

**TAXONOMY AND ECOLOGY OF PADDY FIELD ASSOCIATED
PAEDERINAE (COLEOPTERA: STAPHYLINIDAE)
IN PALAKKAD AND WAYANAD DISTRICTS**

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Under the faculty of Science

By

KAVYAMOL P M

Under the Guidance of

Dr. VINEESH P J



PG & RESEARCH DEPARTMENT OF ZOOLOGY

ST. JOSEPH'S COLLEGE (AUTONOMOUS), DEVAGIRI, CALICUT, KERALA.

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ST. JOSEPH'S COLLEGE (AUTONOMOUS),
DEVAGIRI, CALICUT, KERALA, INDIA

*Re-accredited by NAAC with A++
Affiliated to the University of Calicut*

Prof (Dr.) Vineesh P. J.
Department of Zoology
Email: vineeshpj@gmail.com

CERTIFICATE

This is to certify that the Ph.D. thesis entitled **TAXONOMY AND ECOLOGY OF PADDY FIELD ASSOCIATED PAEDERINAE (COLEOPTERA: STAPHYLINIDAE) IN PALAKKAD AND WAYANAD DISTRICTS** is an authentic record of the original research work accomplished by **Ms. KAVYAMOL P M** under my supervision and guidance at the PG & Research Department of Zoology St. Joseph's College (Autonomous) Devagiri, Calicut, Kerala and that no part of this thesis has been published earlier for the award of any other degree or diploma. Also certified that the contents in the thesis have subjected to **Plagiarism Check** using the software **iThenticate** and that no text or data is reproduced from other's work.

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Place: Devagiri

Date: 23/06/2026

Prof (Dr.) VINEESH P J

(Gud)
Prof. (Dr.) Vineesh P.J
Dept. of Zoology (PEN: 469216)
St. Joseph's College, Devagiri
Kozhikode, Kerala, 673008



ST. JOSEPH'S COLLEGE (AUTONOMOUS),
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Place: Devagiri

Date: 23/06/2026

Prof (Dr.) VINEESH P J

(Guide)
Prof. (Dr.) Vineesh P.J
Dept. of Zoology (PEN: 469216)
St. Joseph's College, Devagiri
Kottayam, Kerala, 686008

DECLARATION

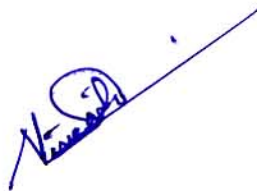
I hereby declare that the work presented in the thesis entitled **TAXONOMY AND ECOLOGY OF PADDY FIELD ASSOCIATED PAEDERINAE (COLEOPTERA: STAPHYLINIDAE) IN PALAKKAD AND WAYANAD DISTRICTS** is based on the original work done by me under the guidance of Prof (Dr.) Vineesh P. J. and has not been included in any other thesis submitted previously for the award of any degree. The contents of the thesis are undergone plagiarism check using iThenticate software at C.H.M.K. Library, University of Calicut, and the similarity index found within the permissible limit. I also declare that the thesis is free from AI generated contents.

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Date: *23/06/2026*



KAVYAMOL P M



Prof. VINEESH P.J
Dept. of Zoology (PEN: 469216)
St. Joseph's College, Devagiri
Kozhikode. Kerala, 673008

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ABSTRACT

Paederinae Fleming, 1821 is the medically and ecologically important subfamily of the family Staphylinidae. This subfamily consists of around 7,600 species in more than 225 genera. Although Paederinae is a diverse group, there is no adequate study on the taxonomy and ecology of this group in Kerala, therefore this study will be remarkable and provide a baseline for future researchers in this field. The present study deals with the taxonomy and ecology of Paederinae in the paddy fields of Palakkad and Wayanad districts. A total of 45 species of Paederinae were identified from four different collection sites (2 sites in Palakkad district: Arayakkad, Pattambi and 2 sites in Wayanad district: Pakkam and Ambalavayal). The most significant findings of this study are the 3 New reports of Paederinae species from India, 10 new reports from south India and 13 new reports Kerala. Checklist, modified taxonomic key and pictorial key for Paederinae in the paddy fields of Palakkad and Wayanad districts is provided. Seasonality, abundance and the influence of environmental factors, which determine the abundance and seasonality were also analysed.

KEYWORDS

Paederinae, new reports, abundance, diversity and seasonality



Kavyamol P M

Research Scholar



Prof. Dr. Vineesh P J

Research Guide

Prof. VINEESH P.J
Dept. of Zoology (PEN: 469216)
St. Joseph's College, Devagiri
Kozhikode, Kerala, 673008

സംഗ്രഹം

സ്റ്റാഫിലിനെഡേ കുടുംബത്തിലെ വൈദ്യശാസ്ത്രപരമായും പാരിസ്ഥിതികമായും പ്രധാനപ്പെട്ട ഉപകുടുംബമാണ് പെഡെറിനേ ഫ്ലൈമിംഗ്, 1821. 225-ലധികം ജനുസ്സുകളിലായി ഏകദേശം 7,600 ഇനങ്ങൾ ഈ ഉപകുടുംബത്തിൽ ഉൾപ്പെടുന്നു. പെഡെറിനേ വൈവിധ്യമാർന്ന ഒരു ഗ്രൂപ്പാണെങ്കിലും, കേരളത്തിലെ ഈ ഗ്രൂപ്പിന്റെ വർഗ്ഗീകരണത്തെയും പരിസ്ഥിതിയെയും കുറിച്ച് മതിയായ പഠനം നടന്നിട്ടില്ല, അതിനാൽ ഈ പഠനം ശ്രദ്ധേയമാകുകയും ഭാവി ഗവേഷകർക്ക് ഒരു അടിസ്ഥാനം നൽകുകയും ചെയ്യും. പാലക്കാട്, വയനാട് ജില്ലകളിലെ നെൽവയലുകളിലെ പെഡെറിനേയുടെ വർഗ്ഗീകരണത്തെയും പരിസ്ഥിതിയെയും കുറിച്ചാണ് പഠനം. നാല് വ്യത്യസ്ത ശേഖരണ സ്ഥലങ്ങളിൽ നിന്ന് (പാലക്കാട് ജില്ലയിലെ 2 സ്ഥലങ്ങൾ: അരയക്കാട്, പട്ടാമ്പി, വയനാട് ജില്ലയിലെ 2 സ്ഥലങ്ങൾ: പാക്കം, അമ്പലവയൽ) ആകെ 45 ഇനം പെഡെറിനേകളെ തിരിച്ചറിഞ്ഞു. ഈ പഠനത്തിലെ ഏറ്റവും പ്രധാനപ്പെട്ട കണ്ടെത്തലുകൾ ഇന്ത്യയിൽ നിന്നുള്ള പെഡെറിനേയുടെ 3 പുതിയ റിപ്പോർട്ടുകൾ, ദക്ഷിണേന്ത്യയിൽ നിന്നുള്ള 10 പുതിയ റിപ്പോർട്ടുകൾ, കേരളത്തിൽ നിന്നുള്ള 13 പുതിയ റിപ്പോർട്ടുകൾ എന്നിവയാണ്. പാലക്കാട്, വയനാട് ജില്ലകളിലെ നെൽവയലുകളിലെ പെഡെറിനേയുടെ ചെക്ക്ലിസ്റ്റ്, പരിഷ്കരിച്ച ടാക്സോണമിക് കീ, ചിത്ര കീ എന്നിവയും നൽകിയിരിക്കുന്നു.

പ്രധാന വാക്കുകൾ

പെഡെറിനേ, പുതിയ റിപ്പോർട്ടുകൾ, സമൃദ്ധി, വൈവിധ്യം, ഋതുഭേദം


കാവ്യമോൾ പി എം
ഗവേഷണ വിദ്യാർത്ഥിനി


പ്രൊഫ്. ഡോ. വിനീഷ് പി ജെ
ഗവേഷണ ഗൈഡ്

Prof. VINEESH P.J
Dept. of Zoology (PEN: 469216)
St. Joseph's College, Devagiri
Kozhikode, Kerala, 673008

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INTRODUCTION

1. INTRODUCTION

Staphylinidae is a family of beetles belonging to the suborder Polyphaga of the order Coleoptera. It is one of the largest and most biologically diverse beetle families (Stašiov *et al.*, 2021). The world fauna consists of more than 63,657 described species of rove beetles (Irmeler *et al.*, 2018). They have fast-moving style and are commonly known as rove beetles (Frank and Thomas, 1999).

The length of adult Staphylinidae ranges from less than 1 mm to 40 mm and most of them are under 7 mm long. They are easily distinguished from other beetles as they have short elytra with exposed abdominal segments, but it would be an error to imagine that all beetles with short elytra belong to the Staphylinidae family. Non-entomologists sometimes confuse Staphylinidae with that of the order Dermaptera (Frank and Thomas, 1999).

Rove beetles are found in almost all habitats viz., tidal zone of seashore (e.g., some species belonging to the tribes Phytosini and Diglottini of Subfamily Aleocharinae, and some species under the tribe Omaliini of Subfamily Omaliinae; Moore and Legner, 1976), mountain-tops (e.g., species under the tribe Coryphiini of the sub family Omaliinae; Zerche, 1990) and the Arctic tundra (e.g., some species under the subfamily Aleocharinae; Lohse *et al.*, 1990). These beetles are not truly aquatic and are rarely seen in very dry habitats. They prefer moist habitats as they provide protection from predation and desiccation (Klimaszewski *et al.*, 1996). Most these beetles are commonly found in leaf litter and decaying plant matter (Ahn *et al.*, 2017). Even though predation is more common, mycophagy, and saprophagy are also widespread types of feeding among Staphylinidae (Thayer, 2005). Most of the rove beetles are generalist predators on insects and other arthropods, (most Aleocharinae,

Philonthus Stephens, 1829, *Staphylinus* Linnaeus, 1758, etc. Mank, 1923; Voris, 1934), but there are so many exceptions. Beetles under the subfamilies like Oxytelinae, Osoriinae, etc., are known to feed on decomposing plant matter (McColl, 1982; Newton, 1984, 1990a, b; Klimaszewski *et al.*, 1996). Members of the Oxyporinae and the Aleocharine subtribe Gyrophaenina are obligate residents of fresh mushrooms, where they are exclusively mycetophagous, feeding on fungal context, hyphae, and spores (Ashe, 1984; Newton, 1984; Leschen and Allen, 1988). All species of Scaphidiinae and some members of other subfamilies are also known to consume various fungi (Newton, 1984). *Aleochara* Gravenhorst, 1802 larvae are ectoparasitoids of dipterous pupae (Fuldner, 1960; Klimaszewski and Jansen, 1993). Rove Beetles that feeds on algae includes Larvae and adults of *Bledius* Leach, 1819 and some other oxytelines, and possibly adults of *Myllaena* Erichson, 1837 (Herman, 1986; Klimaszewski, 1992; Wyatt, 1993). Many beetles under the genera of Omaliinae and *Polylobus* Solier, 1849 (Aleocharinae), are known to feed on pollen (Horion, 1963; Steel, 1970; Thayer, 1977; Klimaszewski and Sturm, 1991). A small number of species belonging to Aleocharine genus *Oligota* Mannerheim, 1830 feed on mites (Williams, 1979; Koch, 1989; Klimaszewski *et al.*, 1996). Due to the cosmopolitan distribution, ecological significance, ecomorphological and behavioural diversity, Staphylinids are becoming an increasingly investigated insect group in the fields of ecology and evolution (Betz *et al.*, 2018; Stašiov *et al.*, 2021). The major groups of Rove beetle in Kerala belongs to the subfamilies Paederinae, Oxytelinae, Staphylininae, Aleocharinae, Tachyporinae, Pselaphinae and Steninae (Personal observation).

Rove beetles are chief component of many agricultural systems in temperate (Bohac, 1999; Andersen and Eltun, 2000; Klimaszewski *et al.*, 2018; Guseva, 2019; Guseva and Koval, 2020) and tropical regions (Cividanes *et al.*, 2009; Martins *et al.*,

2012; Cajaiba *et al.*, 2017). Staphylinids are ecologically relevant as most of these species are generalist predators that eat insects, arachnids and isopods, and therefore play an important role as biological control agents in crops (Dennis *et al.*, 1991; Good and Giller, 1991; Balog *et al.*, 2008; Vizitiu *et al.*, 2022).

Rove beetles are very useful for farmers as they are predators that prey upon agricultural pests. They are the major biological control agents against pest populations in agroecosystems (Klimaszewski *et al.*, 2018). In addition to the benefits they offer to farmers, certain species of them can induce skin irritation known as Paederus dermatitis, which makes them harmful to humans. Some species under the genus *Paederus* Fabricius, 1775 of the subfamily Paederinae are the causative agent of Paederus dermatitis, also known as Spider lick, dermatitis linearis etc. These beetles do not bite or sting, but the accidental rubbing or crushing of the beetle releases hemolymph containing pederin that cause skin irritation.

Paederinae Fleming, 1821 is one of the largest subfamilies of Staphylinidae, and it consists of around 7,600 species in more than 225 genera (Żyła *et al.*, 2019). The very high diversity of species and the limited pool of experts working on this group make Paederinae one of the most challenging subfamilies of rove beetles in terms of their taxonomy and systematics (Żyła *et al.*, 2021).

Paddy fields are one of the chief habitats of Paederinae (Krinsky, 2019). Rice (*Oryza sativa* L.) is the world's principal staple food and it feeds more than half of the world population. India ranks second in rice production after China. Rice fields not only serves the staple food to us but also provides a diverse assemblage of insects to make it a lively ecosystem (Edirisinghe and Bambaradeniya, 2006; Pavithran *et al.*, 2020). Palakkad (Palghat) is known as the 'rice bowl' of Kerala. This district has close proximity to Western Ghats and has extensive paddy fields (Palot *et al.*, 2005). The total area under paddy cultivation in Kerala during the year 2022-2023 is 1.91 lakh Ha

(Prasad and Kuruvila, 2024). In that 73462 Ha of area is in Palakkad district and it is in the top most position for paddy cultivation. Palakkad accounts for 38.2% of the total paddy area in Kerala and 62% of rice grown in Kerala is produced from Palakkad. According to the Agriculture statistics 2018-2019, district wise analysis of wetland paddy area records that, Palakkad district ranks first position with 76,942.68 Ha. (38.85% of total wetland paddy area in the state).

Like Palakkad district, a large area of land in Wayanad is also used for Paddy Cultivation. The name Wayanad is believed to be derived from the word ‘Vayalnadu’, which literally means ‘the land of Paddy fields’ (Pramod, 2013). In Wayanad, paddy is cultivated in 7822 hectares of land and it is in the fifth position for the total area under paddy cultivation in Kerala.

Among the 13 categories given by Kerala Agricultural University 2011, Palakkad comes under Palakkad plains and Wayanad belongs to a high range agro-ecological zone, (Prajeesh *et al.*, 2014). As there are no authentic works on the species composition of Paederinae in different topographic areas of Kerala, this study is relevant in comparing the abundance and diversity of Paederinae beetles in different topographic areas with different temperature, rainfall and relative humidity.

1.1. Taxonomy of subfamily Paederinae

Staphylinidae is one of the largest families under the Super family Staphylinoidea. About 30,000 species are known from the world and more than 3000 species have been reported from India. Motschulsky (1858), Kraatz (1859), Fauvel (1895) and Bernhauer (1915) are the pioneer workers of Staphylinidae. Cameron's work on Staphylinidae fauna of British India, Sri Lanka and Burma series (1930, 1931, 1932) is the most significant Indian Taxonomic literature (Sar and Hedge, 2015).

Paederinae is one of the largest subfamilies of Staphylinidae, which includes around 7,600 species in more than 225 genera (Żyła *et al.*, 2019, 2021). Malcolm Cameron is the pioneer worker in the taxonomy of Paederinae. In 1931, Cameron listed and keyed 321 species of Paederinae, belonging to 33 genera of 2 tribes, in “The Fauna of British India, including Ceylon and Burma”. In that 226 species belonging to 32 genera of 2 tribes are distributed in India. Based on the comparative evolution of the records provided by Cameron (1931) and the catalogue of Lobl & Lobl 2015, a total of 333 species of paederinae were recorded from India. There is no recent taxonomic analysis of the Paederinae beetles in the paddy fields of Kerala. Present study was undertaken to identify the species of Paederinae in the paddy fields of Palakkad and Wayanad and to generate baseline ecological data of these beetles in these regions.

The subfamily Paederinae is characterized by head more or less constricted posteriorly, antennae inserted along the anterior margin of the head, insertions concealed in dorsal view; hind coxa narrow, triangular, its apex strongly projecting posteriorly; pronotum with a large, opaque procoxal process of the pronotal hypomeron (Cameron, 1931; Newton *et al.*, 2000; Cho, 2014).

1.2. Ecology of subfamily Paederinae

Paederinae is the only known medically (Vieira, 2014), economically (Frank and Thomas, 2008) and ecologically (Bohac, 1999) important subfamily of Staphylinidae. The subfamily is distributed worldwide and is found in almost all types of ecosystems (Anlaş and Cevik, 2008). Paederinae staphylinids are usually found under bark, near water, under stones, and in agricultural habitats (Hagen *et al.*, 1999). They are most abundant in areas of moist soil, such as irrigated fields and other crop lands, where the adult beetles prey upon various herbivorous insects (Krinsky, 2019). They are predators that are highly specialized on elusive prey such as Collembola (Stocker *et al.*, 2022). Paederinae have Pre-oral digestion. They hold their food using

mandibles, release digestive fluids and imbibe partially digested food (Frank and Thomas, 2008).

Beneficial and harmful characteristics of Paederinae

Paederinae act as pest (Bong *et al.*, 2015) as well as biological control agent (Zakqy and Wiyatiningsihm, 2023). These beetles prey upon leafhoppers and plant hoppers, which are the significant pests on rice plants (Kavyamol *et al.*, 2024). Besides the beneficial predatory behaviour of Paederinae beetles in controlling the agricultural pests, their high prevalence in residential areas has raised them to pest status even in urban areas, educational institutions, and hospitals.

Paederus dermatitis

Oedemeridae, Meloidae, and Staphylinidae are the three major families of beetles that cause dermatitis or skin irritation in humans. In the Meloidae and Oedemeridae families cantharidin is the vesicant chemical responsible for causing dermatitis, whereas in the Staphylinidae family it is pederin (Uzunoğlu *et al.*, 2017).

The genus *Paederus* is the only known medically important group under Staphylinidae and it is a threat to human beings. These beetles have become a nuisance and great threat to the people of Kerala (Vineesh *et al.*, 2023). *Paederus* beetles live in moist habitats. They are predators found associated with many crop pests. They mainly feed on other insects, moths, soil nematodes, *etc.* and hence act as biological control agents. Proximity to paddy fields is an important reason for the outbreak of *Paederus* beetle dermatitis (Coondoo and Nandy, 2013). Attraction towards light and home invasion of the beetles leads to contact with human beings. When these beetles are crushed on human skin, it releases a toxic haemolymph, a complex of three non-proteinaceous toxins named pederin, pseudopederin and pederone which causes *Paederus* dermatitis and some sporadic cases of conjunctivitis (Vieira *et al.*, 2014).

Pederin is produced by an endosymbiotic bacterium. This vesicant toxin, responsible for Paederus dermatitis, is not synthesised by the beetle itself but is instead generated by a bacterium from the genus *Pseudomonas* Migula 1894 and this bacterium is vertically transmitted within populations of *Paederus* (Karthikeyan and Kumar, 2017; Inbamani *et al.*, 2024). Pederus dermatitis is also known as night burn, spider lick and dermatitis linearis (Nasir *et al.*, 2015).

Outbreaks of dermatitis is reported in various countries including Kenya (Beaulieu and Irish, 2016), India (Mathews *et al.*, 2021; Toppo *et al.*, 2013), Brazil (Vieira *et al.*, 2014), Turkey (Turan, 2014), Australia (McGrath *et al.*, 2013), Central Africa (Verma and Gupta, 2012), France (Drouet *et al.*, 2013), Malaysia (Rahmah and Norjaiza, 2008), Ecuador (Singh and Ali, 2007), Sierra Leone (Qadir *et al.*, 2006), Iran (Zargari *et al.*, 2003), Sri Lanka (Kamaladasa *et al.*, 1997), Nigeria (George & Hart, 1990), Okinawa (Armstrong and Winfield, 1968), Uganda (McCrae and Visser, 1975), Venezuela (Kerdel and Goihman, 1966) and Argentina (Dallas, 1936). *Paederus alternans* Walker, 1858 is reported to cause dermatitis in India (Frank and Kanamistu, 1987), *Paederus tamulus* Erichson, 1840 is reported to cause dermatitis in China (Baba, 1943) and *Paederus nigricornis* Bernhauer, 1911 reported to cause dermatitis in Iran (Nikbakhtzadeh and Tirgari, 2008). These species are also present in India (Cameron, 1931).

Several *Paederus* dermatitis cases have been reported in India especially in the state of Tamil Nadu (Gnanaraj *et al.*, 2007), Madhya Pradesh (Toppo *et al.*, 2013), Rajasthan (Mittal *et al.*, 2013), Andhra Pradesh (Gopal, 2014), Karnataka (Srihari *et al.*, 2017) Telangana (Lakshminarayana, 2018) and from Kerala (Kambil, 2018; Ramakrishnan *et al.*, 2019; Mathews *et al.*, 2021).

Among the 43 *Paederus* species reported from India, Ceylon and Burma (Cameron, 1931), 4 species of *Paederus* (*P. extraneus* Wiedemann, 1823, *P. melampus*

Erichson 1840; *P. fuscipes* Curtis 1826 and *P. alternans* Walker, 1858) causes Paederus dermatitis in different regions of India viz., *P. fuscipes* in Kerala (Ramakrishnan *et al.*, 2019), *P. extraneus* in Karnataka (Taneja *et al.*, 2013), *P. extraneus* and *P. melampus* in Andhra Pradesh (Gopal 2014.) *P. fuscipes* in Madhya Pradesh (Toppo *et al.*, 2013).

1.3. OBJECTIVES

- Taxonomic identification of Paederinae in the paddy fields of Palakkad and Wayanad districts
- Preparation of a revised Key for the identification of Paederinae in the paddy fields of Palakkad and Wayanad districts.
- Preparation of a Pictorial Key for Paederinae in the paddy fields of Palakkad and Wayanad districts
- Prepare a checklist of Paederinae in the paddy fields of Palakkad and Wayanad districts
- Record the abundance of Paederinae in the paddy fields of Palakkad and Wayanad districts
- Record the seasonality of Paederinae in the paddy fields of Palakkad and Wayanad districts
- Record the influence of environmental factors, which determine the abundance and seasonality of Paederinae in the paddy fields of Palakkad and Wayanad districts

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REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

2.1. WORLDWIDE STUDIES ON THE TAXONOMY OF PAEDERINAE

In *Systema Naturae*, Linnaeus (1758) described 19 species of Staphylinidae and placed them in the genus *Staphylinus* Linnaeus. He was the first to use the word Staphylinus to refer to rove beetles. In 1775 the Danish Zoologist Johan Christian Fabricius (1775) first described the genus *Paederus*.

Nordmann 1837 first created the tribe Pinophilini, and in 1839, Erichson created the tribe Paederinae. In 1895, Ganglbauer combined the Pinophilini and Paederini groups to form the Paederinae subfamily. Bierig, 1943 created the tribe Cylindroxystini, but this tribe wasn't mentioned again until the revision of Herman, 1991 where he downgraded the tribe Cylindroxystini into a subtribe Cylindroxystina. Jeannel and Jarrige (1949) modified the tribal system of Paederinae by dividing the tribe Paederini into Paederini and Lathrobiini. Ganglbauer's system of Paederinae with these two tribes (Pinophilini and Paederini) was followed by numerous researchers including Cameron 1931 but in 2017, Schomann and Solodovnikov proposed that Paederinae could be divided into four tribes: Cylindroxystini, Lathrobiini, Paederini, and Pinophilini and, the most recent phylogenetic analysis of the Paederinae, conducted by Żyła *et al.*, in 2021, lowered the number of tribes from four to three i.e., Pinophilini, Paederini and Lathrobini.

Herman *et al.*, (1969) described a troglobitic staphylinid (Paederinae). Kasule (1970) examined the larvae of Paederinae and Staphlininae and provided keys to the known British genera. In 1970, Herman discussed the ecology, phylogeny, and taxonomy of Stilicolina. He has also done Generic revision of the *Stereocephalus* Lynch, 1884; subtribe *Procirrina* and genus *Oedichirus* Erichson, 1839 (Herman, 1979, 2010, 2013). Herman also revised the Paederinae subtribes Dolicaonina,

Cylindroxystina, Scopaeina and Sphaeronina (Herman, 1981, 1991, 2023). Frania (1986) described Larvae of *Eustilicus* Sharp 1886, *Rugilus* Leach 1819, *Deroderus* Sharp 1886, *Stilocharis* Sharp 1886, and *Medon* Stephens 1833 and their phylogenetic significance. Campbell and Peck (1989) described and illustrated *Pinostygus galapagoensis*, a new genus and species of eyeless rove beetle. In 1992, Drugmand revised the genus *Monocrypta* Casey 1905, and described three new species namely, *M. francoiseae*, *M. jarrigei* and *M. lecoqi*. Kellner and Dettner (1992) studied the comparative morphology of abdominal glands in Paederinae. Hoebeke (1995) provided redescriptions, new synonymy, North American records of the genus *Rugilus*. Klimaszewski *et al.*, 1996 provided a preliminary review of the New Zealand rove beetles.

Volker Assing, a German entomologist, had done a large number of works on the taxonomy of Paederinae. He studied about different genera of Paederinae, and revised, described and contributed new species and additional records of *Sunius* Erichson, 1839; *Pseudobium* Mulsant and Rey, 1877; *Patchymedon* Blackwelder, 1939; *Leptobium* Casey 1905; *Lobrathium* Mulsant and Rey, 1878; *Medon* Stephens 1833; *Domene* Fauvel 1873; *Micrillus* Raffray 1873; *Nazeris* Fauvel, 1873; *Luzea* Blackwelder, 1912; *Lathrobium* Gravenhorst, 1802; *Tetartopeus* Czwalina, 1888; *Pseudomedon* Mulsant & Rey, 1878; *Pseudolathra* Casey 1905 and *Rugilus* Leach 1819. He has also worked on the taxonomy and zoogeography of Paederinae (Assing 1999, 2001; 2002, 2003a, 2003b 2004 a, 2004 b, 2005a, 2005 b, 2005c, 2006a ,2006b, 2006c, 2007a, 2007b, 2007c, 2007d, 2008a, 2008b, 2008c, 2009a, 2009b, 2009c, 2009d, 2009e, 2009f, 2009g, 2009h, 2010a, 2010b, 2011a, 2011b, 2011c, 2012a, 2012b, 2012c, 2013a, 2013b, 2013c, 2013d, 2013 e, 2013 f, 2013g, 2013h, 2013i, 2013j, 2014, 2021). In 2002, Assing and Schulke described new species and records of *Lobrathium*.

In 2003, Herman implemented more than 70 nomenclatural changes for Paederinae. In 2014, Frisch and Herman published a species catalogue of the genus *Micranops* Cameron, 1913 and described a new species, *Micranops bartolozzii* Frisch. Feldmann and Hernando (2005) described two new species of *Domene* and provided a catalogue of the Iberian species of the genus. Frisch studied the genus *Scopaeus* Erichson, 1839 and described new species *Scopaeus hyrcanus* Frisch 2006, and has revised the monophyletic *Scopaeus gracilis* Sperm, 1835 species group and *Scopaeus mutatus* Gemminger & Harold, 1868 species group with descriptions of new species, its phylogenetic and biogeographical relations (Frisch 2006, 2007, 2008, 2009, 2010). Li and Zhou (2007) studied the subgenus *Harpopaederus* of the genus *Paederus*. Bibars 2018 has done taxonomical Studies of Subtribe Astenina in Egypt.

Anlaş and Cevik (2008) have done faunistic studies on Paederinae. In 2009, Anlaş and Rose contributed new records for Paederinae. Anlaş contributed new species and additional records of the genus *Tetartopeus* in 2009. Anlaş *et al.*, (2011) contributed new records on the distribution of some species of Paederinae.

In 2011, Frank and Ahn provided a worldwide checklist, biogeography and natural history of coastal staphylinidae. Reboleira *et al.*, (2011) studied the Iberian endemic subgenus *Lathromene* Koch and described the genus *Domene*. Hu *et al.*, (2011) has described twelve new species of the genus *Nazeris*. Peng *et al.*, (2012) had done taxonomic study on *Lathrobium* Gravenhorst. Anlaş described and illustrated one new species and additional records of the genus *Leptobium* Casey, 1905 and also described new species of *Astenus (Eurysunius)* Dejean, 1833. He has also described new species of *Medon* and *Lobrathium*, and provided further reports of 14 species of *Medon* and 14 species of *Lobrathium* (Anlaş 2012, 2014, 2015, 2020).

In 2017, Schomann and Solodovnikov did phylogenetic placement of the austral rove beetle genus *Hyperomma* Fauvel, 1878 which triggered changes in classification

of Paederinae. Bogri *et al.*, (2018) studied the genus *Dysanabatium* Bernhauer, 1915. Staniec *et al.*, 2022 provided a detailed study on the Morphology of the Larval stages of Paederinae. In 2024, Guzman and Żyła added a new eyeless species namely *Micranops bolivianus*.

2.2. INDIAN STUDIES ON THE TAXONOMY OF PAEDERINAE

In 1931, Cameron described 321 species of Paederinae, in “The Fauna of British India, including Ceylon and Burma”. Biswas 1986 recorded 21 species under 5 subfamilies of Staphylinidae from Silent Valley, Kerala. Assing described and illustrated the genera *Orsunius* Assing, 2011; *Rugilus*, *Pseudolathra*, *Lathrobium* and *Nazeris* in the Palaearctic and Oriental regions (Assing 2011d, 2012a, 2012b, 2012e, 2014a). In 2015, Sar and Hedge recorded 16 species belonging to 3 subfamilies of Staphylinidae from Uttar Pradesh. Sar and Ilango 2016 recorded 21 species belonging to 10 genera of the subfamily Paederinae from Mizoram. Sreevidhya *et al.*, 2021 described two new light attracted rove beetle species of *Astenus* Dejean, 1833 from Kerala, and has also provided the checklist of *Astenus* from India. Kavyamol *et al.*, 2023 provided 3 new records of *Paederus* beetles; *Paederus nigricornis* Bernhauer, 1911 from south India, *P. extraneus* Wiedemann, 1823 and *P. alternans* Walker, 1858 from Kerala.

2.3. WORLDWIDE STUDIES ON THE ECOLOGY OF PAEDERINAE

In 1999, Schmidt elucidated the materials and methods for rearing selected species of the subfamilies Paederinae and Staphylininae. Ghahari *et al.*, 2009 studied rove beetles in rice fields and surrounding grasslands.

Nikbakhtzadeh *et al.*, 2012 studied the faunal diversity of *Paederus* in Iran. In 2012, Nasir *et al.*, examined the Population Dynamics, Ecological and Seasonal Activity of *Paederus fuscipes* Curtis (Staphylinidae; Coleoptera) in the Punjab, Pakistan. Bong *et al.*, 2012 studied the life history characteristics of *Paederus fuscipes*. Sert *et al.*, 2013 has done faunistical, ecological and zoogeographical evaluations on Paederinae in the Central Anatolian Region of Turkey. Bong *et al.*, 2013 scrutinized the Dispersal Pattern of *Paederus fuscipes* in relation to environmental

factors and the annual rice crop cycle in Mainland Penang, Malaysia.

In 2015, Lima *et al.*, studied the abundance and night hourly dispersal of the vesicating beetles of the Genus *Paederus* (Coleoptera: Staphylinidae) attracted to fluorescent, incandescent, and black light sources. Rafinejhad *et al.*, 2018 studied the Occurrence of *Paederus fuscipes* (Coleoptera: Staphylinidae) in the sandy tidal zone of the Caspian seashore. Anlaş *et al.*, 2021 described the seasonal dynamics of some Paederinae species in the Western Anatolia.

2.4. INDIAN STUDIES ON THE ECOLOGY OF PAEDERINAE

Nikhita *et al.*, 2014 studied the prevalence of *Paederus* species and dermatitis in Tamilnadu. Vineesh *et al* 2023, investigated the use of essential oils of cinnamon, turmeric and neem as potential control agents against home-invading acid flies (*Paederus fuscipes*) and darkling beetles (*Luprops tristis* Fabricius, 1801). Kavyamol *et al.*, 2024 studied the species composition, abundance, and seasonality of *Paederus* in the paddy fields of the Malabar region, Kerala.

2.5. REVIEW ON THE MEDICAL IMPORTANCE OF PAEDERINAE

2.5.1. World Review

The natural history and medical importance of *Paederus* beetles was studied by Frank and Kanamitsu in 1987. The first documented report of paederus dermatitis dates back to 1901, when Vorderman described an outbreak of dermatitis among employees at the Anjet-Kidoel lighthouse in Jawa that was brought on by insects called locally as semoet-kalong. The species recorded by Vorderman was *Paederus peregrinus* Erichson, 1840 which is regarded as a variety of *Paederus fuscipes*. A second outbreak was reported by Pirajá da Silva in 1912 in Brazil and it was caused by *Paederus columbinus* Laporte, 1835.

Nikbakhtzadeh and Tirgari, 2008 explored medically important Coleopterans in Iran. Vieira *et al.*, 2014 investigated the rove beetles of medical importance in Brazil.

Silva *et al.*, 2017 described the seasonal abundance and the effect of light trap height on the captures of the vesicating beetles of the genus *Paederus* (Coleoptera: Staphylinidae) in Brazil. Maryam *et al.*, 2017 investigated the abundance, distribution and dispersal time of *Paederus fuscipes* (Coleoptera: Staphylinidae) and its association to human settings. Brindle *et al.*, 2024 examined the outbreak of *Paederus* dermatitis among US troops. Dehghani *et al.*, 2025 had a detailed investigation on the poisonous and venomous arthropods, including *Paederus* in Iran.

2.5.2 Indian Review

Paederus dermatitis caused by *Paederus* beetles has been reported from different regions of India. In 1961, Somerset conducted a study in Kolkata, on Spider lick, an epidemic ophtho- dermatozoosis caused due to beetles of the genus *Paederus*. Sengupta and Lahiri 1997 recorded blister beetle dermatitis in West Bengal.

Gnanaraj *et al.*, 2007 reported 123 cases of *Paederus* dermatitis in Tamil Nadu. Padhi *et al.*, 2007 provided Clinic epidemiological profile of 590 cases of beetle dermatitis in Orissa. Verma and Gupta 2012, documented ocular manifestations due to *Paederus sabaeus* Erichson, 1840 in Punjab. Ali *et al.*, 2013, conducted a study on *Paederus* Dermatitis Outbreak in a Suburban Teaching Research Hospital, in Kanchipuram, Tamilnadu. Coondoo and Nandy 2013 recorded *Paederus* Dermatitis outbreak and its increasing incidence or changing seasonal pattern in Kolkata. Mittal *et al.*, 2013 conducted a study on beetle dermatitis in Udaipur, Rajasthan. Taneja *et al.*, 2013 conducted a clinical and epidemiological study of *Paederus* dermatitis in Manipal. Toppo *et al.*, 2013 conducted an outbreak investigation of *Paederus* dermatitis among residents of nursing hostel in Madhya Pradesh. Gopal 2014 conducted a Clinical, Epidemiological and Therapeutic Study of 417 Cases of *Paederus* dermatitis and also found that *Paederus extraneus* and *Paederus melampus* were the common species causing dermatitis in Andhra Pradesh. Chauhan *et al.*, 2017 conducted a detailed study

of 75 cases of Paederus dermatitis in Khaneri, Himachal Pradesh. Srihari 2017 studied about Paederus dermatitis in Karnataka. Karthikeyan and Kumar, 2017 studied Paederus dermatitis in Tamil nadu. Kambil, 2018 conducted a study on blister beetle dermatitis in Palakkad, Kerala. Ramakrishnan *et al.*, 2019 conducted an outbreak investigation of acid fly attack among residential students in a tertiary care and identified *Paederus fuscipes* as the causative agent of Paederus dermatitis in central in Kerala. Inbamani *et al.*, 2024 conducted a study in Tamil Nadu and described the morphological and clinical patterns of dermatitis caused by *Paederus* beetles.

METHODOLOGY

3. METHODOLOGY

3.1. STUDY AREA

The study site includes 2 paddy fields in Palakkad (Arayakkad 10.6726°N latitude 76.7531°E longitude and Pattambi 10.8057°N latitude, 76.1957°E longitude and 2 paddy fields in Wayanad district (Ambalavayal 11.6197°N latitude, 76.2103°E longitude; and Pakkam 11.6182°N latitude, 76.1722°E longitude) (Plate 1).

Palakkad is often called the Gateway of Kerala. The Sahya Mountain Ranges borders the region and the 32 Km to 40 Km long gap, known as the “Palakkad Gap”, in the mountains exerts a dominant influence on the climate of the region. Palakkad is situated at the foot of the Western Ghats and lies between 10.3500° to 11.2333° North latitudes and 76.03333° to 76.7500° East longitudes. It is located at an altitude of 94 meters above the sea level. The district has its special characteristics. It is known as the Granary of Kerala. The district has vast stretches of lush green paddy fields, with tributaries of Bharathapuzha river criss-crossing it.

Wayanad, the land of paddy fields, is situated on the southern tip of the Deccan plateau. This region lies in the Western Ghats on the eastern portion of north Kerala at a height between 700 meters and 2100 meters above the mean sea level. It is located between 11.41111° and 11.967222° North latitudes and 76.436389° and 76.777222° East longitudes.

3.2. SAMPLE COLLECTION

Specimens were collected on different paddy cultivation seasons using light trap (Hollingsworth & Hartstack, 1972), floatation method (Moore, 1954), baited pitfall trap (Spector & Forsyth, 1998) and by sweeping net (Rudd & Jensen, 1977).

3.2.1. Light traps

Light traps were found to be an efficient method for trapping rove beetles as most of them are light attracted. Ten light traps (SAFS ltrap 01 B) were employed at each site and monthly collections were made during Pre-summer (Dec- Feb), Summer (March-May) and Monsoon (June-November) seasons respectively. Thus, a total of 30 samples in each season were collected. The traps were installed by 6 pm and the trapped insects were collected on the next day by 7 am. Trapped beetles were transferred into vials containing 80% ethyl alcohol (Plate 2.A).

3.2.2. Floatation method

30 dung pats of 250 g were placed 50 m apart in each site. Then the pats were taken back on the 3rd day and it was made to submerge under water taken in a tray. When the beetles inhabiting that dung pats tried to escape from water and at that time they were collected by sieving and also, they were separated with the aid of small brush. The collected specimens were washed and transferred into vials containing 80% alcohol. This method is also repeated in all the three seasons (Plate 2.B).

3.2.3. Baited Pitfall trap

It consists of a container buried in the ground with its rim at surface level and the bait used was cattle dung. The mobile beetles actively moving through the ground fall get attracted towards the bait and fall into it. The container contains a mixture of detergent and salt water. The detergent reduces the surface tension so that the trapped beetles were unable to escape from the container. The brine solution helps to preserve the beetles for a few hours and the traps were placed during the evenings and the samples were collected on the next day morning. Likewise, 30 samples were collected in each season of Pre-Summer, Summer and Monsoon (Plate 2.C).

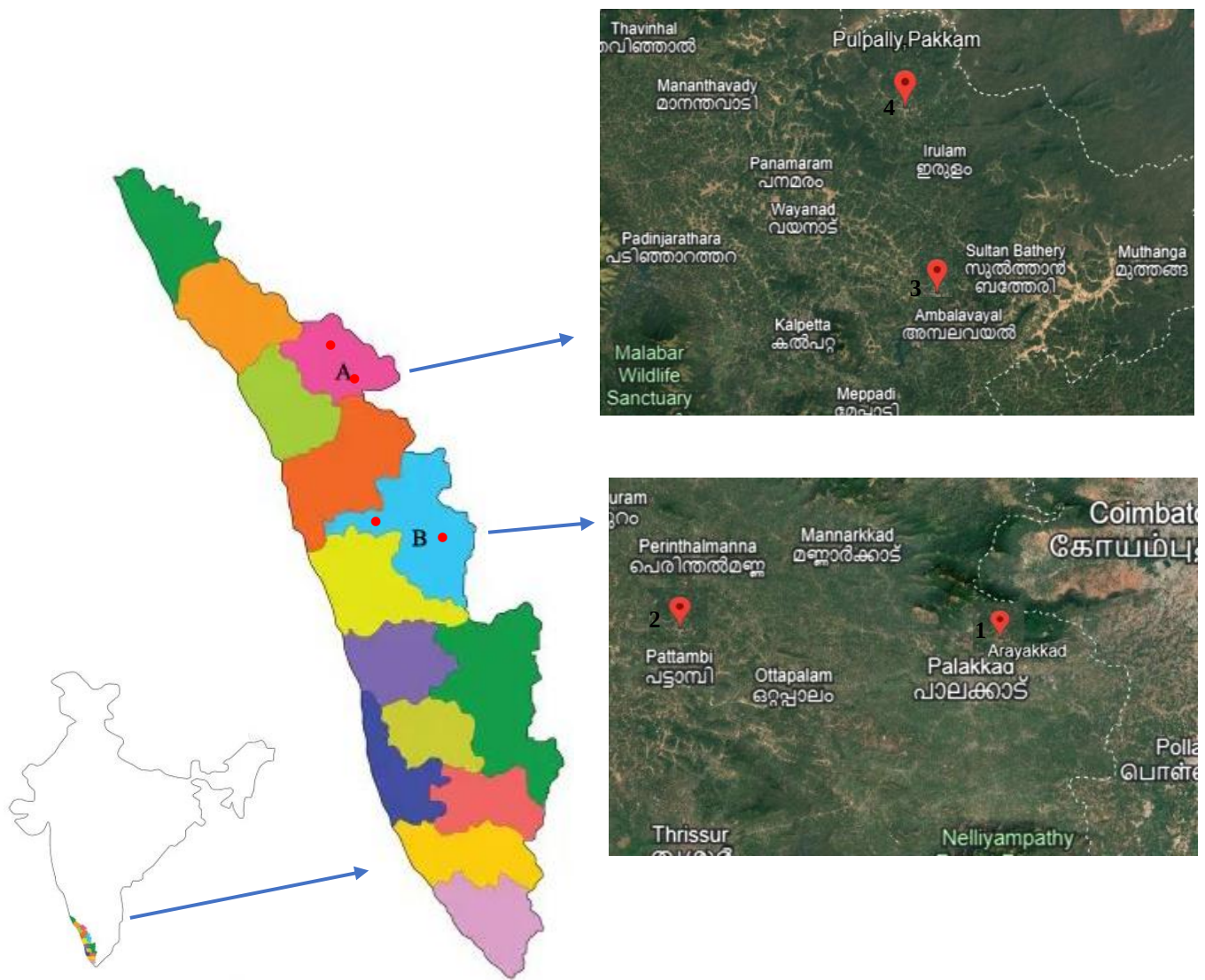


Plate 1: Map showing the collection sites A) Wayanad B) Palakkad

1) Pattambi 2) Arayakkad 3) Ambalavayal 4) Pakkam



A



B



C



D

Plate 2: Sample collection methods A) Light trap B) Floatation method C) Baited pitfall trap D) Sweeping net

3.2.4. Sweeping net

Sweeping net was used to sweep through the Paddy cultivation to collect the beetles actively moving through the paddy leaves. Specimens were collected in three different seasons i.e., Pre- Summer, Summer and Monsoon (Plate 2.D).

3.3. PRESERVATION

The collected specimens were preserved in separate labelled vials containing 80% alcohol for identification.

3.4. IDENTIFICATION

The collected rove beetles were taken from the solution by using small hair brush and forceps from the vials, examined and sorted under Stereo Zoom Trinocular Microscope, (LABOMED-200 MAR, CODE:ZM 45 TM) and adult organisms were identified upto species level using the key of Cameron, 1931 and with the help of various other literature (Assing, 2012d; Sar and Hedge, 2015; Herman 2003, 2023). The photographs of the entire body of rove beetles were taken using an image processing system (NICON D 90-DSLR CAMERA).

After analysis, the beetles were placed back in the vial containing 80% ethyl alcohol. The count of each category of beetles was entered on a pre-printed tally sheet that has the date of collection, preservation, and sorting sample code. Each species collected were categorized into major, minor, and rare based on the percentage of abundance of each species in the collection. Species with a percentage greater than 3 is considered as major; 0.3 to 3% is considered as minor and <0.3% is considered as rare. The identified specimens were deposited at the national insect collection, Zoological Survey of India, Kozhikode.

Checklist and pictorial key of species collected from Palakkad and Wayanad districts were prepared using Cameron, 1931 and various literature available (Biswas,

1986; Schomann and Solodovnikov, 2017; Herman 2003, 2023). Details of all literature references and distributional data of each species are provided along with the checklist.

3.5. STATISTICAL ANALYSIS

Species abundance data was tested for normality with Anderson-Darling test and opted for parametric tests for further analysis. Two- way ANOVA was done to compare the species abundance between habitats and seasons. Relationship of abiotic factors like temperature, rainfall and relative humidity with each species were analyzed by linear regression. Bray Curtis similarity values of the abundance of Paederinae species between different collection sites were also analysed. All statistical analysis was done using PAST software version 3.15 (Hammer *et al.* 2001). For all analyses, significance was determined at $P < 0.05$.

Diversity Indices

The diversity indices, such as the Shannon-Wiener diversity (H), Simpson diversity (1-D), Margalef's richness, and Pielou's evenness index ($e^{H/S}$) were used to compare the diversity between the collection sites and also to compare the seasonal variation (Pre- summer, Summer and Monsoon) in each site.

The formula for the Shannon diversity index is:

$$H = -\sum [(pi) \times \ln(pi)]$$

In this formula, pi is the proportion of individuals in a species

$\ln$ is the natural log, and Σ is the sum of the calculations.

The formula for Simpson's diversity index is:

$$D = \sum n(ni-1)/N(N-1)$$

In this formula, ni represents the number of individuals in a species, and

N represents the total number of individuals in the population.

The formula for Margalef's richness index is

$$D = S - 1/\log(N)$$

where:

S: is the total number of species observed

N: is the total number of counts

The formula for Pielou's evenness index is

$$J' = H'/\log(S)$$

where,

J' = The Pielou index

H' = The Shannon-Weaver diversity index and,

S = The total number of species in a sample.

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RESULTS

4. RESULTS

Forty-five species belonging to three tribes (Lathrobiini, Paederini and Pinophilini) and twenty-two genera (*Acanthoglossa*, *Astenus*, *Cephalochaetus*, *Charichirus*, *Cryptobium*, *Hyperscopaeus*, *Lobrathium*, *Lithocharis*, *Medon*, *Micranops*, *Micrillus*, *Monocrypta*, *Ochthephilum*, *Oedichirus*, *Paederus*, *Palaminus*, *Pinobius*, *Pinocharis*, *Pinonepalus*, *Pseudolathra*, *Rugilus* and *Scopaeus*) were recorded from the paddy fields of Palakkad and Wayanad.

