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TEMPORAL VARIAB1L1TIES IN A COMMUNITY OF SPIDERS INHABITING THE GROUND SURFACE OF A CITRUS ORCHARD

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The spiders inhabiting the ground surface of a citrus orchard were studied by using_fall traps for two years. A total of 912 specimens representing 29 species and eight families was collected. Nearly 86% of population was due to family *Lycosidae* alone. Three species *viz. Pardosa birmanica* (31.9%), *Pardosa oakleyi (20.5%)* and *Lycosa vulgaris* (2.8%) were the most dominant species which jointly constituted 74.2% of the total number of the spiders caught. The *diversity* index and species richness increased during the warmer months of the year while the *evenness* index *value* was low during these months.

Key words: *diversity* index, *evenness* index, Pakistan, Punjab, spider species richness

INTRODUCTION

Spiders reduce and regulate the size of insect populations in the agro-ecosystems through their predatory and other disruptive *activities* (Dippenaar-Schoeman, 1979; Mansour *et et., 1980,* 1981; Batra, 1982). They feed themselves almost exclusivetv , on insects and rarely show specificity towards their prey (Riechert and Lockely, 1984). In most of the spiders, consumption is not only limited to the adults but *larvae* and nymphs are preyed upon as well (Whitcomb *et al.,* 1963; Smith and Stadelbacher, 1978; Room, 1980). On account of these attributes spiders are rated as important biological agents for controlling insect pests in the orchards and farmlands. To know the spider fauna of the central Punjab, a study on the taxonomy and ecology of 'wandering spiders affecting the ground surface of some fruit orchards was carried out. During the course of this study a citrus orchard located in the Experimental Fruit Orchards of the University of Agriculture, Faisalabad, was sampled for the cursorial spiders. This paper describes the abundance and biological diversity of the cursorial spiders inhabiting the ground floor of this citrus orchard.

MATERIALS AND METHODS

Spiders were collected each month from March, 1992 through February, 1994, using pitfall traps. During each month *twelve* traps (12 cm long and 6 cm wide glass jars) were set for four *consecutive* days in two parallel rows of six traps. The traps were so sunk in the ground that their mouth was at *level* with the ground surface. Each trap contained 150 ml of ethyl alcohol and a small quantity of kerosene oil as a *preservative* and killing agent. After two days, these traps were replaced by a set of fresh ones. The traps were brought to the laboratory for counting and identifying the spiders caught in them.

The number of species (= species richness) in each of the monthly samples was recorded, while species *diversity* was assessed using Hill's *diversity* number, $N1 = e^{H'}$; where H' is Shannon's index. *Evenness* was calculated using modified Hill's ratio, $E = (1-)/e^{H'}-1$, where H'is Simpson's index (see LUdwig and Reynolds, 1988). The *diversity* of the two yearly samples was compared by using Magurran (1988) formula of Hest. Two way ANOVA was used to compare fluctuations in the density and richness of the spider populations in the monthly and yearly samples.

The ground fauna of the orchard under study was disturbed by ploughing, flooding by irrigation water, and precipitation. But such *activities* are known to disturb the spider community only temporarily which comes to its normal position after two or three days (Duffey, 1978; Culin and Rust, 1980),

RESULTS

In *all,* 912 specimens of spiders which belonged to eight *families,* 16 genera and 29 species were caught in the pitfall traps from March, 1992 through February, 1994. Of these, 442 specimens belonging to six families, 12 genera, and 21 species were recorded during the first year (1992-93) and 470 specimens belonging to eight families, 15 genera, and 25 species during the second year (1993-94) of the study. Of the eight families, *Lycosidae* contributed

Table 1. Relative abundance of spiders in rhssernples collected from the ground floor of the citrus orchard during March through February, 1994

