

## Survey of Reduviids in Cotton Agro-Ecosystem of Tamil Nadu, India

Kalidas Subramanian and Sahayaraj Kitherian

Department of Zoology, St Xavier's College,  
Crop Protection Research Centre, Palayamkottai 627 002, Tamil Nadu, India

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**Abstracts:** Cotton, *Gossypium hirsutum* L. is grown as a key fibre crop in the world. Natural enemy's complex like reduviid predators in cotton agro-ecosystems is not available in the literature. A study was undertaken to explore the diversity of reduviid predators in cotton plantation of seven southern district of Tirunelveli, Thoothukudi, Kanyakumari, Theni, Virudhunagar, Sivagangai and Madurai in Tamil Nadu, India, from April 2009 to March 2010. The study revealed the presence of nine species belonging to six genera. They were observed and six major pests in all the districts were recorded. Among the nine reduviids, *Rhynocoris fuscipes* population was higher than that of other reduviid predators. Reduviid population has been depending up on with the prey population such as *Dysdercus cingulatus*, *Aphis gossypii* and *Helicoverpa armigera*.

**Key words:** Cotton • India • Reduviid predators • Tamil Nadu • Survey

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### INTRODUCTION

Reduviids are distributed in agroecosystems, semi-arid zones, scrub jungles and borders of agro-ecosystems and they consume considerable numbers of preys [1-5]. Generalist reduviid predator is predominantly found in agro-ecosystems such as cotton [6-10], groundnut [4, 11], legumes and rice [12, 13], tea [14], cowpea [15], pegionpea [16-18], cabbage [19], millet [20], tropical and rain forest [21,22], forest [23-25], sun flower [26], cucumber [27] and tobacco [28] world wide.

Cotton, *Gossypium hirsutum* L. (Malvaceae), is one of the most commercially important fibre crops in the world. It is a perennial semi-shrub grown as an annual crop in both tropical and warm temperate regions. Cotton production is adversely affected by many insect pests, which have been traditionally controlled by large quantities of insecticides. Although chemical insecticides provide an excellent control, resistance in insect pests of cotton have been reported against many pesticides. This enhances the use of increased amount of insecticides [29]. Many natural enemies are found in the cotton agro-ecosystem such as parasitoids and predators. For instance, the parasitoids of *Cotesia marginiventris*,

*Copidosoma floridanum* [30] and *Trichogramma chilonis* [31,32], *Bemisia tabaci* [33] and predators like, spiders [34-38], pentatomidae [15, 39, 40] and coccinelids [41-43] are worth recording.

The reduviid predators are found in cotton agro-ecosystem and they are one of the important natural enemies on the cotton hemipteran and lepidopteran pests [4, 8, 15, 16, 44]. The following reduviid species were recorded in the agro-ecosystem, *Rhynocoris marginatus*, *Rhynocoris fuscipes*, *Rhynocoris longifrons*, *Catamiarus brevipennis*, *Coranus* sp, *Irantha armipes*, *Rhynocoris kumarii* and *Sycanus pyrromelas* [4, 16, 18], *Rhynocoris ventralis* and *Peirontis modesia* [45], *Rhynocoris christophi*, *Rhynocoris ibericus*, *Rhynocoris iracundus*, *Rhynocoris punctiventris* and *Rhynocoris rubricoxa* [46, 47] and *Rhynocoris rubricus* [44] in world wide. However, no information is available about the reduviid predator's complex in cotton agro-ecosystems except the record in Georgia and the south-eastern USA (<http://www.tifton.uga.edu/lewis/Proj.HTM>). This study was undertaken to record the reduviid predator's population in Tirunelveli, Thoothukudi, Kanyakumari, Theni, Virudhunagar, Sivagangai and Madurai in Tamil Nadu, India, from April 2009 to March 2010.

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**Corresponding Author:** Sahayaraj Kitherian, Department of Zoology, St Xavier's College,  
Crop Protection Research Centre, Palayamkottai 627 002, Tamil Nadu, India.  
Tel: + 91 462 4264376, Fax: +91 462 2561765.