4.1. TAXONOMY OF PAEDERINAE

4.1.1. TAXONOMIC KEY

Key to the Tribes

- 1) Last joint of the maxillary palpi large Pinophilini
 - Last joint of the maxillary palpi small 2
- 2) 4th joint of the maxillary palpi nipple like, short and truncate Paederini
 - 4th joint of the maxillary palpi small, simple and conical... Lathrobini

Key to the genera of Pinophilini

- 1. Abdomen with distinct border.....3
 - Abdomen not bordered...2
- 2. Rounded post-ocular region; abdomen with punctures; First four joints of the anterior tarsi not patellate.....*Oedichirrus*
 - Post-ocular region truncate; abdomen with imbricate sculpture; first four joints of the anterior tarsi patellate..... *Palaminus*
- 3. Thorax as long as broad, widest in front; the sides very gently rounded and slightly retracted to the rounded posterior angles...*Pinocharis*
 - Thorax a little broader than long, sides parallel for the anterior half, then gradually rounded and narrowed to the completely rounded posterior angles... *Pinonepalus*

Key to the genera of Paederini

1. Strongly geniculate antennae, almost like a knee or elbow shaped.....3
-Antennae not geniculate.....2
2. Fourth tarsal joint bilobed; neck with normal width.....*Paederus*
-Fourth tarsal joint simple; neck broad.....*Pinobius*
3. Last joint (fourth) of the maxillary palpi broad and obtuse; scarcely visible; tibiae with setae; presence of raised lines on the thorax *Cephalochetus*
-Last joint of the maxillary palpi subulate; tibiae with spines; absence of raised lines on thorax4
4. Head oval or subtriangular; broader than the thorax *Ochtheophilum*
-Head oblong and more or less dilated behind.....5
5. Head oblong; both sides parallel;.....*Cryptobium*
-Head less oblong and posteriorly more or less dilated... *Monocrypta*

Key to the genera of Lathrobini

1. Fourth tarsal joint bilobed.....*Astenus*
-Fourth tarsal joint simple...2
2. Neck very slender.....3
-Neck at least a fourth as broad as the base of the head.....6
3. Head and pronotum with strong, navel like punctures with the spaces between them very narrow or with punctures running into each other. Head large with the rear edge semicircular; Labrum 2-dentate..... *Rugilus*
-Head and pronotum with fine punctures. Head parallel- sided or weakly broadening towards the back; Labrum 4-dentate4

4. Metakatepisternal process short and apically rounded or blunt.....*Hyperscopaeus*
-Metakatepisternal process wide or short, long or moderately long.....5
5. Metakatepisternal process wide with a diagonally truncate apical margin.....*Micranops*
-Metakatepisternal process apically acute, slender and short or long..... *Scopaeus*
6. First joint of the posterior tarsi longer than the second..... 7
-First joint of the posterior tarsi not longer than the second... 11
7. First joint of the posterior tarsi much longer than the second; labrum emarginate in the middle and more or less bilobed... *Micrillus*
-First joint of the posterior tarsi slightly longer than the second; labrum dentate..... 8
8. Fifth tarsal joint inserted near the base of the fourth hence appears to be bilobed.....
..... *Acanthoglossa*
-Fifth tarsal joint simple and normally inserted.....9
9. Labrum bidentate in the middle or at least trisinulate; eyes shorter than the temples*Medon*
-Labrum unidentate; eyes normal..... 10
10. Abdomen keeled.....*Lithocharis*
-Abdomen not keeled... *Charichirus*
11. Elytra with irregular punctures...*Lobrathium*
-Elytra serially punctured..... *Pseudolathra*

Key to the Species of Paederinae recorded from Palakkad and Wayanad

TRIBE: PINOPHILINI

Genus: *Palaminus*

1. Larger (5mm) and more robust; species entirely ferruginous red.....*Palaminus rufus*
- Smaller (3.5mm) and narrower; species entirely reddish brown.....
.....*Palaminus nilgiriensis*

TRIBE: PAEDERINI

Genus: *Ochthephilum*

1. Species entirely black.....2
- Species not entirely black... ..3
2. Larger species (12.5 mm); thorax broader; elytra slightly longer than the thorax
.....*Ochthephilum gastrale*
- Smaller species (10 mm); thorax cylindrical shaped and narrower.....
.....*Ochthephilum elephas*
3. Elytra unicolorous blackish... ..*Ochthephilum filum*
- Elytra black; the posterior- external angles yellowish.... *Ochthephilum extraneum*

Genus: *Paederus*

1. Legs wholly dark brownish black including the coxae 2
- Legs in part at least testaceous... ..3
2. Post- ocular region almost rounded.....*Paederus extraneus*
- Post-ocular region straightly converging to the neck.....*Paederus nigricornis*
3. Legs black coloured, the coxae and extreme base of the femora reddish yellow...
.....*Paederus alternans*
- Legs almost yellowish and anterior femora entirely testaceous..... 4
4. Larger (>9 mm). Last joint of antennae testaceous*Paederus sondaicus*
- Smaller (<7.5 mm). Last joint of antennae concolorous.*Paederus fuscipes*

Genus: *Pinobius*

1. Larger and more robust species (9 mm).....*Pinobius robustus*
-Smaller and narrower species (7 mm).....*Pinobius indicus*

TRIBE: LATHROBINI

Genus: *Astenus*

1. Sides of the elytra with black setae either outstanding or decumbent.....2
-Sides of the elytra devoid of black setae*Astenus melanurus*
2. Larger (5 mm) and more robust; post-ocular region parallel for a short distance, then broadly rounded to the base*Astenus nilgiriensis*
-Smaller (4 mm) and narrower; post-ocular region coarctate with the base
.....*Astenus gracilentus*

Genus: *Lithocharis*

1. Species densely and finely pubescent, subsericeous; head black, thorax ferruginous-red, elytra ochraceous, more or less broadly infusate on the disc *Lithocharis uvida*
-Species less pubescent, not subsericeous...2
2. Head more quadrate, more parallel behind the eyes, the posterior angles more briefly rounded.....3
-Head less quadrate, more rounded behind the eyes, the posterior angles more broadly rounded.....*Lithocharis ochracea*
3. Elytra distinctly longer and slightly broader than the thorax *Lithocharis vilis*
-Elytra slightly longer and little broader than the thorax *Lithocharis sororcula*

Genus: *Medon*

1. Sculpture of the thorax consisting of asperate granules.....2
-Sculpture of the thorax consisting of punctures... ..*Medon pallidus*
2. First visible segment of abdomen thickly covered with yellow pubescence, the posterior margin of the fifth segment yellow; large species (7 mm)... ..*Medon auripilis*
-First visible segment of abdomen normally pubescent; smaller species (3 mm)*Medon cinnamopterus*

Genus: *Micrillus*

1. Penultimate joints of the antennae longer than broad.....*Micrillus indicus*
-Penultimate joints of the antennae transverse.....*Micrillus fulvescens*

Genus: *Pseudolathra*

1. Larger species (6 mm); colouration variable; head usually blackish brown, rarely reddish brown; pronotum reddish; elytra usually blackish brown.....
.....*Pseudolathra pulchella*
-Smaller and narrower species (5 mm); unicolorous reddish testaceous species
.....*Pseudolathra unicolor*

Genus: *Scopaeus*

1. Head suborbicular, the posterior angles broadly rounded, never widened behind...
.....*Scopaeus bicuspis*
-Head subquadrate, the posterior angles briefly rounded, sometimes slightly widened behind..... 2
2. Larger; sculpture of the head and thorax finely granular *Scopaeus testaceus*
-Smaller; sculpture not granular 3
3. Head and thorax concolorous, red or yellowish-red.....4
-Head and thorax not concolorous; very rarely concolorous in *S. limbatus* 5

PICTORIAL KEY:

KEY TO THE TRIBES

1. Last of the maxillary palpi large..... Pinophilini



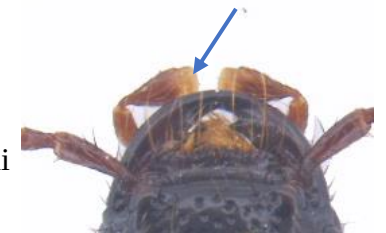
- Last joint of the maxillary palpi small.....2



2. 4th joint of the maxillary palpi small, simple and conical.....Lathrobini

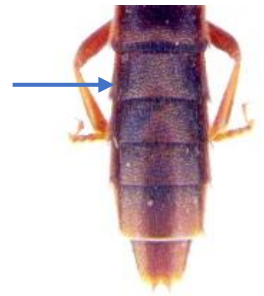


- 4th joint of the maxillary palpi nipple like, short and truncate...Paederini

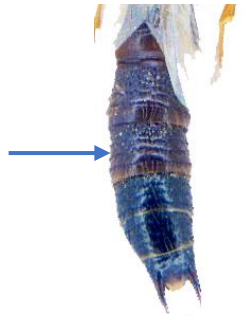


Key to the genera of Pinophilini

1. Abdomen with distinct border.....3



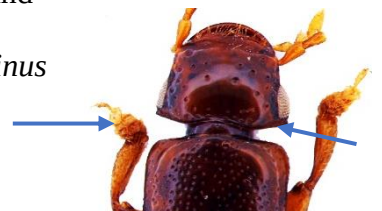
-Abdomen not bordered.....2



2. Rounded post-ocular region; First four joints of the anterior tarsi separately dilated, not patellate.....*Oedichirrus*



-Post-ocular region truncate; first four joints of the anterior tarsi dilated and patellate*Palaminus*



3. Thorax as long as broad, the sides very gently rounded and slightly retracted to the rounded posterior angles.....*Pinocharis*

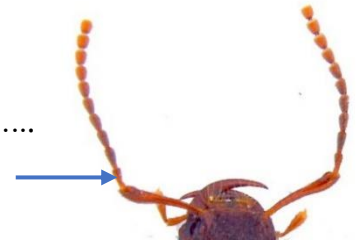


-Thorax a little broader than long, sides gradually rounded and narrowed to the completely rounded posterior angles.....*Pinonepalus*



Key to the genera of Paederini

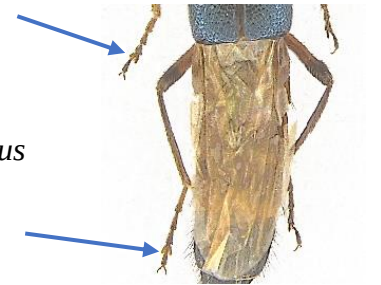
1. Strongly geniculate antennae, almost elbow shaped.....



- Antennae not geniculate.....2



2. Fourth tarsal joint bilobed.....*Paederus*



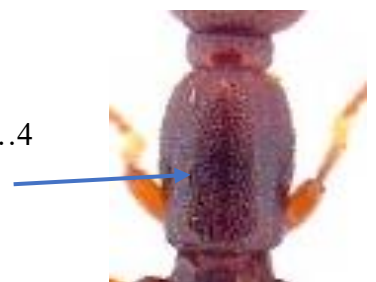
- Fourth tarsal joint simple.....*Pinobius*



3. Presence of raised lines on the thorax.....*Cephalochetus*



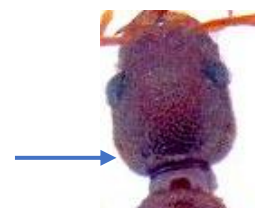
- Absence of raised lines on the thorax.....4



4. Head oval or subtriangular; broader than the thorax.....*Ochtheophilum*



-Head oblong and more or less dilated behind.....5



5. Head oblong; both sides almost parallel.....*Cryptobium*

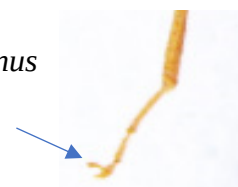


-Head less oblong and posteriorly more or less dilated.....*Monocrypta*



Key to the genera of Lathrobini

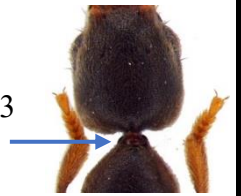
1. Fourth tarsal joint bilobed.....*Astenus*



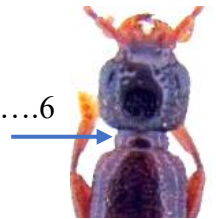
-Fourth tarsal joint simple.....2



2. Neck very slender.....3



-Neck at least a fourth as broad as the base of the head.....6



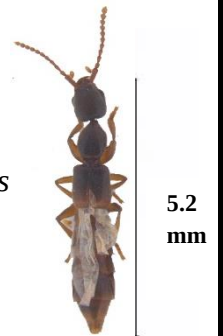
3. Head large with the rear edge semicircular.....*Rugilus*



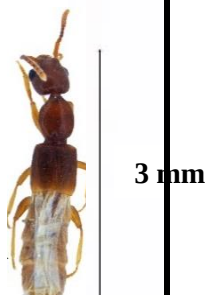
-Head parallel- sided or weakly broadening towards the back.....4



4. Body length more than 5 mm.....*Hyperscopaeus*



-Body length less than 5 mm.....5



5. Presence of post orbital furrow.....*Micranops*



- Absence of post orbital furrow*Scopaeus*



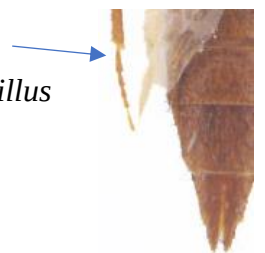
6. First joint of the posterior tarsi longer than the second.....7



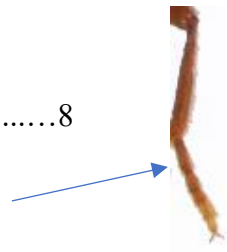
-First joint of the posterior not tarsi longer than the second.....11



7. First joint of the posterior tarsi much longer than the second.....*Micrillus*



-First joint of the posterior tarsi slightly longer than the second.....8

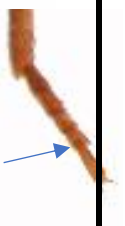


8. Fifth tarsal joint inserted near the base of the fourth hence appears to be bilobed.

.....*Acanthoglossa*



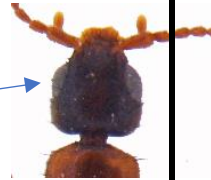
-Fifth tarsal joint simple and normally inserted.....9



9. Eyes very small; shorter than the temples... ..*Medon*



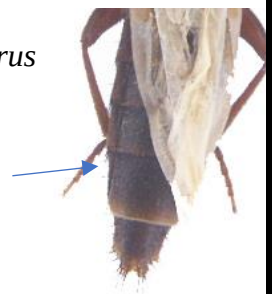
-Eyes normal... ..10



10. Abdomen keeled... ..*Lithocharis*



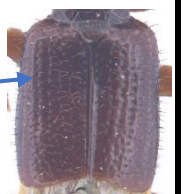
-Abdomen not keeled... ..*Charichirus*



11. Elytra with irregular punctures... ..*Lobrathium*



-Elytra serially punctured... ..*Pseudolathra*

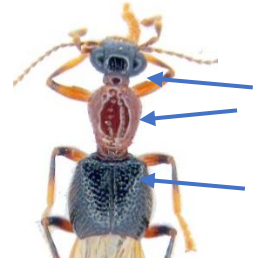


Key to the species of Paederinae recorded from Palakkad and Wayanad

TRIBE: PINOPHILINI

Genus: *Oedichirus*

1. Bicolourous species with head and elytra entirely black....*Oedichirus longipennis*



Genus: *Palaminus*

1. Thorax with larger punctures.....*Palaminus rufus*



- Thorax with fine punctures.....*Palaminus nilgiriensis*



Genus: *Pinocharis*

1. Antennae with the penultimate joints clavate.....*Pinocharis genalis*



Genus: *Pinonepalus*

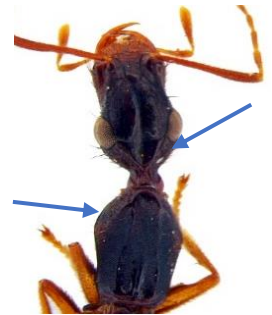
1. Head with a triangular space.....*Pinonepalus cameroni*



TRIBE: PAEDERINI

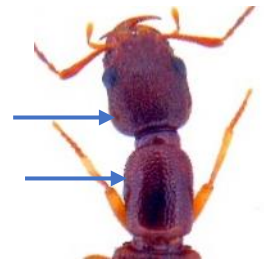
Genus: *Cephalochaetus*

1. Sides of the head strongly constricted to the neck; lateral lines of the thorax very shining.....*Cephalochaetus brunneus*



Genus: *Cryptobium*

1. Head oblong and thorax cylindrical.....*Cryptobium fulvescens*



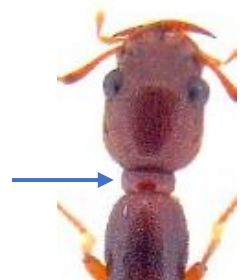
Genus: *Monocrypta*

1. Presence of furrow, a median line on the thorax.....*Monocrypta abdominalis*

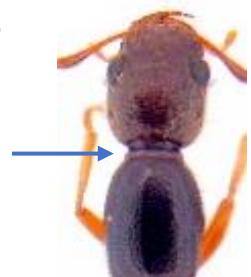


Genus: *Ochtheophilum*

1. Neck thicker and more distinct from head and thorax.....2



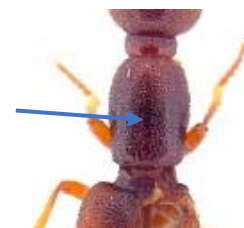
- Neck indistinct.....3



2. Thorax broader.....*Ochthephilum gastrale*



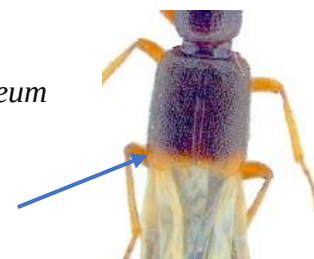
-Thorax cylindrical shaped and narrower*Ochthephilum elephas*



3. Elytra unicolorous*Ochthephilum filum*

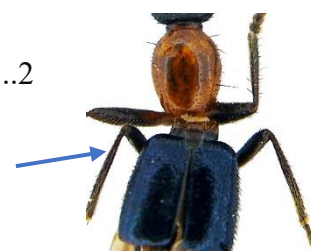


-Elytra with the posterior- external angles yellowish...*Ochthephilum extraneum*

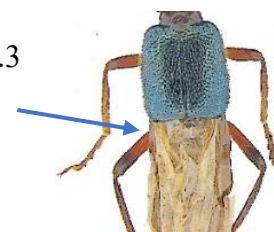


Genus: *Paederus*

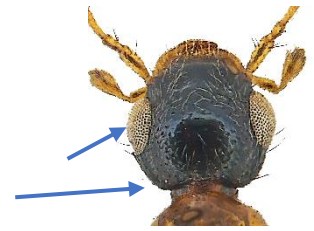
1. Legs wholly dark brownish black2



-Legs in part at least testaceous.....3

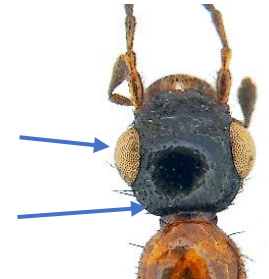


2. Eyes normal; Post-ocular region almost rounded.....*Paederus extraneus*

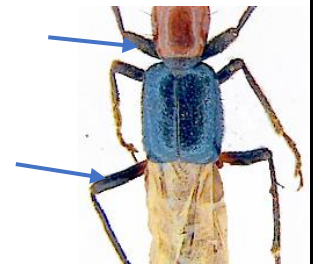


- Eyes prominent; Post-ocular region straightly converging to the neck.....

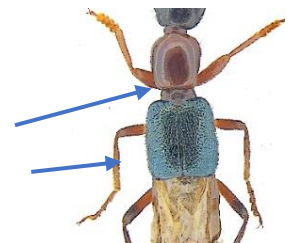
.....*Paederus nigricornis*



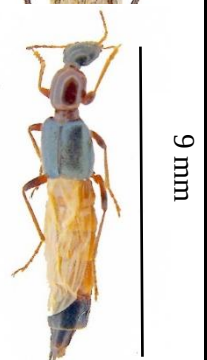
3. Legs black coloured anterior femora black.....*Paederus alternans*



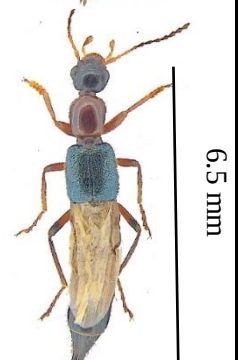
-Legs almost yellowish and anterior femora entirely testaceous.....4



4. Larger species with size approximately 9 mm..... *Paederus sondaicus*

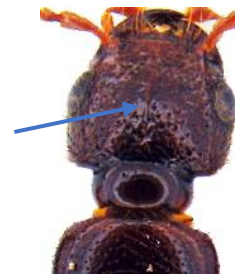


-Smaller species with size approximately 6.5 mm*Paederus fuscipes*

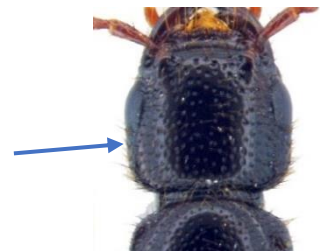


Genus: *Pinobius*

1. Head not finely and closely punctured.....*Pinobius robustus*



- Head very finely and closely punctured.....*Pinobius indicus*

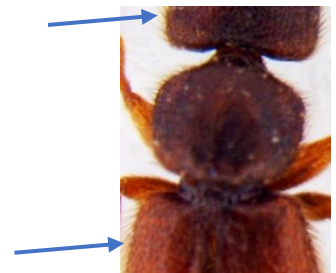


TRIBE: LATHROBINI

Genus: *Acanthoglossa*

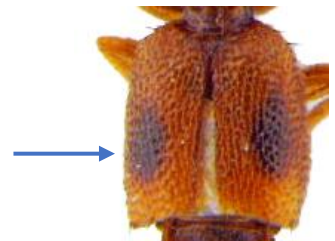
1. Species entirely covered with long, coarse, erect yellow hairs.....

.....*Acanthoglossa hirta*

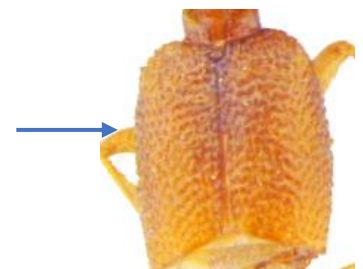


Genus: *Astenus*

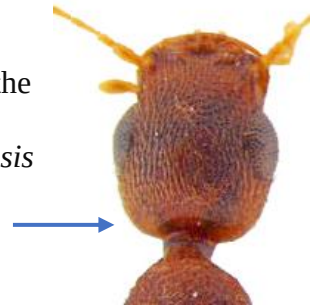
1. Elytra with black spot2



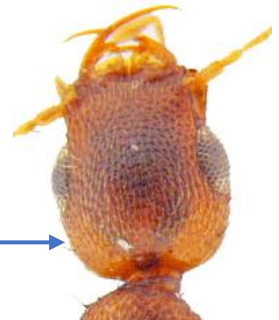
- Elytra devoid of black spot *Astenus melanurus*



2. Post-ocular region parallel for a short distance, then broadly rounded to the base.....*Astenus nilgiriensis*

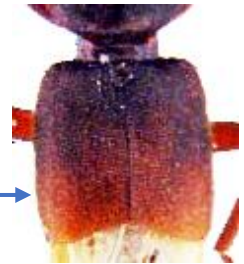


- Post-ocular region coarctated with the base.....*Astenus gracilentus*



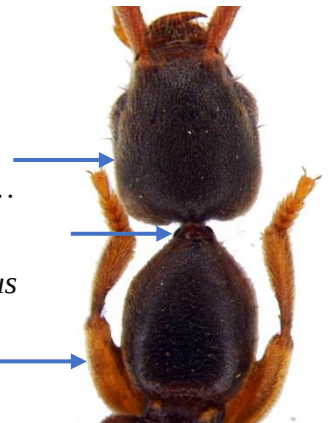
Genus: *Charichirus*

1. Elytra black with a broad red fascia posteriorly which extends forwards along the suture nearly to the scutellum.....*Charichirus chinensis*



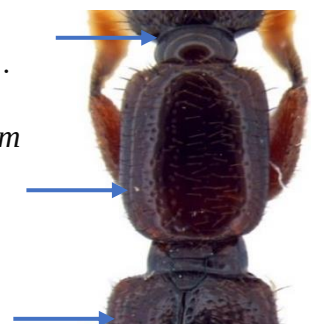
Genus: *Hyperscopaeus*

1. Head subquadrate; longer than broad; narrow neck; legs entirely testaceous...
.....*Hyperscopaeus puberulus*



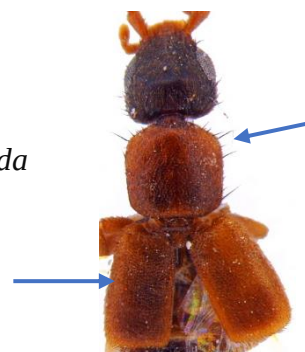
Genus: *Lobrathium*

1. Neck broad; thorax and elytra irregularly punctured.....
.....*Lobrathium badium*

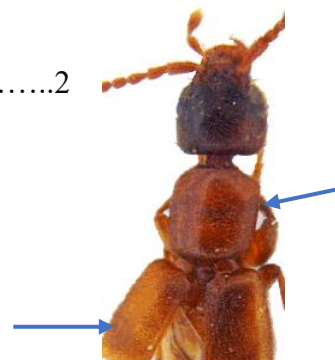


Genus: *Lithocharis*

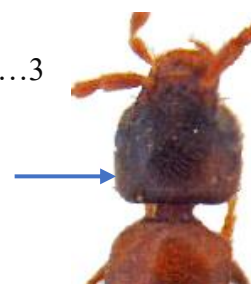
1. Species densely and finely pubescent, subsericeous.....*Lithocharis uvida*



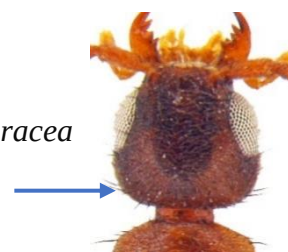
- Species less pubescent, not subsericeous.....2



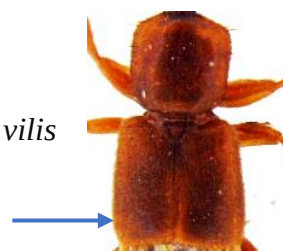
2. Head more quadrate, more parallel behind the eyes.....3



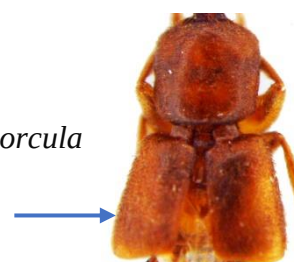
- Head less quadrate, more rounded behind the eyes.....*Lithocharis ochracea*



3. Elytra distinctly longer than the thorax.....*Lithocharis vilis*

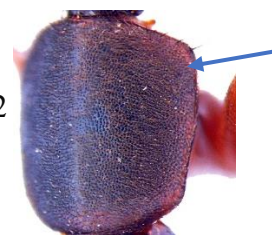


- Elytra slightly longer than the thorax*Lithocharis sororcula*

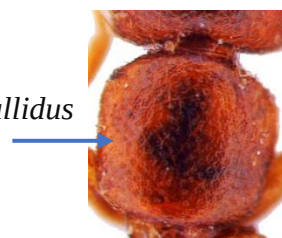


Genus: *Medon*

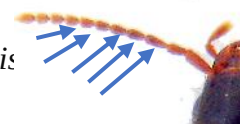
1. Sculpture of the thorax consisting of asperate granules.....2



- Sculpture of the thorax consisting of punctures.....*Medon pallidus*

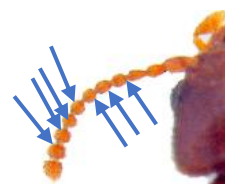


2. 3rd to 7th antennal segments longer than broad *Medon auripilis*



- 4th to 6th antennal segments longer than broad 7th to 10th as long as broad.....

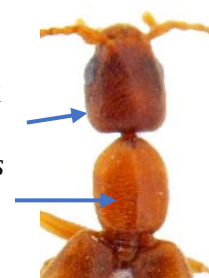
- *Medon cinnamopterus*



Genus: *Micranops*

1. Head oblong, slightly longer than broad; a fine shining line at the middle of the thorax

-*Micranops pallidulus*

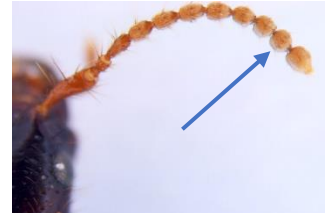


Genus: *Micrillus*

1. Penultimate joints of the antennae longer than broad.....*Micrillus indicus*

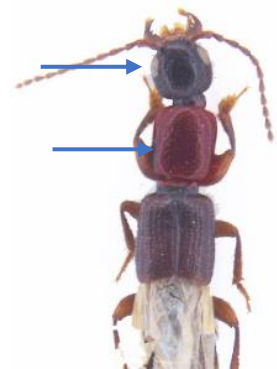


- Penultimate joints of the antennae transverse.....*Micrillus fulvescens*

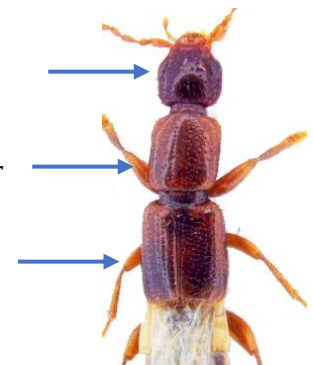


Genus: *Pseudolathra*

1. Species not unicolorous*Pseudolathra pulchella*



- Unicolorous reddish testaceous species.....*Pseudolathra unicolor*



Genus: *Rugilus*

1. Elytra darker with larger and smaller punctures; antennae and legs testaceous.....*Rugilus rufescens*



Genus: *Scopaeus*

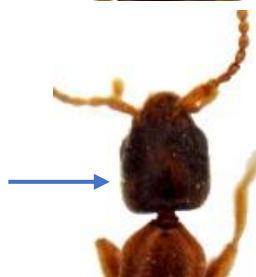
1. Head suborbicular, the posterior angles broadly rounded.....

.....*Scopaeus bicuspis*



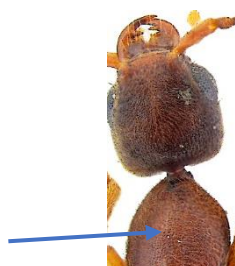
- Head subquadrate, the posterior angles briefly rounded.....

.....2



2. Sculpture of the head and thorax finely granular.....

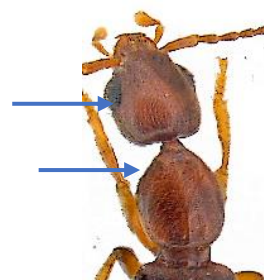
.....*Scopaeus testaceus*



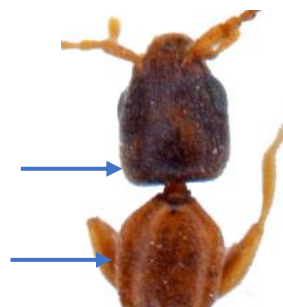
- Sculpture not granular.....3



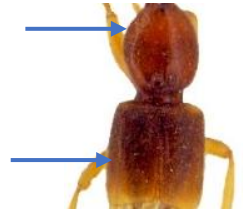
3. Head and thorax concolorous.....4



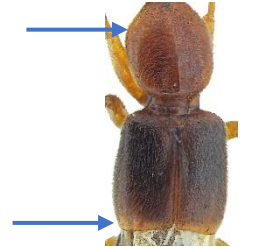
- Head and thorax not concolorous.....5



4. Elytra scarcely longer than the thorax.....*Scopaeus fulvus*



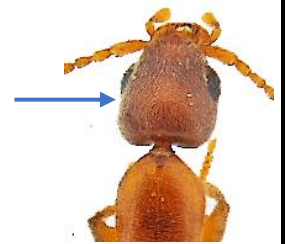
-Elytra longer than the thorax..... *Scopaeus dilutus*



5. Head quadrate; dark and shining..... *Scopaeus limbatus*



-Head narrow; greasy lustrous.....*Scopaeus velutinus*



- 4. Elytra uniformly reddish yellow *Scopaeus fulvus*
 - Elytra reddish, more or less extensively infusate on the disc *Scopaeus dilutus*
- 5. Less closely punctured and pubescent *Scopaeus limbatus*
 - Very closely and finely punctured and pubescent.....*Scopaeus velutinus*

Note: Twelve species were excluded from the key because they are the sole representatives of their respective genera in this region.

4.1.2. CHECKLIST OF PAEDERINAE COLLECTED FROM PALAKKAD AND WAYANAD

Tribe: Pinophilini Nordmann, 1837

Subtribe: Procirrina Bernhauer & Schubert, 1912

I. Genus: *Oedichirus* Erichson, 1839

Oedichirus Erichson 1839: 684; Reitter 1906: 8; Cameron 1931: 25; Herman 2013: 1;
Li *et al.*, 2015: 81; Irmeler 2015: 113; Assing 2019 a: 33.

1. *Oedichirus longipennis* Kraatz 1859

Oedichirus idae Sharp, 1874: 76; Shibata *et al.* 2013: 161.

Oedichirus schultheissi Fauvel, 1895: 217.

Oedichirus excellens Cameron, 1925 a: 180.

Oedichirus longipennis Kraatz 1859: 154; Cameron 1931: 26; Herman 2010: 43;
Sanyal *et al.*, 2012: 81; Rougemont 2018: 483; Assing 2019 a: 34; Senda and Nakamura
2020: 206; Matějček and Boháč 2020: 658.

Materials Examined: (n=3) Ambalavayal 3 ex., Light trap, 22.ii.2020

Distribution: India (Kerala: Trivandrum: Kallar; Tamil Nadu: Nilgiri Hills; Karnataka:
Coorg, Shivamogga; Uttarakhand: W. Almora, Kumaon, Nainital; Himachal Pradesh:
Patlikuh; Assam: Barpeta; West Bengal). Pakistan; Nepal; Sri Lanka; Malaysia;
Singapore; China; Taiwan; Thailand; Laos; Vietnam; Indonesia; Japan.

II. Genus: *Palaminus* Erichson, 1839

Palaminus Erichson 1839: 681; Lacordaire, 1854: 104; Sharp, 1876: 340; id. 1886: 631;
Fauvel, 1878: 225; id.1891: 95; Lynch, 1884: 327; Casey, 1910: 197; Cameron 1931:
20; Scheerpeltz, 1933: 1213; Blackwelder, 1944: 130; Adachi, 1955: 14; Arnett, 1963
a: 243; Fagel, 1971: 11; Seevers, 1971: 84; Shibata, 1973: 42; id. 1977: 20; Moore and
Legner, 1974: 555; id. 1975: 151; id. 1979: 122; Blackwelder and Arnett, 1974: 48;

Bordoni, 1975: 418; Spahr, 1981: 96; Frank, 1982: 27; id. 1986: 367; Hammond, 1984: 203; Lecoq, 1986: 81; Biswas and Biswas, 1995: 266; Downie and Arnett, 1996: 424; Lundgren, 1998: 48; Newton *et al.*, 2000: 389; Navarrete-Heredia *et al.*, 2002: 294; Cho and Ahn 2004: 287; Smetana, 2004: 624; Herman 2010: 50; Janák 2021:58.

2. *Palaminus rufus* Cameron 1931

Palaminus rufus Cameron 1931: 23

Materials Examined: (n=3) Arayakkad 3 ex., Light trap, 19.i.2020

Distribution: India (Tamil Nadu: Nilgiri Hills)

3. *Palaminus nilgiriensis* Cameron, 1931

Palaminus nilgiriensis Cameron 1931: 23; Herman 2010: 61; Khan *et al.*, 2023: 105

Materials Examined: (n=232) Pattambi 80 ex., Light trap, 04.iii.2019; 110 ex., Light trap, 30.iv.2019; 42 ex., Light trap, 15.xi.2019

Distribution: India (Tamil Nadu: Nilgiri Hills); Pakistan (Dera Ismail Khan)

Subtribe: *Pinophilina* Nordmann, 1837

III. Genus: *Pinocharis* Fagel, 1963

Pinocharis Fagel, 1963 a: 251; Newton 2017: 18; Assing 2022 a: 381

4. *Pinocharis genalis* Fauvel, 1895

Pinocharis genalis Fauvel 1895; Assing 2022 a: 383

Pinophilus genalis Fauvel 1895: 219; Cameron 1931: 14

Materials Examined: (n=10) Pattambi 10 ex., Light trap, 04.iii.2019

Distribution: Bangladesh (Dhaka); Myanmar (Bhamo; Schwego-myo; Pegu); Thailand (Siam) and Cambodia.

Subtribe: *Pinophilina* Nordmann, 1837

IV. Genus: *Pinonepalus* Coiffait, 1982

Pinonepalus Coiffait 1982: 84; Thapa 2000: 257; Assing 2022 a: 230

5. *Pinonepalus cameroni* (Scheerpeltz, 1933)

Pinophilus cameroni Scheerpeltz, 1933

Pinonepalus cameroni Assing 2022 a: 9

Pinophilus speculifrons Cameron 1914: 534; id. 1931: 8

Materials Examined: (n=4) Arayakkad 4 ex., Light trap, 10.xi.2018

Distribution: India (Tamil Nadu: Nilgiri Hills, Oucherlony Valley)

Tribe: Paederini Fleming, 1821

Subtribe: Cryptobiina Casey, 1905

V. Genus: *Cephalochetus* Kraatz, 1859

Cephalochetus Kraatz 1859: 122; Blackwelder 1939 a: 116

Cephalochaetus Gemminger & Harold, 1868: 616; Cameron 1931: 219

Calliderma Motschulsky 1858: 653

6. *Cephalochetus brunneus* Motschulsky, 1858

Calliderma brunnea Motschulsky 1858: 653

Cephalochaetus brunneus Cameron 1931: 220; Sreevidhya and Sebastian 2020: 192

Materials Examined: (n=10). Pattambi 10 ex., Light trap, 4.iii.2019

Distribution: India (Kerala: Malappuram) Sri Lanka; Malay Peninsula and widely distributed in the Oriental Region.

Subtribe: Cryptobiina Casey, 1905

VI. Genus: *Cryptobium* Mannerheim, 1830

Cryptobium Mannerheim 1830: 38; Erichson 1839: 500; id. 1840: 561; Thomson 1860: 201; Fauvel 1872: 364; Sharp 1876: 210; id. 1885: 506; Mulsant & Rey 1877: 4; Lynch 1884: 202; Horn 1885: 85; Ganglbauer 1895: 495; Casey 1905: 27; Cameron 1931: 225.

7. *Cryptobium fulvescens* Motschulsky, 1858

Spirosoma fulvescens Motschulsky 1858: 207

Cryptobium testaceum Kraatz 1859: 120.

Cryptobium fulvescens Cameron 1931: 231; Chandra and Boaz 2018: 208

Materials Examined: (n=124) Arayakkad 8 ex., Light trap, 7. x.2019; Pattambi 40ex., Light trap, 19.xii.2018; 10ex., 6 ex., Light trap, 15.xi.2019; Pakkam 60 ex., Light trap, 23.xi.2019

Distribution: India (Chhattisgarh: Bilaspur), Sri Lanka.

VII. Genus: *Monocrypta* Casey, 1905

Monocrypta Casey 1905: 27; Bernhauer & Schubert. 1912: 278; Blackwelder 1939: 113; Blackwelder. 1952: 251; Fagel. 1977: 35; Drugmand 1991: 329; id. 1992: 76; Drugmand & Wauthy 1992:8; Assing 2008 b: 57

8. *Monocrypta abdominalis* Motschulsky, 1858

Cryptobium abdominale Motschulsky 1858: 402; Anon 1916: 418; Bernhauer 1920: 14; Chapman 1934: 22; Chandra and Boaz 2018: 207

Cryptobium pygiale Kraatz 1859: 121.

Cryptobium pygiale var. *discoideum* Eppelsheim 1895: 402.

Cryptobium pygiale var. *indicum* Kraatz 1859: 121.

Cryptobium abdominale var. *rufipenne* Motschulsky 1858: 651.

Monocrypta abdominalis Matějček and Boháč 2020: 676.

Materials Examined: (n=394) Arayakkad.6 ex., Light trap, 10.xi.2018; 13 ex., Light trap, 7.x.2019; 3 ex., Light trap, 19.i.2020; Pattambi 6 ex., Light trap, 12.ix.2018; 330 ex., Light trap, 4.iii.2019; 6 ex., Light trap, 15.xi.2019; Ambalavayal 30 ex., Light trap, 11.iv.2021

Distribution: India (Chhattisgarh: Bilaspur), Sri Lanka and the Indian Archipelago, Australia: Queensland.

VIII. Genus: *Ochthephilum* Stephens, 1829

Ochthephilum Stephens 1829: 24; Watanabe 1979: 43; Drugmand and Wauthy 1992:5; Watanabe and Ning-nian 1994: 109; Vorst 1995: 73; Cho 2000 a: 193; Assing 2008 b: 53

9. *Ochthephilum elephas* Fauvel, 1904

Cryptobium elephas Fauvel 1904 a: 54; Cameron 1931: 230; Biswas 1986; Sar *et al* 2016: 52

Materials Examined: (n=14) Arayakkad.4 ex., Light trap, 7.x.2019; Pattambi 6 ex., Light trap, 12.ix.2018; Ambalavayal 4 ex., Light trap, 11.iv.2021

Distribution: India (Kerala: Silent Valley; Tamil Nadu: Nilgiri hills; West Bengal: Gosaba island)

10. *Ochthephilum extraneum* Fauvel, 1904

Ochthephilum extraneum Sreevidhya and Sebastian 2020: 192

Cryptobium extraneum Fauvel 1904 a: 55; Chandra and Boaz 2018: 207.

Materials Examined: (n=108) Arayakkad 11 ex., Light trap, 10.xi.2018; 9 ex., Light trap, 8.ii.2019; 23 ex., Light trap, 20.iv.2019; 12 ex., Light trap, 7.x.2019; Pattambi 6 ex., Light trap, 12.ix.2018; 20 ex., Light trap, 4.iii.2019; 6 ex., Light trap, 5.xi.2019; Pakkam 15 ex., Light trap, 20.v.2019; 6 ex., Light trap, 19.ii.2020

Distribution: India (Kerala: Kozhikode- Parambil Bazar; Tamil Nadu: Nilgiri Hills; Chhattisgarh: Bilaspur). Bengal: Tetara.

11. *Ochthephilum filum* Kraatz 1859

Cryptobium filum Kraatz 1859: 119; Cameron 1931: 231; Sreevidhya and Sebastian 2020: 192

Materials Examined: (n=3) Arayakkad 3 ex., Light trap, 8.ii.2019.

Distribution: India (Kerala: Kozhikode- Kakkayam); Sri Lanka. Singapore. Indonesia (Sumatra). Borneo

12. *Ochtheophilum gastrale* Fauvel, 1895

Cryptobium gastrale Fauvel 1895: 237; Cameron 1931: 229; Thapa 2000: 252

Materials Examined: (n=4) Pakkam 4 ex., Light trap, 23.xi.2019

Distribution: India (Assam) Myanmar (Rangoon; Bhamo; Prome; Carin Cheba; Carin Asciuii Ghecu; Pegu; Palon; Tenasserim; Kawkareik), Thailand and Indo-China. Nepal: Kathmandu - Chauni; Makawanpur - Rapti Valley (Manahari Khola); Chitwan - Jhuwani (Jhawari); Vietnam.

Subtribe: *Paederina* Fleming, 1821

IX. Genus: *Paederus* Fabricius, 1775

Paederus Fabricius 1775: 268; Curry 1927: 37; Cameron 1931: 33; Sanderson 1967: 59; McCrae and Visser 1975: 109; Frank and Kanamitsu 1987:155; Frank 1988: 483; Nikbakhtzadeh and Tirgari 1999: 73; Willers 2001 a; id. 2002: 155; id. 2018: 195; Stan 2004: 151; Nikbakhtzadeh and Tirgari 2008: 597; Nikbakhtzadeh *et al.*, 2012: 1; Li *et al.*, 2013 d: 562; Vieira *et al.*, 2014: 244; Li *et al.*, 2014 a: 382; Li *et al.*, 2014 b: 431; Silva *et al.*, 2014: 351; Bong *et al.*, 2015: 517; Lima *et al.*, 2015: 50; Li *et al.*, 2016: 576; Silva *et al.*, 2017: 21; Assing 2017 a: 253; id. 2020 a: 91; id. 2022 b: 75; Anlaş 2018: 3.

13. *Paederus alternans* Walker, 1858

Paederus alternans Walker 1858: 205; Gemminger & Harold 1868: 626; Cameron 1925b: 34; id. 1930: 332; id. 1931: 41; Scheerpeltz 1933: 1220; id.1935: 607; id.1965: 103; id. 1978: 196; Biswas & Sen Gupta 1982: 150; Frank 1988:100; Willers 2001 b:

21; Lobl & Smetana 2004: 614; Li and Zhou 2008: 336; Lobl & Lobl 2015: 986; Kavyamol *et al.*, 2023: 119.

Paederus ruficoxis Kraatz 1859: 151; Fauvel 1904a: 54 (syn. of *P. alternans* Walker); Bernhauer and Schubert 1912: 203; Frank 1988: 130; You *et al.*, 2003: 386; Lobl & Smetana 2004: 614; Lobl & Lobl 2015: 986.

Materials Examined: (n=16) Pattambi 10 ex., Light trap, 4.iii.2019; Pakkam 6 ex., Light trap, 19.ii.2020.

Distribution: India (Kerala: Palakkad, Wayanad; Tamil nadu: Nilgiri Hills; Karnataka: Kanara; Himalayas); Myanmar (Kawkaireik: Pegu, Annam, Tonkin); China (Guangxi, Hainan); Vietnam (Tonkin); Sri Lanka (Colombo, Maskeliya) ; Oriental Region.

14. *Paederus extraneus* Wiedemann, 1823

Paederus extraneus Wiedemann, 1823: 13; Dejean 1833: 65; Erichson 1840: 661; Kraatz 1859: 152; Gemminger & Harold 1868: 627; Bernhauer & Schubert 1912: 206; Cameron 1925b: 35; id. 1931: 41; Scheerpeltz 1933: 1223; Frank 1988: 110; Taneja *et al.*, 2013: 135; Gopal 2014: 4736; Willers 2018: 200; Kavyamol *et al.*, 2023: 118.

Paederus pubescens Cameron 1914: 539

Materials Examined: (n=51) Arayakkad 9 ex., Light trap, 19.i.2020; Pakkam 42 ex., Light trap, 19.ii.2020

Distribution: India (Kerala: Palakkad Wayanad, Kannur; Karnataka: Manipal; Andhra Pradesh; Bengal (ex Erichson); Nepal; Afrotropical Region; Oriental Region.

15. *Paederus fuscipes* Curtis, 1826

Paederus fuscipes Curtis 1826: 108; Stephens 1833: 280; Fairmaire & Laboulvne 1856: 570; Gemminger & Harold 1868: 627; Fauvel 1869: 491; id. 1873: 334; id. 1879: 90; id. 1886a: 32; id. 1886b: 148; id. 1897: 281; id. 1903: 154; id. 1904a: 53; id. 1904b: 290; Ganglbauer 1895: 537; Bernhauer & Schubert 1912: 206; Bernhauer 1915: 362;

id. 1917:558; id. 1931:575; Lea 1923: 14; Cameron 1925b: 35; id. 1930: 332; id.1931: 40; id. 1949: 466; Wendeler 1926: 328; Kirschenblatt 1932: 217; Roubal 1932: 60; Scheerpeltz 1933: 1223; Koch 1934: 82; Blackwelder 1939: 112; id. 1944: 123; Jarrige 1944: 8; 1971: 491; Hansen 1951: 224; Fagel 1958: 311; id. 1959: 62; id. 1960: 121; id. 1961 a: 268; id. 1963 b: 347; id.1966: 259; Smetana 1959: 204; Scheerpeltz 1957: 461; id. 1963: 8; id. 1965: 103; id. 1968: 47; id. 1976: 82; Ferreira 1962: 14; Legosz-Owsianna 1963: 335; Szujewski 1965: 29; Tikhomirova 1973: 175; Shibata 1973: 43; id. 1977: 24; Manley 1977:47; Coiffait 1976: 243; 1982a: 34; id. 1982b: 60; Hammond 1977: 27; Muona 1979: 16; Bohac 1981: 358; id. 1985 a: 371; Tronquet 1981: 70; Biswas & Sen Gupta 1982: 153; Frank 1988:111; Rabil 1991: 54; Mokhtar *et al.*,1993:403; Biswas and Biswas, 1995: 274; Kamaladasa *et al.*,1997: 34; Thapa 2000: 256; Scholze *et al.*, 2002: 804; Devi *et al.*, 2003:137; You *et al.*, 2003: 386; Stan 2004: 98; Bordoni 2010: 103; Singh & Ali 2007:13; Rahmah & Norjaiza 2008:53; Huang *et al.*, 2009: 128; Özgen *et al* 2010: 24; Abdullah 2010: 81; Samin *et al.*, 2011; 145; Assing, 2012 b: 353; Assing *et al.*, 2013: 144; Nikbakhtzadeh *et al.*, 2012: 5; Bong *et al.*, 2012:451; id.2013:2530; Veraldi *et al.*, 2013:387; Bacal *et al.*, 2013: 425; Nikhita *et al.*, 2014:194; Peck *et al.*, 2014:36; Nasir *et al.*, 2015:1; Sar and Hedge, 2015:101; Lobl & Lobl 2015: 988; Maryam *et al.*, 2017:59; Karthikeyan & Kumar 2017: 424; Uzunoğlu *et al.*, 2017: 483; Good and Anderson 2017: 227; Willers 2018: 201; Anlaş 2018: 6; Chandra and Boaz 2018: 207; Metin & Elmas 2019: 427; Sreevidhya and Sebastian 2020: 191; Senda and Nakamura 2020: 207; Egorov *et al.*, 2020: 47; Ferreira 2021: 226; Mnguni *et al.*, 2022: 2.

