CHAPTER-I

1. INTRODUCTION

1.1 Southern Tropical Dry Deciduous Forest

Forests are one of the important ecosystems which have potential to sustain variety of flora and fauna. Gujarat state is famous for harboring diverse kinds of flora and fauna. This is possible only because of presence of variety of habitats which are protected in the form of Sanctuaries and National Parks. In total Gujarat have 24 protected areas of which only two are considered under the category of dry deciduous forests namely, Gir National Park and Sanctuary and Jambughoda Wildlife Sanctuary (Champion & Seth, 1968). Out of which we preferred to work in Southern Tropical Dry Deciduous Forests of Gujarat which is well depicted by Jambughoda Wildlife Sanctuary. It is located between Panchmahal and Vadodara districts of Gujarat and known for its relatively rich biodiversity including flagship species like sloth bear and leopard. Studies in the past in Jambughoda WLS were restricted to flora and higher vertebrates like mammals, birds, reptiles and fishes (Vyas, 2006; Devkar et al., 2013a; Padate et al., 2003). Moreover, invertebrate documentation in this area was restricted to preliminary listing of gastropods, insects, lepidopterans and few other invertebrate species which does not include spiders (Padate et al., 2003). So far, there have been no studies on spiders from Jambughoda WLS. Hence there is a serious need to work on the ecology and diversity of spiders. As there are no exclusive studies on fauna there is association of flora and fauna therefore, the flora of JWLS was also studied.

1.2 Flora and Fauna

The Jambughoda Wildlife Sanctuary harbors 105 species of trees which includes 42 flowering plant families belonging to 88 genera (Asari & Padate, 1978; Pandya & Oza, 1998; Pandya, 1995) whereas, 116 tree species are listed in the Management Plan of

Jambughoda Wildlife Sanctuary. Major part of forest area (about 50%) is covered with teak (*Tectona grandis*). Due to continuous clearing of tree growth for cultivation and heavy pressure of grazing and forest fires the natural regeneration of natural forest tree species is heavily affect. But now due to the conservation and protection of forest and also due to plantation activities the forest is again getting profuse regeneration.

It also provides home for about 26 species of mammals (Devkar et al., 2011; Devkar et al., 2013a; Devkar et al., 2013b; Upadhyay et al., 2014; Vyas & Upadhayay, 2011; Vyas & Upadhyay, 2014a; Vyas & Upadhyay, 2014b) and about 215 species of birds were recorded from the area (Padate et al., 2003; Vyas et al., 2013). The sanctuary is also home for certain migratory birds like glossy ibis, teals, shovellers, storks and pochards. Besides mammals and avifauna there are 28 species of reptiles, belonging to 12 families, including one species of each crocodile and turtle, 12 species of lizard and 14 species of snakes (Vyas, 2006; Vyas & Upadhyay, 2013). There are about 12 species of amphibians reported from the sanctuary area (Vyas, 1999; Vyas et al., 2003; Vyas & Upadhyay, 2004) whereas, 11 species of fishes have been reported in the biodiversity survey (Padate et al., 2003). The historical background of Jambughoda says it to be a rich forest. Here the richness is with reference to invertebrates and vertebrates. Hence there is a need not only to see spider diversity but also to study and observe the faunal diversity of other groups which are dependent on the forest.

1.3 Cultural and Social Believes

The tribals of Jambughoda Wildlife Sanctuary directly or indirectly help in conservation of flora and fauna of the forest. It is evident by the paintings named ‘pithora’ which are drawn on the walls of hut. The specialty of ‘pithora’ paintings is it depicts all the life forms. All the different pithora paintings have their own story. Some people say that these were painted when the tribals were unable to identify organisms and hence whatever they see in the forest they draw on the walls. In other words they leave informing for their upcoming generations to know that at times there was presence of such organisms. In these paintings they had also drawn spider at top right hand side corner of the wall (Figure 1) depicting that the spider has attached one string of silk on the earth and is moving towards heaven. They consider spiders as one of the powerful

creations of god as it can take us to heaven “Swarg ni sidi” (Ladder to heaven) when we die. This concept came into existence since spiders are the only ones which can produce silk and spin wonderful webs with complex geometrical structures. For this reason spider are one of the important god’s creations and are worshiped by tribals of Jambughoda Wildlife Sanctuary and helps in conservation of spiders. Apart from this each village has their own typical ‘Devsthaan’ (Place of worship) where the deities are made from clayey mud into various shapes viz., Horses, Jars and beehive-shaped vessels.

