with no horny outgrowths. Thoracic groove transverse in female but longitudinal in male, often having lateral prolongations. Ocular quadrangle forming a trapezium, not much longer than wide, median eyes slightly unequal in size, laterals close and usually situated on prominent tubercles, both row of eyes recurved. Males with a hook on coxa I and a groove on femur II, tibia II armed with spines on prolateral side and often bent. Epigyne with a prominent scape, which may be long, wrinkled or in some straight and short; epigynal openings situated into the groove at the base. Palp of male with a large terminal apophysis, palpal patella with two strong long and curved spines. These spiders are orb web builders but do not usually rest in the center of their webs at least in daylight. They tend to have hair-covered carapace and abdomen, very hairy and spiny legs, subdued colouring and a camouflage pattern that can render them relatively cryptic. They rest in a silken retreat constructed with leaves in the side of the web. At rest, the tips of their front legs are in contact with a signal thread, which runs directly to the center of the web.

Specimens examined:
2. \textit{Araneus ellipticus} (Tikader & Bal, 1981)
3. \textit{A. insutus} (Koch, 1871)
4. \textit{A. nympha} (Simon, 1889)

\textbf{Genus III} \textit{Argiope} Audouin, 1826

Cephalothorax remarkably flat, clothed with thick layer of white pubescence. Ocular quadrangle forms trapezium; longer than wide and wider behind than in front; posterior row of eyes strongly procurved, anterior lateral eyes smaller than posterior laterals, lateral eyes close and
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situated on conspicuous tubercles. Chelicerae small, weak and provided with small boss. Legs long and strong, metatarsus and tarsus together longer than patella and tibia together. Abdomen generally flat with variable shape. Epigyne with thin or thick median septum. Web of argiope consists of closely spaced radial threads, a coarse inner spiral and a very fine closely woven outer spiral. Across the inner spiral, the spider attaches some broad white zigzag stitching forming a stabilimentum on which the spider rests, head down. As one approaches, the spider moves to the opposite side of the stabilimentum.

Key to the species of the genus *Argiope*

1a. Abdomen broadly oval and conspicuously truncated anteriorly; dorsal provided with black transverse stripes and forming a network on the posterior half...............................*aemula*

1b. Abdomen elongated oval with no truncation anteriorly; dorsal with no network of black stripes........................................2

2a. Abdomen anteriorly blunt; dorsal with a median longitudinal portion clothes with silky pubescence and some yellowish patches.......................................................*catenulata*

2b. Abdomen broadest at the middle; anterior edge of the epigyne provided with very thin and incospicous lip; epigynal septum gradually wider posteriorly...........................................*pulchella*

Specimens examined:
5. *Argiope aemula* (Walckenaer, 1842)
6. *A. catenulata* (Doleschall, 1859)
7. *A. pulchella* Thorell, 1881

Genus IV *Cyclosa* Menge, 1866

Cephalothorax with anteriorly narrow cephalic region, cephalic region distinctly separated from thoracic region by an oblique groove forming a “U” shape. Ocular quadrangle trapezium like, much narrower behind than in front; anterior median eyes usually larger than posterior median eyes, posterior median eyes very close, almost touching, laterals close and situated on prominent tubercles, both rows of eyes recurved. Palpal patella of male with one large, strong and curved spine. Abdomen with humps, both paired and median unpaired. Epigyne with a small, weak scape, which may be straight, wrinkled, bent, pointed or circular. Spiders of this genus make their closely woven orb webs on vegetation at a height of one meter from ground surface. A distinguishing feature of the web is the presence of a stabilimentum constructed by debris and cocoon. The spider rests at the centre of the web and is of a size comparable to
the pieces of the debris in the stabilimenta. A few white-coloured species make zigzag stabilimentum with white silk bands. This has an effect of rendering the spider indistinguishable from the stabilimentum and easily overlooked.

Specimens examined:
8. *Cyclosa confraga* (Thorell, 1892)
9. *C. fissicauda* Simon, 1889

**Genus V Cyrtophora** Simon, 1864
Carapace nearly flat with long cephalic region. Ocular quadrangle a little longer than wide, lateral eyes equal and slightly separated from each other. Legs moderately long and stout. Abdomen very high anteriorly and provided with paired tubercles. Females have abdomen with pointed or rounded shoulders. Sometimes, there are pairs of additional tubercles along the dorsal side of the abdomen. Members of this genus build more or less horizontal orb webs in shrubs. The web is held in position by the combination of a substantial tangle of silken threads attached to the shrubs, both above and below the orb. The structure of the orb itself is quite characteristic, consisting of an extremely fine, virtually square mesh which gives the impression of finely woven gauze. The hub of the orb is drawn vertically upwards for a short distance towards the spider’s retreat, which is located in the midst of the super structure.

Specimen examined:
10. *Cyrtophora citricola* (Forskal, 1775)

**Genus VI Neoscona** Simon, 1864
Presence of a longitudinal thoracic groove in the female separates *Neoscona* from the members of the genus *Araneus*. Ocular quadrangle forms a trapezium, which is slightly longer than wide. Anterior medians largest or subequal to the posterior medians, lateral eyes closer and situated on prominent tubercles, posterior lateral eyes smallest, both row of eyes recurved. In male, coxae I ventrally provided with a hook on the distal rim, tibiae II having marcosetae (spines) on prolateral surface. Abdomen may be oval, suboval or subtriangular in shape. Epigyne with a simple tongue-like scape completely fused to the base and provided with one or two pairs of lateral lobes, epigynal opening situated on the underneath of scape. Palpal patella of male with two strong, curved and long spines; cymbium of male palp broad but it is rather narrow strip like in *Araneus*. Construct orb webs in grasslands associated with marshy habitats and rest on a platform at the hub of the web. All species have characteristic but different abdominal patterns.
Specimen examined:

11.  *Nesocona vigilans* (Blackwall, 1865)

3. FAMILY CLUBIONIDAE Wagner, 1887 (Sac spiders) (Plate 1.11)

**Identification features:** Cephalothorax ovoid, distinctly longer than wide; fovea shallow to absent, pale yellowish white or brownish; chelicerae and anterior region of eyes usually dark brown. Eight eyes in two rows, small and uniform in size, posterior eye row slightly longer than anterior row. Maxillae longer than wide, with oblique indentation medially on lateral side, apex truncated and furnished with scopulae. Labium longer than wide. Chelicerae long, slender or stout, promargin with 2 to 7 teeth, retromargin with 2 to 4 small teeth; in some, especially male, strongly developed with a long fang. Legs longer, strongly spined, with tarsi and metatarsi scopulate, tarsi furnished with ungual tufts and two claws, trochanters with or without notches, leg formula 1423, two claws with dense claw tufts and scopulae. Abdomen oval, males sometimes with small dorsal scutum. Anterior spinnerets conical or cylindrical and contiguous, median spinnerets cylindrical in both sexes, posterior spinnerets two segmented with apical segment short; anterior spinnerets in contact. Epigynal plate convex and sometimes sclerotized. Male palp with variable retrolateral apophysis, embolus and cymbium present.

These are hunting spiders commonly found on foliage or on the ground, where they make tubular retreats in rolled up leaves or under debris in litter. The flattened egg sac is suspended inside the retreat and the female guards it. They are aggressive and use front legs to detect and grab prey.

**Genus VII Clubiona** Latreille, 1804

Cephalothorax rather long, somewhat narrowed in front and slightly convex, covered with fine, sometimes silky hairs, with a few large hairs on anterior part. Eyes nearly straight or very slightly procurred, posterior
row markedly the longest. Anterior medians closer together than posterior medians. Posterior medians nearer to posterior laterals than to each other or all posterior eyes somewhat equidistant. Fovea usually short, faint, radiating striae sometimes originate from it and occasionally form a pattern of darker veining. Sternum attenuated in front and pointed behind. Chelicerae with two rows of teeth in fang furrow, inner margin in females with 2 to 6 teeth often reduced in size and number in males. Leg formula 4123, unicolourous and bearing scopulae. Abdomen with a noticeable dagger shaped cardiac area, which starts at the front of the dorsal side and runs along the middle for a half the length. These are frequently encountered on foliage and play an important role as biocontrol agents. Some species shelter in paper-like silk cells inside a folded leaf or between leaves. Some small species build retreat under stones while some larger species can be found in leaf litter.

Specimens examined:
12. *Clubiona drassodes* Cambridge, 1874
13. *Clubiona sp.*

4. **FAMILY CORINNIDAE** Karsch, 1880 (Ant mimicking sac spiders) (Plate 1.12)

**Identification features:** Cephalothorax ovoid in dorsal view, sometimes elongated in ant mimics, sometimes heavily sclerotized. Eyes in two rows, widely spaced or closely grouped or bulging anteriorly; posterior eye row straight or curved. Sternum oval, flat or slightly impressed, marginate and apex ends bluntly in front of posterior coxae. Labium slightly convex, usually depressed transversely. Chelicerae sturdy, convex, with strong curved setae on upper edge, both rows with teeth. Legs long and slender in ant mimics, sturdy with variable setae on front legs, with two claws, claw tufts present with light scopule, tarsal trichobothria present. Abdomen ovoid, elongate in ant like
species, sometimes with scutum or transverse bands or patches or white setae. Integument fully with recumbent feathery setae, which frequently form lines or other patterns. Colulus triangular in shape, sclerotised. Anterior spinnerets sturdy and contiguous, posterior spinnerets slightly further apart than anterior pair; median spinnerets with three and posterior spinnerets with two large cylindrical gland spigots, spigots absent in males. Epigyne complex and variable. Male palp with tegulum tapering gradually towards embolus, sperm ducts with a conspicuous loop in proximal part of tegulum, bulbus without median apophysis in most genera.

Corinnids are free-living ground dwellers, usually found in debris, litter or humus in shaded areas. Some members of the subfamily Castianeirinae are good ant mimics. Their movements are ant like, involving rapid movements with jerky pauses and sudden changes in direction. While walking, the abdomen moves up and down and the front legs are held in the air to mimic the antennae of ants. Some species are dark to metallic, or dark to yellowish brown with a shiny red to reddish brown carapace and a pale abdomen. They build silky retreats in rolled up leaves and plant debris. If disturbed, they run rapidly in all directions and are very difficult to catch.

**Genus VIII Castianeira** Keyserling, 1879

Cephlothaorax oval, convex and with a well-marked median furrow; lower margin of chelicerae with two small teeth. Labium wider than long. Tibia I and II with two or three pairs of ventral spines. The legs are comparatively long and thin with dark stripes. The carapace is not waisted, but the abdomen tends to be long and narrower at the front with the rear wider and rounder. Medium-sized spiders with brown or black colour, with abdomen ringed or otherwise marked with white or some other bright colour. These spiders run over the ground and may resemble larger ants.

Specimen examined:
14. **Castianeira zetes** Simon, 1897

5. FAMILY GNAPHOSIDAE Pocock, 1898 (Mouse spiders) (Plate 1.13)

**Identification features**: Cephalothorax ovoid, smoothly convex at sides and rather low, gradually or narrowed towards front; usually with distinct fovea. Eight small eyes in two transverse rows of four each; anterior eyes round and the remaining eyes round, ovoid or angular, depending on the genus; posterior medians flattened, irregular in shape. Sternum flat,
ovoid, with pointed apex, truncate in front. Maxillae obliquely depressed ventrally with serrula. Chelicerae short, robust, tapered from base to tip and hairy in front; promargin with or without teeth or with a carina; retromargin with keel or rounded laminae. Legs short, stout, hairy with two-toothed claws and claw tufts. Tarsi I and II often with dense scopulae, leg formula 4123, preening comb present in metatarsi IV in some species. Abdomen oval to elongate, somewhat cylindrical; cluster of erect, curved setae present on anterior edge; usually uniform in colour or decorated with bands or other markings; usually with dorsal scutum in adult males. Anterior spinnerets parallel, large, cylindrical and usually well separated; piriform gland spigots of anterior spinnerets greatly enlarged, with widened base and shaft and a slit like opening. Epigyne complex with conspicuous cuticular margins. Male palp variable, usually with a stout, pointed, retrolateral tibial apophysis, bulb convex, tegulum large, subtegulum smaller and slender embolus.

Most gnaphosids are ground dwellers, with only a few living on plants where they roll up leaves similar to clubionids. Most of the ground-dwelling species construct a silk retreat in debris within which they remain during inactive period. They do not spin a web and catch their prey using speed, force and agility. Their eyesight is poor and prey is perceived by tactile or chemotactic stimuli. Feed on a variety of ground-dwelling animals such as ants, termites or other insects. The ant is attacked head-on and the bite is delivered at the base of the antennae. The spider then withdraws and waits until the ant is paralysed. The ant is then tucked underneath the spider’s body and carried away from other ants.

**Genus IX Gnaphosa** Latreille, 1804

These are predominantly ground-dwelling spiders, nocturnal in habit, hunting by stealth. Most of the members of this genus have the carapace dark-brown with black markings. There are eight heterogeneous eyes in two rows. The body is depressed dorsoventrally. The oval abdomen is similarly flattened, but not greatly larger than the carapace. The abdomen
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is dark grey to black covered with hairs. The legs are tapered and moderately short and spinose. The anterior spinnerets are cylindrical, longer and more heavily sclerotized than posterior, and separated from each other by a distance about equal to the diameter of one. Gnaphosids spin delicate silken sacs, within which they moult or mate.

Specimen examined:
15. *Gnaphosa* sp.

6. FAMILY HERSILIIDAE Thorell, 1870 (Two tailed spiders) (Plate 1.14)

**Identification features:** Cephalothorax ovoid and flattened, with narrow longitudinal fovea and radiating striations; densely covered with plumose setae. Eight eyes in two strongly recurved rows on a large tubercle. Anterior medians larger than posterior medians. Sternum heart shaped with straight or slightly concave anterior edge. Labium free with rounded tip; maxillae converging. Chelicerae weak with very small cheliceral fang, furrow with or without teeth. Legs with three simple claws, a few spines and trichobothria. Males with very long legs, third leg the shortest, autospasy occurs at patella-tibia joint. Abdomen flat, wider behind than in front, densely covered with plumose setae. Posterior spinnerets as long as abdomen, cylindrical with elongated and tapering apical segments, inner surface with a series of tubules producing thin silk threads; colulus present. Epigyne complex with broad central septum. Male palp without tibial apophysis; bulb tubular, ovoid or circular; conductor filiform and pointed.

These are very fast running active hunting spiders. The most easily distinguishable feature of hersiliids is the extremely long posterior lateral spinnerets which are often longer than the abdomen and sometimes approaching the total body length, hence the name two-tailed spiders. The flattened body allows them to lie very close to the substratum without casting any shadow. When disturbed, the spider runs very swiftly to the opposite side.

with the spinnerets raised like a pair of horns. When a small insect comes close, the insect triggers those silk and the spider senses this. The spider will quickly run around the insect in circles, with the insect in centre. The spider will also lay more silk at the same time, until the insect is entangled by the silk, and becomes the meal of the spider.

**Genus X Hersilia** Audouin, 1826
Ocular quadrangle parallel sided, head flat, angular laterally; clypeus usually very high, prominent; metatarsi II, III and IV legs bi-segmented. These spiders do not build webs but attack pedestrian prey. While facing away from the prey, they circle and fix it to the substratum with bands of silk emanating from the long spinnerets, which they rotate rapidly so as to encapsulate the prey. Egg sacs are attached to the substratum and camouflaged with bits of debris.

Specimen examined:
16. **Hersilia sp.**

7. **FAMILY LINYPHIIDAE** Blackwall, 1859 (Sheet web spiders) (Plate 1.15)

**Identification features:** Cephalothorax variable in shape, clypeus height usually exceeding that of median ocular region, some species with raised frontal region or with modified frontal region. Eight heterogeneous eyes in two rows, anterior medians slightly darker. Sternum variable but usually heart shaped, pointed or truncated at the back, rebordered labium with parallel sided maxillae. Chelicerae robust, usually with strong teeth on fang furrow and lateral stridulating file. Legs three clawed, usually slender and provided with setae especially on tibiae and metatarsus; female palp usually with tarsal claw. Abdomen usually longer than wide, sometimes with characteristic pattern, scutum present in some males. Six spinnerets, anterior and posterior pair short, conical and concealing median pair, colulus present. Epigyne complex,
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variable, often simple with flat surface modified by groove, pit or notches or with scapus. Male palp lack tibial apophysis but paracymbium well developed.

Linyphiids are known as sheet web spiders, which can be flat, domed or hammock shaped, above the sheet isolated threads form a scaffolding web. The spider hangs upside down under the sheet and does not make any retreat. Prey is bitten from below through the sheet, and is then pulled through the sheet before being consumed. Webs are found in tall grass and occasionally close to the ground. When disturbed, the spider quickly disappears into the vegetation. Linyphiids make dense sheet webs in green vegetation and often are found in large numbers on the surfaces of field margins. The web may have a funnel in the center and the spider waits for its prey below the entrance to this funnel.

**Genus XI Atypena** Simon, 1894
Cephalothorax slightly high in the cephalic region and broadest between coxae II and III. Lateral eyes contiguous, anterior eye row strongly recurved and posterior row straight, posterior medians largest and anterior medians smallest; ocular quad usually wider behind than in front; high clypeus. Simple epigynum. On the contrary, males with elevated head forming a transverse lobe bearing the posterior median eyes, area between posterior medians and anterior medians hairy. Palpal organ complex with embolic portion rather wide apically. Tibia III and IV of both sexes bear single spines each.

Specimens examined:
17. *Atypena adelinae* Barrion & Litsinger, 1995
18. *A. thailandica* Barrion & Litsinger, 1995
19. *Atypena sp.*

**Genus XII Erigone** Audouin, 1826
Members of the genus are readily separated from other members of the family by the presence of teeth in the margin of cephalothorax and chelicerae, male head elevated with no definite lobe, male maxillae with warts, metatarsus IV with trichobothria. Female epigynum simple usually with a procurred posterior boarder.

Specimens examined:
8. FAMILY LYCOSIDAE  Sundevall, 1833 (Wolf spiders) (Plate 1.16)

**Identification features**: Cephalothorax longer than wide, narrower and higher in cephalic region; fovea elongated; carapace covered with dense setae; sternum oval shaped. Eyes eight in three rows of 4, 2, 2; all dark in colour, unequal in size; anterior row with four small eyes lying in straight or often slightly curved line, second row with two large eyes which approximately as wide as front row and third row with two eyes of intermediate size which is as wide as or usually wider than second row situated on anterolateral surface of carapace. Labium as wide as long, half the length of maxillae. Chelicerae strong with toothed furrow and condyles. Legs three clawed, usually with scopulae and spines; trochanters notched. Abdomen oval and covered with dense setae. Some species with characterisitic hairs over the surface of the abdomen for carrying spiderlings on the body of mother. Spinnerets are of usual type; colulus absent. Epigyne generally complex with a well sclerotized median septum. Male palp without tibial apophysis and with varying embolus. Females carry their cocoons attached to the spinnerets. Abdomen often brownish or greyish in colour, some are sandy coloured with cryptically marked abdomen while some small species are brown to almost black in colour.

Most members of this family are free running. In relatively undisturbed open areas, they are the commonest spiders likely to be encountered in the field. Larger lycosids make burrows in the ground. Others make silken webs and retreats in the grass, whilst some of the smaller species do not make webs at all. Females of many small lycosid species attach the egg sac to their spinnerets and carry them under their abdomen. These egg sacs are often white or light coloured and often larger than the female's abdomen. The young spiderlings climb onto the mother's back after emerging from the egg sac where they remain until the second moult. They do not eat during the time when the young are attached to the body of their mother. These spiders are real hunters and have
excellent eyesight. The spider vigorously attacks her prey crushing it with her stout chelicerae. Most species hunt during day, but some are nocturnal. When at rest, they are usually found under debris. They have good vision and their sense of touch is highly developed. Contrary to the common belief, recent studies indicate that they adopt a sit and wait strategy for feeding. Prey is grabbed with the legs, forming a basket around the prey before it is bitten.

Key to the genera of the family Lycosidae:

1a. Carapace with paired longitudinal streaks inside pale anterior area to fovea……………………………………..Trochosa
1b. Carapace without paired longitudinal streaks …………………2

2a. Clypeus vertical; metatarsus IV longer than or as long as tibia and patella IV together…………………………………..Pardosa
2b. Clypeus slanting; metatarsus IV shorter than tibia and patella together…………………………………………………………3

3a. Tibia IV dorsally provided with proximal spine usually thinner or reduced to a bristle; tarsi with a dorso basal bristle; carapace glabrous…………………………………………………………Arctosa
3b. Tibia IV with two dorsal spines about equally stout; anterior row of eyes straight or slightly procurred, anterior median eyes larger than anterior laterals……………………………………………...Lycosa

Genus XIII Arctosa Koch, 1847
They are moderately large spiders found to be very rare in the fields. Most of them are nocturnal. They spend most of the time under dead leaves and often found running about in sunshine. They are greyish brown, carapace more darker, without any longitudinal bands. The cocoon is fastened to the mother’s spinnerets and carried with her. After hatching the spiderlings crawl over to the body of the mother and carried about by her for a considerable time till they disperse.