Paederus abyssinicus Cameron, 1950: 186

Paederus aestuans Erichson, 1840: 655.

Paederus angolensis Erichson, 1843: 222.

Paederus corsicus Gaut. des Cottés, 1861: 393.

Paederus erichsoni Wollaston, 1867: 247.

Paederus fennicus J. Sahlberg, 1876: 38.

Paederus idae Sharp, 1874: 75.

Paederus longipennis Erichson, 1839: 517; Thomson, 1860: 196.

Paederus reparius Gravenhorst, 1802: 62.

Paederus mayumbeanus Cameron, 1939: 4

Paederus reparius var. *peregrinus* Erichson, 1840: 656; Blanchard, 1842: 55; Kraatz 1859: 151.

Paederus breviceps Bernhauer, 1902: 37.

Paederus densipennis Bernhauer, 1916: 30

Paederus kalalovae Roubal, 1932: 60

Paederus iliensis Coiffait, 1970: 102

Materials Examined: (n=503) Arayakkad 60 ex., Light trap, 8.ii.2019; 63 ex., Light trap, 10.ii.2019; 8 ex., Light trap, 20.iv.2019; 57 ex., Light trap, 19.i.2020; Pattambi 25 ex., Light trap, 04.iii.2019; 25 ex., Light trap, 30.iv.2019; 1 ex Baited pitfalltrap 14.ii.2020; Ambalavayal 28 ex., Light trap, 3.ii.2019; 25 ex., Light trap, 19.v.2019; 9 ex., Light trap, 24.xi.2019; 32 ex., Light trap, 22.ii.2020; 27 ex., Light trap, 11.iv.2021; Pakkam 34 ex., Light trap, 20.v.2019; 47 ex., Light trap, 23.xi.2019; 18 ex., Light trap, 19.ii.2020; 44 ex., Light trap, 10.iv.2021

Distribution: India (Kerala: Palakkad, Malappuram, Calicut, Wayanad; Tamil Nadu: Annamalainagar, Chidambaram; Karnataka; Uttar Pradesh: Rampur, Ballia, Mirzapur, Allahabad; Gujarat; Uttarakhand; Himachal Pradesh; Bihar; Kashmir, Madhya Pradesh; Chhattisgarh: Bilaspur; West Bengal: Sikkim, Darjeeling District; Meghalaya and Tripura); Pakistan (Punjab); Sri Lanka; Nepal (Kathmandu, : Godawari);

Malaysia(Penang,Terengganu,Kelantan); Italy; Iran (Anbar-Abad, Fars, Golestan, Guilan, Hormozgan, Kerman, Khuzestan Mazandaran, Tehran, Zanjan) ; China (Yunnan, Chongqing, Fujian, Guizhou, Guangxi, Hebei, Hong Kong, Sichuan, Shaanxi, Shanxi) Taiwan; Thailand; Afghanistan; Bhutan; Russia: West Siberia, East Siberia Central European Territory; Iraq; Israel; Japan; Jordan; Kyrgyzstan; Kazakhstan; North Korea; Saudi Arabia; South Korea; Syria; Tajikistan; Turkmenistan; Turkey (Anatolia); Uzbekistan; Afrotropical Region; Australian Region Vietnam; Laos; Indonesia; Azerbaijan; Albania; Armenia; Austria; Belgium; Bulgaria; Czech Republic; Denmark; Estonia; Finland; France (Guadeloupe, Corsica, Monaco); Great Britain (incl. Channel Islands); Germany; Georgia; Greece (incl. Crete); Hungary; Iceland; Ireland; Italy (incl. Sardinia, Sicily); San Marino; Latvia; Lithuania; Macedonia; Moldova; Moldavia; The Netherlands; Norway; Poland; Portugal; Romania; Slovakia; Slovenia; Spain (incl. Gibraltar), Russia: South European Territory; Sweden; Switzerland; Ukraine; Serbia and Montenegro; Algeria; Egypt; Tunisia ; Oriental Region.

16. *Paederus nigricornis* Bernhauer, 1911

Paederus nigricornis Bernhauer 1911: 61 (type locality: Nepal: Soondrijal); Bernhauer & Schubert 1912: 209; Cameron 1925b:36; id. 1928: 560; id. 1931: 47; Scheerpeltz 1933:1226; id. 1957: 474; Blackwelder 1939: 112; Coiffait 1978: 553; id. 1982a: 33; id. 1982b:49; Frank 1988: 123; Willers 1999: 157; id. 2001 a: 308; id. 2001 b: 21; Thapa 2000; Löbl & Smetana 2004: 611; Li *et al.*, 2008: 337; Nikbakhtzadeh *et al.*, 2012: 5; Sar and Hedge 2015:102; Lobl & Lobl 2015: 987; Sar and Ilango 2016: 234.

Materials Examined: (n=6) Pakkam 6 ex., Light trap, 19.ii.2020

Distribution: India (Uttar Pradesh: Allahabad-Ramghat; Mizoram; Uttaranchal; Uttarakhand: Chakrata district Garhwal hills; West Bengal: Darjeeling, Nurbong and

Mahanadi Valleys; Sikkim; Himachal Pradesh: Simla Hills); Nepal: Sundarimal, Ramechhap: Khimti Khola, Shivalaya; Iran (Mt. Taftan); China (Hubei, Sichuan, Xizang,); Afghanistan; Pakistan.

17. *Paederus sondaicus* Fauvel, 1895

Paederus javanus Erichson, 1840: 654; Kraatz 1859: 150

Paederus sondaicus Fauvel, 1895: 232; Bernhauer & Schubert 1912: 211; Cameron 1914: 525-544; id. 1925 b: 37; id. 1930: 332; id. 1931: 37; id. 1936: 42; id. 1949: 467; Wendeler 1926: 328; Scheerpeltz 1933: 1228; id. 1935: 609; id. 1957: 462; id. 1965: 103; Blackwelder 1939: 112; Shibata 1973: 44; Biswas & Gupta 1982: 1531; Biswas 1986: 124; Frank 1988:132; Willers, 1999: 155; Smetana, 2004: 614; Li and Zhou 2009: 46; Abdullah 2010:81; Lobl & Lobl 2015: 989; Assing 2022 b: 76.

Materials Examined: (n=729). Arayakkad 69 ex., Light trap, 70 ex., Light trap, 8.ii.2019; 10.ii.2019; 8 ex., Light trap, 19.iv.2019; 4 ex., Light trap, 7.x.2019; 68 ex., Light trap, 19.i.2020; Pattambi 20 ex., Light trap, 19.xii.2018; 10 ex., Light trap, 4.iii.2019; Ambalavayal 77 ex., Light trap, 3.ii.2019; 30 ex., Light trap, 19.v.2019; 3 ex., Light trap, 24.xi.2019; 82 ex., Light trap, 22.ii.2020; 41 ex., Light trap, 11.iv.2021; 1 ex., Sweeping net, 24.xi.2019 ; Pakkam 57 ex., Light trap, 20.v.2019; 103 ex., Light trap, 23.xi.2019; 8 ex., Light trap, 19.ii.2020; 10 ex., Light trap, 21.ii.2020; 69 ex., Light trap, 10.iv.2021

Distribution: India (Kerala: Palakkad, Wayanad; Tamil nadu: Nilgiri Hills; Karnataka: Belgaum, Nagargali, Khanapur, Sampgaon; Meghalaya: Khasia Hills, Maharashtra), Sri Lanka (Dikoya; Kandy), Nepal, Myanmar (Carin Cheba), East Indies: Indonesia (Sumatra, Java), Malaysia (Kelantan), Vienam (Tonkin), China (Fujian, Jiangxi, Guangxi, Yunnan, Hainan, Xizang, Shanghai) Taiwan (Formosa) Thailand, Vietnam.

Subtribe: Dolicaonina Casey, 1905

X. Genus: *Pinobius* MacLeay, 1871

Pinobius MacLeay 1871: 148; Herman 2003: 4; Assing 2014 h: 115; id. 2018 a: 998

18. *Pinobius indicus* Kraatz, 1859

Dolicaon indicus Kraatz 1859: 118; Cameron 1931: 218

Dolicaon longipennis Cameron 1931: 219

Pinobius longipennis Herman 2003:4

Pinobius indicus Assing 2014: 132

Materials Examined: (n=169) Arayakkad. 8 ex., Light trap, 19.iv.2019; Pattambi 19 ex., Light trap, 12.ix.2018; 17 ex., Light trap, 13.ix.2018; 54 ex., Light trap, 4.iii.2019; 47 ex., Light trap, 30.iv.2019; 24 ex., Light trap, 15.xi.2019

Distribution: India: (Pondicherry; Uttarakhand: Dehradun; West Bengal) Also in Sri Lanka, China, East and West Africa.

19. *Pinobius robustus* Kraatz, 1859

Dolicaon robustus Kraatz 1859: 117; Cameron 1931: 217

Pinobius robustus Assing 2014:143; id. 2018 a: 998

Materials Examined: (n=71) Arayakkad 8 ex., Light trap, 20.iv.2019; Pattambi 10 ex., Light trap, 19.xii.2018; 50 ex., Light trap, 4.iii.2019; Ambalavayal 3 ex., Light trap, 3.ii.2019

Distribution: India (Himachal Pradesh, Meghalaya and Tamil Nadu: Tranquebar), Nepal, Java, Sumatra, and Kei Island.

Subtribe: Astenina Hatch, 1957

XI. Genus: *Astenus* Dejean, 1833

Astenus Dejean, 1833:65; Cameron 1931:64; Blackwelder 1939: 115; Bousquet and Bouchard 2013: 13; Anlaş 2015 a: 472; 2017 a: 407 id. 2020 a: 251; Janák and Baňar

2021: 127; Sreevidhya *et al.*, 2021: 18220

Astenus Stephens, 1832: 275

Sunius Erichson, 1839: 523

20. *Astenus gracilentus* Fauvel, 1879

Sunius gracilis Kraatz 1859: 147

Astenus gracilentus Fauvel 1879: 83; Cameron 1931: 84; Sreevidhya *et al.*, 2021: 18220

Materials Examined: (n=10). Pattambi 10 ex., Light trap, 4.iii.2019.

Distributon: India (Himachal Pradesh; Uttar Pradesh; Uttarakhand: Dehradun, Lachiwala; West Bengal: Darjeeling; Manipur; Meghalaya; Tripura; Tamil Nadu: Nilgiri Hills); Bangladesh: Dhaka. Singapore. China: Hong Kong.

21. *Astenus melanurus* Küster, 1853

Sunius melanurus Küster, 1853: 76

Sunius aemulus Rotenberg, 1870: 33

Astenus adonis Coiffait, 1960: 96

Astenus melanurus Cameron 1931: 86; Scheerpeltz 1961: 5; Kascheev and Ishkov 2001: 102; Anlaş and Deveci 2011:434; Assing 2014 c: 417; Anlaş 2017 a: 407 id. 2020 a: 251; Özgen and Örgel 2021: 22; Sreevidhya *et al.*, 2021: 18221

Materials Examined: (n=30). Arayakkad 3 ex., Light trap, 8.ii.2019; Pattambi 10 ex., Light trap, 4.iii.2019; Pattambi 10 ex., Light trap, 13.ii.2020; Ambalavayal 4 ex., Light trap, 10.iii.2018; 3 ex., Light trap, 20.ii.2020

Distribution: India: Uttar Pradesh: Lakhimpur Kheri; Uttarakhand: Dehradun; West Bengal; Manipur; Maharashtra. Indonesia: Java. Cyprus. Iran. Syria. Turkey. Croata. France. Greece. Italy. Malta. Portugal. Slovakia. Slovenia. Algeria. Bulgaria, Canary Islands. Egypt. Libya. Morocco. Tunisia. South Africa

22. *Astenus nilgiriensis* Cameron, 1931

Astenus nilgiriensis Cameron, 1931: 82; Sreevidhya *et al.*, 2021: 18221

Materials Examined: (n=14). Arayakkad 4 ex., Light trap, 7.x.2019; Pattambi 10 ex., Light trap, 4.iii.2019

Distribution: India (Tamil Nadu: Nilgiri Hills; Kerala: Pookkotur)

Subtribe: *Lathrobiina* Laporte de Castelnau, 1835

XII. Genus: *Lobrathium* Mulsant & Rey, 1878

Lobrathium Mulsant & Rey 1878: 1; Assing 2007 e: 731; id. 2012 c: 49; id. 2013 e: 191; id. 2014 d: 429; id. 2017 b: 299; Li *et al.*, 2013 a: 569; id. 2013 c: 49; id. 2013 d: 47; Lü and Li 2014: 447; Peng *et al.*, 2016: 47; Anlas 2020 b: 446.

23. *Lobrathium badium* Cameron 1924

Lathrobium badium Cameron 1924: 193; id. 1931: 207.

Lobrathium badium Herman 2003:4; Assing 2012 c: 59; id. 2013 e: 194; id. 2014 d: 430; Staniec *et al.*, 2022: 4.

Materials Examined: (n=12) Pakkam 12 ex., Light trap, 19.ii.2020

Distribution: India (Uttarakhand: Mussoorie, DehraDun; Uttaranchal, Himachal Pradesh)

XIII. Genus: *Micrillus* Raffray, 1873

Micrillus Raffray 1873:362; Assing 2008 c: 301; id. 2013 g:1479; id. 2018 c: 977; Bogri *et al.*, 2020: 451.

Schatzmayria Gridelli 1914: 69

24. *Micrillus flavescens* Motschulsky, 1858

Lithocharis flavescens Motschulsky 1858: 643.

Scimbalium asperiventre Fauvel 1895: 235; Cameron 1931: 215

Micrillus flavescens Motschulsky, 1858: 643; Assing 2013 g: 1503; Bogri *et al.*, 2020: 45

Materials Examined: (n=3) Ambalavayal 3 ex., Light trap, 24.xi.2019

Distribution: Myanmar: Katha, Pegu, Palon; Thailand: Siam; Borneo.

25. *Micrillus indicus* Eppelsheim, 1890

Scimbalium indicum Eppelsheim 1890: 277; Cameron 1931: 214

Materials Examined: (n=3) Arayakkad 3 ex., Light trap, 19.i.2020

Distribution: India (Maharashtra: Nagpur; West Bengal: Kolkata).

XIV. Genus: *Pseudolathra* Casey, 1905

Pseudolathra Casey 1905; Assing 2012 d: 299; id. 2013 f: 205; id 2014 b: 1151; id 2021 a: 451; Li *et al.*, 2013 b: 1; Peng *et al.*, 2014: 597; Rougemont 2015: 1785; Kocian and Hlaváč 2018: 437; Li *et al.*, 2021: 39; Brunke and Schnepf 2021: 883; Koszela *et al.*, 2023: 521.

26. *Pseudolathra pulchella* Kraatz, 1859

Lathrobium cafrum Boheman 1848: 285; Cameron 1931:209; Sar *et al.*, 2016: 52; Chandra and Boaz 2018: 207.

Lathrobium pulchellum Kraatz 1859: 116; Fauvel 1903: 154.

Pseudolathra pulchella Assing 2012 d: 299; id. 2013 f: 208; id. 2014 b: 1153; id. 2018 b: 1006; id. 2021 a: 453; Li *et al.*, 2013 b: 7; Rougemont 2015: 1787; Matějček and Boháč 2020: 657

Materials Examined: (n=696) Arayakkad 178 ex., Light trap, 10.xi.2018; 14 ex., Light trap, 8.ii.2019; 13 ex., Light trap, 10.ii.2019; 19 ex., Light trap, 19.iv.2019; 19 ex., Light trap, 20.iv.2019; 175 ex., Light trap, 7.x.2019; Pattambi 46 ex., Light trap, 19.xii.2018; 31 ex., Light trap, 4.iii.2019; 69 ex., Light trap, 30.iv.2019; 30 ex., Light trap, 15.xi.2019; 51 ex., Light trap, 13.ii.2020; Ambalavayal 11 ex., Light trap,

11.iv.2021; Pakkam 6 ex., Light trap, 20.v.2019; 4 ex., Light trap, 23.xi.2019; 30 ex., Light trap, 19.ii.2020

Distribution: India (Kerala: Mahe; Calicut; Periyar National Park; Assam; Arunachal Pradesh; Uttarakhan: Dehra Dun; Rajasthan; Chhattisgarh: Bilaspur; West Bengal; Odisha; Meghalaya: Cherapunjee); Sri Lanka; Pakistan; Nepal; Laos; Thailand; Vietnam; Malaysia; Philippines; Indonesia; Myanmar: Pegu; East and West Africa.

27. *Pseudolathra unicolor* Kraatz, 1859

Pseudolathra unicolor Kraatz, 1859: 117; Assing 2012 d: 306; id. 2013 f: 207; id. 2014 b: 1153; id. 2018 b:1007; id. 2021 a: 453; Senda an Nakamura 2020: 207; Li *et al.*, 2013 b: 8.

Lathrobium unicolor Kraatz, 1859: 117; Cameron 1931: 210

Lathrobium testaceum Motschulsky, 1858: 646 f.; preoccupied.

Lathrobium pallens Gemminger & Harold, 1868: 611; replacement name.

Lathrobium chujoi Last, 1966: 5 f.; syn. n.

Materials Examined: (n=2243) Arayakkad 5 ex., Light trap, 8.ii.2019; 4 ex., Light trap, 10.ii.2019; 180 ex., Light trap, 20.iv.2019; 11 ex., Light trap, 7.x.2019; 6 ex., Light trap, 19.i.2020; Pattambi 117 ex., Light trap, 12.ix.2018; 101 ex., Light trap, 13.ix.2018; 757 ex., Light trap, 4.iii.2019; 863 ex., Light trap, 30.iv.2019; 34 ex., Light trap, 15.xi.2019; 140 ex., Light trap, 13.ii.2020; Ambalavayal 15 ex., Light trap, 11.iv.2021; Pakkam 4 ex., Light trap, 23.xi.2019; 6 ex., Light trap, 19.ii.2020

Distribution: India (Assam: Kaziranga Wildlife; West Bengal: Darjeeling; Meghalaya; Arunachal Pradesh: Sessa; Uttar Pradesh: Kheri Forest; Bihar: Pusa) Nepal, Myanmar, Bangladesh, Thailand; Andaman Islands, Havelock Island; China; Japan; Laos; Thailand; Vietnam; Philippines; Indonesia; Cambodia.

Subtribe: Medonina Casey, 1905

XV. Genus: *Acanthoglossa* Kraatz, 1859

Acanthoglossa Kraatz 1859: 144; Fauvel 1901: 250; Sharp 1886: 606; Cameron 1931: 219; Blackwelder 1939: 117; Assing 2009 a: 1161; id. 2016: 317.

Cephisus Fauvel 1873: 299.

Eomedon Sharp 1889: 90.

28. *Acanthoglossa hirta* Kraatz, 1859

Acanthoglossa hirta Kraatz, 1859: 144; Cameron 1931: 122; Blackwelder 1939: 117; Assing 2009 a: 1166; id. 2012 f: 976; id. 2016: 318; Sreevidhya and Sebastian 2020: 192.

Materials Examined: (n=64). Arayakkad, 4 ex., Light trap, 7.x.2019; Pattambi, 60 ex., Light trap, 4.iii.2019.

Distribution: India (Kerala: Kozhikode; Odisha), Sri Lanka, Thailand, Laos, Singapore, Indonesia (Sumatra), Korea, Yemen

XVI. Genus: *Charichirus* Sharp, 1889

Charichirus Sharp 1889: 262; Fauvel 1895: 227; Cameron 1931: 165

29. *Charichirus chinensis* Boheman, 1858

Lathrobium chinense Boheman, 1858: 32

Lithocharis dimidiatus Motschulsky 1858: 645.

Lithocharis obliquus Walker, 1859: 52

Lithocharis spectabilis Kraatz, 1859: 135.

Charichirus chinensis Boheman, 1858: 32; Cameron 1931: 167; Watanabe 2011: 177; Sar and Ilango 2016: 236; Matějček and Boháč 2020: 657; Sreevidhya and Sebastian 2020: 192.

Materials Examined: (n=8). Arayakkad, 8 ex., Light trap, 20.iv.2019

Distribution: India (Kerala: Kodumbu-Palakkad; Mizoram: Chhimtuipui, Khawnaus; Sikkim; West Bengal: Darjeeling). Pakistan, Sri Lanka, China and Japan.

XVII. Genus: *Lithocharis* Dejean, 1833

Lithocharis Dejean, 1833: 65; Casey 1886 a: 29; Cameron 1931:155; Bousquet and Bouchard 2013: 14; Assing 2015 a: 1133.

30. *Lithocharis ochraea* Gravenhorst, 1802

Lithocharis ochracea Gravenhorst 1802: 59; Erichson, 1839: 516; id. 1840: 623; Thomson 1860: 204; Wollaston 1864: 587; Morris 1865: 10; Fauvel 1872: 320; Mulsant and Rey 1877: 174; Sharp 1887: 551; Ganglbauer 1895: 525; Dugés 1901: 32; Fall 1901: 15; Cameron 1928: 244 id.1931: 158; Blackwelder 1939:102; Bohac 1981: 358; Goff *et al.*, 1986: 55; Frank 1986: 368; Cervenka and Moon 1991: 135; Peitzmeier *et al.*, 1992: 270; Hernandez *et al.*, 1994: 189; Allison *et al.*, 1999: 12; Assing, 2000:115; id 2015 a: 1137; Kenward and Hall 2000: 30; Boieiro *et al.*, 2001:21; Stan 2004: 98; Assing and Schülke 2006: 51; Denux and Zagatti 2010:401; Bordoni 2010: 130; Özgen *et al* 2010: 23; Saloña *et al.*, 2010: 1654; Samin *et al.*, 2011: 144; Anlaş and Deveci 2011:434; Webster and Demerchant, 2012: 276; Bacal *et al.*, 2013: 425; Peck *et al.*, 2014:36; Webster 2016: 434; Çiftçi and Hasbenli, 2017: 326; Good and Anderson 2017: 226; Meurgey and Ramage 2020: 68; Ferreira 2021: 225; Levesque and Levesque 2022: 5; Borges *et al.*, 2022: 12

Paederus ochraceus Gravenhorst, 1802: 59.

Lithocharis rubricollis Gravenhorst, 1806: 236

Lithocharis brunniceps Fairmaire, 1849: 1

Lithocharis fastidiosa Fairmaire & Germain, 1862: 1

Lithocharis alutacea Casey, 1886: 1

Lithocharis quadricollis Casey, 1886: 1

Materials Examined: (n=79) Arayakkad 38 ex., Light trap, 7. x.2019; 3 ex., Light trap, 19. i.2020; Pattambi 20 ex., Light trap, 19.xii.2018; 2 ex Floatation, 1.v.2019; Pakkam 9 ex., Light trap, 20. v. 2019; 6 ex., Light trap, 10.iv.2021; Ambalavayal 1 ex., Floatation, 21.v.2019.

Distribution: India (Himachal Pradesh: Simla Hills); Iran: Tehran; Turkey (Anatolia, Sündiken Mountains, Gaziantep, Şahinbey, Çimenli). West Palaearctic region (including Middle Asia); El Hierro; Hawaiian Islands; Canada (Campton, New Brunswick); Portugal (Madeira); Moldova; Ireland; Romania; California; Florida; Mexico; Zanzibar; Mauritius; Jamaica; France (Guadeloupe); US (Nebraska, Minnesota), Spain. Probably cosmopolitan.

31. *Lithocharis sororcula* Kraatz, 1859

Lithocharis sororcula Kraatz 1859: 140; Cameron 1928: 245; id. 1931:162; Blackwelder 1939: 102; Beatty 1944: 135; Ivie *et al.*, 2008: 243; Peck 2009:11; id 2010: 21; Frank *et al.*, 2011:6; Assing 2015 a: 1145; Meurgey and Ramage 2020: 68.

Materials Examined: (n=10) Pattambi 10 ex., Light trap, 30.iv.2019.

Distribution: India: (Karnataka; Uttarakhand: Dehradun; Siwaliks) Sri Lanka; China: Beijing, Yunnan; Hong Kong; Thailand; Malaysia; Singapore; East Timor. Australian Region. Neotropical Region: Peru; West Indies, Singapore; West Indies; France (Guadeloupe); Montserrat, Saint Lucia, St. Vincent island.

32. *Lithocharis uvida* Kraatz, 1859

Lithocharis uvida Kraatz 1859: 138; Cameron 1931:157; id. 1949: 467; Assing 2015 a: 1150; Ahn *et al.*, 2017; Cho 2000 b: 163

Materials Examined: (n=86) Arayakkad 8 ex., Light trap, 10.ii.2019; 8 ex., Light trap, 19.iv.2019; 38 ex., Light trap, 7.x.2019; 7 ex., Light trap, 19.i.2020; 1 ex., Floatation, 10.ii.2019; Ambalavayal 3 ex., Light trap, 3.ii.2019; 5 ex., Light trap,

19.v.2019; 3 ex., Light trap, 11.iv.2021; 1 ex., Floatation, 21.v.2019; Pakkam 3 ex., Light trap, 20.v.2019; 7 ex., Light trap, 19.ii.2020; 1 ex., Floatation, 21.ii.2020.

Distribution: India (Kerala: Aleppey; Uttarakhand: Dehra Dun; Assam: Bhalukpong); Sri Lanka (Kandy; Dikoya); Nepal (Phewa-Tal, Pokhara); Singapore; Indonesia (Sumatra; South Sulawes); Japan (Tokyo; Tachikawa); Malaysia (Penang); Laos (Vientiane); China (Sichuan); Taiwan (Chiayi Hsien; Dalin; Formosa); Korea.

33. *Lithocharis vilis* Kraatz, 1859

Lithocharis vilis Kraatz, 1859: 139; Cameron 1931: 162; id 1936: 6; Blackwelder 1939:102; Erber 1990:150; Kuschel 1990: 44; Hernandez *et al.*, 1994: 189; Assing, 2000: 115; id. 2015 a: 1142; Boieiro *et al.*, 2001:21; Assing and Schülke 2006: 52; Prasad 2010: 89; Peck *et al.*, 2014:36; Sar and Ilango 2016:236; Meurgey and Ramage 2020: 68; Chandra *et al.*, 2021: 394.

Lithocharis jacobsoni Cameron, 1928:246, 247 nov.syn.

Lithocharis vexans Cameron, 1936: 159; nov.syn

Materials Examined: (n= 77) Arayakkad 3 ex., Light trap, 10.ii.2019; 23 ex., Light trap, 20.iv.2019; 19 ex., Light trap, 7.x.2019, 4 ex., Floatation, 10.ii.2019; Pattambi 6 ex., Light trap, 13.ix.2018; 1 ex Floatation, 1.v.2019; Ambalavayal 9 ex., Light trap, 19.v.2019; 6 ex., Light trap, 11.iv.2021; Pakkam 6 ex., Light trap, 20.v.2019

Distribution: India: Nilgiri Hills; Mizoram; Sri Lanka (Kandy: Udawattakele Reserve); China (Hubei: Xingshan); Laos (Udomxai); Thailand (Mae Hong Son; Bangkok); Malaysia (Pahang; Penang; Sarawak); Indonesia (Sumatra: Bukittinggi, Sumatera; Sulawesi Tengah); Philippines (Palawan); Micronesia (Caroline Islands); El Hierro; Marquesas Islands; Singapore; Samoa; Australia (Queensland); Portugal (Madeira); France (Guadeloupe); Oceania (Samoa; Fiji Islands).

XVIII. Genus: *Medon* Stephens, 1833

Medon Stephens 1833: 273; Cameron 1931: 129; Assing 2004a:33; id. 2004b:655; id. 2005 c: 1027; id. 2006d: 25; id. 2007a: 23; id. 2007b: 791; id. 2009b: 1253; id. 2010c: 489; id. 2013c: 233; id. 2014g: 515; id. 2018d: 69; id. 2021b: 247; Kim *et al.*, 2011: 69; Anlaş 2015b: 620; Shibata and Fujimoto 2017:55; Örgel *et al.*, 2021: 414; Caterino 2023: 507; Örgel *et al.*, 2023: 50

34. *Medon auripilis* Fauvel, 1895

Medon auripilis Fauvel 1895: 228; Cameron 1931: 133; Newton 2021

Medon thaxteri Bernhauer 1927: 11.

Materials Examined: (n=23) Arayakkad 9 ex., Light trap, 19.i.2020; Pattambi 10 ex., Light trap, 13.ii.2020; Pakkam 4 ex., Light trap, 23.xi.2019

Distribution: Myanmar: Carin Cheba; Indonesia: Sumatra, Java, and Borneo.

35. *Medon cinnamopterus* Kraatz, 1859

Lithocharis cinnamoptera Kraatz 1859: 141.

Medon orientalis Cameron 1920: 281.

Medon chatterjeei Cameron 1924: 188.

Medon cinnamopterus Kraatz, 1859: 141; Cameron 1931: 138; Assing 2013c: 257

Materials Examined: (n=3) Ambalavayal 3 ex., Light trap, 24.xi.2019

Distribution: India (Uttarakhand: DehraDun. Mussoorie district: Arni Gad; Kempti Falls), Thailand: Malay Peninsula; Indonesia: Sumatra, Borneo.

36. *Medon pallidus* Motschulsky, 1858

Lithocharis pallida Motschulsky 1858: 644.

Medon pallidus Cameron 1931: 144

Materials Examined: (n=23) Arayakkad 15 ex., Light trap, 20.iv.2019; 8 ex., Light trap, 7.x.2019.

Distribution: "Indes orientales " (ex Motschulsky)

Subtribe: *Scopaeina* Mulsant and Rey, 1878

XIX. Genus: *Hyperscopaeus* Coiffait, 1984

Hyperscopaeus Coiffait 1984: 150; Frisch *et al.*, 2002a: 45; Smetana 2004: 615; Frisch 2016: 65; Herman 2023: 110.

37. *Hyperscopaeus puberulus* Kraatz, 1859

Hyperscopaeus puberulus Kraatz 1859: 128; Herman 2023: 120

Scopaeus puberulus Kraatz 1859: 128; Cameron 1931: 172

Materials Examined: (n=38) Arayakkad 3 ex., Light trap, 19.i.2020; Pattambi 6 ex., Light trap, 12.ix.2018; Ambalavayal 4 ex., Light trap, 19.v.2019; 3 ex., Light trap, 24.xi.2019; Pakkam 9 ex., Light trap, 20.v.2019; 13 ex., Light trap, 23.xi.2019

Distribution: India (Tamil Nadu: Nilgiri Hills; Uttarakhand: Dehradun, Siwaliks). Myanmar. Malay Peninsula.

XX. Genus: *Micranops* Cameron, 1913

Micranops Cameron 1913: 350; Cameron, 1923: 400; Scheerpeltz, 1933: 1271; Blackwelder, 1939: 98; id. 1944: 119; id. 1952: 243; Blackwelder and Arnett, 1974: 57; Frisch *et al.*, 2002a: 35; id. 2002b: 1; Smetana, 2004: 615; Frisch and Oromí, 2006: 23; Frisch and Herman, 2014: 67; Assing and Brachat 2021: 273; Herman 2023: 121; Guzman and Żyła 2024: 154

Nivorus Herman, 1965: 119

Microscopaeus Coiffait, 1981: 19

38. *Micranops pallidulus* Kraatz, 1859

Micranops pallidulus Kraatz, 1859: 131; Frisch and Herman 2014: 70; Herman 2023: 133

Scopaeus pallidulus Kraatz, 1859: 131; Cameron 1931: 180; Bernhauer 1939: 106

Materials Examined: (n=3) Ambalavayal 3 ex., Light trap, 22.ii.2020

Distribution: India (Uttarakhand: Dehradun); Sri Lanka; Ethiopia, Philippines, Vietnam. Singapore

XXI. Genus: *Scopaeus* Erichson, 1839

Scopaeus Erichson 1839: 29; id. 1840: 604; Redtenbacher 1849: 61; id. 1857: 213; id. 1874: 230; Schaum, 1852: 27; id. 1859: 28; Lacordaire, 1854: 95; Mulsant and Rey, 1855: 161; id. 1878: 179; Fairmaire and Laboulbène, 1856: 558; Kraatz, 1857: 667; Jacquelin du Val, 1857: 46; Thomson, 1858: 40; id. 1859: 28; id. 1860: 207; id. 1867: 180; Waterhouse 1858: 27; LeConte, 1861: 66; id. 1863: 25; id.1880: 178; Gredler 1863: 110; Crotch, 1863: 35; id. 1873: 32; Wencker and Silbermann, 1866: 32; Rye 1866: 249; Fauvel 1867: 2; id. 1873a: 292; id. 1873b: 134; id. 1873c: 21; id. 1875a: 19; id. 1875b: 221; id. 1889: 255; Gemminger and Harold, 1868: 618; Jacquelin 1868: 72; Sharp, 1871: 12; id. 1876: 248; id. 1886: 540; id. 1887: 795; Cox, 1874: 277; Von, 1880: 76; id. 1893: 45; id. 1896: 34; Duvivier, 1883: 168; Lynch 1884: 245; Casey, 1886a: 38; id. 1886b: 217; id. 1905: 191; Fowler, 1888: 310; Von *et al.*, 1891: 108; Seidlitz, 1889a: 93, 371; id. 1889b: 93, 395; Sharp and Fowler, 1893: 13; Ganglbauer, 1895: 526; Von *et al.*, 1906: 154; Reitter, 1909: 140; Sainte 1910: 139; id.1935: 96; Kuhnt, 1912: 218; Bernhauer and Schubert, 1912: 245; Petri, 1912: 65; Johansen, 1914: 442, 460; Bruch, 1915: 496; id. 1928: 442; Chagnon, 1917: 192; Leng 1920: 104; Cameron, 1921: 353; id. 1925: 44; id. 1931: 169; Winkler, 1925: 364; Porta, 1926: 68; id. 1949: 144; Leng and Mutchler 1927: 20; Portevin, 1929: 384; Beare, 1930: 16; Roubal 1930: 354; Joy 1932: 136; Scheerpeltz 1933: 1264; id. 1968: 52; Binaghi 1935; Blackwelder 1939a: 100; id. 1939b: 24; id.1943: 230; id.1944: 119; id. 1952: 347; Glick, 1939: 31; Hansen *et al.*, 1939: 33; Tottenham 1940: 53; id. 1949: 415; Kloet and Hincks, 1945: 164; Adachi 1955: 15; Hatch 1957: 151; Kocher 1958: 127; Coiffait,

1960: 284; id. 1982 b: 11; id. 1984: 148; Hansen *et al.*, 1960: 134; Fagel, 1961a: 273; id. 1961b: 200; id. 1963 b: 355; id. 1965: 209; Ferreira, 1962: 15; Arnett, 1963: 244; Székessy, 1963: 42; Palm, 1963: 14; Szujecki, 1965: 34; Coiffait and Saiz, 1968: 380; Allen 1969: 198; Shibata, 1973: 51; 1977: 58; Tikhomirova, 1973: 177; Moore and Legner, 1974: 558; id. 1975: 137; id.1979: 114; Blackwelder and Arnett, 1974: 57; Pope 1977: 27; Burakowski *et al.*, 1979: 219; Muona, 1979: 17; Uhlig 1979: 249; Dvořák, 1979: 114; Uhlig *et al.*, 1980: 243; Spahr 1981: 96; Matthews, 1982: 8; Tóth 1983: 2; Hammond 1984: 204; Boháč, 1985 b: 453; id. 1993: 46; Outerelo and Gamarra 1985: 35; Frank 1986: 369; Segers 1986: 38; Silfverberg, 1992: 19; Navarrete and Márquez 1993; Frisch 1994: 4; id. 2003: 649; id. 2005: 73; id. 2006a: 20; 2006 b: 5; 2007: 195; id. 2009: 271; id. 2011: 363; id. 2012a: 277; id.2012b: 370; id. 2014: 201; id. 2015a: 139; id. 2015 b: 61; id. 2016: 88; Terlutter 1995: 68; Ciceroni and Zanetti 1995: 21; Biswas and Biswas, 1995: 279; Hansen 1996: 103; Hansen *et al.*, 1996: 242; Downie and Arnett 1996: 405; Lundgren 1998: 49; Hansen *et al.*, 1998: 71; Newton *et al.*, 2000: 386; Assing and Schülke 2001: 132; Frisch *et al.*, 2002a: 27; id. 2002b: 2; id. 2002c: 1; Navarrete *et al.*, 2002: 280; Smetana 2004: 615; Stan 2004: 99; Jiménez *et al.*, 2009: 167; Assing 2012b: 322; Herman 2023: 61.

39. *Scopaeus bicuspis* Kraatz, 1859

Scopaeus bicuspis Kraatz 1859: 129; Cameron 1931: 185; Sanyal *et al.*,2012: 89; Sreevidhya and Sebastian 2020: 192; Herman 2023: 99.

Materials Examined: (n=162) Pattambi 144 ex., Light trap, 13.ix.2018; Ambalavayal 15 ex., Light trap, 11.iv.2021; Pakkam 3 ex., Light trap, 10.iv.2021

Distribution: India (Kerala: Kasargod; West Bengal). Vietnam.

40. *Scopaeus dilutus* Motschulsky 1858

Scopaeus dilutus Motschulsky 1858: 642; Cameron 1931: 176; Herman 2023: 101

Scopaeus suturalis Kraatz 1859: 130.

Materials Examined: (n=26) Arayakkad 23 ex., Light trap, 07. x.2019; Ambalavayal 3 ex., Light trap, 24.xi.2019

Distribution: India (Kerala: Mahe) Sri Lanka. Myanmar. Malay Peninsula, Malaysia (Penang); Indonesia (Sumatra, Java) Philippines, China (Hong Kong), and New Guinea.

41. *Scopaeus fulvus* Cameron, 1931

Scopaeus fulvus Cameron 1931:179; Frisch 2005: 73; Herman 2023: 102

Materials Examined: (n=333) Arayakkad 38 ex., Light trap, 07.x.2019; 3 ex., Light trap, 19.i.2020; Pattambi 42 ex., Light trap, 12.ix.2018; 10 ex., Light trap, 4.iii.2019; 170 ex., Light trap, 13.ii.2020; Ambalavayal 24 ex., Light trap, 10.iii.2018; 21 ex., Light trap, 19.v.2019; 3 ex., Light trap, 24.xi.2019; 3 ex., Light trap, 22.ii.2020; Pakkam 5 ex., Light trap, 20.v.2019; 4 ex., Light trap, 23.xi.2019; 6 ex., Light trap, 19.ii.2020; 4 ex., Light trap, 10.iv.2021

Distribution: India (Uttarakhand: Dehradun), Nepal, Bhutan, Thailand, Laos, Vietnam.

42. *Scopaeus limbatus* Kraatz, 1859

Scopaeus limbatus Kraatz 1859: 130; Cameron 1931: 177; Frisch 2005: 73; Herman 2023: 104; Jeon and Ahn 2024: 4.

Materials Examined: (n=3704) Arayakkad 34 ex., Light trap, 8.ii.2019; 33 ex., Light trap, 10.ii.2019; 173 ex., Light trap, 19.iv.2019; 35 ex., Light trap, 19.i.2020; Pattambi 800 ex., Light trap, 19.xii.2018; 6 ex., Light trap, 12.ix.2018; Ambalavayal 4 ex., Light trap, 3.ii.2019; 5 ex., Light trap, 19.v.2019; 12 ex., Light trap, 24.xi.2019; 5 ex., Light trap, 22.ii.2020; 6 ex., Light trap, 11.iv.2021; 1 ex., Baited pitfall trap, 4.ii.2019; Pakkam 23 ex., Light trap, 20.v.2019; 2435 ex., Light trap, 23.xi.2019; 102 ex., Light

trap, 19.ii.2020; 28 ex., Light trap, 10.iv.2021; 1 ex., Floatation, 21.ii.2020. 1 ex., Baited pitfall trap, 21.ii.2020.

Distribution: India (Karnataka: Mysore; Bihar: Pusa; Uttarakhand: Dehradun, Siwaliks, Mussoorie; Himachal Pradesh; West Bengal); Sri Lanka (Trincomalee; Kanthale; Anuradhapura). Malay Peninsula, Singapore, Penang, Taiwan, Philippines.

43. *Scopaeus testaceus* Motschulsky, 1858

Scopaeus testaceus Motschulsky 1858: 642; Cameron 1931: 173; Herman 2023: 108; Jeon and Ahn 2024: 8.

Scopaeus rubrotestaceus Kraatz 1859: 128.

Scopaeus semifuscus Kraatz 1859: 128.

Materials Examined: (n=1644) Arayakkad 11 ex., Light trap, 10.xi.2018; 8 ex., Light trap, 8.ii.2019; 7 ex., Light trap, 10.ii.2019; 40 ex., Light trap, 19.iv.2019; 35 ex., Light trap, 20.iv.2019; 15 ex., Light trap, 7.x.2019; Pattambi 38 ex., Light trap, 12.ix.2018; 49 ex., Light trap, 13.ix.2018; 256 ex., Light trap, 19.xii.2018; 10 ex., Light trap, 4.iii.2019; 47 ex., Light trap, 8.x.2019; 294 ex., Light trap, 13.ii.2020; Ambalavayal 3 ex., Light trap, 3.ii.2019; 200 ex., Light trap, 19.v.2019; 3 ex., Light trap, 22.ii.2020; 216 ex., Light trap, 11.iv.2021; Pakkam 24 ex., Light trap, 20.v.2019; 184 ex., Light trap, 23.xi.2019; 180 ex., Light trap, 19.ii.2020; 24 ex., Light trap, 10.iv.2021

Distribution: India (Karnataka: Belgaum; Uttarakhand: Dehradun). Sri Lanka (Colombo; Kanthale; Anuradhapura). Singapore and New Guinea.

44. *Scopaeus velutinus* Motschulsky, 1858

Scopaeus velutinus Motschulsky 1858: 642; Cameron 1931: 178; Matějček and Boháč 2020: 657; Herman 2023: 109

Scopaeus decipiens Kraatz 1859: 131.

Materials Examined: (n=933) Arayakkad 4 ex., Light trap, 10.xi.2018; 15 ex., Light trap, 8.ii.2019; 124 ex., Light trap, 19.iv.2019; 169 ex., Light trap, 20.iv.2019; 4 ex., Light trap, 7.x.2019; Pattambi 6 ex., Light trap, 12.ix.2018; 175 ex., Light trap, 19.xii.2018; 10 ex., Light trap, 4.iii.2019; 175 ex., Light trap, 13.ii.2020; Ambalavayal 3 ex., Light trap, 3.ii.2019; 12 ex., Light trap, 24.xi.2019; 3 ex., Light trap, 22.ii.2020; 22 ex., Light trap, 11.iv.2021; Pakkam 41 ex., Light trap, 20.v.2019; 90 ex., Light trap, 23.xi.2019; 24 ex., Light trap, 19.ii.2020; 55 ex., Light trap, 10.iv.2021; 1 ex., Flootation, 21.ii.2020

Distribution: India: Nagargali; Belgaum; Uttarakhand: Dehradun; UP. Myanmar, Afghanistan, Taiwan, Sri Lanka, Borneo, Afrotropical, Pakistan.

Subtribe: *Stilicina* Casey, 1905

XXII. Genus: *Rugilus* Leach, 1819

Rugilus Leach 1819: 173; Frania 1986: 2543; Hoebeke 1995: 69; Ryabukhin 2007: 1; Assing 2012 a: 118; 2015 b: 1; id. 2020 b: 145; Hu *et al.*, 2015: 147; Anlaş 2017 b: 197

45. *Rugilus rufescens* Sharp, 1874

Stilicus rufescens Sharp 1874: 61; Cameron 1931: 108

Stilicus rubellus Eppelsheim 1885: 121.

Stilicus rufescens var. *indicus* Cameron 1914: 542.

Rugilus kamchaticus Ryabukhin, 2007: 2

Rugilus rufescens Assing 2012 a: 167; id. 2013 d: 185; id. 2014 c: 458; id. 2015 b: 81; id. 2019 b: 17; id. 2020 b: 150; Hu *et al* 2015: 150; Ahn *et al.*, 2017: 322

Materials Examined: (n=3) Ambalavayal 3 ex., Light trap, 3.ii.2019

Distribution: India (Kerala: Idukki: Kumily; Tamil Nadu: Nilgiri Hills; Uttarakhand: Mussoorie; Assam: Patkai) Sri Lanka; China (Jiangsu; Zhenjiang; Beijing; Heilongjiang; Shanxi; Hebei; Shaanxi; Hunan; Hubei); Taiwan; North Korea

(Wonsan); Laos; Myanmar; Singapore; Vietnam (Bắc Kạn); Japan (Honshu; Ibaraki); Russia (Kamchatka; Siberia; Uksichan); Africa.

4.1.3. TAXONOMIC DESCRIPTION OF SPECIES COLLECTED FROM PALAKKAD AND WAYANAD DISTRICTS

1) *Acanthoglossa hirta*

Body length: 3-3.5 mm

Colour: Head and thorax reddish brown, elytra testaceous, abdomen brown; whole body covered with yellow pubescence. Antennae reddish-yellow. Legs yellowish.

Head: broad, transverse and closely punctured.

Thorax: as broad as head with a smooth median line reaching middle.

Elytra: Shorter; Coarsely and sparingly punctured

Abdomen: not closely punctured

Remarks: *Acanthoglossa hirta* is previously reported from Kerala

2) *Astenus gracelintus*

Body length: 4-4.5 mm

Colour: Reddish yellow species with a blackish spot in elytra. 7th and 8th abdominal segments black with posterior margin yellowish. Antennal segments, palpi and legs yellow in colour.

Head: Larger; longer than broad.

Thorax: Broader in front and little narrow behind

Elytra: Slightly longer than thorax

Abdomen: with many black setae

Remarks: *Astenus gracelintus* is previously reported from Kerala

3) *Astenus melanurus*

Body length: 3-3.5 mm

Colour: Yellowish red species; elytra yellow and shining; abdomen also shining with 7th segment blackish. Antennal segments, palpi and legs yellow in colour.

Head: Subquadrate and broader than thorax with large eyes; penultimate joints of antenna longer than broad.

Thorax: Markedly widened in front and anterior angles rounded; 2 long and black setae present on both sides.

Elytra: broader and longer than thorax; closely and finely punctured; fine yellow pubescence; setae absent.

Abdomen: Finely and closely punctured with less punctures behind; fine yellow pubescence all over abdomen; presence of black setae on the side of each abdominal segment.

Remarks: *Astenus melanurus* is previously reported from Kerala.