Figure 1. Pithora Paintings

The Jambughoda Wildlife Sanctuary has its own unique geographical location in central Gujarat. It has undulating hilly tracts (Figure 2) covered by natural vegetation, plantations and cultivated lands. Most of the hills run in east to west direction and only some in north to east direction. These hills are the southernmost extensions of the Aravalli hills forming the western fringe of the Vindhya Mountain ranges. In the neighborhood of sanctuary, towards the north-west, the historic hill of Pavagadh is situated having an altitude of 865 m. Within the sanctuary the highest altitude is of Masabar hill (354 m) which forms the

southern boundary of the sanctuary. The second highest point recorded was of Poyali hill (353 m) forming the northern boundary of the sanctuary (Pandya & Oza, 1998). There are no perennial natural sources of water in the sanctuary but few seasonal springs are present at Jhand, Jabban and Ranjitnagar. Only the Dev, Sukhi and Orsang rivers are almost perennial depending on the rainfall. The water flowing down from the hills has been dammed at several places in the sanctuary, *viz.*, Kada, Dharia, Laphni and Targol. The Sukhi River runs almost parallel to Eastern boundary of the Sanctuary and the man-made canals from the Sukhi Dam connected to Kada-Targol-Dev Dam provides water throughout the year to the peripheral villages on the Eastern and Southern fringes.

Figure 2. Overview of Undulating Terrain in JWLS

The climate of Jambughoda Wildlife Sanctuary remains dry throughout the year except in the monsoon season. The mean annual temperature in the sanctuary is 25.5˚C, with a maximum of 45˚C and a minimum of 7˚C. The area receives an average annual rainfall, which ranges between 800 mm to 1, 200 mm (Pandya & Oza, 1998). In general, rainfall is very erratic and irregular, consisting of few heavy showers interspersed with long spells of drought. The relative humidity is very high during monsoon and in July-August

it reaches upto 70% to 90%. In other season the weather is dry with humidity below 20% in the evening and reaching only upto 40% in the cool mornings during February to May. These climatic conditions affect the spider diversity, their habitat preferences, feeding habits, type of prey and also affect their reproductive ecology which suggests the importance of ecological studies. Ecological studies also help in known the extent of environmental changes and disturbance in a particular habitat. Spiders are one of the biological indicators of habitat health as they forms an important link in the food chain by feeding on insects and been fed by thier predators. Spiders belong to: Phylum-Arthropoda; Class-Arachnida and Order-Araneae.

About 45, 743 valid species of spiders belonging to 3, 973 genera and 114 different families have been reported throughout the world (Catalog, 2015). Out of which, about 1700 species belonging to 440 genera and 61 different families have been reported from India (Keswani et al., 2012; Catalog, 2015). In Gujarat, majority of work was done on taxonomy and diversity of spiders in the form of checklist but ecology and diversity was little discussed by researchers. So far, only 208 species of spiders have been reported from Gujarat (Kumar, 2015; Patel, 1971).

Also most of the spider documentation in Gujarat state has been done from non-protected areas like agriculture fields and very few from protected areas. Out of 24 protected areas in Gujarat state, documentation of spiders is only from five protected areas viz., Vansda National Park (Patel & Patel, 1972; Patel, 1973; Patel & Patel, 1973a; Patel, 1975b ; Reddy & Patel, 1994; Patel, 2003a; Parmar et al., 2014; Kulkarni & Yadav, 2015), Hingolgadh Nature Education Sanctuary (Patel & Vyas, 2001), Purna WLS (Siliwal & Pilo, 2003), Ratanmahal Sloth Bear Sanctuary (Patel et al., 2012) and Shoolpaneshwar WLS (Bhatt, 2014), whereas there is only one report on distribution of Theraphosidae spiders from five protected areas of Gujarat namely, Vansda National Park, Gir National Park and Sanctuary, Girnar WLS, Purna WLS and Ratanmahal WLS (Parasharya et al., 2011).

1.4 Spiders and their relatives

All spiders belong to order: Araneae of class Arachnida (Phylum Arthropoda). The term Arachnida was given by Lamarck in 1815 to incorporate spiders, scorpions and mites. Arachnids are considered to be monophyletic in origin. At present there are 11 traditionally recognized arachnid orders namely, Palpigradi (micro-whip-scorpions), Araneae (spiders), Amblypygi (whip-spiders), Thelyphonidae (whip-scorpions), Schizomidae, Ricinulei (ricinuleids), Acari (mites and ticks), Opiliones (harvestman or daddy-long-legs) (Figure 3), Scorpiones (scorpions) (Figure 5), Pseudoscorpiones (false scorpions) (Figure 4) and Solifugae (sun spiders) (Figure 6). Out of these 11 orders the most dominant arachnid order is Acari (55,214 mite and tick species) followed by Araneae (44,863 spider species) (Zhang, 2013). Based on many morphological characters the order Araneae was found to be most closely related to the group Pedipalpi (Amblypygi, Schizomida, and Uropygi) of class Arachnida (Shultz, 1990).

