BIOSYSTEMATICS OF A CHOSEN GROUP OF REDUVIIDS (INSECTA: HEMIPTERA: REDUVIIDAE: REDUVIINAE)

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By

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Declaration

I hereby declare that the thesis entitiled "**Biosystematics of a chosen group of reduviids (Insecta: Hemiptera: Reduviidae: Reduviinae)**" submitted by me for the Degree of Doctor of Philosophy in Zoology is the result of my original and independent research work carried out under the guidance of Dr. Dunston P. Ambrose, D. Sc., Director, Entomology Research Unit, St. Xavier's College (Autonomous), Palayamkottai-627 002 and it has not been submitted for the award of any degree, diploma, associateship, fellowship of any University or Institution.

(S. JESU RAJAN)

Place: Palayamkottai

Date: 13.12.12

CONTENTS

Abstract

The knowledge of biosystematics of any group of organisms is the foundation of all meaningful further research (Narendren, 2001). One must know not only what an organism is but also what its relatives and the phylogenetic relationships are; such knowledge broadens and deepens the biological information and thereby makes it more useful (Ambrose, 2000; Schaefer, 1988). The biosystematics helps one to determine the organism and to trace its phylogenetic relationship. Such knowledge has great relevance in the field of biodiversity, agriculture, medicine, forestry, etc. The exact determination and understanding the phylogeny of species especially of sibling species, ecotypes, polymorphs etc., are crucial in such fields of research (Ambrose, 2004 a, b).

The Reduviidae (Insecta: Hemiptera) is a family of predaceous cimicomorphan bugs called the assassin bugs which have a cosmopolitan distribution (Maldonado, 1990). Reduviidae with more than 6600 described species is one of the largest and morphologically most diverse groups of true bugs (Heteroptera) (Cassis and Gross, 1995; Froeschner and Kormilev, 1989; Maldonado, 1990; Melo and Coscarón, 2004). The family Reduviidae contains more subfamilies than any other hemipteran family (Ambrose, 2006; Cassis and Gross, 1995; Clayton, 1991; Froeschner and Kormilev, 1989; Maldonado, 1990). Among the 31 subfamilies of assassin bugs (Maldonado, 1990), the Reduviinae is one of the most heterogeneous including 141 genera and more than 1070 species occurring in all biogeographic regions. It is characterized by a combination

of characters such as the presence of ocelli, fossula spongiosae on fore- and midlegs and three segmented tarsi and the immature stages with three abdominal scent glands whose openings are located on the anterior margins of fourth, fifth and sixth of terga (Melo, 2007; Schuh and Slater 1995). Ambrose (2006) prepared the checklist 14 subfamilies with 144 genera and 464 species from Indian faunal limits. Moreover, many reduviine assassin bugs are reported as promising biological control agents of insect pests of agricultural and forestry (Ambrose, 1999). Hence, the author has developed an interest in studying the biosystematics of Reduviinae. He has been working on this area of vital importance since 2006 at Entomology Research Unit, St. Xavier's College, Palayamkottai, Tamil Nadu with Dr. Dunston P. Ambrose. The present Ph. D thesis entitled "Biosystematics of a chosen group of reduviids (Insecta: Hemiptera: Reduviidae: Reduviinae)" is presented under the following four Chapters: 1) Field record of reduviine assassin bugs 2) Redescription and Description of reduviine assassin bugs 3) A key to the redescribed and newly described *Acanthaspis* species and 4) A checklist of Indian reduviine assassin bugs.

Field record of reduviine assassin bugs:

Reduviine assassin bugs were reported and recorded from scrub jungles, semiarid zones, tropical rainforests and agroecosystems and as light attracted. The present field record comprises of 126 species of reduviine assassin bugs belonging to 25 genera and 5 divisions. The division Acanthaspisaria dominates with 9 genera and 83 species, followed by Reduviaria with 4 genera and 15 species, Lenaearia with 6 genera and 14 species, Conorhinaria with 5 genera and 12 species and Psopharia with 1 genus and 2 species. The statewise and habitatwise distribution of reduviine assassin bugs was analysed.

