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Seasonal Variation and Regional Distribution of Spider Families Across Akole, Parner and Sangamner

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ABSTRACT

Spiders play a crucial role in terrestrial ecosystems, particularly in regulating pest populations. This study investigates how weather parameters-temperature, relative humidity, and rainfall-affect spider diversity in the agricultural landscapes of western Ahmednagar district, Maharashtra. We found that Araneidae (orb-weaving spiders) are positively correlated with humidity and rainfall, especially during the rainy season, while Lycosidae and Salticidae, as active hunters, show stronger correlations with temperature and sunshine hours, indicating their resilience to changes in humidity and rainfall. These findings align with existing research on spider ecology and highlight the significant role of microclimatic factors in shaping web architecture, species behavior, and spider abundance in agro-ecosystems. Seasonal distribution patterns across the locations of Akole, Parner and Sangamner were found to be strongly influenced by local weather conditions. Akole, with its higher humidity and rainfall, supports a diverse range of spiders, including web-builders like Araneidae and hunting spiders like Lycosidae during the winter. Parner with warmer, drier conditions, favors hunting spiders, such as Lycosidae and Salticidae, while Sangamner shares similar trends but supports some web-builders during the rainy season due to slightly higher moisture levels. Overall, Akole's humid environment supports greater spider diversity, while Parner and Sangamner favor active hunters, reflecting the strong influence of local climate on spider diversity and ecosystem dynamics. Future studies should further explore the impact of climate change on spider populations and their role in ecosystem services in agro-ecosystems.

1. Introduction

Spiders (Order Araneae) are among the most abundant predatory arthropods, occupying a wide variety of ecological niches and demonstrating remarkable diversity in morphology and behavior (World Spider Catalog, 2023). They play a crucial role in maintaining ecological balance through their predation on insect pests (Ambily & Antony, 2016). Web-building spiders, in

particular, influence trophic interactions and energy flow within ecosystems (Bhat et al., 2013).

Impact of weather parameters on spider diversity is a topic of significant interest in ecology, as environmental conditions directly influence various aspects of spider behavior, survival, and reproduction. Temperature plays a critical role in regulating spider activity, with most spiders being ectothermic and thus highly sensitive to thermal changes. Higher temperatures can increase activity and reproductive rates but can also lead to stress and limit survival under extreme heat (Robinson & Robinson, 1973). Conversely, low temperatures, particularly in temperate and cold climates, can cause dormancy or death, reducing species diversity during winter months (Kaston, 1978). Humidity is another essential factor, as spiders rely on moisture to prevent desiccation, with higher humidity generally supporting a greater diversity of species (Morse, 2014). In arid environments, low humidity can lead to decreased spider activity and biodiversity (Scharf & Schneider, 2013). Precipitation, particularly rainfall, affects spider habitats by influencing prey availability and microhabitat conditions; moderate rainfall can promote spider activity and increase food resources, while heavy rainfall may wash away webs and displace spider populations (May & Rypstra, 2000; Tinghitella & Zuk, 2014). Long-term climate changes, such as rising temperatures and changing precipitation patterns due to global climate change, are increasingly altering spider diversity and distribution, especially for species with specific habitat requirements (Elias & Kasumovic, 2015). Studies in both tropical and temperate regions indicate that spider communities respond dynamically to these weather factors, with some species thriving under specific conditions while others decline due to unfavorable weather extremes (Vinson & Denny, 2004; Waldock & McKinney, 1997). Consequently, weather parameters not only shape local spider diversity but also drive broader ecological patterns of adaptation and community structure across different ecosystems (Scharf & Schneider, 2013; Schmidt & Moore, 2008). The present study, aims to Seasonal distribution patterns across the locations of Akole, Parner and Sangamner were found to be strongly influenced by local weather conditions.

2. Materials and Methods

2.1 Study Area

The study focuses on seasonal collection of spiders from agro-ecosystem sites in Akole, Sangamner and Parner representing western Ahmednagar district, Maharashtra. These areas experience a tropical semi-arid climate with distinct seasonal variations: winter (December–February), summer (April–June), and monsoon (August–October).

