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Spider Diversity in Kavvayi River Basin, Kerala, Southern India

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Abstract

Kavvayi river basin is a typical lateritic biotope situated in the Northern part of Kerala, which holds various ecological units such as lateritic vegetation, agro-ecosystems, seasonal pools, Grass lands, Kanams, Sacred groves, Mangrove-marsh and riparian vegetation. Many of these microhabitats are unique in character and poorly documented. A preliminary study was conducted to document the diversity of spider fauna inhabiting in the different ecosystems of Kavvayi river basins.India is having 1,686 species of spiders belonging to 60 families and 438 genera, which constitutes 3.6% of world's spider population. The present study resulted in the documentation of 112 species of spiders belonging to 81 genera and 21 families. Araneidae was the most dominant family which constitutes 21.5% of the total spider species collected. The second dominant family was Salticidae which constitutes 19.5% of total spider population. Guild structure analysis of the collected spiders revealed seven feeding guilds, namely stalkers, orb web builders, ambushers, foliage runners, space web builders, ground runners and wandering sheet weavers. The spider fauna of this ecosystem is qualitatively rich due to varied microhabitats, which supports high floral and faunal diversity. The present study suggests a detailed investigation at ecosystem level to understand the role of spiders in ecosystem function.

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Introduction

As one of the most widely recognized group of arthropods, spiders make up a diverse portion of the world's invertebrates[1]. They are distributed on every continent except Antarctica and have adapted to all known ecological environments except air and open sea[2]. Spiders globally include about 47,099 described species in 4,073 genera and 113 families[3]. They are unique among all organisms in their modes of silk production and usage and of reproduction.

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Spiders are clearly an integral part of the global biodiversity since they play an important role in ecosystems as predators and source of food for other creatures[4]. They primarily feed on insects, but also eat other arthropods, including other Araneae. They are suitable biological indicators of ecosystem changes and habitat modifications due to their small body size, short generation time, and high sensitivity to temperature and moisture changes[5].

Spiders form one of the most diverse groups of organisms existing in India. Previous conservation efforts in India have focused on the larger vertebrates while invertebrates were largely ignored. There is now a growing need to conserve all species and not only the larger vertebrates[6]. Documentation of spider fauna is more important because they play a significant role in the regulation of insects and other invertebrate populations in most ecosystems. A comprehensive data on diversity and distribution of spiders from Kerala region is sparse as compared to other regions of the country. India is having 1,686 species of spiders belonging to 60 families and 438 genera, which constitutes 3.6% of world's spider population[7]. Very little work has been done on spider diversity of Kerala[8,9,10]. Joseph *et al.,*[11]reported 20 species of spiders from Periyar Tiger Reserve. Patel B.H.[12] described 91 species of spiders from Parambikulam tiger reserve. Sudhikumar *et al.,*[13] reported 75 species of spiders from Mannavan shola forest areas and Sunil *et al.,*[14] reported 147 species of spiders from Parambikulam tiger reserve. Most recently Sudhikumar[15] listed 210 species of spiders from Nelliyampathy hill ranges of Western Ghats. This is higher than the number recorded from any other regions surveyed in Kerala. The present study is carried out in Kavvayi River Basin, which is in Northern Kerala. This region is abundantly blessed with rich flora and fauna. The only reported study from this area on spiders was Palot and Balakrishnan[16] in which they reported 17 species from Madayipara, a lateritic hill of Northern Kerala. The aim of this study was to compile the first checklist of spiders of the Kavvayi river basin and to determine the percentage of species protected.