The statewise distribution of reduviine assassin bugs reported and recorded covers 14 states and 2 union territories. They include Andaman and Nicobar Islands, Andhra Pradesh, Assam, Delhi, Jharkhand, Jammu and Kashmir, Karnataka, Kerala, Maharashtra, Meghalaya, Nagaland, Orissa, Sikkim, Tamil Nadu, Uttar Pradesh and West Bengal. Tamil Nadu yielded 57 species of reduviine assassin bugs under 10 genera and 3 divisions. Among them, the division Acanthaspisaria dominates with 51 species, followed by Lenaearia with 4 species and Reduviaria with 2 species. Karnataka yielded 14 species under 3 genera and 2 divisions. Among them, as observed for Tamil Nadu, the division Acanthaspisaria dominates with 13 species, followed by Reduviaria with only one species. Kerala yielded 13 species under 6 genera and 3 divisions. Among them, again the division Acanthaspisaria dominates with 9 species, followed by Lenaearia with 3 species and Reduviaria with only one species. West Bengal yielded 11 species under 6 genera and 3 divisions. Among them the division Acanthaspisaria dominates with 8 species, followed by Reduviaria with 2 species and Lenaearia with only one species. Maharashtra yielded 11 species under 3 genera and 2 divisions. Among them the division Acanthaspisaria dominates with 9 species and Reduviaria with 2 species. Assam yielded 9 species under 3 genera and 3 divisions. Sikkim yielded 7 species under 3 genera and 3 divisions. Meghalaya yielded 5 species under 2 genera and 2 divisions. Andaman and Nicobar Islands yielded 4 species under 2 genera and 2 divisions. Andhra Pradesh, Delhi, Jharkhand, Jammu and Kashmir, Nagaland, Orissa and Uttar Pradesh yielded only one division and one genus, each.

The tropical rainforest yielded 51 species belonging to 9 genera and 3 divisions. Here also, the division Acanthaspisaria dominates with 42 species, followed by Lenaearia with 6 species and Reduviaria with 3 species. The scrub jungles yielded 23 species belonging to 7 genera and 3 divisions. Here again, Acanthaspisaria dominates with 20

species, Reduviaria with 2 species and Lenaearia with only one species. The semiarid zones yielded 23 species under 8 genera and 3 divisions. Here too, Acanthaspisaria dominates with 21 species and Lenaearia and Reduviaria have one species, each. Agroecosystems yielded 12 species under 5 genera and 2 divisions. As observed in other ecosystems Acanthaspisaria dominates with 11 species and Lenaearia with only one species. Light attracted 8 species under 4 genera and 2 divisions. Here also, Acanthaspisaria dominates with 7 species and Lenaearia with only one species.

Redescription and Description of reduviine assassin bugs:

The following eleven species of *Acanthaspis* were redescribed and thirteen species were described with camera lucida diagrams, micrometry and colour microphotographs.

Redescribed species:

1. *Acanthaspis biguttula* Stål 1863
2. *Acanthaspis bistillata* Stål 1858
3. *Acanthaspis inscripta* Distant 1903a
4. *Acanthaspis livingstonei* Vennison and Ambrose 1988
5. *Acanthaspis pedestris* Stål 1863
6. *Acanthaspis philomanmariae* Vennison and Ambrose 1988
7. *Acanthaspis quinquespinosa* (Fabricius) 1781
8. *Acanthaspis rugulosa* Stål 1863
9. *Acanthaspis sexguttata* (Fabricius) 1775
10. *Acanthaspis siva* Distant 1902c
11. *Acanthaspis subrufa* Distant 1903b

Newly Described species:

1. *Acanthaspis anamalaiensis* sp. nov.
2. *Acanthaspis ananthakrishnanii* sp. nov.
3. *Acanthaspis babinaensis* sp. nov.
4. *Acanthaspis courtallamensis* sp. nov.
5. *Acanthaspis karnatakensis* sp. nov.
6. *Acanthaspis oolakkaruviensis* sp. nov.
7. *Acanthaspis rubersonii* sp. nov.
8. *Acanthaspis saminathanii* sp. nov.
9. *Acanthaspis schaeferii* sp. nov.
10. *Acanthaspis thekkadyensis* sp. nov.
11. *Acanthaspis thenmalaiensis* sp. nov.
12. *Acanthaspis webbii* sp. nov.
13. *Acanthaspis whitmanii* sp. nov.

Key:

A key to 24 species of *Acanthaspis* (11 redescribed and 13 described) was formulated based on their morphological and morphometric characters.

Checklist of Indian reduviine assassin bugs:

An updated checklist of Reduviinae contains 99 species under 5 division and 25 genera from Indian faunal limits with their taxonomical status and microhabitatwise and habitatwise distribution and morphological characteristics is prepared. Among the reduviines, *Acanthaspis* Amyot and Serville dominates with 43 species followed by *Reduvius* Fabricius and *Tiarodes* Burmeister with 8 species, each; *Edocla* Stål,

Empyrocoris Miller and *Tapeinus* Laporte have 5 species, each; *Velitra* Stål has 4 species and *Ganesocoris* Miller, *Pasiropsis* Reuter and *Psophis* Stål have 2 species, each. All the other 15 genera viz., *Alloeocranum* Reuter, *Durganda* Amyot and Serville, *Durgandana* Miller, *Gerbelius* Distant, *Hadrokerala*, *Isdegardes* Distant, *Lenaeus* Stål, *Mesacanthaspis* Livingstone and Murugan, *Nanokerala*, *Neoacanthaspis*, *Neotiarodes* Miller, *Paralenaeus* Reuter, *Pasira* Stål, *Raipurocoris* Miller and *Tiarodurganda* Breddin are represented by only one species, each.