1.5 Morphology and terminology in spider taxonomy

Spiders belong to phylum Arthropoda; Class Arachnida; Order Araneae. They can be easily differentiated from insects by having body divided into two parts viz., Cephalothorax and Abdomen, absence of wings and antennae, four pairs of legs, mostly presence of eight eyes, presence of spinnerets, unsegmented abdomen except in primitive spiders, breaths through book lungs and occurrence of indirect copulation.

The entire body of spider is divisible into two parts namely cephalothorax and abdomen which is connected by a slender pedicel (Figure 7). The cephalothorax is the fusion of head and thorax and is covered dorsally with hard scleroised carapace and ventrally by sternum. Cephalic region consists of four pairs of simple eyes. Basically there are two types of eyes, nocturnal and diurnal eyes. When both the types of eyes are present in a single species of spider, the condition is termed as Heterogeneous condition of eyes whereas, when only one type of eyes are present in a spider, the condition is called Homogenous condition of eyes. Usually there are two rows of eyes namely anterior row of eyes and posterior row of eyes, in few families there is presence of three rows of eyes. When the row of eyes is curved towards the chelicerae, it is termed as procurved row of

eyes and when the row of eyes is curved away from the chelicerae, it is termed as recurved row of eyes (Figure 9).

Depending up on the position of eyes, there are anterior lateral eye and anterior median eyes, both forming anterior row of eyes whereas posterior lateral eyes and posterior median eyes forms posterior row of eyes. The arrangement of eyes is taxonomically important as it is one of the identifying characters in spiders to identify them till family level.

In the middle of the thorax (posterior part of cephalothorax) there is a depression called as thoracic groove or fovea which demarcates cephalic region from thoracic region of cephalothorax. Anteriroly cephalothorax bears one pair of chelicerae with fangs at the tip, which fits into the cheliceral groove. The inner surface of the chelicerae may or may not have dentition (Figure 12). Also one pair of palp is present at the anterior part of cephalothorax. These palps are divided into six segements namely, coxa, trochanter, femur, patella, tibia and tarsus. In case of adult male spiders the tarsus of palp gets modified into copulatory organ which is a complex structure, termed as padipalp and taxonomically most important to identify adult male specimen till species level (Figure 10). In case of females palp the tarsus is simple with or without tarsal claw. On the lateral side of cephalothorax there are four pairs of legs, articulated in the pleural membrane. Each leg is having seven segments namely, coxa, trochanter, femur, patella, tibia, metatarsus and tarsus with two or three tarsal claws. Legs are often covered with either spines, hairs, bristles or spinules.

The abdomen in spider bears anal tubercle and three pairs of spinnerets posteriorly. Looking into the arrangement of spinnerets they are termed as anterior pair of spinnerets, posterior pair of spinnerets and median pair of spinnerets (Figure 11).

Looking into the ventral surface of the abdomen there is presence of one or two pairs of book-lungs which helps in breathing, followed by one or two pairs of spiracles. In spiders, female genital organ is termed as epigyne, which is situated just anterior to transverse fold termed as the epigastric furrow located between the pairs of book-lungs (Figure 8). Externally, epigyne has two openings which lead to spermathecae inside

where the sperms are stored, nourished and activated. At the posterior median margin of the spermathecae there is presence of a pair of narrow curved tubes called as fertilization tubes. Depending upon the spider species, complexity in the structure of epigyne varies and these variations in the epigyne structure are one of the major identifying characters in female spiders to identify them till species level.

As spiders being chiefly entomophagous plays an important ecological role in terrestrial ecosystem (Marc et al., 1999; Skerl & Gillespie, 1999). They also play an important role in the food chain by being abundant food source for birds, lizards, wasps and other animals hence, spiders are of great value to the environment. Therefore, in order to understand their role in the southern tropical dry deciduous forest of Gujarat, there is a need to study ecological parameters like habitat preferences, web building behavior, feeding habits, type of prey and reproductive ecology along with diversity studies.

1.6 Objectives

Hence the work was done with the following objectives:

- Taxonomic identification of the spider fauna and designing spider inventory as baseline data.
- To explore the habitat preferences, web building behavior, feeding habits, type of prey and reproductive ecology.
- To explore the ecological roles of spiders in providing ecosystem services.