4) *Astenus nilgiriensis*

Body length: 5 mm

Colour: Reddish yellow species with an oval black spot on the posterior half of elytra; 7th abdominal segment black with posterior margin reddish yellow. Antennal segments, palpi and legs yellow.

Head: large and oblong, broader than thorax; with small eyes

Thorax: Long and oval with sides having 4-5 black setae.

Elytra: slightly longer but noticeably wider than thorax; finely yellow pubescent; closely and moderately coarsely punctured and sides bearing many black setae lying flat against elytra.

Abdomen: anterior region closely and rarely finely punctured than elytra; fine yellow pubescence and several black setae all over the abdomen.

Remarks: *Astenus nilgiriensis* is previously reported from Kerala.

5) *Cephalochaetus brunneus*

Body length: 5 mm

Colour: Blackish; abdomen with basal segments reddish-brown and extreme base of elytra indistinctly reddish; antennae testaceous with last 5 or six joints lighter; legs reddish yellow.

Head: longer than broad; as broad as thorax; both sides parallel before prominent eyes and slightly rounded and strongly narrowed to neck. Antennae with distinctly very long 1st joint which is about half as long as rest of segments.

Thorax: considerably longer than broad; rounded anterior angles broader; both sides then sharply retract and gently slant to directly ahead of the base, where they abruptly narrow, forming a right angle with truncate base, with anterior border abruptly and obliquely narrowing to neck.

Elytra: with same length of thorax but a little broader; parallel, very closely and less finely punctured and almost smooth without pubescence.

Abdomen: Puncturation fine and closely seen in posterior region; anterior region less closely punctured than elytra.

Remarks: *Cephalochaetus brunneus* is previously reported from Kerala.

6) *Charichirus chinensis*

Body length: 6.5 mm

Colour: Thorax black; posterior third of elytra reddish; abdominal segments with posterior margins reddish; antennae reddish in colour and legs reddish yellow.

Head: transverse and subquadrate; slightly broader than thorax; eyes shorter than temples.

Thorax: somewhat transverse; both sides straight and retracted behind; a fine shining line present along middle portion.

Elytra: almost half longer and slightly broader than thorax; densely and finely granular with very fine pubescence.

Abdomen: finely, closely and somewhat roughly punctured with fine pubescence.

Remarks: *Charichirus chinensis* is previously reported from Kerala.

7) *Cryptobium fulvescens*

Body length: 7 mm

Colour: Ferruginous red; antennae red and legs yellow coloured

Head: Oblong; both sides parallel; a little bit wider and almost as long as thorax; discreetly fine and close superficial and umbilicate punctures; front margin of head nearly smooth; punctures in sides and base almost confluent.

Thorax: Cylindrical; a short keel extended forward almost to front margin, forming a fine impunctate line; puncturation almost same size as that of head, deeper but not confluent.

Elytra: Slightly longer and broader than thorax; puncturation as same as thorax.

Abdomen: closely and finely punctured.

Remarks: *Cryptobium fulvescens* is previously reported from Kerala.

8) *Hyperscopaeus puberulus*

Body length: 5 mm

Colour: Reddish brown species; antennae red; legs reddish testaceous.

Head: narrower; slightly longer than broad; closely punctured

Thorax: narrower; little longer than broad; anterior angles rounded; closely and finely punctured.

Elytra: Slightly longer and broader than thorax; with less fine puncturation.

Abdomen: finely and closely punctured; all over pubescent.

Remarks: First record of *Hyperscopaeus puberulus* from Kerala.

9) *Lobrathium badium*

Body length: 9 mm

Colour: head and thorax bright-reddish to dark-reddish color; elytra dark brown to blackish, sometimes with reddish posterior margin; abdomen reddish with infusate apex or reddish-brown with paler apex; legs yellowish to reddish coloured; antennae completely reddish to reddish-brown.

Head: Orbicular; as wide as long; posterior angles widely rounded, almost obsolete; broader than thorax; lateral and posterior dorsal portion heavily, somewhat coarsely and discreetly finely punctured, with interstices reduced to narrow ridges; median dorsal portion and middle of frons relatively impunctate; front margin, a triangular space present and one on vertex impunctate; eyes large, either slightly larger or half the length measured from posterior edge of eye to neck.

Thorax: longer than broad, broadest at broadly rounded anterior angles; sides nearly straight and gradually tapering posteriorly; punctation almost alike to that of head, but less dense; median line without punctures while other portions discreetly finely and closely punctured.

Elytra: Longer or approximately as long as thorax and distinctly wider than thorax; noticeably longer than broad; punctation coarse and dense, not arranged in distinct series; sub- serially arranged punctures; hind wings present.

Abdomen: narrower than elytra; bases of abdominal segments closely and moderately finely punctured, remaining portion very finely and little closely punctured and pubescent; more sparingly on last segment.

Remarks: First record of *Lathrobium badium* from South India.

10) *Lithocharis ochracea*

Body length: 3.5-4 mm

Colour: head black; thorax yellowish red; elytra yellow; abdomen brown with posterior borders of segments lighter. Antennae reddish-yellow. Legs yellow coloured.

Head: approximately as long as thorax; transverse; a little broader behind; posterior angles somewhat broadly rounded; base truncate; eyes longer than temples; puncturation very fine and close.

Thorax: length and width almost same; sides straight, a little retracted behind, along central portion with fine shining line; less finely and rather closely punctured than that of head.

Elytra: almost a third longer and slightly broader than thorax; puncturation closer and rougher.

Abdomen: very finely and closely punctured all over.

Remarks: First record of *Lithocharis ochracea* from South India.

11) *Lithocharis sororcula*

Body length: 3 mm

Colour: head black; thorax testaceous; elytra yellow; abdomen brown; antennae reddish-yellow. Legs yellow coloured; colour similar to that of *L. ochracea*.

Head: subquadrate, scarcely dilated behind; eyes slightly larger.

Thorax: as long as broad; sides almost parallel and a little retracted behind; less finely and rather closely punctured.

Elytra: slightly longer and little broader than thorax; roughly and closely punctured.

Abdomen: Finely and closely punctured; black setae present

Remarks: First record of *Lithocharis sororcula* from Kerala.

12) *Lithocharis uvida*

Body length: 5 mm

Colour: Head black, thorax rusty red, elytra ochraceous; abdomen brown with posterior borders of segments and apex reddish; antennae reddish yellow; legs yellow.

Head: subquadrate; hardly broadened behind; base truncate; eyes slightly longer than temples; puncturation very fine and close.

Thorax: trapezoidal with almost same length and width; with fine raised line along middle; less finely punctured than head.

Elytra: approximately a third longer than thorax and slightly broader; finely, closely, and roughly punctured.

Abdomen: puncturation very fine and closer.

Remarks: *Lithocharis uvida* is previously reported from Kerala.

13) *Lithocharis vilis*

Body length: 3.75-4 mm

Colour: head black; thorax reddish testaceous; elytra yellow; abdomen brown; antennae reddish-yellow; legs yellow; colour similar to that of *L. ochracea*.

Head: transversely subquadrate; same width as that of thorax; not at all broadened behind; posterior angles broadly round, more shining; puncturation less fine and less close; eyes larger.

Thorax: less closely punctured

Elytra: distinctly longer and slightly broader than thorax; with close punctures.

Abdomen: emargination of abdominal segments furnished with short and firm black pectinations.

Remarks: First record of *Lithocharis vilis* from Kerala.

14) *Medon auripilis*

Body length: 7 mm

Colour: head and thorax rusty red; elytra pitchy; abdomen brown; posterior borders of 5th and 6th segments being lighter; antennae reddish with 4th and 5th joints pitchy; legs reddish testaceous.

Head: transversely subquadrate; slightly slenderer than thorax; temples parallel, posterior angles briefly rounded; rugose and some black setae present on both sides.

Thorax: noticeably transverse; both sides slightly retracted behind; anterior angles briefly and posterior largely rounded; along posterior central area with a very fine shining line; other areas covered with rather fine granules, each with a fine puncture; black setae present on both sides.

Elytra: almost a third longer and somewhat broader than thorax; slightly longer than broad; puncturation close and finely asperately punctured; posterior third covered with a fine, thick, yellow pubescence and remaining area with a fine, less noticeable greyish pubescence.

Abdomen: closely and finely punctured; pubescent; 1st visible abdominal segment more thickly pubescent than rest.

Remarks: First record of *Medon auripilis* from India.

15) *Medon cinnamopterus*

Body length: 3 mm

Colour: Pitchy-red, elytra and abdomen rather more shining; antennae, mouth- parts, and legs reddish-yellow.

Head: large and transversely quadrate; of same breadth as that of thorax; posterior angles rounded and base feebly emarginate; moderate eyes; sculpture on disc consisting of discreetly bulky close punctures; temples granular.

Thorax: hardly wider than long; sides narrowed from top to bottom; fine close granulation present, a trace of a smooth median line in disc.

Elytra: longer and slightly broader than thorax; longer than wide with a close granular sculpture; with fine yellow pubescence.

Abdomen: all over closely and finely punctured with close yellow pubescence.

Remarks: First record of *Medon cinnamopterus* from South India.

16) *Medon pallidus*

Body length: 2 mm

Colour: elytra, abdomen, legs, antennae and palpi pale testaceous.

Head: dilated behind; puncturation strong

Thorax: nearly square with obtuse angles; with rather strong puncturation; strongly coriaceous

Elytra: longer than thorax; puncturation rather strong.

Abdomen: coarse puncturation

Remarks: First record of *Medon pallidus* from South India.

17) *Micranops pallidulus*

Body length: 2-3 mm

Colour: head, thorax, and elytra yellow; abdomen brown with apex lighter; antennae and legs yellowish.

Head: slightly longer than broad; oblong; little broader than thorax; base truncate and posterior angles briefly rounded, extremely finely and closely punctured; with fine pubescence.

Thorax: lengthier than its width; a little narrowed behind; obliquely truncate in front; middle of thorax with an extremely fine line.

Elytra: slightly longer and broader than thorax; extremely finely and closely punctured; pubescence present.

Abdomen: finely and closely punctured and all over pubescent

Remarks: First record of *Micranops pallidulus* from South India

18) *Micrillus flavescens*

Body length: 4.5 mm

Colour: Reddish testaceous species; finely pubescent; elytra brownish-yellow; antennae and legs reddish-yellow.

Head: convex and more parallel; more strongly more sparingly punctured.

Thorax: narrow and more convex; more parallel; anterior region as broad as head, smooth median line present; both sides sparingly and much more strongly punctured.

Elytra: barely longer than thorax; one-fourth broader; scarcely asperate and rather closely, finely, squamosely punctured

Abdomen: scanty pubescence and punctures scattered, asperate, more finely punctured on two basal and apical abdominal segments.

Remarks: First report of *Micrillus flavescens* from India.

19) *Micrillus indicus*

Body length: 4.5 mm

Colour: reddish testaceous; finely pubescent; elytra yellowish; antennae and legs reddish-yellow.

Head: sub orbicular; of same breadth as that of thorax; temples almost parallel, posterior angles briefly rounded, both sides very finely, sparingly, unequally punctured; anterior region more sparingly punctured; two larger punctures located obliquely on each side behind antennal tubercle.

Thorax: Slightly longer than broad; sides straight and retracted behind; central portion with narrow, smooth and impunctate line subcarinate behind; very finely, closely, and obsoletely punctured.

Elytra: Slightly longer than thorax; closely, finely and roughly punctured.

Abdomen: closely and unequally punctured in anterior region; more sparingly and more asperately punctured on posterior region.

Remarks: First record of *Micrillus indicus* from South India.

20) *Monocrypta abdominalis*

Body length: 6 mm

Colour: Black species with reddish elytra; antennae reddish-testaceous, apex of 1st and 2nd to 5th joints dark; legs yellow.

Head: oblong; wider than thorax; posterior angles broadly rounded with base, closely and almost finely punctured.

Thorax: Cylindrical; scarcely retracted behind; a smooth raised median line present; puncturation nearly as close as, but noticeably coarser than head.

Elytra: as long as and slightly wider than thorax; puncturation almost close and very similar to that of thorax.

Abdomen: with very fine and close punctures.

Remarks: *Monocrypta abdominalis* is previously reported from Kerala.

21) *Ochthephilum elephas*

Body length: 9 mm

Colour: Black or brown species; posterior border of last two abdominal segments slightly reddish yellow; antennae red; legs pale yellow; tibiae a little darker.

Head: subtriangular; broader behind; longer and broader than thorax; posterior angles rather generally rounded; densely, finely and sub rugosely punctured; only extreme anterior border smooth and even.

Thorax: with sides straight and parallel; slightly retracted behind; middle with a very narrow and smooth line and its behind slightly dilated; closely punctured as on head, but much more coarsely punctured.

Elytra: Slightly longer and broader than thorax; as closely punctured as thorax, but slightly less coarse.

Abdomen: finely and closely punctured in front, more sparingly behind.

Remarks: First record of *Ochthephilum elephas* from Kerala.

22) *Ochthephilum extraneum*

Body length: 7 mm

Colour: Black; postero-external angle of elytra hardly yellowish; posterior border of 5th and 6th segments of abdomen obscurely reddish; antennae reddish- testaceous; Legs yellow.

Head: oval; slightly broader than thorax; closely and more rugosely punctured with very prominent eyes

Thorax: narrower and slightly more coarsely and more rugosely punctured; a narrow median line present

Elytra: more strongly and sparingly punctured; a distinct spot present on elytra

Abdomen: more strongly and more sparingly punctured

Remarks: *Ochthephilum extraneum* is previously reported from Kerala.

23) *Ochthephilum filum*

Body length: 7 mm

Colour: head and thorax brownish black; elytra black or brown; abdomen dark brown with 4th and 5th segments blackish; antennae and legs reddish testaceous.

Head: subtriangular; broader behind; wider than thorax; posterior angles slightly rounded; very small eyes; closely enclosed with umbilicate punctures which towards base transversely confluent thus forms an interrupted transverse rugae.

Thorax: cylindrical with close umbilicate puncturation; with a narrow smooth line throughout mid portion.

Elytra: slightly longer and wider than thorax; as closely punctured as thorax, but less coarse.

Abdomen: puncturation rather fine and close, puncturation more or less elongate on 5th segment, forming striae.

Remarks: *Ochthephilum filum* is previously reported from Kerala.

24) *Ochthephilum gastrale*

Body length: 12.5 mm

Colour: Black species; posterior margin of last two abdominal segments scarcely reddish; anal styles and legs red; antennae red but last four joints little lighter.

Head: Oval; broader than thorax; eyes small; rounded and slightly dilated post-ocular region, front between antennal tubercles depressed, smooth anteriorly and remaining area of front with slightly large, superficial, close and confluent punctures, other regions rugose, closely covered with umbilicate punctures.

Thorax: lengthier than broad; with sides straight and parallel; a little retracted behind with a smooth impunctate space along central portion, finely sulcate behind; almost as coarsely as head, but less closely punctured and not rugose.

Elytra: wider and almost one fourth longer than thorax; puncturation close, rather coarse and rugose.

Abdomen: finely and closely punctured; slightly more finely and sparingly behind.

Remarks: First record of *Ochtheophilum gastrale* from South India.

25) *Oedichirus longipennis*

Body length: 6 mm

Colour: head black; elytra and last two abdominal segments black; thorax, scutellum, and rest of abdomen reddish brown; antennae, palpi and legs testaceous; intermediate joints of antennae a little darker; apex of femora and base of tibia blackish.

Head: transverse; same breadth as thorax; with large and prominent eyes which occupies entire side of head; several large punctures between eyes.

Thorax: noticeably longer than broad; broadest in front and narrowed behind; anterior angles rounded; dorsal row of seven punctures on each side of disc; posterior five punctures more closely packed than two anterior ones; lateral margin with two small punctures; externally at widest part with two other large punctures; pubescence long, sparing, greyish and erect.

Elytra: length and breadth more than thorax; sides rounded; strongly punctured but punctures not closer; long semi-erect greyish pubescence present.

Abdomen: four transverse rows of close and discreetly coarse punctures on each segment of first four visible segments; last two segments with three rows of fine punctures; pubescence long, semi erect and yellowish.

Remarks: *Oedichirus longipennis* is previously reported from Kerala.

26) *Paederus alternans*

Body length: 6-7 mm

Colour: head and last two abdominal segments black, thorax and first four abdominal segments red; elytra blue; antennae black, first three joints more or less reddish testaceous; palpi with 3rd joint black; legs black, coxae and extreme base of femora reddish-testaceous.

Head: orbicular, post- ocular region evenly rounded to neck, slightly broader than thorax, a few small setiferous punctures present.

Thorax: ovate and convex; longer than broad; less narrowed behind; middle smooth and both sides with fine, sparing, setiferous punctures.

Elytra: slightly broader and almost one third longer than thorax; parallel; rather finely and not very closely punctured; fine greyish semi-erect pubescence present.

Abdomen: sparingly and finely punctured; finely and sparingly pubescent; with some long black setae.

Remarks: First record of *Paederus alternans* from Kerala. This species is known to cause Paederus dermatitis.

27) *Paederus extraneus*

Body length: 6.5-7.5 mm

Colour: head black; elytra blue; thorax and first four segments of abdomen reddish; base of antennae and palpi dark; first two antennal joints obscure reddish-testaceous below, dark above, remaining portion black; palpi pitchy-testaceous, 3rd joint blackish; mandibles black; thorax red and scutellum black; first four abdominal segments red; remaining black; sternum black; legs with coxae black.

Head: orbicular; same breadth as thorax but slightly convex above; puncturation close, fine and obsolete.

Thorax: shortly oval; nearly with same breadth as elytra; slightly longer than broad; both sides a little rounded and narrowed behind; convex, closely, finely and obsoletely punctured; middle with impunctate area.

Elytra: scarcely one fourth longer than thorax; closely but not very strongly punctured; fully covered with white pubescence.

Abdomen: puncturation fine; long and white pubescence present.

Remarks: First record of *Paederus extraneus* from Kerala. This species is known to cause Paederus dermatitis.

28) *Paederus fuscipes*

Body length: 6.5-7 mm

Colour: head and last two abdominal segments black; thorax and first four segments reddish; elytra blue; mandibles and palpi testaceous; apex of 3rd joint barely darker; antennae dark with first three or four joints testaceous; Legs testaceous with apex of femora, base of tibiae and tarsi more or less infusate.

Head: orbicular head with large eyes; head with same breadth as thorax; nearly smooth along middle but sides and base finely and not very closely punctured. **Thorax:** convex;

slightly longer than broad; sides almost straight and not much retracted behind; middle portion smooth but sides finely and sparingly punctured.

Elytra: wider and parallel; almost a half as long again as thorax; closely and rather strongly punctured; a fine scanty whitish pubescence present.

Abdomen: not very closely punctured, but punctures very fine; fine and scanty whitish pubescence present.

Remarks: *Paederus fuscipes* is previously reported from Kerala. This species is known to cause Paederus dermatitis.

29) *Paederus nigricornis*

Body length: 7-8 mm

Colour: head black; 1st visible segment of abdomen and last two segments black; thorax and 2nd to 4th abdominal segments reddish; elytra blue; antennae black but first two joints more or less testaceous; Palpi and legs together with coxae entirely black.

Head: elongate; longer than broad; wider than thorax; eyes prominent and post-ocular region nearly straight and converging to neck; impressed on both sides on anterior part; sculpture sparing and consisting of both large and small punctures; a few setae present at post-ocular region, or else smooth.

Thorax: narrow and oval; not much broadened in front; lengthier than broad; middle portion impunctate but sides very finely and sparingly punctured and a few erect black setae present.

Elytra: parallel; slightly longer and broader than thorax; puncturation rather fine and not very close having rather long, semi-erect, black pubescence.

Abdomen: puncturation at base of 1st visible segment rather coarse and close; remaining area with very finely and sparingly punctured; pubescence yellow, scanty, and with some longer black setae.

Remarks: First record of *Paederus nigricornis* from South India. This species is known to cause Paederus dermatitis.

30) *Paederus sondaicus*

Body length: 9 mm

Colour: head and last two segments of abdomen black; thorax and first four visible segments reddish; elytra blue; antennae blackish, but testaceous on first three or four and 11th joints; mandibles red and palpi testaceous; Legs black but coxae and base of femora testaceous.

Head: orbicular; with same breadth as thorax; impressed on both sides in anterior region; middle portion smooth, but sides finely, moderately closely punctured with unequal sized punctures; numerous black erect setae present.

Thorax: convex; slightly longer than broad; immarginate laterally; slightly narrowed behind; almost straight sides; middle portion impunctate with sides being very finely and sparingly punctured with numerous black setae.

Elytra: parallel; slightly longer and broader than thorax; closely and deeply punctured; fine setae present.

Abdomen: with fine and moderately close punctures; finely setiferous.

Remarks: *Paederus sondaicus* is previously reported from Kerala.

31) *Palaminus nilgiriensis*

Body length: 3.5 mm

Colour: species entirely reddish brown; antennae, palpi, and legs a little lighter

Head: almost as broad as thorax; base truncate; a few rather large umbilicate punctures at disc.

Thorax: transverse; less coarsely punctured

Elytra: twice as long as thorax with finer puncturation

Abdomen: 6th ventral segment with an emargination

Remarks: First record of *Palaminus nilgiriensis* from Kerala.

32) *Palaminus rufus*

Body length: 5 mm

Colour: ferruginous red; elytra with sutural region behind and apical border often lighter and yellowish; abdomen brown; antennae, palpi, and legs yellowish.

Head: with same breadth as thorax; base truncate; dentiform posterior angles; disc with some moderately large umbilicate punctures.

Thorax: transverse and sub cordate; carinate and bi-impressed before base; puncturation similar to that of head, but punctures closer.

Elytra: almost twice as long as thorax; closely punctured and rather coarse.

Abdomen: 6th ventral abdominal segment rounded.

Remarks: First record of *Palaminus rufus* from Kerala.

33) *Pinobius indicus*

Body length: 7 mm

Colour: reddish-brown species; antennae red; legs reddish-yellow.

Head: transverse and subquadrate; same breadth as thorax; posterior angles briefly rounded and smooth on central portion of disc; remaining portion rather finely and closely punctured; punctures fine and umbilicate.

Thorax: slightly longer than broad; somewhat narrowed behind; sides straight with anterior angles briefly and posterior more broadly rounded; truncate anterior margin, along middle rather broadly impunctate and remaining portion more finely and more closely punctured.

Elytra: as long as and slightly broader than thorax; more closely, scarcely more finely punctured having fine yellow pubescence.

Abdomen: rather closely and very finely punctured and pubescent.

Remarks: First record of *Pinobius indicus* from Kerala.

34) *Pinobius robustus*

Body length: 9 mm

Colour: reddish-brown species, elytra redder; antennae red; legs reddish- testaceous.

Head: transverse and sub quadrate; of same breadth as thorax; posterior angles briefly rounded; middle of disc smooth; remaining portion rather finely and not very closely punctured; punctures finely umbilicate.

Thorax: slightly longer than broad and narrowed behind; sides straight and parallel, anterior angles briefly while posterior more broadly rounded; truncate anterior border; along middle rather broadly impunctate and remaining portion punctured like head.

Elytra: as long as thorax but slightly broader; more closely, scarcely more finely punctured; fine yellow pubescent present.

Abdomen: very finely and rather closely punctured; pubescent.

Remarks: First record of *Pinobius robustus* from Kerala.

35) *Pinocharis genalis*

Body length: 7.5-8 mm

Colour: ferruginous red; abdominal segments with lighter posterior borders; antennae, palpi, and legs reddish-testaceous.

Head: large; scarcely narrower than thorax; with well-developed temples, obtuse posterior angles; front with six punctures; two punctures immediately behind middle of anterior border and close together; two larger punctures on each side and further back; disc with four quadrately placed punctures and other two punctures on each side placed obliquely, posteriorly with a few irregular punctures, all umbilicate.

Thorax: of same length and breadth; widest in front and sides very gently rounded and a little retracted to rounded posterior angles; scarcely perceptibly bi-impressed and carinate at base; on each side of front with a smooth space and remaining surface with rather fine, umbilicate moderately close punctures.

Elytra: a little longer and slightly narrower than thorax; more closely and more strongly punctured; scarcely rugose.

Abdomen: moderately finely punctured and punctures closer; pubescence rather long, yellowish and more evident on abdomen.

Remarks: First record of *Pinocharis genalis* from India.

36) *Pinonepalus cameroni*

Body length: 10.5 mm

Colour: head black; elytra reddish-brown; antennae, palpi, and legs reddish-testaceous.

Head: transverse and subtriangular; puncturation coarse and umbilicate, except for a narrow, smooth and curved transverse space extending between eyes and a triangular smooth space at front margin; with scanty yellow pubescence; temples minute and eyes large.

Thorax: slightly broader than head; a little broader than long; at anterior half, sides parallel, then gradually rounded and narrowed to completely rounded posterior angles; bluntly rectangular anterior angles; very less coarse punctures than on head, umbilicate, with narrow smooth central line on disc; scanty, yellow pubescence; scutellum punctured.

Elytra: narrower but slightly longer than thorax; a bit longer than broad; with strong, deep and close punctures; pubescence yellow and scanty.

Abdomen: puncturation strong and moderately close; pubescence yellow, rather long.

Remarks: First record of *Pinonepalus cameroni* from Kerala.

37) *Pseudolathra pulchella*

Body length: 5.5-7 mm

Colour: head usually black to blackish-brown, rarely entirely or in part red; pronotum reddish; elytra usually blackish-brown to blackish, sometimes reddish-brown; abdomen uniformly reddish to uniformly blackish-brown, sometimes reddish with darker apex; legs reddish yellow; antennae reddish-yellow to brown.

Head: almost as broad as long; narrower than thorax; subquadrate; posterior angles usually broadly convex and rounded; disc smooth at front and middle; at sides and base rather finely and rather closely punctured; more coarsely and more sparingly towards front; eyes large; antennae slender; all antennomeres oblong.

Thorax: cylindrical; longer than broad; along middle smooth; on each side with a row of about fifteen fine punctures and outwardly with narrow impunctate area; sides rather closely and almost finely punctured.

Elytra: approximately same length as thorax, but broader; punctures arranged in distinct series with several rows of moderately fine punctures present.

Abdomen: a little narrower than elytra; very finely, very densely and closely punctured and pubescent all over.

Remarks: *Pseudolathra pulchella* previously recorded from Kerala.

38) *Pseudolathra unicolor*

Body length: 5-6 mm

Colour: body entirely unicolorous, reddish testaceous; sometimes head, postero-lateral portion of elytra and 3rd to 6th abdominal segments more or less distinctly infusate; legs yellowish to reddish-yellow; antennae reddish testaceous.

Head: subquadrate; almost as broad as long or weakly transverse; posterior angles rounded; disc smooth at front and middle; rather finely and rather closely punctured along sides and base; anterior region of front more strongly and more sparingly punctured; eyes large, but of variable size, usually slightly longer, hardly shorter than postocular region in dorsal view; antennae slender; all antennomeres oblong.

Thorax: cylindrical; longer than broad with smooth middle area; on each side with a row of about fifteen fine punctures with narrow impunctate area externally; sides rather closely and moderately finely punctured.

Elytra: approximately as long as thorax or slightly longer; broader than thorax; moderately fine punctures arranged in more or less pronounced series in several rows; hind wings fully developed.

Abdomen: a little narrower than elytra; closely and finely punctured and pubescent throughout abdomen.

Remarks: First record of *Pseudolathra unicolor* from South India.

39) *Rugilus rufescens*

Body length: 4-4.5 mm

Colour: Head and thorax reddish, elytra copper-bronze with apical borders and postero-external angles testaceous; abdomen pitchy; antennae, palpi, and legs reddish yellow.

Head: large and transverse; of same breadth as elytra; temples gradually converging behind; posterior angles rounded; densely punctured.

Thorax: longer than broad; anterior angles of thorax discrete and obtuse; sides rather strongly narrowed backwards; with coarse punctures than that of head; disc lacking smooth central line.

Elytra: slightly longer than the thorax; length and breadth almost same; puncturation fine and rather close; disc with some very irregular and larger punctures; finely pubescent.

Abdomen: puncturation is rather close and fine; pubescence present.

Remarks: *Rugilus rufescens* is previously reported from Kerala

40) *Scopaeus bicuspis*

Body length: 3.5-3.75 mm

Colour: reddish-brown species; paler posterior margin of the elytra and lighter abdomen; antennae and legs reddish testaceous.

Head: suborbicular; the post-ocular region gradually narrowed and rounded to the broadly rounded posterior angles; very finely and closely punctured; with fine pubescence.

Thorax: oval, short median keel before the base and a little fovea on each side; a very fine more line along the middle; the puncturation is very fine and close.

Elytra: slightly longer and broader than the thorax; less finely and more roughly punctured.

Abdomen: very finely and closely punctured and pubescent.

Remarks: *Scopaeus bicuspis* is previously reported from Kerala.

41) *Scopaeus dilutus*

Body length: 3 mm

Colour: the head red but occasionally infusate at the sides and on the vertex; thorax red; elytra infusate while the base, suture, and apical margins narrowly and indeterminately reddish but, occasionally entirely reddish; abdomen brownish; antennae reddish-testaceous; legs testaceous.

Head: quadrate; broader than thorax; briefly rounded posterior angles; base truncate; puncturation very fine and close.

Thorax: slightly longer than broad; narrower behind; obtusely rounded anterior angles; at middle of base with a small keel and on both side with a little fovea; puncturation as close as but finer than head.

Elytra: slightly longer and broader than thorax; closely and finely asperate punctures present.

Abdomen: subsericeous; very finely and closely punctured and pubescent.

Remarks: *Scopaeus dilutus* is previously reported from Kerala.

42. *Scopaeus fulvus*

Body length: 3 mm

Colour: Head red; thorax yellowish-red; elytra infusate with posterior region indeterminately yellow; abdomen brownish-yellow; antennae and legs yellow.

Head: slightly longer than broad; broader than thorax but not widened behind; base truncate; posterior angles almost rounded; very finely and closely punctured with fine pubescence.

Thorax: slightly longer than broad; somewhat narrowed behind; obtusely rounded anterior angles; bi-impressed before base having short median keel; puncturation extremely fine but less close than that of head.

Elytra: hardly longer than thorax; puncturation extremely fine and closely; finely pubescence present.

Abdomen: very finely and closely punctured and pubescent.

Remarks: First record of *Scopaeus fulvus* from South India.

43. *Scopaeus limbatus*

Body length: 3 mm

Colour: head black, sometimes brown or red; thorax red; elytra black with posterior margin narrowly reddish testaceous; abdomen brown; antennae reddish testaceous; legs yellow.

Head: quadrate; broader than thorax; rounded posterior angles with truncate base; with extremely fine and close punctures.

Thorax: slightly narrowed behind; longer than broad; rounded anterior angles and base in middle with a very short keel; with extremely fine and closer puncturation as that of head.

Elytra: slightly longer and broader than thorax; as closely punctured as thorax but much less finely punctured.

Abdomen: puncturation very fine and closer; with pubescence.

Remarks: First record of *Scopaeus limbatus* from Kerala.

44. *Scopaeus testaceus*

Body length: 4 mm

Colour: head and thorax brownish-red; elytra yellowish-red; abdomen yellowish-brown; antennae reddish; legs testaceous.

Head: slightly longer than broad; subquadrate; base emarginate, with close, fine and granular sculpture.

Thorax: oval; with a fine line along middle, shortened in front and behind; sculpture as on head.

Elytra: slightly longer and broader than thorax; with close, fine, asperate punctures.

Abdomen: puncturation very fine and close; pubescence present.

Remarks: First record of *Scopaeus testaceus* from Kerala.

45. *Scopaeus velutinus*

Body length: 2.8 mm

Colour: head brown or red; thorax reddish; elytra reddish testaceous; abdomen brown; antennae reddish testaceous; legs yellow.

Head: narrow; quadrate; broader than thorax; rounded posterior angles with truncate base; with deep punctures

Thorax: a little narrowed behind; longer than broad; rounded anterior angles; base in middle with a very short keel; deeply punctured

Elytra: slightly longer and broader than thorax; almost as deeply and closely punctured as thorax.

Abdomen: closely and finely punctured and pubescence present.

Remarks: First record of *Scopaeus velutinus* from Kerala.

TRIBE PINOPHILINI

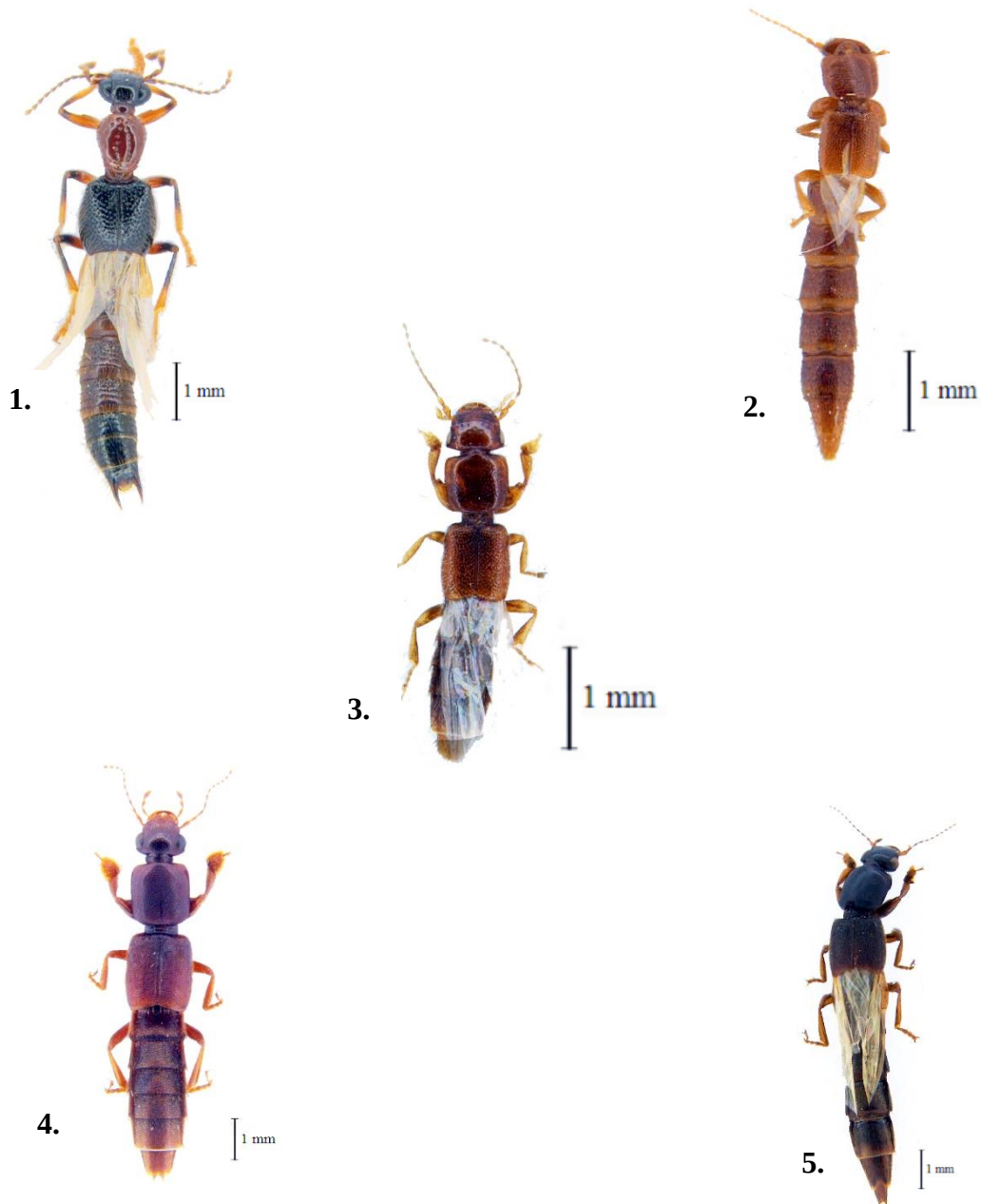


Plate 3: Dorsal habitus of 1. *Oedichirus longipennis* (Kraatz, 1859) 2. *Palaminus rufus* (Cameron, 1931) 3. *Palaminus nilgiriensis* (Cameron, 1931) 4. *Pinocharis genalis* (Fauvel, 1895) 5. *Pinonepalus cameroni* (Scheerpeltz, 1933)

TRIBE PAEDERINI

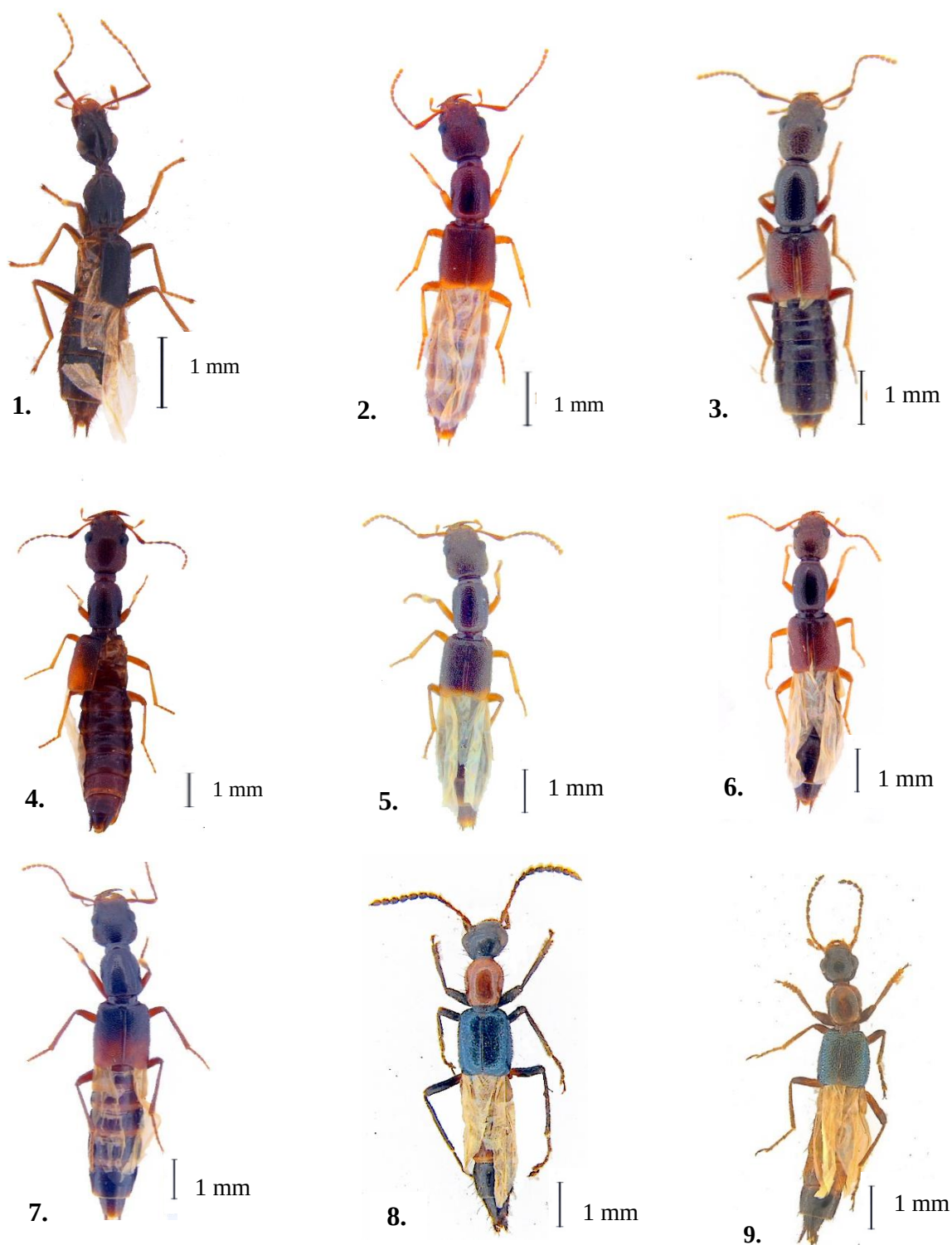
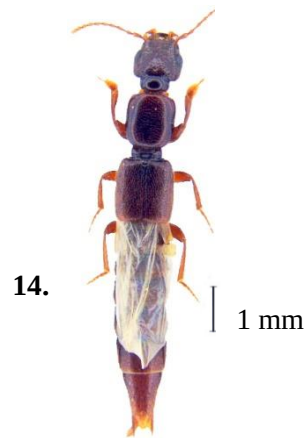
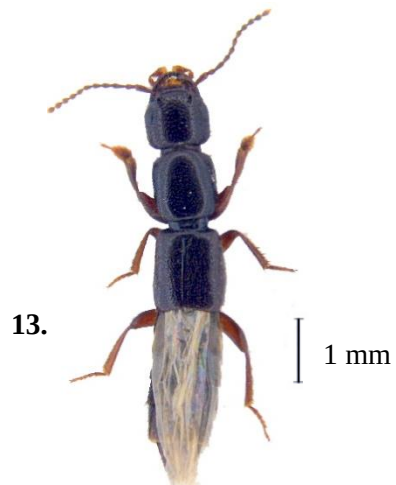


Plate 4: Dorsal habitus of 1. *Cephalochetus brunneus* (Motschulsky, 1858) 2. *Cryptobium fulvescens* (Motschulsky, 1858) 3. *Monocrypta abdominalis* (Motschulsky, 1858) 4. *Ochthephilum elephas* (Fauvel, 1904) 5. *O. extraneum* (Fauvel, 1904) 6. *O. filum* Kraatz 1859 7. *O. gastrale* (Fauvel, 1895) 8. *Paederus alternans* (Walker, 1858) 9. *P. extraneus* (Wiedemann, 1823)



**Plate 5: 10. *Paederus fuscipes* (Curtis, 1826) 11. *Paederus nigricornis* (Bernhauer, 1911)
 12. *Paederus sondaicus* (Fauvel, 1895) 13. *Pinobius indicus* (Kraatz, 1859) 14. *Pinobius
 robustus* (Kraatz, 1859)**

TRIBE LATHROBINI

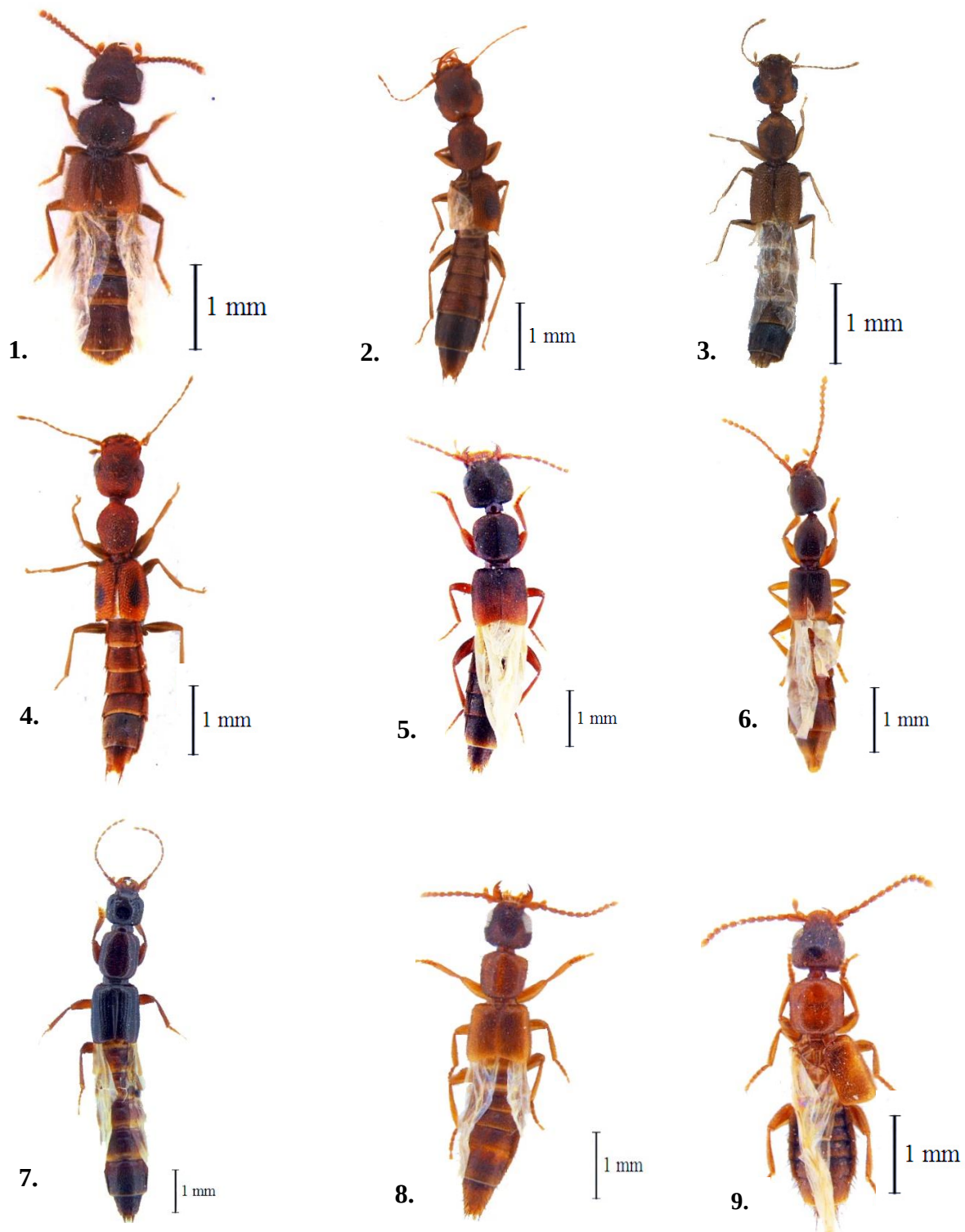


Plate 6: Dorsal habitus of 1. *Acanthoglossa hirta* (Kraatz, 1859) 2. *Astenus gracilentus* (Fauvel, 1879) 3. *A. melanurus* Küster, 1853 4. *A. nilgiriensis* (Cameron, 1931) 5. *Charichirus chinensis* Boheman, 1858 6. *Hyperscopaeus puberulus* (Kraatz, 1859) 7. *Lobrathium badium* (Cameron 1924) 8. *Lithocharis ochraea* (Gravenhorst, 1802) 9. *L. sororcula* (Kraatz, 1859)



10.



11.



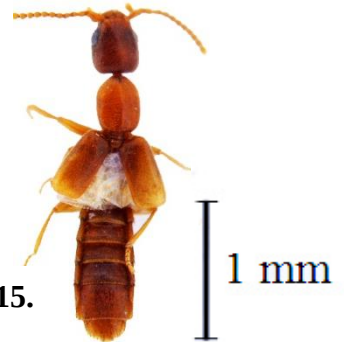
12.



13.



14.



15.



16.



17.



18.

Plate 7: 10. *Lithocharis uvida* (Kraatz, 1859) 11. *L. vilis* (Kraatz, 1859) 12. *Medon auripilis* (Fauvel, 1895) 13. *M. cinnamopterus* (Kraatz, 1859) 14. *M. pallidus* (Motschulsky, 1858) 15. *Micranops pallidulus* (Kraatz, 1859) 16. *Micrillus flavescens* (Motschulsky, 1858) 17. *M. indicus* (Eppelsheim, 1890) 18. *Pseudolathra pulchella* (Kraatz, 1859)

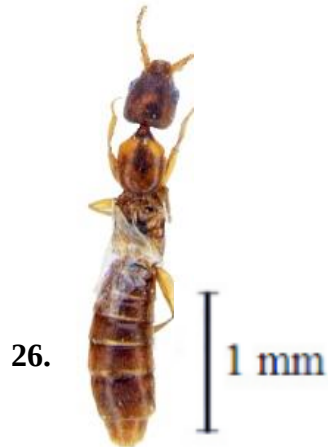


Plate 8: 19. *Pseudolathra unicolor* (Kraatz, 1859) 20. *Rugilus rufescens* (Sharp, 1874) 21. *Scopaeus bicuspis* (Kraatz, 1859) 22. *S. dilutus* (Motschulsky 1858) 23. *S. fulvus* (Cameron, 1931) 24. *S. limbatus* (Kraatz 1859) 25. *S. testaceus* (Motschulsky 1858) 26. *Scopaeus velutinus* (Motschulsky, 1858)

4.2 ECOLOGY OF PAEDERINAE

4.2.1. Abundance and Diversity of Paederinae beetles in Arayakkad- Palakkad District

A total of 30 species of Paederinae were collected from the paddy field at Arayakkad during the entire period of study irrespective of seasons. 30 species of Paederinae were collected using light traps; 2 species of *Lithocharis* genus i.e., *Lithocharis uvida* and *Lithocharis vilis* were collected by floatation method. No Paederinae species was collected by Baited Pitfall trap. As these beetles are very small in size and due to their rapid moving style, it was unable to capture these beetles using Sweeping net from Arayakkad.