CHAPTER - I

Field record of reduviine assassin bugs

Reduviine assassin bugs were reported and recorded from scrub jungles, semiarid zones, tropical rainforests and agroecosystems and as light attracted.

1.1. Materials and Methods

This record was compiled from literature (Ambrose, 1980, 1987a and b, 1996a, b, 1999, 2000, 2003, 2004a and 2006; Biswas and Mitra, 2010; Distant, 1902c and 1910; Edwin, 1997; Ishikawa *et al.,* 2005; Kumaraswami, 1991; Lakkundi, 1989; Maldonado, 1990; Sahayaraj, 1991; Thanasingh, 2002; Vennison, 1988) and from my personal work.

Random survey of reduviine assassin bugs were carried out. Concealed microhabitats such as underneath boulders, bark, litter, cervices etc. and shrubs were examined with collection appliances for reduviine assassin bugs. Type specimens of all the collected species of reduviine assassin bugs were pinned and deposited at present in the Entomology Research Unit, St. Xavier's College (Autonomous), Palayamkottai and subjected to determination and identification. The field record of reduviine assassin bugs was analyzed under three headings: divisionwise, statewise and habitatwise.

Redescription and description of reduviine assassin bugs

The following eleven species of *Acanthaspis* were redescribed and thirteen new species were described with camera lucida diagrams, colour microphotographs and micrometry.

Redescribed species:

1. *Acanthaspis biguttula* Stål 1863
2. *Acanthaspis bistillata* Stål 1858
3. *Acanthaspis inscripta* Distant 1903a
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9. *Acanthaspis sexguttata* (Fabricius) 1775
10. *Acanthaspis siva* Distant 1902c
11. *Acanthaspis subrufa* Distant 1903b

CHAPTER - III

A key to the redescribed and newly described *Acanthaspis* species

Introduction

Distant (1902c) in his fauna of British India presented the key for the genera of the Oriental Reduviidae. Later, Cook (1977) made an attempt to prepare the key for the genera of the Oriental Ectrichodiinae found in the repository of the British Museum. The division of family Reduviidae was subdivided into tibiaroliate and non- tibiaroliate groups for the first time and keys for the various subfamilies and their genera of the tibiaroliate group of Reduviidae of southern India were prepared by Livingstone and Murugan (1988c). Subsequently, Livingstone and Ravichandran (1991b) prepared keys for the identification of the subfamilies and genera of the non- tibiaroliate group of Reduviidae of southern India. Ravichandran and Livingstone (1992) also prepared a key for the identification of 43 species of Harpactorinae. Also Murugan and Livingstone (1995b) prepared keys for the identification of 52 species belonging to 10 genera and 5 subfamilies of the tibiaroliate group of Reduviidae. Morphology of the antennae, rostrum, ocelli, pronotum and scutellum were considered devising the keys.

CHAPTER - IV

Checklist of Indian reduviine assassin bugs

4.1. Introduction

The family Reduviidae, included within the infraorder Cimicomorpha, is one of the largest, morphologically most diverse and worldwide distributed families of the suborder Heteroptera or true bugs (Cassis and Gross, 1995; Clayton, 1991; Froeschner and Kormilev, 1989; Ishikawa, 2005b; Kerzhner, 1992; Maldonado, 1990; Melo, 2007; Schuh and Slater 1995). The subfamily composition and relationship of Reduviidae with other heteropterous families remain unsettled (Ambrose, 2004a, b and 2006).

Assassin bugs show a remarkable morphological diversity: some species are only a few millimeters long, others are about 3 cm, and the so-called thread-legged bugs (Emesinae) and kissing bugs (Triatominae) are only two of several subfamilies with distinctive appearance in this heterogeneous taxon. Reduviids also show a wide range of life habits. Most species are predators of insects or other arthropods, either specialized on certain groups of prey organisms or apparently relatively unspecialized, but Triatominae are haematophagous on vertebrates and are known as vectors of Chagas disease in human beings (Ishikawa, 2005b; Melo, 2007; Melo and Coscarón, 2004; Schuh and Slater, 1995). This chapter reviews information available on the taxonomic status, microhabitats, habitats, diagnostics morphological characteristics of reduviine assassin bugs from Indian faunal limits and their relation to their ecological, behavioural and biological functions.

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