



Faculty of Resource Science and Technology

**Systematics and Phylogeny of Family Reduviidae Latreille, 1807 (Insecta:
Hemiptera: Heteroptera) in Sarawak**

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**Master of Science
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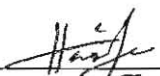
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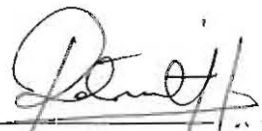
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Systematics and Phylogeny of Family Reduviidae Latreille, 1807 (Insecta:
Hemiptera: Heteroptera) in Sarawak

Siti Hanisah Binti Zahuri

A thesis submitted

In fulfilment of the requirements for the degree of Master of Science (Zoology)

Faculty of Resource Science and Technology
UNIVERSITI MALAYSIA SARAWAK
2018

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I hereby declare that, except as acknowledged in the text, the work presented in the thesis is entirely my own. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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ABSTRACT

The family Reduviidae Latreille, 1807 (Insecta: Hemiptera: Heteroptera) is composed approximately 25 subfamilies, 913 genera and with almost 7,000 species worldwide, their diversity was mostly found in the tropics. However, it is yet the most poorly studied species of Reduviidae. In Sarawak, there is no effort done on the systematics and phylogeny study on heteropterans although there were some revisions of genus and species that have been documented. The findings of this study will be useful as the fundamental to ecological and pest management of heteropterans and significantly contribute to the worldwide studies of Reduviidae. This study constructs a phylogenetic tree of described species of Reduviidae in Sarawak based on the morphological structures with reference to voucher specimens from UNIMAS Insect Reference Collection (UIRC), Forest Research Centre (FRC), Semongok Agriculture Research Centre (ARC), and Sarawak Biodiversity Centre (SBC), as well as new field collections. A phylogenetic analysis using maximum parsimony criteria which included 101 ingroup and 3 outgroup (Pentatomorpha) of taxa based on 61 morphological structures was run using Tree Analysis using New Technology (TNT) software is constructed. The monophyly of Reduviidae is well supported with Pentatomorpha as their outgroup. The results also present the monophyly of Tribelocephalinae, Salyavatinae, and Ectrichodiinae in a clade that also include Physoderinae, Saicinae and Reduviinae (*Acanthaspis quadriannulata*). The monophyly of Harpactorinae with basal position of Harpactorini in a clade is presented. In addition, a systematic account based on 23 genera and 52 species of subfamily Harpactorinae is presented. A key to the genera Harpactorinae is provided based on the comparative morphological structures with addition geological distribution map of each Harpactorinae

species in Sarawak.

Keywords: Systematics, morphological structures, Reduviidae, Harpactorinae, Sarawak

Sistematik dan Filogeni Famili Reduviidae Latreille, 1807 (Insecta: Hemiptera: Heteroptera) di Sarawak
ABSTRAK

Famili Reduviidae Latreille, 1807 (Insecta: Hemiptera: Heteroptera) terdiri daripada 25 subfamili, 913 genus dan dengan mempunyai hampir 7,000 spesies di seluruh dunia, kepelbagaian mereka kebanyakannya dijumpai di kawasan tropika. Namun begitu spesies Reduviidae yang paling kurang dikaji. Di Sarawak, tiada usaha terhadap kajian sistematik dan filogenesis pada heteropteran, walaubagaimanapun terdapat beberapa semakan genus dan spesies yang telah didokumenkan. Hasil kajian ini akan berguna sebagai kajian asas mengenai pengurusan ekologi dan perosak heteropteran, dan menyumbang kepada kajian Reduviidae dengan lebih meluas. Kajian ini membina pokok filogenetik terhadap spesies Reduviidae yang telah diperihalkan berdasarkan struktur morfologi dengan merujuk kepada spesimen baucer dari Koleksi Rujukan Serangga UNIMAS (UIRC), Pusat Penyelidikan Pertanian Semongok (ARC), Jabatan Hutan Sarawak (SFD), dan Pusat Kepelbagaian Biologi Sarawak (SBC), serta spesimen daripada koleksi lapangan. Satu analisis filogenetik menggunakan kriteria maksimum parsimoni yang mengandungi 101 ingroup dan 3 outgroup (Pentatomorpha) taxa berdasarkan 61 struktur morfologi telah dijalankan melalui perisian Tree Analysis using New Technology (TNT). Monofili Reduviidae telah disokong baik dengan Pentatomorpha sebagai outgroup mereka. Hasil kajian juga membentangkan monofili Tribelocephalinae, Salyavatinae, dan Ectrichodiinae di dalam satu klad yang sama dengan Physoderinae, Saicinae dan Reduviinae (Acanthaspis quadriannulata). Monofili Harpactorinae dengan Harpactorini berada di kedudukan basal di dalam satu klad dibentangkan. Tambahan pula, sistematik akaun berdasarkan 23 genus dan 52 spesies dari subfamili Harpactorinae dibentangkan. Kunci

kepada genus Harpactorinae disediakan berdasarkan perbandingan struktur morfologi dengan tambahan peta taburan geologi untuk setiap spesies di Sarawak.