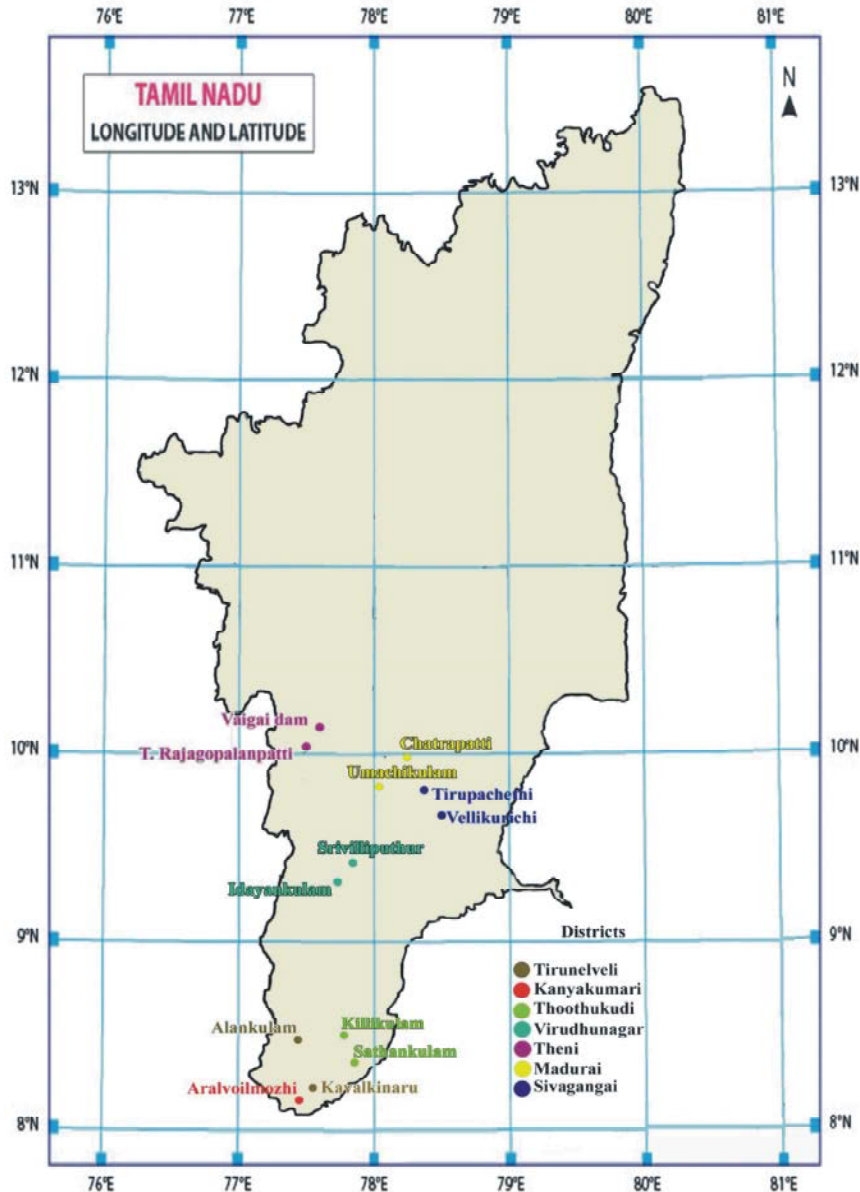


Fig. 1: Map showing the reduviid predators collection cites of seven different districts of Tamil Nadu

## MATERIALS AND METHODS

Field survey was conducted from April 2009 - March 2010 in seven districts viz., Tirunelveli, Thoothukudi, Kanyakumari, Theni, Virudhunagar, Sivagangai and Madurai of Tamil Nadu (Fig. 1). Two or three cotton cultivating villages are randomly selected from each district for this study. In each village more than two cotton fields of 1 ha<sup>-1</sup> were considered for the reduviid survey, variety of cotton at these districts such as MCU, SVPR, Bunny, local variety and Uganda. Sweeping net and hand picking methods were used to collect the

reduviids. Immature stages and adult predators were considered for this study. The reduviid and predominant pests prevailed during the study time were recorded carried out from flowering and bolling stage (40 to 90 days old plant) of cotton plant. Two to three field visits in a month were made in each district. All the observation were made either in the morning (7.00am to 9.00am) or in the evening (4.30pm to 6.30pm).