Specimen examined:
21. Arctosa khudiensis (Sinha, 1951)

Genus XIV Lycosa Latreille, 1804
This is a very large genus including majority of species of wolf spiders. Carapace long, dark brown with a light, wide longitudinal median stripe; facial area vertical and the sides of the face slanting. Four posterior eyes larger and arranged in a quadrangle which is slightly wider behind than in front. The labium is always longer than wider and the basal excavation is prominent, usually one third or more of the length of the labium.
Clypeus is not vertical. Tibiae I and II armed with three pairs of ventral spines. Metatarsus IV never longer than tibia and patella together. Abdomen overall greyish with a dark median stripe, often breaking into chevrons, bars or dots. Members of this genus spins no web. The larger forms live in a silk lined burrow and under stones, the entrance is covered by a thin sheet of silk. The female carries the cocoon attached to its spinnerets and the young after hatching swarm on the mother’s back.

**Key to the species of the genus Lycosa:**
1a. Anterior row of eyes straight or nearly so…………………………2
1b. Anterior row of eyes procurved; carapace provided with the mid longitudinal pale band; femora of legs pale…………**mackenziei**

2a. Total length less than 10.00 mm; carapace not provided with the broad pale band; chelicerae moderately strong; coxae of all legs provided with brown patches; dorsal side of abdomen dark brown with small pale patches…………………………...**tista**
2b. Total length more than 10.00 mm; carapace brown and provided with a mid-longitudinal and sub-marginal pale bands……………………………………………………**poonaensis**

Specimens examined:
22. *Lycosa mackenziei* Gravely, 1924
23. *L. poonaensis* Tikader & Malhotra, 1980
24. *L. tista* Tikader, 1970

**Genus XV Pardosa** Koch, 1847
Cephalic region elevated, clypeus vertical; chelicerae much smaller than in most other lycosids so that their height is less than the height of the head, brown in colour with a yellow median stripe and oftorn with chitinous or broken yellow lateral stripe. Cephalic region almost entirely occupied by posterior two rows of eyes. The anterior row of eyes shorter than the second row, labium usually wider than long with basal articular notches. Legs relatively long and thin and provided with long spines. Metatarsus IV usually longer than or at least as long as patella plus tibia together. Tibia I with three pairs of ventral spines. Some males with very large black hairy palps. Abdomen greyish or brown and mottled, cardiac mark edged with white colour and this mark is often followed towards the rear by dark chevrons. These spiders are generally found in wet ground near ponds and streams. The egg sac is lenticular, usually greenish when fresh, changing to dirty grey when older.

**Key to the species of the genus Pardosa:**
1a. Spiders of small size; total length not more than 6 mm ……….. 2
1b. Spiders of bigger size; total length more than 6 mm .......... 3

2a. Sternum uniform pale in colour and abdomen provided dorsally with chalk white patches ......................... amkhasensis

2b. Sternum not uniform pale in colour and abdomen not provided dorsally with chalk white patches ................... shyamae

3a. Ocular area black and hairy, and maxillae provided with inconspicuous scopulae ....................... pseudoannulata

3b. Ocular area not black and hairy (except bases of posterior eyes), and maxillae provided with conspicuous scopulae ................................................................................... sumatrana

Specimens examined:
25. Pardosa amkhasensis Tikader & Malhotra, 1976
26. P. pseudoannulata (Bosenberg & Strand, 1906)
27. P. shyamae (Tikader, 1970)
28. P. sumatrana (Thorell, 1890)

Genus XVI Trochosa Koch, 1847
These are moderately large lycosids, common in small hollows under stones or in the small cracks and crevices in bunds or leaves in the field. The carapace has a pair of longitudinal bars. Chelicerae have two or three retromarginal teeth. They hunt at night and spent the day hidden amongst moss and detritus. The females spent most of the day with an egg sac in a burrow but may be spotted during the dull daylight.

Specimens examined:
29. Trochosa punctipes (Gravely, 1924)

9. FAMILY MITURGIDAE Simon, 1885 (Dark Sac spiders) (Plate 1.17)

Identification features: Cephalothorax longer than wide, red brown to dark brown in colour; eight eyes in two rows; sternum oval and flat, apex with obtuse angle; labium long and usually truncated anteriorly; maxillae enlarged with or without lateral notch. Chelicerae strong with teeth on fang furrow. Legs prograde, with two claws and claw tufts or with three claws. Claw tuft varies from weak to dense; scopulae dense; two rows of tarsal trichobothria; trochanters shallow to deeply notched; tibiae of front legs with paired setae; long and sturdy legs in females, longer and slender in males. Abdomen oval with markings, bands, chevrons or spots. Posterior spinnerets two segmented, distal segment distinctly
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conical, apical segment either as long as or shorter than basal segment; anterior spinnerets conical in shape; colulus present. Cribellum entire or divided with an oval or elongated area of densely spaced calamistral setae in some genera. Epigyne complex, with a small median plate with anterior extensions and heavily sclerotized internal ducts. Male palp with distally expanded retrotibial apophysis and prolateral embolus.

These free living spiders are commonly found in the sac-like retreats made up of green leaves. Different types of sacs are used for resting, mating and breeding. While the eggs are developing, the female encloses herself with the eggs and guards them.

Genus XVII Cheiracanthium Koch, 1839
Eyes smaller, relative to distance between them. Posterior row scarcely longer than anterior. Poserior median eyes further from posterior laterals than from each other. Trapezium formed by four median eyes relatively narrow in front as in Clubiona. Eyes of lateral pairs very close. Sternum broader, not attenuated in front. Inner row with two teeth far removed from fang. Legs relatively longer and slender, first leg longer than fourth. No dorsal spines on femora I and II, no ventral spines on tibiae III. Male palp of tibia noticeably longer and more slender. Bulb with sexual organs not reaching the end of the tarsus, at the basal end of which is a long spur extending back over the tibia.

The genus Cheiracanthium was previously placed in the family Clubionidae and is very similar in appearance and habitat to Clubiona. Both spiders are small, about 10 mm in length and have a similar body shape, straw colour and make similar silk sac retreats, hence the common name of sac spider. The legs and cephalothorax are similarly coloured but sometimes the cephalothorax and legs might be slightly darker. However, Clubiona has a brown to maroon face and chelicerae with the first and fourth pairs of legs of similar size. Cheiracanthium, on the other hand, has a black face and
chelicerae, with the first pair of legs noticeably longer than the fourth pair and these they use for detecting and capturing prey. Sac spiders are fast and aggressive, nocturnal and commonly occur in vegetation.

Specimens examined:
30. *Cheiracanthium melanostomum* (Thorell, 1895)

10. FAMILY OXYOPIDAE Thorell, 1870 (Lynx spiders) (Plate 1.18)

**Identification features:** Cephalothorax longer than wide, high and convex anteriorly, sloping posteriorly, usually with conspicuous stripes and spots, clothed with thin setae and wide clypeus. Clypeus very high and vertical, usually with conspicuous stripes and spots. Eight eyes in two rows occupying a small area on the edge of carapace, eyes form a hexagon by slightly procurred posterior row and strongly recurved anterior row. Anterior median eyes smallest, much smaller than the anterior lateral eyes. Scutiform sternum tapers between coxae IV, labium longer than wide, maxillae long and converging. Chelicerae long and tapering at distal end with short fangs. Cheliceral margin short and armed with one tooth on each side or without teeth. The boss on the anterior lateral face of the chelicerae not so prominent. Legs long, three clawed, with prominent spines; trochanters shallowly notched, without scopulae. Abdomen posteriorly tapering, with patches or bands. Body colour varies from bright green to yellowish brown or dark brown. Integument clothed in thin setae and sometimes with iridescent scales. Spinnerets of usual type with small median pair, colulus present. Epigyne complex, structure varies between genera from a semicircular dark rim surrounding a shallow median depression to a deep pit in front with paired projections or median depression with scape like process. Male palp with tibial apophysis and paracymbium.
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Mainly foliage dwelling spiders, commonly found on green leaves. They are also known as lynx spiders because of the way in which prey is hunted. Diurnal or nocturnal hunters with good vision, enabling quick detection of prey. They move around on plants, leaping from leaf to leaf. Prey is caught with legs, and often by jumping a few centimetres or more into the air to seize a passing insect in full flight or executing short jumps in pursuit of prey flying over plants. The eggs sac is fastened to twig or leaf or suspended in small irregular web. The eggs are guarded by the female.

Genus XVIII Oxyopes Latreille, 1804
Cephalothorax high and rounded with the front face vertical and then continues almost level for most of its length to a steep thoracic part. Eye pattern 2,2,2,2 with the very small anterior medians being over half way up to the front face and the posterior medians just beyond the top of the front face. Posterior row of eyes strongly recurved and equidistant from each other. Ocular quadrangle longer than wide and limited by the PME and the ALE. A thin black straight line starts from each of the anterior medians down the vertical face and continues on down the centre of the long pale chelicerae to the tip. Abdomen long and thin, rounded and widest at the front and then tapering all the way to the spinnerets.

Key to the species of the genus Oxyopes:
1a. Spider of small size (Total length up to 9 mm)..........................2
1b. Spider of large size (Total length more than 9 mm).................4

2a. Carapace with three to four longitudinal lines..................3
2b. Carapace without three to four longitudinal lines........sakuntalae

3a. Carapace clothed with spatulate hairs......................sunandae
3b. Carapace not clothed with spatulate hairs................ashae

4a. Carapace with longitudinal bands..............................5
4b. Carapace with deep brown patches, abdomen with lance shaped brown patch, laterally with blackish line......................shweta

5a. Abdomen mid-dorsally with broad light brownish green band and laterally with black patches...........................bharatae
5b. Abdomen with four or five diagonal grey bands interspersed with white laterally.................................javanus

Specimens examined:
31 Oxyopes ashae Gajbe, 1999

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32. *O. bharatae* Gajbe, 1999
33. *O. javanus* Thorell, 1887
34. *O. sakuntalae* Tikader, 1970
35. *O. shweta* Tikader, 1970
36. *O. sunandae* Tikader, 1970
37. *Oxyopes* sp.

Genus XIX *Peucetia* Thorell, 1869

Cephalothorax not so high or convex as that of *Oxyopes*. Face vertical and the eyes occupy a comparatively smaller area. Anteiro median eyes smallest, posterior medians and posterior laterals subequal in size, longer than median eyes; anterior laterals the largest. Labium longer than wide. Maxillae very long, slightly enlarged distally and greatly the length of labium, converging in front of it. Cheliceral retromargin without tooth. Abdomen very elongate, almost cylindrical, tapering gradually behind the spinnerets. Legs very long in comparison to body length, with conspicuous black spines. Integument free of hairs except for white hairs in eye region. Predominant colour of integument green or shades of green in the living spider. Male palp with characteristic paracymbial process.

Specimens examined:
38. *Peucetia viridana* (Stoliczka, 1869)

11. FAMILY PHILODROMIDAE Thorell, 1870 (Elongated crab spiders) (Plate 1.19)

Identification features: Cephalothorax slightly flattened, as long as wide or elongated and smoothly convex on lateral sides, clothed in soft recumbent setae, white to pale cream and reddish brown or greyish brown in colour, frequently mottled with longitudinal bands or chevrons. Eight eyes in two rows, both eye rows recurved, sometimes posterior row strongly recurved. Apex of sternum with an obtuse point between coxae IV. Labium slightly longer than wide. Chelicerae usually without teeth. Legs slender, laterigrade, with two claws and semi-erect or recumbent spines; femora I without cluster of erect spines; legs I, III and IV almost equal in length, leg II usually longer, sometimes much longer; tarsi I and II with scopulae and claw tufts. Abdomen oval or elongated, covered with soft recumbent setae; usually with a dark, heart shaped mark and a series of chevrons. Spinnerets simple, colulus absent. Epigyne complex, small, usually with median septum, sometimes with folds and copulatory openings on the laterals; spermatheca kidney shaped. Male palp with small apophysis on tibia, embolus long to short, slender and arched at the distal end of tegulum.
Philodromidae are small-to-medium sized spiders, closely resembling the family Thomisidae in terms of erratic movements and laterigrade legs. These are free-living hunters commonly found on foliage. Their movements are erratic and using their claw tufts and scopulae, they are able to move swiftly. Their elongated, straw-coloured bodies with dark longitudinal lines, as well as their posture, render them inconspicuous on dry grass. Most of the philodromids inhabit grasses, marshes and mate in the rainy season, female lays eggs at the onset of summer. The female makes egg sacs on the folded grass leaf.

Genus XX Philodromus Walckenaer, 1826

Cephalothorax broader than long, relatively narrow in front; carapace flattened, smoothly convex at lateral sides. Eyes small and uniform in size and in a smaller crescent shaped group with the anterior row shortest, posterior row strongly recurved, the median farther from each other than from the lateral. Legs are long, slender and laterigrade, leg II generally longer than leg I, legs III and IV a little shorter than I and II. Abdomen usually oval, not appreciably widened or truncated behind, angulated laterally, moderately flat and dorsally bears heart shaped markings and chevrons.

Specimens examined:
39. Philodromus sp.

Genus XXI Thanatus Koch, 1837

Members of this genus are rapidly recognized by their least agile movement, least flattened bodies, and least laterigrade legs. They have a moderately convex, slightly longer than wide carapace, smoothly convex on lateral sides. Abdomen is broadest at mid length, rounded along margins, moderately convex dorsally, with a prominent dark heart-shaped marking on yellow or red background. Legs II and IV are longer than legs I and III.
Specimens examined:
40. *Thanatus parangvulgaris* Barrion & Litsinger, 1995

12. FAMILY PHOLCIDAE Koch, 1851 (Daddy long leg spiders) (Plate 1.20)

**Identification features:** Cephalothorax short and broad, almost rounded; cephalic region usually elevated on the sides with deep striations; thoracic region with deep median longitudinal fovea; clypeus high, sometimes concave beneath eyes; pedicel dorsally with two parallel or “V” shaped chitinious bands. Six or eight eyes occupying entire width of carapace, anterior medians smallest or absent, the rest large and forming two triads on each side. Sternum flat or slightly convex, broadly truncated posteriorly, wider than long; labium fused to sternum. Chelicerae chelate, weak and cylindrical; cheliceral margin with lobed or tooth-like transparent lamina. Legs extremely long, thin, fragile and slender; furnished with three claws and very short membranous onychium, tarsi flexible. Abdomen either globose or cylindrical to elongated, epigastric region well developed, triangular shaped large anal tubercle. Anterior spinnerets thick and cylindrical, slightly separated by small colulus in between; posterior spinnerets smaller, conical and compressed. Tracheal spiracle lacking in some genera. Female lacks an epigyne but has a swollen, sclerotized area on underside of abdomen. Male palp complex, large, with very small patella, tibia large and swollen, tarsus divided into two parts.

These spiders are sedentary in habit and construct loose tangled webs of different configurations. Some webs are irregular with long threads criss-crossing in an irregular fashion; or the centre of the web consisting of a large, more compactly woven sheet, with a network of irregular threads above and below. The females always carry the agglutinated mass of eggs in their chelicerae. They hang upside down in the webs and when
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disturbed, vibrate themselves so vigorously that they blur themselves in
the eyes of the intruder.

**Key to the genera of family Pholcidae:**

1a. Sternum posteriorly acuminate; mandible armed with two teeth
    on the fang groove....................................................Artema

1b. Sternum broadly truncate posteriorly, mandible with one tooth
    on fang groove........................................................2

2a. Abdomen short, oval, prominent posteriorly above the
    spinnerets...............................................................Crossopriza

2b. Abdomen long, more than twice as long as wide, and more than
    twice as long as cephalothorax ....................................3

3a. Abdomen cylindrical..................................................Pholcus

3b. Abdomen less cylindrical............................................Uthina

**Genus XXII Artema** Walckenaer, 1837

Cephalothorax circular and flattish with a tall, slightly protruding
clypeus; yellow, with a brown median patch and a brown stripe on the
clypeus. Eight eyes, two in front with two compact groups of three just
behind and to the side. Anterior median eyes not much smaller than the
rest, anterior eye row slightly recurved, posterior eye row strongly
recurred; median ocular quadrangle not longer than wide. Chelicerae
armed with two teeth in the inner margin. Sternum posteriorly acuminate,
projecting between the posterior coxa. Abdomen high, globular, higher
than wide, rounded at the top and gradually tapering below to the
spinnerets. It is greyish yellow in colour with three rows of grey patches.
Cardiac area bare and light. Legs very long, yellow in colour with brown
patellae and brown rings apically on femora and tibiae.

Specimen examined:

41. Artema sp.

**Genus XXIII Crossopriza** Simon, 1893

Cephalothorax circular with slightly raised and forwardly projected eye
region; yellow with a brown median stripe. Ocular quadrangle as long as
wide and the posterio median eyes separated by a space exceeding the
diameter of an eye. Abdomen is short, ovate, posteriorly prominent and
sloping abruptly away to the spinnerets and looks like a box. Abdomen
yellowish brown with dark patches and dense yellowish spots. Legs
spotted and streaked with black.

Specimens examined:

42. Crossopriza sp.
Genus XXIV Pholcus Walckenaer, 1805
Carapace circular, slightly longer than broad and has sinuous indentation near the pedicel. The two triads of eyes are slightly raised. Carapace pale grey with a large brown area around the fovea. Abdomen shorter and about twice longer than carapace, cylindrical or sausage shaped. Legs extremely long and thin, longest being fifteen times the length of carapace and are yellowish with patellae brown in colour. The male palpal tibia is very swollen.

Specimens examined:
43. Pholcus sp.

Genus XXV Uthina Simon, 1893
Cephalothorax flat or slightly domed, almost circular with long clypeus projecting slightly forward. It is pale yellow in colour with occasional brownish areas near the eyes or on the clypeus. Six eyes arranged in two triads. Abdomen long, thin, cylindrical, abruptly truncated at the rear and is three to four times as long as carapace. It is white with some varying dark spots or patches on the sides. Legs long, thin, pale in colour; joints of both ends of tibiae darkened.

Specimen examined:
44. Uthina sp.

13. FAMILY PISAURIDAE Simon, 1890 (Nursery web spiders) (Plate 1.21)

Identification features: Cephalothorax longer than wide, clothed with plumose setae, wide and rounded near the rear, broad truncated front, clypeus in some genera with blunt tubercles on anterolateral edge. Frequently decorated with a broad longitudinal dark brown stripe running the length of cephalothorax. Dark homogenous eyes, in two or three rows, at least one pair of eyes on shallow tubercles. Sternum and labium longer than wide, sternal apex blunt. Powerful chelicerae are toothed, and provided with boss and scopulae. Three clawed legs are long and tapered, sometimes slightly latergrade, numerous trichobothria irregularly distributed in the tibia, metatarsi and tarsi; trochanters deeply notched, inferior claw with 2-3 teeth, sometimes onychium present. Abdomen usually elongate, widest and rounded at the front, and narrowing toward the spinnerets and covered with plumose setae. There is often with longitudinal bands, folium or spots. Anterior and posterior spinnerets similar in size. Complex epigyne consists of two integument
folds, forming two lateral elevations with median area, vulva complex consisting of a base with enlarged lumen and stalk leading to spermathecae. Tibial apophysis of palp usually present, cymbium usually elongated anteriorly, bulbous oval, longitudinal axis frequently inclined, median apophysis present, embolus varies from simple and short to long and curved.

These are active wanderers and mostly do not spin webs. Some species are found in open areas of grass and dwarf shrub while others are found along the edges of streams and ponds, where they prey on fish. Females carry egg sac underneath the sternum, held in position by the chelicerae and palpi. Just before the young emerge, the female constructs a framework of silk, known as nursery web, in which the eggs are deposited. After emerging from the egg-sac, the young remain in the nursery web until dispersal commences, hence the common name “nursery web spiders”.

**Genus XXVI Perenethis** Koch, 1878
Characterized by strongly recurved anterior eye row, clypeus beyond ocular quadrangle, eyes in frontal view show AME-ALE-PME-PLE, chelicerae usually with three retromarginal teeth, tibial apophysis of pedipalp reduced, epigynum with distinct lateral lobes and median septum. These are known as fish eating spiders, and inhabit the fringes of fresh water pools, they can walk as well on water as on land. The front legs are used as feelers that are held up in the air while the hind legs are dragged along. They hunt on the surface of water, preying not only on small fish but also on tadpoles, fresh water shrimps, insects and small toads. They dive into the water to grab their preys.

Specimens examined:
46. *Perenethis* sp.

**Genus XXVII Pisaura** Simon, 1885
Anterior eye row slightly recurved, PME usually larger than anterior eye, MOQ much wider behind than in front; dorso-median band of carapace if present divided by longitudinal narrow white stripe in the middle, chelicerae with three retromarginal and promarginal teeth each. Patella I-IV with two dorsal spines, tibia I bears four pairs of ventral spines, tibial apophysis of male pedipalp distinctly developed.

Specimen examined:
45. *Pisaura* sp.