Kata kunci: *Sistematik, struktur morfologi, Reduviidae, Harpactorinae, Sarawak*

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LIST OF ABBREVIATIONS

ARC	Agriculture Research Centre
ENSP	Ectrichodiinae species
FRC	Forest Research Centre
HNSP	Harpactorinae species
LED	Light-emitting diode
QGIS	Quantum Geographic Information System
SBC	Sarawak Biodiversity Centre
SEM	Scanning Electron Microscope
SLSP	Salyavatinae species
STSP	Stenopodainae species
TNT	Tree Analysis using New Technology
UIRC	UNIMAS Insect Reference Collections

CHAPTER 1

GENERAL INTRODUCTION

1.1 Introduction

Reduviidae, or commonly known as the assassin bugs, is a family of terrestrial predators within suborder Heteroptera (Insecta: Hemiptera) with almost to 7,000 species worldwide. Reduviidae is well known as the second largest, after Miridae, and one of the most diverse families of true bugs with their diversity was mostly found in the tropics (Patterson, 2007; Swanson, 2011; Weirauch, 2008).

The members of assassin bugs are predaceous on other insects and zoophagous although some of the species are found feeding on the blood of mammals and birds (Biswas & Mitra, 2011; Froeschner, 1985; Grimaldi & Engel, 2005; Patterson, 2007; Triplehorn & Johnson, 2005). Some members of Reduviidae are valuable as a control agent for specified pests or also known as a biological control agent due to their habit on preying other insects.

Wygodzinsky and Usinger (1960) has described Reduviidae according to the following characters: 1) body elongate-oval or slender; 2) legs variously incrassate and sometimes spines; 3) rostrum three-segmented, stout and curved, the tip reaching prosternal stridulatory sulcus; 4) antennae four-segmented except in the Ectrichodiinae, where eight segments are visible; 5) head divided behind eyes by transverse sulcus; 6) abdominal spiracles 2 to 7 ventral; 7) hemelytra without cuneus; 8) adults with metathoracic scent gland openings concealed in acetabula of hind coxae; and 9) eggs with distinct cap or lid.

Systematics is the study of organismal diversity and understanding biological phenomena in an evolutionary context, whether based on molecular data or morphology, which it

depends on the study (Gullan & Cranston, 2010; Hwang, 2012; Simola, 2005). Based on three different studies, Reduviidae has shown to be a monophyletic group (e.g. based on morphological characters performed by Weirauch (2008), based on molecular data (Hwang and Weirauch, 2012), and a combination of both morphological characters and molecular data by Schuh et al. (2009). However, there are significant difficulties in establishing generic limits of genera in the family Reduviidae as it is the second largest family of the suborder Heteroptera, and some information and description of genera are inadequately defined.

In this study, a total of 101 species, 50 genera and 12 subfamilies of Reduviidae from four institutions: 1) UNIMAS Insect Reference Collection (UIRC); 2) Forest Research Centre (FRC); 3) Semongok Agriculture Research Centre (ARC); 4) Sarawak Biodiversity Centre (SBC), and four new field collections: 1) PPB Oil Palm Plantations, Miri; 2) Borneo Highland, Padawan; 3) Santubong National Park, Kuching; and 4) Sri Aman were examined and documented. However, there are 44 species that could not be identified due to lack of literature on the identification of true bugs from this region. A total of 101 species of Reduviidae were used in the phylogenetic study using Tree Analysis using New Technology (TNT) based on 61 morphological characters, which include colouration, structures, and vestiture.

On the other hand, the systematics revision of Reduviidae mainly focused on the subfamily Harpactorinae, the largest subfamily within Reduviidae, and the most collected specimens from the institutions and field collection with a total of 23 genera and 52 species, including 22 undescribed species. A key to the genera of Harpactorinae is provided based on the comparative morphological structures; with additional geological distribution map

constructed using QGIS of each Harpactorinae species in Sarawak.

The third chapter of this project focuses on the phylogenetic relationships of family Reduviidae from Sarawak. Specific objective is to study the relationship among the subfamilies of reduviids from Sarawak using morphological data. The fourth chapter discusses on the systematic revision of the subfamily Harpactorinae in Sarawak.

1.2 Problem Statement

The true bugs (Heteroptera) are known to be abundant and well distributed throughout the world. The heteropteran normally act as biological control agent, predatory of insect pest and also as bio-indicator to the environmental pollution. Although several studies had been conducted on this group, the systematic of the true bugs in Malaysia are inadequately defined and the knowledge on the morphology of this local species is limited. Until now, there is no study that has been done on the systematics and phylogeny of heteropterans in Sarawak. The majority of published studies on the systematics and phylogeny of the true bugs focus on the Palaearctic, Afrotropical, Nearctic and Australian regions. This study will cover important information such as external morphology features, as well as species redescription of the family Reduviidae. This information will provide a baseline data for future reference, management and conservation of the insect fauna in this country. In addition, these findings will be useful as the fundamentals to the ecological and pest management studies of heteropteran in the future and will make a significant contribution to worldwide studies of Reduviidae.