Monthly records of abiotic factors such as maximum and minimum temperature (°C) relative humidity (RH) (%), wind velocity (Km/hr) and total rain fall (mm) which prevailed during the periods of the field experiments were

collected from the District Meteorological Stations or District Statistical Department. The insect population data recorded was subjected to correlation with monthly data of maximum and minimum temperature, relative humidity, wind velocity and their co-efficient ( $r^2$ ) is recorded in the text and tables.

### RESULTS AND DISCUSSION

Totally 131 individuals belonging to Harpactorinae (*Rhynocoris* spp., *Sphedanolestes* sp. and *Lophocephalus* sp.), Peiratinae (*Catamarius* sp. and *Ectomocoris* sp.) and Reduviinae (*Acanthaspis* sp.) were observed in the cotton agro-ecosystem of Tamil Nadu, India. *R. fuscipes*, *R. marginatus* and *S. variabilis* were found on the tender part of the cotton or under the leaves. *A. pedestris*, *C. brevipennis*, *R. longifrons* and *E. tibialis* were found underneath cotton litters. The number of reduviid predators collected from the cotton agro-ecosystem and their bordering ecosystem like scrub jungle and semi-arid zones of seven districts of Tamil Nadu, India are presented in Table 1. It shows the reduviid predators collected from different localities with their dominant cotton pests. Among the seven districts, Kanyakumari district harboured more number of reduviids of *Rhynocoris* spp. than *A. pedestris* and *E. tibialis*.

*Rhynocoris fuscipes* (41) was observed in more number. For instance, in Kanyakumari district the *R. fuscipes* (18) population was high followed by Thoothukudi district (9) and Tirunelveli district (7) from April 2009 to March 2010. *Rhynocoris longifrons* (18) was also collected in large numbers at Kanyakumari district.

*Rhynocoris marginatus* and *S. variabilis* were collected from three districts (Table 2). The fluctuation of rainfall (Tirunelveli and Thoothukudi) and wind velocity (Kanyakumari) have no effects on the population of these reduviids (Table 3-9). However, the correlation between minimum temperature and maximum temperature does not have any influence on the population of reduviid predator in Tirunelveli district. Similar relation was also observed in Kanyakumari district. In the present study it was observed that in all the study sites, the reduviid predators were high in June 2009 followed by May 2009 and July 2009. Furthermore, results also reveal that tibialorate reduviids were preferred to those that dwelt in scrub jungles and semi-arid zones, whereas non-tibialorate reduviids dwelled in cotton agro-ecosystem.

The survey conducted in cotton agro-ecosystem of seven districts of Tamil Nadu revealed that more number of reduviids were recorded in Tirunelveli (7 species) and Kanyakumari (6 species) districts as reported earlier [3]. This might be due to (i) multiple crops cultivation recorded in and around the study site and (ii) preys of different insects order were abundant in these study areas. *Rhynocoris* spp. were recorded from all the seven districts and *R. fuscipes* were distributed in all districts. Previously these reduviids have been recorded from pigeon pea [18], grams [48], chilli [49], rice [50] and also in cotton [10, 26, 51-54] which indicated that *R. fuscipes* is a potential reduviid predatory on more than 45 insect pests belonging to various insect order. Moreover, more than 39 *Rhynocoris longifrons* recorded from cotton (SVPR II, SVPR IV and local variety) in the bordering ecosystems.

Table 1: Reduviid predators recorded in cotton agro-cosystem and their border ecosystem of seven districts of Tamil Nadu from April 2009 – March 2010

