

INTRODUCTION

Spiders are the ancient Arthropods belonging to the class Arachnida having history of about 350 million years ago. These are the air breathing arthropods known to have special characteristics containing eight legs, two to eight eyes and spinnerets to spin the silk. They differ from class Insecta due to the absence of antennae and wings. Class Arachnida contains orders- Scorpiones, Schizomida, Amblypygi, Uropygi, Opiliones, Pseudoscorpiones, Palpigradi, Solifuge, Ricinulei, Acari and Araneae, (Tikader, 1982; Sebastian and Peter 2009). Spiders belonging to order Araneae differ from other orders of Arachnids by the presence of pedicel that joins the cephalothorax and the abdomen. Their special characteristic is the presence of spinnerets which secrete silk, this character differs them from the mites, which also secrete the silk by the glands in their palp as there are no spinnerets. Order Araneae constitutes the largest order, which ranks 7th in all over diversity of species. Spiders are very small to large sized arthropods with some special features within environment and ubiquitous in terrestrial habitat, (Turnbull, 1973; Preston, 1984; Nyfeller, 1987).

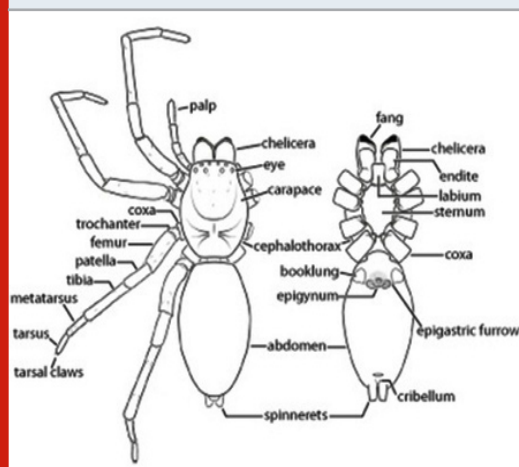
Arachnids are an important but generally poorly studied group of phylum Arthropoda. Many authors are making a lot of efforts to bring forward the research on spider biology and educate its importance to society. Many reviews have been

collected from international context which have helped in supporting research on spiders, which are meant to have precious role in ecology as they are mostly predatory in nature which help in reducing insect pests and invertebrate population in most ecosystems, (Jennings, 1986; Wise, 1993; Russell 1999; Maloney, 2003 and Plantnick 2019). Many researchers have conducted baseline studies involving role of spiders as biological, ecological indicators of natural ecosystem (McIver, 1990; Churchill, 1997; Maelfait, 1998) and in conservation planning, (Kremen, 1993). Allred (1969) and Allred (1976) also reported diversity of spiders in Arizona and Utah after new power plant installations in Nevada at the Nevada Nuclear test site to indicate any harmful changes in the ecosystem due to this plant.

Wise (1993) recorded importance of spiders in ecological web. Spiders are widely distributed group of predaceous organisms in the animal kingdom, (Riechert, 1984). Knowing the importance of presence of diverse Araneo fauna and its role in the ecosystem, the present review was aimed on the spider diversity of Satara, Sangli, Kolhapur districts which are the important locations of Western Ghats of Maharashtra known for their varied and rich biodiversity. According to World Spider Catalogue (Version 20.5) by Plantnick (2019), there are 48,334 species belonging to 4,143 genus representing 120 families. The pioneer contribution in Arachnology of Indian Spiders was given by European arachnologist, Stoliczka (1869).

Earliest contribution in arachnology was given by Blackwell (1867), Karsh (1873), Simon (1887), Thorell (1895), Pocock (1900), Malhotra (1980) and Tikader (1980, 1982). Gajbe (1978-2009) gave precious contributions on the Spiders of India. According to Indian Spiders checklist given by Siliwal (2005), 1442 species belonging to 361 genus of 59 families have been recorded and in 2012, Keswani recorded 1685 species of 438 genus belonging to 60 families, out of them, 91 species are of Infraorder Mygalomorphae and 1595 species of Araneomorphae. As per Tikader (1974), knowledge on diversity and distribution of spiders in Maharashtra is sparse, as compared to other regions of the world. Gazetteer of India which

Figure 1. Spider- Dorsal and ventral view



included 90 species, 14 families. Hippargi (2011b) recorded 19 families from Lonar, 25 families from Melghat and 31 families from Southern Tropical thorn forest, Solapur. From Western Ghats, Sebastian (2012) recorded 275 species belonging 139 genus and 39 families. Wasankar (2016) recorded 37 species of spiders belonging to 25 genera representing 17 families from Buldhana. 21 species representing 19 genus of 13 families recorded by Gajbe (2016) from Nagpur. 71 species of 15 families by Maheshwari (2018), and 104 species of 18 Families by Deshmukh (2014) recorded from Satpura ranges. From Amravati 31 species of 8 genera of 1 family were recorded by Deshmukh (2018). From Vidarbha in cotton fields 70 species belonging to 29 genera of 7 families were recorded, and in orange fields total 64 species of 13 families were recorded by Deshmukh (2017). Gajbe (2016) recorded 13 species of 9 families from Chandrapur and from Akola 26 species were recorded by Shirbhate (2017) (Table No 2).