Materials and Methods

Study Area

We conducted our study in the Kavvayi river basin, located between 12^0 05' to 12^0 15' North latitude and 75^0 05' to 75^0 20' East longitude. It spread over an area of 164.76 km^2 spreads over nine local administrative bodies in the districts of Kannur and Kasaragode. The Kavvayi River emerges from the Cheemeni laterite hills at an elevation of 119 m above MSL having a length of 31 Km and directly flows into the Kavvayi backwater. The river basin is topographically complex, biodiversity-rich, fragmented and densely populated cultural landscape. Even though the Kavvayi River is prominent among the 14 rivers originating in midland in Kerala there is no reserved forest patch in the river basin. According to land use or land cover pattern, the study area has major subdivisions such as Lateritic exposed area, Sacred Groves, Kaanams, Plantations and Agro-ecosystems, Mangrove or marsh (Figure-i).

Sampling

The study has been carried out during the month of January to December 2014 in the Kavvayi river basin of Kerala. Two surveys were conducted per month at selected areas of the river basin. Spider collection was done during the morning (7.00 am to 11.00 am) and evening (16.00 pm to 18.00 pm) time to maximize the species richness. An all out search method was used for spider collection and the collection was conducted mainly by handpicking and beating methods. Pitfall sampling was also employed for spider collection. Spider microhabitats like fallen logs and leaf litters were thoroughly checked for ground-dwelling spiders while leaves of trees and visible webs were searched for arboreal spiders. Smaller spiders were collected by leading them into tubes containing alcohol with the help of brush dipped in alcohol. Most of the spiders were photographed in the field itself with the help of SLR Camera Canon EOS 5D Mark-III. Identification was done at the Centre for Animal Taxonomy and Ecology (CATE), Dept. of Zoology, Christ College, Irinjalakuda. The specimens were preserved in 70% alcohols with proper labeling of locality, date of collection and other notes of importance. The mature specimens were identified up to the species level with the help of stereo zoom microscope (Magnus MSZ TR) and also with available literature[17,18,19,20,21].

Results and Discussion

A total of 112 species of spiders belonging to 81 genera and 21 families were collected(Table 1) during

the study period. The genera such as Oxyopes and Neoscona show high species diversity. Out of the 438 genera reported from Indian region[7], 81 genera were collected from Kavvayi River Basin. Maximum generic diversity was found in families including Salticidae (18), Araneidae(14), Theridiidae(9) and Thomisidae(8). Out of the 60 families recorded from the Indian region, 21 families were collected from Kavvayi river basins. This represents 35% of the total families reported from India. Araneidae was the most dominant family corresponding 24 species from 14 genera constituting 21.5% of total spider population. The second dominant family was Salticidae with 22 species from 18 genera constituting 19.5% of the total population. The relative species abundance of various families recorded during the study can be represented as Salticidae>Theridiidae >Thomisidae Tetragnathidae>Oxyopidae>Lycosidae =Uloboridae>Pholcidae=Sparassidae=Pisauridae> Ctenidae=Gnaphosidae= Linyphiidae=Eutichuridae =Scytodidae>Corinnidae=Eresidae=Hersilidae =Philodromidae=Theraphosidae (Figure-ii).. The spiders collected from the study area can be divided into seven functional groups or guilds based on the classification system proposed by Uetz *et al.,*[22]. Orb weavers was the dominant feeding guild with 32% of the total population, which was followed by stalkers with 28%, ambushers with 12%, space web builders with 12%, ground runners with 7% , foliage runners with 6%, wandering sheet weavers with 2% and sheet web weavers with 1% (Figure-iii).