2.2 Method of Collection

Standard collection techniques were employed based on recommendations from prior arachnological studies (Keswani & Vankhede, 2014). Spider collection was conducted in 2024-2025 in agro-ecosystems across various locations. A 50x50 meter quadrat was surveyed in-depth, with surveys held in the morning from 7:00 am to 9:00 am. The following methods were simulated in the dataset to represent realistic field protocols: (i) sweep netting on crop fields and grasslands; (ii) beating sheets for canopy-dwelling species; (iii) hand collection for ground-dwelling species; and (iv) litter sampling for cryptic taxa. For each observation, concurrent weather data temperature (°C), relative humidity (%), and rainfall (mm) were recorded. Orb-web occurrence was treated as a binary variable (presence/absence).

Preservation: After being photographed in their natural state, collected spiders were preserved in 70% ethyl alcohol.

Identification: Stereo zoom microscopes were used to view spiders in order to study keys for identification. The standard monographs, Majumder S.C. and Tikader B. K. (1991), were used to identify spiders up to the Family level.

4. Result and Discussion

The seasonal distribution of spider families in Akole, Parner and Sangamner is strongly influenced by local weather conditions, such as temperature, humidity, precipitation, and sunshine hours, which directly affect spider activity and distribution. During the summer, Parner and Sangamner recorded higher temperatures (36.33°C and 36.06°C, respectively) compared to Akole (33.33°C), with relative humidity being the lowest across all locations. The dry and hot conditions likely favored Lycosidae and Salticidae, active hunters less reliant on web-building, consistent with findings by Bultman & Riechert (1985) and Schmidt & Moore (2008), who noted that such spiders are more resilient to fluctuating weather. Akole, with relatively higher humidity (43%), supported some web-building

species like Araneidae, although their abundance was lower due to the drier conditions in Parner and Sangamner.

In the rainy season, Akole experienced the highest rainfall (236.67 mm) and humidity (71%), creating favorable conditions for Araneidae, which thrived in these moist conditions, supporting the findings of Sudhikumar et al. (2005) and Ambily & Antony (2016), who observed that high humidity enhances silk adhesion for effective web-building. In contrast, Parner and Sangamner, with lower rainfall and humidity, supported fewer web-builders. The reduced sunshine hours across all locations also created conditions conducive to web-building spiders, particularly in Akole, where humidity and rainfall peaked.

In winter, Akole recorded the lowest average low temperature (15°C) and sunshine hours (7.1 hrs/day), while Parner and Sangamner were warmer, with higher sunshine hours. These cooler and less sunny conditions likely favored Lycosidae, which thrives in colder temperatures and is less dependent on web-building, as noted by Bultman & Riechert (1985). The warmer temperatures and higher sunlight in Parner and Sangamner supported Lycosidae and Salticidae, which are more active in such conditions. Araneidae, which relies on warmer, humid conditions for web-building, was less abundant in the winter months.

The seasonal variation in spider family abundance in Akole, Parner and Sangamner is closely tied to local weather conditions, especially temperature, humidity, and rainfall. The warmer, drier conditions of the summer favored Lycosidae and Salticidae, while the wetter, more humid rainy season supported Araneidae. The cooler, less sunny winter conditions in Akole favored hunting spiders like Lycosidae, while in Parner and Sangamner, Lycosidae and Salticidae dominated due to their resilience in harsher conditions. These findings are consistent with previous studies (Morse, 2014; Scharf & Schneider, 2013) and demonstrate the complex relationship between weather and spider ecology, further supporting the use of spiders as bioindicators for environmental monitoring (Pande et al., 2019).

5. Conclusion

In conclusion, the seasonal distribution of spider families across Akole, Parner and Sangamner is shaped by local weather conditions. Akole, with its higher humidity and rainfall, supports a diverse range of spiders, particularly web-builders like Araneidae, and hunting spiders like Lycosidae in winter. Parner experiences warmer, drier conditions, favoring hunting spiders such as Lycosidae and Salticidae, with fewer web-builders like Araneidae. Sangamner, similar to Parner, also favors hunting spiders in summer and winter, but with slightly more moisture in the rainy season, allowing for some web-building species. Overall, Akole's humid conditions support more diverse spider populations, while Parner and Sangamner favor active hunters, reflecting the influence of local climate on spider diversity.