Looking at the scenario of diversity of spiders from Maharashtra, a data from 2012-2019 was compared with India (Keswani,2012) which suggests that a lot of species still have to be explored on large scale before any natural calamities or any other environmental hazards make any species extinct without being explored Fig No.4. So this review has been carried out on to present the current status of spider diversity in three regions of Maharashtra, Satara, Sangli and Kolhapur which are the main parts of Northern Western Ghats known for one of the hottest biodiversity spots of India, [Fig No.2]. Along

with their importance as bioindicators they are also known popularly for Spider venom, which plays precious role in pharmacological extracts, by preying larva and adults of mosquito which carry malarial parasite (Choi, 2004; Ndava,2018). Spiders contain venom which is rich in proteins, containing disulfide peptides which have affinity and specificity towards specific subtype of ion channels and receptors. According to a report by Honor,(2015) only 0.01 % of its enormous pharmacological component has been explored till now. This discovery has accelerated the hope of development of novel molecules from such animal sources for drug discovery. This has also been innovatively used in medical,pharmaceuticals, and therapeutics, as a non polluting biopesticide, (Bode, 2001; Fry, 2009; Saez,2010; Herzig,2011;Windley, 2012; King and Hardy 2013; Mammola,2017; Li, 2017; Pineda,2018; Halarhkar,2018 and Luddecke,2019)

Recently various non chemical control methods are used in integrated pest management. Spiders in the rice field control the population of plant hoppers and leafhoppers, also in the cotton fields. And it is observed that web weavers controls the population of adult white fly and hunters control the population of nymph of pests in the field, without damaging plants. Thus they maintain the equilibrium in the ecosystem by playing major role in lower food web in the ecosystem, (Hamamura,1969; Sasaba,1973; Gavarra,1973; Samal, 1975; Kobayashi,1977; Chiu,1979;Vanden,1982; Holt,1987; Tanaka,1989; Jeyaparvathi, 2013; Lee;

Figure 2. Map showing three districts of Maharashtra-Sangli,Satara,Kolhapur(part of northern western ghats)