Reduviid Predators	Locality collection Parentheses indicates varieties	Number of insects		Dominated pests during the observation
		Cotton ecosystem	Bordering ecosystem	
<i>Acanthaspis pedestris</i> (Stål)	Kanyakumari and Tirunelveli districts (MCU 5)	11	15	<i>Dysdercus cingulatus</i> , <i>Odontotermes obesus</i>
<i>Catamarius brevipennis</i> (Servile)	Tirunelveli district (MCU 5 and MCU 7)	3	6	<i>Dysdercus cingulatus</i> , <i>Spodoptera litura</i> , <i>Mylabris pustulata</i> .
<i>Ectomocoris tibialis</i> (Distant)	Tirunelveli and Kanyakumari districts (Bunny and SVPR II)	2	4	<i>Dysdercus cingulatus</i> , <i>Spodoptera litura</i> , <i>Mylabris pustulata</i> .
<i>Lophocephalus guerini</i> (Lap.)	Kanyakumari district (SVPR II)	-	1	<i>Dysdercus cingulatus</i> , <i>Spodoptera litura</i>
<i>Rhynocoris marginatus</i> (Fab.)	Tirunelveli district, Sivagangai, Virudhunagar and Tuticorin districts (SVPR II, SVPR IV and MCU 5)	5	-	<i>Dysdercus cingulatus</i> , <i>Aphis gossypii</i> , <i>Helicoverpa armigera</i> , <i>Phenacoccus solenopsis</i>
<i>Rhynocoris fuscipes</i> (Fab.)	Tuticorin, Tirunelveli, kanyakumari, Madurai, Sivagangai, Theni and Virudhunagar districts (SVPR II, SVPR IV and local variety)	34	7	<i>Dysdercus koengii</i> , <i>Spodoptera litura</i> , <i>Mylabris pustulata</i> , <i>Mylabris indica</i> , <i>Helicoverpa armigera</i> .
<i>Rhynocoris longifrons</i> (Stål)	Kanyakumari and Tirunelveli districts (MCU 5, SVPR IV and SVPR II)	11	18	<i>Dysdercus cingulatus</i> , <i>Spodoptera litura</i> , <i>Phenacoccus solenopsis</i>
<i>Rhynocoris kumarii</i> (Ambrose and Livingston)	Kanyakumari district (Uganda, SVPR II)	-	8	<i>Dysdercus cingulatus</i> , <i>Aphis gossypii</i>
<i>Sphedanolestes variabilis</i> Distant	Tuticorin, Tirunelveli and Virudhunagar (MCU 5 and MCU 7)	6	-	<i>Dysdercus cingulatus</i> , <i>Aphis gossypii</i> , <i>Phenacoccus solenopsis</i>

Districts: Tirunelveli, Thoothukudi, Kanyakumari, Virudhunagar, Theni, Sivagangai and Madurai

Table 2: Distribution of reduviid predators in cotton agro-ecosystem of seven districts of Tamil Nadu, India from April 2009 to March 2010

Month	Tirunelveli districts							Kanyakumari districts					Thoothukudi districts			Virudhunagar districts			Theni districts			Sivagangai districts			Madurai districts
	AP	CB	ET	RM	RF	RL	SV	AP	ET	RF	LG	RK	RL	SV	RF	RM	RM	RF	SV	RF	RF	RF	RM	RF	
April 2009	4	-	-	-	1	2	-	7	1	5	-	3	5	-	-	-	-	-	-	-	-	-	-	-	
May	-	-	1	-	1	-	-	6	1	3	-	-	-	-	4	1	-	-	-	-	-	-	-	-	
June	4	3	-	1	1	-	1	-	2	-	1	-	-	1	1	-	-	1	1	1	1	1	1	1	
July	2	-	1	-	-	6	-	-	-	-	-	-	3	-	1	-	1	2	1	-	-	-	-	-	
August	-	-	-	-	-	-	-	-	-	3	-	-	-	-	1	-	-	-	-	-	-	-	-	-	
September	-	4	-	1	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	
October	-	2	-	-	2	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	
November	-	-	-	-	-	3	-	-	-	-	4	1	-	-	-	-	-	-	-	-	-	-	-	-	
December	-	-	-	-	-	-	1	-	-	7	-	-	-	1	-	-	-	-	-	-	-	-	-	-	
January 2010	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	
February	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
March	-	-	-	-	1	-	-	3	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	
Total	10	9	2	2	7	11	2	16	4	18	1	8	18	2	9	1	1	3	2	2	1	1	1	1	

AP- *Acanthaspis pedestris*, CB – *Catamarius brevipennis*, ET- *Ectomocoris tibialis*, LG- *Lophocephalus guerini*, RF- *Rhynocoris fuscipes*, RL- *Rhynocoris longifrons*, RK- *Rhynocoris kumarii*, RM- *Rhynocoris marginatus* and SV- *Sphedanolestes variabilis*

- Indicates no reduviids observed during the study period

Table 3: Meteorological data recorded at Tirunelveli district from April 2009 to March 2010

