UNIVERSITI PUTRA MALAYSIA

TAXONOMY OF SUBFAMILIES MELOLONTHINAE AND RUTELINAE IN MALAYSIA

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FP 2016 64

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By

ALI MOHAMMAD AMEEN ABDULLAH

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Master of Science

November 2016

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DEDICATION

To my late father Mohammed Ameen His words of inspiration and encouragement in pursuit of excellence, still linger on. I would express my full gratitude for my beloved wife who helped me all the time. Similarly, many thanks go to my father and brothers who supported me with prayers and endured the pain of being away for three years. My friends, who helped me with all what they got, are people whom I will never forget.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the Degree of Master of Science

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November 2016

Chairman : Associate Professor Nur Azura Adam, PhD
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Most of the species in Scarabaeidae are economically important all over the world and especially in Southeast Asia. Hence, it is important to identify, construct keys and also develop a checklist of Malaysian Melolonthinae and Rutelinae. This study establishes the current taxonomical status of 15 species of these two subfamilies in Malaysia. A total of 320 specimens were collected from 10 states (Selangor, N. Sembilan, Melaka, Johor, Pahang, P. Pinang, Kedah, Perak, Sabah and Sarawak), 22 area and 72 sampling points. Four species recorded for the first time in Malaysia: *Anomala shainica*, *Mimela malaise*, *Schoenherria vervex*, *Lepidiota leai*. All genera and species have been described and illustrated. Taxonomic keys were constructed based on morphological characters particularly the mouth part, pronotum, elytra, front tibia and male genitalia. The latest checklist was developed for Malaysian Melolonthinae and Rutelinae. The total number of Melolonthinae species is 166 belonging to 22 genera and the total number of Rutelinae species is 165 belonging to 14 genera. Therefore this study successfully provides a taxonomical information on both subfamilies in Malaysia which will be a basic knowledge for further applied field studies.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Sarjana Sains

TAKSONOMI SUBFAMILI MELOLONTHINAE DAN RUTELINAE DI MALAYSIA

Oleh

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Kebanyakan species Scarabaeidae mempunyai kepentingan ekonomi di seluruh dunia khususnya di Asia Tenggara. Sehubungan dengan itu, adalah penting untuk mengcam, membina kekunci dan membangunkan senarai semak spesies Melolonthinae dan Rutelinae di Malaysia. Kajian ini telah mengemaskini kini status taksonomi 15 spesies daripada kedua-dua subfamili tersebut di Malaysia. Sejumlah 320 spesimen telah dikumpul dari 10 negeri (Selangor, N. Sembilan, Melaka, Johor, Pahang, P. Pinang, Kedah, Perak, Sabah dan Sarawak), 22 kawasan dan 72 titik persampelan. Empat spesies merupakan rekod baharu di Malaysia iaitu *Anomala shainica*, *Mimela malaise*, *Schoenherria vervex*, *Lepidiota leai*. Semua genus dan spesies telah diperihal dan diilustrasikan. Kekunci taksonomi telah dibina berdasarkan ciri morfologi seperti bahagian mulut, pronotum, elytra, tibi hadapan, genitalia jantan dan sayap belakang. Senarai semak terkini telah dibangunkan bagi Melolonthinae dan Rutelinae Malaysia. Sebanyak 166 spesies daripada 22 genus di bawah subfamili Melolonthinae, Manakala sebanyak 165 spesies daipada 14 genus merupakan spesies Rutelinae. Kajian ini telah berjaya menyediakan maklumat taksonomi bagi kedua-dua subfamili di Malaysia yang akan menjadi pengetahuan asas bagi kajian gunaan akan datang.

ACKNOWLEDGEMENTS

All praise and gratitude for the beloved Allah; the Compassionate, the Merciful.

This work would have been impossible without the continuous support and supervision of my supervisor, Associate Professor Dr. Nur Azura Adam. All steps taken on the way to finishing this thesis were under her direct guidance and also the other members of my supervisory committee, Professor Dr. Rita Muhamad Awang and Dr. Azman Sulaiman. I am also thankful Mr. Hishamuddin Zainuddin, for the laboratory assistant, and endured with great patience in all my laboratory tasks.

