

Studies on the Ecology of Spiders in the Paddy Field

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INTRODUCTION

In recent years, many works on spiders in the paddy field have been reported with special reference to their relation with the hoppers and to their predatory ability. It has been estimated that in western Japan a large proportion of the total animals falling prey to the spider *Lycosa pseudoannulata* is taken up by the hopper *Nephotettix cincticeps*^{1),2)}. So it was suggested that this species of spider may play an important role in controlling *N. cincticeps*. But in the Tohoku districts, the coefficient of correlation of the population density between spiders and hoppers was low³⁾.

This is a preliminary investigation on the fauna constitution, population density, fecundity and predatory ability of spiders in the paddy field.

MATERIALS AND METHODS

Investigations were conducted using the following methods from the middle of May to the middle of September 1973, in the campus of Ibaraki University. The paddy field was surrounded on different sides by houses, a grass field and a chestnut orchard.

1) Faunal composition of spiders

From May to September spiders were collected at random locations in the paddy field and field ridges by sweeping or by hand and were put into glass tubes containing 70% alcohol.

2) Survey of the number of eggs

As the leaf nests made by *Clubiona japonicola* were easily found, only the egg-sacs of this species were collected during the period from 28th July to 11th August.

The leaf nests were cut at the lower part, then each of them was put into a glass tube (11.5cm in height, 2.7cm in diameter) containing water and stopped with cotton. Afterwards the eggs were inspected under a biocular to look for unfertilized and parasitized ones.

3) Predatory ability of spiders

Individuals of various species of spiders were kept in a glass tube in which wet cotton was placed and which was stopped with cotton. From 20th May to 4th June, a sufficient number of arti-

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fically reared adults of *Drosophila melanogaster* were given as food every day. The number of prey was counted every day and survivors were eliminated before the next supply of food.

4) Seasonal changes in population density

In order to count the spiders, 10 hills of rice plants were selected from each of the four corners of the paddy field. In this case, the field ridges were not examined. Counts were made irrespective of species, excepting newborn nymphs, and size on every other day from 24th July to 11th September.

Pesticide and fungicide were not sprayed, but herbicide was sprayed after transplanting.

5) Parasites

Small wasps and flies emerged from the eggs of *Clubiona japonicola* and these were immersed in 70% alcohol in glass tubes afterwards and inspected under a biocular.

RESULTS AND DISCUSSION

1) Faunal composition of spiders

The various species of collected spiders are listed in Table 1. Among the collected spiders, 21 species of 8 families were indentified and 8 species of 5 families were not. There was an exception in that *Oedothorax insecticeps*, which is said to be ordinarily found all over Japan, was not collected.

2) Survey of the number of eggs

In the paddy field, 34 egg-sacs of *Clubiola japonicola* were collected, among them 5 (14.7%) were decayed and 14 (41.1%) parasitised. After inspection, it was found that there were no unfertilized eggs, so the number of newborn nymphs was regarded as that of the number of eggs in an egg-sac.

The number of newborn nymphs is shown in Table 2. The number ranged from 42 to 163 with an average of 77.8. There is a difference in the number of eggs in a egg-sac, as compared with the other species such as *Lycosa pseudoannulata*, a female of which generally produces eggs two times each with the average number of 65 and 93⁵⁾. While a female of *Oedothrax insecticeps* produces four egg-sacs with an average of 42 eggs and *Enoplognatha japonica* respectively 7, 120¹⁰⁾.

3) Predatory ability of spiders

The results are shown in Table 3. The greatest number of flies consumed daily by *Dolomedes sulfureus* was 11.3 and the smallest number 2.6 by *Misumenops tricuspидatus*. Individuals of *Lycosidae* sp. preyed on flies with daily averages ranging from 5.5 to 8.0 according to body size.

Concerning the food consumption in other species, the following studies have been reported. In *Lycosa T-insignita*, the nymphal period was prolonged and the number of molts increased as the interval of rearing was delayed⁴⁾. And in *L. pseudoannulata*, the daily food consumption was much higher during the succeeding periods of pre-oviposition, copulation and oviposition⁵⁾. Also in *L. pseudoannulata*, subadults developed normally when they had consumed more than one prey of

Table 1. List of spider species in the paddy field.

Species
Theridiidae
<i>Theridion octomaculatum</i>
Agriopidae
<i>Neoscona doenitzi</i>
<i>N. Adianta</i>
Tetragnathidae
<i>Dyschiriognatha quadrimaculata</i>
<i>D. tenera</i>
<i>Tetragnatha caudicula</i>
<i>T. pinicola</i>
<i>T. praedomia</i>
<i>Pachygnatha clercki</i>
Lycosidae
<i>Lycosa pseudoannulata</i>
<i>Pirata procurvus</i>
Oxyopidae
<i>Oxyopes sertatus</i>
Thomisidae
<i>Misumenops tricuspoidatus</i>
Salticidae
<i>Evarcha albaria</i>
<i>Rhene atrata</i>
<i>Silerella vittata</i>
<i>Jotus difficilis</i>
<i>Menemerus confusus</i>
<i>Euophrys undulato-vittata</i>
Clubionidae
<i>Culbiona japonicola</i>
<i>Chiracanthium japonicum</i>

Table 2. Number of newborn nymphs emerged from an egg-sac.