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Table 1: Seasonal and Locational Variations in Weather Parameters in Akole, Parner and Sangamner.

Sr.No.	Weather parameter	Season	Akole	Parner	Sangamner
1	Avg.High Temperature (°C)	Winter Summer Rainy	29.33 ± 1.53 33.33 ± 2.08 27.33 ± 1.53	29.13 ± 1.99 36.33± 3.42 29.23 ± 0.61	29.7 0 ± 2.04 36.06 ± 3.35 28.80 ± 1.05
2	Avg. Low Temperature (°C)	Winter Summer Rainy	15 ± 3.61 23..67 ± 0.58 21.33 ± 0.58	17.67 ± 1.77 25.63±0.96 21.83 ± 0.35	16.60 ± 1.22 24.17 ±0.29 21.57 ± 0.21
3	Relative Humidity (%)	Winter Summer Rainy	41.33 ± 1.15 43 ± 19.16 71 ± 9.64	36.33 ± 7.02 38.66 ± 20.82 70.33 ± 9.87	42.67 ± 2.31 38.67 ± 20.82 70.33 ± 9.87
4	Rainfall (mm / month)	Winter Summer Rainy	4.67 ± 2.08 91 120.93 236.67 ± 120.55	2 ±1 49.33 ± 74.20 104 ± 18.19	1.93 ± 0.93 39.47 ± 59.42 104.00 ± 18.20
5	Sunshine (hrs/day)	Winter Summer Rainy	7.1 ± 5.74 10.17 ± 1.04 8 ± 1	9.80± 1.48 10.53 ± 1.36 7.97 ± 1.11	10.13 ± 1.69 10.53 ± 1.36 7.83 ± 1.26

Figure 1: Effect of Seasonal Variation and Its Impact on Spider Family Distribution Across Ahmadnagar District, Maharashtra.

