CHAPTER-5

DISCUSSION

The present study shows that diversity and ecology of spiders is closely related to the structural complexity of the environment. Maximum spiders were observed from July to December because of the moist habitat. However there are good numbers of species that are new to science. This indicates that Champaner-Pavagadh has rich diversity of spider fauna as spiders are good indicators of healthy ecosystem and maintain ecological balance by feeding on various insect pests.

Hence the information on their diversity and ecological studies would be helpful in conserving the ecosystem. This study indicates that the spider fauna in the Champaner-Pavagadh is moderately rich. Some rare and uncommon spiders were found from study sites such as Tarantula spider (Theraphosidae), *Plesiophrictus* sp. and tube dwelling spider *Ariadna* sp. during the study. Two genera and eight species that are new records from India were also found. Moreover, three genera and nine species is also been recorded for the first time from Gujarat. Ten species which are new to science were documented from Champaner-Pavagadh Archaeological Park. The high number of species recorded indicates the rich spider diversity of Champaner-Pavgadh Archaeological Park. Spiders are ubiquitous in nature and their diversity depends on many factors like habitat structure, temperature, humidity and vegetation of the areas Uniyal *et al* (2011). Therefore, keeping these factors in mind the study site was divided into different habitats.

5.1 Spider diversity in sub-sites

In the present study Champaner-Pavagadh Archaeological Park and its surrounding areas were explored. Multiple areas were selected on the basis of their vegetation types namely forest area, agriculture fields, concrete structure like mosque, small temples, residential areas and garden area.

Forest Area: After compilation of the data we could find that forest area had maximum spider species i.e. a total of 50 species belonging to 41 genera and 20 families. The reason

could be forest habitat being natural and undisturbed, having mixed type of vegetation viz; trees, shrubs, climbers, grasses giving enough space for making different orb webs. Forest area has abundance of trees like *Tectona grandis, Cassia siamea*, *Leucaena leucoephala, Annona squamosa, Moringa olifera*, *Manilkara hexandra* etc*.,* shrubs like *Cassia tora, Euphorbia nerifolia, Nytanthus arbor tristis* etc. and climbers namely *Cuscuta reflexa, Demia extensa, Leptadenia reticulate* etc (Table 1).

Maximum spiders in forest area are from the family Araneidae making Orb-webs. This undisturbed forest gave enough space to orb web spiders. Mixed type of plant vegetation provides enough space to build the web of different sizes. The common families Salticids, Lycosids, Gnaphosids, Corinnids, etc. (Table 4) were also present as they are ground spiders found in leaf litter, forest floor. For ground spiders and foliage runners, there are more retreats and hiding places in the forest. Forest floor and leaf litters were providing shelter to the spiders. The temperature and humidity of the forest area was good enough for the ground spiders to flourish. In a similar study Suthar *et al* (2017) documented spider diversity of natural wild mango forest of Chinchali, Pipaladevi forest range of Dangs district. They reported maximum spiders from the family Araneidae followed by Lycosidae and Tetragnathidae, Pholcidae, Scytodidae and Thomisidae. Solanki and Kumar (2016) have worked in Jambughoda wild life sanctuary and reported the presence of high diversity of Orb-web and ground spiders in the dry deciduous forest of Gujarat. Ganesan *et al*. (2012) has studied in Perumalmalai forest area, Kodaikanal hills, Dindigul district, Tamil Nadu and reported Araneidae as the most dominant family. Sudhikumar *et al* (2005) also reported Araneidae, Tetragnathidae, Salticidae families were maximum in the forest habitat of the Mannavan Shola forest of Kerala.

Agricultural fields: This area also has a good number of spider diversity and total 42 species belonging to 33 genera and 17 familieswere reported (Annexure 1).