Date	No. of nymphs	Date	No. of nymphs
VII 28	163	7	59
30	82	"	64
"	51	"	42
"	84	"	79
VIII 2	45	10	49
"	65	"	126
4	74	11	77
"	107	mean	77.8

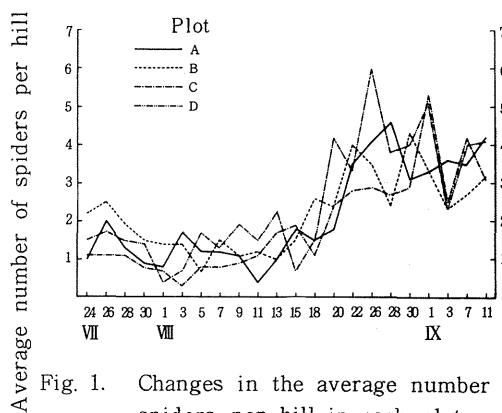


Fig. 1. Changes in the average number of spiders per hill in each plot.

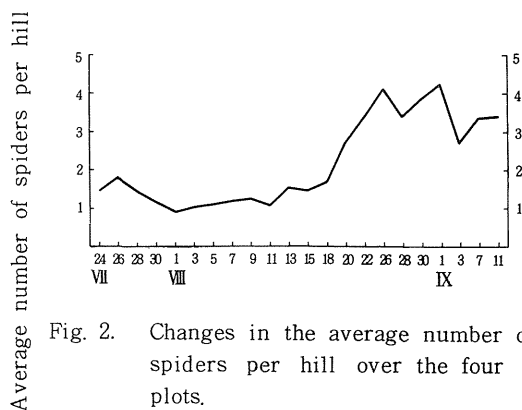


Fig. 2. Changes in the average number of spiders per hill over the four plots.

Nephotettix cincticeps per day, and the number of eggs increased with the amount of prey per day⁹⁾. The rates of food consumption of spiders decreased with the increase of the amount of prey⁸⁾.

Table 3. Daily food consumption of spiders.

Date	No. of flies fed per day							
	A	B	C	D	E	F	G	H
V 20		6						8
21		}6	4					}10
22			—					
23	2	3	6	1				6
24	2	2	12	1				20
25	10	2	9	7				15
26	13	15	16	14	3	7	11	24
27	7	3	11	7	0	4	9	15
28	9	18	—	15	7	1	—	10
29	3	0	16	12	3	4	8	8
30	4	12	6	12	5	4	11	16
31	6	9	7	9	2	3	—	14
VI 1	3	3	4	12	3	4	4	17
2	5	6	6	8	1	0	4	—
3	6	4	5	5	0	1	—	16
4	2	13	4	2	2	5	5	14
mean	5.53	6.37	7.57	8.07	2.60	3.30	5.20	11.35

A, B, C, D: *Lycosidae* sp., Body length measured respectively 5.5, 6.0, 7.0, 9.5. mm; E, F: *Misumenops tricuspidatus* (nymph ♀, adult ♀); G: *Thomisidae* sp. (adult ♂); H: *Dolomedes sulfureus* (adult, body length 14.0 mm).

4) Seasonal changes in population density

The mean numbers of spiders per hill in each plot and over the four plots in the paddy field are shown in Fig. 1 and 2. The average over the four plots was 0.9–1.8 (Fig. 2) from the end of July to the middle of August. This increased sharply up to two peaks showing 4.1 on 26th August and 4.2 on 1st September. Later it maintained a moderately lower level. These two peaks were caused by a large number of spiders appearing in two different plots at different times (Fig. 1).

In other investigations, the peak in population density occurred twice from July to January in Kanagawa prefecture¹³⁾ and three times from April to November in Miyagi prefecture³⁾.

The maximum number of spiders per hill in the autumn was different according to species, time, place and etc. For example, such numbers were reported as 8 in August in Koich Prefecture⁷⁾, 2.2 in July-August and September in Miyagi prefecture³⁾, 17 of *Oedothorax inceciceps* and 12 of *Enoplognatha japonica* in October in Osaka prefecture¹⁰⁾.

5) Parasites

Out of 29 egg-sacs of *Clubiona japonicola*, parasitic wasps emerged from 13 egg-sacs and flies from 1. None of these were identified, but their body length were measured to be 2–3mm.

All the females of *C. japonicola* which bore parasitised egg-sacs were already dead at the time

of collection. The possibility therefore exists that parasites had deposited their eggs either after killing the female spiders or after selecting dead females.

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水田に生息するクモ類の生態

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摘 要

茨城大学農学部構内の水田において、クモ類に関する各種の子備調査を、1973年5月中旬より9月中旬の間に行い、次の結果を得た。

1. 採集したクモ類の種構成は判明したもの8科21種、不明なもの5科8種であった。当水田は人家、牧草畑、クリ園に囲まれているためか種類は比較的少ない。

2. ハマキフクログモの卵のう34個を採集したが、5個は腐敗し、14個は被寄生卵のうであった。残りの卵のうからふ化した幼生は45~163頭（平均77.8頭）であっ

た。被寄生卵のう13個から寄生蜂が、1個から寄生蠅が羽化脱出したが、いずれも体長は2~3mmであった。

3. 数種のクモ類を1頭ずつ管瓶に入れ、飼育したシヨウジョウバエを毎日与えた結果、1日1頭当り捕食数は2.6~11.3頭（平均6.24頭）であった。

4. 水田の4隅から10株ずつ計40株を選び、株と其の基部付近に生息したクモ類の頭数を7月下旬から9月上旬まで1日おきに調査した。株当り平均クモ数は7月末~8月中旬の間には0.8~1.8と少なく、その後は増加して8月26日に4.1、9月1日に4.2と2山を示し、9月上旬には3頭前後となった。