Pseudolathra pulchella (4.65 ± 3.52) was the dominant species collected from this site followed by *Scopaeus velutinus* (3.51 ± 3.10). Abundance data of species collected from Arayakkad is provided in Table1. Among the 30 species collected, 7 were major, 14 were minor species and 9 were rare species.

Table 1. Abundance data of species collected from Arayakkad

SI NO	Species Name	Mean $\pm$ SD	Percentage
1	<i>Acanthoglossa hirta</i>	0.04 ± 0.20	0.19
2	<i>Astenus melanurus</i>	0.03 ± 0.18	0.14
3	<i>Astenus nilgiriensis</i>	0.04 ± 0.20	0.19
4	<i>Charichirus chinensis</i>	0.09 ± 0.26	0.37
5	<i>Cryptobium fulvensens</i>	0.09 ± 0.26	0.37
6	<i>Hyperscopaeus puberulus</i>	0.03 ± 0.17	0.14
7	<i>Lithocharis ochraea</i>	0.46 ± 0.42	1.92
8	<i>Lithocharis uvida</i>	0.68 ± 0.15	2.86

9	<i>Lithocharis vilis</i>	0.5 ± 0.23	2.11
10	<i>Medon auripilis</i>	0.1 ± 0.38	0.42
11	<i>Medon pallidus</i>	0.26 ± 0.33	1.08
12	<i>Micrillus indicus</i>	0.03 ± 0.17	0.14
13	<i>Monocrypta abdominalis</i>	0.24 ± 0.58	1.03
14	<i>Ochthephilum filum</i>	0.03 ± 0.17	0.14
15	<i>Ochthephilum elephas</i>	0.04 ± 0.20	0.19
16	<i>Ochthephilum extraneum</i>	0.61 ± 0.12	2.58
17	<i>Paederus extraneus</i>	0.1 ± 0.37	0.42
18	<i>Paederus fuscipes</i>	2.09 ± 2.36	8.83
19	<i>Paederus sondaicus</i>	2.43 ± 2.59	10.28
20	<i>Palaminus rufus</i>	0.03 ± 0.17	0.14
21	<i>Pinobius indicus</i>	0.09 ± 0.26	0.37
22	<i>Pinobius robustus</i>	0.09 ± 0.26	0.37
23	<i>Pinonepalus cameroni</i>	0.04 ± 0.20	0.19
24	<i>Pseudolathra pulchella</i>	4.65 ± 3.52	19.62
25	<i>Pseudolathra unicolor</i>	2.29 ± 2.76	9.67
26	<i>Scopaeus dilutus</i>	0.26 ± 0.63	1.08
27	<i>Scopaeus fulvus</i>	0.46 ± 0.46	1.92
28	<i>Scopaeus limbatus</i>	3.06 ± 2.37	12.91
29	<i>Scopaeus testaceus</i>	1.29 ± 0.36	5.45
30	<i>Scopaeus velutinus</i>	3.51 ± 3.10	14.84

4.2.2. Seasonality of Paederinae beetles in Arayakkad- Palakkad District

Twenty species belonging to eleven genera namely, *Astenus*, *Hyperscopaeus*, *Lithocharis*, *Medon*, *Micrillus*, *Monocrypta*, *Ochthephilum*, *Paederus*, *Palaminus*, *Pseudolathra* and *Scopaeus* were collected during the pre- summer season; fourteen species belonging to eight genera namely *Charichirus*, *Lithocharis*, *Medon*, *Ochthephilum*, *Paederus*, *Pinobius*, *Pseudolathra* and *Scopaeus* were collected during the summer season; eighteen species belonging to eleven genera namely *Acanthoglossa*, *Astenus*, *Cryptobium*, *Lithocharis*, *Medon*, *Monocrypta*, *Ochthephilum*, *Paederus*, *Pinonepalus*, *Pseudolathra* and *Scopaeus* were collected during the monsoon season (Table 2). Graph showing the seasonal abundance of major Paederinae species collected from Arayakkad is provided (Figure 1). Rarefraction curve of Paederinae species collected from Arayakkad in each season is also provided (Figure 2; Figure 3; Figure 4).

Among the thirty species recorded from Arayakkad seven species namely *Astenus melanurus*, *Hyperscopaeus puberulus*, *Medon auripilis*, *Micrillus indicus*, *Ochthephilum filum*, *Paederus extraneus* and *Palaminus rufus* were recorded only on Pre- Summer; three species namely *Charichirus chinensis*, *Pinobius indicus* and *Pinobius robustus* were recorded only during Summer season; six species namely *Acanthoglossa hirta*, *Astenus nilgiriensis*, *Cryptobium fulvensens*, *Ochthephilum elephas*, *Pinonepalus cameroni* and *Scopaeus dilutus* were recorded only during Monsoon season. *Paederus fuscipes* and *Scopaeus limbatus* were recorded both in the Pre-summer and Summer season; *Medon pallidulus* was recorded in the Summer and Monsoon Seasons; *Lithocharis ochracea*, *Monocrypta abdominalis* and *Scopaeus fulvus* were recorded both in the Pre-summer and Monsoon seasons; *Lithocharis uvida*, *Lithocharis vilis*, *Ochthephilum extraneum*, *Paederus sonaicus*, *Pseudolathra pulchella*, *Pseudolathra unicolor*, *Scopaeus testaceus* and *Scopaeus velutinus* were collected in

all the three seasons.

Table 2. showing seasonal abundance of Paederinae collected from Arayakkad

SI NO	SPECIES NAME	PRE-SUMMER	SUMMER	MONSOON
1	<i>Acanthoglossa hirta</i>	0±0	0±0	0.13±0.35
2	<i>Astenus melanurus</i>	0.1±0.31	0±0	0±0
3	<i>Astenus nilgiriensis</i>	0±0	0±0	0.13±0.35
4	<i>Charichirus chinensis</i>	0±0	0.27±0.45	0±0
5	<i>Cryptobium fulvansens</i>	0±0	0±0	0.27±0.45
6	<i>Hyperscopaeus puberulus</i>	0.1±0.31	0±0	0±0
7	<i>Lithocharis ochraea</i>	0.1±0.31	0±0	1.27±0.83
8	<i>Lithocharis uvida</i>	0.5±0.63	0.27±0.45	1.27±0.74
9	<i>Lithocharis vilis</i>	0.1±0.31	0.77±0.73	0.63±0.67
10	<i>Medon auripilis</i>	0.3±0.65	0±0	0±0

11	<i>Medon pallidus</i>	0±0	0.5±0.57	0.27±0.58
12	<i>Micrillus indicus</i>	0.1±0.3	0±0	0±0
13	<i>Monocrypta abdominalis</i>	0.1±0.3	0±0	0.63±1.13
14	<i>Ochthephilum filum</i>	0.1±0.3	0±0	0±0
15	<i>Ochthephilum elephas</i>	0±0	0±0	0.13±0.35
16	<i>Ochthephilum extraneum</i>	0.3±0.53	0.77±0.63	0.77±0.77
17	<i>Paederus extraneus</i>	0.3±0.65	0±0	0±0
18	<i>Paederus fuscipes</i>	6±4.3	0.27±0.45	0±0
19	<i>Paederus sondaicus</i>	6.9±4.9	0.27±0.45	0.13±0.35
20	<i>Palaminus rufus</i>	0.1±0.3	0±0	0±0
21	<i>Pinobius indicus</i>	0±0	0.27±0.45	0±0
22	<i>Pinobius robustus</i>	0±0	0.27±0.45	0±0
23	<i>Pinonepalus cameroni</i>	0±0	0±0	0.13±0.35
24	<i>Pseudolathra pulchella</i>	0.9±0.99	1.27±0.78	11.77±6.98
25	<i>Pseudolathra unicolor</i>	0.5±0.63	6±5.37	0.37±0.56
26	<i>Scopaeus dilutus</i>	0±0	0±0	0.77±1.1
27	<i>Scopaeus fulvus</i>	0.1±0.3	0±0	1.27±0.91
28	<i>Scopaeus limbatus</i>	3.4±4.7	5.77±2.95	0±0
29	<i>Scopaeus testaceus</i>	0.5±0.82	2.5±1.53	0.87±1.11
30	<i>Scopaeus velutinus</i>	0.5±0.97	9.77±6.07	0.27±0.45

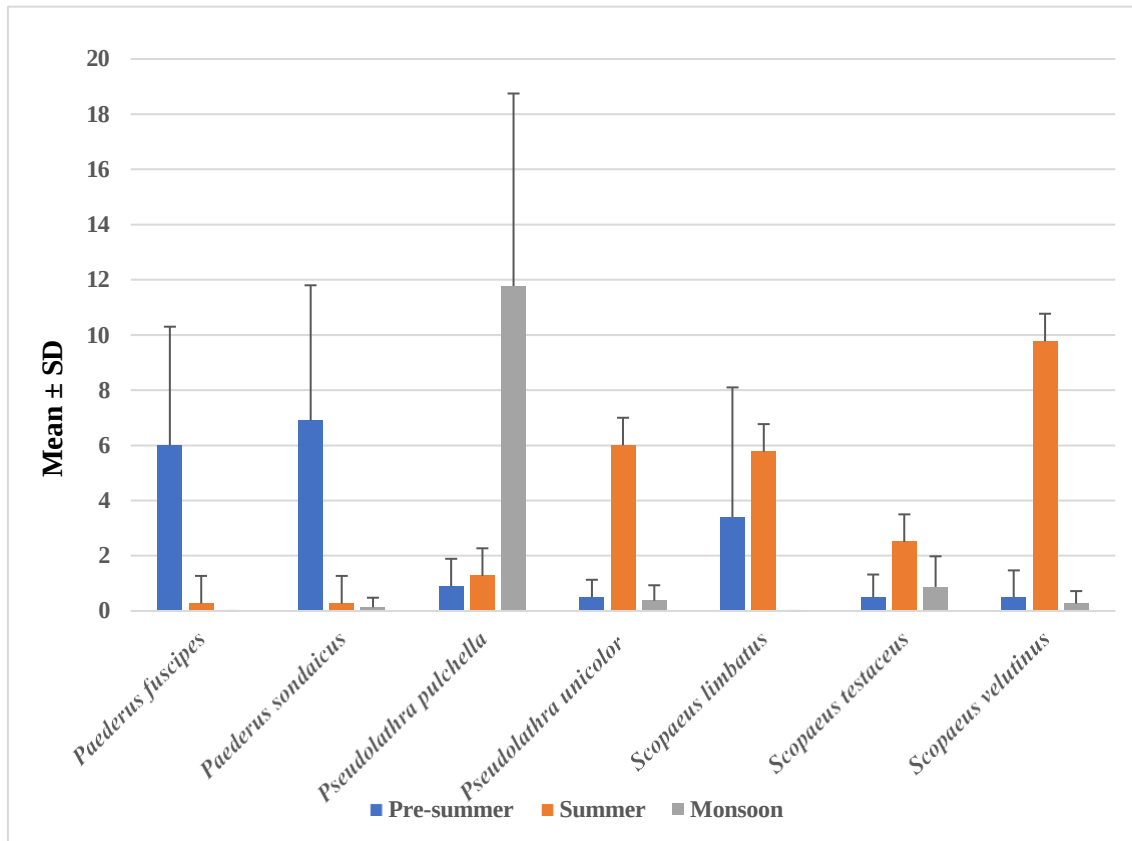


Figure 1. Graph showing the seasonal abundance of major Paederinae species collected from Arayakkad

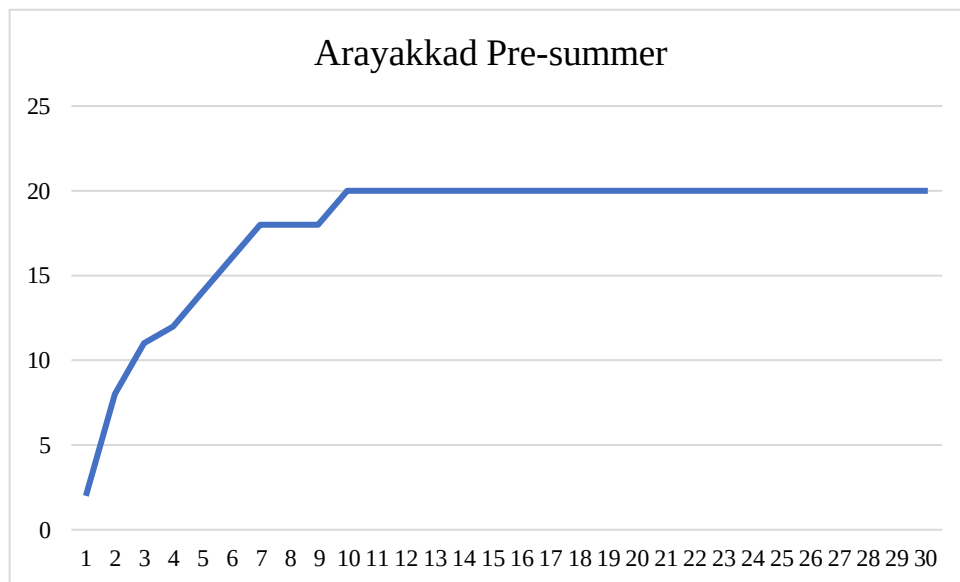


Figure 2. Rarefaction curve of samples collected from Arayakkad in Pre- Summer season

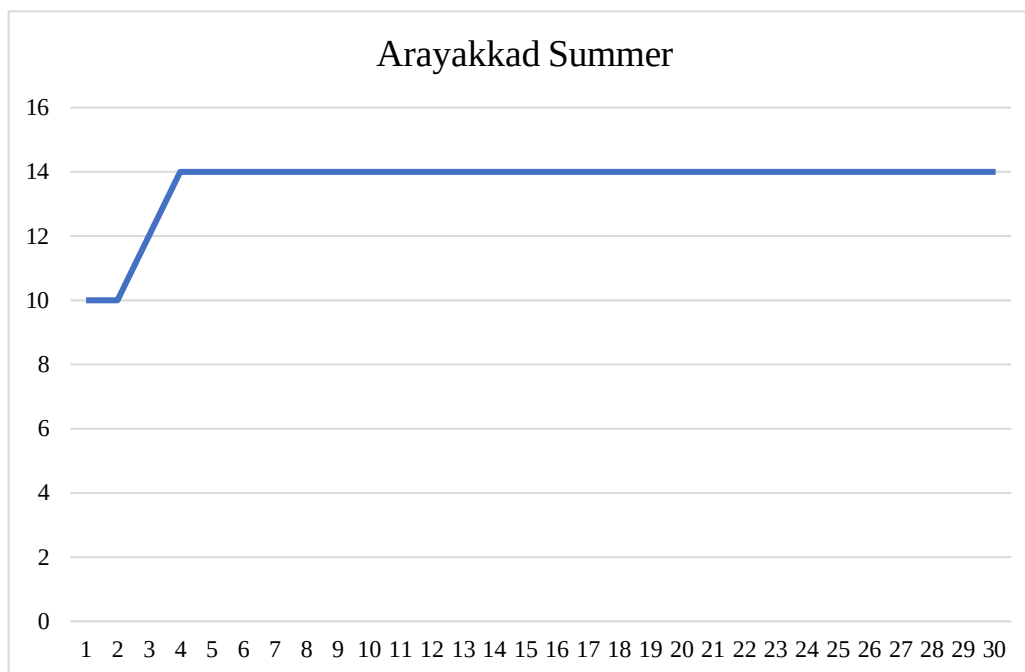


Figure 3. Rarefaction curve of samples collected from Arayakkad in Summer season

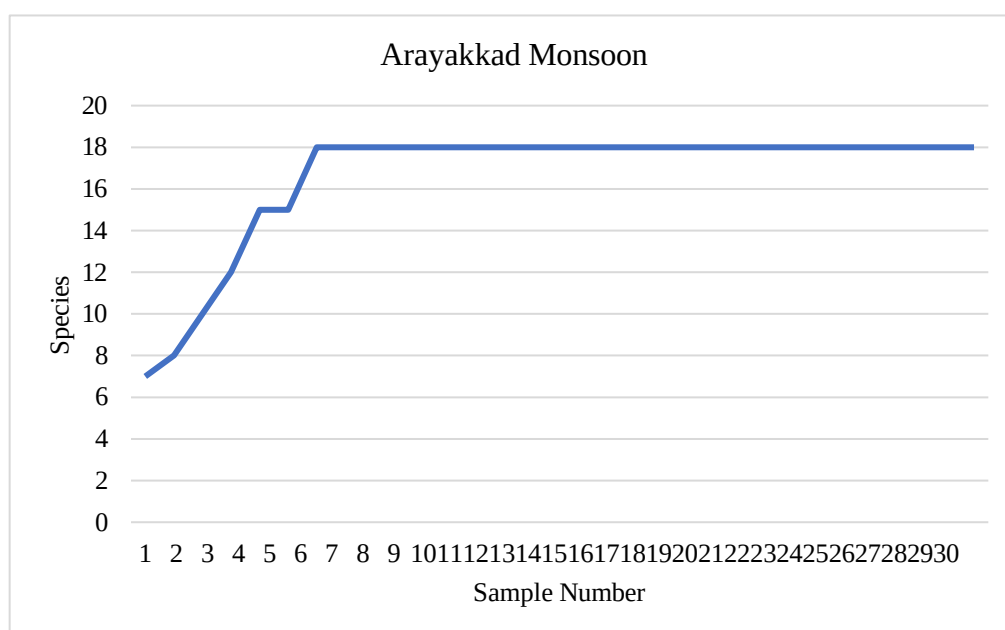


Figure 4. Rarefaction curve of samples collected from Arayakkad in Monsoon season

Highest diversity was shown during Pre- summer season (Table 3). The results show that there is no significant seasonal variation between the samples collected ($F=0.1673$; $P>0.5$). The influence of climatic factors on the abundance of Paederinae beetles collected from Arayakkad is also analysed (Table 4).

Table 3. Diversity indices of samples collected from Arayakkad in 3 different seasons

DIVERSITY INDICES	PS	S	M
Simpson_1-D	0.7793	0.7917	0.67
Shannon_H	1.921	1.885	1.812
Evenness_e^H/S	0.3413	0.4703	0.3402
Margalef	2.948	1.921	2.636

Table 4. Bivariate linear regression of samples collected from Arayakkad

Variables	Slope a	Intercept b	P
<i>Acanthoglossa hirta</i> - Temperature	-1.064	27.414	NS
<i>Astenus melanurus</i> -Temperature	-0.63793	27.388	NS
<i>Astenus nilgiriensis</i> -Temperature	-1.064	27.414	NS
<i>Charichirus chinensis</i> -Temperature	1.7927	27.207	***
<i>Cryptobium fulvescens</i> -Temperature	-1.1159	27.466	**
<i>Hyperscopaeus puberulus</i> -Temperature	-0.63793	27.388	NS
<i>Lithocharis ochraea</i> -Temperature	-0.77373	27.719	***
<i>Lithocharis uvida</i> -Temperature	-0.70116	27.842	***
<i>Lithocharis vilis</i> -Temperature	0.42597	27.154	**
<i>Medon auripilis</i> -Temperature	-0.39362	27.406	NS
<i>Medon pallidus</i> -Temperature	0.70783	27.186	**
<i>Micrillus indicus</i> -Temperature	-0.63793	27.388	NS
<i>Monocrypta abdominalis</i> -Temperature	-0.454	27.478	**
<i>Ochtheophilum filum</i> -Temperature	-0.63793	27.388	NS

N.S.- Not significant; * $P \leq 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$

<i>Ochtheophilum elephas</i> -Temperature	-1.064	27.414	NS
<i>Ochtheophilum extraneum</i> -Temperature	0.20859	27.239	NS
<i>Paederus extraneus</i> -Temperature	-0.39362	27.406	NS
<i>Paederus fuscipes</i> -Temperature	-0.07902	27.532	*
<i>Paederus sondaicus</i> -Temperature	-0.07434	27.548	**
<i>Palaminus rufus</i> -Temperature	-0.63793	27.388	NS
<i>Pinobius indicus</i> -Temperature	1.7927	27.207	***
<i>Pinobius robustus</i> -Temperature	1.7927	27.207	***
<i>Pinonepalus cameroni</i> -Temperature	-1.064	27.414	NS
<i>Pseudolathra pulchella</i> -Temperature	-0.08376	27.756	***
<i>Pseudolathra unicolor</i> -Temperature	0.18503	26.943	***
<i>Scopaeus dilutus</i> -Temperature	-0.49623	27.493	**
<i>Scopaeus fulvus</i> -Temperature	-0.71878	27.694	***
<i>Scopaeus limbatus</i> -Temperature	0.15727	26.886	***
<i>Scopaeus testaceus</i> -Temperature	0.45576	26.779	***
<i>Scopaeus velutinus</i> -Temperature	0.161	26.801	***
<i>Acanthoglossa hirta</i> -Relative humidity	10.671	70.749	**
<i>Astenus melanurus</i> -Relative humidity	-9.2	71.53	*
<i>Astenus nilgiriensis</i> -Relative humidity	10.671	70.749	**
<i>Charichirus chinensis</i> -Relative humidity	-1.4305	71.35	NS
<i>Cryptobium fulvescens</i> -Relative humidity	11.191	70.229	***
<i>Hyperscopaeus puberulus</i> - Relative humidity	-9.2	71.53	*
<i>Lithocharis ochraea</i> -Relative humidity	6.8956	68.082	***

N.S.- Not significant; * $P \leq 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$

<i>Lithocharis uvida</i> -Relative humidity	4.9067	67.898	***
<i>Lithocharis vilis</i> -Relative humidity	3.5605	69.443	**
<i>Medon auripilis</i> -Relative humidity	-5.6766	71.791	**
<i>Medon pallidus</i> -Relative humidity	2.6824	70.538	NS
<i>Micrillus indicus</i> -Relative humidity	-9.2	71.53	*
<i>Monocrypta abdominalis</i> - Relative humidity	3.5832	70.347	**
<i>Ochtheophilum filum</i> -Relative humidity	-9.2	71.53	*
<i>Ochtheophilum elephas</i> -Relative humidity	10.671	70.749	**
<i>Ochtheophilum extraneum</i> - Relative humidity	3.0082	69.385	**
<i>Paederus extraneus</i> -Relative humidity	-5.6766	71.791	**
<i>Paederus fuscipes</i> -Relative humidity	-1.3001	73.939	***
<i>Paederus sondaicus</i> -Relative humidity	-1.1344	73.984	***
<i>Palaminus rufus</i> -Relative humidity	-9.2	71.53	*
<i>Pinobius indicus</i> -Relative humidity	-1.4305	71.35	NS
<i>Pinobius robustus</i> -Relative humidity	-1.4305	71.35	NS
<i>Pinonepalus cameroni</i> -Relative humidity	10.671	70.749	**
<i>Pseudolathra pulchella</i> -Relative humidity	0.88435	67.116	***
<i>Pseudolathra unicolor</i> -Relative humidity	-0.17304	71.619	NS
<i>Scopaeus dilutus</i> -Relative humidity	4.9769	69.951	***
<i>Scopaeus fulvus</i> -Relative humidity	6.4059	68.305	***
<i>Scopaeus limbatus</i> -Relative humidity	-0.8109	73.701	***
<i>Scopaeus testaceus</i> -Relative humidity	0.1783	70.994	NS

N.S.- Not significant; * $P \leq 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$

<i>Scopaeus velutinus</i> -Relative humidity	-0.15141	71.755	NS
<i>Acanthoglossa hirta</i> -Rainfall	269.92	171.13	*
<i>Astenus melanurus</i> -Rainfall	-188.17	189.4	NS
<i>Astenus nilgiriensis</i> -Rainfall	269.92	171.13	**
<i>Charichirus chinensis</i> -Rainfall	-83.445	190.54	NS
<i>Cryptobium fulvenses</i> -Rainfall	283.09	157.96	***
<i>Hyperscopaeus puberulus</i> -Rainfall	-188.17	189.4	NS
<i>Lithocharis ochraea</i> -Rainfall	176.89	102.54	***
<i>Lithocharis uvida</i> -Rainfall	130.18	94.891	***
<i>Lithocharis vilis</i> -Rainfall	67.694	149.28	*
<i>Medon auripilis</i> -Rainfall	-116.1	194.74	*
<i>Medon pallidus</i> -Rainfall	39.917	172.93	NS
<i>Micrillus indicus</i> -Rainfall	-188.17	189.4	NS
<i>Monocrypta abdominalis</i> -Rainfall	93.407	160.29	***
<i>Ochtheophilum filum</i> -Rainfall	-188.17	189.4	NS
<i>Ochtheophilum elephas</i> -Rainfall	269.92	171.13	**
<i>Ochtheophilum extraneum</i> -Rainfall	61.527	145.53	*
<i>Paederus extraneus</i> -Rainfall	-116.1	194.74	*
<i>Paederus fuscipes</i> -Rainfall	-26.91	239.34	***
<i>Paederus sondaicus</i> -Rainfall	-23.325	239.88	***
<i>Palaminus rufus</i> -Rainfall	-188.17	189.4	NS
<i>Pinobius indicus</i> -Rainfall	-83.445	190.54	NS
<i>Pinobius robustus</i> -Rainfall	-83.445	190.54	NS
<i>Pinonepalus cameroni</i> -Rainfall	269.92	171.13	**

N.S.- Not significant; * $P \leq 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$

<i>Pseudolathra pulchella</i> -Rainfall	22.243	79.822	***
<i>Pseudolathra unicolor</i> -Rainfall	-9.1825	204.15	NS
<i>Scopaeus dilutus</i> -Rainfall	125.89	150.96	***
<i>Scopaeus fulvus</i> -Rainfall	164.33	108.27	***
<i>Scopaeus limbatus</i> -Rainfall	-22.7	252.49	***
<i>Scopaeus testaceus</i> -Rainfall	-9.0531	194.8	NS
<i>Scopaeus velutinus</i> -Rainfall	-8.0088	211.25	*

N.S.- Not significant; * $P \leq 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$

4.2.3. Abundance and Diversity of Paederinae beetles in Pattambi- Palakkad District

A total of 28 species of Paederinae were collected from the paddy field at Pattambi during the entire period of study irrespective of seasons. 28 species of Paederinae were collected using light traps; 2 species of *Lithocharis* genus i.e., *Lithocharis vilis* and *Lithocharis ochracea* were collected by floatation method. *Paederus fuscipes* was the only species of Paederinae collected by Baited Pitfall trap. As these beetles are very small in size and due to their rapid moving style, it was unable to capture these beetles using Sweeping net from Pattambi.

Pseudolathra unicolor was the dominant species collected from this site (22.36±7.44) followed by *Scopaeus limbatus* (8.96 ±4.73). Abundance data of species collected from Pattambi is provided in Table 5. Among the 28 species collected, 8 were major, 10 were minor species and 10 were rare species.

Table 5. Abundance data of species collected from Pattambi

SI NO	Species Name	Mean $\pm$ SD	Percentage
1	<i>Acanthoglossa hirta</i>	0.67 $\pm$ 0.73	1.07
2	<i>Astenus gracelintus</i>	0.11 $\pm$ 0.28	0.18
3	<i>Astenus melanurus</i>	0.22 $\pm$ 0.28	0.36
4	<i>Astenus nilgiriensis</i>	0.11 $\pm$ 0.28	0.18
5	<i>Cephalochaetus brunneus</i>	0.11 $\pm$ 0.28	0.18
6	<i>Cryptobium fulvescens</i>	0.62 $\pm$ 0.18	1
7	<i>Hyperscopaeus puberulus</i>	0.07 $\pm$ 0.24	0.11
8	<i>Lithocharis ochracea</i>	0.22 $\pm$ 0.35	0.36
9	<i>Lithocharis sororcula</i>	0.11 $\pm$ 0.28	0.18
10	<i>Lithocharis vilis</i>	0.07 $\pm$ 0.24	0.11
11	<i>Medon auripilis</i>	0.11 $\pm$ 0.28	0.18
12	<i>Monocrypta abdominalis</i>	3.80 $\pm$ 2.40	6.08
13	<i>Ochthephilum elephas</i>	0.07 $\pm$ 0.24	0.11
14	<i>Ochthephilum extraneum</i>	0.36 $\pm$ 0.36	0.57
15	<i>Paederus alternans</i>	0.11 $\pm$ 0.28	0.18
16	<i>Paederus fuscipes</i>	0.56 $\pm$ 0.65	0.89
17	<i>Paederus sondaicus</i>	0.33 $\pm$ 0.29	0.53
18	<i>Palaminus nilgiriensis</i>	2.58 $\pm$ 1.84	4.13
19	<i>Pinobius indicus</i>	1.79 $\pm$ 1.32	2.86
20	<i>Pinobius robustus</i>	0.66 $\pm$ 0.56	1.07
21	<i>Pinocharis genalis</i>	0.11 $\pm$ 0.28	0.18
22	<i>Pseudolathra pulchella</i>	1.56 $\pm$ 0.69	4.04

23	<i>Pseudolathra unicolor</i>	22.36±7.44	35.78
24	<i>Scopaeus bicuspis</i>	1.60±2.30	2.56
25	<i>Scopaeus fulvus</i>	2.47±1.41	3.95
26	<i>Scopaeus limbatus</i>	8.96±4.73	14.34
27	<i>Scopaeus testaceous</i>	7.71±2.38	12.34
28	<i>Scopaeus velutinus</i>	4.07±2.68	6.51

4.2.4. Seasonality of Paederinae beetles in Pattambi- Palakkad District

Twelve species belonging to 8 genera namely, *Astenus*, *Cryptobium*, *Lithocharis*, *Medon*, *Paederus*, *Pinobius*, *Pseudolathra* and *Scopaeus* were recorded during Pre- summer season. 21 species belonging to 13 genera namely, *Acanthoglossa*, *Astenus*, *Cephalochetus*, *Cryptobium*, *Lithocharis*, *Monocrypta*, *Ochtheophilum*, *Paederus*, *Palaminus*, *Pinobius*, *Pinocharis*, *Pseudolathra* and *Scopaeus* were recorded during Summer season. 15 species belonging to 10 genera namely, *Astenus*, *Cryptobium*, *Hyperscopaeus*, *Lithocharis*, *Monocrypta*, *Ochtheophilum*, *Palaminus*, *Pinobius*, *Pseudolathra* and *Scopaeus* were recorded during Monsoon season (Table 6). Graph showing the seasonal abundance of major Paederinae species collected from Pattambi is provided (Figure 5). Rarefraction curve of Paederinae species collected from Pattambi in each season is provided (Figure 6; Figure 7; Figure 8).

Among the 28 species recorded using Light trap from Pattambi, 2 species namely *Lithocharis ochracea* and *Medon auripilis* were recorded only on Pre- Summer; 8 species namely *Acanthoglossa hirta*, *Astenus gracilentus*, *Astenus nilgiriensis*, *Cephalochetus brunneus*, *Lithocharis sororcula*, *Paederus alternans*, *Paederus fuscipes* and *Pinocharis genalis* were recorded only during Summer season; 4 species namely *Ochtheophilum elephas*, *Hyperscopaeus puberulus*, *Lithocharis vilis* and

Scopaeus bicuspis were recorded only during Monsoon season. *Astenus melanurus*, *Paederus sondaicus* and *Pinobius robustus* were recorded both in the Pre-summer and Summer season; *Monocrypta abdominalis*, *Ochtheophilum extraneum*, *Palaminus nilgiriensis*, and *Pinobius indicus* were recorded in the Summer and Monsoon Seasons; *Scopaeus limbatus* was recorded in both Pre-summer and Monsoon seasons. 6 species namely *Cryptobium fulvescens*, *Pseudolathra pulchella*, *Pseudolathra unicolor*, *Scopaeus fulvus*, *Scopaeus testaceus* and *Scopaeus velutinus* were recorded in all the three seasons.

Table 6. showing seasonal abundance of Paederinae collected from Pattambi

SI NO	SPECIES NAME	PRE SUMMER	SUMMER	MONSOON
1	<i>Acanthoglossa hirta</i>	0±0	2±1.26	0±0
2	<i>Astenus gracelintus</i>	0±0	0.33±0.48	0±0
3	<i>Astenus melanurus</i>	0.33±0.48	0.33±0.48	0±0
4	<i>Astenus nilgiriensis</i>	0±0	0.33±0.48	0±0
5	<i>Cephalochaetus brunneus</i>	0±0	0.33±0.48	0±0
6	<i>Cryptobium fulvescens</i>	1.33±0.76	0.33±0.48	0.2±0.41
7	<i>Hyperscopaeus puberulus</i>	0±0	0±0	0.2±0.41
8	<i>Lithocharis ochracea</i>	0.67±0.61	0±0	0±0
9	<i>Lithocharis sororcula</i>	0±0	0.33±0.48	0±0
10	<i>Lithocharis vilis</i>	0±0	0±0	0.2±0.41
11	<i>Medon auripilis</i>	0.33±0.48	0±0	0±0
12	<i>Monocrypta abdominalis</i>	0±0	11±4.39	0.4±0.49
13	<i>Ochtheophilum elephas</i>	0±0	0±0	0.2±0.41

14	<i>Ochtheophilum extraneum</i>	0±0	0.67±0.71	0.4±0.49
15	<i>Paederus alternans</i>	0±0	0.33±0.48	0±0
16	<i>Paederus fuscipes</i>	0±0	1.67±1.12	0±0
17	<i>Paederus sondaicus</i>	0.67±0.55	0.33±0.48	0±0
18	<i>Palaminus nilgiriensis</i>	0±0	6.33±3.63	1.4±1.3
19	<i>Pinobius indicus</i>	0±0	3.37±2.62	2±1.02
20	<i>Pinobius robustus</i>	0.33±0.48	1.67±1.12	0±0
21	<i>Pinocharis genalis</i>	0±0	0.33±0.48	0±0
22	<i>Pseudolathra pulchella</i>	3.34±1.34	3.33±2.29	1±0.95
23	<i>Pseudolathra unicolor</i>	4.67±1.69	54±16.4	8.4±7.09
24	<i>Scopaeus bicuspis</i>	0±0	0±0	4.8±3.99
25	<i>Scopaeus fulvus</i>	5.67±3.03	0.33±0.48	1.4±0.72
26	<i>Scopaeus limbatus</i>	26.67±8.39	0±0	0.2±0.41
27	<i>Scopaeus testaceus</i>	18.33±5.21	0.33±0.48	4.47±2.35
28	<i>Scopaeus velutinus</i>	11.67±5.09	0.33±0.48	0.2±0.41

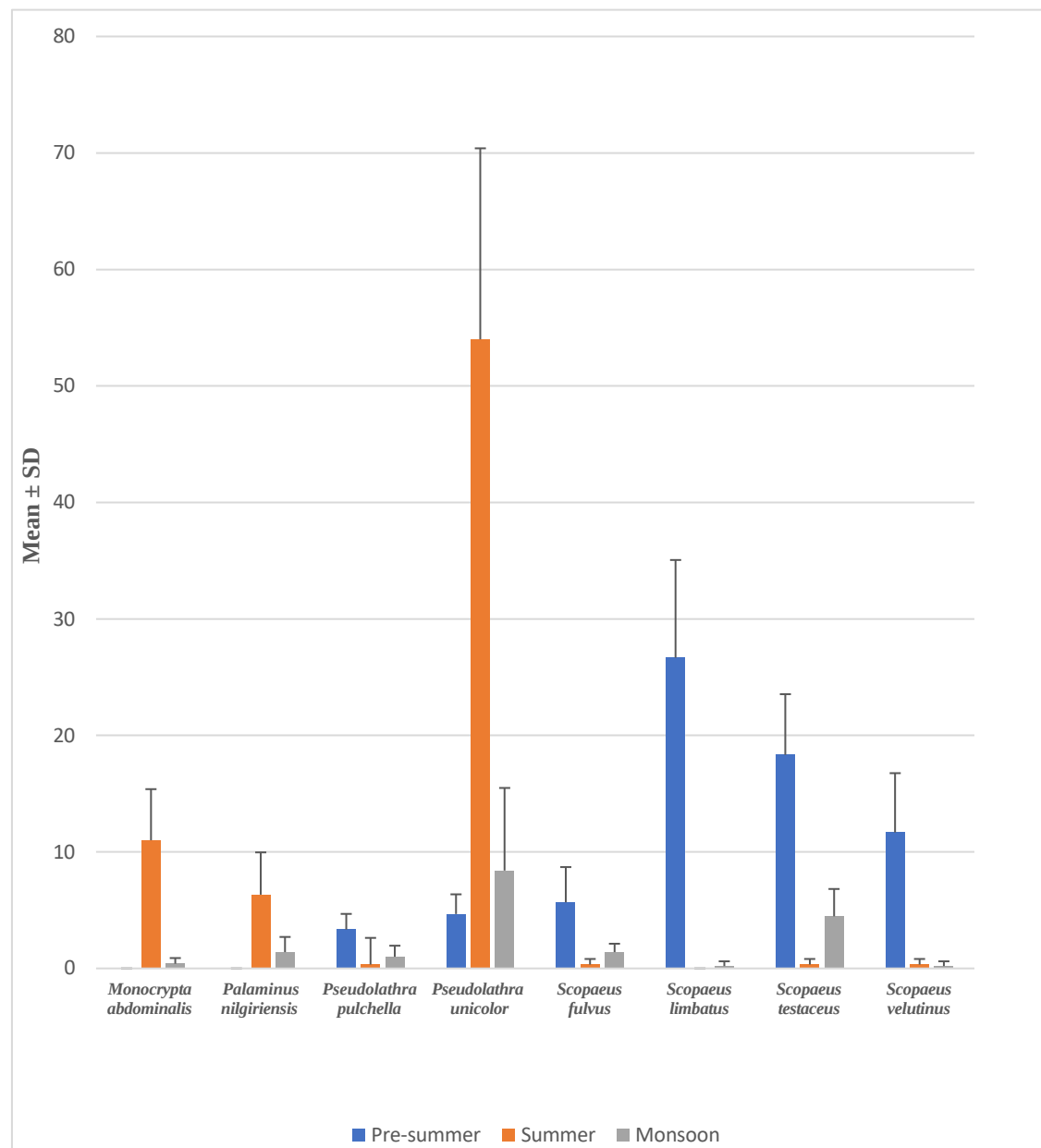


Figure 5. Graph showing the seasonal abundance of major Paederinae species collected from Pattambi

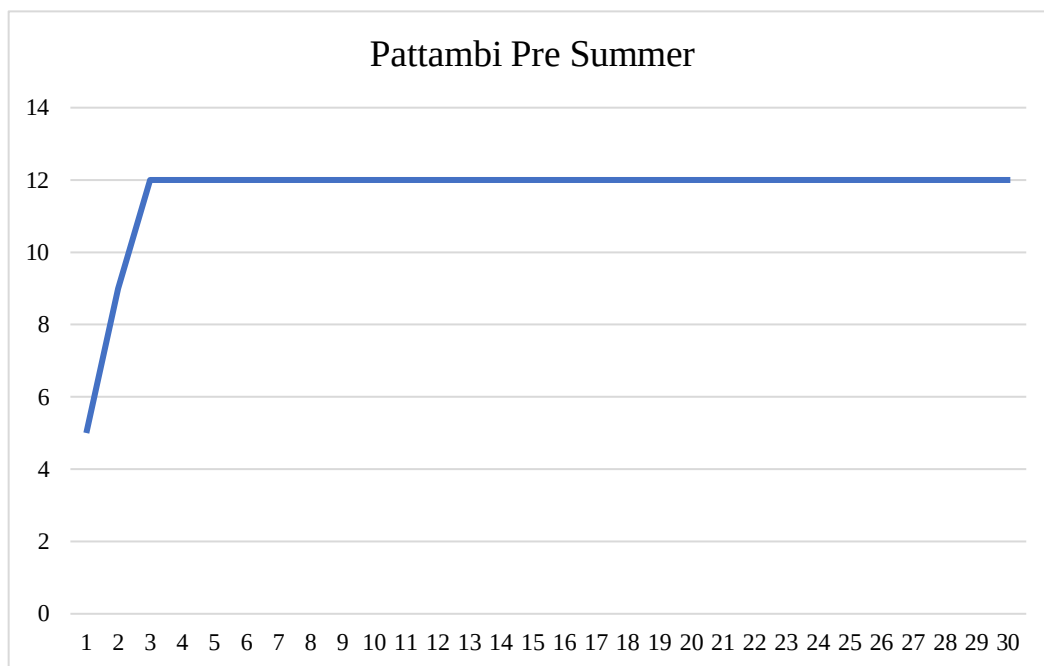


Figure 6. Rarefraction curve of samples collected from Pattambi in Pre-summer Season

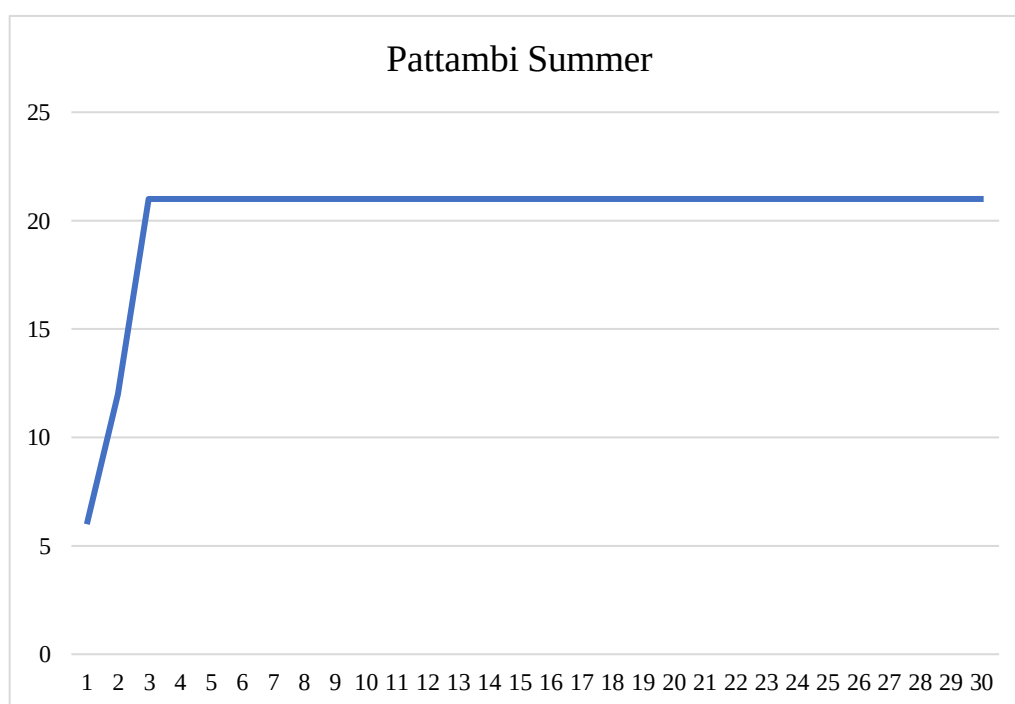


Figure 7. Rarefraction curve of samples collected from Pattambi in Summer Season

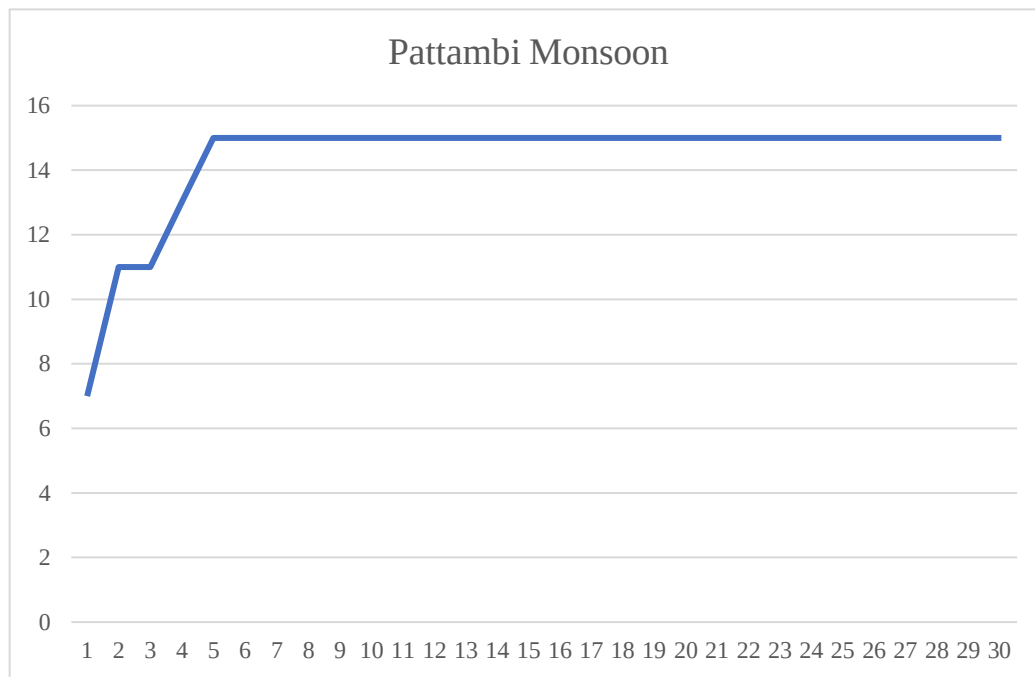


Figure 8. Rarefraction curve of samples collected from Pattambi in Monsoon Season

Highest diversity was shown during the Monsoon season (Table 7). The results show that there is no significant seasonal variation between the samples collected ($F=0.7807$; $P>0.5$). Influence of climatic factors on the abundance of each species recorded from Pattambi is provided in Table 8.