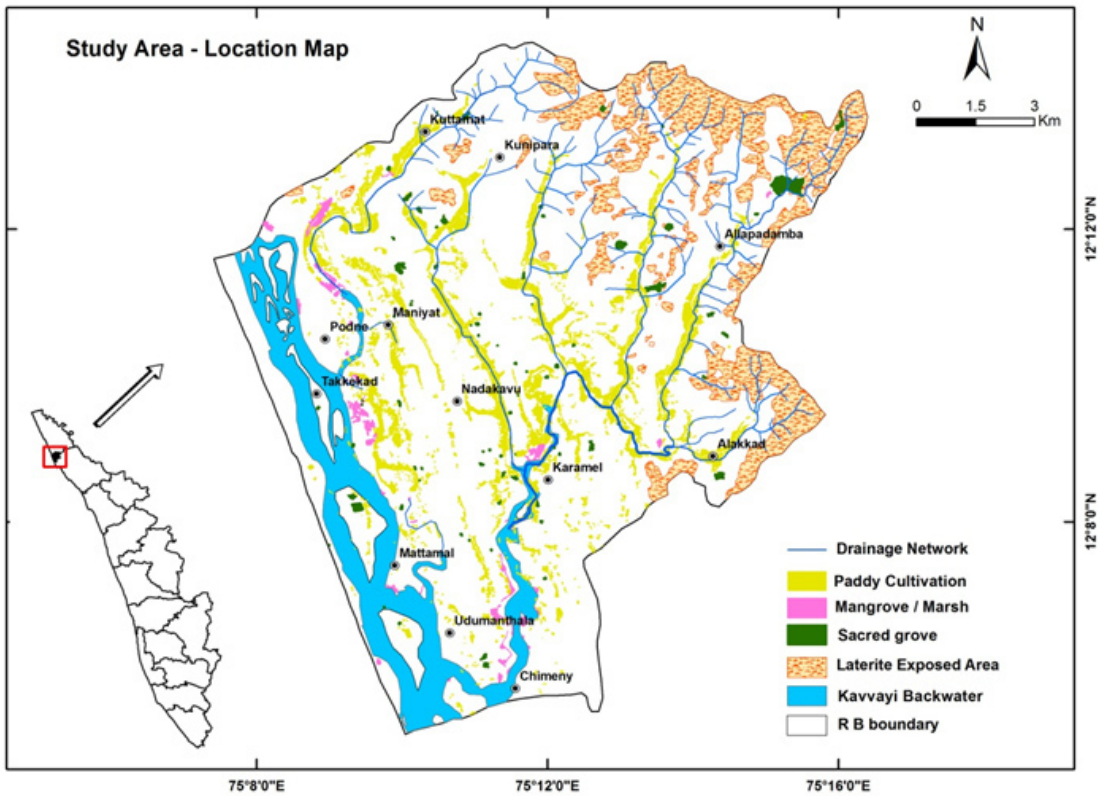

Fig. i: Location map of Kavvayi river basin showing critical land cover

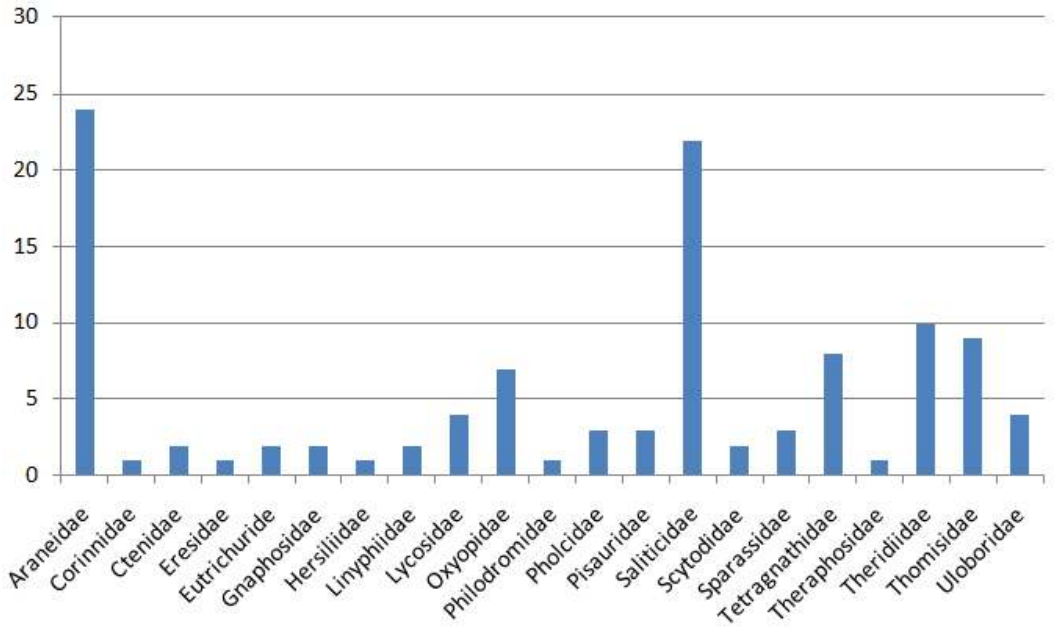

Fig.ii: Species diversity in different families found in Kavvayi river basin

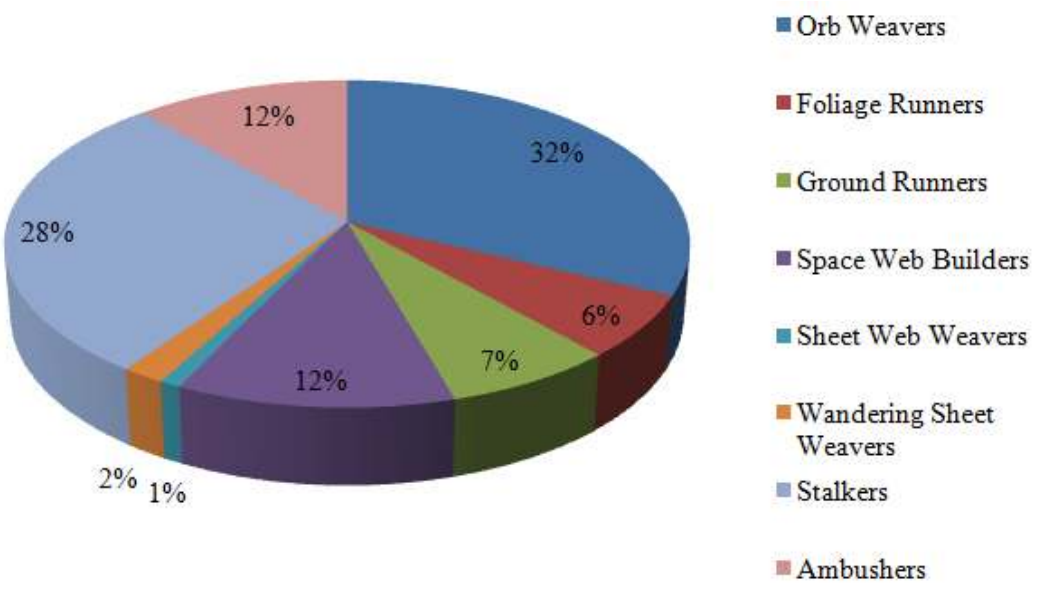

Fig. iii: Guild structure analysis of spiders collected from Kavvayi river basin

Table 1: Checklist of spiders identified in Kavvayi river basin, North Kerala

Sl No.	Species Name	Guild
	Family: Araneidae	
1	*Arachnuraangura*Tikader, 1970	Orb weavers
2	*Araneusmitificus*,Simon, 1886	Orb weavers
3	*Argiopeaemula*,Walckenaer, 1842 (Image 1)	Orb weavers
4	*Argiopeanasuja*Thorell, 1887	Orb weavers
5	*Argiopepulchella*Thorell, 1881	Orb weavers
6	*Cyclosahexatuberculata*Tikader, 1982	Orb weavers
7	*Cyclosa bifida*Doleschall 1859	Orb weavers