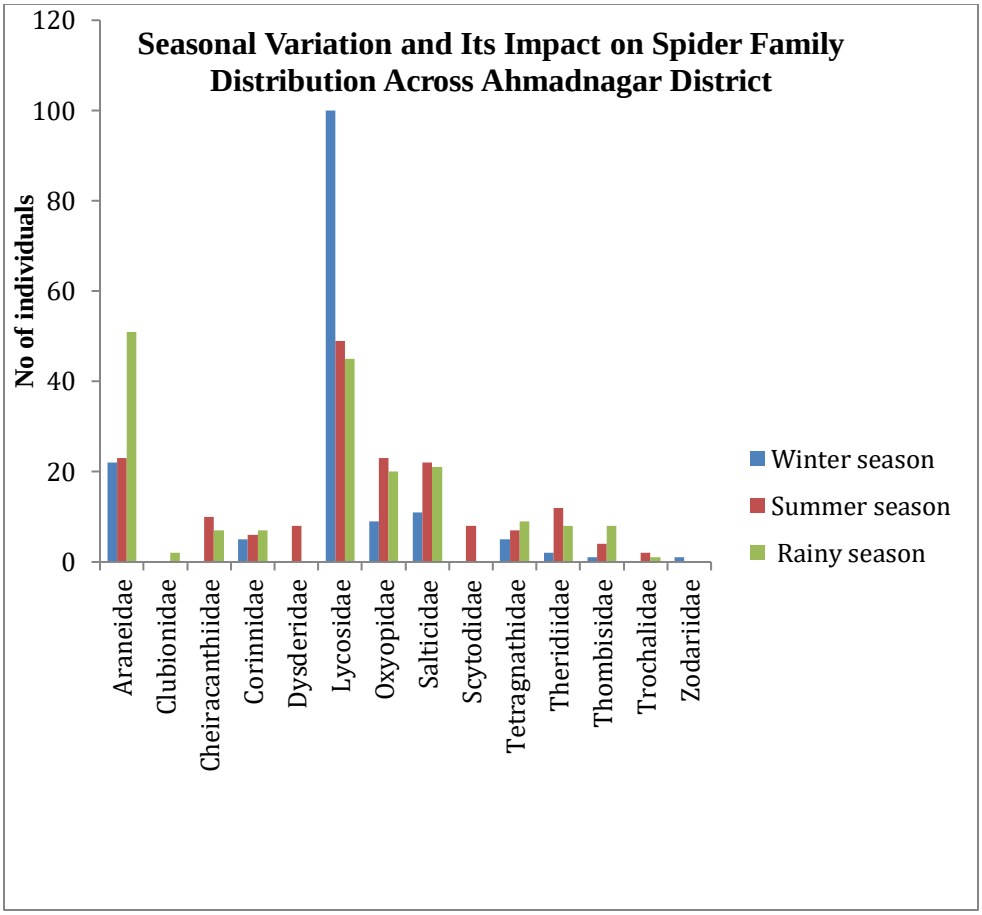

Figure 2: Spider Family Distribution Across Akole Parner and Sangamner tehsil of Ahmadnagar District, Maharashtra during winter season.

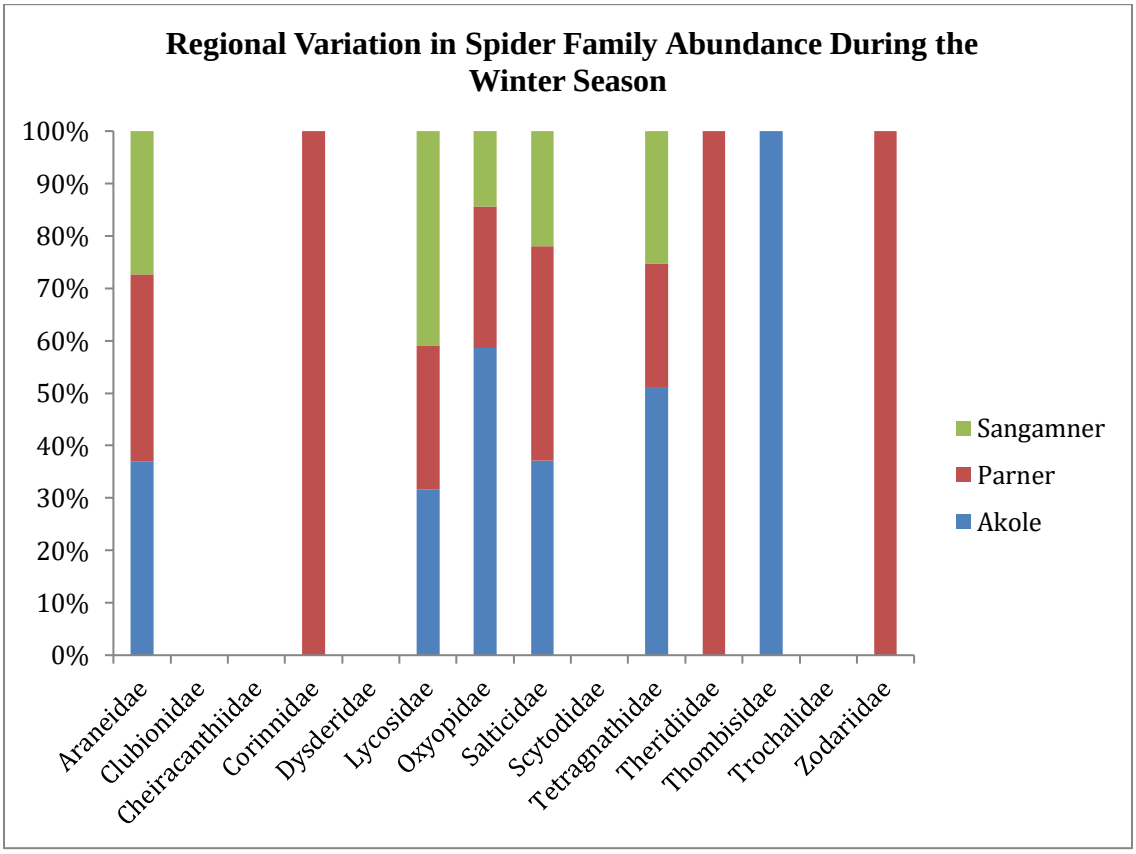

Figure 3: Spider Family Distribution Across Akole Parner and Sangamner tehsil of Ahmadnagar District, Maharashtra during summer season.