Species	1st year	2nd year	Total
Lycosidae	377(85.3)	411(87.5)	788(86.4)
Perdose oakleyi	58(13.1)	129(27.4)	187(20.5)
Pardosa birmanica	114(25.8)	177(37.7)	291 (31.9)
Hippsa dignus	10(2.3)	12(2.6)	22(2.4)
Lycosa vulgaris	139(31.4)	60(12.8)	199(21.8)
Lycosa terrestris	44(10.0)	14(3.0)	58(6.4)
Lycosa remota	-	7(1.5)	7(0.8)
Lycosa nigricans	8(1.8)	11 (2.3)	19(2.1)
Lycosa erronis	3(0.7)	1(0.2)	4(0.4)
Lycosa maculata	1(0.2)	-	1(0.1)
Gnaphosidae	20(4.5)	17(3.6)	37(4.1)
Gnaphosa elegantis	8(1.8)	2(0.4)	10(11.7)
Gnaphosasubpoonaens~	1(0.2)	-	1(0.1)
Zelotus illustris	3(0.7)	3(0.6)	6(0.7)
Zelotus pakistaniensis	-	2(0.4)	2(0.2)
Zelotus pulchellus	-	2(0.4)	2(0.2)
Gnaphosidae 1	8(1.8)	8(1.7)	16(1.8)
Salticidae	15(3.4)	14(3.0)	29(3.2)
Marpissa carinata	2(0.5)	1(0.2)	3(0.3)
Marpissa tenebrosa	9(2.0)	3(0.6)	12(1.3)
Marpissa mirabilis	1(0.2)	-	1(0.1)
Marpissa insiqnis	-	1(0.2)	1(0.1)
Plexippus primarius	1(0.2)	-	1(0.1)
Plexippus eximius	1(0.2)	1(0.2)	2(0.2)
Phidippus notabilis	1(0.2)	8(1.7)	9(1.0)
Thomisidae	-	3(0.6)	3(0.3)
Oxyptila nemestrina	-	1(0.2)	1(0.1)
Runcinia trabecula	-	1(0.2)	1(0.1)
Philodromus amoenus	-	1(0.2)	1(0.1)
Erigonidae			
Erigone dentata	27(6.1)	19(4.0)	46(5.0)
Clubionidae			
Castianeira amiantis	2(0.5)	1(0.2)	3(0.3)
Oxyopidae			
Oxyopes azhari	1(0.5)	4(0.9)	5(0.6)
Sparassidae			
Eusparassus sp.	-	1(0.2)	1(0.1)
Proportion of specimens	442	470	912
Total number of species	21	25	29

86.4% of the specimens and 31.0% of the species. *Erigonidae, Gnaphosidae* and *Salticidae* contributed 5.0%,4.1 %, and 3.2% of the specimens and 20.7%, 24.1 %, and 10.3% of the species, respectively. The contribution of other families was very small (Table 1). Three species of family *Lycosidae* viz. *Pardosa birmanica* (31.9%), *Lycosa vulgaris* (21.8%) and *Pardosa oekleyi* (20.5%) were the dominant ones as

