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Diversity of Scarab Fauna (Coleoptera: Scarabaeidae) – Importance and Implications

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Scarab fauna include most economically important dung rollers and white grubs, which are diverse and speciose. These belong to the family Scarabaeidae of Coleoptera. The dung beetles or dung rollers being beneficial play an important role in cleaning the debris/faeces and thus improve the soil structure and fertility through nutrient recycling. On the other hand white grubs are destructive and herbivores causing damage to the plants of several commercial agricultural and horticultural crops affecting the yields. Understanding the species diversity of the dung rollers and white grubs aids in conservation of the former group and management of the latter for the benefit of all lives on this earth. The chapter focuses on the classification, diversity and its importance of both the groups.

Introduction

Scarabaeids belonging to the family Scarabaeidae of Coleoptera comprises of both beneficial coprophagous and harmful phytophagous groups. The former is known as Laprosticti and the latter as Pleurosticti. The family belongs to the superfamily Scarabaeoidea, which is one of the largest superfamilies of the order Coleoptera. It constitutes a very diverse and cosmopolitan group comprising of nearly 31,000 species world wide of which Scarabaeidae constitutes about 91% representing 27,800 species worldwide (Ratcliffe and Jameson, 2004). The superfamily Scarabaeoidea is divided into 12 families, 43 subfamilies, 118 tribes and 94 subtribes (Smith *et al*., 2006) of which Scarabaeidae is the largest family. The scarab species are widely adapted to most terrestrial habitats comprising of phytophages, fungivores, herbivores, necrophages, coprophages and saprophages and are ubiquitous. The degradation of natural habitats and changes in the land use patterns are posing threat to the biodiversity worldwide (Newbold *et al*., 2015). The conservation of dung beetles and management of white grubs is utmost crucial and understanding the diversity (both alpha and beta) will help in working towards the targeted goals. The decline in species richness of the dung beetles will threaten their functionality and the ecosystem services rendered (Verdu *et al.,* 2020). So, the present chapter presents a brief overview with respect to the classification and diversity of coprophagous and phytophagous groups of Scarabaeidae.

Classification

Scarabaeidae is the largest family of Scarabaeoidea and according to Lawrence and Newton (1995), it comprises of 11 subfamilies *viz.,* Melolonthinae, Rutelinae, Dynastinae, Cetoniinae, Scarabaeinae, Aphodiinae, Trichiinae, Valginae, Aclopinae, Orphininae and Allidiostomatinae while Grebennikov and Scholtz (2004) recognized 13 subfamilies, Aphodiinae, Scarabaeinae, Pachypodinae, Orphininae, Allidiostomatinae, Dynamopodinae, Aclopinae, Euchiriinae, Phaenomeridinae, Melolonthinae, Rutelinae, Dynastinae and Cetoninae and Smith (2006) documented 16 subfamilies, 82 tribes and 94 subtribes under Scarabaeidae. In earlier classification of Ritcher (1966) and Booth *et al*. (1990), Scarabaeidae comprised of six major subfamilies *viz.,* Scarabaeinae, Aphodiinae, Cetoniinae, Rutelinae, Melolonthinae and Dynastinae, where the former two are grouped as Laprosticti that are coprophagous and latter four are grouped as Pleurosticti that are phytophagous. The four groups *viz.,* Scarabaeinae, Rutelinae, Cetoniinae, Dynastinae along with the small subfamily Euchirinae of the Indian subcontinent were comprehensively explored taxonomically by Arrow (1910, 1917 and 1931) in the three volumes of his 'Fauna of British India' series. Other major groups of taxa that require comprehensive taxonomic treatises are Melolonthinae and Aphodiinae.

The beetles belonging to Laprosticti are primarily dung feeders, while that of Pleurosticti are phytophagous. Among the Pleurosticti, Melolonthinae, Rutelinae and

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few species of Dynastinae comprises of white grubs where either or both larval and adult stages are phytophagous in nature. In certain species of Dynastinae and Cetoniinae, the adults form the damaging stages and their larvae feed on soil organic matter or humus (detrivorous). Of all, Melolonthinae is the largest subfamily comprising of 10 tribes *viz.,* Oncerini, Podolasiini, Sericini, Melolonthini, Diplotaxini, Pachydemini, Dichelonychini, Macrodactylini, Lichniini and Hopliini (Evans and Smith, 2009) followed by Rutelinae. Aaccording to several workers, Melolonthinae comprises of 10 to 13 tribes, of which Melolonthini, Sericini, Diplotaxini, Macrodactylini, Hopliini (Sabatinelli, 1993) are known to occur in India. A comprehensive work on Indian Sericini was carried out by Ahrens and Fabrizi (2016).