8	*cyclosa sp.*1	Orb weavers
9	*Cyrtarachnekeralensis*Jose, 2011	Orb weavers
10	*Cyrtophoracitricola*,Forskal, 1775 (Image 2)	Orb weavers
11	*Eriovixiaexcelsa*,Simon, 1889 (Image 3)	Orb weavers
12	*Eriovixialaglaizei,*Simon, 1877	Orb weavers
13	*Gasteracanthageminata*,Fabricius, 1798	Orb weavers
14	*Geasubarmata*,Thorell, 1890	Orb weavers
15	*Nephilapilipes*,Fabricius, 1793 (Image 6)	Orb weavers
16	*Nephilengysmalabarensis*Walckenaer, 1841	Orb weavers
17	*Neosconabengalensis*,Tikader & Bal, 1981	Orb weavers
18	*Neosconamukerjei* Tikader, 1980	Orb weavers
19	*Neosconanautica*C.L. Koch, 1875	Orb weavers
20	*Neosconavigilans*,Blackwall, 1865	Orb weavers
21	*Neoscona sp.*	Orb weavers
22	*Parawixiadehaani*,Doleschall, 1859 (Image 4)	Orb weavers
23	*Poltyssp* 1	Orb weavers
24	*Poltyssp* 2	Orb weavers
	Family: Corinnidae	
25	*Castianeirazetes*,Simon, 1897 (Image 5)	Foliage runners
	Family: Ctenidae	
26	*Ctenuscochinensis*,Gravely, 1931	Ground runners
27	*Ctenus sp.*	Ground runners
	Family: Eresidae	
28	*Stegodyphussarasinorum*Karsch, 1892	Sheet web weavers
	Family: Eutrichuride	
29	*Cheiracanthiumdanieli*Tikader, 1975	Foliage runners
30	*Cheiracanthiummelanostomum*Thorell, 1895	Foliage runners
	Family: Gnaphosidae	
31	*Scotophaeus* sp.1	Ground runners
32	*Scotophaeus* sp.2	Ground runners
	Family: Hersiliidae	
33	*Hersiliasavignyi,*Lucas, 1836	Foliage runners
	Family: Linyphiidae	
34	*Atypena* sp_1	Wandering sheet weavers
35	*Nerienesundaica*Simon, 1905	Wandering sheet weavers
	Family: Lycosidae	
36	*Hippasaagelenoides*Simon, 1884	Ground runners
37	*Lycosamackenziei*Gravely, 1925	Ground runners