14. FAMILY SALTICIDAE Blackwall, 1841 (Jumping spiders) (Plate 1.22)

**Identification features:** Very small to medium sized, active, hunting spiders capable of jumping or leaping to a distance. Most characteristic feature is the ocular clad on the cephalothorax delimited by eight eyes arranged in three or four rows. Front row formed of forwardly directed four eyes among which the anterior median eyes are very large and easily noticeable. Legs are two clawed with claw tufts. Uniquely designed cephalothorax with anterior cephalic region formed of a broad rectangular ocular clad often covered with setae in attractive patterns and colours. Eight eyes are present in three or four rows arranged around the ocular clad. Anterior end of it is broadly truncated and occupied the first row, formed of four eyes. Among these forwardly looking eyes, the anterior median eyes are very large and prominent. The two anterior lateral eyes, only about half the size of anterior median eyes, usually arranged in the front row or in some genera form the second row. Two posterior median eyes, usually smaller than anterior lateral eyes form the next row. Two posterior lateral eyes almost same as to anterior lateral eyes, positioned at the posterior corners of the ocular clad constitute the last row. These eyes together provide excellent eyesight about 360 degree. Jumping spiders are capable of recognising colours and distinguishing the prey from a considerable distance.
Thoracic region is in continuation with the cephalic part in most but remains clearly separated by a constriction in some. Sternum is variable in size and shape. Labium is usually a triangular plate with a blunt anterior edge often bears scopula. Maxillae formed as fairly long plates, broad distally also bear thick scopulae. Maxillary palps are simple in female but very complex in male and act as copulatory organs. They often bear tibial apophysis and sometimes femoral protuberances. Chelicerae bear a fang and teeth on outer and inner margins in variable numbers and shape. In males of some genera they are elongated. Legs are segmented, usually long and stout ending in hairy tuft having two claws. Structure of legs especially that of the first pair vary in some genera and some times with fringes of hairs. Cephalothorax remains connected to the abdomen by a pedicel not visible in most. But in some genera it is long and clearly visible. Abdomen generally small, oval or round but in some elongated. It is usually covered with hairs forming attractive colour patterns and designs especially on dorsal side; helpful in distinguishing species. Spinnerets situated at the posterior end of the abdomen are two pairs and almost similar. Epigyne is situated on the ventral side of the abdomen towards the anterior end. It is highly variable and sometimes complex in structure.

Jumping spiders are diurnal in activities. Move by walking, running, jumping or leaping and use all these movements for prey capture. They hunt the prey by stalking, chasing and leaping over it. Prey includes mainly insects; some also prefer other spiders or ants. Few salticids also exhibit aggressive mimicry or even invading of webs of other spiders as aids in prey capture. Usually they do not use web for capturing the prey. Salticids make silken retreat in the form of tube or sac fastened to various substrata. They use the retreat to moult, sometimes to mate, egg-laying or as night shelter. Sexual dimorphism is present in many. Courtship behaviour varies according to species.

Key to the genera of family Salticidae:

1a. Inferior margin of the chelicerae armed with a row of several isolated teeth

1b. Inferior margin of the chelicerae with a single pointed tooth or none

2a. Labium much longer than wide, spinnerets apical

2b. Sternum strongly attenuated in front, virtually pointed, and the coxae of the first pair of legs very close together; upper margin of the anterior eyes form a slightly procurved

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3a. The tooth, when present, is compressed and divided by a notch, or rarely either truncate or serrate.................................4
3b. Tooth, when present, not compressed..................................5

4a. Cephalothorax short, ocular quadrangle very large, much longer than the short and sloping pars thoracica, anterior legs with broadly clavate femur, the other segments slender and cylindrical.................................................................Siler
4b. Cephalothorax long and ovate, pars thoracica roughly equal in length to the ocular quadrangle. Anterior legs with the femur clavate, the patella and tibia thick and slightly angled; superior margin of the chelicerae bidentate.................................Hasarius

5a. Inferior margin of the chelicerae with a single tooth..............6
5b. Inferior margin of the chelicerae without a tooth or with only a very minute and fine tooth; pars cephalica flat, not impressed on the sides; sternum strongly attenuated in front, and the coxae of the first pair of legs close together........................Asemonea

6a. First pair of legs robust; femur clavate and tibia ovate.................................................................Brettus
6b. First pair of legs not robust..............................................7

7a. Tibia and patella of the third pair of legs longer (or at least not shorter) than the tibia and patella of the fourth pair of legs.................................................................8
7b. Tibia and patella of the third pair of legs shorter than the tibia and patella of the fourth pair of legs.................................10

8a. Ocular quadrangle trapezoidal and rather small, much narrower behind than the cephalothorax; small eyes of the second row located much closer to the anterior laterals than to the posterior laterals; posterior legs rather sparsely spined.................................................................Harmochirus
8b. Ocular quadrangle with parallel sides or often narrower behind than in front.................................................................9

9a. Ocular quadrangle with virtually parallel sides, posterior eyes of moderate size, separated from the small eyes of the second row by more than the width of one posterior eye; small eyes of the second row perhaps a little closer to the anterior laterals.................................................................Hyllus
9b. Ocular quadrangle a little narrower behind than in front; posterior eyes large, separated from the small eyes of the second row by less than the width of the posterior eye (or at least not more); small eyes midway between the anterior and posterior laterals or perhaps slightly closer to the posteriors…………………………………………………………Plexippus

10a. Small eyes of the second row much further from the posterior laterals than from the anterior……………………………………11

10b. Small eyes of the second row midway (or nearly) between the anterior and posterior laterals……………………………………12

11a. Cephalothorax very wide, thick and flat on top; abdomen oval, slightly truncate at front and slightly pointed at rear; legs sturdy with swollen femora, patellae and tibiae……………………Rhene

11b. Cephalothorax sloping steadily to the posterior margin with very steep sides; abdomen oval, slightly pointed at rear; legs sturdy with swollen femora, patellae and tibiae; ventral spines on tibiae I and metatarsi I……………………………………Bianor

12a. Sternum attenuated in front and not widely truncate between the anterior coxae……………………………………Carrhotus

12b. Sternum not attenuated in front and widely truncate between the anterior coxae……………………………………………………13

13a. Sternum strongly attenuated in front and the coxae of the first pair of legs subcontiguous; thoracic groove rather long, situated a little behind the posterior eyes; anterior legs usually strongly spined; posterior metatarsi longer than the tarsi……………………………………………………Menemerus

13b. Anterior legs not strongly spined; posterior metatarsi not longer than the tarsi……………………………………………………14

14a. Cephalothorax cube shaped and long; slightly tapering; abdomen tubular; slender legs carry numerous spines; cephalic part of the carapace usually coloured; usually two coloured longitudinal stripes running the length of the abdomen………………Telamonia

14b. Cephalothorax quite high, with the cephalus flat and thorax sloping; abdomen oval, widish anteriorly and narrowing to a rounded posterior; spiny legs are longish and slender; cephalus covered with dense, bluish-white, iridescent squamose hairs……………………………………………………Phintella
Genus XXVIII Asemonea Cambridge, 1869
Spiders of this genus are associated with stones, rocks or bare areas in the open with dead leaves, twigs or litter provided these habitats are warmed by sun. These are medium-sized spiders. The male has v-shaped rows of hairs on its head and a pronounced white median stripe on its abdomen. The palpal organ with ventral tibial apophysis triangular, separated from the dorsal apophysis by "V" shape groove. The epigynum has two "wings" - sclerotized diagonal edges, spermathecae in the form of complicated sclerotized chambers.
Specimens examined:
47. Asemonea sp.

Genus XXIX Bavia Simon, 1877
Medium sized salticids having moderately flat cephalothorax, broader than long, broadest at the middle, truncate anteriorly, curved posteriorly, Ocular clad flat, widest posteriorly, with scanty hairs, rough textured. Abdomen slender widest anteriorly, tapering posteriorly, with incomplete longitudinal bands on dorsal side. First pair of legs dark brown in colour, thick, robust and sturdy, bears long stiff spines on swollen, stumpy lobe in two rows on the ventral surface of tibia and tarsus. Rests of the legs thin and slender. Some species mimic scorpions in behaviour. Palpal organ in male comparatively simple, bearing an almost transparent bulbous with a posterior pouch and medium narrow conductor. Small curved tibial apophysis. Epigyne moderately schlerotized with a roughly ‘S’- shaped copulatory canal and spherical spermathecae.
Specimens examined:
48. Bavia sp.

Genus XXX Bianor Peckham & Peckham, 1886
These are moderately small spiders. Cephalothorax is usually brown, slightly flattened and enlarged, and only slightly longer than broad. Ocular quadrangle is much wider behind than in front. The chelicerae have two teeth in the promargin and one tooth in the retromargin. Leg I is robust and thick without enlarged segments and feathery setae. There are ventral spines on tibiae I and metatarsi I and a few more elsewhere. The abdomen is light brown and sometimes carries two or three pairs of large circular tufts of light coloured hairs. The swollen segments of leg I can be orange-brown and with thick grey-brown hairs with the other segments orange. The other legs are lighter in colour.
Specimens examined:
49. Bianor sp.
**Genus XXXI Brettus** Thorell, 1895
Medium-sized salticids having cephalothorax more or less oval in outline with the widest part at the middle; posterior end somewhat flat. In lateral view, cephalothorax convex with the highest point at the middle of the ocular clad which is narrow and covered with hairs. Due to highly recurved anterior row, the arrangements of eyes found to be in four rows. Posterior median eyes very small. A long fovea present. A white band along the margin of the cephalothorax. Abdomen spherical or oval, in some species with characteristic colour patterns or covered with lustrous flat setae. Legs long and slender; femur, patella and tibia of first pair of legs robust with fringe of hairs on ventral margins. Sharp spines on tibia. Metatarsus and tarsus slender and elongated. Ventral side of abdomen with soft hairs. Palpal organ in male complex in structure; bulbus spherical; conductor hair-like, long, and placed around the bulbus. Tibia with flat lobe-like lateral extension and a pointed apophysis. Epigyne conspicuous, sclerotized with a small spherical spermatheca laterally and those of two sides unite together to a vertical median limb. In overall appearance, epigyne forms an anchor-like pattern.

Specimens examined:
50. **Brettus** sp.

**Genus XXXII Carrhotus** Thorell, 1891
Small-to-medium sized spiders with a conspicuous, longer than wide cephalothorax with distinctly slopping posterior part. Wider than long ocular clad with posterior median eyes midway between anterior lateral and posterior laterals. Abdomen perfectly oval in blackish or brownish general colouration with chevron pattern in some. Unident chelicerae with two teeth on promargin and one on retromargin.

Specimens examined:
51. **Carrhotus viduus** (Koch, 1846)

**Genus XXXIII Harmochirus** Simon, 1885
Very small, usually ground or litter-dwelling salticids. Cephalothorax laterally pulled outwards at the level of posterior lateral eyes, otherwise roughly squarish in outline. Cephalic part very high with almost vertical lateral sides. Ocular clad broad and almost spreads the entire cephalic region, highly sclerotized with smooth, shiny cuticle in dark brown colouration. In relatively young specimens covered entirely with dull yellow to golden flat setae. Posterior median eyes midway between anterior medians and posterior laterals. Abdomen small, circular or oral; covered uniformly with setae in young specimens. Scutum sclerotized
and shiny. Legs generally small except the first pair, which is
conspicuously robust with flat femur, patella and tibia. Row of fringe
hairs present on patella and tibia of first pair of legs along ventrolateral
margin. Long and slightly curved spines are also present along with hairs
on femur and metatarsus. Metatarsus and tarsus long and slender.

Specimens examined:
52. *Harmochirus* sp.

**Genus XXXIV Hasarius** Simon, 1871
This genus consists of squat, dull brown coloured Salticids, cephalothorax thick, flat top extend on to the thorax with the rear slope to the margin very steep. Sides are vertical. In plan the carapace is ‘U’ shaped with the sides virtually parallel and the rear margin modestly truncate. Abdomen broad oval, rounded at the front and very slightly tapering to the rear, legs are long and moderately spiny, with legs I and II very slightly more robust than legs III and IV. Dark brown eye area is bordered by a lightly crescent shaped area carrying white hairs, the rest of the carapace is dark brown. The underlying colour of abdomen is a mottled dark brown. Around the shoulders there is white crescent-shaped collar. Towards the rear there is a vague, brown lighter area in the middle and several white spots, two of which are prominent. Legs uniform darkish brown. The female is lighter edition of the male and white spots on the abdomen are not evident.

Specimens examined:
53. *Hasarius adansoni* (Audouin, 1826)

**Genus XXXV Hyllus** Koch, 1846
Comparatively large salticids with swollen spherical head having conspicuous ocular clad and large round eyes. Abdomen broad at base, blunt towards tip. Body and legs with thick covering of hairs. Strong stout legs with sharp spines and thick hairs. A tuft of long, stiff, slightly curved hairs on lateral sides, just outer to anterior lateral eyes in some species. Palpal organ simple, with roughly rectangular cymbium, round bulbous and coiled embolus. Tibial apophysis in some with few spur-like projections at the flat tip. Epigyne not much conspicuous, roughly semicircular in out line.

Specimens examined:
54. *Hyllus semicupreus* (Simon, 1885)
Genus XXXVI Menemerus Simon, 1868
Medium sized jumping spiders with flat cephalothorax having almost truncated anterior margin and curved posterior margin. Lateral margins with a band of white hairs. Legs short, moderately thick, with light brown patches on a dark brown background. Abdomen generally in shades of light brown, with a broad dark brown band along the mid dorsal line, flat, broadest at the middle and with a pointed tip. In females, a broad whitish brown band runs from the anterior row of eyes to the tip of the abdomen.

Specimens examined:
55. Menemerus sp.

Genus XXXVII Myrmarachne MacLeay, 1839
Ant mimicking salticid spiders. In some species mimicry is perfect to an extent which cause great difficulty in recognizing the spider from its ant model even by an expert arachnologist. Peduncle connecting cephalothorax and abdomen is very conspicuous. Cephalothorax, elongated, roughly rectangular with a flat ocular clad, separated from the thoracic region by a constriction. Abdomen is also elongated, oval or spherical according to the ant model. Colour varies from reddish orange, brown and to black. Legs slender with long segments. Reproductive structures show similarities among different species and cause difficulties in taxonomical identification. Palpal organs with round swollen bulbous and long coiled embolus. Cymbium roughly oval in shape. Epigyne sclerotized with usually kidney-shaped spermathecae and anteriorly projecting copulatory ducts. Chelicerae swollen and generally elongated and sometimes it is extraordinarily long and conspicuous. Large number of sharp pointed cheliceral teeth in ventro-lateral row. Fang long, curved, all most as long as the chelicerae.

Specimens examined:
56. Myrmarachne orientales Tikader, 1973
57. M. plataleoides (Cambridge, 1869)

Genus XXXVIII Phintella Strand, 1906
These are colourful salticids and quite commonly found on leaves. The cephalothorax is quite high, with the cephalus flat and the thorax sloping, slowly at first and then steeply to the posterior margin. The sides are more or less vertical. The abdomen is oval, widish anteriorly and narrowing to a rounder posterior. The moderate spiny legs are longish and slender and all of much the same size, with the front legs of the male marginally longer and stronger than others.
Specimens examined:

58. **Phintella vittata** (Koch, 1846)

**Genus XII. Plexippus Koch, 1846**

Medium sized active jumping spiders, cephalothorax almost longer than wide truncate at posterior and curved upwards towards the front row of eyes. Ocular clad wider than long, dark brown. Anterior row of eyes moderately recurved. Abdomen roughly oval, broadest at the middle. General body colour in female dull sand yellow. Male dark brown to brownish black in general background colouration. Males usually with a conspicuous white or dull white dorso-median band from the lower margin of ocular clad to the posterior end of cephalothorax. In some species it merges with the narrow band along the lateral sides of the cephalothorax. A broad white band is also present on the midline of the abdomen up to the spinnerets. Two pairs of conspicuous white spots close to the median band present, one at about one third of the abdomen from the tip and the other more close to it. In females bands on cephalothorax are absent. Median band on abdomen is not continuous and conspicuous. Two pairs of spots appear prominent against the much dull background colouration. Palpal organ in male thick, sclerotized, dark brown with almost rectangular bulbous and sharply pointed, slightly curved embolus originating from the upper inner corner of the bulbous. Tibial apophysis sharp, short, broad, slightly curved inwards. Tibia with a tuft of long hairs. Cymbium broad, flat and hairy. Epigyne appears as with a transverse base and a median upward canal.

Specimens examined:

59. **Plexippus paykulli** (Audouin, 1826)
60. **P. petersi** (Karsch, 1878)
61. **Plexippus sp.**

**Genus XI. Rhene** Thorell, 1869

This is a quite large, widespread genus of small furry salticids with broad, oblong carapaces. Typically the cephalothorax is fairly thick and flat on top. In plan, the carapace is broader than long and widest at the level of the rear eyes. The flat top is almost trapezoidal in shape, widest just behind the rear eyes and narrowest at the front row of eyes. The sides are most of the thorax are vertical, with the rear margin very wide and truncate. The abdomen is oval, slightly truncate at the front and slightly pointed at the rear. The legs are fairly sturdy with the femora, patellae and tibiae noticeably swollen.
Specimens examined:
63. *R. flavigera* (Koch, 1848)

**Genus XLI Siler** Simon, 1889
Small salticids usually with an attractive colouration. Cephalothorax circular or ‘U’ shaped in general outline; with a flat, almost rectangular ocular clad. Cephalic region remains very high with vertical sides. Entire cephalothorax is covered with soft, usually colourful hairs in patterns characteristic to each species. Abdomen elongated or oval with soft hairs or lustrous setae. Legs slender; first pair of legs in males of some species robust with flat tibia bearing fringe of stiff hairs along the dorsal and ventral line. Short, stiff spines are also present on legs. During walking, males often stop a while and repeatedly raise the robust first legs and wave in air. Male palpal organ moderately sclerotized, embolus swollen, with a thick, short curved conductor and a pouch pointing downwards. Epigyne moderately sclerotized, spermathecae spherical with a short, curved copulatory canal.

Specimens examined:
64. *Siler* sp.

**Genus XLII Telamonia** Thorell, 1887
Comparatively large spiders among salticids. Very active, males often show ferocious posture when threatened. Large swollen cephalothorax, slender, elongated, pointed abdomen. Sexual dimorphism common. Female, pale cream in colour with a pair of longitudinal lines on the abdomen. Male, dark brown with broad white patch on lateral sides of cephalothorax and a white longitudinal stripe on the abdomen. Legs long, stout hairy with spines. The most characteristic morphological feature of *Telamonia* is the presence of short thick bristles on the lateral surface of cymbium of males just above the tips of tibial apophysis. Stout, sclerotized tibial apophysis often with apical teeth. Epigyne conspicuous, encircled with sclerotized semicircular plates.

Specimens examined:
65. *Telamonia dimidiata* (Simon, 1899)
15. FAMILY SCYTODIDAE Blackwall, 1864 (Spitting spiders) (Plate 1.23)

**Identification features:** Shiny and glabrous cephalothorax domed towards thoracic region, fovea absent, decorated with symmetrical dark stripes or spots. It has a distinctive shape with a domed, oversized cephalothorax which houses an anterior venom gland that is connected to a posterior section that synthesises sticky silk used for defence and prey capture. Six small eyes arranged in three well-separated contiguous diads. Apex blunt, oval sternum with sclerotized edge. Labium as wide as long with slightly concave anterior margin fused to sternum, maxillae converging. Basally fused chelate chelicerae with very short fangs, conspicuous chitinous lamina on outer margin of basal segment. Long and slender legs with three claws and onychium, metatarsi longer than tarsi and slightly covered with setae and without spines. Claws also present in female palp. Broad oval abdomen with slight covering of dark setae, chitinous depression behind genital groove on ventral side. Anterior contiguous spinnerets slightly larger than others, pointed large colulus with numerous setae. Simple epigyne with multiple spermatheca and scattered glands on paired vulva. Male palp with slender embolus and without basal haematodocha.

These are nocturnal cursorial spiders with a specialized way of catching prey. These are the only spiders known to possess prosomal gland that produce silk. This gland can produce venom and gluey silk. They squirt a mixture of venom and gluey silk from the chelicerae up to a distance of 2 cm. The prey is glued to the substrate and paralyzed by the action of venom. Females build silk retreats with a few threads during egg laying. Eggs are simply held together by silk threads and carried in the chelicerae.
Genus XLIII Scytodes Latreille, 1804

Cephalothorax high, subglobose behind and slopes forward. Eyes six, small and light coloured, arranged in three widely separated pairs. Anterior eye row strongly recurved. The only genus of this family, Scytodes, can be regarded as the stealth fighter of spiders and is commonly called the spitting spider. This roams nocturnally and actively hunts its prey. It can be found in leaf litter. After laying, the eggs are held together with a few strands of silk and carried around by the female in her chelicerae. Some species use a lace-like covering for the eggs.

Specimens examined:

66. *Scytodes fusca* Walckenaer, 1837
67. *S. thoracica* (Latreille, 1802)

16. FAMILY SPARASSIDAE Bertkau, 1872 (Giant crab spiders) (Plate 1.24)

**Identification features:** Broadly oval cephalothorax longer than wide, narrower in eye region, covered with a dense layer of fine setae, fovea present, cream to dark brown or grey or green or white, often with dark stripes and mottles pattern in colour. Eight eyes in two rows, size of anterior eyes varies between genera, medians usually largest, posterior row evenly spaced. Apex-pointed sternum longer than wide to almost circular. Free labium short and rebordered distally, never beyond half the length of maxillae, maxillae with thick scopula and serula. Chelicerae with two rows of teeth on fang furrow and boss. Long laterigrade legs held at right angles to body, I and II legs larger than III and IV, leg scopulae well developed, tarsal claws with claw tufts, trochanters are slightly notched, apical ends of metatarsi furnished with a soft trilobate membrane. Due to their laterigrade legs they run sideways. Female palp also with claw. Abdomen round to oval, clothed in dense layer of fine setae, often with dark, median, heart shaped mark. Colulus absent. Complex epigyne scelrotised and conspicuous. Male palp with
strong tibial apophysis. The typical body and leg colours are grey, brown and black, often with enough mottling to provide useful camouflage when the spiders are resting in dry grass.