Table 7: Diversity indices of samples collected from Pattambi in 3 different seasons

DIVERSITY INDICES	PS	S	M
Simpson_1-D	0.771	0.5986	0.8103
Shannon_H	1.744	1.524	1.99
Evenness_e ^{H/S}	0.4766	0.2187	0.4879
Margalef	1.428	2.538	2.109

Table 8: Bivariate linear regression of samples collected from Pattambi

Variables	Slope a	Intercept b	P
<i>Acanthoglossa hirta</i> – Temperature	0.77778	26.848	***
<i>Astenus gracelintus</i> – Temperature	1.8375	27.162	***
<i>Astenus melanurus</i> – Temperature	0.65357	27.221	*
<i>Astenus nilgiriensis</i> – Temperature	1.8375	27.162	***
<i>Cephalochaetus brunneus</i> – Temperature	1.8375	27.162	***
<i>Cryptobium fulvescens</i> – Temperature	-0.28215	27.542	NS
<i>Hyperscopaeus puberulus</i> – Temperature	-1.0893	27.439	*
<i>Lithocharis ochracea</i> – Temperature	-0.63068	27.507	*
<i>Lithocharis sororcula</i> – Temperature	1.8375	27.162	***
<i>Lithocharis vilis</i> - Temperature	-1.0893	27.439	*
<i>Medon auripilis</i> - Temperature	-0.69375	27.444	NS
<i>Monocrypta abdominalis</i> - Temperature	0.1815	26.677	***
<i>Ochtheophilum elephas</i> - Temperature	-1.0893	27.439	*
<i>Ochtheophilum extraneum</i> – Temperature	0.71506	27.112	***
<i>Paederus alternans</i> - Temperature	1.8375	27.162	***
<i>Paederus fuscipes</i> - Temperature	0.88554	26.875	***
<i>Paederus sondaicus</i> - Temperature	0.18182	27.306	NS
<i>Palaminus nilgiriensis</i> - Temperature	0.2442	26.737	***
<i>Pinobius indicus</i> – Temperature	0.25928	26.903	***
<i>Pinobius robustus</i> – Temperature	0.83889	26.807	***
<i>Pinocharis genalis</i> – Temperature	1.8375	27.162	***
<i>Pseudolathra pulchella</i> - Temperature	0.21136	26.835	***

N.S.- Not significant; * $P \leq 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$

<i>Pseudolathra unicolor</i> - Temperature	0.042175	26.424	***
<i>Scopaeus bicuspis</i> - Temperature	-0.15851	27.62	***
<i>Scopaeus fulvus</i> – Temperature	-0.17119	27.789	***
<i>Scopaeus limbatus</i> - Temperature	-0.03089	27.643	***
<i>Scopaeus testaceus</i> – Temperature	-0.07302	27.93	***
<i>Scopaeus velutinus</i> – Temperature	-0.06116	27.615	**
<i>Acanthoglossa hirta</i> - Relative humidity	-0.62063	71.637	NS
<i>Astenus gracelintus</i> - Relative humidity	-1.4663	71.386	NS
<i>Astenus melanurus</i> - Relative humidity	-6.555	72.68	***
<i>Astenus nilgiriensis</i> - Relative humidity	-1.4663	71.386	NS
<i>Cephalochaetus brunneus</i> - Relative humidity	-1.4663	71.386	NS
<i>Cryptobium fulvescens</i> - Relative humidity	-6.0128	74.965	***
<i>Hyperscopaeus puberulus</i> - Relative humidity	10.925	70.495	***
<i>Lithocharis ochracea</i> - Relative humidity	-9.0955	73.245	***
<i>Lithocharis sororcula</i> - Relative humidity	-1.4663	71.386	NS
<i>Lithocharis vilis</i> - Relative humidity	10.925	70.495	***
<i>Medon auripilis</i> - Relative humidity	-10.005	72.335	***
<i>Monocrypta abdominai</i> - Relative humidity	-0.10603	71.626	NS
<i>Ochtheophilum elephas</i> - Relative humidity	10.925	70.495	***
<i>Ochtheophilum extraneum</i> - Relative humidity	3.3643	70.027	*
<i>Paederus alternans</i> - Relative humidity	-1.4663	71.386	NS
<i>Paederus fuscipes</i> - Relative humidity	-0.70663	71.616	NS
<i>Paederus sondaicus</i> - Relative humidity	-8.6773	74.116	***
<i>Palaminus nilgiriensis</i> - Relative humidity	0.16481	70.798	NS

N.S.- Not significant; * $P \leq 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$

<i>Pinobius indicus</i> - Relative humidity	1.1974	69.081	**
<i>Pinobius robustus</i> - Relative humidity	-1.7122	72.365	*
<i>Pinocharis geNSlis</i> - Relative humidity	-1.4663	71.386	NS
<i>Pseudolathra pulchella</i> - Relative humidity	-2.0998	76.679	***
<i>Pseudolathra unicolor</i> - Relative humidity	-0.01441	71.545	NS
<i>Scopaeus bicuspis</i> - Relative humidity	1.5898	68.68	***
<i>Scopaeus fulvus</i> - Relative humidity	-1.4309	74.753	***
<i>Scopaeus limbatus</i> - Relative humidity	-0.43632	75.131	***
<i>Scopaeus testaceus</i> - Relative humidity	-0.5628	75.563	***
<i>Scopaeus velutinus</i> - Relative humidity	-0.91163	74.931	***
<i>Acanthoglossa hirta</i> - Rainfall	-36.204	207.26	*
<i>Astenus gracelintus</i> – Rainfall	-85.531	192.63	NS
<i>Astenus melanurus</i> – Rainfall	-165.81	219.97	***
<i>Astenus nilgiriensis</i> – Rainfall	-85.531	192.63	NS
<i>Cephalochaetus brunneus</i> – Rainfall	-85.531	192.63	NS
<i>Cryptobium fulvescens</i> – Rainfall	-126.84	262.05	***
<i>Hyperscopaeus puberulus</i> – Rainfall	276.35	164.7	***
<i>Lithocharis ochracea</i> – Rainfall	-186.03	224.47	***
<i>Lithocharis sororcula</i> – Rainfall	-85.531	192.63	NS
<i>Lithocharis vilis</i> – Rainfall	276.35	164.7	***
<i>Medon auripilis</i> - Rainfall	-204.63	205.86	***
<i>Monocrypta abdominalis</i> - Rainfall	-7.5779	211.92	*
<i>Ochtheophilum elephas</i> – Rainfall	276.35	164.7	***
<i>Ochtheophilum extraneum</i> - Rainfall	55.01	163.57	NS

N.S.- Not significant; * $P \leq 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$

<i>Paederus alternans</i> - Rainfall	-85.531	192.63	NS
<i>Paederus fuscipes</i> - Rainfall	-41.22	206.03	*
<i>Paederus sondaicus</i> - Rainfall	-199.92	249.77	***
<i>Palaminus nilgiriensis</i> - Rainfall	-3.2962	191.62	NS
<i>Pinobius indicus</i> - Rainfall	19.443	148.35	*
<i>Pinobius robustus</i> - Rainfall	-62.448	224.76	***
<i>Pinocharis genalis</i> - Rainfall	-85.531	192.63	NS
<i>Pseudolathra pulchella</i> - Rainfall	-53.17	320.79	***
<i>Pseudolathra unicolor</i> - Rainfall	-1.5313	217.36	NS
<i>Scopaeus bicuspis</i> - Rainfall	40.213	118.79	***
<i>Scopaeus fulvus</i> - Rainfall	-27.205	250.23	***
<i>Scopaeus limbatus</i> - Rainfall	-8.9057	262.88	***
<i>Scopaeus testaceus</i> - Rainfall	-10.537	264.38	***
<i>Scopaeus velutinus</i> - Rainfall	-18.704	259.19	***

N.S.- Not significant; * $P \leq 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$

4.2.5. Abundance and Diversity of Paederinae beetles in Pakkam- Wayanad District

A total of 21 species of Paederinae were collected from the paddy field at Pakkam during the entire period of study irrespective of seasons. 21 species of Paederinae were collected using light traps; 3 species namely *Lithocharis uvida*, *Scopaeus limbatus* and *Scopaeus velutinus* were the species collected by floatation method. *Scopaeus limbatus* was the only species collected by the Baited Pitfall trap. Paederinae beetles were not trapped in sweeping net from Pakkam.

Scopaeus limbatus was the dominant species collected from this site (28.76±52.48) followed by *Scopaeus testaceus* (4.58±2.66). Abundance data of species collected from Pakkam is provided in Table 9. Among the species collected, 5 were major, 8 were minor species and 8 were rare species.

Table 9. Abundance data of species collected from Pakkam

SI NO	Species Name	Mean ± SD	Percentage
1	<i>Cryptobium fulvescens</i>	0.67±1.42	1.55
2	<i>Hyperscopaeus puberulus</i>	0.24±0.34	0.57
3	<i>Lathrobium badium</i>	0.13±0.36	0.31
4	<i>Lithocharis ochracea</i>	0.17±0.4	0.39
5	<i>Lithocharis uvida</i>	0.11±0.22	0.26
6	<i>Lithocharis vilis</i>	0.07±0.23	0.15
7	<i>Medon auripilis</i>	0.04±0.2	0.1
8	<i>Ochtheophilum extraneum</i>	0.23±0.31	0.54
9	<i>Ochtheophilum gastrale</i>	0.04±0.2	0.1
10	<i>Paederus alternans</i>	0.07±0.23	0.15
11	<i>Paederus extraneus</i>	0.47±0.49	1.08
12	<i>Paederus fuscipes</i>	1.59±0.85	3.69
13	<i>Paederus nigricornis</i>	0.07±0.23	0.15
14	<i>Paederus sondaicus</i>	2.74±1.82	6.37
15	<i>Pseudolathra pulchella</i>	0.44±0.31	1.03
16	<i>Pseudolathra unicolor</i>	0.11±0.22	0.26
17	<i>Scopaeus bicupsis</i>	0.03±0.17	0.08

18	<i>Scopaeus fulvus</i>	0.21±0.03	0.49
19	<i>Scopaeus limbatus</i>	28.76±52.48	66.7
20	<i>Scopaeus testaceus</i>	4.58±2.66	10.62
21	<i>Scopaeus velutinus</i>	2.33±1.13	5.41

4.2.6. Seasonality of Paederinae beetles in Pakkam- Wayanad District

Fourteen species belonging to 6 genera namely *Cryptobium*, *Lithocharis*, *Pseudolathra*, *Paederus*, *Lathrobium* and *Scopaeus* were recorded during Pre- summer season. Thirteen species belonging to 6 genera namely *Hyperscopaeus*, *Lithocharis*, *Ochtheophilum*, *Paederus*, *Pseudolathra* and *Scopaeus* were recorded during Summer season. Twelve species belonging to 7 genera namely *Cryptobium*, *Hyperscopaeus*, *Medon*, *Ochtheophilum*, *Paederus*, *Pseudolathra* and *Scopaeus* were recorded during Monsoon season (Table 10). Graph showing the seasonal abundance of major Paederinae species collected from Pattambi is provided (Figure 9). Rarefaction curve of Paederinae species collected from Pakkam in each season is provided (Figure 10; Figure 11; Figure 12).

Among the 21 species recorded using Light trap from Pakkam, 4 species namely *Lathrobium badium*, *Paederus alternans*, *Paederus extraneus* and *Paederus nigricornis* were recorded only on Pre- Summer; 3 species namely *Lithocharis ochracea*, *Lithocharis vilis* and *Scopaeus bicupsis* were recorded only during Summer season; 3 species namely *Cryptobium fulvescens*, *Medon auripilis* and *Ochtheophilum gastrale* were recorded only during Monsoon season. *Lithocharis uvida* and *Ochtheophilum extraneum* were recorded both in the Pre-summer and Summer season; *Hyperscopaeus puberulus* was recorded in the Summer and Monsoon Seasons; *Pseudolathra unicolor* was recorded in both Pre-summer and Monsoon seasons. 7 species namely *Paederus*

fuscipes, *Paederus sondaicus*, *Pseudolathra pulchella*, *Scopaeus fulvus*, *Scopaeus limbatus*, *Scopaeus testaceus* and *Scopaeus velutinus* were recorded in all the three seasons.

Table 10. showing seasonal abundance of Paederinae collected from Pakkam

SI NO	SPECIES NAME	PRE SUMMER	SUMMER	MONSOON
1	<i>Cryptobium fulvescens</i>	0±0	0±0	2±2.46
2	<i>Hyperscopaeus puberulus</i>	0±0	0.3±0.4	0.43±0.68
3	<i>Lobrathium badium</i>	0.4±0.62	0±0	0±0
4	<i>Lithocharis ochracea</i>	0±0	0.5±0.7	0±0
5	<i>Lithocharis uvida</i>	0.24±0.43	0.1±0.3	0±0
6	<i>Lithocharis vilis</i>	0±0	0.2±0.4	0±0
7	<i>Medon auripilis</i>	0±0	0±0	0.13±0.35
8	<i>Ochthephilum extraneum</i>	0.2±0.4	0.5±0.6	0±0
9	<i>Ochthephilum gastrale</i>	0±0	0±0	0.13±0.35
10	<i>Paederus alternans</i>	0.2±0.4	0±0	0±0
11	<i>Paederus extraneus</i>	1.4±0.85	0±0	0±0
12	<i>Paederus fuscipes</i>	0.6±0.56	2.6±2.1	1.57±1.94
13	<i>Paederus nigricornis</i>	0.2±0.4	0±0	0±0
14	<i>Paederus sondaicus</i>	0.6±0.56	4.2±3.4	3.43±3.95
15	<i>Pseudolathra pulchella</i>	1±0.91	0.2±0.4	0.13±0.35
16	<i>Pseudolathra unicolor</i>	0.2±0.4	0±0	0.13±0.35
17	<i>Scopaeus bicupsis</i>	0±0	0.1±0.3	0±0

18	<i>Scopaeus fulvus</i>	0.2±0.4	0.3±0.4	0.13±0.35
19	<i>Scopaeus limbatus</i>	3.4±1.85	1.7±1.6	81.17±92.63
20	<i>Scopaeus testaceus</i>	6±3.17	1.6±1.4	6.13±6.63
21	<i>Scopaeus velutinus</i>	0.8±0.71	3.2±2.4	3±2.85

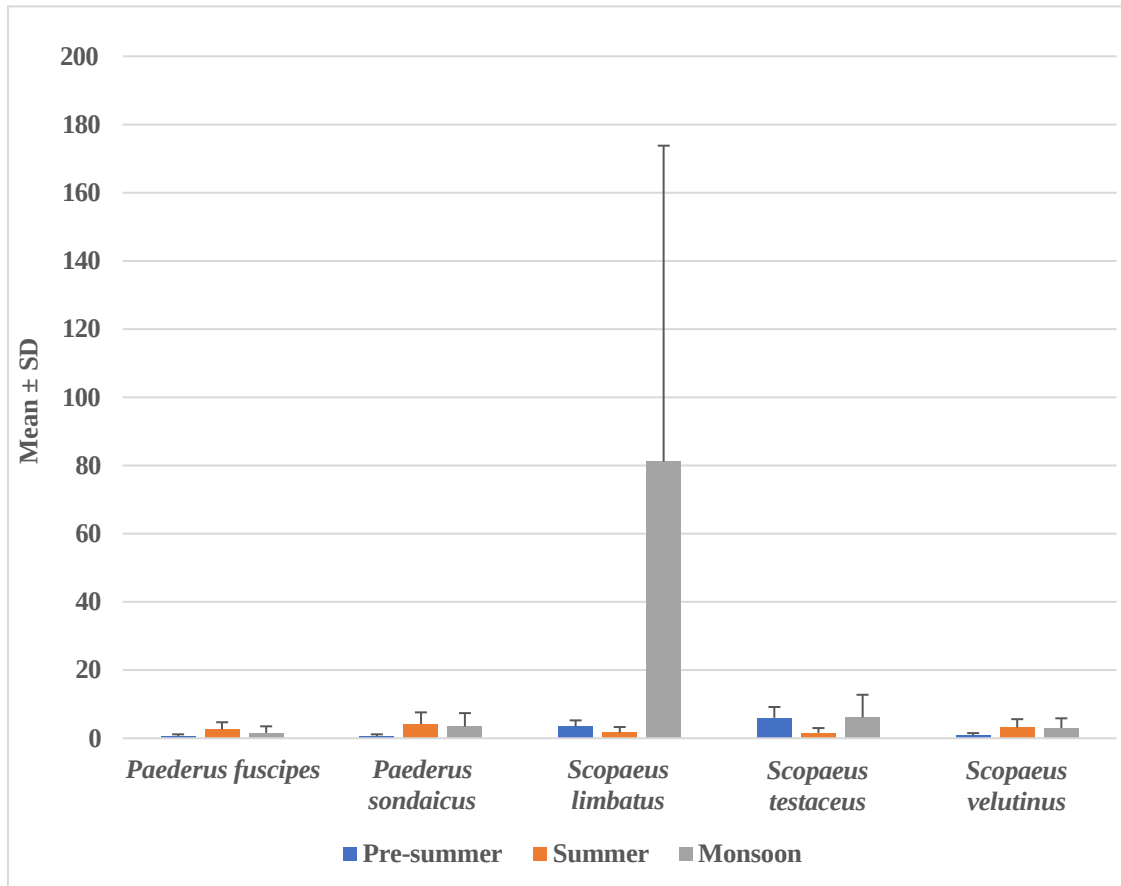


Figure 9. Graph showing the seasonal abundance of major Paederinae species collected from Pakkam

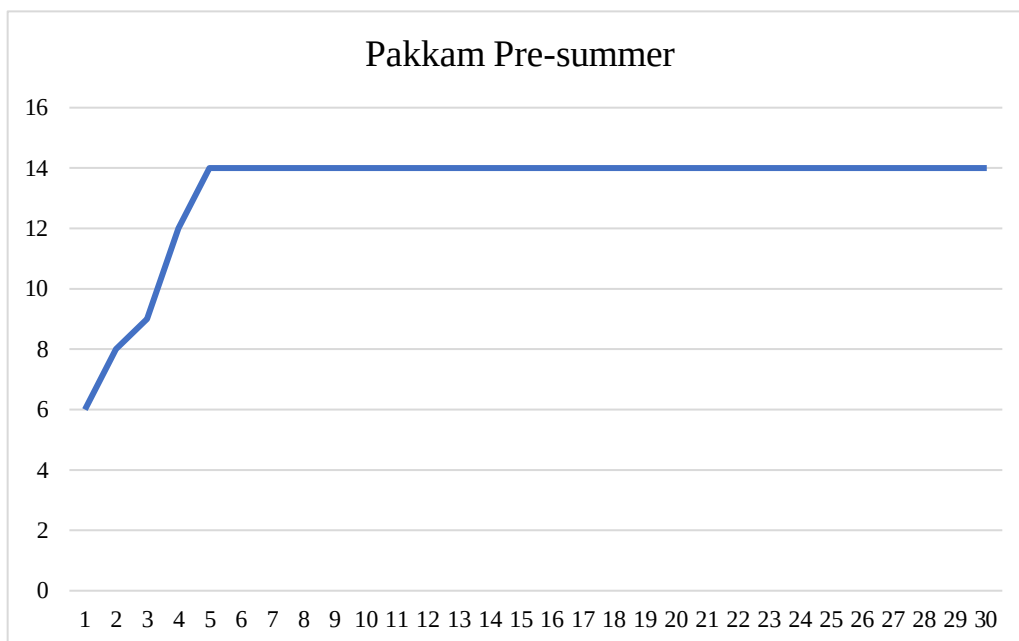


Figure 10. Rarefraction curve of samples collected from Pakkam in Pre-summer
Season

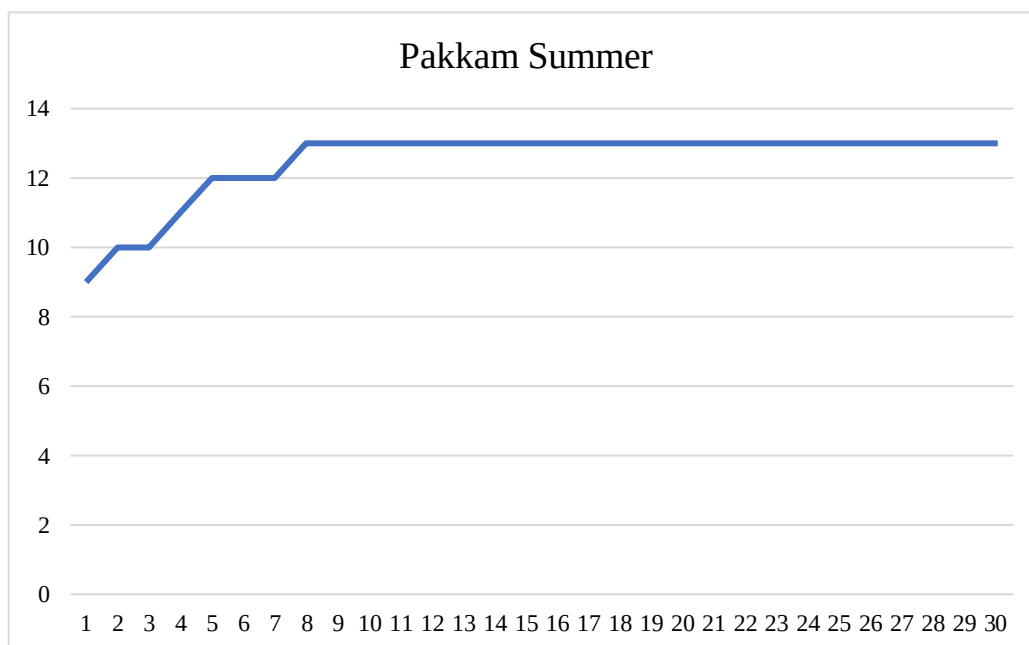


Figure 11. Rarefraction curve of samples collected from Pakkam in Summer Season

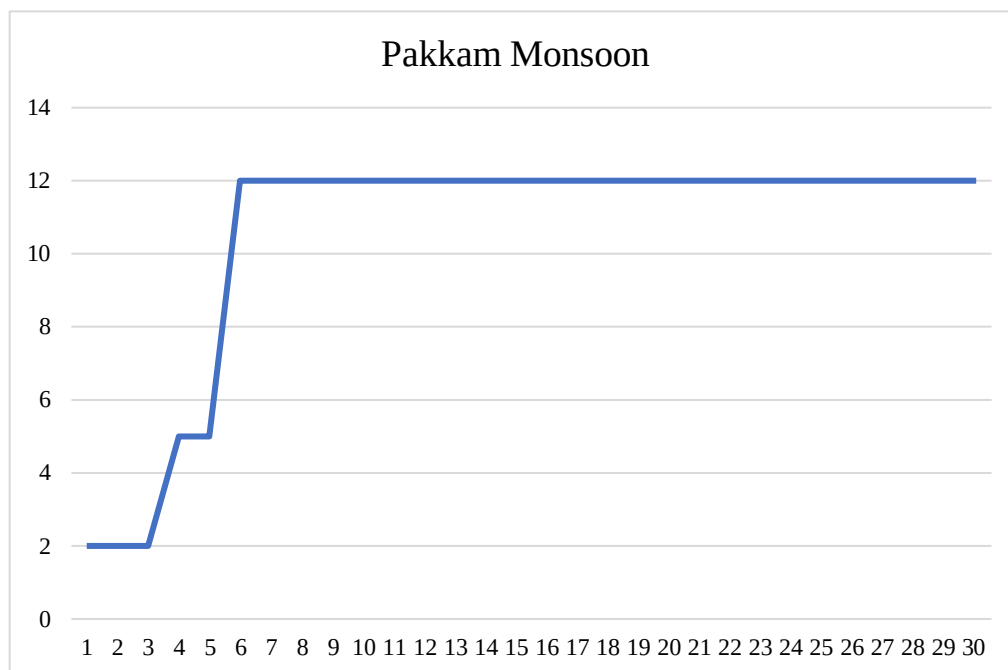


Figure 12. Rarefaction curve of samples collected from Pakkam in Monsoon Season

Highest diversity was shown during the Summer season (Table 11). The results show that there is no significant seasonal variation between the samples collected ($F=1.045$; $P<0.5$). Influence of climatic factors on the abundance of each species recorded from Pakkam is also analysed (Table 12).

Table 11. Diversity indices of samples collected from Pakkam in 3 different seasons

DIVERSITY INDICES	PS	S	M
Simpson_1-D	0.7806	0.8299	0.3125
Shannon_H	1.942	2.007	0.7678
Evenness_e ^{H/S}	0.4981	0.5726	0.1796
Margalef	5.421	5.004	2.41

Table 12. Bivariate linear regression of species collected from Pakkam

Variables	Slope a	Intercept b	P
<i>Cryptobium fulvescens</i> - Temperature	-0.19297	23.542	**
<i>Hyperscopaeus puberulus</i> – Temperature	0.19789	23.365	NS
<i>Lobrathium badium</i> – Temperature	-0.71944	23.509	*
<i>Lithocharis ochracea</i> - Temperature	1.2341	23.208	***
<i>Lithocharis uvida</i> - Temperature	-0.12171	23.437	NS
<i>Lithocharis vilis</i> - Temperature	1.3316	23.325	**
<i>Medon auripilis</i> - Temperature	-0.86163	23.452	NS
<i>Ochtheophilum extraneu</i> - Temperature	1.1116	23.154	***
<i>Ochtheophilum gastrale</i> - Temperature	-0.86163	23.452	NS
<i>Paederus alternans</i> - Temperature	-0.925	23.475	NS
<i>Paederus extraneus</i> - Temperature	-0.60033	23.693	***
<i>Paederus fuscipes</i> - Temperature	0.25622	23.006	***
<i>Paederus nigricornis</i> - Temperature	-0.925	23.475	NS
<i>Paederus sondaicus</i> - Temperature	0.11029	23.111	**
<i>Pseudolathra pulchella</i> - Temperature	-0.41264	23.597	*
<i>Pseudolathra unicolor</i> - Temperature	-0.95325	23.519	*
<i>Scopaeus bicupsis</i> - Temperature	1.7448	23.355	**
<i>Scopaeus fulvus</i> - Temperature	0.44744	23.319	NS
<i>Scopaeus limbatus</i> – Temperature	-0.00538	23.568	**
<i>Scopaeus testaceus</i> - Temperature	-0.11163	23.924	***
<i>Scopaeus velutinus</i> - Temperature	0.12757	23.116	**
<i>Cryptobium fulvescens</i> - Relative humidity	1.1461	79.556	***

N.S.- Not significant; * $P \leq 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$

<i>Hyperscopaeus puberulus</i> - Relative humidity	2.9811	79.591	****
<i>Lobrathium badium</i> - Relative humidity	-4.4333	80.911	****
<i>Lithocharis ochracea</i> - Relative humidity	0.31463	80.268	NS
<i>Lithocharis uvida</i> - Relative humidity	-4.1174	80.842	**
<i>Lithocharis vilis</i> - Relative humidity	0.33947	80.297	NS
<i>Medon auripilis</i> - Relative humidity	5.1174	80.093	*
<i>Ochtheophilum extraneum</i> - Relative humidity	-1.4072	80.648	NS
<i>Ochtheophilum gastrale</i> - Relative humidity	5.1174	80.093	*
<i>Paederus alternans</i> - Relative humidity	-5.7	80.7	****
<i>Paederus extraneus</i> - Relative humidity	-3.6993	82.046	****
<i>Paederus fuscipes</i> - Relative humidity	0.55539	79.438	*
<i>Paederus nigricornis</i> - Relative humidity	-5.7	80.7	****
<i>Paederus sondaicus</i> - Relative humidity	0.45431	79.073	****
<i>Pseudolathra pulchella</i> - Relative humidity	-2.9739	81.642	****
<i>Pseudolathra unicolor</i> - Relative humidity	-1.3905	80.475	NS
<i>Scopaeus bicupsis</i> - Relative humidity	0.44483	80.305	NS
<i>Scopaeus fulvus</i> - Relative humidity	-0.56642	80.44	NS
<i>Scopaeus limbatus</i> - Relative humidity	0.030552	79.441	****
<i>Scopaeus testaceus</i> - Relative humidity	-0.01838	80.404	NS
<i>Scopaeus velutinus</i> - Relative humidity	0.67243	78.751	****
<i>Cryptobium fulvescens</i> - Rainfall	50.303	152.6	****
<i>Hyperscopaeus puberulus</i> - Rainfall	107.76	159.79	****
<i>Lobrathium badium</i> - Rainfall	-146.22	205.63	****
<i>Lithocharis ochracea</i> - Rainfall	-28.656	190.91	NS

N.S.- Not significant; * $P \leq 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$

<i>Lithocharis uvida</i> - Rainfall	-151.4	202.96	**
<i>Lithocharis vilis</i> - Rainfall	-30.918	188.19	NS
<i>Medon auripilis</i> - Rainfall	224.61	176.15	**
<i>Ochtheophilum extraneum</i> - Rainfall	-90.62	207.28	*
<i>Ochtheophilum gastrale</i> - Rainfall	224.61	176.15	**
<i>Paederus alternans</i> – Rainfall	-188	198.67	**
<i>Paederus extraneus</i> - Rainfall	-122.01	243.07	***
<i>Paederus fuscipes</i> - Rainfall	12.838	165.74	NS
<i>Paederus nigricornis</i> – Rainfall	-188	198.67	**
<i>Paederus sondaicus</i> - Rainfall	13.778	148.32	**
<i>Pseudolathra pulchella</i> - Rainfall	-100.39	230.75	***
<i>Pseudolathra unicolor</i> - Rainfall	-21.856	188.56	NS
<i>Scopaeus bicupsis</i> - Rainfall	-40.514	187.48	NS
<i>Scopaeus fulvus</i> - Rainfall	-36.477	193.83	NS
<i>Scopaeus limbatus</i> – Rainfall	1.3489	147.35	***
<i>Scopaeus testaceus</i> - Rainfall	2.9784	172.5	NS
<i>Scopaeus velutinus</i> - Rainfall	21.57	135.8	**

N.S.- Not significant; * $P \leq 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$

4.2.7. Abundance and Diversity of Paederinae beetles in Ambalavayal- Wayanad District.

A total of 22 species of Paederinae were collected from the paddy field at Ambalavayal during the entire period of study irrespective of seasons. 22 species of Paederinae were collected using light traps; *Lithocharis uvida* was the only species collected by floatation method from Ambalavayal and *Scopaeus limbatus* was the only

species collected by the Baited Pitfall trap. 1 species namely, *Paederus sondaicus* was collected by sweeping net in the paddy field of Ambalavayal.

Scopaeus testaceus was the dominant species collected from this site (4.69±7.38) followed by *Paederus sondaicus* (2.59±1.87). Abundance data of species collected from Ambalavayal is provided in Table 13. Among the species collected, 6 were major, 7 were minor species and 9 were rare species.

Table 13. Abundance data of species collected from Ambalavayal

SI NO	Species Name	Mean ± SD	Percentage
1	<i>Astenus melanurus</i>	0.08±0.19	0.68
2	<i>Hyperscopaeus puberulus</i>	0.08±0.19	0.68
3	<i>Lithocharis uvida</i>	0.12±0.23	1.06
4	<i>Lithocharis vilis</i>	0.17±0.33	1.45
5	<i>Medon cinnamopterus</i>	0.03±0.17	0.29
6	<i>Micranops pallidulus</i>	0.03±0.17	0.29
7	<i>Micrillus flavescens</i>	0.03±0.17	0.29
8	<i>Monocrypta abdominalis</i>	0.33±0.57	2.9
9	<i>Ochthephilum elephas</i>	0.04±0.2	0.39
10	<i>Oedichirus longipennis</i>	0.03±0.17	0.29
11	<i>Paederus fuscipes</i>	1.34±0.6	11.69
12	<i>Paederus sondaicus</i>	2.59±1.87	22.51
13	<i>Pinobius robustus</i>	0.03±0.17	0.29
14	<i>Pseudolathra pulchella</i>	0.12±0.32	1.06
15	<i>Pseudolathra unicolor</i>	0.17±0.36	1.45

16	<i>Rugilus rufescens</i>	0.03±0.17	0.29
17	<i>Scopaeus bicuspis</i>	0.17±0.47	1.45
18	<i>Scopaeus dilutus</i>	0.03±0.17	0.29
19	<i>Scopaeus fulvus</i>	0.57±0.44	4.93
20	<i>Scopaeus limbatus</i>	0.36±0.09	3.09
21	<i>Scopaeus testaceus</i>	4.69±7.38	40.77
22	<i>Scopaeus velutinus</i>	0.44±0.28	3.86

4.2.8. Seasonality of Paederinae beetles in Ambalavayal- Wayanad District.

Twelve species belonging to 8 genera namely *Astenus*, *Lithocharis*, *Micranops*, *Oedichirus*, *Paederus*, *Pinobius*, *Rugilus* and *Scopaeus* were recorded during Pre-summer season. Fifteen species belonging to 8 genera namely *Astenus*, *Hyperscopaeus*, *Lithocharis*, *Monocrypta*, *Ochtheophilum*, *Paederus*, *Pseudolathra* and *Scopaeus* were recorded during Summer season. Nine species belonging to 5 genera namely *Hyperscopaeus*, *Medon*, *Micrillus*, *Paederus* and *Scopaeus* were recorded during Monsoon season (Table 14). Graph showing the seasonal abundance of major Paederinae species collected from Ambalavayal is provided (Figure 13). Rarefaction curve of Paederinae species collected from Ambalavayal in each season is provided (Figure 14; Figure 15; Figure 16).

Among the 22 species recorded using Light trap from Ambalavayal, 4 species namely *Micranops pallidulus*, *Oedichirus longipennis*, *Pinobius robustus* and *Rugilus rufescens* were recorded only on Pre- Summer; 4 species namely *Lithocharis vilis*, *Monocrypta abdominalis*, *Ochtheophilum elephas* and *Scopaeus bicuspis* were recorded only during Summer season; 5 species namely *Medon cinnamopterus*, *Micrillus flavescens*, *Pseudolathra pulchella*, *Pseudolathra unicolor* and *Scopaeus dilutus* were

recorded only during Monsoon season. *Astenus melanurus*, *Lithocharis uvida* and *Scopaeus testaceus* were recorded both in the Pre-summer and Summer season; *Hyperscopaeus puberulus* was recorded in the Summer and Monsoon Seasons; *Paederus fuscipes*, *Paederus sondaicus*, *Scopaeus fulvus*, *Scopaeus limbatus* and *Scopaeus velutinus* were recorded in all the three seasons.

Table 14. showing seasonal abundance of Paederinae collected from Ambalavayal

SI NO	SPECIES NAME	PRE SUMMER	SUMMER	MONSOON
1	<i>Astenus melanurus</i>	0.1±0.3	0.13±0.35	0±0
2	<i>Hyperscopaeus puberulus</i>	0±0	0.13±0.35	0.1±0.3
3	<i>Lithocharis uvida</i>	0.1±0.3	0.27±0.45	0±0
4	<i>Lithocharis vilis</i>	0±0	0.5±0.57	0±0
5	<i>Medon cinnamopterus</i>	0±0	0±0	0.1±0.3
6	<i>Micranops pallidulus</i>	0.1±0.3	0±0	0±0
7	<i>Micrillus flavescens</i>	0±0	0±0	0.1±0.3
8	<i>Monocrypta abdominalis</i>	0±0	1±0.98	0±0
9	<i>Ochtheophilum elephas</i>	0±0	0.13±0.35	0±0
10	<i>Oedichirus longipennis</i>	0.1±0.3	0±0	0±0
11	<i>Paederus fuscipes</i>	2±1.6	1.73±1.46	0.3±0.5
12	<i>Paederus sondaicus</i>	5.3±4	2.37±1.71	0.1±0.3
13	<i>Pinobius robustus</i>	0.1±0.3	0±0	0±0
14	<i>Pseudolathra pulchella</i>	0±0	0.37±0.56	0±0
15	<i>Pseudolathra unicolor</i>	0±0	0.5±0.63	0±0

16	<i>Rugilus rufescens</i>	0.1±0.3	0±0	0±0
17	<i>Scopaeus bicuspis</i>	0±0	0.5±0.82	0±0
18	<i>Scopaeus dilutus</i>	0±0	0±0	0.1±0.3
19	<i>Scopaeus fulvus</i>	0.1±0.3	1.5±1.07	0.1±0.3
20	<i>Scopaeus limbatus</i>	0.3±0.5	0.37±0.56	0.4±0.67
21	<i>Scopaeus testaceus</i>	0.2±0.4	13.87±12.97	0±0
22	<i>Scopaeus velutinus</i>	0.2±0.4	0.73±0.94	0.4±0.56

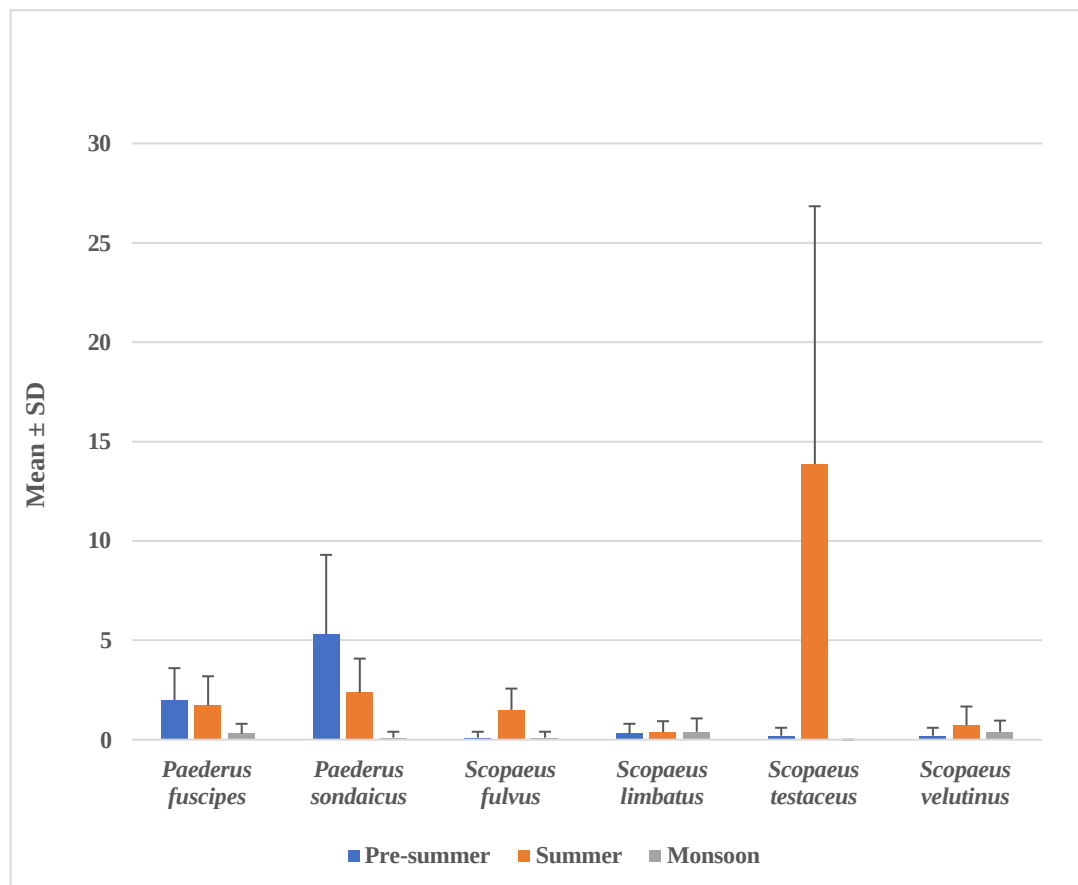


Figure 13. Graph showing the seasonal abundance of major Paederinae species collected from Ambalavayal

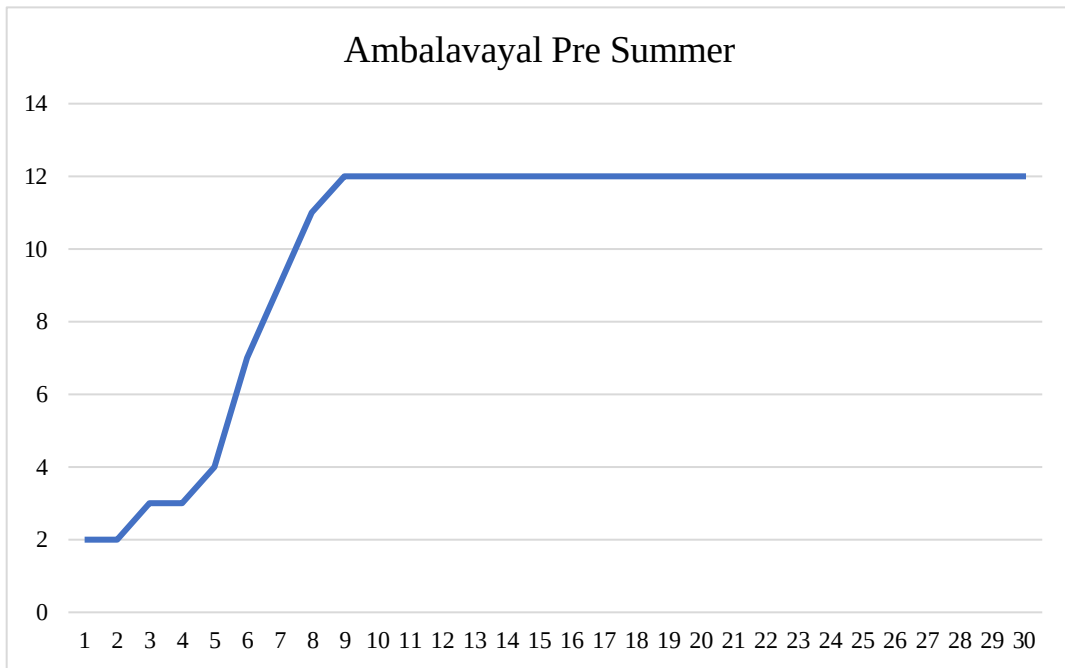


Figure 14. Rarefaction curve of samples collected from Ambalavayal in Pre-summer

Season

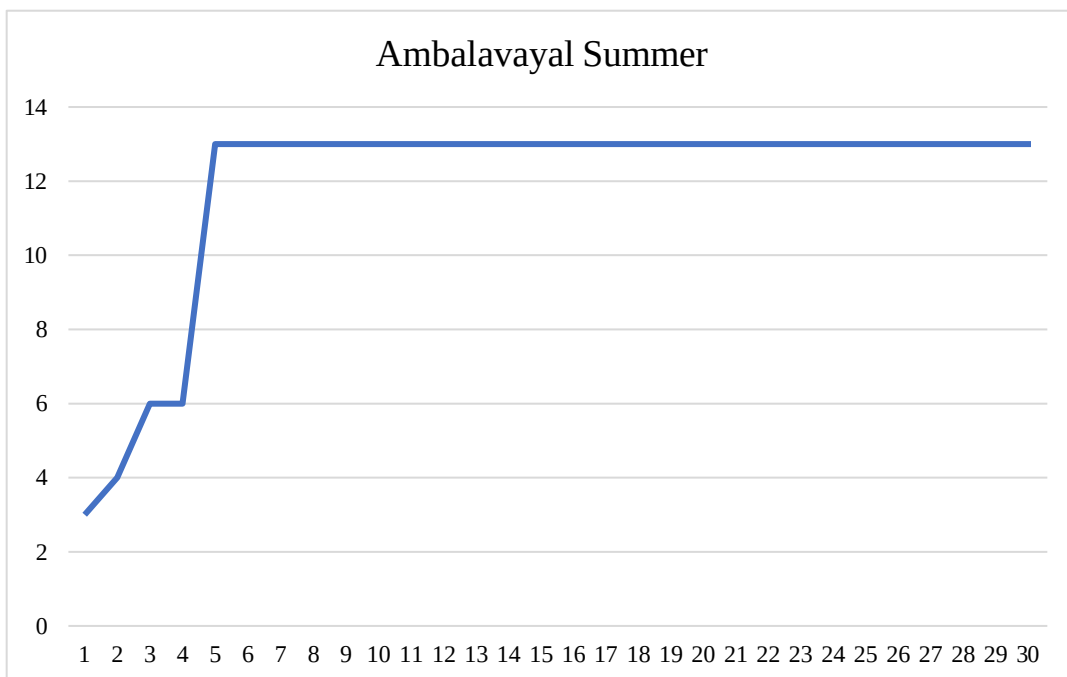


Figure 15. Rarefaction curve of samples collected from Ambalavayal in Summer

Season

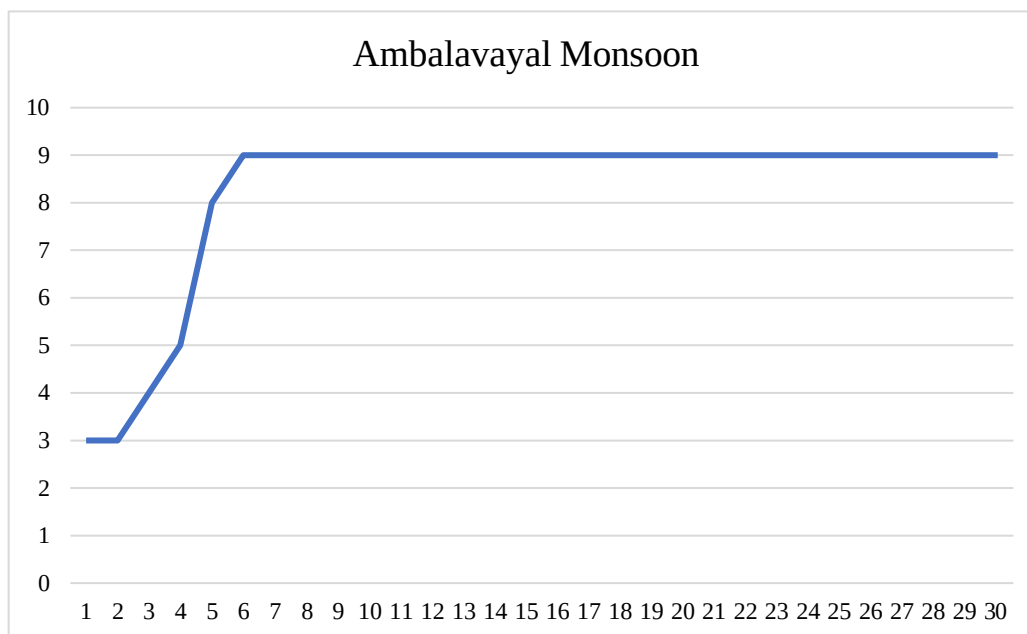


Figure 16. Rarefaction curve of samples collected from Ambalavayal in Monsoon
Season

Highest diversity was shown during the Monsoon season (Table 15). The results show that there is a significant seasonal variation between the samples collected ($F=1.801$; $P>0.5$). Influence of climatic factors on the abundance of each species recorded from Ambalavayal is also analysed (Table 16).