38	*Pardosapseudoannulata*,Bosenberg&Strand,1906	Ground runners
39	*pardosasumatrana*Thorell 1890	Ground runners
	Family: Oxyopidae	
40	*Oxyopesbirmanicus*,Thorell, 1887	Stalkers
41	*Oxyopesjavanus*Thorell, 1887 (Image 7)	Stalkers
42	*Oxyopeslineatipes*C. L. Koch, 1847	Stalkers
43	*Oxyopesshweta*,Tikader, 1970 (Image 8)	Stalkers
44	*Oxyopessunandae*,Tikader, 1970	Stalkers
45	*Oxyopessp.*	Stalkers
46	*Hamadruasinsulana*,Thorell 1891	Stalkers
	Family: Philodromidae	
47	*Tibellus elongates*,Tikader, 1960	Ambushers
	Family: Pholcidae	
48	*Artemaatlanta,*Walckenaer, 1837	Space web builders
49	*Crossoprizalyoni*Blackwall 1867	Space web builders
50	*Pholcusphalangioides*Fuesslin 1775	Space web builders
	Family: Pisauridae	
51	*Dendrolycosagitae*Tikader, 1970 (Image 9)	Ambushers
52	*Perenethisvenusta*L. Koch, 1878 (Image 10)	Ambushers
53	*Nilusalbocinctus*Doleschall, 1859 (Image 11)	Ambushers
	Family: Saliticidae	
54	*Asemoneatenuipes*O.P.Cambridge, 1869	Stalkers
55	*Baviainsularis*Malamel Sankaran& amp; Sebastian, 2015	Stalkers
56	*Brettusalbolimbatus*Simon, 1900	Stalkers
57	*Carrhotusviduus*,C.L. Koch, 1846	Stalkers
58	*Chalcotropispennatus*Simon 1902	Stalkers
59	*Epeusindicus,*Proszynski, 1992	Stalkers
60	*Epeustener*,Simon 1877	Stalkers
61	*Epocillaaurantiaca*,Simon, 1885	Stalkers
62	*Hasariusadansoni*,Audouin, 1826	Stalkers
63	*Hyllussemicupreus,*Simon, 1885 (Image 12)	Stalkers
64	*Rheneflavigera*C.L. Koch 1846	Stalkers
65	*Menemerusbivittatus*,Dufour, 1831	Stalkers
66	*Myrmarachnekochi*Reimoser, 1925	Stalkers
67	*Myrmarachneorientales*Tikader, 1973	Stalkers
68	*Myrmarachneplataleoides*O. P.Cambridge, 1869 (Image 13)	Stalkers
69	*Phintellavittata*,C.L. Koch, 1846 (Image 14)	Stalkers
70	*Plexippuspaykulli*,Audouin, 1826 (Image 15)	Stalkers
71	*Plexippuspetersi*Karsch, 1878 (Image 16)	Stalkers
72	*Portiafimbriata*,Doleschall, 1859	Stalkers
73	*Siler semiglaucus*Simon, 1901	Stalkers
74	*Telamoniadimidiata*,Simon, 1899	Stalkers
75	*Thianiabhamoensis,* Thorell,1887 (Image 17)	Stalkers
	Family: Scytodidae	
76	*Scytodespallida*Doleschall, 1859	Stalkers
77	*Scytodesthoracica*Latreille, 1802	Stalkers
	Family: Sparassidae	
78	*Heteropodavenatoria*,Linnaeus, 1767	Foliage runners
79	*Oliosmilleti*Pocock, 1901 (Image 18)	Foliage runners

80	*Thelcticopis*sp.	Foliage runners
	Family: Tetragnathidae	
81	*Leucaugedecorata,*Blackwall, 1864	Orb weavers
82	*Leucaugepondae*,Tikader, 1970	Orb weavers
83	*Opadometafastigata*Simon 1877	Orb weavers
84	*Tetragnathamaxillosa*Thorell, 1895	Orb weavers
85	*Tetragnathamandibulata*Walckenaer, 1841	Orb weavers
86	*Tetragnathaviridorufa*Gravely, 1921	Orb weavers
87	*Tetragnathajavana*Thorell 1890	Orb weavers
88	*Tyloridastriata*Thorell, 1877	Orb weavers
	Family: Theraphosidae	
89	*Chilobrachyshardwicki,*Pocock, 1895	Stalkers
	Family: Theridiidae	
90	*Achaearaneadurgae*Tikadar 1970	Space web builders
91	*Argyrodesflavescens*,Cambridge, 1880	Space web builders
92	*Argyrodesflavescens*O.P. Cambridge 1869	Space web builders
93	*Chikunianigra*O. Pickard-Cambridge,1880	Space web builders
94	*Meotipapictuarata*,Simon, 1895	Space web builders
95	*Nihonhimeamundula*L. Koch,1872 (Image19)	Space web builders
96	*Ariamnes flagellum*Doleschall, 1857	Space web builders
97	*Chryssoangula*Tikader, 1970	Space web builders
98	*Theridionmanjithar*Tikader, 1970	Space web builders
99	*Phycosoma*sp.	Space web builders
	Family: Thomisidae	
100	*Amyciaeaforticeps*,O.P.Cambridge, 1873	Ambushers
101	*Camaricusfomosus*Thorell, 1887	Ambushers
102	*Indoxysticusminutus*Tikader, 1960	Ambushers
103	*Oxytatevirens*Thorell, 1891	Ambushers
104	*Runciniaaffinis*Simon, 1897	Ambushers
105	*Runciniaroonwali*Tikader, 1965 (Image 20)	Ambushers
106	*Strigoplusnetravati*Tikader, 1963	Ambushers
107	*Thomisuslobosus*Tikader 1965 (Image 21)	Ambushers
108	*Thomisusprojectus*Tikader, 1960	Ambushers
	Uloboridae	
109	*Miagrammopesextensus*Simon, 1889	Orb weavers
110	*Uloborusdanolius*Tikader, 1969	Orb weavers
111	*Uloboruskrishnae*Tikader, 1970	Orb weavers
112	*Zosisgeniculata*Olivier, 1789	Orb weavers