These spiders are nocturnal, females with their egg sac hide by day. The female of some species carry their egg sac underneath the body by clasping it with their pedipalp. They do not spin webs, only build silk retreats.

Key to the genera of the family Sparassidae:
1a. Posterior row of eyes recurved; lateral eyes prominent.................................*Heteropoda*
1b. Posterior row of eyes straight or procurved; lateral eyes not prominent and may be sessile.................................2

2a. Cephalic part of carapace remarkably higher than the thoracic part; labium rounded at the apex; tibia I armed with 2 pairs of inferior spines; spinnerets without any membranous stalk and without any membranous chitinous ring.........................*Olios*
2b. Cephalothorax longitudinally convex; labium truncated at the apex; tibia I armed with 5-7 pairs of inferior spines; spinnerets supported on a membranous stalk and strengthened by a hairy chitinous ring..................................*Theleticopis*

**Genus XLIV Heteropoda** Latreille, 1804
Carapace nearly as long as wide, upper surface nearly flat or in some very high posteriorly, cephalic part slightly depressed in front. Posterior row of eyes recurved, the lateral eyes larger and prominent, eyes of anterior row straight or little procurved, anterior lateral larger than median. Ocular quadrangle longer than wide, narrow in front. Maxillae plain, not crested. Epigynum provided with a pair of lobes usually separated by a median septum.

Specimens examined:
68. *Heteropoda venatoria* (Linnaeus, 1767)

**Genus XLV Olios** Walckenaer, 1837
Carapace distinctly high and convex, thoracic groove indistinct or may be absent. Anterior row of eyes straight, anterior medians largest and larger than laterals, posterior row of eyes slightly procurved, posterior laterals sessile, ocular quadrangle square. Clypeus very low. Labium rounded at the apex. Second leg longer than first. Tibia I armed with 2 pairs of inferior spines.
Specimens examined:
69. *Olios* sp.

**Genus XLVI Thelcticopis** Karsch, 1884
Cephalothorax longer than broad, thick, anteriorly broad and longitudinally convex. Posterior row of eyes procurred, lateral eyes sessile, anterior median eyes larger than anterior laterals, ocular quadrangle more or less squarish. Legs short, less laterigrade, first leg longer than second or may be equal, tibia I armed with 5 to 7 pairs of inferior spines. Spinnerets supported on a membranous stalk and strengthened by a hairy chitinous ring. Constructs retreat between two leaves. On disturbance, it falls to the ground and it is very difficult to find it in the ground due to the body colour matching with the ground colour.

Specimens examined:
70. *Thelcticopis* sp.

17. **FAMILY TETRAGNATHIDAE** Menge, 1866 (Long jawed spiders) (Plate 1.25)

**Identification features:** Cephalothorax longer than wide, general colour fawn to dull brown or grey with silvery markings, sometimes with grey and silvery folium. Eight eyes in two rows, lateral eyes contiguous or apart. Longer than wide sternum pointed posteriorly, labium rebordered and maxillae parallel. Chelicerae variable, short and stout or long and well developed, with row of large teeth and strong projecting spurs. Long and slender three clawed legs, with or without spines, some species have conspicuous tufts or setae on femora and tibia of legs or posterior femora with a double fringe of trichobothria on prolateral surface of basal half or rows of straight trichobothria on
tibia of all legs. Abdomen variable, elongated and cylindrical or round to ovoid, in some species extending caudally beyond spinnerets, epigastric furrow nearly straight. Anterior and posterior spinnerets similar in size. In some species, tracheal spiracle halfway between spinnerets and epigyne. Complex epigyne with unsclerotized genital plate, male paracymbium separate and movable, spherical tegulum with coiled embolus and conductor at distal tip, median apophysis absent, embolus–tegulum membrane present. These are orb weavers occupying a variety of habitats.

**Key to the genera of family Tetragnathidae:**

1a. Femur IV with trichobothria......................................................................2
1b. Femur IV without trichobothria.................................................................4

2a. Femora I-IV each with a single row of trichobothria....................................Tylorida
2b. Femora IV with two rows of long trichobothria..........................................3

3a. Legs robust and relatively longer......................................................Orsinome
3b. Legs comparatively shorter and thin....................................................Leucauge

4a. Abdomen spherical.................................................................Dyschiriognatha
4b. Abdomen slender and elongate..........................................................Tetragnatha

**Genus XLVII Dyschiriognatha** Simon, 1893
Reddish brown cephalothorax with cephalic region higher than thoracic, heavily sclerotized sternum extended posteriorly between coxae IV, rough and moderately stout chelicerae with teeth, subequal eyes except small posterior lateral eyes. Median ocular quadrangle often squarish, anterior median eyes slightly projected anterior to clypeus, legs without spines. Globose silvery abdomen with or without dorsal spots, female tracheal spiracle between epigastric fold and spinnerets. Male palp with a strongly rounded bulb, slender paracymbium without or with a reduced porlateral process, embolic division with a sclerotized and membranous structure apically with serrated row of teeth.

Specimens examined:
71. **Dyschiriognatha dentata** Zhu & Wen, 1978

**Genus XLVIII Leucauge** White, 1841
Carapace truncate anteriorly, thoracic furrow deep and posteriorly directed. Legs I and II long and slender, femora IV with a double fringe
of hairs on the prolateral surface of the basal half. Abdomen nearly twice as long as wide, having silvery pigmentation, epigastric plate without any furrow. Spins large vertical to almost horizontal webs in vegetation, several species of the genus spin webs both in the morning and during the day and occasionally re-use the frame and anchor lines.

Specimens examined:
72. *Leucauge decorata* (Blackwall, 1864)  
73. *L. pondae* Tikader, 1970

**Genus XLX Orsinome Thorell, 1890**

In general appearance this genus resembles *Leucauge* but differs from the latter in having more robust and relatively longer legs. Legs I are much the longest, with legs I and II more robust than others. The legs are fairly spiny, and there are numerous long erect bristly hairs. The legs of the female are brown with vague yellowish annulations and those of the male are brownish-yellow. The large webs of this genus are typically to be found on suitable vegetation over streams or water.

Specimens examined:
74. *Orsinome sp.*

**Genus L Tetragnatha Latreille, 1804**

Body prominently long and narrow, several times longer than wide, carapace oval, widest near the middle, flattened above, with a conspicuous thoracic groove, eye rows either parallel or converge or diverge, but lateral eyes never contiguous, each eye surrounded by a black ring. Chelicerae well developed, especially in the males, margins of fang furrow provided with numerous teeth, in males a strong projecting clasping spur may or may not be bifid at its tip. Maxillae parallel, long and dilated at the distal ends. Abdomen at least twice as long wide, in females often swollen at base, often base is slightly bifid and overhangs cephalothorax, epigynal slit posterior to lung slits in the procurved epigastric furrow, spinnerets usually terminal or almost so. Legs and palpi very long and thin, but proportion differs in various species.

**Key to species of the genus Tetragnatha:**

1a. Ocular quadrangle very much narrower in front than behind.................................................................*javana*  
1b. Ocular quadrangle little or no narrower in front than behind.................................................................2
2a. Fang with more or less distinct tooth situated ventrally on outer side of the basal bend……………………….……………….…..
2b. Fang without any tooth in this position…………………………...4

3a. Fang unarmed except for the above-mentioned tooth; first two teeth of ventral row situated at the base of fang and not markedly larger than others……………………………………………………fletcheri
3b. Fang armed on inner side with a strong tooth about a third of the way from the base to tip of first ventral tooth very large……………………………………………………mandibulata

4a. Abdomen slender………………………………………………….5
4b. Abdomen stouter…………………………………………………6

5a. Abdomen with a brown diagonal line extending from anterior dorsal end to the epigastric plate………………………...andamanensis
5b. Abdomen without the brown diagonal line…………cochinensis

6a. Fang very stout in the basal half, then very slender; first dorsal tooth broad and obliquely truncate…………………………maxillosa
6b. Fang more evenly tapering; first dorsal tooth acuminate; chelicerae very long and slender………………………………viridorufa

Specimens examined:
75. Tetragnatha andamanensis Tikader, 1977
76. T. javana (Thorell, 1890)
77. T. cochinensis Gravely, 1921
78. T. fletcheri Gravely, 1921
79. T. mandibulata Walckenaer, 1842
80. T. maxillosa Thorell, 1895
81. T. viridorufa Gravely, 1921

Genus LI Tylorida Simon, 1894
The characteristic shape of the abdomen distinguishes Tylorida from other members of this group. From the side, the abdomen is high and roughly forms a right-angled triangle in shape. The right-angle is located at the highest point from where a short steep side slopes to the front and a long steep side slopes to the spinnerets. In plan, the abdomen is oval, slightly attenuated towards the spinnerets, with very steep sides and with a truncated rear running from the highest point. The legs are fairly uniformly brownish.

Specimens examined:
82. Tylorida sp.
18. FAMILY THERIDIIDAE Sundevall, 1833 (Comb footed Spiders) (Plate 1.26)

Identification features: Cephalothorax variable in shape, flat to high, clypeus relatively high, in some species frontal region of cephalothorax with modifications. Eight eyes in two rows, more or less parallel, usually encircled by brownish ring, anterior medians dark and the rest are pale. Scutiform to triangular sternum attenuated posteriorly, maxillae usually converging slightly. Chelicerae sometimes very long and cheliceral teeth absent or few in number. Three-clawed legs are relatively long and curved, without spines on the femur, tibia and metatarsi; tarsi usually tapering towards tip. Large theridiids have a series of bristles on tarsi IV, called tarsal comb, the comb may be reduced or absent in smaller species and males, tarsal comb is used to lengthen the throw of sticky silk threads over the prey. Trichobothria are arranged in two rows on each tibia, female palp with a claw. Shape of abdomen varies from oval to round and high to elongate, extending beyond spinnerets, some species with a dorsal stridulating plate near pedicel, cryptic with darker patterns on a brownish grey background in colour, colulus present or absent. Complex epigyne with single or double pairs of spermatheca. Male palp without apophysis, paracymbium forming a hook on distal margin of cymbium.

These spiders have diverse life styles. Most species construct different shaped three-dimensional space webs. Some webs enable the spider to catch flying insects and consist of criss-cross viscid threads. The threads break easily and prey glued to them becomes more entangled during escape activities. Some species build special retreats inside or outside the frame and use plant or soil particles to camouflage the web. Some species, hide in a dark or debris covered silken retreat which is built in an angle or corner with the web stretched out below. Some species make no web at all, they may be found walking in leaf
litter or in the case of certain cryptic species just resting on bare twigs.

**Key to the genera of family Theridiidae:**

1a. Colulus and paired setae absent........................................2
1b. Colulus large to small or reduced to pair of setae only........5

2a. Abdomen longer than wide, high with distinct, long spines posterodorsally above spinnerets, sometimes subtriangular in lateral view.........................................................*Chrysso*
2b. Abdomen without distinct long spines posterodorsally........3

3a. Clypeus projected forward in females; males with constriction in the middle and with sclerotized ring around abdomen encircling pedicel and covering epigastric region..........................*Colesoma*
3b. Female clypeus and male abdomen not as above..............4

4a. Anterior median eye diameter greater than posterior median eye, posterior eye row usually straight to slightly recurved.........................................................*Achaearanea*
4b. Anterior median eye diameter equal to or smaller than posterior median eye; posterior eye row commonly straight and lateral eyes contiguous.........................................................*Theridion*

5a. Colulus indistinct, replaced by two small setae..........*Phycosoma*
5b. Colulus large and highly visible......................................*Argyrodes*

**Genus II Achaearanea** Strand, 1929

Members of this genus spin irregular networks of fine threads built commonly in hidden or sheltered habitats. In profile they have a characteristic shape, the abdomen is balloon shaped with its axis almost vertical and spinnerets at the bottom. The pedicel is located near the middle of the wide area where it joins the smoothly curved, flattish cephalothorax. Anterior row of eyes procured and posterior row slightly recurved or straight, subequal eye diameter, squarish median ocular area. Abdomen higher than long, colulus and paired setae absent, moderately long legs with spines and many hairs, leg formula 1432 in females and 1234 in males.

Specimens examined:
83. *Achaearanea sp.*
Spiders of Kuttanad

Genus LIII Argyrodes Simon, 1864
Carapace flat and are rather low posteriorly in the thoracic area, fovea transverse, clypeus and ocular region high. In males, ocular region or clypeus or both modified to bear snout-like projection or horn. Chelicera bears two or three promarginal teeth and one or two in the retromargin or a row of small and equal sized denticles. Leg formula 1423, tarsus IV bears no tarsal comb, replaced by few serrated bristles, middle claw longer than outer claws. Abdomen bears tubercles, extended subtrianlgular to very long, higher than long and rarely globular, anterior border with stridulating ridges in both sex and a pair also in carapace, tiny colulus bears setae shorter than the fleshy base, general colouration of abdomen uneven, usually silvery or with silvery patches. Male pedipalp with poorly sclerotized median apophysis, cymbium spoon-shaped to truncate, female epigynum with a scelorotised plate covered with resinous material and two ovoid to globose receptacles, tube shaped in some groups.

Specimens examined:
84. Argyrodes andamanensis Tikader, 1977

Genus LIV Chrysso Cambridge, 1882
Cephalothorax longer than wide, anterior row of eyes slightly procurved, posterior row straight or slightly procurred or recurved, anterior median eyes separated from each other by one anterior median eye diameter or more and set closer to anterior lateral eye than to each other, posterior median eyes moderately closer to each other than to lateral. Eyes subequal in size or anterior median eyes slightly larger or smaller than the rest, clypeus height and shape of carapace variable. Length of chelicerae almost as long clypeus height, anterior margin of chelicerae armed with two large teeth. Sternum truncate between posterior coxae. Leg I the longest, patellae with a retrolateral tubercle, tarsus IV bears a tarsal comb. Abdomen longer than width and height, extends beyond spinnerets, laterals with furrows or stripes and dorsolateral spines, often subtriangular in lateral view. Female epigynum with a sclerotised plate with indistinct orifice, sacs present ventrally. Male pedipalp bears a distinct radix, embolus base curved and its length supported by radix and its tip by both radix and conductor, hematodocha connected to the bulb in the proximal part of alveolus.

Specimens examined:
85. Chrysso argyrodiformis (Yaginuma, 1952)
**Genus LV Coleosoma** Cambridge, 1882
Eyes small, posterior eye row separated by one to two eye diameter, clypeus rounded and projected anteriorly. Chelicerae bear zero to one teeth in promargin, legs I and II longest in males and I and IV in females, tarsal comb present but hardly visible. Abdomen always modified in males, usually constricted and with sclerotized ring or scutum, less modified in the females, colulus absent, male pedipalp bears a functional median apophysis, weakly sclerotized conductor, sclerotized radix, and thin thread shaped embolus. Epigynum of female poorly sclerotised without clear orifices.

Specimens examined:
86. *Coleosoma floridanum* Banks, 1900

**Genus LVI Phycosoma** Cambridge, 1879
Cephalothorax subovoid, eye region slightly projecting, very high and concave clypeus, subglobose abdomen, sternum broadly produced between coxae IV, leg I longer than IV. Female epigynum with a distinct opening, bears a pair or spherical spermatheca and ducts with minimal coils, male pedipalp usually bears a large median apophysis, embolus long and forming a circle, conductor with small projection and accessory apophysis usually attached to embolus.

Specimens examined:
87. *Phycosoma martinae* (Roberts, 1983)

**Genus LVII Theridion** Walckenaer, 1805
Carapace longer than wide without stridulating structures, fovea indistinct, anterior eye row straight or procurved as viewed frontally, posterior eye row straight as seen dorsally, eyes subequal in size, anterior median eyes either slightly larger or smaller than other, sternum usually bluntly pointed between coxae IV, enlarged chelicerae present in males, female chelicerae each with one or two teeth in promargin, retromargin bears no teeth, patella I and tibia I at least 1.5 times as long as cephalothorax, leg formula in female 1423, leg II longer than IV in males. Abdomen usually spherical, longer than high, sometimes wider than long, subtriangular, without plate or tubercles, colulus absent. Female epigynum weakly sclerotised, with indistinct opening, one pair of seminal receptacles present, male pedipalp with distinct median apophysis conductor and radix though varies in position.

Specimens examined:
88. *Theridion lumabani* Barrion & Litsinger, 1995
89. *Theridion sp.*
19. FAMILY THOMISIDAE Sundevall, 1833 (Crab spiders) (Plate 1.27)

**Identification features:** Shape of cephalothorax varies from semicircular, ovoid to elongated, usually with simple erect setae, some species with strong rounded or distinct protuberances or eye tubercles. Dark and homogenous eight eyes in two rows, often outline in white, posterior row is usually recurved, usually lateral eyes are elevated on tubercles, which may be joined, medians usually larger than others. Sternum heart shaped, labium and maxillae usually longer than wide. Chelicerae free, boss present usually, cheliceral teeth absent, sometimes cusps or small denticles on promargin, retromargin indistinct and unarmed, scopulae poorly developed. Two clawed latergrade legs, first two pairs bear paired ventral spines, more enlarged and more powerful than third and fourth pairs, I and II longer than III and IV, anterior tarsi without scopulae, usually claw tuft absent. The powerful and spinous legs are used for seizing the prey as these spiders construct no webs but hunt by stealth and ambush. Abdomen is somewhat large and more variable in shape than the cephalothorax, from round to ovoid or elongated, extending caudally beyond spinnerets and usually covered with scattered simple setae. The body colour may be white, green or brown to match the colour of the surfaces on which the spider is most likely to be found. Anterior spinnerets short, conical and narrowly separated, colulus present. Complex epigyne usually with hood and bordered atrium. Male palp with ventral and retrolateral apophysis on tibia, disc like tegulum. The typical members have a peculiar crab like appearance.

The usual habitats are leaves or flowers where the spider's surfaces are roughened to improve the camouflage. They usually do not produce webs. They are mainly active during the day and their gait is sideways or crab-like, hence their common name. Although they have weak chelicerae, they secrete extremely potent venom that enables them to
attack big insects. No cheliceral teeth are present and prey is not mashed but sucked dry.

**Key to the genera of family Thomisidae:**

1a. Tarsi of I and II leg not furnished with scopuale..................2
1b. Tarsi of I and II leg furnished with scopuale......................5

2a. Lateral eyes on strong conical protuberance.....................3
2b. Lateral eyes not on protuberance....................................4

3a. Abdomen widened and truncated behind.........................Thomisus
3b. Abdomen long, lateral sides with longitudinal muscular corrugation............................................Runcinia

4a. Integument clothed with some clavate setae....................Ozyptila
4b. Integument not clothed with clavate setae......................Misumenops

5a. Posterior eyes strongly recurved....................................Oxytate
5b. Posterior eyes not strongly recurved..............................Xysticus

**Genus LVIII Misumenops** Cambridge, 1900
Spiders of this genus are seen among the dried leaves and on flower parts of the plants. The cephalothorax is low, with the cephalus flattish or slightly convex. Legs are clothed with spines and abdomen decorated with some brown patches.

Specimens examined:
90. *Misumenops maygitgitus* Barrion & Litsinger, 1995

**Genus LIX Oxytate** Koch, 1878
Cephalothorax flat, thoracic slope steep, carapace is almost circular, but near the front carapace narrows suddenly to a wide, projecting rectangular eye region. Lateral eyes protrude slightly and there are white rings surrounding the lateral eyes. Abdomen elongate, widest near the front and tapers gradually to the spinnerets. The legs long, provided with spines, I and II much longer than III and IV. In general, these spiders appear to be plain pale green coloured spiders lacking any pattern on the abdomen.

Specimens examined:
91. *Oxytate virens* (Thorell, 1891)
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Genus LX *Ozyptila* Simon, 1864
These spiders are dull brown and grey in colour. They are found on the ground. Majority of them live under dried leaves and crevices in the soil. The abdomen is short and round provided with clavate hairs.

Specimens examined:
92. *Ozyptila* sp.

Genus LXI *Runcinia* Simon, 1875
Cephalothorax slightly wider than long, cephalic region with prominent ocular tubercles, clothed with hairs and spines, low cephalothorax with long cephalus more or less flat, convex sides, flat short thorax slopes steadily downwards to the margin. From top, cephalothorax is wide and nearly circular with a wide truncated posterior margin and a wide truncated slightly diverging and projecting eye region. A broad pale band runs the length of the carapace from the eyes to the posterior margin, bordered on the sides by two very broad brown bands. The eye region is white but the carina which runs between the eye rows is thin and white. Leg I and II are quite robust and longer than III and IV, two rows of short strong spines on the ventral surface of tibiae and metatarsi I and II. Abdomen long, spined, narrower behind, lateral sides with conspicuous longitudinal muscular corrugation, abdomen obliquely truncated at the front from side, and more or less converging at thorax, terminating abruptly at the rear and just covering the spinnerets.

Specimens examined:
93. *Runcinia* sp.