Figure 3. Opilion

Figure 4. Pseudoscorpion

Figure 5. Scorpion

Figure 6. Solifugae

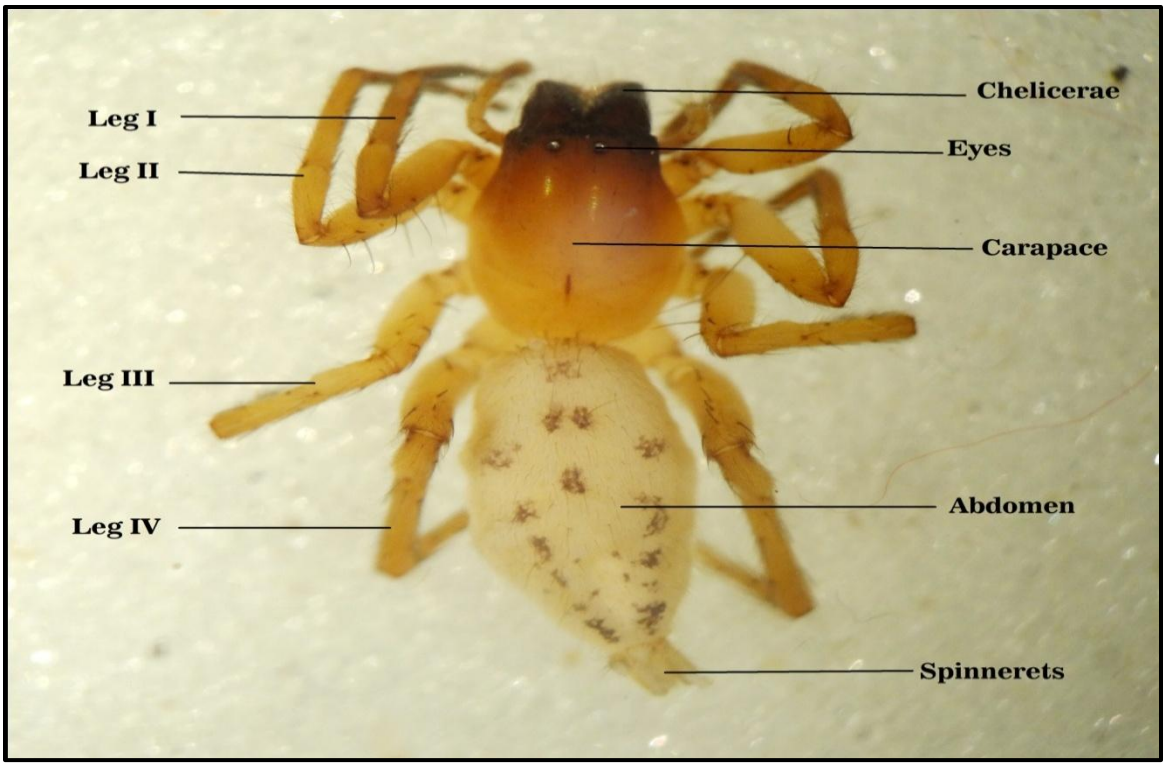

Figure 7. Dorsal View of Female *Clubiona foliata*

Figure 8. Ventral View of Female *Clubiona foliata*

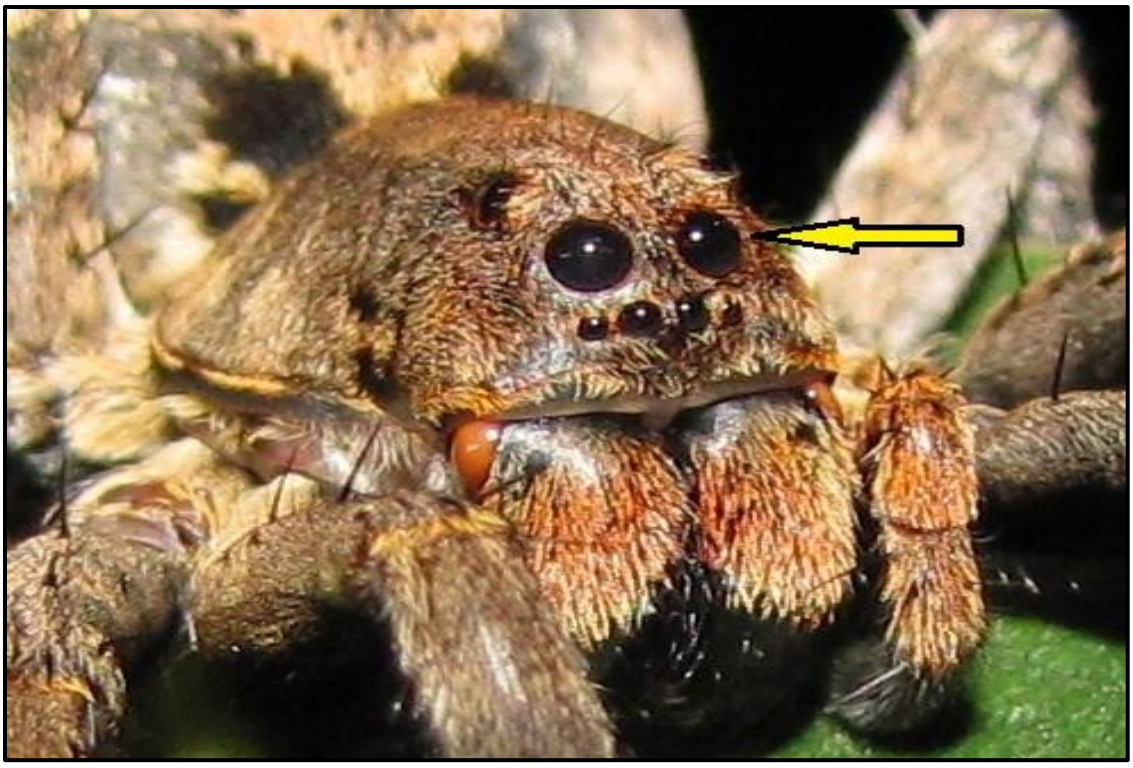