The spider fauna of the entire regions of Kavvayi river basin has never been documented or summarized. The only reported study from this area on spiders was carried out by Palot and Balakrishnan[16], who listed 17 species of spiders from Madayipara, a typical lateritic biotope of Kavvayi river basin. The present study covers the entire ecosystems of Kavvayi river basin and it resulted in the documentation 112 species of spiders. The study emphasizes that the spider fauna of Kavvayi river basin is qualitatively rich. This area holds a wide range of unique habitats and these varied habitats provide a greater array of microhabitats, microclimatic features, alternative food sources, retreat sites and web attachment sites. The rich floral and faunal diversity is the key to building microhabitats for a variety of spiders. All of which probably favors the colonization and establishment of a high number of spider species in the study area. Many other studies also have demonstrated a correlation existed between the structural complexity

of habitat and species diversity[23]. In 1991, Uetz[24] reported that structurally more complex shrub can support a more diverse spider community.

At present, the study area is facing unprecedented levels of fragmentation. The changes in land use pattern led to over exploitation of ecologically important land classes like Laterite exposed area, mangrove – marsh lands, paddy cultivation, eco-groves, etc.., without considering its importance. Due to the scarcity of woody species or forest cover the lateritic exposed regions in the study area appear devoid of vegetation in remote sensing images and often considered as 'wastelands' that's why miners easily get the permission from the authorities for mining and reclamation of the area but, in reality, these landscape units having high biodiversity value and ecological significance. At present only a small portion of the lateritic exposed area remains undisturbed. There is no reserve or protected forest in the study area that's why no parts of the river basin other than some sacred groves got authorized protection, sacred groves got cultural or religious protection from the local people. Considering their ecological importance there is an urgent need to conserve the critical ecosystems in the river basin. Our study provides baseline information of spiders inhabiting in this ecosystem. The habitat destruction is at its peak, this type of valuable scientific information would help to create proper conservation and management strategies of this landscape

Image : 01. ***Argiopeaemula***

Image:02. ***Cyrtophoracicatrosa***

Image: 03.*Eriovixia exelsa*

Image: 04.*Parawixia dehaani*

Image: 05.*Castianeira zetes*

Image:06. *Nephilapilipes*

Image: 07. *Oxyopesjavanus*

Image:08. *Oxyopesshweta*

Image:09.*Dendrolycosa gitae*

Image:10.*Perenthis vennsta*

Image: 11. *Nilusalbocinctus*

Image:12.*Hyllus semicupreus*

Image:13. *Myrmarachne plataleoides*

Image:14.*Phintella vittata*

Image: 15. *Plexippus paykkulli*

Image: 16. *Plexippus petersi*

Image:17. *Thiania bhamoensis*

Image: 18. *Oliosmilleti*

Image:19. *Nihonhimeamundula*

Image:20. *Runcinia sp.*

Image: 21.*Thomisus lobosus*

Conclusion

This was the first attempt to document spider diversity in a lateritic biotope of Southern India. The diversity both at ecosystem and microhabitat level supports large number spiders in the Kavvayi river basin. Since the study area is a human dominated landscape, they are facing threats like habitat loss, laterite mining, pollution and changes in land use pattern. Appropriate conservation strategies should be developed and implemented to conserve the faunal and floral diversity in the lateritic biotope of the region.

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