Genus LXII *Thomisus* Walckenaer, 1805
Cephalothorax truncated in front, with upper corners strongly and conically protuberant and divergent, bearing the lateral eyes. Wide cephalothorax as long as broad and widest at the level of highest point. Posterior margin is very wide, curved lateral margins converge to a broad anterior margin. From above a wide straight ridge which forms with the carapace as distinct pointed horns. Eyes very small. Rhombus pentagonal shaped abdomen narrow and truncated in front, enlarging to a considerable width behind, where at either corner of the dorsal side is a short blunt conical protuberance. From these tubercles the sides drop away very steeply and converge to the spinnerets. Legs long, I and II much longer than III and IV, typical crab like in appearance.

Specimens examined:
94. *Thomisus pugilis* Stoliczka, 1869
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**Genus LXIII Xysticus** Koch, 1835

Cephalothorax fairly low and convex, with the highest point behind centre. Flat cephalic region slopes gently downwards from the highest point to the eye region and thoracic region slopes more steeply to the margins. Sides are curved and towards the front straighten out to a wide, parallel sided and quiet sharply truncated anterior. The rear is broadly truncated. Legs are long and spiny with I and II much longer and robust than others. Abdomen is broadly ovate and widest behind the centre.

Specimens examined: 95. *Xysticus* sp.

20. **FAMILY ULOBORIDAE** Thorell, 1869 (Hackled web spiders) (Plate 1.28)

**Identification features:** Shape of cephalothorax variable with a pair of lateral swellings posterior or median to posterior lateral eyes. Eight homogenous dark eyes arranged in two well separated rows or four eyes in a single posterior row only. Sometimes posterior laterals on a tubercle. Sternum long, oval to triangular, in some species two separate sternites with coxae II and III surrounded by a sternal plate. Free labium semicircular or long and distally pointed. Chelicerae with or without a boss, and the fang margins may have several small teeth to only one large tooth. Unlike other spiders, uloborids lack a venom gland. Legs with 3 claws, femora with rows of long trichobothria, metatarsi IV ventrally with a row of macrosetae, this segment dorsally compressed and curved under uniseriate calamistrum. Female palp with toothed claw. Slender abdomen with one or two humps, narrow and elongated, sometimes extending beyond spinnerets, anal tubercle usually large and two segmented, usually dull, shades of cream, grey or brown in colour. Anterior spinnerets three segmented with ring shaped very short second segment, third segment domed, median spinnerets unsegmented,

Plate 1.28. *Miagrammopes* sp.
posterior spinnerets with two cylindrical segments. Undivided cribellum in front of spinnerets.

These spiders spin modified versions of orb webs made up of cribellated silk. Web modifications range from triangular to a single thread. The web is usually tugged forcefully to locate and entangle the prey while the spider is approaching it. The first pair of legs and to a lesser extent the second pair are used for tugging. The front leg is used to lightly touch the prey. Hanging from the first and second pair of legs, the spider uses the fourth pair to cast silk onto the prey to subdue it. It faces away from the prey while wrapping it. These spiders lack venom glands but pour digestive enzymes onto the prey to kill it. The silk wrapped around the prey becomes transparent after absorbing some of the enzymes. The spiders do not use their chelicerae while wrapping the prey.

Key to the genera of family Uloboridae:

1a. Eyes in one row of four; anterior eyes lacking, legs moderately short; abdomen elongate..........................Miagrammopes

1b. Eyes in two rows of four each........................................2

2a. Cephalothorax flatter; female has a single, much flattened hump on the abdomen........................................Zosis

2b. Female abdomen with two humps.................................Uloborus

Genus LXIV Miagrammopes Cambridge, 1870

The cephalothorax appears flat and thin, with the thorax, cephalus and clypeus all horizontal but rounded at the sides in lateral view. From above, carapace is about twice as long as wide with straight sides, which are parallel or slightly diverging to the front until reaching the posterior lateral eyes. A dry twig like body with prominently longer than wide cephalothorax and elongate abdomen, four eyes in a transverse row with posterior lateral eyes on lateral tubercles and anterior eye row absent. Lateral eyes large and protruding sideways. From here, the sides of the carapace converge quite sharply to a wide, truncated anterior. It has only four large eyes, appearing to have lost the front row. Abdomen is very long and thin, almost tubular and five times as long as wide. From the sides, both the front and rear of the abdomen are obliquely truncated, with the front overhanging the posterior edge of the cephalothorax and the rear overhanging the spinnerets. The top is flattish, very slightly widened and truncated anteriorly and bluntish posteriorly. The legs are very long and slender with legs I and IV being roughly equal length and much longer than others. Leg I more robust than the rest. Rows of short spines occur dorsally on tibiae I of males and ventrally on metatarsi IV of females. Sternal suture developed, coxae II closer to I than to III,
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cribellum and calamistrum present, tarsi shorter than metatarsi and tarsus IV bears ventral row of macrosetae. Pedipalp of female with tarsal claws, males have tibial projection.

Specimens examined:
96. Miagrammopes sp.

Genus LXV Uloborus Latreille, 1806
Cephalothorax broader in dorsal view, but slightly longer than wide with moderately curved sides, anterior end narrowed. Male cephalothorax is flatter edition of that of the female with anterior end narrower than posterior. Laterally, the abdomen of female has hunch backed appearance. Front of abdomen curves and rises quite steeply to the highest part, then slopes quite steeply downwards to the spinnerets. Abdomen longer than broad, spear shaped rounded at front and pointed at rear. At the widest part, there are two substantial but well separated humps giving the impression of shoulders. In both male and female, leg I is much longer and more robust than others. Dorsally on tibia I of the male there are rows of quite strong spines, while dorsal and ventral surface of tibia I of the female have substantial fringes of hairs. Elsewhere on the legs, there are few spines. Except for the pale coloured shallow gully on the thorax, the cephalothorax is more or less uniformly brown, some leg segments are brown with yellowish annulations while other segments are part brown and part yellow.

Specimens examined:
97. Uloborus danolius Tikader, 1969
98. U. krishnae Tikader, 1970

Genus LXVI Zosis Walckenaer, 1842
This is a very small group of feather legged spiders. These spiders have eight eyes in two rows, PE row slightly recurved, PLE not on tubercles. Cribellum and calamistrum present. Femora II and III with trichobothria, tibia I without brush or hairs. Tarsus IV with ventral row of macrosete, sternum undivided. Epigynum has no ventral atrium or paired lobes. Male pedipalp without a conductor but with a long broad and flat tegular spur functioning as an embolus, femoral tubercle visible. Females produce pinkish orange egg cocoons with six to eight rays.

Specimen examined:
99. Zosis sp.
1. 4. 2. First reports

Among the 99 species of spiders collected from the Kuttanad rice agroecosystem, a total of 5 genera and 10 species are the first report from India.

List of genera first reported from India:
1. *Atypena* Simon, 1894 (Family Linyphiidae)
2. *Coleosoma* Cambridge, 1882 (Family Theridiidae)
3. *Dyschiriognatha* Simon, 1893 (Family Tetragnathidae)
4. *Erigone* Audouin, 1826 (Family Linyphiidae)
5. *Phycosoma* Cambridge, 1879 (Family Theridiidae)

List of species first reported from India:
1. *Atypena adelinae* Barrion & Litsinger, 1995 (Family Linyphiidae)
2. *Atypena thailandica* Barrion & Litsinger, 1995 (Family Linyphiidae)
3. *Chrysso argyrodiiformis* (Yaginuma, 1952) (Family Theridiidae)
4. *Coleosoma floridanum* Banks, 1900 (Family Theridiidae)
5. *Dyschiriognatha dentata* Zhu & Wen, 1978 (Family Tetragnathidae)
7. *Misumenops maygitgitus* Barrion & Litsinger, 1995 (Family Thomisidae)
8. *Phycosoma martinae* (Roberts, 1983) (Family Theridiidae)
9. *Thanatus parangvulgaris* Barrion & Litsinger, 1995 (Family Philodromidae)
10. *Theridion lumabani* Barrion & Litsinger, 1995 (Family Theridiidae)

Detailed description of species first reported from India:

Abbreviation used are as follows: AME - Anterior median eyes, ALE - Anterior lateral eyes, PME - Posterior median eyes, PLE - Posterior lateral eyes, LE - Lateral eyes, MOQ - Median ocular quadrangle.

1. *Atypena adelinae* Barrion & Litsinger, 1995 (Figure 1. 2. a - j)

**Female:** Total length 2.78 mm, cephalothorax 0.95 mm long, 0.62 mm high and 0.76 mm wide. Cephalothorax pale yellowish brown with greyish tinge, becoming darker in the cephalic area, black eye margins and fovea, and grey in the lateral margins. Cephalic area higher than the
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Ph. D. Thesis

thoracic region, moderately deep anterior to fovea. Eight eyes in two rows, anterior eye row strongly recurved and posterior eye row straight to slightly procurved. Eye diameter (mm): AME = 0.05, ALE = 0.08, PME = PLE = 0.07. Eye separation (mm): AME-AME = 0.03, AME-ALE = 0.04, PME-PME = 0.03, PME-PLE = 0.04, LE contiguous. Median ocular quadrangle 1.3 times wider behind than in front, length 1.2 times longer than anterior width. Clypeus height twice AME diameter. Sternum greyish yellow, slightly longer than wide, extended between coxae IV, entire to labium with yellow apical margin. Maxillae pale orange yellow, similar to chelicerae, apices converging. Chelicerae vertical, promargin with 4 teeth and 3 teeth in the retromargin. Legs yellow in the basal one half of tarsi and femur, rest pale orange. All patella sub equal and all tibiae with one dorsal spine each. Leg formula 4123. Length of leg segments as in Tab. 1. 3. Pedipalp yellowish and longer than any of femora I-IV, almost as long as combined length of patella II and tibia II.

Abdomen 1.83 mm long, 1.54 mm wide, 1.33 mm high, ovoid, whitish yellow, finely haired, with 4 pairs of large oval to triangular or elongate black to grey spots, arranged in two longitudinal rows. Venter pale yellow with a grey tinge along the ventrolaterals near the spinnerets. Epigynum with a pair of diverging spermatheca, connected to each other by the posterior epigynal margin. Epigyne and internal genitalia as in Fig. 1. 2. h and i.

Male: Total length 1.87 mm, cephalothorax 0.80 mm long, 0.86 mm high and 0.68 mm wide. Cephalothorax pale yellow, except greyish brown cephalic area tapering to a point beyond the black fovea and thoracic region with a pale grey “M” shaped band posterior to fovea. Tubercles present in the cephalic region, entire portion yellow, except for a pair of median parallel grey stripes in the posterior one half with a hair in between, contains PME projected posteriorly in the dorsoventrolateral part. Anterior margin of tubercle cleft and posterior margin concave when viewed dorsally, frontal face of tubercle with a mat of transversely set black hairs converging towards each other and lateral pit like scar between PME and PLE, closer to PLE than to PME. Eight eyes in two rows, strongly recurved anterior eye row slightly shorter than procurved to straight posterior eye row. Eye diameter (mm): AME = 0.06, ALE = PLE = 0.07, PME = 0.09. Eye separation (mm): AME-AME = 0.03, AME-ALE = 0.06, PME-PME = 0.15, PME-PLE = 0.20, LE contiguous. Median ocular quadrangle 1.6 times wider behind than in front, length twice anterior width. Clypeus height twice AME diameter. Sternum greyish yellow, slightly longer than wide and posterior end extended beyond coxae, midanterior entire to the labium with a yellow apical one half. Maxillae yellow-brown with greyish scopulae, apices converging.
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Chelicerae pale orange yellow to red, vertical, and bearing two retromarginal and four promarginal teeth. Legs yellowish towards tarsi and orange–yellow to pale orange–red in apical one half of femur, entire patellae and tibiae. Tibiae I and II each with two dorsal spines and one each in III and IV. Base of median claw of tarsus slightly rounded, less projected forward, tip of median claw long and very sharply pointed. Leg formula 4123. Length of leg segments are as in Table 1.3. Pedipalp as long as combined length of patella and tibia of leg II which bears a strongly sclerotized, shortly curved lateral apophysis pointed at tip in tibia, median apophysis less sclerotized, rounded apically and with a small hump between two apophysis. Paracymbium with a strong and inwardly curved apex. Terminal apophysis broad and scoop-like, lamella pointed at tip, angulate at base. Embolic division with two apical processes, apex of one rounded in retrolateral view and a sharp tooth in ventrolateral view, the other indented or grooved apically. Basolateral of cymbium facing paracymbium bears nine setae. Ventral view as in Fig. 1.2.j.

Abdomen 1.05 mm long, 0.83 mm wide, 0.78 mm high. Abdomen ovoid, yellowish white, with a pair of black to grey longitudinal broad bands interrupted above midlength, dorsal band “C” shaped in lateral view and highlighted by the lateral band near base of spinnerets. Spinnerets pale yellow-orange.

**Distribution:** Kuttanad, Kerala, India; Luzon Is; Laguna, Philippines.

**Natural History:** These spiders are found in groups at the base of the rice plant and build webs within the base of rice tillers above the water line and catch most of its prey in webs.

**Table 1.3. Length of leg segments of the spider Atypena adelinae**

<table>
<thead>
<tr>
<th></th>
<th>Femur</th>
<th>Patella</th>
<th>Tibia</th>
<th>Metatarsus</th>
<th>Tarsus</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0.88</td>
<td>0.65</td>
<td>0.28</td>
<td>0.24</td>
<td>0.81</td>
<td>0.61</td>
</tr>
<tr>
<td>II</td>
<td>0.81</td>
<td>0.64</td>
<td>0.28</td>
<td>0.22</td>
<td>0.79</td>
<td>0.59</td>
</tr>
<tr>
<td>III</td>
<td>0.72</td>
<td>0.57</td>
<td>0.27</td>
<td>0.23</td>
<td>0.62</td>
<td>0.46</td>
</tr>
<tr>
<td>IV</td>
<td>0.91</td>
<td>0.69</td>
<td>0.28</td>
<td>0.24</td>
<td>0.88</td>
<td>0.68</td>
</tr>
</tbody>
</table>
2. *Atypena thailandica* Barrion & Litsinger, 1995 (Fig. 1. 3. a - f)

**Female:** Total length 2.35 mm. Cephalothorax 0.85 mm long, 0.70 mm wide, 0.55 mm high. Abdomen 1.50 mm long, 1.40 mm wide, 1.40 mm high. Cephalothorax yellow, except black eye rings and pale grey lateral margins, cephalic region distinctly higher than thoracic region, with short pale grey fovea. Eight eyes in two rows, AE strongly recurved and PE row straight to slightly procured. Eye diameter (mm): PME = PLE = 0.08, ALE = 0.07, AME = 0.05. Eye separation (mm): AME-AME = ALE-AME = 0.03, about 0.6 AME diameter, PME-PME = 0.05, PME-PLE = 0.04. LE contiguous. MOQ 1.25 times wider behind than in front; length 1.2 times more than anterior width. Clypeus height twice AME diameter. Sternum, labium, and maxillae as in male, except the very yellow inner lateral margin of maxillae. Chelicerae vertical, stridulating organ absent, promargin with five teeth and three in the retromargin. Legs uniformly yellow, tibiae I and II each with two dorsal spines and one each in tibiae III and IV. Tibia III as long as metatarsus III. Base of median claw of tarsus knob-like or protruded forward. Leg formula 4123. Pedipalp longer than all of the femora. Length of leg segments as in Tab. 1. 4.

Abdomen yellow, globular, and bears five pairs of black to grey spots dorsally, arranged in two longitudinal rows. Epigynum bears a broad posteriorly truncate median process, its length about twice diameter of spermatheca, in dorsal view anterior margins of median process almost converging, forming inside a series of scape-like striae. Ventrally median process truncate posteriorly, with angulate lateral epigynal margins terminating in a twisted orifice. Spermathecae globular, borne on the single coiled duct, and separated from each other by almost the length of median process. Epigyne and internal genitalia as in Fig. 1. 3. d and e.

**Male:** Total length 1.65 mm. Cephalothorax 0.75 mm long, 0.60 mm wide, 0.70 mm high. Abdomen 0.90 mm long, 0.70 mm wide, 0.70 mm high. Cephalothorax yellowish brown to light reddish brown, with black eye margins, longer than wide, cephalic hump sub rectangular with straight anterior margin and rounded posterior in top view carrying PME, dense mat of yellowish hairs present between PME and AME frontally, and a brownish pit-like scar between PME and PLE laterally. Eight eyes in two rows, strongly recurved AE row slightly shorter than the straight to procured PE row. Eye diameter (mm): PME = 0.08, ALE = 0.07, PLE = 0.06, AME = 0.05. PME almost on the dorsoanterolateral corner of the tubercle. Eye separation (mm): AME-AME = AME-ALE = 0.05, PME-PME = 0.14, PME-PLE = 0.13. MOQ 1.85 times wider behind than in front, length 2.35 times anterior width. Clypeus height 2.5 times
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AME diameter. Sternum greyish yellow, 1.25 times wider than long. Labium and sternum entire and similar in color, except yellow apical part. Maxillae yellow with pale grey scopulae, apices converging. Chelicerae vertical, separated basally as seen in front, diverging apically. Promargin with five teeth and retromargin two teeth. Legs uniformly yellow, with fine yellow hairs and few spines. Base of median claw of tarsus knob-like. Leg formula 4123. Length of leg segments as in Tab. 1.

4. Pedipalp longer than combined length of any femur and patella, yellow except brown palpal organ. Apex of pedipalp's tibiae with two processes, lateral one reduced to a small tooth and the inner one sclerotized, flat and large with a rounded apex. Paracymbium longer than wide, sub rectangular with a semi concave distal end and curved apex much wider than base. Lamella slender, swollen at midhalf and concave sub basally, sharply pointed and higher than shoe-like terminal apophysis with a blunt end. Embolic division with two sclerotized processes and a semi membranous structure adjacent to them, with a thin spur and swollen base, embolic base a large tooth-like process. Cymbium rounded apically with ten setae basolaterally facing paracymbium. Ventral view of palp as in Fig. 1. 3. f.

Abdomen ovate, yellow, and clothed with short fine brown hairs, dorsum with five pairs of grey to black spots in two longitudinal rows, elongate apical most pair longitudinal and parallel to each other, the rest transverse.

Distribution: Kuttanad, Kerala, India; Thailand.

Natural History: These spiders construct sheet webs at the base of the rice plants.

Table 1. 4. Length of leg segments of the spider *Atypena thailandica*

<table>
<thead>
<tr>
<th></th>
<th>Femur</th>
<th>Patella</th>
<th>Tibia</th>
<th>Metatarsus</th>
<th>Tarsus</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ƃ</td>
<td>ƃ</td>
<td>ƃ</td>
<td>ƃ</td>
<td>ƃ</td>
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</tr>
<tr>
<td>I</td>
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<td>0.55</td>
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<td>III</td>
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<td>0.50</td>
<td>0.18</td>
<td>0.20</td>
<td>0.45</td>
<td>0.46</td>
</tr>
<tr>
<td>IV</td>
<td>0.69</td>
<td>0.64</td>
<td>0.23</td>
<td>0.23</td>
<td>0.63</td>
<td>0.59</td>
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</tbody>
</table>
Figure 1. 3. *Atypena thailandica*. a. Female - Dorsal view, b. Male - Dorsal view, c. Female - Sternum with Labium and Maxillae, d. Epigyne, e. Internal genitalia, f. Pedipalp - Ventral view
3. *Chrysso argyrodiformis* (Yaginuma, 1952) (Fig. 1. 4. a - f)

**Female**: Total length 3.39 mm. Carapace 1.07 mm long, 0.87 mm wide, 0.68 mm high. Abdomen 2.32 mm long, 1.20 mm wide, 2.00 mm high. Cephalothorax rather ovate, yellow with black eye surrounds and light brown, thin V-shaped longitudinal fovea, cephalic area short and narrow, thoracic area widest between coxa II and III. Eight eyes in two rows, strongly recurved, AE shorter than the straight PE. Eye diameter (mm): PME = PLE = 0.08, AME = 0.06, ALE = 0.05. Eye separation (mm): AME separation 1.5 times eye diameter. AME-ALE separation two thirds AME diameter. PME and PLE-PME separation subequal, as long as one AME diameter. Median ocular quadrangle wider in front than behind. Sternum yellow, longer than wide, lateral margins slightly indented, distal end straight, posterior tapers to a rounded end. Labium contiguous to sternum, yellow with a brown, rounded to slightly triangular apical margin. Maxilla concolorous with the sternum, twice longer than broad, ocular laterodistal side sigmoid shaped, terminating in a brown serrula, rather narrowed towards tip. Inner lateral side with yellow scopula, thick in the apical one third, and sparse below. Chelicerae yellow with light brown fang, and promargin with bifurcated tooth. Yellow legs long and slender with or without grey bands and bearing a few, dark brown spines, tibiae have only two dorsal spines in legs I, II and IV and one in leg III, tarsus three clawed with five to seven toothed superior claws. Leg formula 1423. Palp yellow and approximately one seventh of leg IV, single clawed with seven teeth. Length of leg segments as in Tab. 1. 5.

Abdomen yellow with chalk-white marks, rather oblong, pointed to a tubercle posteriorly, with four black and medially broad setae, laterally triangular, with distinct posterodorsal hump and ventrally projected spinnerets, indented before and after hump, anterior portion overhangs the cephalothorax. Epigynum simple, hat-like, with extended flaps and a pair of black bolt knots, spermalheca globular with converging arms. Epigyne and internal genitalia as in Fig. 1. 4. d and e.

