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FAUNAL DIVERSITY AND RECENT TRENDS in ANIMAL TAXONOMY

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Chapter 14

EFFECT OF FRINGE VEGETATION ON THE DIVERSITY AND COMMUNITY STRUCTURE OF PADDY FIELD SPIDERS (ARACHNIDA: ARANEAE) OF MURIYAD KOL WETLANDS, KERALA

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ABSTRACT

Spiders are among the most common predators in the agricultural landscapes of rice paddy fields. High degrees of heterogeneity in the surrounding landscape have been demonstrated to have a positive effect on spider abundance and species richness on arable land. The present study was designed to evaluate the effects of fringe/surrounding vegetation on the diversity and community structure of spiders in the paddy field ecosystem. For this purpose, five plots of paddy fields, having varying degree of vegetation structure surrounding the plots, were selected in the Muriyad Kol wetlands, Thrissur. The mean abundance, richness and diversity of spiders among the plots were compared. The results suggested a significant difference in the mean abundance, richness and estimated Shannon diversity among the sites close to the edge and >25 m away from the edge of the paddy field. However, the community structure did not differ significantly among fields.

Key words: Arachnology, ecology, Ramsar site

INTRODUCTION

Spiders play a very important role in terrestrial ecosystems, both as a major predator and prey for a wide range of organisms. They are nature's master spinners of silken webs and highly proficient predators for, in their absence, the insect pest world would run amock, creating havoc in the entire balance of their ecosystems posing serious threat to human health and food resources. Spiders are extremely predatory arthropods and they have significant role in its habitat in controlling the insect populations. The agricultural landscape of irrigated rice fields and its surrounding environments have inherent high arthropod biodiversity prominently shown on arthropod food webs, of which, spiders are among the most common predators (Barrion & Litsinger, 1984 & 1995, Okuma et al. 1993). The importance of spiders in regulating rice insect pests has long been recognized and studied in India. The community and structure of vegetation also influence the community composition and diversity of the arthropod assemblages (Ysnel et al. 1996). The growth of weeds in the rice field proper and surrounding bunds adds another dimension to this ecosystem that is dominated by the monocrop (Edirisinghe & Bambaradeniya, 2006). The present study investigates the effect of fringe or surrounding vegetation on the abundance, diversity and community structure of spiders in the paddy fields of Muriyad Kol wetlands, which part of the Vembanad-Kol Ramsar site, Kerala, India.

METHODOLOGY

The present study was carried out in the selected paddy fields of Muriyad Kol wetlands, which is part of the South Kol wetlands of Kerala. Five paddy plots were selected for the study in the *Puncha* season (March - May 2016) and sampling was done between crop flowering and harvest. To study the effect of fringe or surrounding vegetation on the spider assemblages of the paddy fields, each plot was sampled at two areas: area 1 with <5 m and area 2 with >25 m from the edge of the field. Based on bordering vegetation, plots were categorised into: type A with thick vegetation and average tree height of > 10 m, and type B with tall grass and small shrubs. Quadrate method was followed for the study, by placing 2 m x 2 m quadrates at four positions within each area. Hand collection and sweep net methods were employed for collecting spiders from the paddy field and each collection lasted for 1 hour. The collected specimens were preserved in 70 % ethyl alcohol and abundance data from the four quadrats were pooled to form a sample. A total of 30 samples were obtained for the analysis.