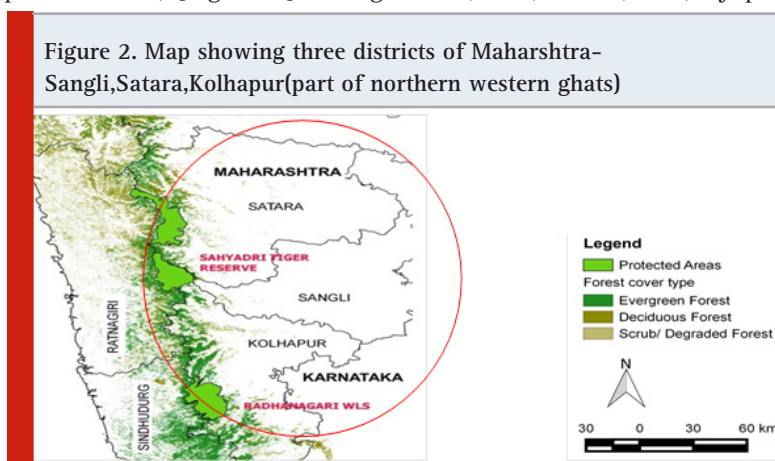


Table 1. List of Family wise Distribution of Spiders

Sr.No	Name of Family	Genus
01	Araneidae	i)Araneus ii)Argiope iii) Cyclosa iv)Gasteracantha v)Eriovixia vi)Larinia vii)Neoscona ix) Nephila x)Parawixia xi) Plebs xii)Guizygiella xiii) Cyrtophora xiv)Arachnura xv) Telecantha xvi)Polys
02	Salticidae	i)Aemonea ii)Bavia iii)Brettus iv) Currhotus v)Epeus vi)Epocilla vii) Hasarius viii) Hyllus ix)Menemerus x) Phintella xi)Marpissa xii)Myrmarachne xiii) Plexippus xiv)Portia xv) Rhene xvi)Telamonia xvii)Thiania
03	Lycosidae	i)Geolycosas ii)Hippasa iii) Lycosa iv)Pardosa v) Architosa vi)Evippa
04	Thomisidae	i)Amyciaea ii)Misumena iii)Oxytate iv) Ozyptila v)Runcinia vi) Thomisus vii)Xysticus viii)Tmarus
05	Sparassidae	i)Heteropoda ii)Olios
06	Theridiidae	i)Achaearanea ii)Argyodes iii) Chikunia iv)Enoplognatha v)Episinus vi) Euryopsis vii)Nesticodes viii) Phoroncidia ix)Phycosoma x) Rhomphaea xi)Steatoda xii)Theridion xiii)Theridula xiv)Latroedectus xv)Propostira
07	Oxyopidae	i)Oxyopes ii)Peucetia
08	Pholcidae	i)Artema ii)Crossopriza iii)Pholcus
09	Pisauridae	i)Pisaura ii)Nilus iii)Thalassius iv)Dolomedes v)Perenethis
10	Tetragnathidae	i)Leucauge ii)Opadometa iii)Tetragnatha
11	Gnaphosidae	i)Gnaphosa ii) Scotophaesis iii) Poecilochroa iv)Scopoides v)Zelotes
12	Eresidae	i)Stegodyphus
13	Corinnidae	i)Castianeira
14	Hersiliidae	i)Hersilia
15	Philodromidae	i)Philodromus ii)Tibellus iii)Tibilus
16	Ctenidae	i)Ctenus
17	Dipluridae	i)Diplura
18	Linyphiidae	i)Neriene
19	Euticharidae	i)Chieracanthium
20	Sicariidae	i)Loxosceles
21	Ulboridae	i)Uloborus Zosis
22	Zodariidae	i)Mallinella ii)Zodarion
23	Miturgidae	i)Cheiracanthium
24	Scytodidae	i)Scytodes
25	Clubionidae	i)Clubiona
26	Theraphosidae	ii)Unknown
27	Nephilidae	iii)Nephila
Total	27	101

Found species of spiders in study area -

- o *Araneus mitificus* , *Stegodyphus sarasinorum* , *Hyllus semicupreus*
- o *Argiope aemula* , *Argiope anasuja* , *Castianeira zetes*
- o *Cyclosa confrag* , *Neoscona bengalensis* , *Scytodes fusca*

Cotes, 2018; Tabasum, 2018 and Ndava, 2018). Spiders silk is used to explore evolution, biomaterial engineering, to check physical properties of protein fibres (Hinman, 2000; Heim, 2009; Mammola, 2017). Spiders are very careful about habitat changes. Their occurrence depends on the microclimatic characters, vegetation of biotic and abiotic factors. Their diversity is going to decrease due to habitat destruction, anthropogenic activities, environmental changes, cannibalism, territoriality, natural calamities hence they are on the verge of extinction, (Pinkus, 2006; Cardoso, 2010; Lee; Cardoso, 2017; Tabasum, 2018; Halarnkar, 2018). Taking into consideration the importance of spiders as biocontrol agents, bioindicators of ecosystem and therapeutic potential of Venom and economic importance of silk produced by them, it is a matter of concern to protect the diversity of spiders found in such area of varied biodiversity and pave the way to explore their pharmaceutical potential. The species level spider list used here is taken from literature, based

on i) modern literature ii) new species records with genitalia dissection and morphological, behavioural characters. All the valid Genus and species are summarised. The record of spiders of Satara, Sangli, Kolhapur has not yet been listed before so it was short of references. Total 27 families representing 101 genera belonging to 178 species have been recorded by authors in a diversity of papers. Some new species of spiders have been also recorded from Satara district. These families are present in every habitat. Infra-order Araneomorphae shows its dominance over Mygalomorphae. They show different types of web pattern. New species are recorded according to morphological and reproductive characters also the notes of its life stages, keys of identification, and their behavior were studied. The organisms morphology, habit, habitat, its life cycle study is crucial for its study and identification. More, (2010) recorded dominant families are Oxyopidae, Thomisidae, Araneidae, and Salticidae from the Radhanagari wildlife sanctuary, Chandoli national park, Koyana wildlife sanctuary.