**Male**: Total length 2.40 mm. Cephalothorax 1.10 mm long, 0.85 mm wide, 0.75 mm high. Abdomen 1.30 mm long, 1.00 mm wide, 1.15 mm high. Cephalothorax yellow with a moderately deep fovea, a long brown seta midway between fovea and PE rows, forming a triangle anterior to fovea, and black eye margins. Eight eyes in two recurved rows, with AE shorter than PE row. Eye diameter (mm): AME = 0.10, ALE = PME = PLE = 0.08. Eye separation (mm): AME-AME = 0.12, AME-ALE = 0.04, PME-PME = 0.05, PME-PLE = 0.07. LE contigous. MOQ wider in front than behind. Clypeus height wide, 1.3 times AME diameter. Sternum, labium, and maxillae as in female. Chelicerae yellow, vertical and
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moderately slender. Legs long and slender, yellow with black patches or small bands on apices of tibiae and metatarsi, bases of tibiae, and subapicoventral parts of femora. Patella with a strong apicodorsal spine and tibia with one middorsal and one apicodorsal spines. Leg formula 1423. Length of leg segments as in Tab. 1. 5. Pedipalp barely one half of femur IV, bulb nearly ovoid, with a basally stout and apically pointed median apophysis, conductor flat distally and expanded laterally, forming two sharply pointed processes. Ventral view of palp as in Fig. 1. 4. f.

Abdomen yellow or with a black band along cardiac margins, a pair of black spots medially and a moderately broad black band in posterodorsal one half, constricted twice laterally. Dorsal surface more hirsute than rest of abdominal areas and with scattered white spots. Posterior end prominently wider than anterior end in lateral view.

Table 1. 5. Length of leg segments of the spider Chrysso argyrodiformis

<table>
<thead>
<tr>
<th>Femur</th>
<th>Patella</th>
<th>Tibia</th>
<th>Metatarsus</th>
<th>Tarsus</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>3.90</td>
<td>2.96</td>
<td>0.95</td>
<td>0.48</td>
<td>3.55</td>
</tr>
<tr>
<td>II</td>
<td>2.20</td>
<td>1.84</td>
<td>0.40</td>
<td>0.40</td>
<td>1.75</td>
</tr>
<tr>
<td>III</td>
<td>1.60</td>
<td>1.40</td>
<td>0.30</td>
<td>0.32</td>
<td>1.00</td>
</tr>
<tr>
<td>IV</td>
<td>2.40</td>
<td>2.48</td>
<td>0.35</td>
<td>0.48</td>
<td>1.65</td>
</tr>
</tbody>
</table>

**Distribution**: Kuttanad, Kerala, India; China, Japan, Philippines.

**Natural History**: Construct irregular webs on the bottom surface of leaf blades.
Figure 1.4. *Chryso argyrodiformis*. a. Female - Dorsal view, b. Male - Dorsal view, c. Female - Sternum with Labium and Maxillae, d. Epigyne, e. Internal genitalia, f. Pedipalp - Ventral view
4. *Coleosoma floridanum* Banks, 1900 (Fig. 1. 5. a - f)

**Female:** Total length 2.21 mm. Cephalothorax 0.71 mm long, 0.62 mm wide, 0.45 mm high. Abdomen 1.50 mm long, 0.80 mm wide, 1.00 mm high. Cephalothorax reddish to dark brown, ocular area slightly elevated, and eye margins black. Light eyes in two rows, AE strongly recurved, PE straight. Eye diameter (mm): AME = PME = PLE = 0.04, ALE = 0.05. Eye separation: AME-AME = AME-ALE one fourth shorter than one AME diameter. PME-PME = PLE-PME as long as one AME diameter. Clypeus height large, 3.25 times AME diameter. Sternum greyish brown, longer than wide, posterior end rounded between coxae IV. Labium same color as sternum and maxillae, wider than long, distal end light yellow. Maxillae longer than wide, apices converging towards each other. Chelicerae yellow with some grey tinges, small, promargin with a single tooth. Legs yellow except apices of tibiae IV black, moderately slender, tibiae I with two strong dorsal spines. Leg formula 1423. Length of leg segments as in Tab. 1. 6. Pedipalp blackish brown, about as long as tibia IV.

Abdomen pointed posteriorly, grey brown dorsally but yellowish mediolaterally and brownish towards spinnerets and epigynum. Generally subtriangular in lateral view. Epigynum with a Y shaped orifice surrounded by a grey brown band, two longitudinal lateral black bands, and a short anterior one. Epigyne and internal genitalia as in Fig. 1. 5. d and e.

<table>
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<th>Metatarsus</th>
<th>Tarsus</th>
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Figure 1.5. *Coleosoma floridanum*. a. Female - Dorsal view, b. Male - Dorsal view, c. Female - Sternum with Labium and Maxillae, d. Epigyne, e. Internal genitalia, f. Pedipalp - Ventral view
Spiders of Kuttanad

Male: Total length 2.18 mm. Cephalothorax 0.88 mm long, 0.60 mm wide, 0.53 mm high. Abdomen 1.30 mm long, 0.50 mm wide, 0.55 mm high. Cephalothorax yellowish brown, except grey lateral margins and black eye rings, cephalic area only slightly higher than the thoracic area. Fovea indistinct. Eight eyes in two rows, AE strongly recurved and PE straight. Eye diameter (mm): PME = ALE = PLE = 0.05, AME = 0.04. Eye separations: AME-AME as long as one AME diameter, AME-ALE one fourth narrower than one AME diameter, PME-PME = PME-PLE as long as one PME diameter. Clypeus height large, 3.2 times AME diameter. Sternum yellow, with greyish margins, longer than wide, narrowed posteriorly between coxae IV. Labium brown and wider than long. Maxillae yellowish brown, longer than wide and towards each other distally. Chelicerae moderately robust subbassaly, yellow with grey specks, promargin with a minute bifurcated tooth. Legs yellow except the black ring in the apices of tibiae I, II and IV. Tibia I with a strong middorsal spine. Leg formula 1423. Length of leg segments as in Tab. 1. 6. Pedipalp brown with grey tinges in the cymbium, subtegulum narrow with a pit-like process at base, terminal apophysis strongly lanceolate, tegular apophysis with two minute subapical teeth. Ventral view of palp as in Fig. 1. 5. f.

Abdomen whitish yellow with three pairs of elongate black spots and a pair of long longitudinal bands lateroapically, anterior margin deeply cleft at median with the humps extended over the cephalothorax. Sides of abdomen with a diagonal sclerotization extended ventrally. Spinnerets with black to grey margins.

Distribution: Kuttanad, Kerala, India; Cosmopolitan.

Natural History: Commonly present in irregular webs at the base of rice plant.

5. Dyschiriognatha dentata Zhu & Wen, 1978 (Fig. 1. 6. a - f)

Female: Total length 2.39 mm, cephalothorax 1.17 mm long, 0.80 mm wide, 0.85 mm high. Abdomen 1.22 mm long, 1.00 mm wide, 0.95 mm high. Cephalothorax reddish brown except black eye margins. Cephalic region prominently higher than thoracic region, sloping posteriorly at about 55° angles. Eight eyes in two rows, anterior eyes strongly recurved and posterior eyes nearly straight. Eye diameter (mm): AME = PME = PLE = 0.08, ALE = 0.06. Eye separation (mm): AME-AME = 0.08, AME-ALE = PME-PME = PME-PLE = 0.06, PME-PLE = 0.10. LE pedal like and subcontiguous. AME projected anterior to clypeus. Ocular quadrangle almost a square, slightly wider in front than behind, posterior width as long as length. Clypeus slightly cleft mid longitudinally, height 2.5 times
AME diameter. Sternum moderately swollen, brownish red to grey, slightly longer than wide, midanterior end intend to receive base of labium, extending laterally to carapace between coxae II and III, and widely truncate behind coxae IV. Labium twice wider than long, base 1.66 times wider than anterior end. Maxillae yellowish brown, longer than wide, and slightly converging apically. Chelicerae short and robust, vertical, swollen at mid half, and rough ventrally opposite maxillae. Promargin bears 3 widely separated teeth. Retromargin with 3 teeth, apical one close to fang base, widely separated from the basal teeth. Legs uniformly yellow, bear no strong spines. Tibia III as long as metatarsus III. Leg formula 1243. Pedipalp yellow, longer than all femora. Length of leg segments as in Tab. 1. 7.

Abdomen sub globose, silvery, with two pairs of grey to black spots dorsally and a pale grey transverse band anterior to anal tubercle, extending laterally towards anterolaterals in line with swollen epigynal fold. Venter moderately high medially, lung slits separated by about 4.25 times lung slit length. Tracheal spiral transversely long, constricted at mid anterior, about twice the length of one lung slit, much closer to spinnerets than to epigynal fold, by one diameter of basal segment of anterior spinnerets. Apices of anterior spinnerets small and converging, base of first segment broad, twice that of apical segment. Epigyne as in Fig. 1. 6. e.

Table 1. 7. Length of leg segments of the spider *Dyschiriognatha dentata*

<table>
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<tr>
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<td>Tarsus</td>
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Figure 1. 6. Dyschiriognatha dentata. a. Female - Dorsal view, b. Male - Dorsal view, c. Female - Sternum with Labium and Maxillae, d. Chelicerae, e. Epigyne, f. Pedipalp - Ventral view
**Male:** Total length 2.24 mm, cephalothorax 1.20 mm long, 0.80 mm wide, 0.63 mm high. Abdomen 1.04 mm long, 0.95 mm wide, 0.95 mm high. Cephalothorax similar in colour to female, cephalic region less elevated than female and thoracic dorsum somewhat coarse. Eye diameter (mm): PME = 0.10, ALE = AME = 0.09, PLE = 0.08. Eye separation (mm): AME-AME = AME-ALE = 0.08, PME-PME = 0.05, PME-PLE = 0.10. Ocular quadrangle slightly wider in front than behind to sub equal, length 1.19 times that of anterior width (0.21mm). Clypeus height 2.22 times AME diameter. Sternum, labium and maxillae colouration and pattern as in female. Chelicerae rough ventrally and dorsally. Pro and retromargins each with three teeth, in both cases apical teeth distally separate from the two basal teeth and the basal tooth largest. Fangs bear an inner tooth almost at midlength. Legs uniformly yellow, and bear no spines. Leg formula 1243. Pdeipalp slightly longer than combined length of femur II and patella II, but shorter to as long as combined length of patella II and tibia II. Tibia of pediplap bears apical apophysis on both sides and strongly rounded process in between as viewed laterally, and with a sub basal trichobothrium, dorsally with a trichobothrium. Paracymbium sickle shaped, apex with 3 or 4 long setae, and angulated approximately at apical one third. Cymbium constricted at basal three fifths, pit of palpal organ in basal one third, and club shaped apically. Bulb distinctly sub globular and wider than high. Embolus region rough and with membranous and strongly sclerotized serrated teeth. Sclerotized serrated row of about 8 teeth, all projected posterolaterally. Ventral view of palp as in Fig. 1. 6. f.

Abdomen globular to sub globular, with pattern similar to female. Venter greyish yellow, with brownish lung slits and tracheal spiracle. Lung slits separated from each other as much as three lung slits length. Tracheal spiracle at about distal one third of distance between lung slit area and base of spiracles. Spinnerets yellow brown, broad basally and converging apically.

**Distribution:** Kuttanad, Kerala, India; Bangladesh, China, Japan, Philippines.

**Natural history:** Both male and female are collected from perfect orb webs in the ground layer vegetation.

6. *Erigone bifurca* Locket, 1982 (Fig. 1. 7. a - j)

**Female:** Total length 1.58 mm. Cephalothorax 0.65 mm long, 0.53 mm wide, 0.45 mm high; abdomen 0.93 mm long, 0.68 mm wide, 0.68 mm high. Eight eyes in two rows, anterior row of eyes slightly recurved and posterior row straight. Eye diameter (mm): ALE = 0.07, PME = PLE =
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0.06, AME = 0.05. Eye separation (mm): AME-AME = AME-ALE = PME-PLE = 0.04, PME-PME = 0.05. Cephalothorax dark brown in colour. Clypeus height twice AME diameter. Chelicerae dark brown without frontal peg-like spines. Promargin bears three teeth and one in the retromargin. Legs yellowish, femora I and II without peg-like teeth and spines. Leg formula 1423. Length of leg segments is given in Tab. 1.

8. Epigynum with a small scape like median process. Abdomen ovoid and uniformly grey except the yellow spinnerets. Epigyne and internal genitalia as in Fig. 1. 7. h and i.

**Male:** Total length 1.37 mm. Cephalothorax 0.75 mm long, 0.55 mm wide, 0.50 mm high. Abdomen 0.62 mm long, 0.50 mm wide, 0.40 mm high. Cephalothorax uniformly pale reddish brown, ocular area elevated and half-circular in top view, entire margins lined with teeth. Eight eyes in two opposite rows, anterior row of eyes slightly recurved and posterior eye row slightly procurved. Eye diameter (mm): ALE = 0.06, PME = PLE = 0.05, AME = 0.04. Eye separation (mm): AME-AME = ALE-AME=0.03, PME-PME = PLE-PME=0.04. Median ocular quadrangle wider behind than in front; length slightly less than posterior width. Clypeus high, wide, almost 6 times AME diameter. Sternum greyish yellow, wider than long. Maxillae yellowish brown with a subquadrate inner apical half. Chelicerae reddish brown with seven frontal spurs, promargin bears five teeth and three in the retromargin. Legs long and yellowish, femora roughened by peg-like tooth. Leg formula 1423. Length of leg segments is given in Tab. 1. 8. Pedipalp more than twice longer than femur I. Tip of tibia bifid, lateral apophysis apically membranous, suprategular apophysis with a membranous process at tip. Structure of pedipalp as in Fig. 1. 7. j.

Abdomen globular, uniformly grey. Spinnerets greyish yellow, anterior pair closed basally.
Spiders of Kuttanad

Table 1.8. Length of leg segments of the spider *Erigone bifurca*

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<tr>
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<th>Tibia</th>
<th>Metatarsus</th>
<th>Tarsus</th>
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<td>0.18</td>
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<td>IV</td>
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<td>0.19</td>
<td>0.17</td>
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**Distribution:** Kuttanad, Kerala, India; Malaysia, Philippines, Krakatau.

**Natural History:** Both male and female were collected from the sheet webs.

7. *Misumenops maygitigitus* Barrion & Litsinger, 1995 (Fig. 1.8 a - f)

**Female:** Total length 7.10 mm. Cephalothorax 2.90 mm long, 2.40 mm wide, 2.10 mm high; abdomen 4.20 mm long, 2.60 mm wide, 2.45 mm high. Eight eyes in two recurved rows, anterior row of eyes slightly shorter than posterior row. Eye diameter (mm): ALE = 0.23, PLE = 0.16, AME = 0.10, PME = 0.09. Eye separation (mm): AME-AME = 0.21, AME-ALE = 0.26, PME-PLE = 0.24, PME-PME = 0.23. Cephalothorax yellow brown with a moderately broad brown longitudinal median band running from median eyes and broadened in the clypeus anterior to ALE to posterior of foveal area; brown V shaped band in foveal area and dark brown lateral margins distinct, margins of eyes each with a narrow white ring and rest black, particularly the tubercles of lateral eyes; cephalic area with more setae than the thoracic area. Median ocular quadrangle with similar anterior and posterior widths, height greater than width. Clypeus height 3.5 times AME diameter. Sternum yellow and clothed with short black fine hairs, longer than wide, anteriorly concave and posterior end blunt. Labium reddish brown and longer than wide. Maxillae yellow except dark brown apical part of the outer side, longer than wide, apices moderately converge. Chelicerae brown with black mottles dorsally; a promargin bear a small tooth and has two teeth covered by scopulae. Legs slender, long I and II yellowish brown and short III and IV yellow. Femur I with three prolateral spines and II with only one. Leg formula 2143. Length of leg segments is given in Table 1.9.

Abdomen pale yellow with chalk white spots and four transverse black bands in the broadest posterior one half, venter yellow with a brown median band lined with eight paired brown dots, laterals greyish black with chalk white dots. Spinnerets brown, anterior pair with bases closes to each other and diverging towards apices. Epigynum simple with
a pair of moderately C shaped bands with a U shaped sclerotized plate in the middle. Epigyne and internal genitalia as in Fig. 1. 8. d and e.

**Male:** Total length 4.40 mm. Cephalothorax 2.10 mm long, 2.20 mm wide, 1.20 mm high. Abdomen 2.30 mm long, 2.20 mm wide, 1.40 mm high. Cephalothorax dark yellow with whitish eye tubercles and brown fine hairs, long setae scattered in the cephalic and thoracic areas. Eight eyes in two recurved rows, AE row shorter than PE row. Eye diameter (mm): ALE = 0.14, AME = PME = 0.08, PLE = 0.10. Eye separation (mm): AME-AME = ALE-AME = 0.03, PME-PME = PLE-PME = 0.04. Median ocular quadrangle wider behind than in front, both widths longer than length. Clypeus height large, 3 times AME diameter. Sternum dark yellow, heart shaped, with a concave apical margin and blunt posterior tip between coxae IV. Labium longer than wide, distal end strongly rounded. Outhet lateral margin of maxillae concave at midlength and broadens sub-apically. Chelicerae with a small fang, promargin bear 2 teeth and retromargin has one tooth. Legs relatively long, particularly I and II. Tibia I with 5 ventral spines, promarginal spines larger than retromarginal spines. Metatarsi I and II with two prolateral and 5 retrolateral spines. Tarsi two clawed with tenent hairs, each claw with at least three teeth. Leg formula 1243. Length of leg segments is given in Table 1. 9. Structure of pedipalp as in Fig. 1. 8. f.

Abdomen white with five light brown spots in the apical one half, finely haired and bears five U shaped striae emanating from basal one third of the abdomen to the laterals. Spinnerts not visible dorsally, anterior pair broad basally, yellow brown and close to each other, posterior pair yellow and slightly larger than anterior pair.

Table 1. 9. Length of leg segments of the spider *Misumenops maygitgitus*

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<th>Femur</th>
<th>Patella</th>
<th>Tibia</th>
<th>Metatarsus</th>
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<td>0.75</td>
<td>0.63</td>
<td>1.50</td>
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Figure 1.8, *Misumenops maygititus*. a. Female - Dorsal view, b. Male - Dorsal view, c. Female - Sternum with Labium and Maxillae, d. Epigyne, e. Internal genitalia, f. Pedipalp - Ventral view
Distribution: Kuttanad, Kerala, India; Philippines.

Natural History: Commonly present in the panicle of rice plant.

8. *Phycosoma martinae* (Roberts, 1983) (Fig. 1. 9. a - g)

**Female:** Total length 2.42 mm. Cephalothorax 0.85 mm long, 0.83 mm high and 0.93 mm wide. Cephalothorax yellowish brown, becoming yellow subposterior medially and at median base of cephalic area, eye margin black, and cephalic area with short hairs, transversely concave groove with nine branches in the flat, globular dorsum. Eight eyes, clear and homogenous, in two curved rows. Anterior row strongly recurved and shorter than posterior row. Eye diameter (mm): AME = 0.08, ALE = 0.04, PME = 0.06, PLE = 0.03. Eye separation (mm): AME-AME = 0.06, AME-ALE = 0.03, PME-PME = 0.03, PME-PLE = 0.04, ALE-PLE - contiguous. Median ocular quadrangle wider in front than behind. Black margin present on backside of AME, inner side of LE and front side of PME. Clypeus very high. Sternum light yellow, slightly wider than long, anterior margin projecting contiguous to labium, posterior end tapering to a narrow blunt point between coxae IV. Maxillae long, pale yellow, inner lateral boarder with scopulae. Chelicerae yellowish brown, vertical, small, shorter than transverse length of clypeus. Promargin with 3 teeth, subbasal tooth the largest and partially projected down ward. Retromargin with two diverging teeth. Legs hirsute, yellow, all longer than length of abdomen, patellae with long apical spine, femur I with a long subapical prolateral spine, tibia I with a sub median prolateral spine. Length of leg segments as in Tab. 1. 10. Tarsi 3 clawed with a tooth in each superior claw, inferior clawless. Leg formula 1423.

Abdomen 1.57 mm long, 1.12 mm wide, 1.13 mm high, sub globular, brownish yellow, anterodorsal highly sclerotized, dark brown, sparsely hirsute with brown hair bases, dorsum with two longitudinal rows of four grey spots, and 4 brown spherical sigilla, laterals each with 10 grey spots. Venter with a wasp head like band anteriorly and 3 transverse rows of 10 yellow brown spots posterior to the epigastric furrow, posterior end of venter with a broad transverse yellow band anterior to the anterior spinnerets. Anterior spinnerets closes to each other basally and separated by a V shaped space anteriorly. Posterior spinnerets smaller than anterior ones and widely separated from each, closer to the anterior pair than each other. Anal tubercle brown basally and yellow apically, with a yellow brown band and two small brown spots dorsal of it. On dorsum, a grey coloured vertical band present in front of spinnerets. Spinnerets visible dorsally. Epigynum simple, anterior margin of orifice tongue like, spermathecae spherical, with coiled
Figure 1.9  Phycosoma martinae. a. Female - Dorsal view, b. Lateral view, c. Female - Sternum with Maxillae, d. Chelicerae, e. Epigynae, f. Internal genitalia, g. Pedipalp - Ventral view
perimethcal opening posteriorly leading to indentions in posterior epigynal margin. Epigyne and internal genitalia as in Fig. 1.9. e and f.