Table 15. Diversity indices of samples collected from Ambalavayal in 3 different seasons

DIVERSITY INDICES	PS	S	M
Simpson_1-D	0.5729	0.6455	0.8374
Shannon_H	1.289	1.65	1.987
Evenness_e ^{H/S}	0.3024	0.3472	0.8104
Margalef	5.653	4.844	0

Table 16. Bivariate linear regression of samples collected from Ambalavayal

Variables	Slope a	Intercept b	P
<i>Astenus melanurus</i> - Temperature	0.64389	23.363	NS
<i>Hyperscopaeus puberulus</i> - Temperature	0.66248	23.362	NS
<i>Lithocharis uvida</i> - Temperature	1.1292	23.275	**
<i>Lithocharis vilis</i> - Temperature	1.7448	23.123	***
<i>Medon cinnamopterus</i> - Temperature	-0.85172	23.442	NS
<i>Micranops pallidulus</i> - Temperature	-0.8931	23.443	NS
<i>Micrillus flavescens</i> - Temperature	-0.8931	23.443	NS
<i>Monocrypta abdominalis</i> - Temperature	-0.85172	23.442	NS
<i>Ochtheophilum elephas</i> - Temperature	1.0542	23.062	***
<i>Oedichirus longipennis</i> - Temperature	1.7651	23.335	**
<i>Paederus fuscipes</i> - Temperature	-0.8931	23.443	NS
<i>Paederus sondaicus</i> - Temperature	0.14665	23.216	NS
<i>Pinobius robustus</i> - Temperature	-0.02078	23.467	NS
<i>Pseudolathra pulchella</i> - Temperature	-0.8931	23.443	NS
<i>Pseudolathra unicolor</i> - Temperature	1.5918	23.219	***
<i>Rugilus rufescens</i> - Temperature	1.5333	23.158	***
<i>Scopaeus bicuspis</i> - Temperature	-0.8931	23.443	NS
<i>Scopaeus dilutus</i> - Temperature	1.0327	23.241	***
<i>Scopaeus fulvus</i> - Temperature	-0.85172	23.442	NS
<i>Scopaeus limbatus</i> - Temperature	0.90704	22.899	***
<i>Scopaeus testaceus</i> - Temperature	0.080282	23.037	***
<i>Scopaeus velutinus</i> - Temperature	0.49854	23.192	**

N.S.- Not significant; * $P \leq 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$

<i>Astenus melanurus</i> - Relative humidity	-2.2059	80.492	NS
<i>Hyperscopaeus puberulus</i> - Relative humidity	2.5389	80.123	NS
<i>Lithocharis uvida</i> - Relative humidity	-1.2967	80.478	NS
<i>Lithocharis vilis</i> - Relative humidity	0.44483	80.246	NS
<i>Medon cinnamopterus</i> - Relative humidity	5.0586	80.151	*
<i>Micranops pallidulus</i> - Relative humidity	-5.5034	80.503	*
<i>Micrillus flavescens</i> - Relative humidity	-5.5034	80.503	*
<i>Monocrypta abdominalis</i> - Relative humidity	5.0586	80.151	*
<i>Ochtheophilum elephas</i> - Relative humidity	0.26875	80.23	NS
<i>Oedichirus longipennis</i> - Relative humidity	0.45	80.3	NS
<i>Paederus fuscipes</i> - Relative humidity	-5.5034	80.503	*
<i>Paederus sondaicus</i> - Relative humidity	-1.3011	82.069	***
<i>Pinobius robustus</i> - Relative humidity	-0.83249	82.475	***
<i>Pseudolathra pulchella</i> - Relative humidity	-5.5034	80.503	*
<i>Pseudolathra unicolor</i> - Relative humidity	0.40582	80.27	NS
<i>Rugilus rufescens</i> - Relative humidity	0.39091	80.255	NS
<i>Scopaeus bicuspis</i> - Relative humidity	-5.5034	80.503	*
<i>Scopaeus dilutus</i> - Relative humidity	0.26327	80.276	NS
<i>Scopaeus fulvus</i> - Relative humidity	5.0586	80.151	*
<i>Scopaeus limbatus</i> - Relative humidity	0.23124	80.189	NS
<i>Scopaeus testaceus</i> - Relative humidity	0.01694	80.241	NS
<i>Scopaeus velutinus</i> - Relative humidity	0.81905	79.956	NS
<i>Astenus melanurus</i> - Rainfall	-105.81	194.36	NS
<i>Hyperscopaeus puberulus</i> - Rainfall	75.474	180.26	NS

N.S.- Not significant; * $P \leq 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$

<i>Lithocharis uvida</i> - Rainfall	-86.965	196.76	NS
<i>Lithocharis vilis</i> - Rainfall	-40.514	192.89	NS
<i>Medon cinnamopterus</i> - Rainfall	222.03	178.73	*
<i>Micranops pallidulus</i> - Rainfall	-181.51	192.18	NS
<i>Micrillus flavescens</i> - Rainfall	-181.51	192.18	NS
<i>Monocrypta abdominalis</i> - Rainfall	222.03	178.73	*
<i>Ochtheophilum elephas</i> - Rainfall	-24.477	194.29	NS
<i>Oedichirus longipennis</i> - Rainfall	-40.985	187.95	NS
<i>Paederus fuscipes</i> - Rainfall	-181.51	192.18	NS
<i>Paederus sondaicus</i> - Rainfall	-54.717	259.7	****
<i>Pinobius robustus</i> - Rainfall	-31.229	266.98	****
<i>Pseudolathra pulchella</i> - Rainfall	-181.51	192.18	NS
<i>Pseudolathra unicolor</i> - Rainfall	-36.961	190.65	NS
<i>Rugilus rufescens</i> - Rainfall	-35.603	192.07	NS
<i>Scopaeus bicuspis</i> - Rainfall	-181.51	192.18	NS
<i>Scopaeus dilutus</i> - Rainfall	-23.978	190.13	NS
<i>Scopaeus fulvus</i> - Rainfall	222.03	178.73	*
<i>Scopaeus limbatus</i> - Rainfall	-21.061	198.07	NS
<i>Scopaeus testaceus</i> - Rainfall	-1.9993	195.51	NS
<i>Scopaeus velutinus</i> - Rainfall	14.951	179.49	NS

N.S.- Not significant; * $P \leq 0.05$; ** $P \leq 0.01$; **** $P \leq 0.001$

Bray Curtis similarity values of the abundance of Padaerinae in the four different collection sites were analysed. The highest similarity was shown between Arayakkad and Ambalavayal and least similarity was shown between Pattambi and Ambalavayal (Table 17).

Table 17: Bray Curtis similarity values of Paederinae assemblage associated with four different collection sites

Collection sites	Arayakkad	Pattambi	Pakkam	Ambalavayal
Arayakkad				
Pattambi	0.359133			
Pakkam	0.368719	0.356557		
Ambalavayal	0.41643	0.216915	0.367854	

Based on the examination of published records and taxonomic literature, a total of 73 species of Paederinae are recorded till now from Kerala. The overall distribution of Paederinae in Kerala is provided in Table 18.

Table 18. Table showing the distribution of Paederinae in Kerala

SI NO	SPECIES NAME	DISTRIBUTION IN KERALA	REFERENCE	AUTHOR'S OBSERVATION
1	<i>Acanthoglossa hirta</i> (Kraatz, 1859)	Kozhikode: Parambil Bazar	Sreevidhya and Sebastian, 2020	Palakkad: Arayakkad, Pattambi
2	<i>Astenus flavus</i> (Kraatz, 1859)	Wayanad: Tholpetty	Sreevidhya <i>et al.</i> , 2021	
3	<i>Astenus gracilentus</i> (Fauvel, 1879)			Palakkad: Pattambi

4	<i>Astenus indicus</i> (Kraatz, 1859)	Malappuram: Thenjipalam	Sreevidhya and Sebastian, 2020; <i>Sreevidhya et al.</i> , 2021	
5	<i>Astenus keralensis</i> (Sreevidhya, Akhil and Sebastian, 2021)	Malappuram: Chelari	<i>Sreevidhya et al.</i> , 2021	
6	<i>Astenus kraatzi</i> (Bernhauer, 1902)	Malappuram: Chelari	<i>Sreevidhya et al.</i> , 2021	
7	<i>Astenus leptocerus</i> (Eppelsheim, 1895)	Malappuram: Chelari	<i>Sreevidhya et al.</i> , 2021	
8	<i>Astenus maculipennis</i> (Kraatz, 1859)	Kozhikode: Parambil Bazar	<i>Sreevidhya et al.</i> , 2021	
9	<i>Astenus melanurus</i> (Küster, 1853)			Palakkad: Arayakkad, Pattambi; Wayanad: Ambalavayal
10	<i>Astenus nilgiriensis</i> (Cameron, 1931)	Malappuram: Pookkottur.	<i>Sreevidhya et al.</i> , 2021	Palakkad: Arayakkad, Pattambi

11	<i>Astenus rougemonti</i> (Sreevidhya, Akhil and Sebastian, 2021)	Malappuram: Chelari	Sreevidhya <i>et al.</i> , 2021	
12	<i>Astenus setiferides</i> (Newton, 2017)	Wayanad: Kambalakkad.	Sreevidhya <i>et al.</i> , 2021	
13	<i>Astenus terminalis</i> (Cameron, 1931)	Malappuram: Kozhippara (Nilambur)	Sreevidhya <i>et al.</i> , 2021	
14	<i>Cephalochetus brunneus</i> (Motschulsky, 1858)	Malappuram: Thenjipalam	Sreevidhya and Sebastian, 2020	Palakkad: Pattambi
15	<i>Cephalochetus elegans</i> (Kraatz, 1859)	Kannur: Cherupuzha	Sreevidhya and Sebastian, 2020	
16	<i>Charichirus chinensis</i> (Boheman, 1858)	Palakkad: Kodumbu	Sreevidhya and Sebastian, 2020	Palakkad: Arayakkad
17	<i>Cryptobium bhattacharyyai</i> (Biswas, 1986)	Palakkad: Silent Valley	Biswas, 1986	
18	<i>Cryptobium fulvescens</i> (Motschulsky, 1858)			Palakkad: Arayakkad, Pattambi; Wayanad: Pakkam

19	<i>Cryptobium nilamburens</i> (Cameron, 1931)	Malappuram: Nilambur	Cameron, 1931	
20	<i>Cryptobium nilgiriense</i> (Cameron, 1914)	Malappuram: Padikkal,	Sreevidhya and Sebastian, 2020	
21	<i>Hyperscopaeus puberulus</i> (Kraatz, 1859)			Palakkad: Arayakkad, Pattambi; Wayanad: Ambalavayal, Pakkam
22	<i>Lobrathium badium</i> (Cameron 1924)			Wayanad: Pakkam
23	<i>Lithocharis ochracea</i> (Gravenhorst 1802)			Palakkad: Arayakkad, Pattambi; Wayanad: Pakkam
24	<i>Lithocharis sororcula</i> (Kraatz 1859)			Palakkad: Pattambi
25	<i>Lithocharis uvida</i> (Kraatz 1859)	Palakkad: Pattambi	Sreevidhya and Sebastian, 2020	Palakkad: Arayakkad; Wayanad: Ambalavayal, Pakkam

26	<i>Lithocharis vilis</i> (Kraatz, 1859)			Palakkad: Arayakkad, Pattambi; Wayanad: Ambalavayal, Pakkam
27	<i>Medon andrewesi</i> (Cameron 1931)	Kannur: Aralam	Sreevidhya and Sebastian, 2020	
28	<i>Medon auripilis</i> (Fauvel 1895)			Palakkad: Arayakkad, Pattambi; Wayanad: Pakkam
29	<i>Medon cinnamopterus</i> (Kraatz, 1859)			Wayanad: Ambalavayal
30	<i>Medon pallidus</i> (Motschulsky 1858)			Palakkad: Arayakkad
31	<i>Micranops pallidulus</i> (Kraatz, 1859)			Wayanad: Ambalavayal
32	<i>Micrillus flavescens</i> (Motschulsky, 1858)			Wayanad: Ambalavayal
33	<i>Micrillus indicus</i> (Eppelsheim, 1890)			Palakkad: Arayakkad

34	<i>Monocrypta abdominalis</i> (Motschulsky, 1858)			Palakkad: Arayakkad, Pattambi; Wayanad: Ambalavayal
35	<i>Neosclerus anguliceps</i> (Assing, 2017)	Thiruvananthapuram: Kallar	Assing, 2017	
36	<i>Ochtheophilum elephas</i> (Fauvel, 1904)	Palakkad: Silent Valley	Biswas, 1986	Palakkad: Arayakkad, Pattambi; Wayanad: Ambalavayal
37	<i>Ochtheophilum extraneum</i> (Fauvel, 1904)	Kozhikode: Parambil Bazar	Sreevidhya and Sebastian, 2020	Palakkad: Arayakkad, Pattambi; Wayanad: Pakkam
38	<i>Ochtheophilum filum</i> (Kraatz, 1859)	Kozhikode: Kakkayam	Sreevidhya and Sebastian, 2020	Palakkad: Arayakkad
39	<i>Ochtheophilum gastrale</i> (Fauvel, 1895)			Wayanad: Pakkam
40	<i>Ochtheophilum sanguinolentum</i> (Motschulsky, 1858)	Kozhikode: Medical College; Kannur: Karuvanchal	Sreevidhya and Sebastian, 2020	
41	<i>Oedichirus longipennis</i> (Kraatz, 1859)	Thiruvananthapuram: Kallar	Rougemont, 2018	Wayanad: Ambalavayal

42	<i>Paederus mussardi</i> (Biswas and Sengupta, 1982)	Palakkad: Silent Valley	Biswas, 1986	
43	<i>Paederus alternans</i> (Walker, 1858)		Kavyamol <i>et al.</i> , 2023, 2024	Palakkad: Pattambi; Wayanad: Pakkam
44	<i>Paederus extraneus</i> (Wiedemann, 1825)		Kavyamol <i>et al.</i> , 2023, 2024	Palakkad: Arayakkad; Wayanad: Pakkam
45	<i>Paederus fuscipes</i> (Curtis, 1826)	Malappuram: Musliyarangadi; Thrissur; Palakkad; Kozhikode; Kannur; Wayanad	Sreevidhya and Sebastian, 2020; Vineesh <i>et al.</i> , 2023; Kavyamol <i>et al.</i> , 2024	Palakkad: Arayakkad, Pattambi; Wayanad: Ambalavayal, Pakkam
46	<i>Paederus hingstoni</i> (Cameron, 1928)	Malappuram: Kozhippara	Sreevidhya and Sebastian, 2020	
47	<i>Paederus kuluensis</i> (Bernhauer, 1914)	Palakkad: Silent Valley	Biswas, 1986	
48	<i>Paederus nigricornis</i> (Bernhauer, 1911)		Kavyamol <i>et al.</i> , 2023, 2024	Wayanad: Pakkam

49	<i>Paederus sondaicus</i> (Fauvel, 1895)	Palakkad: Silent Valley	Biswas, 1986	Palakkad: Arayakkad, Pattambi; Wayanad: Ambalavayal, Pakkam
50	<i>Paederus variicornis</i> (Fauvel, 1903)	Palakkad: Silent Valley	Biswas, 1986	
51	<i>Palaminus nilgiriensis</i> (Cameron, 1931)			Palakkad: Pattambi
52	<i>Palaminus rufus</i> (Cameron 1931)			Palakkad: Arayakkad
53	<i>Pinobius indicus</i> (Kraatz, 1859)			Palakkad: Arayakkad, Pattambi
54	<i>Pinobius robustus</i> (Kraatz, 1859)			Palakkad: Arayakkad, Pattambi; Wayanad: Ambalavayal
55	<i>Pinocharis genalis</i> (Fauvel 1895)			Palakkad: Pattambi
56	<i>Pinonepalus cameroni</i> (Scheerpeltz, 1933)			Palakkad: Arayakkad

57	<i>Pinophilus aegyptius</i> (Erichson, 1840)	Malabar	Cameron, 1931	
58	<i>Pinophilus malabarensis</i> (Cameron, 1931)	Malabar	Cameron, 1931	
59	<i>Pinophilus javanus</i> (Erichson, 1840)	Idukki: Mannavan shola	Mathews <i>et al.</i> , 2021	
60	<i>Pseudolathra pulchella</i> (Kraatz, 1859)	Kozhikode; Malappuram: Padikkal	Cameron 1931; Sreevidhya and Sebastian, 2020	Palakkad: Arayakkad, Pattambi; Wayanad: Ambalavayal, Pakkam
61	<i>Pseudolathra unicolor</i> (Kraatz, 1859)			Palakkad: Arayakkad, Pattambi; Wayanad: Ambalavayal, Pakkam
62	<i>Rugilus ocularis</i> (Fauvel, 1895)	Thiruvananthapuram: Kumily, Ponmudi	Assing, 2012 a	
63	<i>Rugilus rufescens</i> (Sharp, 1874)	Thiruvananthapuram: Kumily	Assing, 2012 a	Wayanad: Ambalavayal
64	<i>Scopaeus andrewesi</i> (Cameron, 1931)	Palakkad: Silent Valley	Biswas, 1986	

65	<i>Scopaeus beelsoni</i> (Cameron, 1931)	Wayanad: Tholpetty	Sreevidhya and Sebastian, 2020	
66	<i>Scopaeus bicuspis</i> (Kraatz, 1859)	Kasaragod: Ranipuram	Sreevidhya and Sebastian, 2020	Palakkad: Pattambi; Wayanad: Ambalavayal, Pakkam
67	<i>Scopaeus dilutus</i> (Motschulsky, 1858)			Palakkad: Arayakkad; Wayanad: Ambalavayal
68	<i>Scopaeus fulvus</i> (Cameron, 1931)			Palakkad: Arayakkad, Pattambi; Wayanad: Ambalavayal, Pakkam
69	<i>Scopaeus limbatus</i> (Kraatz, 1859)			Palakkad: Arayakkad, Pattambi; Wayanad: Ambalavayal, Pakkam
70	<i>Scopaeus obscuripes</i> (Cameron, 1931)	Palakkad: Nelliampathi	Sreevidhya and Sebastian, 2020	

71	<i>Scopaeus testaceus</i> (Motschulsky, 1858)			Palakkad: Arayakkad, Pattambi; Wayanad: Ambalavayal, Pakkam
72	<i>Scopaeus velutinus</i> (Motschulsky, 1858)			Palakkad: Arayakkad, Pattambi; Wayanad: Ambalavayal, Pakkam
73	<i>Stiliderus crassus</i> (Kraatz, 1859)	Athirappilly, Thrissur	Sreevidhya and Sebastian, 2020	

DISCUSSION

5. DISCUSSION

5.1 TAXONOMY (DISTRIBUTIONAL DATA)

Out of the Forty-five species collected from Palakkad and Wayanad, three species namely, *Medon auripilis*, *Micrillus flavescens* and *Pinocharis genalis* were recorded for the first time from India. *Medon auripilis* was previously recorded from Myanmar and Indonesia (Fauvel, 1895; Cameron, 1931); *Micrillus flavescens* has previous records from Myanmar and Thailand (Motschulsky, 1858; Fauvel, 1895; Cameron, 1931; Assing, 2013g and Bogri *et al.*, 2020); *Pinocharis genalis* was previously recorded from Bangladesh, Myanmar, Thailand and Cambodia (Fauvel, 1895; Cameron, 1931; and Assing, 2022a).

Ten species namely, *Lobrathium badium*, *Lithocharis ochracea*, *Medon cinnamopterus*, *Medon pallidus*, *Ochthephilum gastrale*, *Paederus nigricornis*, *Pseudolathra unicolor*, *Micranops pallidulus*, *Micrillus indicus* and *Scopaeus fulvus* were new records from south India. *Lobrathium badium* was previously recorded from some northern states of India i.e., Uttarakhand, Uttaranchal and Himachal Pradesh (Cameron, 1924; 1931; Herman, 2003; Assing, 2012c; 2013e; 2014d and Staniec, 2022); in India, *Lithocharis ochracea* was previously recorded from Himachal Pradesh (Gravenhorst, 1802, 1806; Fairmaire, 1849; Fairmaire and Germain, 1862 and Casey, 1886); *Medon cinnamopterus* from Uttarakhand (Kraatz, 1859; Cameron, 1920, 1924, 1931; Kraatz, 1859; Assing, 2013c; *Medon pallidus* from Indes orientales (Cameron, 1931) the exact locality is not known; *Ochthephilum gastrale* from Assam (Fauvel, 1895; Cameron, 1931); *Paederus nigricornis* from Uttar Pradesh, Mizoram, Uttaranchal, Uttarakhand, West Bengal, Sikkim and Himachal Pradesh (Bernhauer, 1911; Bernhauer and Schubert, 1912; Cameron, 1925b, 1928, 1931; Scheerpeltz, 1933, 1957; Blackwelder, 1939; Coiffait, 1978, 1982a, 1982b; Frank, 1988; Willers, 1999,

2001a, 2001b; Thapa, 2000; Löbl and Smetana, 2004; Li *et al.*, 2008; Nikbakhtzadeh *et al.*, 2012; Sar and Hedge, 2015; Löbl and Löbl, 2015; Sar and Ilango, 2016); *Pseudolathra unicolor* from Assam, West Bengal, Meghalaya, Arunachal Pradesh, Uttar Pradesh and Bihar (Kraatz, 1859; Assing, 2012d, 2013f, 2014b, 2018b, 2021a); *Micranops pallidulus* from Uttarakhand (Kraatz, 1859; Cameron, 1931; Bernhauer, 1939; Frisch and Herman, 2014; Herman, 2023); *Micrillus indicus* from Maharashtra and West Bengal (Eppelsheim, 1890; Cameron, 1931) and *Scopaeus fulvus* from Uttarakhand (Cameron, 1931; Frisch, 2005; Herman, 2023).

Thirteen species namely, *Hyperscopaeus puberulus*, *Lithocharis sororcula*, *Lithocharis vilis*, *Paederus alternans*, *Paederus extraneus*, *Palaminus nilgiriensis*, *Palaminus rufus*, *Pinobius indicus*, *Pinobius robustus*, *Pinonepalus cameroni*, *Scopaeus limbatus*, *Scopaeus testaceus* and *Scopaeus velutinus* were recorded for the first time from the state of Kerala. In South India, *Hyperscopaeus puberulus* was previously recorded from Tamil Nadu (Cameron, 1931); *Lithocharis sororcula* from Karnataka (Kraatz, 1859; Cameron, 1928, 1931; Blackwelder, 1939; Beatty, 1944; Ivie, *et al.*, 2008; Peck, 2009, 2010; Frank, *et al.*, 2011; Assing, 2015a; Meurgey and Ramage, 2020); *Lithocharis vilis* from Tamil Nadu (Cameron, 1931); *Paederus alternans* from Karnataka and Tamil Nadu (Cameron, 1931); *Paederus extraneus* from Andhra Pradesh and Karnataka (Cameron, 1931, Taneja *et al.*, 2013; Gopal, 2014); *Palaminus nilgiriensis* from Tamil Nadu (Cameron, 1931); *Palaminus rufus* from Tamil Nadu (Cameron, 1931); *Pinobius indicus* from Pondicherry (Assing 2014); *Pinobius robustus* from Tamil Nadu (Cameron, 1931; Assing, 2014); *Pinonepalus cameroni* from Tamil Nadu (Cameron, 1914, 1931; Assing, 2022a); *Scopaeus limbatus* from Karnataka (Cameron, 1931); *Scopaeus testaceus* from Karnataka (Cameron, 1931); *Scopaeus velutinus* from Karnataka (Cameron, 1931).

Fourteen species namely, *Acanthoglossa hirta*, *Astenus gracelintus*, *Astenus nilgiriensis*, *Cephalochaetus brunneus*, *Charichirus chinensis*, *Lithocharis sororcula*, *Medon pallidus*, *Micrillus indicus*, *Ochthephilum filum*, *Palaminus nilgiriensis*, *Palaminus rufus*, *Pinobius indicus*, *Pinocharis genalis* and *Pinonepalus cameroni* were recorded only from Palakkad district. This may be due to the altitude preference of these species to the mid-elevations. This is consistent with the study of Sabu *et al.*, (2008) that, mid-elevations provide favourable environment and prey resources for insects. Eight species namely, *Lobrathium badium*, *Medon cinnamopterus*, *Micranops pallidulus*, *Micrillus flavescens*, *Ochthephilum gastrale*, *Oedichirus longipennis*, *Paederus nigricornis* and *Rugilus rufescens* were recorded only from Wayanad district. This may be due to the altitude preference of these species to the high-elevations. Twenty three species namely, *Astenus melanurus*, *Cryptobium fulvescens*, *Hyperscopaeus puberulus*, *Lithocharis ochracea*, *Lithocharis uvida*, *Lithocharis vilis*, *Medon auripilis*, *Monocrypta abdominalis*, *Ochthephilum elephas*, *Ochthephilum extraneum*, *Paederus alternans*, *Paederus extraneus*, *Paederus fuscipes*, *Paederus sondaicus*, *Pinobius robustus*, *Pseudolathra pulchella*, *Pseudolathra unicolor*, *Scopaeus bicuspis*, *Scopaeus dilutus*, *Scopaeus fulvus*, *Scopaeus limbatus*, *Scopaeus testaceus* and *Scopaeus velutinus* were recorded from the paddy fields of both Palakkad and Wayanad districts. These results show that more than half of the collected species were recorded from both Palakkad and Wayanad districts. This shows the ability of most of the Paederinae species to adapt to varying climatic conditions in different altitudes. It may also be due to habitat similarity i.e., all the collection sites were paddy fields which lead to overlap in species composition, even across different geographic locations. This is because similar habitats tend to provide similar environmental conditions like the availability of prey resources that favor similar species to thrive. It

is supported by the study of Anlas, 2021 which states that most of the Paederinae species are predators seen in association with humid agricultural areas.

Three species namely, *Astenus flavus* (Kraatz, 1859), *Astenus setiferides* (Newton, 2017) and *Scopaeus beesoni* (Cameron, 1931) were previously reported from Tholpetty forest and Coastal plains of Wayanad (Sreevidhya and Sebastian, 2020; Sreevidhya *et al.*, 2021), but these species were not recorded in this study. *Paederus mussardi* (Biswas and Sengupta, 1982), *Paederus kuluensis* (Bernhauer, 1914), *Paederus variicornis* (Fauvel, 1903), *Scopaeus andrewesi* (Cameron, 1931), *Scopaeus obscuripes* (Cameron, 1931) and *Cryptobium bhattacharyyai* (Biswas, 1986) were the six species previously reported from Palakkad (Biswas, 1986; Sreevidhya and Sebastian, 2020), but were not recorded in the present study. It may be due to varying environmental conditions in different habitats (Ramzan *et al.*, 2021). This study focused on Paederinae in Paddy fields while the previous studies mentioned were conducted on forest ecosystems and coastal plains.

5.2 ECOLOGY

The current study revealed that paddy fields serve as the optimal habitat for Staphylinidae beetles, especially, Paederinae, indicating their preference for this particular ecological niche. This finding agrees with the earlier research works, such as Heinrichs and Barrion (2004) and Ghahari *et al.* (2009), which assert paddy fields as a primary habitat for staphylinids. This observation underscores the significance of paddy agroecosystems in shaping the ecological dynamics of the population of Paederinae and highlights the potential implications for pest management strategies in paddy fields.

A total of forty five species belonging twenty two genera (*Acanthoglossa*- 1 species, *Astenus*- 3 species, *Cephalochaetus*- 1 species, *Charichirus*- 1 species, *Cryptobium*- 1 species, *Hyperscopaeus*- 1 species, *Lobrathium*- 1 species, *Lithocharis*-

4 species, *Medon*- 3 species, *Monocrypta*- 1 species, *Ochtheophilum*- 4 species, *Oedichirus*- 1 species, *Paederus*- 5 species, *Palaminus*- 2 species, *Pinobius* - 2 species, *Pinocharis*- 1 species, *Pinonepalus*- 1 species, *Pseudolathra*- 2 species, *Micranops*- 1 species, *Micrillus*- 2 species, *Rugilus*- 1 species and *Scopaeus*- 6 species) were recorded from Palakkad (37 species) and Wayanad (31 species) with 30 species from Arayakkad, 28 species from Pattambi, 21 species from Pakkam and 22 species from Ambalavayal. This shows that highest number of Paederinae species were recorded in gap region as compared to ghat region (Personal observation). The climatic condition prevailing in Palakkad gap is wet (Biswas and Karanth, 2021) and Paederinae species always prefer moist habitats (Anlaş *et al.*, 2021).

Palakkad district is known as “the granary of Kerala” and is the chief rice producing district followed by Alappuzha and Thrissur (Kala and Leena, 2018). Paederinae beetles are predators that prey upon planthoppers and leafhoppers seen in association with paddy fields and Palakkad has the largest acreage of paddy cultivation in the state and it contributes to more than 45% of the total rice production in Kerala (Aparna *et al.*, 2018), it may be the major reason for the high abundance and diversity of Paederinae in Palakkad. Hence the higher abundance of Paederinae beetles in Palakkad district can be correlated with the higher availability of prey resources in the vast area of paddy cultivation. Additionally, the district wise analysis of wet land paddy area for the year 2018-2019 records that, Palakkad district ranks first position with 76,942.68 Ha *i.e.*, 38.85% of total wet land paddy area in the state (Agricultural statistics, 2020). Since the paddy field area is more in Palakkad district, the population of insect pests of rice are more, consequently the abundance of Paederinae beetles which feed on the pests are more in this collection site.

The next possible reason for the high abundance and diversity of Paederinae in Palakkad is the presence of a major break in the Western Ghats Mountain range in south western India called “Palakkad gap”. It is almost 32 to 42 km wide and it opens the state to the rest of the country and is perhaps the most influential factor for the distinctive characteristics of the district, such as the climate. (Sasidharan *et al.*, 2020). The climate of Palakkad is therefore found to support diverse fauna of Paederinae. It is characterized by hot summers that reach a maximum temperature of 41°C from January to May, 242.81 mm of annual rainfall, and 228.92 rainy days (62.72% of the time) (Jayasree *et al.*, 2023).

According to Sert *et al.*, (2013), the collecting altitude is an important parameter in ecological assessments. Arayakkad in Pudukkottai panchayat Palakkad district is located in Palakkad Gap which is a low mountain pass in the Western Ghats between Coimbatore in Tamil Nadu and Palakkad in Kerala (Varada *et al.*, 2022) and this collection site is located 84 meters above the mean sea level; altitude of the collection site of Pattambi is located 25 meters above the mean sea level; Collection site of Ambalavayal is 974 meters above the mean sea level and the collection site of Pakkam is located approximately 763 meters above the mean sea level. Arayakkad and Pattambi in Palakkad district which comes under mid land region recorded the highest diversity and abundance in comparison with the high-altitude region of Wayanad. This result contradicts with the findings of Manoj *et al.*, (2017).

Pseudolathra species was dominant in Palakkad district. This genus is found in all zoogeographic regions, although most of the species have been recorded from the Oriental and East Palaearctic regions (Rougemont, 2015; Assing, 2018, 2019; Li *et al.*, 2019). *Pseudolathra pulchella* was dominant in Arayakkad and *Pseudolathra unicolor* in Pattambi. Peng *et al.*, (2014); Rougemont, (2015) and Assing, (2018), stated that, *P.*

pulchella and *P. unicolor* are the most widespread and commonest members of the genus. These results are consistent with the findings of the present study.

Scopaeus species was dominant in Wayanad district. It constitutes likely the most speciose genus of this subfamily and the group is distributed throughout the tropics, subtropics and the temperate zones and are found mainly on moist, denuded grounds like banks and shorelands (Frisch and Narakusumo, 2023). *Scopaeus limbatus* was the dominant species in Pakkam and *Scopaeus testaceus* in Ambalavayal. Frisch and Narakusumo (2023) also state that *Scopaeus limbatus* and *Scopaeus testaceus* are widespread throughout the Oriental region.

There were no significant seasonal variations between the samples collected. Highest species diversity was recorded during pre-summer season in Arayakkad and during monsoon season in Pattambi. So, in Palakkad district the diversity was least recorded during the summer season most probably due to the extreme heat and dryness during Summer (Kavyamol *et al.*, 2024). In Pakkam, the highest species diversity was recorded during Summer season and in Ambalavayal highest diversity was recorded during monsoon season. So, the least diversity was recorded during the Pre-summer season in Wayanad district. The average minimum temperature recorded from the collection site during the month of January which comes under Pre-summer season was least in comparison with Summer and Monsoon seasons (RARS, Ambalavayal). This shows that extreme high and extreme low temperatures adversely affect the diversity and abundance of Paederinae. These results agree with the study of Yan *et al.*, (2022) on the impact of temperature change on agricultural pest.

Bray Curtis similarity values of the collection sites shows highest similarity between Arayakkad and Ambalavayal may be due to the presence of grazing cattles over these sites as dung is a favourable microhabitat for many insects including Paederinae (Stocker *et al.*, 2022).

The altitude variation of Palakkad and Wayanad is also a pivotal factor in determining the faunal diversity and abundance. Wayanad is a high-altitude region while most areas of Palakkad come under midland regions.

Changes in humidity have a significant impact on the distribution of arthropods and the structure of their assemblages (Holland et al., 2007). According to Babko et al., (2020), a decrease in humidity often leads to a decrease in the diversity of arthropods, but our findings contradicts with Babko et al., (2020), as the average humidity of Wayanad is higher compared to Palakkad, but the abundance and diversity of Paederinae were higher in Palakkad because in Kerala, Palakkad district ranked first in terms of both the area of land and production of rice (House *et al.*, 2024).

Among the forty-five species collected from paddy fields of Palakkad and Wayanad districts, *Paederus fuscipes* (Frank and Kanamistu 1987; Verma and Agarwal 2006; Toppo et al., 2013; Ramakrishnan *et al* 2019); *Paederus alternans* (Frank and Kanamistu 1987), *Paederus extraneus* (Taneja *et al.*, 2013; Gopal 2014) and *Paederus nigricornis* (Nikbakhtzadeh and Tirgari, 2008) are reported to cause dermatitis in different parts of the world. Although the present study focused on the distribution and abundance, the presence of these beetles in the study sites suggests a potential risk of *Paederus* dermatitis among agricultural workers and residents of these areas. *Paederus* dermatitis is usually treated conservatively. Topical corticosteroids are applied to minimise inflammation, oral antihistamines are used when pruritus is present, and the afflicted region is immediately cleaned with soap and water after contact. If secondary bacterial infections develop, topical or systemic antibiotics may be necessary. With the right care, the majority of instances go away in one to three weeks, however post-inflammatory hyperpigmentation may last longer (Plate 9).



A.



B.

**Plate 9: Paederus dermatitis A) Bullous lesions on the face
B) Linear lesions on the arm**

SITE WISE ANALYSIS

Arayakkad

Arayakkad comes under Palakkad gap region. Seasonal variation in the abundance of Paederinae species collected from Arayakkad is analyzed and there is no significant seasonal variation between the samples collected from this site. It may be due to the availability of prey resources and the ability of Paederine to adapt to diverse conditions.

Among thirty species of Paederinae collected from Arayakkad, twenty species were recorded in Pre-Summer, fourteen species were recorded in Summer and eighteen species during Monsoon season. It may be due to the climatic conditions prevailing over there. Highest diversity was recorded in Pre- summer season may be due to the mild weather that supports the growth of most species (Kavyamol *et al.*, 2024). The population of Paederinae beetles is greatly impacted by the amount of rainfall. Extreme weather during the summer and monsoon causes a discernible decline in the diversity of beetles. The summer months were extremely hot and dry, which resulted in the least diversity of these beetles throughout the collection period. These findings are consistent with the study of Nasir *et al.*, (2012), which states that heavy rainfall in the Monsoon season cause suffocation of larvae and pupae in the soil, this reduces the population of *Paederus* beetles during the months of heavy rainfall.

Pseudolathra pulchella was the dominant species collected from this site. This agrees with the study of Assing, (2018), which states that *Pseudolathra pulchella* is a very common species and are frequently found at light traps.

The relationship between each species collected from Arayakkad and meteorological data such as temperature, rainfall and relative humidity were analysed by regression analysis. All the species collected from this site have a significant difference either with temperature or relative humidity or rainfall or all three of these factors. The result of linear regression analysis shows that, eighteen species namely, *Charichirus chinensis*, *Cryptobium fulviansiens*, *Lithocharis ochraea*, *Lithocharis uvida*, *Lithocharis vilis*, *Medon pallidus*, *Monocrypta abdominalis*, *Paederus fuscipes*, *Paederus sondaicus*, *Pinobius indicus*, *Pinobius robustus*, *Pseudolathra pulchella*, *Pseudolathra unicolor*, *Scopaeus dilutus*, *Scopaeus fulvus*, *Scopaeus limbatus*, *Scopaeus testaceus* and *Scopaeus velutinus* were found to have a significant difference due to temperature. Twenty-three species namely, *Acanthoglossa hirta*, *Astenus melanurus*, *Astenus nilgiriensis*, *Cryptobium fulviansiens*, *Hyperscopaeus puberulus*, *Lithocharis ochraea*, *Lithocharis uvida*, *Lithocharis vilis*, *Medon auripilis*, *Micrillus indicus*, *Monocrypta abdominalis*, *Ochtheophilum filum*, *Ochtheophilum elephas*, *Ochtheophilum extraneum*, *Paederus extraneus*, *Paederus fuscipes*, *Paederus sondaicus*, *Palaminus rufus*, *Pinonepalus cameroni*, *Pseudolathra pulchella*, *Scopaeus dilutus*, *S. fulvus* and *S. limbatus* were found to have a significant difference due to relative

humidity which was analysed by regression analysis. Result of linear regression analysis shows that nineteen species namely, *Acanthoglossa hirta*, *Astenus nilgiriensis*, *Cryptobium fulvensiens*, *Lithocharis ochraea*, *Lithocharis uvida*, *Lithocharis vilis*, *Medon auripilis*, *Monocrypta abdominalis*, *Ochthephilum elephas*, *Ochthephilum extraneum*, *Paederus extraneus*, *Paederus fuscipes*, *Paederus sondaicus*, *Pinonepalus cameroni*, *Pseudolathra pulchella*, *Scopaeus dilutus*, *Scopaeus fulvus*, *Scopaeus limbatus* and *Scopaeus velutinus* were found to have a significant difference due to rainfall. All these results show that Paederinae population is influenced by abiotic factors and these findings are in agreement with the study of Maher *et al.*, 2022 on the influence of abiotic factors on arthropod communities.

Pattambi

Analysis of the abundance of Paederinae species collected from Pattambi reveals no significant seasonal variation among the samples taken from this site. The availability of prey resources and the paederine's capacity for environmental adaptation could be the cause.

Out of twenty-eight species collected from Pattambi, twelve species were recorded in Pre- Summer, twenty-one species were recorded in Summer and fifteen species during Monsoon season. It may be due to the climatic conditions prevailing over there. Highest diversity was recorded in Monsoon season may be due to the temperature prevailing over there during this season.

When comparing the two sites in Palakkad, i.e., Arayakkad and Pattambi, high diversity was recorded during pre-summer in Arayakkad and during Monsoon in Pattambi. Palakkad experiences a severe summer with hot and dry climate while the average temperature during the other seasons are almost same. Most of the Paederinae

species cannot withstand severe hot climate and hence the diversity is least. These findings agree with the study of Anlaş *et al.*, 2021., in which very few Paederinae species were collected during summer season compared to other seasons.

Pseudolathra unicolor was the dominant species collected from this site. It is a common and widely distributed species and its distribution ranges from the Himalaya to the Oriental region (Assing 2012d, 2013f; Li *et al.*, 2013b).

The relationship between each species collected from Pattambi and meteorological data such as temperature, rainfall and relative humidity were examined by regression analysis. The results of linear regression analysis shows that, twenty-five species namely, *Acanthoglossa hirta*, *Astenus gracelintus*, *Astenus melanurus*, *Astenus nilgiriensis*, *Cephalochaetus brunneus*, *Hyperscopaeus puberulus*, *Lithocharis ochracea*, *Lithocharis sororcula*, *Lithocharis vilis*, *Monocrypta abdominalis*, *Ochthephilum elephas*, *Ochthephilum extraneum*, *Paederus alternans*, *Paederus fuscipes*, *Palaminus nilgiriensis*, *Pinobius indicus*, *Pinobius robustus*, *Pinocharis genalis*, *Pseudolathra pulchella*, *Pseudolathra unicolor*, *Scopaeus bicuspis*, *Scopaeus fulvus*, *Scopaeus limbatus*, *Scopaeus testaceus* and *Scopaeus velutinus* were significantly influenced by temperature. Seventeen species namely *Astenus melanurus*, *Cryptobium fulvescens*, *Hyperscopaeus puberulus*, *Lithocharis ochracea*, *Lithocharis vilis*, *Medon auripilis*, *Ochthephilum elephas*, *Ochthephilum extraneum*, *Paederus sondaicus*, *Pinobius indicus*, *Pinobius robustus*, *Pseudolathra pulchella*, *Scopaeus bicuspis*, *Scopaeus fulvus*, *Scopaeus limbatus*, *Scopaeus testaceus* and *Scopaeus velutinus* were found to have a significant difference due to relative humidity. Nineteen species namely, *Acanthoglossa hirta*, *Astenus melanurus*, *Cryptobium fulvescens*, *Hyperscopaeus puberulus*, *Lithocharis ochracea*, *Lithocharis vilis*, *Medon auripilis*, *Monocrypta abdominalis*, *Ochthephilum elephas*, *Paederus fuscipes*, *Paederus*

sondaicus, *Pinobius indicus*, *Pinobius robustus*, *Pseudolathra pulchella*, *Scopaeus bicuspis*, *Scopaeus fulvus*, *Scopaeus limbatus*, *Scopaeus testaceus* and *Scopaeus velutinus* were found to have a significant difference due to rainfall. The result of linear regression analysis shows that abiotic factors has a great influence on the population of Paederinae. This is consistent with the study of Maher *et al.*, 2022 on the influence of abiotic factors on arthropod communities.

Pakkam

A total of twenty-one species of Paederinae were collected from Pakkam in that, fourteen species were recorded in Pre-Summer, thirteen species were recorded in Summer and twelve species during Monsoon season. Analysis of the seasonal variation in the abundance of Paederinae species collected from Pakkam shows that there is no significant seasonal change among the samples taken from this location.

Unlike the result obtained from all other sites, highest diversity was recorded during Summer season. This may be due to large number of grazing cattles present over there during this season. Paederinae beetles are seen in association with cattle dung. This study shows that cow dung is a favourable microhabitat for Paederinae and this result are consistent with the study of Sar and Hedge, 2015 and Stocker *et al.*, 2022.

Scopaeus limbatus was the dominant species collected from this site. In South India, this species is previously reported from Karnataka (Cameron, 1931; Jeon and Ahn, 2024) and it has to be noted that Wayanad shares boundary with Karnataka. *Scopaeus* species feed smaller arthropods (Jeon and Ahn, 2024) which are numerous present in paddy fields

The relationship between each species collected from Pakkam and meteorological data such as temperature, rainfall and relative humidity were analysed. Fourteen species namely, *Cryptobium fulvescens*, *Lobrathium badium*, *Lithocharis ochracea*, *Lithocharis vilis*, *Ochtheophilum extraneum*, *Paederus extraneus*, *P. fuscipes*,

Paederus sondaicus, *Pseudolathra pulchella*, *Pseudolathra unicolor*, *Scopaeus bicupsis*, *Scopaeus limbatus*, *Scopaeus testaceus* and *Scopaeus velutinus* were found to have a significant difference due to temperature. Fourteen species namely, *Cryptobium fulvescens*, *Hyperscopaeus puberulus*, *Lobrathium badium*, *Lithocharis uvida*, *Medon auripilis*, *Ochthephilum gastrale*, *Paederus alternans*, *Paederus extraneus*, *Paederus fuscipes*, *Paederus nigricornis*, *Paederus sondaicus*, *Pseudolathra pulchella*, *Scopaeus limbatus* and *Scopaeus velutinus* were found to have a significant difference due to relative humidity. Fourteen species namely, *Cryptobium fulvescens*, *Hyperscopaeus puberulus*, *Lobrathium badium*, *Lithocharis uvida*, *Medon auripilis*, *Ochthephilum extraneum*, *Ochthephilum gastrale*, *Paederus alternans*, *Paederus extraneus*, *Paederus nigricornis*, *Paederus sondaicus*, *Pseudolathra pulchella*, *Scopaeus limbatus* and *Scopaeus velutinus* were found to have a significant difference due to rainfall. These results are in agreement with the study of Maher *et al.*, 2022 on the influence of abiotic factors on arthropod communities.

Ambalavayal

Twenty-two species of Paederinae were recorded in Ambalavayal. Twelve species were recorded in Pre-Summer, fifteen species were recorded in Summer and nine species during Monsoon season. Seasonal variation in the abundance of Paederinae species collected from Ambalavayal is analyzed and there is no significant seasonal variation between the samples collected from this site. Highest diversity in this collection site was recorded during Monsoon season. It is most probably due to the high amount of rainfall and relative humidity during Monsoon. This finding agrees with the study of Nasir *et al.*, 2019.

Scopaeus testaceus was the dominant species collected from Ambalavayal. In South India, this species is previously reported from Karnataka (Cameron, 1931) and it has to be noted that Wayanad shares boundary with Karnataka.

According to Nasir *et al.*, 2019, the abundance and species richness of Staphylinidae beetles are influenced by abiotic factors. This study also analysed the relationship between each species collected and abiotic factors i.e., temperature, rainfall and relative humidity.

Ten species namely, *Lithocharis uvida*, *Lithocharis vilis*, *Ochtheophilum elephas*, *Oedichirus longipennis*, *Pseudolathra unicolor*, *Rugilus rufescens*, *Scopaeus dilutus*, *Scopaeus limbatus*, *Scopaeus testaceus* and *Scopaeus velutinus* were found to have a significant difference due to temperature. Ten species namely, *Medon cinnamopterus*, *Micranops pallidulus*, *Micrillus flavescens*, *Monocrypta abdominalis*, *Paederus fuscipes*, *Paederus sondaicus*, *Pinobius robustus*, *Pseudolathra pulchella*, *Scopaeus bicuspis* and *Scopaeus fulvus velutinus* were found to have a significant difference due to relative humidity. Five species namely, *Medon cinnamopterus*, *Monocrypta abdominalis*, *Paederus sondaicus*, *Pinobius robustus* and *Scopaeus fulvus* were found to have a significant difference due to rainfall. These findings agree with the study of Fazal, (2012) and Maher *et al.*, (2022) which states that, abiotic factors (temperature and humidity) influence insect communities.

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CONCLUSION

6. CONCLUSION

This study provides the first record of Paederinae beetles from paddy fields of Palakkad and Wayanad districts, Kerala. The most significant findings of the present study are the 3 New reports of Paederinae species from India, 10 new reports from south India and 13 new reports Kerala. Checklist, images, pictorial key and revised taxonomic key up to species level of Paederinae collected from Palakkad and Wayanad is compiled using the available literatures like Cameron, 1931; Biswas, 1986; Schomann and Solodovnikov, 2017; Herman, 2003, Herman 2023.

6.1. TAXONOMY

- 45 species of Paederinae were recorded from Palakkad and Wayanad districts.
- Among the 45 species, 37 species of Paederinae were recorded from Palakkad and 31 species from Wayanad and 23 species from both Palakkad and Wayanad.
- Sitewise: 30 species from Arayakkad, 28 species from Pattambi, 21 species from Pakkam and 22 species from Ambalavayal.
- 3 species namely, *Medon auripilis*, *Micrillus flavescens* and *Pinocharis genalis* were recorded for the first time from India.
- 10 species namely, *Lobrathium badium*, *Lithocharis ochracea*, *Medon cinnamopterus*, *Medon pallidus*, *Ochtheophilum gastrale*, *Paederus nigricornis*, *Pseudolathra unicolor*, *Micranops pallidulus*, *Micrillus indicus* and *Scopaeus fulvus* were new records from south India.
- 13 species namely, *Hyperscopaeus puberulus*, *Lithocharis sororcula*, *Lithocharis vilis*, *Paederus alternans*, *Paederus extraneus*, *Palaminus nilgiriensis*, *Palaminus rufus*, *Pinobius indicus*, *Pinobius robustus*, *Pinonepalus cameroni*, *Scopaeus*

limbatus, *Scopaeus testaceus* and *Scopaeus velutinus* were recorded for the first time from the state of Kerala.

- Checklist of species, images, pictorial key and revised taxonomic key up to species level of Paederinae collected from Palakkad and Wayanad are also provided.

6.2. ECOLOGY

- Site-wise comparison done, and the highest diversity was recorded in Arayakkad (Palakkad district).
- No significant variation in the abundance of Paederinae between sites was observed.
- Seasonal variation of Paederinae was analysed in each collection site and no significant seasonal variation was observed in any of the collection sites.
- The relationship between the abundance of each species collected and meteorological data i.e., temperature, rainfall, and relative humidity were analysed by regression analysis.
- Bray Curtis similarity values of the abundance of Paederinae in the four different collection sites were analysed and the highest similarity was shown between Arayakkad and Ambalavayal.

SITE WISE ANALYSIS

Arayakkad

- Among the 30 species collected from Arayakkad, 7 were major, 14 were minor species and 9 were rare species.
- *Pseudolathra pulchella* was the dominant species collected from Arayakkad.
- Highest diversity of species in Arayakkad was recorded during Pre-summer season.

Pattambi

- Among the 28 species collected from Pattambi, 8 were major, 10 were minor and 10 were rare species.
- *Pseudolathra unicolor* was the dominant species collected from Pattambi.
- Highest diversity of species in Pattambi was recorded during Monsoon season.

Pakkam

- Among the 21 species collected from Pakkam, 5 were major, 8 were minor species and 8 were rare species.
- *Scopaeus limbatus* was the dominant species collected from Pakkam.
- Highest diversity of species in Pakkam was recorded during Summer season.

Ambalavayal

- Among the 22 species collected from Ambalavayal, 6 were major, 7 were minor species and 9 were rare species
- *Scopaeus testaceus* was the dominant species collected from Ambalavayal
- Highest diversity of species in Ambalavayal was recorded during Monsoon season.

