

ABSTRACT

Family Acrididae encompassed of the short-horned grasshoppers and locusts belonging to the suborder Caelifera with over 28 subfamilies, 1,400 genera and 6,700 valid species described, distributed across the world. However, knowledge on the phylogeny and systematics of the family were still lacking in the Bornean region, although other documentations relation to their composition, diversity and ecology have been reported. Most studies on phylogeny and systematics of Acrididae were centralised on the Western world. Plus, the relationship between members of the family had always been ambiguous as family Acrididae were used as the taxonomic dumping group for aberrant species, thus leading to conflicting taxonomic theories by different researchers. Thus, the goal of this study is to describe the species within family Acrididae in Malaysian Borneo, record their distributions and build taxonomic keys for the family represented by the eastern region of Malaysia. Next, this study aims to construct the phylogeny within subfamilies of Acrididae from Malaysian Borneo by using morphological data. The systematics study was based on an examination of voucher specimens from several different institutions in Malaysian Borneo, as well as new collections. A total of 1,216 acridoid specimens represented by 28 species of 20 genera from five subfamilies were successfully examined, with no new species recorded. Phylogenetic analysis using neighbour-joining and maximum parsimony consisting of 100 morphological characters coded based on 28 ingroups and two outgroups (Pyrgomorphidae) were performed using Phylogenetic Analysis Using Parsimony (*and Other Methods) (PAUP*) and Tree Analysis Using New Technology (TNT) software. The result deduced a monophyletic Acrididae when rooted with the sister group, Pyrgomorphidae, although paraphyly were rampant throughout subfamily Acridinae, Catantopinae, Cyrtacanthacridinae, and Oedipodinae, while Oxyinae was deduced to be

monophyletic on the basal position of the clade. Additionally, systematics revision based on 28 species of 20 genera were presented. Dichotomous key to the subfamilies of Acrididae based on comparative morphology study, as well as habitus-coloured photographs and geological distribution maps for all species documented in Malaysian Borneo were provided. The outcomes of this study were hoped to benefit in providing baseline data for taxon sampling in future studies, adding new insights on the phylogenetic relationships between subfamilies of Acrididae based on sampled taxa in Malaysian Bornean region, as well as revising the documentation of the family recorded from Sabah and Sarawak while contributing worthwhile knowledge to the studies of Acrididae worldwide.

Keywords: Acrididae, phylogeny, Sarawak, short-horned grasshoppers, systematics

Sistematik dan Filogeni Belalang Tanduk Pendek dan Belalang Juta (Orthoptera: Acrididae) dari Malaysia Timur

ABSTRAK

*Famili Acrididae merangkumi belalang tanduk pendek dan belalang juta daripada suborder Caelifera merangkumi 28 subfamili, 1,400 genus dan 6,700 spesies sah yang telah dilaporkan dengan populasi menyeluruh di serata dunia. Namun begitu, pengetahuan mengenai filogeni dan sistematik famili ini masih sangat terbatas di wilayah Borneo, walaupun maklumat lain mengaitkan komposisi, kepelbagaian spesies dan ekologi famili tersebut telah direkodkan. Kebanyakan kajian mengenai filogeni dan sistematik famili Acrididae hanya bertumpu di dunia Barat. Tambahan pula, hubungan di antara ahli dalam famili ini sentiasa tidak jelas kerana selalu digunakan sebagai kumpulan lambakan taksonomi untuk spesies aberan, sekaligus menyumbang kepada percanggahan teori taksonomi dalam kalangan penyelidik. Oleh itu, matlamat kajian ini adalah untuk menerangkan spesies dalam famili Acrididae di Malaysia Timur, merekodkan taburan dan membina kekunci taksonomi bagi famili ini yang diwakili oleh wilayah timur Malaysia. Seterusnya, kajian ini juga bertujuan untuk membina filogeni di antara subfamili dalam Acrididae dari Malaysia Timur dengan menggunakan data morfologi. Kajian sistematik ini dijalankan berdasarkan pemeriksaan spesimen baucar dari beberapa institusi di Malaysia Timur, serta pengumpulan spesimen tambahan. Sebanyak 1,216 spesimen diwakili oleh 28 spesies daripada 20 genus dan lima subfamili telah berjaya diperiksa, tanpa ada rekod mengenai spesies baharu. Analisis filogenetik menggunakan kelompok kejiranan dan parsimoni maksimum menerusi 100 ciri morfologi yang disenaraikan berdasarkan 28 spesies dalam kumpulan dan dua spesies di luar kumpulan (Pyrgomorphidae) dicapai melalui perisian Phylogenetic Analysis Using Parsimony (*and Other Methods) (PAUP*)*

dan Tree Analysis Using New Technology (TNT). Hasil kajian menunjukkan hubungan monofiletik famili Acrididae sekiranya kumpulan terdekat, famili Pyrgomorphidae digunakan sebagai kumpulan luar bagi pembinaan topologi pohon. Parafili pula meluas dalam subfamili Acridinae, Catantopinae, Cyrtacanthacridinae, dan Oedipodinae, sementara Oxyinae disimpulkan sebagai monofiletik yang terletak di tapak klad. Tambahan pula, semakan sistematik berdasarkan 28 spesies diwakili oleh 20 genus telah disediakan. Kekunci dikotomi kepada famili Acrididae berdasarkan morfologi perbandingan, serta fotograf habitus berwarna dan peta taburan geologi untuk semua spesies yang direkodkan di Malaysia Timur juga telah disediakan. Hasil kajian ini diharap dapat membantu untuk menyediakan data asas bagi pensampelan taksa untuk kajian akan datang, menguatkan fahaman ke atas hubungan filogeni antara subfamili dalam Acrididae berdasarkan taksa sampel di kawasan Malaysia Timur, dan mengemaskini dokumentasi famili tersebut yang direkodkan di Sabah dan Sarawak, serta menyumbang kepada pengetahuan tentang kajian ke atas Acrididae di serata dunia.

Kata kunci: Acrididae, filogeni, Sarawak, belalang tanduk pendek, sistematik