**Male:** Total length 2.34 mm. Cephalothorax 0.82 mm long, 1.16 mm high and 0.86 mm wide. Abdomen 1.52 mm long, 1.11 mm wide, 1.14 mm high. Cephalothorax yellowish brown, barrel shaped, with a yellow basal one third with more hairs. Eight eyes in 2 rows, strongly recurved anterior row shorter than the straight posterior row. Eye diameter (mm): AME = 0.08, ALE = 0.06, PME = 0.07, PLE = 0.07. Eye separation: AME-AME separation one AME diameter. AME-ALE separation one half AME diameter. PME-PME separation one ALE diameter. LE contiguous. PME-PLE separation 1.1 PLE diameter. Median ocular quadrangle wider in front than behind. Clypeus very high, 8.3 times AME diameter. Sternum yellow, as long as wide, with 3 sparse row of hairs near margins, lateral margins straight, posterior tapers to a truncated end, median areas partially raised. Chelicerae smaller than female. Legs yellow, all longer than length of abdomen. Tarsi three clawed, with a tooth in each superior claw, inferior clawless. Length of leg segments are as in Tab. 1.10. Pedipalp yellow, except reddish brown cymbium and light brown tibia. Ejaculatory ducts triple coiled, embolus short, tibia cup like in ventral view as in Fig. 1. 9. g.

Abdomen globular, yellow, anterodorsal highly sclerotised, brown, sparsely hirsute with brown hair bases, dorsum with two longitudinal rows of 5 small grey spots, and 4 brown spherical sigilla, laterals each with 3 grey spots with a broad transverse yellow band anterior to the anterior spinnerets. Anterior spinnerets close to each other basally and separated by a V shaped space anteriorly. Posterior spinnerets smaller than anterior ones and widely separated from each, closer to the anterior pair than each other. Anal tubercle brown basally and yellow apically, with a yellow brown band and two small brown spots dorsal of it.

**Table 1.10. Length of leg segments of the spider Phycosoma martinae**

<table>
<thead>
<tr>
<th></th>
<th>Femur</th>
<th>Patella</th>
<th>Tibia</th>
<th>Metatarsus</th>
<th>Tarsus</th>
<th>Total</th>
</tr>
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<td>2.43</td>
<td>2.43</td>
<td>2.43</td>
<td>2.43</td>
</tr>
</tbody>
</table>

**Distribution:** Kuttanad, Kerala, India; Luzon, Laguna, Philippines.
**Natural History**: Both male and female were collected from irregular cobwebs.

9. *Thanatus parangvulgaris* Barrion & Litsinger, 1995 (Fig. 1. 10. a - f)

**Female**: Total length 4.80 mm. Cephalothorax 2.25 mm long, 1.95 mm wide, 1.50 mm high. Abdomen 2.85 mm long, 2.20 mm wide, 1.65 mm high. Cephalothorax yellow with a pair of broad longitudinal brown bands. Cephalic area with long setae, and thoracic area with only fine hairs. Eight eyes in two rows, similar to male. Eye diameter (mm): AME = ALE = 0.10, PLE = 0.09, PME = 0.08. Eye separation: AME - AME 1.6 times eye diameter, AME - ALE one fifth shorter than AME diameter, PME - PME 2.6 times AME diameter. PME - PLE 2.5 times AME diameter. ALE - PLE twice AME diameter. MOQ one fourth wider behind, length 1.2 times longer than anterior width. Clypeus wide, 2.6 times AME diameter, with two transverse row of 13 spines arranged in a set of seven along the anterior margin, and six in the middle row. Sternum, labium and maxillae similar to male in colour and shape. Chelicerae reddish brown and stout basally, anterior tooth of promargin long and slender, unlike the small basal tooth. Retromargin bears no tooth. Legs moderately long and slender, all yellow except brown claws and claw tufts. Leg formula 2413. Length of leg segments are as in Tab. 1. 11.

Abdomen ovate, white except brown cardiac area and yellow brown semi erect setae. Venter similarly white with yellow area anterior to epigastric furrow and spinnerets. Anterior and posterior spinnerets similar to male. Dorsum of epigynum with a broad V shaped black band. Median septum and atrium of epigynum both narrow, spermathecal organ small, located above junction of anterior lateral margin, spermatheca sub ovate, broadly rounded distally, and narrowly rounded proximally. Epigyne and internal genitalia as in Fig. 1. 10 d and e.

**Male**: Total length 4.40 mm. Cephalothorax 2.10 mm long, 2.00 mm wide, 1.50 mm high. Abdomen 2.30 mm long, 1.50 mm wide, 1.50 mm high. Cephalothorax yellowish brown mid dorsally and with a broad brown longitudinal band sub dorsally, cephalic area relatively more hirsute than the thoracic area. Eight eyes, all dark in appearance, in two recurved rows, AE row shorter than PE row. Eye diameter (mm): AME = 0.09, ALE = PME = PLE = 0.08. Eye separation: AME-AME 1.7 times AME diameter, ALE-AME as long as ALE diameter, PME-PME 2.6 times AME diameter, PME-PLE 2.2 times AME diameter. ALE - PLE as long as PME - PLE separation. Median ocular quadrangle one fourth wider behind than in front, anterior width shorter than length. Clypeus
Figure 1.10. *Thanatus parangvulgaris*. a. Female - Dorsal view, b. Male - Dorsal view, c. Female - Sternum with Labium and Maxillae, d. Epigyne, e. Internal genitalia, f. Pedipalp - Ventral view
height large, 2.2 times AME diameter. Sternum yellow and hairy, slightly longer than wide, apical margin straight, laterals with very slight avities opposite each coxa, posterior tip between tibiae IV blunt. Labium yellow, wider than long, basolateral one third straight and apical one third moderately oblique, terminating in a blunt distal end, base of labium straight. Maxillae grey except brown outer lateral margins, slightly projected towards each other, scopulae yellow and located in the inner apical one half, extended to mid half of the lateral margin. Chelicerae yellow except brown connections in the inner base, apex diameter barely one half of broad base, promargin with a long and large apical tooth and a small basal tooth, retromargin without teeth. Boss well developed. Legs moderately long, slender, and yellowish brown. Leg I with three pairs of ventral spines in tibia. Metatarsus I with two pairs in the basal one half. Tarsus and metatarsus I bear ventral scopulae. Tibiae and metatarsi II and III with similar number of ventral spines seen in leg I. Tibia IV bears six ventral spines. Metatarsus IV with five spines, a pair each in the base and mid half and only one in the apex. Tarsi two-clawed with claw tufts, each claw with 6-14 teeth. Leg formula 2413. Length of leg segments are as in Tab. 1 11. Pedipalp almost as long as tibia I or III, embolus short and strongly tapered with a broad base. Cymbium twice longer than broad. Structure of palp as in Fig. 1. 10. f.

Abdomen yellow brown with brownish cardiac area, entire dorsum with fine hairs and moderately long setae. Venter yellow with very fine hairs. Anterior part of spinnerets short but more robust than the widely separated posterior pair of spinnerets.

### Table 1. 11. Length of leg segments of the spider *Thanatus parangvulgaris*

<table>
<thead>
<tr>
<th>Femur</th>
<th>Patella</th>
<th>Tibia</th>
<th>Metatarsus</th>
<th>Tarsus</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>1</strong></td>
<td>2.50</td>
<td>2.10</td>
<td>1.00</td>
<td>0.90</td>
<td>2.00</td>
</tr>
<tr>
<td><strong>II</strong></td>
<td>2.70</td>
<td>2.40</td>
<td>1.10</td>
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<td>2.45</td>
</tr>
<tr>
<td><strong>III</strong></td>
<td>2.40</td>
<td>2.10</td>
<td>0.85</td>
<td>0.80</td>
<td>1.90</td>
</tr>
<tr>
<td><strong>IV</strong></td>
<td>2.75</td>
<td>2.20</td>
<td>0.90</td>
<td>0.85</td>
<td>2.00</td>
</tr>
</tbody>
</table>

**Distribution**: Kuttanad, Kerala, India; Thailand.

**Natural History**: Commonly present in the panicle of rice plant.
10. Theridion lumabani Barrion & Litsinger, 1995 (Fig. 1. 11. a - f)

**Female:** Total length 2.01 mm. Cephalothorax 0.78 mm long, 0.83 mm wide, 0.53 mm high. Abdomen 1.23 mm long, 0.98 mm wide, 1.00 mm high. Cephalothorax yellowish brown except black eye margins. Cephalic area slightly higher than thoracic area. Eight eyes in two rows, AE strongly recurved, and PE row straight to partially recurved. Eye diameter similar, all 0.05 mm. Eye separation: AME-AME as long as PME-PME and PME-PLE about two thirds AME diameter, AME-ALE 0.02 AME diameter. LE contiguous. Clypeus height large, a little more than twice AME diameter. Sternum same color as cephalothorax, labium, and maxillae, slightly longer than wide, heart shaped, and hirsute, posterior end broadly rounded between coxae IV. Labium wider than long, distal margins light yellow. Maxillae longer than wide, apices moderately converging towards each other, serrula reddish brown, Chelicerae weak, yellow, longer than wide, small and stout basally, promargin with a bifurcated tooth. Legs yellow-brown with a black patch in the apices tibiae. Leg formula 1423. Length of leg segments are as in Tab. 1. 12. Pedipalp yellow, total length nearly as long as tibia IV.

Abdomen subglobular dorsally, yellow with four pairs of black spots, apical pair long and longitudinal, rest of pairs subovate to globular. Venter yellow with grey bands on each lateral side of epigynum and anterior to spinnerets. Epigynum with a transverse orifice, apical margin slightly wavy, fertilization duct relatively short, spermathecal sacs of unequal sizes, right side more globular than the left one. Epigyne and internal genitalia as in Fig. 1. 11. d and e.

**Male:** Total length 1.44 mm. Cephalothorax 0.64 mm, 0.56 mm wide, 0.44 mm high. Abdomen 0.80 mm long, 0.62 mm wide, 0.58 mm high. Cephalothorax pale greyish yellow, a broad dark grey arrow-like band with seven long striae or lines prominent dorsally, eye margins reddish brown, posterior end of thorax sloping, and grooved medially. Eight eyes in two rows, AE row strongly recurved, PE row straight. Eye diameter (mm): AME = 0.09, PLE = PME = 0.08, ALE = 0.06. Eye separation: AME-AME separation two thirds AME diameter, AME-ALE separation one third ALE diameter, PME-PME separation one half PME diameter, PME-PLE separation three fourths PME diameter. LE with a hair-line separation. Median ocular quadrangle wider in front than behind. Clypeus height twice AME separation and bears transversely a pair of ovoid humps. Sternum black, end convex, wider than long, broadest opposite coxae II, median apical end concave for the base of labium, posterior end nearly truncated and produced between coxa IV, rather hirsute with bases yellow. Labium reddish brown, as long as wide, and a little above mid length of maxillae, distal end broadly rounded. Maxillae
same color as carapace, longer than wide, ventrolateral sides with a large apophysis basally, inner lateral margins brown and highly sclerotized, serrulae and thin scopulae present. Legs relatively long and slender, except leg III, yellow with apical black bands on each leg segment except tarsi, patellae black in legs I and II, dorsal spines in tibiae with two each except for III with only one. Tarsi three-clawed with a tooth each in the superior and inferior claws. Leg formula 1243. Length of leg segments are as in Tab. 1. Pedipalps pale yellow with brown cymbium, base of femur developed to an apophysis like structure directed ventrally, tibiae with traces of retrolateral tibial apophysis, a trichobothrium borne in an apophysis-like structure, with five long hairs dorsolateral to it, dorsobasal part of cymbium slightly eleft, embolus long and coiled, tip of conductor claw-like and C-shaped. . Structure of palp as in Fig. 1. Abdomen subglobular, black with a transverse white median and T-shaped-like longitudinal band posteriorly, anterior portion grooved along cardiac area, lateral sides with about 7-9 undulating bands in alternating yellow and black patches, venter brownish yellow, epigastric fold strongly procurred, median portion with a transverse, recurved ridge, producing two shallow grooves between spinnerets and an epigastric fold. Spinnerets small, anterior pair larger than posterior pair, basal segment of the anterior broad and close to each other with parallel or touching inner margins, colulus and paired setae absent.

### Table 1.2. Length of leg segments of the spider Theridion lumabani

<table>
<thead>
<tr>
<th></th>
<th>Femur</th>
<th>Patella</th>
<th>Tibia</th>
<th>Metatarsus</th>
<th>Tarsus</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>♂</td>
<td>♀</td>
<td>♂</td>
<td>♀</td>
<td>♂</td>
<td>♂</td>
</tr>
<tr>
<td>I</td>
<td>0.84</td>
<td>0.76</td>
<td>0.28</td>
<td>0.25</td>
<td>0.78</td>
<td>0.60</td>
</tr>
<tr>
<td>II</td>
<td>0.71</td>
<td>0.58</td>
<td>0.28</td>
<td>0.22</td>
<td>0.59</td>
<td>0.46</td>
</tr>
<tr>
<td>III</td>
<td>0.56</td>
<td>0.48</td>
<td>0.20</td>
<td>0.20</td>
<td>0.40</td>
<td>0.33</td>
</tr>
<tr>
<td>IV</td>
<td>0.83</td>
<td>0.72</td>
<td>0.28</td>
<td>0.26</td>
<td>0.68</td>
<td>0.58</td>
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</table>

**Distribution**: Kuttanad, Kerala, India; Philippines.

**Natural History**: Collected from the irregular webs present underneath of curled dry leaves of rice plant.
Figure 1. 11. *Theridion lamabani*. a. Female - Dorsal view, b. Male - Dorsal view, c. Female - Sternum with Labium and Maxillae, d. Epigyne, e. Internal genitalia, f. Pedipalp - Ventral view
1. 4. 3. Diversity

A total of 17717 individuals belonging to 99 species, 66 genera and 20 families were sampled from Kuttanad during the study period (Tab. 1. 13). Voucher specimens were preserved in 70% ethyl alcohol and deposited in the reference collection lodged with the Division of Arachnology, Dept. of Zoology, Sacred Heart College, Thevara, Cochin, Kerala, India.

In Rabi (monsoon) season, 70 species of 17 families were recorded whereas in the Kharif (cold) season, 94 species of 20 families were reported. The spider population in the monsoon and winter has a slightly different species composition. Families like Amaurobiidae, Pisauridae and Pholcidae were present in the cold season but they were absent in the rainy season. Sixty eight species appeared during both cold and rainy season. *Dyschiriognatha dentata* Zhu & Wen, 1978, *Pardosa pseudoannulata* (Bosenberg & Strand, 1906), *Erigone bifurca* Locket, 1982, *Tetragnatha mandibulata* Walckenaer, 1842, *Atypena adelinae* Barrion & Litsinger, 1995, *Phycosoma martinae* (Roberts, 1983), *Araeneus ellipticus* (Tikader & Bal, 1981), and *T. cochinensis* Gravely, 1921 are some of the dominant spiders in the Kuttanad rice agroecosystem. Some families were present only at the final stage of crop growth. The family level composition also shows difference in two seasons. Non-web builders outnumbered the web builders (Tab. 1. 13).

Species composition:

The spiders collected in largest numbers were *P. martinae* (8.12% of total collection), *P. pseudoannulata* (7.13%), *E. bifurca* (7.07%), *T. mandibulata* (7.05%). *A. adelinae* (6.75%), *D. dentata* (5.97%), *A. ellipticus* (5.26%), and *T. cochinensis* (4.77%). The major component of the spider population found in this ecosystem was family Tetragnathidae composed mainly of *D. dentata*, *T. cochinensis*, *T. mandibulata* and family Linyphiidae, which mainly composed of *Atypena* and *Erigone*. Besides these, families Lycosidae and Araneidae were found in relatively larger numbers. Families Tetragnathidae and Linyphiidae constituted 45%, while Lycosidae and Araneidae constituted 31% of the total collection.
Table 1.13. List of spiders collected from Kuttanad rice agroecosystem during the study

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Family</th>
<th>No. of genera</th>
<th>No. of species</th>
<th>No. of individuals</th>
<th>Guild</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Amaurobiidae</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>Sheet webs</td>
</tr>
<tr>
<td>2.</td>
<td>Araneidae</td>
<td>5</td>
<td>2</td>
<td>19</td>
<td>Orb weavers</td>
</tr>
<tr>
<td>3.</td>
<td>Clubionidae</td>
<td>1</td>
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<td>19</td>
<td>Foliage runners</td>
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<tr>
<td>4.</td>
<td>Corinnidae</td>
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<td>1</td>
<td>49</td>
<td>Ground runners</td>
</tr>
<tr>
<td>5.</td>
<td>Gnaphosidae</td>
<td>1</td>
<td>1</td>
<td>11</td>
<td>Ground runners</td>
</tr>
<tr>
<td>6.</td>
<td>Hersiliidae</td>
<td>1</td>
<td>1</td>
<td>8</td>
<td>Foliage runners</td>
</tr>
<tr>
<td>7.</td>
<td>Linyphiidae</td>
<td>2</td>
<td>4</td>
<td>3577</td>
<td>Sheet webs</td>
</tr>
<tr>
<td>8.</td>
<td>Lycosidae</td>
<td>4</td>
<td>9</td>
<td>3378</td>
<td>Ground runners</td>
</tr>
<tr>
<td>9.</td>
<td>Miturgidae</td>
<td>1</td>
<td>1</td>
<td>11</td>
<td>Foliage runners</td>
</tr>
<tr>
<td>10.</td>
<td>Oxyopidae</td>
<td>2</td>
<td>8</td>
<td>432</td>
<td>Stalkers</td>
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<tr>
<td>11.</td>
<td>Philodromidae</td>
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<td>2</td>
<td>47</td>
<td>Ambushers</td>
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<td>12.</td>
<td>Pholcidae</td>
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<td>4</td>
<td>16</td>
<td>Space builders</td>
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<tr>
<td>13.</td>
<td>Pisauridae</td>
<td>2</td>
<td>2</td>
<td>9</td>
<td>Ambushers</td>
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<tr>
<td>14.</td>
<td>Salticidae</td>
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<td>1619</td>
<td>Stalkers</td>
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<tr>
<td>15.</td>
<td>Scytodidae</td>
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<td>2</td>
<td>30</td>
<td>Ground runners</td>
</tr>
<tr>
<td>16.</td>
<td>Sparassidae</td>
<td>3</td>
<td>3</td>
<td>42</td>
<td>Foliage runners</td>
</tr>
<tr>
<td>17.</td>
<td>Tetragnathidae</td>
<td>5</td>
<td>12</td>
<td>4110</td>
<td>Orb weavers</td>
</tr>
<tr>
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<td>Theridiidae</td>
<td>6</td>
<td>7</td>
<td>2168</td>
<td>Space builders</td>
</tr>
<tr>
<td>19.</td>
<td>Thomisidae</td>
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<td>6</td>
<td>42</td>
<td>Ambushers</td>
</tr>
<tr>
<td>20.</td>
<td>Uloboridae</td>
<td>3</td>
<td>4</td>
<td>29</td>
<td>Orb weavers</td>
</tr>
</tbody>
</table>

In the cold season, Tetragnathidae and Lycosidae were the dominant families. However, in the rainy season, the second dominant family was Linyphiidae. Lycosidae constituted 20% of the cold season spiders and 16.91% of the monsoon spiders. Eleven minor families constituted 1.163% of the total collected spiders. Theridiidae (9.93%), Salticidae (9.17%), Oxyopidae (2.42%), and Thomisidae (0.42 %) were other dominant families collected.

**Percentage Composition:**

Figures 1. 12 and 1. 13 indicate the specimen wise and species wise percentage composition of spiders during different crop growth stages. It is evident that spiders of the family Tetragnathidae and Linyphiidae dominated the samples in all cases except for the 6th and 7th fortnight.
In the 1st fortnight, only 6 families were collected and spiders of the family Tetragnathidae were dominant during this fortnight. In the second fortnight, this trend continued and in the 3rd fortnight spiders of the family Oxyopidae appeared in the field for the first time. Members of the other miscellaneous families also appeared during this stage. This condition continued up to 4th fortnight and during 5th to 7th fortnight, spiders belonging to all the 9 dominant spider families were collected. An interesting observation was that spiders which construct perfect orb webs showed a decrease in population as the crop growth advanced and
ground dwellers (hunters) with irregular webs increased in numbers. The number of Lycosidae and Salticidae increased with the decrease in the number of Araneidae and Tetragnathiidae. The same tendency was observed in the species composition also. The number of species of other miscellaneous spider groups was very less.

During different crop stages, different sets of ground wanderers and web–building spiders dominate the environment and the abundances of these species were relatively uniformly distributed. Similarly, species of ambushers, foliage runners, ground runners, and sheet web wanderers constituted a fixed percentage of the crop spider fauna. The uniformity of trophic structures may mirror the spectrum of available species colonizing the habitat.