I would like to express my sincere gratitude to Dr. Julio Ferrer who invited me to the Swedish Natural History Museum.

I thank the individuals who helped my field sampling Dr. Azman Sulaiman and and Mr. Audi.

I certify that a Thesis Examination Committee has met on 29 November 2016 to conduct the final examination of Ali Mohammad Ameen Abdullah on his thesis entitled "Taxonomy of Subfamilies Melolonthinae and Rutelinae in Malaysia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Background of the study

The order Coleoptera contains the largest number of described species of insects and is found in almost every habitat of the word, the superfamily Scarabaeoidea forms a distinct natural group within order Coleoptera that has been recognized since the earliest days of systematic (Houston, 1992). The cosmopolitan Scarabaeidae is so far the largest family of the Scarabaeoidae with a world fauna of about 2300 genera and 27000 species. They are commonly referred as scarab beetles that include dung beetles, chafers or flower beetle and occupy major portion (%91) in superfamily Scarabaeoidea. It is further sub-divided into subfamilies of Scarabaeinae, Melolonthinae, Dynastinae, Rutelinae, Cetoniinae, Trichiinae and Valginae that consist of approximately 20950 species (about % 69 of scarabaeoids and %75 of Scarabaeidae) (Houston, 1992).

Beetles of this family are popular for their bright colors and the large horns of some groups. Their larvae which is known as white grub commonly attack on sugarcane in tropical Asia and Australia (Hill, 2008). The size of these beetles varies greatly from 1.9 mm for *Pleurophorus longulus* to 150 mm for *Goliathus* sp, which is probably the largest insect on earth. The scarabs contain some of the most destructive beetles, such as the Japanese beetle *Popillia japonica,* the Asiatic garden beetle *Maladera castanea* and the European chafer *Amphirnallon majalis*. These belong to a group of scarabs that feed primarily on live plant matter as adults however their larvae usually feed on plant roots or rotting wood (McNamara, 1991). About 600 genera of scarab beetles are found world wide and the two most significant genera of subfamily Scarabaeidae are *Phyllophaga* and *Lepidiota*. Due to their nocturnal feeding activities and their abundance may results in complete defoliate deciduous tree (Hill,2008).

Melolonthinae is the largest subfamily of Scarabaeidae with 750 genera and 11000 species recorded worldwide (Houston, 1992). These are commonly called chafers (Cockchafers) with dull brown coloured beetles, rounded body with fat on surface and nocturnal in nature. Their larvae are serious soil pests eating roots and adults have strong mouthparts thus eat leaves and sometimes young fruits. The subfamily includes an important number of different genera such as *Melolontha, Serica, Holotrichia, Leucopholis* and *Dermolepida* (Hill, 2008). Simiarly, another imperative subfamily of Scarabaeidae is Rutelinae that contains about 200 genera and 3800 cosmopolitan insect species. Generally, these are called Flower and June Beetles, nocturnal in nature and attractive towards light. Adults have well-developed mouthparts and may defoliate most crops and ornamentals by eating both leaves and flowers. The most common genera in this subfamily are important pests including *Adoretus*, *Anomala* and *Popillia* (Hill, 2008).

These two subfamilies were selected in this study due to their economic importance and largely distribution in Malaysia. For example the Cocoa White Grub was first found at Ranau, Sabah and Serian, Sarawak, in Peninsular, this pest was reported to infest young cocoa trees at Kuala Lipis, Pahang and Lenggong, Perak (Saripah, 2012).

Almost every part of a tree can serve as food for insects, and some of the more common groups associated with damage as the genus *Anomala* which is common throughout S.A.E. and especially Malaysia the adult beetles of many species are defoliators of forest trees, while the soil-dwelling larvae or white grubs are sometimes pests of nursery stock, beetles swarm at dusk in May and July, the earliest activity occurring after the first showers of the monsoon season, pairing and egg laying take place throughout this period, eggs are laid singly at night in soil at a depth of 5–8 cm, and one female may lay 30 eggs, the larva tunnels through the soil, eating the fine roots of plants and decaying vegetable matter, and completes its development in about 9 months, pupation takes place in the shelter of the larval skin and may last a month, the immature beetle remains in the soil until suitable climatic conditions stimulate emergence and flight, the generation is usually annual (Wylie & Speight, 2012). Also larvae of some species such as *Lepidiota* spp., feed on the root systems of young trees, often ring-barking and severing the stems below ground, such insects are commonly referred to as white grubs or curl grubs and are important pests in nurseries and young plantations (Wylie & Speight. 2012).