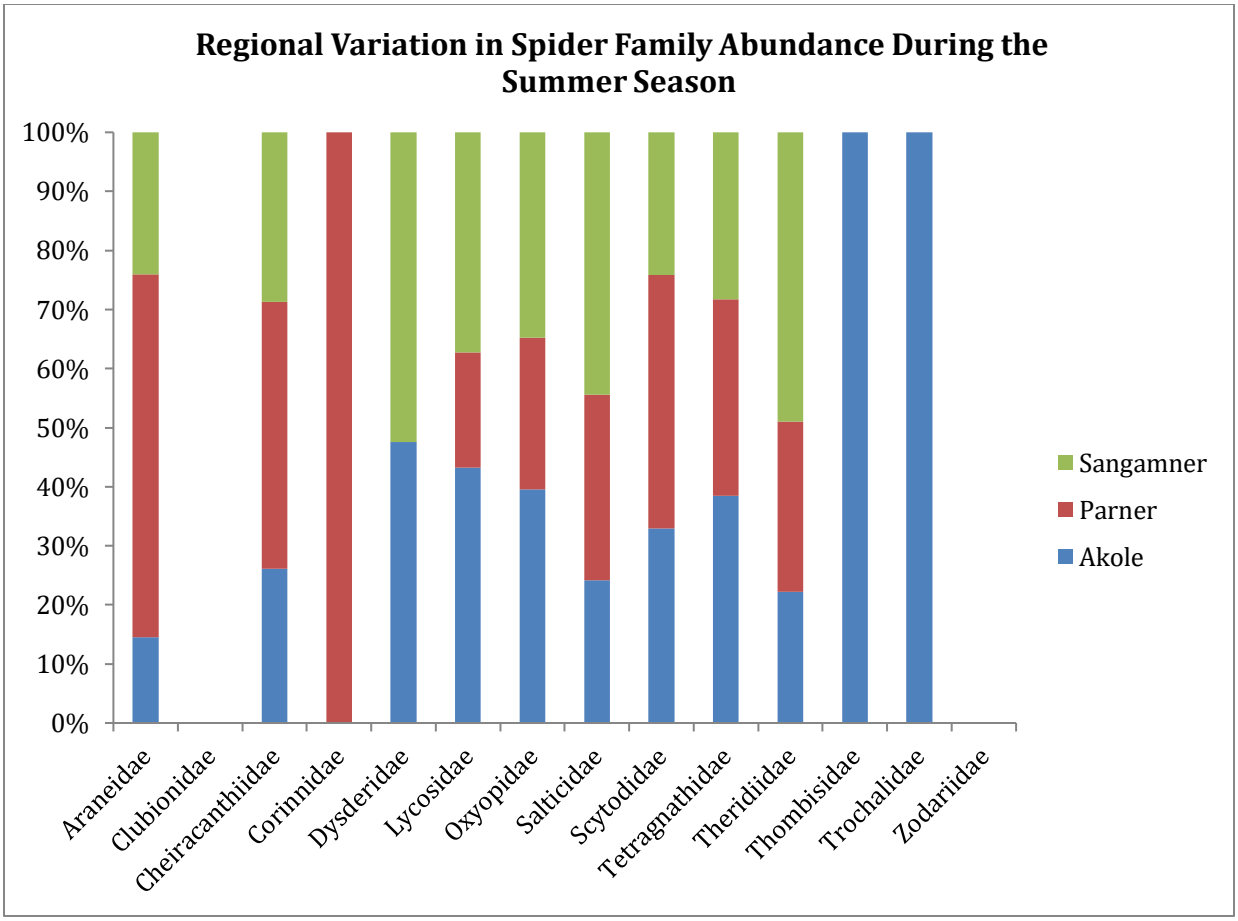

Figure 4: Spider Family Distribution Across Akole Parner and Sangamner tehsil of Ahmadnagar District, Maharashtra during rainy season.