Out of 17717 spiders of 20 families and 99 species, 24.91% consisted of family Tetragnathidae. This was the dominant spider family in the Kuttanad rice agroecosystem with 12 species collected. The order of dominance of other families were as follows; Lycosidae - 9 species (19.07%), Araneidae - 10 species (12.09%), Theridiidae - 7 species (9.93%), Salticidae - 19 species (9.17%) and Linyphiidae - 4 species (2.19%). The other spider families constituted 1.16% of the total collected spiders. Out of the 10229 spiders of 20 families and 94 species collected in the cold season, Tetragnathidae again maintained the dominance with 2418 (23.64%) individuals belonging to 11 species. Linyphiidae - 4 species (19.78), Araneidae - 11 species (12.48%), Theridiidae - 6 species (9.37%), Salticidae - 17 species (7.21%) and Lycosidae - 9 species (2.35%) were the order of dominance of other spiders. Other minor group of spiders consisted of 1.82% of the total spiders. In the rainy season, out of 7488 spiders of 70 species of 17 families collected, the order of dominance was similar as cold season except for linyphiids and lycosids, mutually exchanging their rank of dominance.

**Diversity, Evenness and Richness indices:**

There was some significant difference in Shannon index, Richness index and Evenness indexes between two seasons. However, Simpson index was not significantly different between two seasons. The highest Shannon index recorded for the cold season was 3.55 and the lowest was 2.95 with an average of 3.31±0.04. However, in the rainy season, it was 3.34 and 3.02 with an average of 3.19±0.02. The one way ANOVA showed that Shannon index had significant variation ($F_1, _{30}=7.41, P=0.01$) between two seasons.

In the case of Simpson index, the maximum for cold season was 0.61 and minimum 0.37 with an average of 0.46±0.01. For the rainy season, it was 0.56 and 0.37 and 0.47±0.01. This showed no significant difference between two seasons ($F_1, _{30}=0.061, P=0.04$).
In the case of Richness index, the cold season’s maximum was 9.88 and minimum 4.63 with an average of 7.61±0.40. In the rainy season, it was 7.75 and 4.40 and 5.80±0.27 respectively. This also showed significant difference between two seasons. ($F_{1, 30}=13.70$, $P=0.08$) in the ANOVA.

The average Evenness index of cold season was 0.85±0.05 with a maximum of 0.92 and a minimum of 0.81. In the rainy season, it was 0.88±0.06, 0.91 and 0.83 respectively. The ANOVA result showed significant difference ($F_{1, 30}=18.03$, $P=0.01$).

The above results indicate that the interaction of season on spider composition was significant for Shannon, Richness and Evenness indices but non-significant for Simpson index.

1.4.4. Vertical stratification

Spiders were divided into five strata based on the activity and foraging behaviour related to average height of the rice plant. The spiders which build perfect orb-web were mainly present at the canopy level of the crop. Hence Araneidae and Tetragnathidae were mainly foraging at the top layer of the rice plants. This provides sufficient area for the construction of the web and increases the chance of prey entanglement in the webs. There is very little chance to locate ground dwelling spiders at the canopy level of the plant. Ground dwellers such as lycosids were mainly present at the bottom level of the field, although there is possibility of up-coming of these spiders for pursuing the insect prey. The spiders which build irregular cob-webs also present at near to bottom of the field or below the half level of the average plant height.

Thus, the growth of the individual plant influences species composition of spiders at different stages of the growth of the plant community in the field (Tab. 1.14.).
Table 1. 14. Vertical distribution of 10 dominant species of spiders in Kuttanad rice agroecosystem

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Spider species (%) of total collection</th>
<th>Vertical strata (Above water/soil surface)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>&lt;20 cm</td>
</tr>
<tr>
<td>1.</td>
<td>D. dentata (8.22)</td>
<td>+++</td>
</tr>
<tr>
<td>2.</td>
<td>P. pseudoannulata (7.15)</td>
<td>+++</td>
</tr>
<tr>
<td>3.</td>
<td>T. mandibulata (7.12)</td>
<td>±</td>
</tr>
<tr>
<td>4.</td>
<td>E. bifurca (7.11)</td>
<td>+++</td>
</tr>
<tr>
<td>5.</td>
<td>A. adeleniae (6.71)</td>
<td>+++</td>
</tr>
<tr>
<td>6.</td>
<td>P. martinae (5.98)</td>
<td>+++</td>
</tr>
<tr>
<td>7.</td>
<td>A. ellipticus (5.19)</td>
<td>±</td>
</tr>
<tr>
<td>8.</td>
<td>T. cochinensis (4.79)</td>
<td>±</td>
</tr>
<tr>
<td>9.</td>
<td>L. tista (3.98)</td>
<td>+++</td>
</tr>
<tr>
<td>10.</td>
<td>Bianor sp. (3.94)</td>
<td>+++</td>
</tr>
</tbody>
</table>

±: Very rare, +: Usually present, ++: Fairly common, +++: Abundant

1.4.5. Guild structure

The spiders collected during the study were classified into 7 ecological guilds based on the foraging mode of the spiders (Figure 1.14). Among the 20 families of spiders collected, majority of families (28%) belong to “stalkers” category. The second dominant guild constituted the “orb weavers” (26%). Ground runners (13%), space web builders (11%), ambushers (10%), foliage runners (7%) and sheet web builders (5%) are the other ecological guild of these spiders.

1. Stalkers
Spiders coming under this category actively jump over the prey for feeding. Spiders of the family Salticidae and Oxyopidae show this type feeding behaviour. A total of 432 individuals of 8 species coming under 2 genera were collected from the family Oxyopidae. Family Salticidae constituted 1619 individuals of 19 species coming under 15 genera.

2. Orb weavers
Spiders of this guild construct perfect orb webs for prey capture. Spiders of the family Araneidae, Tetragnathidae and Uloboridae come under this
category. Family Araneidae comprised 2115 individuals of 10 species coming under 5 genera. The long-jawed family Tetragnathidae constituted 4110 individuals of 12 species coming under 5 genera. Family Uloboridae contained only 29 individuals of 4 species of 3 genera.

3. Ground runners
Spiders of this guild mainly feed on ground layer of the field and rarely come to the foliage or canopy of the plant for prey capture. Spiders of the family Corinnidae, Gnaphosidae, Lycosidae and Scytodidae come under this guild. Family Corinnidae contained 49 individuals coming under one species of a single genus. Family Gnaphosidae also contained a single species of one genus with a collection of 11 individuals. Majority of spiders of this category were lycosids comprising 3378 individuals of 9 species of 4 genera. Family Scytodidae contained only 2 species of a single genus with a collection of 30 individuals.

4. Space web builders
These spiders construct irregular space webs for prey capture. Spiders of the family Pholcidae and Theridiidae belong to this category. Family Pholcidae contained 16 individuals of 4 species of 4 genera. Family Theridiidae constituted 2168 individuals of 7 species of 6 genera.

5. Ambushers
These spiders show a “sit-and-wait” type of behaviour for prey capture. Spiders of the families Philodromidae, Pisauridae and Thomisidae belong to this category. Family Philodromidae contained 47 individuals of 2 species of 2 genera. Family Pisauridae constituted only 9 individuals of 2 species of 2 genera. Family Thomisidae contained 42 individuals of 6 species coming under 6 genera.

6. Foliage runners
These spiders hunt on foliage for phytophagous insect pests. This guild is formed of 4 families viz., Clubionidae, Hersiliidae, Miturgidae and Sparassidae. Family Clubionidae constituted 19 individuals of 2 species coming under a single genus. The tailed spider, hersiliids is composed of only one species coming under a single genus and 8 individuals collected. Family Miturgidae constituted 11 individuals of single species coming under a single genus. Family Sparassidae was composed of 42 individuals of 3 species coming under 3 genera.

7. Sheet web builders
These spiders construct sheet like web for prey capture. Only 2 families of paddy field spiders come under this category viz., Amaurobiidae and
Linyphiidae. Family Amaurobiidae constituted only 5 individuals of single species coming under a single genus. Family Linyphiidae contained a total of 3577 individuals of 4 species coming under 2 genera.

![Figure 1.14. Guild structure of Spiders in Kuttanad rice agroecosystem](image)

### 1.5. Discussion

An extensive survey for a period of three years in the Kuttanad rice agroecosystem indicates that the study area is occupied by 99 species of spiders belonging to 66 genera distributed in 20 families. This study, covering an area of 874 km² spread over two districts in Kerala reveals that the spider fauna in the paddy fields is very rich both qualitatively and quantitatively. Twenty spider families recorded from Kuttanad rice agroecosystem represent 43% of the families reported from the country (Siliwal & Molur, 2007; Platnick, 2007). The number of species found here is higher than the number recorded for other agroecosystems surveyed in India (Jose et al., 2007). The numbers of taxa recorded are generally higher than those reported for other surveys of rice ecosystems. Barrion & Litsinger (1984) collected 13,270 specimens belonging to 51 species under 64 genera and 16 families during a 3 year study. This difference in quantity and quality of spider fauna is related to the time of the collection, method of sampling and other geographic features. Coddington et al. (1991) pioneered the development of a sampling protocol and estimation procedure for rapid assessment of spider diversity. This and similar protocols can be structured to provide replicated data sets that reflect the relative abundance of species in the sites and habitats studied and may therefore
provide comparable views of species richness, taxonomic composition, and guild structure across diverse communities and regions (Coddington et al., 1996; Silva & Coddington, 1996; Dobyns, 1997). One goal of species richness inventories should be help to predict how many samples are required for a complete (observed species accumulation curve reaches asymptote) or adequate (accurate estimate of true richness) survey. According to the guild classification, 9 among the 20 families come under the wandering category. They lead a nomadic life in the agroecosystem and may migrate to other ecosystems or immigrate from other systems. These wanderers can be divided into two broad classes of nocturnal runners and diurnal runners. The families Clubionidae, Gnaphosidae and Sparassidae are active at night time and others at daytime. All wandering spiders are hunters except Philodromidae and Thomisidae. They show ambushig behaviour for prey capture. The salticids show a peculiar behaviour of active jumping to the prey. In the seven web-building families, Araneidae, Tetragnathidae and Uloboridae build perfect orb-webs for trapping prey. Pholcidae and Theridiiidae weave scattered lines or irregular webs for prey capture. The amaurobids and linyphiids make sheet webs for food gathering. The most common explanation for the observed pattern of spider guild structure is the effects of the host–crop, including its structural diversity, microenvironment, or the level of disturbance. Ample observations and more recent experimental evidences suggest that habitat structure maintains a diverse spider assemblage (Uetz, 1991) and may be critical to successful insect pest suppression.

Spiders live in a well defined environment with limitations set by both physical conditions and biological factors (Foelix, 1996). They can be grouped into specific functional groups based on the relative distribution and predatory methods (Bultman et al., 1982). Describing the spider diversity in terms of these groups allows greater insights into how habitat differences may be reflected in life history strategies (Lee & Kim, 2003). Guilds are ecological groupings of organisms which exploit a single or similar resource in a similar manner (Root, 1967). Recently, spiders have been subdivided into increasingly finer guild systems (Uetz, 1991). Unfortunately, the present paucity of knowledge of foraging methods of some families of spiders makes the development of highly resolved guild systems difficult. The present system delineates seven guilds, based upon gross differences in foraging behaviour within the resident spider community. Members of the wolf spider guild are "sit and wait" type predators which change sites frequently (Foelix, 1996). Crab spiders, while also being "sit and wait" type predators, are differentiated because of morphological differences. Because the foraging methods of the Clubionidae and Gnaphosidae are not well known, they have been put into a separate guild, the running spiders.
Web-building species are stationary predators that wait for food to come to them. Most web weavers depend largely on relatively few prey groups available in high numbers in a particular environment. In contrast, hunting spiders seem to be less restricted in their diets. Representatives of various hunting spider families have been reported to feed on both moving and motionless prey, which is indicative of a more mobile foraging strategy. It is quite possible that the greater diet breadth of the hunting spiders simply reflects their greater opportunities to actively seek out suitable food due to their higher mobility. They have a better chance of finding suitable food than web-weavers in agroecosystem. Spiders colonizing agricultural fields are mostly generalist predators of arthropods, and while they may have evolved their particular niche exploitation patterns under different ecological circumstances, that exploit same class of resources. Since the predatory potential of spiders in agroecosystem may vary with microhabitat, season, time of day and foraging strategy, spiders may constitute more than one “assemblage guild.”

There are many environmental factors that affect species diversity. Some of these factors includes: 1. seasonality, 2. spatial heterogeneity, 3. competition, 4. predation, 5. habitat type, 6. environmental stability and 7. productivity. (Rosenzweig, 1995). Additionally, there are many factors that determine the species composition. This may be related to the changes in the vegetational structure of the habitat. The final stage of the crop growth appears to be more complex and have high diversity. The results of the present study indicate that the two crop seasons have different species composition.

The difference in the spider species found at the base of the plant and collected from the canopy of the plant was of course due to the difference in position of their habitation on the paddy field. Structural complexity may determine the guild composition of a crop spider fauna and indirectly influence the level of herbivore damage (Young & Edwards, 1990). Structurally complex crops providing a wider assortment of resources would be predicted to support a more diverse spider assemblage, thus increasing the chances of the “best” match between spiders and insect pests. Structurally simple crops may not develop an abundant and species rich spider fauna, perhaps, lowering the importance of spider predation under these conditions. Spider species often have complementary niches, segregating in terms of dimensions such as vertical location, diel cycle and foraging mode (Marc & Canard, 1997). However, when spiders were divided into vertical strata there was a significant effect of the structural complexity. The web building and plant wandering spiders rely on vegetation for some part of their lives, either for finding food, building retreats or for web building. The structure of the vegetation is therefore expected to influence the diversity
of spiders found in the habitat. There were many more plant wanders and web builders sampled than ground dwellers. This again indicates that structural diversity of the vegetation may, in some way, influence the spider diversity. Studies have demonstrated that a correlation exists between the structural complexity of habitat and species diversity (Uetz, 1979; Andow, 1991). Diversity generally increases when a greater variety of habitat types are present. (Hawksworth & Kalin Arryo, 1995). Uetz (1991) suggest that structurally more complex shrubs can support a more diverse spider community. Downie et al. (1999) and New (1999) have demonstrated that spiders are extremely sensitive to small changes in the habitat structure; including habitat complexity, litter depth and microclimate characteristics. Generally, as disturbances increases, the spider species richness decreases. Thus, the physical structure of the environments has an important influence on the habitat preferences of spider species especially web-building species (Utez, 1991; Hurd & Fagan, 1992). Vegetation structure seems to influence the spider composition at the family level because similar families cluster within a similar habitat type. The result also indicates that similar species are present at specific time of the season. Thus, seasonal variation may be a more important determinant than the vegetation structure alone. This provides valuable insights as to why certain species may dominate at different times of the season.

**Effect of season on spider diversity:**

There have been significant differences in diversity, evenness and richness indices between Rabi and Kharif seasons. The results indicate that the two seasons show different species composition. It might be expected that climatic changes through seasons would influence the abundance of spiders (Kato et al., 1995). Studies of Russell-Smith (2002) established the importance of rainfall in the regional spider diversity. In the tropics, a continuum of species with extended seasonal ranges has been found (Basset, 1991), that would give rise to variable samples at different times of the year. Most spiders are limited to a certain extent by environmental conditions. In general, different species have varying humidity and temperature preferences and are limited to those seasons which offer a microclimate within the range of their physiological tolerances. So, the difference in species diversity between the two seasons is likely to be due to the difference in the amount of rainfall and temperature in the two seasons.

However, since the members of the order Araneae exhibit diverse habits and tolerances, it is likely that species representatives can inhabit most areas in similar densities to prey species present. Exceptions include severe or marginal habitats where a limited supply of suitable web sites may influence the number of web-building spiders supported
by the habitat. Other habitats may affect the number of spiders present by offering a limited supply of the structural features necessary for web-building. According to Turnbull (1973), most webs have specific attachment and space requirements. Other workers have also found the availability of specific structural features to limit the habitats occupied by various web-builders (Young & Edwards, 1990). These resources might also limit the number of individuals supported within a given habitat. Lubin (1986) suggested that the observed temporal abundance variation might result from seasonal changes in humidity and prey availability. In addition, the difference in the seasonal abundance of spiders may be due to the variation in patterns of activity of individual spiders and the phenology of total spider community (Corey et al., 1998).

**Effect of crop growth on spider diversity:**

In the present study, the value of $H'$ increased as crop growth advanced. This reflects the increase in number of species in the spider community as crop growth advanced. A decline in the value of $\lambda$ as crop growth in the present study indicates the dominance of some spiders like tetragnathids and lycosids during the initial period of crop growth. It would appear that an unambiguous and straightforward index of species richness would be Margalef Richness index ($R$), the total number of species in a community. Species richness examines the number of species occurring in a habitat. Overall species richness is the most widely adopted diversity measure. When all species in a sample are equally abundant, an evenness index will be at its maximum, decreasing towards zero as the relative abundance of the species diverges away from evenness.

Kajak (1960) found that relative spider and prey densities were related to the structural diversity of the habitat, and Turnbull (1966) attributed similar relative predator and prey densities to environmental conditions operating on both groups. The web building and plant wandering spiders rely on vegetation for some part of their lives, either for finding food, building retreats or for web building. Vegetational architecture plays a major role in the species composition found within a habitat (Greenstone, 1984; Scheidler, 1990), and vegetation which is structurally more complex can sustain higher abundance and diversity of spiders (Hatley & MacMahon, 1980). The final stage of the crop results in a habitat that is more complex and can support higher diversity. Surveys have demonstrated that spiders respond numerically to the diversity and complexity of the vegetation (Rypstra, 1983; Halaj et al., 1998). Difference in vegetational architecture during crop growth accounts for the different community structure of spiders in the present study. An increase in the spider population according to the plant growth tends to depend on prey availability and, if the density of prey becomes
higher, spiders are expected to increase proportionally to some extent. The peak of population density of spiders coincides with an increase of insect pests (Kiritani et al., 1972). It has already been pointed out by Kobayashi (1961) that the values of correlation coefficients between the population density of insect pests and that of spiders tend to increase from negative to positive form as crop growth advanced. As no quantitative evaluation was done on the insect pest density during this study, further investigations should be carried out to reveal the influence of insect pests on the resident spider community. The amount of preys alone does not affect the density of spiders. What can be cited as other important factors is the number of surviving individuals after hibernation and other repair works related to agriculture. The halter often deals a heavy blow up on spiders because it destroys the vegetation on the ground surface. The growth of weeds quickens the time of draining water from paddy fields and this is considered to promote migration of spiders from dikes to paddy fields and dikes can act as an over-wintering place of pests and as a source of spiders (Van Den Bosh & Telford, 1964).

Vegetation structure is one of the essential factors for spiders. Dense and compact vegetation provides shade and humidity, appropriate conditions especially for small spiders of the families Linyphiidae and Theridiidae. These spiders, exposed to loss of water more than larger ones, find hiding places in numerous, tiny spaces of such habitats (Duffey, 1962). Linyphiids were most abundant in the final stages, in which the vegetation provided good support for sheet webs. The study findings support the suggestions of Jennings et al. (1988) and Baur et al. (1996) that communities of spiders or other invertebrates are mainly organized as a function of the structural complexity of the environments. Variations in species composition can be explained by habitat preferences resulting from behavioural and morphological characteristics of the spiders (Johnson, 1995). It can be concluded that structural complexity is an important factor for the organization of spider communities on these plants, a factor that can affect richness and, even more strongly, composition of the spider species associated with them. Although it is reasonable to expect a significant influence of crop characteristics on structuring the resident spider community, the importance of adjacent habitats must also be considered (Duelli et al., 1990). Selective forces of the crop environment can act only on "what is available" i.e., sets of species colonizing in the fields from the neighbouring habitats. Neighbouring habitats may also influence the composition of crop spider fauna indirectly by modifying the dispersal of potential spider prey and predators in the patchy agricultural landscapes (Polis et al., 1998).

Between the irrigated rice fields there are usually bunds, which may be narrow and low and reconstructed often with low and poor
vegetation, or which may be wider and higher and with more permanent vegetation. The bunds surrounding the rice fields provide refugia for predators during fallow periods as well as during farm operations. Bunds may be particularly important as a source of colonization by ground dispersing predators, such as large P. pseudoannulata spiderlings and adults, and may be less important for linyphiids as *Atypena* sp., which colonizes the rice field by ballooning. Preliminary results from a study of the directional movement of predators between the rice field and the bund show that *P. pseudoannulata* is an early colonizer of newly established rice, with the highest relative abundance of *P. pseudoannulata* in the bund, stressing the importance of this habitat (Sigsgaard & Villareal, 1999). The same study showed that three or four weeks after transplanting of rice the directional movement changed and the early planted field may have become a source of *P. pseudoannulata* to later planted fields. Even within the soil cracks of the fallow rice field, some spiders like *P. pseudoannulata* are commonly found (Arida & Heong, 1994). So, the management of bunds can also affect the observed spider diversity.

About 40,000 spider species are currently known throughout the world (Platnick, 2007). All are predators and except for the very well-known larger mygalomorphs, the great majority feed principally on insects. However, despite their almost unique predatory habits, spiders do not constitute a homogeneous functional group and instead exhibit significant behavioural diversity in relation to their different predation strategies, their dispersal modes and their great ability to resist adverse ecological conditions. They colonise almost all habitats and microhabitats, from subterranean environments to mountain tops and include a few fresh water species and intertidal biota. This also explains the generally quite high species diversity found in natural and agricultural areas. This is especially true for wetlands, which always constitute an optimum habitat rich in spider species. Despite this, their specific diversity is generally lower than that of insects, ranging from about 40 to 150 species, depending on the environment, an identification of the dominant species without great difficulty.