Month	Rain fall (mm)	Temperature (°C)		RH (%)	Wind velocity (km/hr)
		Minimum	Maximum		
April 2009	12.0	29.1	31.4	60.8	31.5
May	33.0	30.4	35.0	49.0	13.0
June	8.0	30.0	33.6	51.6	2.6
July	4.30	31.5	34.9	63.3	27.2
August	8.12	31.6	33.4	75.6	2.0
September	0	29.5	31.2	70.2	4.6
October	25.0	28.6	32.6	67.0	1.8
November	157.1	29.3	32.2	75.3	6.4
December	64.5	27.4	31.4	72.1	10.0
January 2010	0	28.2	33.4	73.0	10.0
February	0	27.3	30.2	78.5	12.2
March	0	30.1	33.2	65.1	8.0
Correlation coefficient (r <sup>2</sup> )	-0.12	-0.35	-0.03	0.50	0.36

Table 4: Meteorological data recorded at Kanyakumari district from April 2009 to March 2010

Month	Rain fall (mm)	Temperature (°C)		RH (%)	Wind velocity (km/hr)
		Minimum	Maximum		
April 2009	25	28.1	35.2	63.0	12.2
May	66.5	29.0	32.3	70.1	23.6
June	2	28.6	35.3	68.8	34.5
July	2	27.3	34.8	79.5	22.0
August	0	26.6	32.5	69.2	22.6
September	23	28.1	32.3	56.3	12.3
October	3	26.0	32.6	61.0	6.40
November	233	28.6	31.3	78.0	15.4
December	13.6	25.3	29.3	68.8	34.5
January 2010	7	24.2	32.9	48.6	15.0
February	0	26.8	31.7	55.6	27.2
March	34	26.8	30.0	60.5	20.3
Correlation coefficient (r <sup>2</sup> )	0.12	0.43	0.23	0.13	-0.18

The survey of 6 genera of reduviid predators from the districts revealed that the reduviid population may be regulated by preys, because some abiotic factors like rainfall and wind velocity are not correlated to the reduviid population. However, rainfall level and temperature (either minimum or maximum) negatively influence distribution of reduviids in Tirunelveli, Thoothukudi, Theni, Sivagangai and Madurai districts. Ambrose and Livingstone [55] reported that physical factors like temperature, relative humidity, rainfall and

wind velocity have no correlation with reduviid population under study in semiarid zones. In the present study, six genera of reduviids such as *Acanthaspis* sp., *Catamarius* sp., *Ectomocoris*, *Lophocephalus* sp. *Rhynocoris* spp. and *Sphedanolestes* sp. were recorded from cotton agro-ecosystem. Moreover, it was reported that the occurrence of four species of reduviid such as *Acanthaspis* sp., *Ectomocoris* sp., *Rhynocoris* spp. and *Onococephalus* sp were influenced by both abiotic and biotic factors [4, 56, 57, 58]. It was also previously

Table 5: Meteorological data recorded at Thoothukudi district from April 2009 to March 2010

Month	Rain fall (mm)	Temperature (°C)			Wind velocity (km/hr)
		Minimum	Maximum	RH (%)	
April 2009	22.0	29.1	36.2	64.0	3.20
May	34.0	30.6	37.8	59.5	14.1
June	7.0	30.2	36.3	43.3	2.2
July	4	33.3	36.3	70.3	11.7
August	0	28.7	36.6	68.5	3.5
September	0	29.5	36.6	64.0	7.4
October	27	28.4	36.1	67.6	4.3
November	184.1	27.7	31.2	64.0	3.2
December	72.0	29.6	33.8	41.5	14.1
January 2010	0	30.1	35.3	43.3	2.2
February	0	29.1	36.6	41.0	16.3
March	0	31.4	32.6	52.8	14.1
Correlation coefficient (r <sup>2</sup> )	-0.07	-1.00	0.06	0.02	0.30

Table 8: Meteorological data recorded at Sivagangai district from April 2009 to March 2010.

Month	Rain fall (mm)	Temperature (°C)			Wind velocity (km/hr)
		Minimum	Maximum	RH (%)	
April 2009	53.4	27.1	32.8	66.5	1.28
May	21.6	29.4	34.3	59.7	3.10
June	0	29.0	36.1	49.1	14.0
July	0	28.6	32.1	69.8	12.0
August	0	25.3	33.2	71.3	7.1
September	21.4	26.0	32.3	57.6	1.17
October	63.5	28.2	32.1	67.4	0.91
November	102.4	24.0	28.4	88.3	2.30
December	59.1	23.7	30.2	82.6	1.0
January 2010	0	24.2	26.6	65.3	0.57
February	0	26.8	29.5	63.0	1.12
March	0	28.6	34.4	63.7	0.72
Correlation coefficient (r <sup>2</sup> )	-0.28	0.39	0.48	-0.48	0.48

Table 6: Meteorological data recorded at Virudhunagar district from April 2009 to March 2010.

