

Sex Ratio of *Cryptopygus thermophilus* in Rubber Plantations of Chengannur Thaluk of Alappuzha District, Kerala, India

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Abstract: Sex ratio of *Cryptopygus thermophilus* in Rubber plantation of Chengannur Thaluk, Alappuzha district, Kerala state, India, from June 2014 to August 2015 was studied. 100 samples were randomly collected every month. Hand sorting and light funnel extraction was adopted to extract *Cryptopygus thermophilus*. Ovipositor of females and a small protuberance in the third ventral abdominal segment in male were taken in to consideration for sex identification. The study showed that the male female ratio is almost 1:1.5 in all these months. The Length range sex ratio observed showed that 0-1 cm range, males outnumbered females, but 2-3 cm range, females outnumbered males and above 5 cm length range, males were totally absent. In all these cases critical chi-square value was larger than the computed chi-square value with $P > 0.01$ indicating a deviation of the sex ratio from normal 1:1. Male survivor ship is high in lower length range and female survivor ship is more in upper length range in the studied habitat.

Keywords: Microarthropods, Collembola, Sex Ratio, Ovipositor

1. Introduction

The soil micro arthropod community is a major component of the soil ecosystem. It depends on decomposing plant and animal material for its basic energy input. Different ways are adopted by the micro arthropods to break down the organic materials. First of all they transform the plant and animal tissues to humic substances by decomposing them. Then through bacterial and fungal activities these humic substances are converted in to organic matter. The activity of soil micro arthropods and micro flora are complementary and intricately interrelated and where soil micro arthropods are very numerous, micro-organisms, especially bacteria, are also abundant. Springtails (Collembola) are among the most abundant soil invertebrates, and among arthropods they are one of the earliest colonizers of terrestrial systems. They play an important role in plant litter decomposition, nutrient cycling, in forming soil micro structures and in modifying plant growth, and thus received considerable attention (Parkinson 1988). In contrast, from an evolutionary biology point of view Collembola received little attention, ie little is known about the sex ratio and parthenogenesis. Based on field studies it is now known that beside bisexual reproduction, parthenogenesis is common in Collembola.

The present work was undertaken to study the sex ratio of *Cryptopygus thermophilus* in Rubber plantations of Chengannur Thaluk of Alappuzha district, Kerala .

2. Materials and Methods

Sex ratio studies were conducted from 2014 June to 2015 August (15 months). Random sampling was adopted for the study of sex ratio. 100 samples from Rubber plantations were collected monthly. Each sample is from 5x5x5cm area. Hand sorting followed by light funnel extraction was adopted to extract *cryptopygus thermophilus* from the sample. The extracted animals were transferred to culture bottles for sex

identifications. Ovipositor of females was taken in to consideration for identifications. A small protuberance in the third ventral abdominal segment is the distinguishing mark for male. It is light yellow in colour. The presence of ovipositor and protuberance can be easily identified with naked eye in mature animals and with the aid of the dissection microscope in juveniles and sub adults.

3. Results

In Plantation in 2014 June the males were 27.78% and female 72.22%, 26.37% male and 73.63% in July .In August male 27.66% and female 72.34 .In September 27.84% male and 72.16% females. 28.57% males and 71.43% females in October, 28.97% males and 71.03 % % females in November. In December 28.57% males and 71.43% females, in January 30.69% males and 69.31 % females, In February 28.3% males and 71.7% females, In march 29.9% males and 70.1 % females, in April 30.61% males and 69.39% females, in May 31.68% males and 68.325 females, in June 30.61% males and 69.39% females, July 30.21% males and females 69.79% and in August 31.58% males and 68.42 % females were observed. The male female ratio is almost 1: 1.5 in all these months.

Table 1: Sex Ratio of *Cryptopygus thermophilus* in Rubber Plantations

Year	Month	Total no of Animals	No. of Males	% of Males	No of Females	% of females
2014	June	900	250	27.78	650	72.22
	July	910	240	26.37	670	73.63
	August	940	260	27.66	680	72.34
	September	970	270	27.84	700	72.16
	October	1050	300	28.57	750	71.43
	November	1070	310	28.97	760	71.03
	December	980	280	28.57	700	71.43
2015	January	1010	310	30.69	700	69.31
	February	1060	300	28.3	760	71.7

	March	970	290	29.9	680	70.1
	April	980	300	30.61	680	69.39
	May	1010	320	31.68	690	68.32
	June	980	300	30.61	680	69.39
	July	960	290	30.21	670	69.79
	August	950	300	31.58	650	68.42

The length range sex ratio observed showed that 0-1 cm range males outnumbered females, but 2- 3 cm range females outnumbered males and above 5 cm length range males were totally absent as in the case of grass land .In all these cases table chi-square value was larger than the computed chi-square value with $P > 0.01$ indicating a deviation of the sex ratio from normal 1: 1.