One of the main problems in raising plantations, and mortalities of up to 20% have been recorded, there are numerous species of white grubs which cause this problems in nurseries but some of the most frequently recorded belong to the genera *Lepidiota*, *Anomala*, *Leucopholis* and *Holotrichia* (Bandara, 1990). The larvae of some species of scarab beetles damage trees by feeding on the roots, often ring-barking and severing the stem below ground level, usually white grubs or curl grubs, these insects are important pests of seedlings in forest nurseries worldwide, they live in the soil, feeding on organic plant matter when young and later on plant roots, they migrate through the soil profile in response to temperature extremes and soil conditions, and the larval stages in some species occupy up to 2 years, in nursery beds, injury is usually first recognized when patches of previously healthy seedlings begin to exhibit drought like symptoms, turn a faded green to brown colour and die, these seedlings are pulled out of the soil easily with a gentle tug, revealing damaged root systems , some species feed on the leaves of trees and occasionally can cause severe damage, the life cycle of most species lasts 1–2 years (Wylie & Speight. 2012).

1.2 Significance of the study

The most of the species in Scarabaidae are economical important such as in genera *Lepidiota* (sub family Melolonthinae) *Lepidiota mansueta* Burmeister (white grub) has recently been reported causing sever damage to many field crops including sugarcane, potato, *Colocasia* and green grams (Bhattacharyya *et al.,* 2010). However, many adults of variable species (*Diphucephala, Heteronyx, Liparetrus and*

Phyllotocus) in subfamily Melolonthinae (Lawrence & Britton, 1991) and Rutilinae i.e *Repsimus sp.* (Moore, 1986) are humourless leaves feeder of eucalypts and other trees and can be serious defoliators. Due to their economic damages caused by these species, it is essential to conduct a study for their proper identification. However, there is still a gap in their taxonomical study of the insect species from these subfamilies especially in Malaysia therefore it is an important to identify these species in order to control their damages.

To date, there has been no extensive revision of many genera of these two subfamilies; this study provides an opportunity to really revise the status of the genera, their species, and their geographical distribution within Malaysia. It is envisaged that this study would provide significant contribution in response to the Agenda 21. The contribution would obviously include appraisal of the status of the genera and their species (in relation to closely related genera and the species), description of the genera and their species, based on diagnostic morphological characters as well as male genitalia differences, updating of geographical distribution, and also a checklist of Malaysian Melolonthinae and Rutelinae which is the only one of its kind in Malaysia.

1.3 Research Objective(s)

1- To identify and construct the keys of the species of subfamily Melolonthinae and Rutelinae in Malaysia.
2- To describe and illustrate the morphological characteristics including genitalia of each species.
3- To develop a checklist of Malaysian Melolonthinae and Rutelinae.

1.4 Outline of thesis

This thesis is divided into five chapters. After an introductory chapter, Chapter 2 presented some background of the research with literature addressing two important topics of taxonomy and key constructing. In Chapter 3, material and methods are presented however Chapter 4 postulated the construction of the keys of each species, identification, description and illustration, checklist of Malaysian Melolonthinae and Rutelinae. Finally, in Chapter 5, summary of this study and recommendations for future research have been presented.

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LIST OF PUBLICATIONS

Ferrer, J., Castilla, A. M., Hawez, D., Abdulla, A. M. A., & Al-Hemaidi, A. A. M. (2014). Contributions to the Knowledge of the genus Scaurus Fabricius, 1775 (Coleoptera, Tenebrionidae) with description of the new species from Qatar (Scaurus qataricus n. sp.) and from Cyprys (Scaurus nielseni n. sp.).*Boletín de la SEA*, (55), 53-65.

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