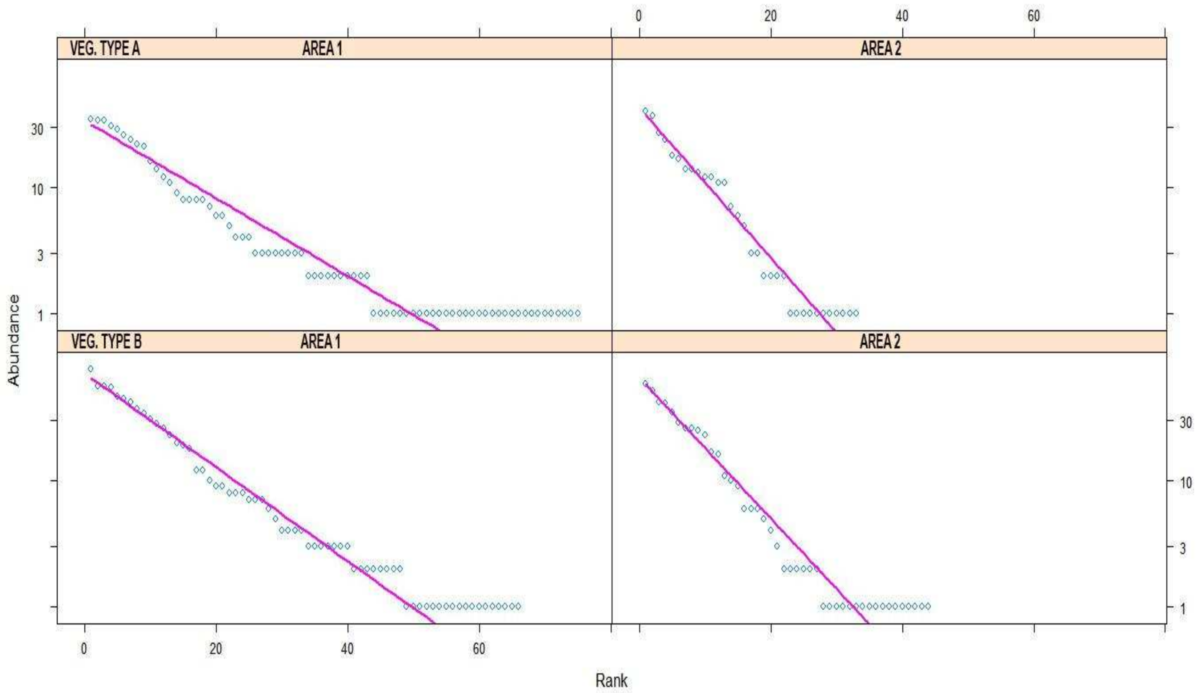
The diversity of the spider assemblages is described as Hill numbers or effective number of species or species equivalents. Hill numbers are a mathematically unified family of diversity that incorporate relative abundance and species richness and overcome many of the shortcomings of the commonly used diversity indices like Shannon entropy and Simpson index (Chao et al. 2014). It is possible to characterize the species diversity of an assemblage using the first three Hill numbers, where q = 0 is the species richness, q =1 is the exponential of Shannon's entropy (Shannon diversity), and q =2 is the inverse of Simpson's concentration index (Simpson index). The diversity indices, Shannon and Simpson, were converted into effective number of species (Jost 2006), which is the number of equally abundant species necessary to produce the observed value of diversity. Effective number of species may be called a good diversity measure, they possess a uniform set of mathematical properties that accurately capture the diversity concept and facilitate the interpretation of results (Jost 2006). Analysis was carried out using Vegan package 2.4-3 (Oksanen et al. 2018) in R version 3.4.3 (R Core Team, 2017). The differences in average abundance and Alpha diversity of spiders among the sites close to the edge and >25 m away from the edge of the paddy field (Richness and Shannon-Weiner) were tested using Welch independent sample t test. The SpadeR package version 0.1.1 (Species Prediction and Diversity Estimation, Chao et al. 2016) was used to estimate the species richness and Shannon diversities (Jacknife) of the sites. We also give the 95% confidence intervals to define the sampling variation, constructed using 300 bootstrap replications (Chao 1987; Chao et al. 2016).

RESULTS

A total of 2,027 individuals of 92 species were collected during the study, of which 1255 individuals were collected from sites near the edges of the paddy field bordering other vegetation and 772 individuals were collected from sites >25 m from the edges. The estimated species Richness

(Chao 1) from pooled samples from area 1 with type A and type B vegetation were 109.40 ± 16.06 (±SE) and 84 ±11.42 respectively. Whereas, area 2 had an estimated species richness of 43 ±7.74 and 79.55 ±8.26 in type A and type B samples respectively. The results of Welch two sample t test indicated significant difference in the average species Richness among the two areas in both type A and B plots. In vegetation type A, there was a significant difference in the average species richness for area 1 (M=31.66, SD= 5.60) and area 2 (17.83 ± 2.93) condition; t (7.5) = 5.355, p <.001. In vegetation type B, there was significant difference in the average species richness for area 1 (30.89 ±5.18) and area (18.44 ±2.78) conditions; t (12.27) = 6.343, p < .001. However, there was no significant difference in the average species richness among the vegetation types. The mean abundance of spiders varied significantly among the areas with area 1 recording 77 ± 10.78 and area 2 with 48.83 ±3.92 individuals (conditions; t(6.29)= 6.011, p < .001) and 88.11 ± 9.72 and 53.22 ±5.38 individuals (conditions; t(12.27)= 6.343, p < .001) in vegetation types A and B respectively. But there was no significant difference in the mean abundance of spiders among the samples from the two vegetation types. The average estimated Shannon diversity also showed significant difference for area 1 (33.45 ±7.55) and area 2 (18.78 ±4.008) in vegetation type A (conditions; t (6.29) = 6.011, p < .001), and 29.85 ±5.28 and 18.89 ±3.83 species in area 1 and 2 respectively with vegetation type B (condition; t (14.59) = 5.035, p < .001). The Species Abundance Distribution (SAD) curve did not show any significant change in the community structure as the dominant species in all the samples from the two areas remained the same (*Tetragnatha mandibulata* and *T. javana*). The pre-emption distribution model was fitted to the Species Abundance Distributions for the two areas.

Figure 1. Species Abundance Distribution (SAD) of spiders from the two areas of paddy fields with vegetation types A and B, fitted to pre-emption model



DISCUSSION

The study indicates the positive effects of fringe or surrounding vegetation on the abundance and diversity of paddy field spiders. The paddy fields close to tree cover recorded the highest estimated species Richness, since it had many rare species which are characteristic of the surrounding vegetation. The surrounding vegetation marked by grass and small shrubs also had significantly higher species richness estimates as compared to the areas away from the surrounding vegetation. The grass lands mostly harbour similar spider community as seen in the paddy fields and acts as a buffer or retreat for spiders that cannot tolerate exposure during periods of pesticide applications. Similar trend in abundance also prove the positive effects of maintaining vegetation in the fringes or bunds in paddy ecosystems. However, the type of vegetation surrounding the fields had no significant effect on the diversity and abundance of spiders in the paddy field. The presence of arthropod natural enemies can be enhanced by manipulation of weed communities through partial slashing of weed cover on the bunds. The non-rice habitats in the vicinity and periphery of rice fields sustain a reservoir of natural enemies during successive cultivation cycles and therefore command special attention (Edirisinghe & Bambaradeniya, 2006).

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