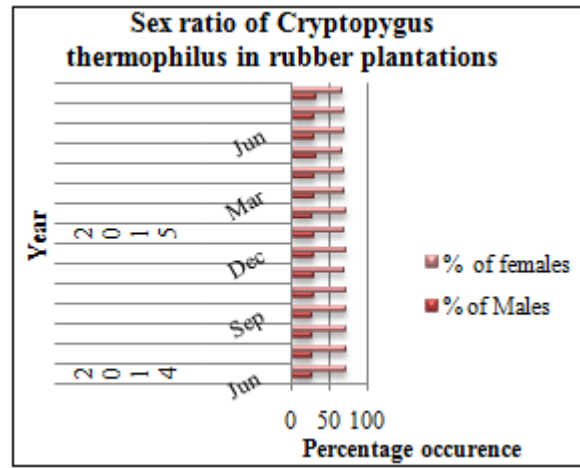


Table 2: Seasonal Changes of the sex ratio in various size classes of *Cryptopygus thermophilus* in Plantation with X^2 and P-Values

Length (cm)	Total Animals	No Of Males	No. Of females	% Of Males	% Of Females	X^2	P >
0-1 cm	150	85	65	56.67	43.33	0.004678	0.01
2- 3cm	245	55	190	22.45	77.55	2.60E-100	0.01
3- 4cm	260	90	170	34.62	65.38	2.26E-86	0.01
4- 5cm	295	105	190	35.59	64.41	2.48E-88	0.01
5- 6cm	62	0	62	0	100	1.192	0.01

4. Discussion

The survivor ship of males is more when compared to females in lower length range such as 0- 1 cm. This is the reason for male outnumbering in this length class interval range and also some entomologist doubts parasitic castration in female collembolan in juvenile stage (Wilkins 1979 and Gieser 1934). This may be the reason for lower number of females in the length class. But sub adult stage onwards females outnumber the males. Here in this study the Sex ratio studies of *Cryptopygus thermophilus* during different month of the year showed a variation in the sex ratio from the normal. In animals the normal male and female sex ratio 1:1. (Nair 1984). Sudden increase in the population size with outnumbering of one sex is a common phenomenon in insects. (Nair 1977). But this is true in the case of Pterygote insects. Pterygote insects are predominantly soil dwelling and there is no such swarming or nuptial flight as in the case of orthopterans. *Cryptopygus thermophilus* coming under the class collembola, there is no reproductive grooming.

Length range of 2-5 cm showed female outnumbering in all the studied habitats. This is the nature's survivor tactics for insects. Since *Cryptopygus thermophilus* is a soil dwelling insect strategically fighting for survival in the community. It is a pray for different types of micro arthropods. Non chitinous cuticle and non calcareous exoskeleton makes them easy prey for larger micro arthropods (Heeley 1941), Nair (1978) also observed cannibalism in some collembolans.

The sex ratio affects the breeding pattern of *Cryptopygus thermophilus*. Mature adults are always above 5 cm and in this length class males are totally absent. Large number of mature females occupy in a microhabitat with 2- 5 cm length range, sub adult and adult males. The adult males are visible

breeding populations with a length range of 4 - 5 cm. 2- 4 cm length range males are always sub adults contribute very few to the population propagation. So it is a peculiar phenomenon in this insect. Breeding mainly occurs between sub adult males and adult females which results in low fecundity and hatching rate. This is peculiar in this insect to check the population size. In the breeding individual class the sex ratio deviates from 1: 1 to 1: 1.5 (male: female). Reverse occurs in the case of lower length range and upper length range. Male survivorship is high in lower length range and female survivorship is more in upper length range. This is true in the case of all studied sites of plantation habitats.

Collembolans are continuous breeders (Sutton et al 1984). They breed continuously all the year round, with population comprises males and females with high reproductive ability. This breeding pattern is in association with several ecological and climatic factors. One or two peak breeding season may be observed in a year depending upon the fluctuations in the edaphic conditions. Different models of breeding phenology like bimodel and polymodel were observed in several collembolans. (Nair and Nair 1986). In some collembolans breeding season is followed by a period of ganadial activity. This is usually in summer months. This is the reason for low population density in summer. Deep vertical migration is also crucial for this phenomenon (Nair 1978).

In collembolans large number of females participating in reproductive processes ensuring species perpetuation where as majority of the males shows intersexual characters.

The size and age at first maturity in collembolans are interrelated. Size at first sexual maturity of *Cryptopygus thermophilus* is at the body length of 3.2 cm in females and 3 cm in males. This body size will be attained with a period of

8 - 9 moults. The lab rearing observations proved sub adults do not breed where as females above 5 cm length breed continuously with a rapid population explosion in the culture. The abnormal Sex ratio observed in *Cryptopygus thermophilus* might be due to difference in the growth rate of males and females and difference in the vertical migration capacity of two sexes. Complete absence of adult male in higher length class interval is due to less life span of male insects.

5. Summary and Conclusion

100 monthly samples were taken from June 2014 to August 2015 to study sex ratio of *Cryptopygus thermophilus*. Sex ratio studies of *Cryptopygus thermophilus* in Rubber plantation showed that the male female ratio is almost 1:1.5 in all the studied months. The table Chi-Square value was larger than the computed Chi-square value, with P- value $P > 0.01$ indicating a deviation of the sex ratio from normal 1:1 to 1: 1.5. In lower length range males outnumbered females but in higher length range groups females outnumbered males. Less life span of male insects may be a factor for their complete absence in higher length class interval.

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