Family Araneidae, Salticidae and Lycosidae were found as dominant species in all the agricultural fields. Bade and Ade (2017) investigated the spider population and diversity in the agroecosystem of Bori-Arab, Yavatmal district, Maharashtra and reported Araneidae as the dominant family followed by Lycosidae and Salticidae. Solanki & Kumar (2015) worked from different agricultural fields of Jambughoda wildlife sanctuary and observed that families Araneidae, Salticidae and Lycosidae were having maximum species diversity in agricultural fields. While Warghat *et al* (2010) worked at different agricultural fields adjoining to foothill of Satpura Mountain ranges of Amravati district. They have also

reported Araneidae, Thomisidae and Salticidae as dominant families. In our study area agricultural fields are present at the base of the hill adjoining the forest area. This gives spiders an alternative habitat at the time of intercropping or due to pesticide spray making their survival easy.

Garden area: The garden area is well maintained with flora having many native and exotic varieties of plants (Table 2). Such type of vegetation sustains the spiders. Thus total 37 species of spiders belonging to 31 genera and 16 families were recorded (Annexure1). This area is slightly disturbed as Champaner-Pavagadh Archeological Park is a tourist spot and garden is frequently visited by people and has less vegetation and leaflitters compared to forest and agriculture areas. Maximum spider species were reported from family Araneidae, Salticidae and Lycosidae due to the presence of ornamental plants, herbs and shrubs. Wankhede *et al* (2012) who worked on various gardens of Pune University found maximum spider species from the family Araneidae

5.2 Diversity of spiders along the slope of Pavagadh hill

The study of spider diversity along the altitude of Pavagadh hill is important to understand the distribution of species diversity along the altitude and obtain a baseline data which can be useful for future studies on spider diversity. A total of 144 species belonging to 92 genera and 29 families were recorded from the hill. In the present research maximum diversity was reported from lower altitude followed by middle and higher altitude. The maximum diversity of spiders in lower altitude was reported due to the presence of a rich diversity of plants and forest floor. It was observed that lower and middle altitude of Pavagadh hill harbors great diversity of herbs and plants as compared to higher altitude. Higher altitude has less number of spiders due to declining pattern in herb and shrub diversity. Similar result of spider abundance declining linearly with increasing altitude elevation was observed by Quasin and Uniyal (2011). They worked on spider diversity along the slope in Nanda Devi Bioshphere, Uttarakhand and reported spider abundance declining linearly with increasing altitude elevation of hill. They reported Araneidae, Salticidae and Lycosidae as the dominant families in the hilly areas. Whereas Sharma *et al* (2009) worked in Species richness and diversity along an slope in moist temperate forest of Garhwal Himalaya and found that higher diversity at lower altitude followed by middle and higher altitude. Jimenez-Valverde and Lobo, 2007 found that spider richness was more strongly correlated with habitat complexity and maximum temperature with elevation at a

regional scale of investigation. Earlier reports also suggest that species diversity is correlated with structural complexity of habitat (Uetz, 1979; MacArthur, 1964; Rosenzweig, 1995).

Amongst the 29 families the most abundant was Salticidae followed by Araneidae and Gnaphosidae (Table 5). Some families like Lycosidae which are more tolerant and overcome harsh conditions were also collected from higher elevations. These families are widely distributed in all geographic regions and have high potential to survive in different habitats and environmental conditions. In the present study we observe some families and species which are found in restricted areas like family Theraphosidae (Mygalomorphae) and Segestriidae (Tube dwelling spiders) were found at higher altitude may be due to its cryptic or patchy distribution.

Most of the spiders are sensitive to small changes in the environment especially changes in the vegetation, topography, temperature and humidity. Thus we have observed that the overall number of spiders decreased with the increase in altitude (Graph 3).