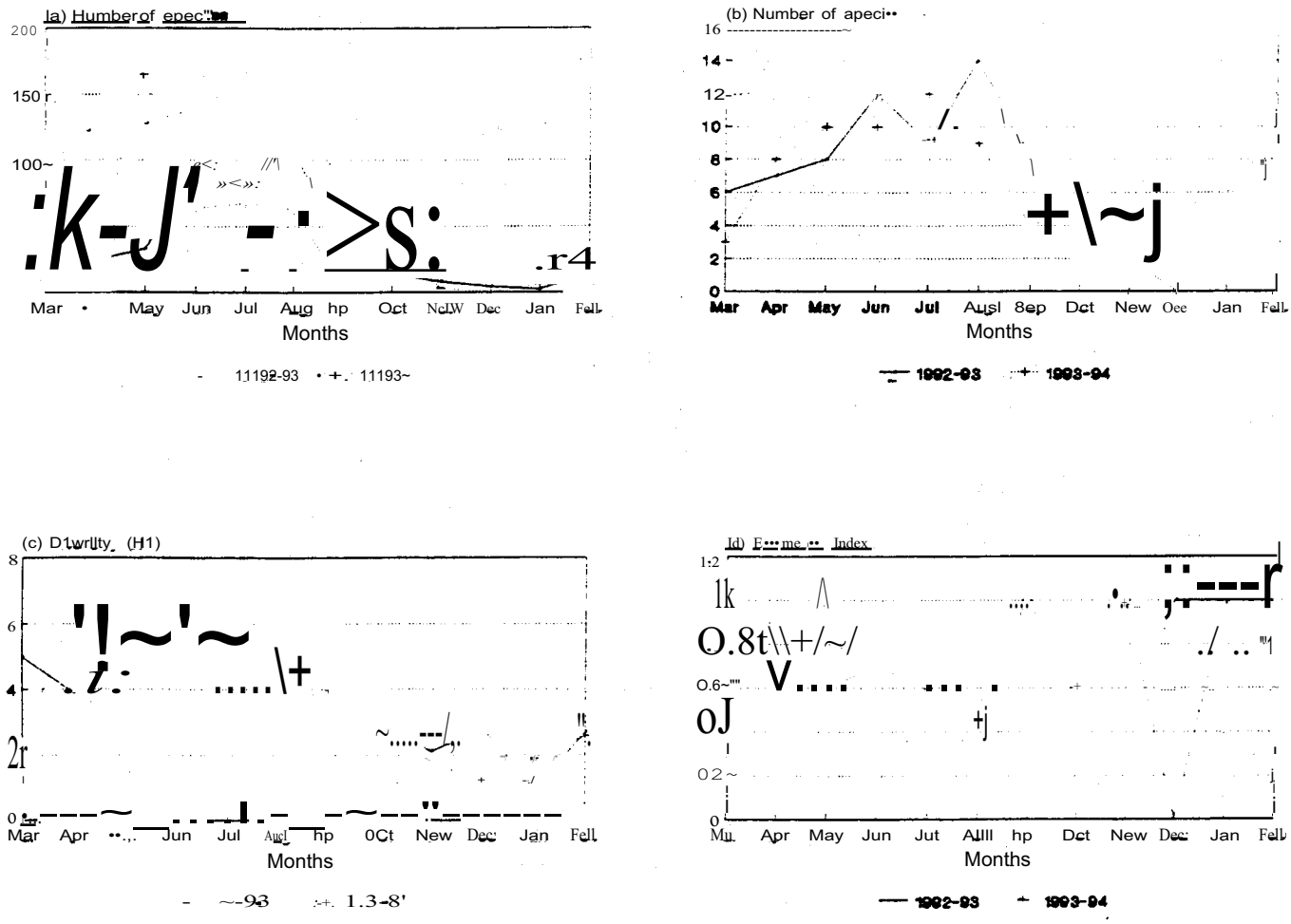

Fig. 1. Abundance (a), species richness (b), diversity (N1) (c), and evenness index (d) of the spiders in the monthly samples taken from the citrus orchard during 1992-94.

they jointly constituted 74;2% of the total specimens caught. In the yearly samples the ranks of these species were variable (Table 1).

Of the 29 species, only four *(Lycosa maculate, Gnaphosa subpooneensis, Marpissa mirabilis,* and *Plexippus primariusJ* were recorded in the 1992-93 sample and eight *(Lycosa remota, Zelotus pakistaniensis, Zelotus pulchellus, Marpissa insignis, Oxyptila nemestrine, Runcinia trabecula, Philodromus emoenus,* and *Eusparassus* sp.) in the 1993-94 sample. The families Thomisidae (with three species) and Sparassidae (with one species) were not recorded in the 1992-93 sample. All the species which were recorded just in one of the two yearly samples, excepting *Lycosa remota,* were represented by single specimens only (Table 1).

Fig. 1a shows changes in the number of spiders in the monthly samples of the two years. During the

first year of the study (1992-93), a plateau of abundance was recorded in June, July and August, while in the second year's (1993-94) samples a high abundance peak in May was followed by a relatively low abundance plateau in June, July, and August.. Two year's data of the study amply show that from February the number of specimens in the monthly samples began rising and remained high during May through August. After August, it declined continually till a nadir during November through January was reached.

ANOVA showed that only the species richness in the monthly samples of two years was statistically different ($F = 6.82$; d.f. = 11; $P < .05$). Faunal diversity in the two annual samples, formed by lumping the monthly samples, was not different. During the first year, diversity peak was recorded in May and richness peak in August, while during the next year these peaks were recorded in April and July, respectively IFig, 1b.c). Evenness also fluctuated during different months but generally remained low from June through November (Fig.1d).

DISCUSSION

During the two years of this study, 912 specimens of spiders were captured from the citrus orchard. As compared to the other habitats viz. vineyard (649) and guava orchard (518) studied during this period (Butt and Beg, 1996 and Butt, 1996), this habitat was better populated. *Lycosidae* was the most dominant family as it contributed 86.4% of the total abundance. Lycosids have been reported to dominate the spider communities inhabiting the ground surface of the agro-ecosystems in the tropical region (Patel *et al.,* 1986; Patel and Pillai, 1988).

Of 29 species recorded from the citrus orchard, only three species viz. *Pardosa birmanica, Lycosa vulgaris* and *Pardosa oakleyi* belonging to the family Lycosidae had c1earcut numerical superiority over the others. Numerical dominance by a few species in spider communities inhabiting agro-ecosystems is a common phenomenon (Leigh and Hunter, 1969). Patel *et al.* (1986) reported that in cotton fields two Lycosid spiders viz. *Pardosa sumatrana* and *Pardosa birmanica* constituted 27.66% and 23.36% of the samples.

The abundance data indicated that during the colder months of the year the activities of the spiders declined. At low temperatures the activities of the spiders as well as those of the insects, which are the main source of nutriment to the spiders, decline or enter into a stage of dormancy to avoid the unfavourable winter conditions (Ford, 1978). Variation in the seasonal abundance of different species is related to the inherent life cycle adaptations toternperature, moisture and food supply changes (Muma. 1973; Bishop, 1980). Gunnarsson (1988) pointed out that during winter three types of mortalities can occur in spiders; cold induced winter mortality, bird predation, and starvation. As for bird predation, it may be pointed out that a dozen of insectivorous birds foraged on the ground surface of the orchard for food. Some of these birds such as the shrikes, black drongo and mynas attended the grazing animals, tractor ploughing the fields and the fields flooded with irrigation water for insects, spiders and other arthropods.

The high abundance of spiders during the hotter months of the year was due to the lycosids. It was reported that seasonal activity. of the spiders depended upon their sensitivity to the amount of humidity in the air. Some lycosids, particularly those of the genus *Lycosa,* have waterproof epicuticular skin which allows them to remain active during the warm periods of the summer season (Williams, 1962). But relatively high richness and diversity in April during the course of this study was mainly due to *Erigone dentata.*

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