Species Diversity in India

The fauna of the Indian subcontinent is very prosperous and diverse, yet to be fully explored. The estimated species of Laprosticti Scarabaeidae will be around 6500+ worldwide, precisely 6,200 species covering 267 genera (Tarasov and Genier, 2015). Pleurosticti Scarabaeidae constitutes nearly 25,000 described species worldwide (Scholtz and Grebennikov, 2005) and occupies more than two thirds of all species of Scarabaeoidea (Ahrens and Vogler, 2008). The maximum number occurs in the tropical areas of the world, particularly in the African and Oriental regions. Ali (2001) reported that the family Scarabaeidae represents about 2500 species from the Indian subcontinent, of which two-thirds are white grubs. Pleurosticti Scarabaeidae include four subfamilies *viz.,* Melolonthinae, Rutelinae, Dynastinae, and Cetoniinae, of which Melolonthinae is the largest subfamily with 750 genera and 11,000 species known to occur in the world and 75 genera with 932 species in India (Houston and Weir, 1992).

An account on diversity of Coprinae belonging to Laprosticti scarab fauna (Arrow, 1931) and the most exhaustive account on Pleurosticti scarab fauna of India and adjacent countries was published by Arrow (1910, 1917) in 'Fauna volumes of British India' wherein 690 species under five subfamilies namely Cetoniinae (241 species), Dynastinae (46 species), Rutelinae (398 species), Desmonychinae (1 species) and Euchirinae (4 species) have been included. Desmonycinae erected by Arrow (1917) as a monotypic taxon with a single genus *Desmonyx* Arrow is unique to Indian subcontinent, which is now merged with Rutelinae by certain workers (https://sv.wikipedia.org/wiki/Rutelidae) and the Desmonycini Arrow is treated as a tribe of Rutelinae.

The second largest subfamily is Rutelinae, and it comprises approximately 200 genera and 4,100 species worldwide (Machatschke, 1972). The subfamily is divided into six tribes, five of which occur in the New World. The tribe Spodochlamyini is found only in Central and South America; the tribe Anoplognathini occurs in Australia and Western Central and South America; the tribe Geniatini is distributed in Central and South America; the tribe Rutelini is widely distributed, but is most speciose in the Neotropics; the tribe Anomalini is widely distributed and is most speciose in the Old World. The tribe Adoretini is exclusively distributed in the Old World. Five tribes Peltonotini, Paratasiini, Anomalini, Adorrhinyptiini and Adoretini are known to occur in India (Arrow, 1917). The economically important genus *Anomala* comprises of 800 species in the Old World (Jameson *et al.,* 2003). Majority of the Ruteline species in India belong to tribes Anomalini and Adoretini. Arrow (1917) reported 398 species to occur in British India, of which 261 species belong to genera *Anomala* and *Adoretus*.

Importance and Implications

Coprophagous: Dung beetles are economically important species that uses the dung of mammals for feeding and nesting. Thus primarily they aid in cleaning the debris by breaking, disintegrating and recycling into the soil. This is an important ecosystem service rendered by these dung beetles. While carrying and decomposing the dung balls, inadvertently the dung beetles disperse the seeds thus indirectly contributing to the multiplication of the plant species diversity. The soil structure is improved by the organic carbon incorporated into the soil through decomposed dung balls. Another added advantage of timely decomposition of dung and faeces is reduction of parasitic flies that are harmful to the livestock and human beings. Certain dung beetles also serve as good bioindicators and thus assessing the coprophagous scarab diversity aid in conserving these dung beetles, which has its multitude benefits.

Phytophagous: White grubs that cause damage to the commercial crops like sugarcane, groundnut, potato, maize, arecanut, soybean, turmeric, ginger, etc. by feeding on the underground portion of the plant at larval stages and aerial parts by the adult beetles are of serious concern. The yield losses by these white grubs

are estimated to range from 40-70% in different crops at different locations in India. The management of the white grub population below the economic threshold level is need of the hour to save the yield losses. In this direction, documentation and knowledge on the diversity and predominance of the white grub species helps in strategizing and timing the management practices in the specified crop and locations.

Conclusion

The diversity in any insect group is yet to be fully explored but specifically in scarab diversity, more explorations and at faster pace needs to be taken up to address the challenges associated with its functional importance. Documentation of the species diversity is the baseline for any further scientific studies that supports database generation. Ahrens and Fabrizi (2016) monograph on Indian Sericini has given a comprehensive account, after which the explorations and taxonomic studies revealed 23 new species of white grubs belonging to tribe Sericini (Sreedevi *et al.,* 2018; Sreedevi *et al.,* 2019; Chandra *et al.,* 2021). This gives us a strong indication of much more taxa to be discovered to explore the diversity. Concerted efforts are to be made towards documenting the dung beetles and white grub diversity of Indian fauna.

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