Bendre, investigated total 11 species belonging to 6 families. Kulkarni, (2011) studied Ecology and behaviour of *Argiope* species during September to November 2010. Kulkarni, (2011) recorded new species of spider belonging to Family, Oxyopidae - *Oxyopes sataricus*. Kulkarni, (2012) recorded the spider *Arachnura angora* from Maharashtra. Kulkarni, (2012) recorded new flower spider

Figure 3. Spider anatomy and some families of order Araneae

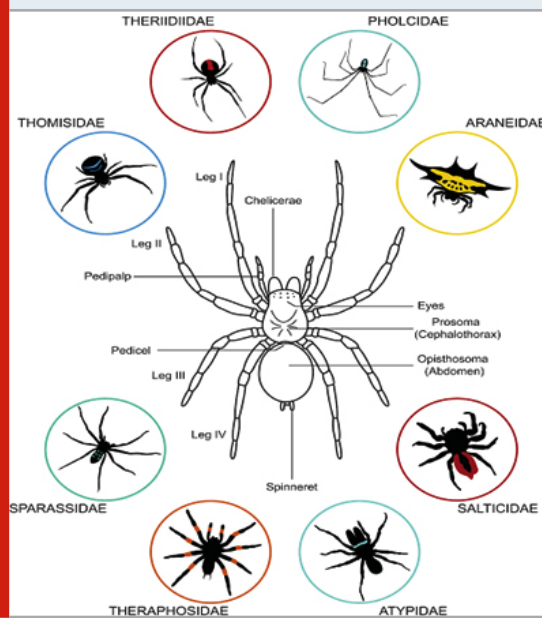


Figure 4. Comparison of species wise diversity of spiders of year 2012 (Keswani) from India with three districts of Maharashtra till 2019

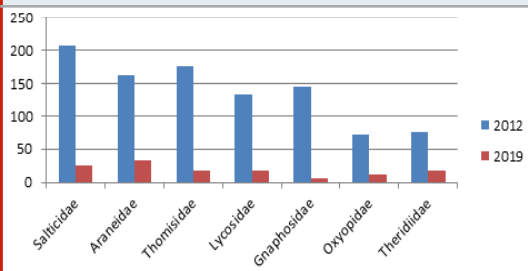


Table 2. Diversity of Spiders in Maharashtra from some areas-

Areas in Maharashtra	Study Year	Family	Genus	Species
Buldhana, Wasankar, (2016).	2014-2015	17	25	37
Nagpur, Gajbe, (2016).	2014-2015	13	19	21
Satpura Ranges, Deshmukh, (2014), Maheshwari, (2018).	2012-2013	18	-	104
Amravati, Deshmukh, (2018).	2014-2015	15	-	71
Vidarbha (Cotton fields and orange fields respectively), Deshmukh, (2017).	2017-2018	1	8	31
Chandrapur, Pawan, Gajbe, (2016).	2011-2012	7	29	70
Akola, Shirbhate, (2017).		13	32	64
	2012	9	12	13
	2015-2016	1	11	26

Thomisus sikkimensis with note on its courtship behaviour. Karanjkar in his minor project recorded 20 Families representing 40 Genus and 90 species from Satara Tehsil. Mirza, (2012) recorded a new species of the Mygalomorphae spiders belonging to family Idiopidae (trapdoor spiders). More, (2013) recorded 24 families representing 150 species of 78 Genera from Bamnoli region of Koyana wildlife Sanctuary during the study year 2011- 2013. Kulkarni, (2013) recorded 63 Genus of 25 Families and have given Generic checklist which showing Araneidae as a dominant family. Kulkarni, (2014) recorded new species *Tylorida satarensis*, with addition of field observations of that species. Kulkarni, (2015) described habit and conservation status of male *Tylorida satarensis*.

Kulkarni, (2015) recorded Genus *Siler Simon, 1889*. More (2015) recorded 90 species belonging to 54 genus from Zolambi region of Chandoli National Park. More (2015) recorded 18 families representing 61 species from Vakoba Devrai region of Radhanagari Wildlife Sanctuary. More (2015) investigated 16 families representing 58 species belonging to 38 genus from Rundiv, Sidheshwar and Ramnadi area of Chandoli national park. Lanka, (2015), investigated 18 families during year 2011-2013 and in that most dominant families are Araneidae representing 16 species and Salticidae representing 10 species. More (2016) recorded 18 families representing 70 species belonging to 48 genus from Dandoba hill forest. Lanka (2017), recorded 106 species belonging to 78 genus of 24 families from Radhanagari wildlife sanctuary. Kulkarni, (2017)

reported a new species of spiny spider *Meotipa sahyadri* belonging to family Theridiidae. Also he have given the phylogenetic analysis of that spider and relationships between *Meotipa* with *Chryso. Sarwade*, (April 2017) studied diversity and seasonal variation of spiders from Mhaishal lake and Brahmanath lake Khanderajuri, from Miraj Tehsil of Sangli. Depending on the habitat, climatic conditions, altitude and latitude diversity of spiders also changes. As they are shy creatures, hide from others. These primitive spiders are on the way of extinction and rarely found. They must be documented as they are less examined by the peoples.

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