5.3 Guild Structure

In the study we have observed six different types of guilds namely Ground dwellers, Orb-web weavers, Foliage dweller, Branch dwellers, Space web builders, Sheet web builders. The dominant guild reported was of ground dwellers followed by Orb-web weaver, Foliage dweller, Branch dwellers (Graph 4). The ground dwellers were dominant due to the fact that this area is having forest, mix vegetation and climbers with more amount of leaf litters. Such type of habitats are favorable for ground dwelling spiders which provide more retreats and hiding places with moderate temperature and humidity (Stevenson & Dindal, 1982). Orb web weavers are the second largest group due to the presence of large trees, herbs and shrubs which help in making the Orb-web for the spiders. Sharma and Singh (2018) worked on the guild structure of spiders from Siddharthnagar, Uttar Pradesh, and found that dominant guild was of Orb-web weavers followed by stalkers, ground runners, space builders, foliage runner, and ambushers. Cardos *et al* (2011) studied global patterns of guild composition and functional diversity of spiders and reported eight different types of webs.

Orb web weavers and ground dwellers were found in almost all the seasons where as Branch dwellers, Space web builders, Sheet web builders were found maximum after the post- monsoon season (October- December). This severe fluctuation in guild structure is

due to the change in climatic conditionsfrom the months of December to May. When leaf litter was maximum in the forest maximum diversity of ground dwellers like the familiesLycosidae, Gnaphosidae, Oonopidae, Palpimanidaeand Zodariidae were recorded.

5.4 Spider webs: Structure and pattern

The web structure and pattern study of spider web is one of the very interesting part of study. Spiders are well known for its different types of web making ability. The web is constructed for various purposes for making egg sac (cocoon), for lining their nests, for ballooning, silk used during mating, for making draglines and also for building webs to capture their prey. From the study site of Champaner-Pavagadh Archeological Park we have found six types of webs namely Orb-web, funnel web, sheet web, tube web, irregular web and tent web. The uniqueness of the web was recorded as the habitat changed. Rich flora which had large number of trees with flowers, herbs and shrubs helped the spiders in making different types, patterns and size of web (Solanki & Kumar 2015b). Family Araneidae were found making orb-web and tent web like species *Neoscona, Parowixia, Argiope*, *Cyrtophira* and such vegetation like shrubs with more spacious branches where they can make Orb-web (Suthar *et. al,* 2018). Funnel web is made by ground spiders belonging to the families Agelenidae, Lycosidae and Eresidae on the ground surface or on the leaf litters or within leaves. Sheet web is made by families Lycosidae, Linyphidae, Filistatidae, Theridiidae and Pholcidaeon the lower vegetation like grass and humid areas or on the bushy vegetation. Irregular webs were found spread in all directions with the branches herbs and shrubs. These types of webs are built by families Pholcidae and Theridiidae. Such webs were commonly found in the crevices of rocks or between the shrubs. Even the fallen leaves and forest floor harbors spider families namely Agelenidae, Corinnidae, Lycosidae, Oonopidae, Zodariidae etc. Thus the present study shows that richness of vegetation affects the abundance and richness of spiders. Few other factors influence the pattern and site selection for web construction which includes web support, wind direction, temperature and humidity (Vollrath *et al.,* 1999). Also they do not eat all the insects which are captured in their web but rather destroys them and helps in keeping check on insect populations (Bilsing, 1920). From economical point of view, the study on web structure becomes more important indicating rich diversity of flora and fauna from the study areas. Diversity and ecology of spiders are closely related to structural complexity of

the environment. Because of the complex interaction of various climatic factors like rainfall, temperature, availability of water source nearby the area may hold many smaller but diverse environmental niche (Wankhade *et al*., 2012).

As spiders are good indicators of healthy ecosystem and maintain ecological balance by feeding on various insect pests like aphids, beetles, bugs, flies etc they become helpful in controlling insect pests. They act as bio-indicators for monitoring the biodiversity and their presence indicates the change in the particular habitat (Hore & Uniyal, 2008). All the above observations definitely bring us to the conclusion that the spider fauna in the Champaner-Pavagadh is moderately rich. Hence we can say that diversity and an ecology study always give an insight of an area, its health and richness and also help in conservation of a specific ecosystem.

> ***Natural species are the library from which genetic engineers can work. Genetic engineers don't make new genes they rearrange existing ones……***
>
> ***Thomas Lovejoy***