Figure 9. Eye Arrangement in Lycosid Spider (Arrowed in Yellow)

Figure 10. Male Palp of *Stenochilus hobsoni* (Arrowed in Yellow)

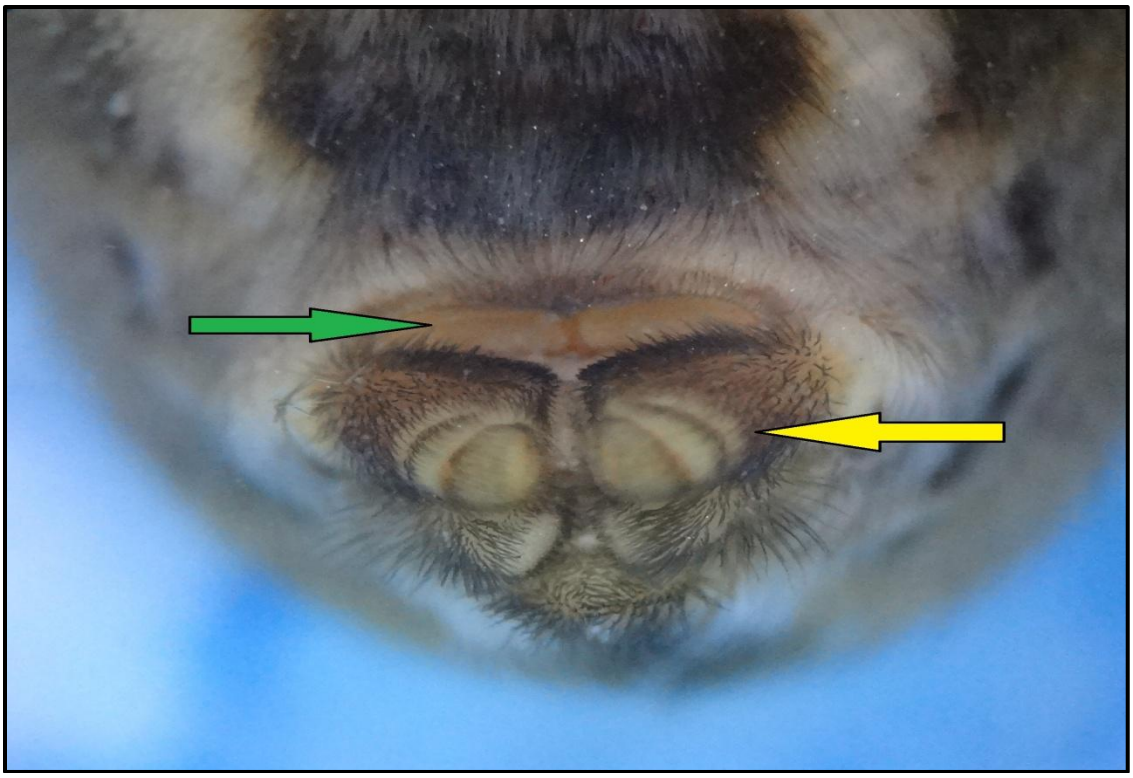

Figure 11. Rare View of Abdomen showing Cribellum & Spinnerets (Arrowed in Green & Yellow)

Figure 12. Chelicera with Fangs (Arrowed in Yellow) (SEM Image)