Month	Rain fall (mm)	Temperature (°C)			Wind velocity (km/hr)
		Minimum	Maximum	RH (%)	
April 2009	37.5	29.7	35.2	66.0	5.0
May	25.0	30.8	35.0	54.3	48.0
June	16.2	29.8	34.1	59.1	9.3
July	28.5	29.7	34.2	67.6	8.7
August	80.5	29.1	34.6	62.1	9.2
September	87.5	28.6	31.5	65.6	1.53
October	69.2	28.3	32.1	67.6	1.40
November	193.3	26.8	31.6	66.2	7.0
December	27.5	25.8	30.9	73.5	1.50
January 2010	0	24.6	31.1	71.0	1.06
February	0	27.3	30.9	62.9	1.38
March	8.10	28.9	33.3	62.8	0.79
Correlation coefficient (r <sup>2</sup> )	0.40	0.31	0.05	-0.05	0.03

Table 9: Meteorological data recorded at Madurai district from April 2009 to March 2010.

Month	Rain fall (mm)	Temperature (°C)			Wind velocity (km/hr)
		Minimum	Maximum	RH (%)	
April 2009	55	28.4	34.4	68.4	3.1
May	89.8	30.3	35.1	90.3	10.2
June	41.8	27.2	32.3	58.6	7.6
July	65.0	28.4	32.0	65.5	5.4
August	108.2	26.8	34.2	72.4	2.8
September	125.6	27.1	32.3	65.9	10.2
October	42.8	26.0	33.1	56.2	8.1
November	304	26.1	33.7	82.1	2.3
December	25.6	24.2	33.3	76.3	1.44
January 2010	0	24.0	30.1	59.3	1.79
February	0	29.3	32.4	69.0	1.10
March	0	30.1	36.6	67.3	2.28
Correlation coefficient (r <sup>2</sup> )	-0.13	0.04	-0.26	-0.39	0.26

Table 7: Meteorological data recorded at Theni district from April 2009 to March 2010.

Month	Rain fall (mm)	Temperature (°C)			Wind velocity (km/hr)
		Minimum	Maximum	RH (%)	
April 2009	30.5	30.5	35.2	63.2	5.03
May	44.2	30.1	35.9	64.0	7.0
June	4.9	28.2	33	59.1	6.65
July	4.4	28.9	36.2	71.2	7.89
August	39.8	26.4	34.9	76.5	6.29
September	10.7	25.9	31.5	72.3	5.73
October	50.7	27.4	34.5	63.9	6.12
November	112.3	23.5	32.7	72.7	3.66
December	35.5	24.5	31.7	73.8	3.26
January 2010	0	23.9	31.5	57.5	2.74
February	0	27.5	34.2	76.9	6.40
March	10.7	28.2	35.8	63.7	5.61
Correlation coefficient (r <sup>2</sup> )	-0.48	-0.16	-0.44	-0.16	-0.24

reported that cropping condition provides suitable microclimate, continuous supply of food and suitable sites of reproduction for arthropod natural enemies including reduviids [14].

It is concluded from this study that 131 reduviids from Harpektorinae, Peiratinae and Reduviinae were recorded from Tirunelveli, Thoothukudi, Kanyakumari, Virudhunagar, Theni, Sivagangai and Madurai districts of Tamil Nadu. More number of reduviids species was recorded from Kanyakumari (65) than from Tirunelveli (43) district. Among the nine reduviids, *R. fuscipes* was recorded in all the districts. Since enormous literature was available about the distribution and diversity of this predator [3, 18, 50], bioecology [59], ethology [60] and biological control potential of *R. fuscipes* [8], we selected *R. longifrons* for this proposed thesis work.

## ACKNOWLEDGEMENT

K. Sahayaraj gratefully acknowledges the CSIR (Ref. No. 37/1043/08/EMR II), New Delhi for the financial assistance. We thank the managements Rev. Fr. A. Joseph S.J., Principal, St. Xavier's College, Palayamkottai for the laboratory facilities and encouragement

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