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RECOMMENDATIONS

7. RECOMMENDATIONS

- The current study documented the Paederinae beetles in the Paddy fields of Palakkad and Wayanad districts. Since the preferred habitat of these beetles is paddy fields, this study was conducted in these fields; additional research is required to complete the faunal inventory of these beetles from other habitats.
- Species composition, abundance, diversity, seasonality, and the relationship of each species of Paederinae with environmental factors (temperature, relative humidity, and rainfall) were analysed in this study. More research is needed to determine how biotic factors, such as competition for resources and interactions with other species, affect the abundance of Paederinae.
- Research on the impact of habitat fragmentation on the population of Paederinae beetles is also advised.
- Further investigations are required to find the effectiveness of Paederinae in specific pest control scenarios and to compare them to other biocontrol methods.
- Additional studies on the molecular level is also advised for a wide range of purposes including phylogenetic analysis, understanding gene expression and analysing the evolutionary origins of specific trait.
- Some species of the genus *Paederus* cause skin irritation called Paederus dermatitis. As these beetles are biological control agents, the eradication of these beetles is not advisable, but it is necessary to find out measures for preventing dermatitis. The main strategy to avoid dermatitis is to prevent human-beetle interaction. Preventive sprays and insect repellents such as Deltamethrin, Baygon 20%, and Malathion 50% are effective against these beetles. A detailed study is required on the life table of each species to identify which species are causing dermatitis and to find a solution to resolve this

problem.

- Further research also reveals the impact of irrigation and land use on *Paederus* populations and their possible role in dermatitis outbreaks.
- Studies can investigate the chemical compounds present in these beetles, such as pederin, and their potential use in pharmaceuticals or other sectors

REFERENCES

8. REFERENCES

- Abdullah F. (2010) Diversity and Abundance of Intertidal Rove Beetles (Coleoptera: Staphylinidae) in Bachok coast, Kelantan, Malaysia. *Malaysian Journal of Science*, 29, 81 – 89.
- Adachi T. (1955) Systematic study on the subfamily Paederinae of Staphylinidae of Japan (eleventh contribution to the knowledge of Staphylinidae of Japan) [in Japanese, English descriptions and summary]. *Journal of the Toyo University*, 7, 11-36.
- Agricultural Statistics 2018-2019 (2020). Annual publications of the Department of Economics and Statistics. Government of Kerala. <https://ecostat.kerala.gov.in>. Accessed on 12 November 2023.
- Ahn K J, Cho Y B, Kim Y H, Yoo I S & Newton A F (2017). Checklist of the Staphylinidae (Coleoptera) in Korea, *Journal of Asia-Pacific Biodiversity*, 10(3), 279-336, ISSN 2287-884X.
- Ali, A., Kathirvel, S., Devika, T., Sivasankaran, M. P., Balan, K., GS, P. K., ... & Vijayalakshmi, T. S. (2013). A study on *Paederus dermatitis* outbreak in a suburban teaching research hospital, Kanchipuram, India. *Medicine Science*, 2(3), 764-769.
- Allen, A.A. (1969). Notes on some British Staphylinidae (Col.). 1. The genus *Scopaeus* Er., with the addition of *S. laevigatus* Gyll. to our list. *Entomologist's Monthly Magazine* 104 (1968), 198–207.
- Allison, E., Hall, A., & Kenward, H. (1999). Technical report. Living conditions and resource exploitation at the Early Christian rath at Deer Park Farms, Co., Antrim, N. Ireland: evidence from plants and invertebrates. Part 1: Text. Environmental Archaeology Unit, 144.
- Andersen, A. & Eltun, R. (2000). Long-term developments in the carabid and staphylinid (Col., Carabidae and Staphylinidae) fauna during conversion from conventional to biological farming. *Journal of Applied Entomology*, 124:51-56.
- Anlaş, S., (2009). On the genus *Tetartopeus* Czwalina 1888 of Turkey. A new species and additional records (Coleoptera, Staphylinidae, Paederinae). *Zootaxa*, 63–67.
- Anlaş, S. (2012). A new species and additional records of the genus *Leptobium* Casey, 1905 (Coleoptera: Staphylinidae, Paederinae) from Turkey. *Turkish Journal of Entomology*, 36(2), 225-230.
- Anlaş, S. (2014). A new species of *Astenus* (Eurysunius) Dejean, 1833 from Turkey (Coleoptera: Staphylinidae, Paederinae). *Turkish Journal of Entomology*, 38(3), 239-244.
- Anlaş, S. (2015 a). Four new species of *Astenus* (Eurysunius) Dejean, 1833 from Western Anatolia, Turkey (Coleoptera: Staphylinidae, Paederinae). *Zootaxa*, 3986(4), 472-482.
- Anlaş, S. (2015b). A new species and additional records of the genus *Medon* Stephens, 1833 (Coleoptera: Staphylinidae: Paederinae) from Turkey. *Turkish Journal of Zoology*, 39(4), 620-624.

- Anlaş, S. (2017 a). Notes on the genus *Astenus* Dejean, 1833 from the Palearctic Region (Coleoptera: Staphylinidae: Paederinae). *Turkish Journal of Entomology*, 41(4), 405-413.
- Anlaş, S. (2017 b). Notes on the genus *Rugilus* Leach, 1819 in the Palearctic Region (Coleoptera: Staphylinidae: Paederinae). *Turkish Journal of Entomology*, 41(2), 197-205.
- Anlaş, S. (2018). Notes on the genera *Paederidus* Mulsant & Rey, 1878, *Paederus* Fabricius, 1775 and *Uncopaederus* Korge, 1969 from the Palearctic Region (Coleoptera: Staphylinidae: Paederinae). *Turkish Journal of Entomology*, 42(1), 3-12.
- Anlaş, S. (2020 a). Notes on the genus *Astenus* Dejean, 1833 in the Mediterranean and adjacent regions. A new species from Turkey, seven new synonyms, and additional records (Coleoptera: Staphylinidae: Paederinae). *Zootaxa*, 4869(2), 251-263.
- Anlaş, S. (2020 b). On the genus *Lobrathium* Mulsant & Rey, 1878 of the Palaearctic region: A new species from Turkey and new zoogeographic data (Coleoptera, Staphylinidae: Paederinae). *Turkish Journal of Zoology*, 44(5), 446-454.
- Anlaş, S., & Çevik, I. E. (2008). Faunistic studies on Paederinae (Coleoptera: Staphylinidae) in Manisa province, Turkey. *Mun Ent Zool*, 3, 665-674.
- Anlaş, S., & Rose, A. (2009). Some additional notes about Staphylininae (Coleoptera: Staphylinidae) fauna of Turkey. *Munis Entomology & Zoology*, 4(2), 327-333.
- Anlaş, S. & Deveci, Ö., (2011). New records of Staphylinidae from Turkey, Syria, and Iran (Insecta: Coleoptera). *Turkish Journal of Zoology*, 35(3), 433-435.
- Anlaş, S., Khachikov, E. A., & Iljina, E. V. (2011). New Records on the Distribution of Some Species of Subfamily Paederinae (Coleoptera: Staphylinidae) from Europe and Asia. *Acta Zoologica Bulgarica*, 63(2), of.
- Anlaş, S., Yener, H., & Yağmur, E. A. (2021). Notes on the seasonal dynamics of some Paederinae (Coleoptera: Staphylinidae) species in the vineyards of Manisa, Western Anatolia. *Journal of the Entomological Research Society*, 23(2), 121-132.
- Anon (1916) Neue Staphyliniden des Indo-malaiischen Faunengebietes besonders der Philippinen (13. Beitrag). *Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien* 66, 418–431.
- Aparna, K. K., Menon, M. V., Joseph, J., & Prameela, P. (2018). Diversity of *Echinochloa* spp. in Palakkad rice tracts of Kerala.
- Armstrong, R. K., & Winfield, J. L. (1968). Staphylinidae dermatitis on Okinawa. *Journal of Medical Entomology*, 5(3), 362-362.
- Arnett, R.H. (1963) The beetles of the United States. (A manual for identification). Washington, DC: Catholic University of America, xi + 1112 pp.
- Ashe, J. S., & Watrous, L. E. (1984). Larval chaetotaxy of Aleocharinae (Staphylinidae) based on a description of *Atheta coriaria* Kraatz. *The Coleopterists' Bulletin*, 165-179.

- Assing, V. (1999). A revision of the Canarian species of *Leptobium* Casey (Coleoptera, Staphylinidae: Paederinae). na.
- Assing, V. (2000). On the Staphylinidae of El Hierro, with additional new records from the Canary Islands. *Entomologische Zeitschrift*, 110(4), 114-118.
- Assing, V., (2001) On the Turkish species of *Sunius* Curtis 1829 (Coleoptera: Staphylinidae, Paederinae). *Linzer biologische Beiträge*, 195-210.
- Assing, V., (2002). New species of *Sunius* Curtis from China and Iran (Coleoptera: Staphylinidae, Paederinae). *Linzer biologische Beiträge*, 289-296.
- Assing, V., (2003a). Two new species of *Platydome* Ganglbauer from Romania and Turkey, with a redescription of *P. stoeckleini* (Koch) (Coleoptera: Staphylinidae, Paederinae). *Linzer biologische Beitrag*, 5-12.
- Assing, V., (2003b). New species and records of *Eurysunius*, subgenus of *Astenus* Dejean, from the Iberian Peninsula (Coleoptera: Staphylinidae, Paederinae). *Linzer biologische Beiträge*, 693-700.
- Assing V (2004a). A revision of the *Medon* species of the Eastern Mediterranean and adjacent regions (Insecta: Coleoptera: Staphylinidae: Paederinae). *Bonn. Zoologische Beiträge* 52: 33–82.
- Assing V (2004b). A revision of Western Palaearctic *Medon* Stephens (Coleoptera: Staphylinidae, Paederinae). Supplement I. *Linzer biologische Beiträge* 36: 655–662.
- Assing, V., (2005 a). On the Turkish species of *Sunius*. IV. New micropterous species from southwestern Anatolia and additional records (Coleoptera: Staphylinidae, Paederinae). *Linzer biologische Beitrag*, 415-423.
- Assing, V., (2005 b). On the Turkish species of *Sunius*. V. New species, additional records, a new synonymy, and an updated key to species (Coleoptera: Staphylinidae, Paederinae). *Beiträge zur Entomologie*, 109-121.
- Assing, V., (2005c). A revision of Western Palaearctic *Medon*. IV. A new species and new records from Iran, and a catalogue of species (Coleoptera: Staphylinidae, Paederinae). *Linzer biologische Beitrag*, 1027-1034.
- Assing, V., (2006a). New species and records of *Pseudobium* Mulsant & Rey (Insecta: Coleoptera: Staphylinidae: Paederinae). *Linzer biologische Beiträge*, 385-391.
- Assing, V., (2006b). A revision of *Leptobium* Casey. Supplement I (Insecta: Coleoptera: Staphylinidae, Paederinae). *Linzer biologische Beiträge*, 381-384.
- Assing, V., (2006c). On the Turkish species of *Sunius*. VII. Five new micropterous species from western Anatolia and additional records (Coleoptera: Staphylinidae, Paederinae). *Beiträge zur Entomologie*, 297-315.
- Assing V (2006 d) A revision of Western Palaearctic *Medon*: the species of the Atlantic Islands, the Western Mediterranean, and Europe, except for the southeast (Insecta: Coleoptera: Staphylinidae: Paederinae). – *Bonner Zoologische Beiträge* 54 (2005) (1–2): 25–95.

- Assing V (2007a). A revision of Western Palaearctic *Medon*. V. A new species from Iran and additional records (Coleoptera: Staphylinidae, Paederinae). *Linzer biologische Beitrage* 39: 23–32.
- Assing V (2007b). A revision of Western Palaearctic *Medon*. VI. A new species from Turkey and additional records (Coleoptera: Staphylinidae, Paederinae). *Linzer biologische Beitrage* 39: 791–797.
- Assing, V., (2007c). The first anophthalmous species of *Domene* Fauvel from Greece (Coleoptera: Staphylinidae: Paederinae). *Linzer biologische Beitrage*, 757-760.
- Assing, V., (2007d). New species and additional records of Paederinae and Aleocharinae from Iran (Coleoptera, Staphylinidae). *Deutsche EntomologischeZeitschrift*, 54 (2), 179-193.
- Assing, V., (2007e). A revision of Palaearctic *Lobrathium* Mulsant & amp; Rey. III. New species, new synonyms, and additional records (Coleoptera: Staphylinidae, Paederinae) *Linzer biologische Beitrage*, 731-755.
- Assing, V., (2008a). On the taxonomy and zoogeography of some Palaearctic Paederinae and Xantholinini (Coleoptera: Staphylinidae). *Linzer biologische Beitrage*, 40(2), 1237-1294.
- Assing, V., (2008b). On the Cryptobiina of the Arabia peninsula (Coleoptera: Staphylinidae: Paederinae). *Zootaxa*, 1892 (1), 53-64.
- Assing, V. (2008 c). A revision of the *Micrillus* species of the Palaearctic region, with notes on two species from adjacent parts of the Afrotropical and Oriental regions (Coleoptera: Staphylinidae: Paederinae). *Stuttgarter Beiträge zur Naturkunde Serie A, Neue Serie*, 1, 301-344.
- Assing, V. (2009 a). On the identity of some *Acanthoglossa* and *Hypomedon* species, primarily from the Mediterranean region (Coleoptera: Staphylinidae: Paederinae). *Linzer Biologische Beiträge*, 41(2), 1161-1173.
- Assing V (2009 b). A revision of Western Palaearctic *Medon*. VII. A new species from southern Turkey and additional records (Coleoptera: Staphylinidae: Paederinae). *Linzer biologische Beitrage* 41: 1253–1268.
- Assing, V., (2009c). Two new species of Paederinae from the Greek island Samos (Coleoptera: Staphylinidae). *Linzer biologische Beitrage*, 437-443.
- Assing, V., (2009d). A revision of the Western Palaearctic species of *Nazeris* Fauvel, 1873 (Coleoptera, Staphylinidae, Paederinae). *Deutsche EntomologischeZeitschrift*.
- Assing, V., (2009e). A revision of *Leptobium* Casey. IV. Three new species and additional records (Coleoptera: Staphylinidae: Paederinae). *Stuttgarter Beitragezur Naturkunde Serie A*, 227-226.
- Assing, V., (2009f). New species and additional records of *Lathrobium* and *Tetartopeus* from the Palaearctic region (Coleoptera: Staphylinidae: Paederinae). *Linzer biologische Beitrage*, 41(2) 1269-1283.

- Assing, V., (2009g). On the *Pseudomedon* species of the Palaearctic region (Coleoptera: Staphylinidae: Paederinae). *Linzer biologische Beiträge*, 41 (2), 1175-1189.
- Assing, V., (2009h) A revision of *Leptobium* Casey. III. A new species from Iran and additional records (Coleoptera: Staphylinidae: Paederinae). *Linzer biologische Beiträge*, 1247-1252.
- Assing, V., (2010a). A revision of the genus *Luzea* (Coleoptera, Staphylinidae, Paederinae). *Deutsche Entomologische Zeitschrift*. 117-135.
- Assing, V., (2010b). On the Lathrobiina of Taiwan (Coleoptera: Staphylinidae: Paederinae). *Beiträge zur Entomologie*, 301-361.
- Assing (2010 c) A revision of Palaearctic *Medon*. VIII. A new species from Nepal and additional records (Coleoptera: Staphylinidae: Paederinae). – *Linzer biologische Beiträge* 42 (1): 489–498.
- Assing, V., (2011a). On the Staphylinidae (Coleoptera) of Iran. II. New species and additional records, with special reference to the Paederinae, Xantholinini, and Aleocharinae. *Stuttgarter Beiträge zur Naturkunde Serie A*. 137-183.
- Assing, V., (2011b). The *Sunius* species of the Palaearctic region (Coleoptera: Staphylinidae: Paederinae). *Linzer biologische Beiträge*. 151-193.
- Assing, V., (2011c). A revision of Palaearctic *Sunius* XIV. Three new species from Turkey and additional records (Coleoptera: Staphylinidae: Paederinae). *Linzer biologische Beiträge*, 1159-1168.
- Assing, V., (2011d). *Orsunius* gen. nov. from the Oriental region (Coleoptera: Staphylinidae: Paederinae: Medonina). *Linzer biologische Beiträge*, 221-244.
- Assing, V. (2012a). The *Rugilus* species of the Palaearctic and Oriental regions (Coleoptera: Staphylinidae: Paederinae). *Stuttgarter Beiträge zur Naturkunde A, Neue Serie*, 5, 115-190.
- Assing, V. (2012b). Unterfamilie Paederinae. In V. Assing and S. Schülke (editors), Freude-Harde-Lohse-Klausnitzer – Die Käfer Mitteleuropas, Band 4. Staphylinidae (exklusive Aleocharinae, Pselaphinae und Scydmaeninae). 2. Auflage: 322–369, 380–383. Heidelberg: Spektrum Akademischer Verlag, xii + 560.
- Assing, V., (2012c). A revision of East Palaearctic *Lobrathium* (Coleoptera: Staphylinidae: Paederinae). *Bonn Zoological Bulletin*, 61 (1), 49-128.
- Assing, V., (2012d). The *Pseudolathra* species of the East Palaearctic and the Oriental regions (Coleoptera: Staphylinidae: Paederinae). *Beiträge zur Entomologie*, 299-230.
- Assing, V., (2012e) A revision of the *Lathrobium* species of the Himalaya (Coleoptera: Staphylinidae: Paederinae). *Bonn Zoological Bulletin*, 142-209.
- Assing, V. (2012f). On the Staphylinidae of Socotra Island, Yemen (Insecta: Coleoptera). *Linzer Biologische Beiträge*, 44(2), 973-986.

- Assing, V., (2013a). On the *Lathrobium* fauna of China III. New species and additional records from various provinces (Coleoptera: Staphylinidae: Paederinae). *Beitrage zur Entomologie*, 25-52.
- Assing, V., (2013b). New species and records of *Lathrobium* from China and Nepal (Coleoptera: Staphylinidae: Paederinae). *Linzer Biologische Beiträge*, 1643-1655.
- Assing V (2013 c). A revision of Palaearctic *Medon* IX. New species, new synonymies, a new combination, and additional records (Coleoptera: Staphylinidae: Paederinae). *Entomol Blätt und Col* 109: 233–270.
- Assing, V. (2013 d) A revision of Palaearctic and Oriental *Rugilus*. III. Five new species from the Palaearctic region and additional records (Coleoptera: Staphylinidae: Paederinae). *Linzer Biologische Beiträge*, 45 (1).
- Assing, V. (2013 e) A revision of Palaearctic *Lobrathium*. IV. Three new species from Nepal and China, a new combination, and additional records (Coleoptera: Staphylinidae: Paederinae). *Linzer Biologische Beiträge*, 45 (1).
- Assing, V. (2013f) A revision of *Pseudolathra* of the East Palaearctic and Oriental regions. II. Six new species and additional records, with notes on some New World species (Coleoptera: Staphylinidae: Paederinae). *Linzer Biologische Beiträge*, 45 (1).
- Assing, V. (2013 g). On the Palaearctic and Oriental species of *Scymbalium* and *Micrillus* (Coleoptera: Staphylinidae: Paederinae). *Linzer biologische Beiträge*, 45(2), 1479-1520.
- Assing, V. (2013 h). Two new genera of Lathrobiina from the East Palaearctic region (Coleoptera: Staphylinidae: Paederinae). *Contributions to Entomology*, 63(2), 219-239
- Assing, V., (2013 i). On the *Lathrobium* fauna of Japan (Coleoptera: Staphylinidae: Paederinae). *Linzer Biologische Beiträge*, 1615-1641.
- Assing, V., (2013j). On the *Nazeris* fauna of China I. The species of the Qinling Shan, the Daba Shan, and adjacent mountain ranges (Coleoptera: Staphylinidae: Paederinae). *Bonn Zoological Bulletin*, 1-29.
- Assing, V., (2014 a) A revision of the *Nazeris* fauna of the Himalaya (Coleoptera: Staphylinidae: Paederinae). *Stuttgarter Beitrage zur Naturkunde A*, 65-130.
- Assing, V. (2014 b) A revision of Palaearctic and Oriental *Pseudolathra*. IV. New species, new combinations and additional records (Coleoptera: Staphylinidae: Paederinae). *Linzer Biologische Beiträge*, 46 (2).
- Assing, V. (2014 c) A revision of Palaearctic and Oriental *Rugilus*. IV. Three new species from Nepal and additional records (Coleoptera: Staphylinidae: Paederinae). *Linzer Biologische Beiträge*, 46 (1).
- Assing, V. (2014 d) A revision of Palaearctic *Lobrathium*. V. Three new species from the Himalaya and China, a new synonymy, and additional records (Coleoptera: Staphylinidae: Paederinae). *Linzer Biologische Beiträge*, 46 (1).

- Assing, V. (2014 e) On the Staphylinidae of Sardinia, Italy (Insecta: Coleoptera). *Linzer Biologische Beiträge*, 46 (1).
- Assing, V., (2014 f). A revision of *Tetartopeus* IV. A new species from Turkey, new synonymies, and additional records (Coleoptera: Staphylinidae: Paederinae). *Linzer Biologische Beiträge*, 1119-1131.
- Assing V (2014 g) Three new species and a new species group of *Medon* from China and Taiwan (Coleoptera: Staphylinidae: Paederinae). – *Linzer biologische Beiträge* 46 (1): 515–523. – https://www.zobodat.at/pdf/LBB_0046_1_0515-0523.pdf
- Assing V., (2014 h) A revision of the species of *Pinobius* MACLEAY, 1871 of the Oriental, Palaearctic, and Australian Regions (Coleoptera: Staphylinidae: Paederinae). *Koleopterologische rundschau*, 84: 115–191.
- Assing, V. (2015 a). A revision of the *Lithocharis* species of the Palaearctic, Oriental and Australian regions (Coleoptera: Staphylinidae: Paederinae: Medonina). *Linzer Biologische Beiträge*, 47(2), 1133-1178.
- Assing, V. (2015 b) A revision of Palaearctic and Oriental *Rugilus*. V. Two new species from China and additional records (Coleoptera: Staphylinidae: Paederinae). *Linzer Biologische Beiträge*, 47 (1).
- Assing, V. (2016). On some *Acanthoglossa* and *Hypomedon* species II. Two new species, a new synonymy, and additional records (Coleoptera: Staphylinidae: Paederinae). *Linzer biologische Beiträge* 48(1): 317–325.
- Assing, V. (2017 a) Two new species and additional records of micropterous *Paederus* from China and Taiwan (Coleoptera: Staphylinidae: Staphylininae). – *Linzer Biologische Beiträge* 49 (1): 253–263.
- Assing, V. (2017 b) A revision of Palaearctic *Lobrathium*. VI. Two new species from Armenia and Taiwan, and additional records (Coleoptera: Staphylinidae: Paederinae). *Linzer Biologische Beiträge*, 49 (1), 299–306.
- Assing V., (2018 a) A revision of *Pinobius*. II. Three new species from Cambodia and Indonesia, and additional records (Coleoptera: Staphylinidae: Paederinae). *Linzer biologische Beiträge* 50 (2): 997–1004.
- Assing, V. (2018 b) A revision of Palaearctic and Oriental *Pseudolathra*. V. Two new species from Cambodia and Thailand, and additional records (Coleoptera: Staphylinidae: Paederinae). *Linzer Biologische Beiträge*, 50 (2).
- Assing, V. (2018 c). A revision of Palaearctic and Oriental *Scymbalium* and *Micrillus* III. New species, new combinations, and additional records (Coleoptera: Staphylinidae: Paederinae). *Linzer biologische Beiträge*, 50 (2), 977-996.
- Assing, V. (2018 d). A revision of *Medon*. XI. Five new species, additional records, and the first confirmed records from the Oriental region (Coleoptera: Staphylinidae: Paederinae). *Beiträge zur Entomologie*, 68 (1), 69-81.
- Assing, V. (2019 a) Three new species and additional records of *Oedichirus* (Coleoptera: Staphylinidae: Aleocharinae). – *Linzer Biologische Beiträge* 51 (1): 33–42.

- Assing, V. (2019 b) A revision of Palaearctic and Oriental *Rugilus*. VI. Two new species from China, a new synonymy, and additional records (Coleoptera, Staphylinidae, Paederinae). *Linzer Biologische Beiträge*, 51 (1).
- Assing, V. (2020 a). On the taxonomy and zoogeography of *Paederus* V. Two new species from Laos and China, a new synonymy, new subgeneric assignments, and new records from the Palaearctic region (Coleoptera: Staphylinidae: Paederinae). *Acta Musei Moraviae, Scientiae biologicae*, 105, 91-102.
- Assing, V. (2020 b) A revision of Palaearctic and Oriental *Rugilus* VII. Two new species from China and Laos, and additional records (Coleoptera: Staphylinidae: Paederinae). *Acta Musei Moraviae, Scientiae Biologicae*, 105 (2) 145-152.
- Assing, V. (2021 a) A revision of Palaearctic, Oriental, and New Guinean *Pseudolathra*. VI. Four new species, two new synonymies, and additional records (Coleoptera, Staphylinidae, Paederinae). *Linzer Biologische Beiträge*, 53 (1).
- Assing, V. (2021 b). A revision of *Medon*. XII. Two new species and a review of the fauna of Georgia (Coleoptera: Staphylinidae: Paederinae): With 15 figures and 2 maps. *Beiträge zur Entomologie= Contributions to Entomology*, 71 (2), 247-254.
- Assing, V. (2022 a) Monograph of Palaearctic, Oriental, and New Guinean Pinophilina (Coleoptera: Staphylinidae: Paederinae). *Acta Musei Moraviae Scientiae Biologicae*.
- Assing, V. (2022 b) On the taxonomy and zoogeography of *Paederus*. VI. Two new species from Nepal and new records from the Palaearctic and Oriental regions (Coleoptera: Staphylinidae: Paederinae). *Contributions to Entomology; Beiträge zur Entomologie*, 72 (1) 75-79.
- Assing, V., & M. Schülke. (2001). Supplemente zur mitteleuropäischen Staphylinidenfauna (Coleoptera, Staphylinidae). II. Entomologische Blätter für Biologie und Systematik der Käfer 97: 121–176.
- Assing, V., & M. Schulke., (2002). New species and records of *Lobrathium* Mulsant & Rey from Turkey, Albania, and Tajikistan (Coleoptera: Staphylinidae, Paederinae). *Linzer biologische Beiträge*, 277–287.
- Assing, V. & Schülke, M., (2006) Systematic Catalogue of the Entomofauna of the Madeira Archipelago and Selvagens Islands: Coleoptera
- Assing, V., Schülke, M., M. R., & A. S. (2013). *Paederus fuscipes* CURTIS 1826. In On the Staphylinidae of Saudi Arabia, with descriptions of two new species (Insecta: Coleoptera), *Linzer biologische Beiträge* 45, 141–154.
- Assing, V., & Brachet, V. (2021). New species of Staphylinidae from Pakistan (Coleoptera: Staphylinidae: Aleocharinae, Paederinae, Pselaphinae). *Acta Musei Moraviae Scientiae biologicae*, 106 (2), 265–278.
- Baba, K. (1943). Linear dermatitis in southern China. *Gun'idan Zasshi* 360, 601–605.
- Babko K, M., Danko, Y., Franus, M., & Stępniewski, W. (2020). Effect of soil moisture on the epigeic arthropods diversity in steppe landscape. *Journal of Ecological Engineering*, 21 (5), 137–147.

- Bacal, S., Munteanu, N. & Toderaş, I. (2013) Checklist of beetles (Insecta: Coleoptera) of the Republic of Moldova. *Bruckenthalia Acta Musei*, 8(3), 415–450.
- Balog, A., Marko, V., & Adam, L. (2008). Rove beetles (Coleoptera: Staphylinidae) collected during the long-term ecological research in a Hungarian oak forest. *Journal of Environmental Biology*, 29(2), 263.
- Beare, T.H. (1930) A catalogue of the recorded Coleoptera of the British Isles. London: Janson Assing (2010 c) A revision of Palaearctic *Medon*. VIII. A new species from Nepal and additional records (Coleoptera: Staphylinidae: Paederinae). – *Linzer biologische Beiträge* 42 (1): 489–498.
- Beatty, H.A. (1944). The insects of St. Croix, VI. I. *Journal of Agriculture of the University of Puerto Rico*, 28 (3-4), 114–172.
- Beaulieu, B. A., & Irish, S. R. (2016). Literature review of the causes, treatment, and prevention of dermatitis linearis. *Journal of Travel Medicine*, 23(4), 32.
- Bernhauer, M. (1902) Zur Staphyliniden-fauna von Ceylon. *Deutsche Entomologische Zeitschrift*, 1902 (1).
- Bernhauer, M. (1911) Zur Staphylinidenfauna Ostindiens und der Sundainseln (3. Beitrag). *Entomologische Blätter*, 7 (2–3).
- Bernhauer, M. (1914) Neue Staphylinen der indo-malaiischen Fauna. Verhandlungen der Kaiserlich-Königlichen Zoologisch-Botanischen Gesellschaft in Wien, 64.
- Bernhauer M. (1915) Coleoptera vii: Staphylinidae. Beitr. Kenntnis Land-Süßwasserf. Deutsch-Südwestafrika. 1: 313–321.
- Bernhauer, M. (1916) Kurzflügler aus dem deutschen Schutzgebiete Kiautschau und China. *Archiv für Naturgeschichte*, 81 (A) (8).
- Bernhauer M. (1917) Staphyliniden von Madagascar, den Comoren und Zanzibar [Vol. 3, p. 552-560, in] A. Voeltzkow (ed.) Reise in Ostafrika in den Jahren 1903-1905, Wissenschaftliche Ergebnisse.
- Bernhauer M (1920) Results of Dr. E. Mjöberg's Swedish scientific expeditions to Australia 1910–1913. 22. Staphylinidae. *Arkiv för Zoologi*, 13, 1–27.
- Bernhauer, M. (1927) Dr. E. Mjöbergs zoological collections from Sumatra: 8. Staphylinidae. *Arkiv för Zoologi*, 19 (A).
- Bernhauer M. (1931) Entomological Expedition to Abyssinia 1926- 1927: Coleoptera, Staphylinidae. Systematic Report by Dr. Max Bernhauer (Horn, Niederösterreich, Austria). *J. Linn. Soc. London, Zool.* 37: 559–605.
- Bernhauer, M. (1939). Zur Staphylinidenfauna Argentinien und Brasiliens (Col.). *Revista de Entomología*, 10(1), 231–249.
- Bernhauer, M. and Schubert, K. (1912) Staphylinidae III. In S. Schenkling, *Coleopterorum Catalogus* 5 (40): 191–288.

- Betz, O., Koerner, L., & Dettner, K. (2018). The biology of Steninae. *Biology of Rove Beetles (Staphylinidae) Life History, Evolution, Ecology and Distribution*, 229-283.
- Bibars, E. E. D. A. E. (2018). Taxonomical Studies of Subtribe Astenina Hatch (Paederinae, Staphylinidae: Coleoptera) in Egypt. *Egyptian Academic Journal of Biological Sciences. A, Entomology*, 11(5), 127–137.
- Bierig, A. (1943). Algunos Estaphylinidae (Col.) nuevos de Costa Rica. *Revista Chilena de Historia Natural*, 45(1941), 154–163.
- Binaghi, G. (1935). Studio sul genere Scopaeus Erich. (Coleopt.: Staphylin.). *Memorie della Società Entomologica Italiana* 14: 84–115.
- Biswas D.N. (1986). Staphylinidae (Coleoptera) of Silent Valley Kerala, India. *Records of the Zoological Survey of India*, 84 (1-4): 121–129.
- Biswas D.N. and Sen Gupta. T (1982) New species and new records of Staphylinidae (Coleoptera) from India and Sri Lanka. *Revue suisse de Zoologie*. 89: 135–154.
- Biswas, D.N., & S. Biswas. (1995) Insecta: Coleoptera: Staphylinidae. In State Fauna Series 3. Fauna of West Bengal. Part 6A (Insecta: Coleoptera): 201–361. Calcutta: *Zoological Survey of India*, 447.
- Biswas, A., & Karanth, K.P. (2021). Role of geographical gaps in the Western Ghats in shaping intra-and interspecific genetic diversity. *Journal of the Indian Institute of Science*, 101(2), 151-164.
- Blackwelder, R.E. (1939a). A generic revision of the staphylinid beetles of the tribe Paederini. *Proceedings of the United States National Museum* 87 (3069): 93–125.
- Blackwelder, R.E. (1939b). Coleoptera of America, north of Mexico. Fourth supplement 1933 to 1938 (inclusive) to the Leng Catalogue. Mount Vernon, NY: John D. Sherman, Jr., 146 pp.
- Blackwelder, R.E. (1943). Monograph of the West Indian beetles of the family Staphylinidae. *United States National Museum Bulletin* 182: i–viii + 1–658.
- Blackwelder, R.E. (1944). Checklist of the coleopterous insects of Mexico, Central America, the West Indies, and South America. Part 1. *United States National Museum Bulletin* 185: xii + 1–188.
- Blackwelder, R. E. (1952) The generic names of the beetle family Staphylinidae, with an essay on genotypy. *United States National Museum Bulletin* 200: i - iv, 1 - 483.
- Blackwelder, R. E., & Arnett. R. H., (1974) Staphylinidae. In North American Beetle Fauna Project. Checklist of the beetles of Canada, United States, Mexico, Central America and the West Indies, 1 (2). The water beetles, rove beetles, and related groups. (Red Version). Latham, NY: *Biological Research Institute of America, Inc.*, 188.
- Blackwelder, R.E., & R.H. Arnett. (1974) Staphylinidae. In North American Beetle Fauna Project. Checklist of the beetles of Canada, United States, Mexico, Central America and the West Indies. 1 (2). The water beetles, rove beetles, and related groups. (Red Version): 1–188.

- Blanchard, C.E. (1842) Famille des brachklytres, pp. 6-88.
- Bogri, A., Solodovnikov, A., & Żyła, D. (2018). Baltic amber impact on historical biogeography and palaeoclimate research: oriental rove beetle *Dysanabatum* found in the Eocene of Europe (Coleoptera, Staphylinidae, Paederinae). *Papers in Palaeontology*, 4(3), 433-452.
- Bogri, A., Solodovnikov, A., Kypke, J. L., & Żyła, D. (2020). Baltic amber members of the extant *Micrillus*–*Scymbalium* lineage of the Paederinae rove beetles (Coleoptera, Staphylinidae) and their systematic and ecological significance. *Invertebrate Systematics*, 34(5), 451-473.
- Bohac J., (1981) Results of the Czechoslovak-Iranian entomological expeditions to Iran. Coleoptera, Staphylinidae. Three new species of staphylinids from Iran. *Acta Entomologica Musei Nationalis Pragae* 40. P. 355-358
- Bohac J. (1985 a) Review of the subfamily Paederinae (Coleoptera Staphylinidae) in Czechoslovakia. *Acta Entomologica Bohemoslovaca*. 82: 369-385.
- Boháč, J. (1985 b). Review of the subfamily Paederinae (Coleoptera, Staphylinidae) in Czechoslovakia. Part II. *Acta Entomologica Bohemoslovaca* 82: 431–467.
- Boháč, J. (1993). Micropeplidae. Staphylinidae. pp. 39–63. In J. Jelínek, Checklist of Czechoslovak insects IV (Coleoptera). *Folia Heyrovskyana*, Supplementum 1. Prague: Vít Kabourek.
- Bohac J (1999) Staphylinid beetles as bioindicators. *Agriculture, Ecosystems & Environment*, 74, 357-372.
- Boheman, C. H. (1848) *Insecta Caffraria annis 1838-1845 a J. A. Wahlberg collecta. Pars I. Fascic. I. Coleoptera. (Carabici, Hydrocanthari, Gyrinii et Staphylinii).* – *Holmiae: Norstedt*: i-vii, 1-297.
- Boheman, C.H. (1858) Coleoptera; species novas descripsit. In: Kongliga Svenska Fregatten *Eugenies* resa omkring Jorden + Vetenskapliga iakttagelser. II. Zoologi. 1. Insecta, pp. 1-112. P. A. Norstedt & Söner, Stockholm.
- Boieiro, M., Serrano, A.R., Menezes, D., Pombo, D. & Capela, R., (2001). A provisional checklist of the Rove Beetles of Madeira Island (Coleoptera, Staphylinidae). *Vieraea*, 29, 17-28.
- Bong L. J., Neoh K. B., Jaal Z & Lee C. Y. (2012) Life table of *Paederus fuscipes* (Coleoptera: Staphylinidae). *Journal of Medical Entomology*, 49: 451–460.
- Bong L.J., Neoh K.B., Lee C.Y & Jaal, Z. (2013) Dispersal pattern of *Paederus fuscipes* (Coleoptera: Staphylinidae: Paederinae) in relation to environmental factors and the annual rice crop cycle. *Environmental entomology*, 42(5): 1013–1019.
- Bong L. J., Neoh, K. B., Jaal Z., & Lee C. Y. (2015). *Paederus* outbreaks in humansettings: a review of current knowledge. *Journal of medical entomology*, 52 (4), 517-526.

- Bordoni, A. (1975) Morfologia cefalica e addominale della sottotribu Medina nov. e del genere Medon Stephens in particolare e suoi rapporti con la sistematica (Col. Staphylinidae). *Redia* 56: 417–445.
- Bordoni, A., (2010). Catalogue of the staphylinidae of cyprus and asia minor (Coleoptera). *Fragmenta entomologica*, 42(1), 35-348.
- Borges P A V, Lamelas-L L, Assing V, & Schülke M (2022). New records, detailed distribution and abundance of rove-beetles (Insecta, Coleoptera, Staphylinidae) collected between 1990 and 2015 in Azores (Portugal) with an updated checklist. *Biodiversity Data Journal*.
- Bousquet, Y., & Bouchard, P. (2013). The genera in the second catalogue (1833–1836) of Dejean’s Coleoptera collection. *ZooKeys*, (282), 1.
- Brindle, A. N., Ballo, G. C., Caley, C. M., Mason, M. J., & Bennett V, W. N. (2024). Paederus Dermatitis: Two Outbreaks of an Entomologic Disease in Austere Expeditionary Care. *Military Medicine*, usae487.
- Bruch, C. (1915) Catálogo sistemático de los coleópteros de la República Argentina. Pars II. Familias: Halipidae, Dytiscidae, Gyrinidae, Hydrophilidae y Staphylinidae. *Revista del Museo de La Plata* 19: 471–526.
- Bruch, C. (1928) Suplemento al catálogo sistemático de los coleópteros de la República Argentina. III. (Addenda, corrigenda y lista de especies). *Boletín de la Academia Nacional de Ciencias en Córdoba* 29: 419–452.
- Brunke, A. J., & Schnepf, K. E. (2021). Taxonomic Changes in Nearctic Paederinae, New Records and a Redescription of the Enigmatic Genus Acrostilicus Hubbard (Coleoptera: Staphylinidae). *The Coleopterists Bulletin*, 75(4), 883-894.
- Burakowski, B., M. Mroczkowski, & J. Stefańska. (1979). Katalog fauny Polski [Catalogus faunae Poloniae] 23 (6). Chrząszcze [Coleoptera]. Kusakowate [Staphylinidae]. Część 1. Polska Akademia Nauk. Warszawa: *Instytut Zoologii* 30: 1–310.
- Cajaiba, R. L., Périco, E., Caron, E., Dalzochio, M. S., Silva, W. B., & Santos, M. (2017). Are disturbance gradients in neotropical ecosystems detected using rove beetles? A case study in the Brazilian Amazon. *Forest Ecology and Management*, 405, 319-327.
- Cameron, M. (1913): Descriptions of new Species of Staphylinidae from the West Indies. – The Annals and Magazine of Natural History (Ser. 8) 12: 321–351.
- Cameron M. (1914) Descriptions of new species of Staphylinidae from India. Transactions of the Entomological Society of London (3): 525-544.
- Cameron M (1920) New species of Staphylinidae from Singapore. Part III. Transactions of the Royal Entomological Society of London, 212–284.
- Cameron, M. (1921). New species of Staphylinidae from Singapore. Part IV. (Conclusion). Transactions of the Entomological Society of London 1920: 347–413.
- Cameron, M. (1923) Descriptions of new species of Staphylinidae from the West Indies. Annals and Magazine of Natural History (9) 11: 363 - 400.

- Cameron M (1924). New species of Staphylinidae from India. Transactions of the Entomological Society of London: 160–198.
- Cameron M. (1925 a): New Staphylinidae from the Dutch East Indies. — *Treubia* VI (2): 174-198.
- Cameron M. (1925 b). Catalogue of Indian insects. Pt. 6 - Staphylinidae, 126 p. Govt. India Central Publ. Br.; Calcutta.
- Cameron M. (1928) On the Oriental species of the *Lithocharis ochracea* group of Staphylinidae (Col.). *The Entomologist's Monthly Magazine* 64: 244-247.
- Cameron M. (1930). Fauna Sumatrensis (Bijdrage Nr. 67). Staphylinidae (Col.). *Tijdschrift voor Entomologie*, 73: 325-348.
- Cameron, M. (1931) Coleoptera, Staphylinidae. Vol. II. In: Stephenson, J. (ed.), The fauna of British India, including Ceylon and Burma. Taylor & Francis, London. viii + 257 pp.
- Cameron, M. (1932). The fauna of British India, incl. Ceylon & Burma (Col.: Staphylinidae), 3: London V+ 443pp.
- Cameron, M. (1936). The Staphylinidae (Coleoptera) of the Mangarevan Expedition. Bishop Museum Press.
- Cameron, M. (1939) New species of Staphylinidae (Col.) from the Belgian Congo. *Bulletin du Musée Royal d'Histoire Naturelle de Belgique*, 15 (52).
- Cameron, M. (1949). New species and records of staphylinid beetles from Formosa, Japan, and South China. *Proceedings of the United States National Museum*.
- Cameron, M. (1950) New species of African Staphylinidae (Coleoptera). Part I. *Journal of the East Africa Natural History Society*, 19.
- Campbell, J. M., & Peck, S. B. (1989). *Pinostygus galapagoensis*, a new genus and species of eyeless rove beetle (Coleoptera: Staphylinidae: Paederinae) from a cave in the Galapagos Islands, Ecuador. *The Coleopterists' Bulletin*, 397-405.
- Casey, T.L. (1886a). Revision of the California species of *Lithocharis* and allied species. *Bulletin of the California Academy of Sciences* 2 (5): 1–40.
- Casey, T.L. (1886b). Descriptive notices of North American Coleoptera. I. *Bulletin of the California Academy of Sciences* 2 (6): 157–264.
- Casey, T.L. (1905). *A revision of the American Paederini*. Transactions of the Academy of Science of St. Louis 15 (2): 17–248.
- Casey T.L. (1910) Synonymic and descriptive notes on the Paederini and Pinophilini. *Memoirs on the Coleoptera* Vol. 1: 184–205. Lancaster, PA: New Era Printing Co.
- Caterino, M. S. (2023). A New, Flightless Species of *Medon* (Coleoptera: Staphylinidae: Paederinae) from High Appalachia, with Intraspecific Phylogeographic Analysis and Description of its Associated Larva. *The Coleopterists Bulletin*, 77 (4), 507–523.

- Cervenka, V.J. & Moon, R.D. (1991) Arthropods associated with fresh cattle dung pats in Minnesota. *Journal of the Kansas Entomological Society*, 131–145.
- Chagnon, G. (1917). A preliminary list of the insects of the province of Quebec. Part III – Coleoptera. Supplement to Report of the Quebec Society for the Protection of Plants: 161–277. Quebec.
- Chandra, K & Boaz A. A. (2018) Faunal Diversity of Bilaspur District Chattisgarh. State Forest Research and Training Institute, Forest Department, Chhattisgarh and Zoological Survey of India, Kolkata. ISBN: 978-81-8171-491-6.
- Chandra, K., Gupta, D., Ghosh, J., Das, P. & Bhunia, D., (2021). Insecta: Coleoptera. *Faunal Diversity of Biogeographic Zones of India: North-East*, 377-451.
- Chapman W (1934) Sur deux espèces asiatiques du genre *Cryptobium* Mannh. et description d'une nouvelle variété. *Bulletin de la Societe Entomologique de France Paris* 39: 21–22. doi: 10.3406/bsef.1934.14675.
- Chauhan, S., Garg, A., Lal, P., Ahluwalia, A. K., & Thakur, K. *Paederus Dermatitis: A Common but Misdiagnosed and Neglected Entity*.
- Cho Y B (2000 a). Taxonomic notes of the genus *Ochtheophilum* Stephens (Coleoptera, Staphylinidae) from Korea.
- Cho, Y. B. (2000 b). Taxonomic Review of the Subtribe Medonina (Coleoptera, Staphylinidae) from Korea. *Korean journal of entomology*, 30(3), 163-167.
- Cho, Y. B. (2014). Five paederine species (Coleoptera: Staphylinidae: Paederinae) new to Korea. *Journal of Asia-Pacific Biodiversity*, 7(3), 225-228.
- Cho, Y. B., & Ahn, K. J. (2004). New Record of the Genus *Palaminus* Erichson in Korea (Coleoptera: Staphylinidae: Paederinae). *Entomological Research*, 34(4), 287-289.
- Ciceroni, A., & A. Zanetti. 1995. [Genera 47–61, 79–147]. In A. Ciceroni, V. Puthz, and A. Zanetti, Fascicolo 48. Coleoptera Polyphaga III. (Staphylinidae): 10–14, 19–33. (In A. Minelli, S. Ruffo, and S. La Posta (editors), Checklist delle specie della fauna italiana). Bologna: Edizioni Calderini.
- Çiftçi, D., & Hasbenli, A. (2018). Diversity analysis of the subfamilies Steninae, Staphylininae and Paederinae (Coleoptera: Staphylinidae) in different habitats of the Sündiken Mountains, Turkey. *Acta Zoologica Bulgarica*, 70 (3), 319-29.
- Cividanes, F. J., Barbosa, J. C., Ide, S., Perioto, N. W., & Lara, R. I. R. (2009). Faunistic analysis of Carabidae and Staphylinidae (Coleoptera) in five agroecosystems in northeastern São Paulo state, Brazil. *Pesquisa Agropecuária Brasileira*, 44, 954-958.
- Coiffait, H. (1960) Les *Astenus* d'Europe et de la région méditerranéenne (Coléoptères, Staphylinidae). *Bulletin de la Société d'Histoire Naturelle de Toulouse*, 95, 49–99.
- Coiffait, H. (1970) Staphylinides nouveaux ou mal connus de la région paléarctique occidentale. *Bulletin de la Société d'Histoire Naturelle de Toulouse*, 106.

- Coiffait H. (1976) Staphylinides récoltés au Népal par le professeur Franz. *Bulletin de la Société d'Histoire Naturelle de Toulouse* 112: 243-275.
- Coiffait H. (1978) Staphylinides du Nouristan (Afghanistan). *Ann. Soc. Ent. France* (n.s.) 14: 551–569.
- Coiffait, H. (1981) Staphylinides nouveaux du Moyen Orient appartenant au Musée Hongrois d'Histoire Naturelle (Coleoptera). *Folia Entomologica Hungarica*, 42 (1).
- Coiffait H. (1982a) Contribution à la connaissance des staphylinides de l'Himalaya (Népal, Ladakh, Cachemire) (Insecta: Coleoptera: Staphylinidae). *Senckenbergiana Biologica*, 62: 21-179.
- Coiffait H. (1982b). Coléoptères Staphylinidae de la région paléarctique occidentale IV. Sous famille Paederinae tribu Paederini 1 (Paederi, Lathmbii). *Nouvelle Revue d'Entomologie* 12 (4) suppl.: 1-440.
- Coiffait, H. (1984) Coléoptères staphylinides de la région paléarctique occidentale. V. Sous famille Paederinae tribu Paederini 2. Sous famille Euaesthetinae. *Nouvelle Revue d'Entomologie (Supplément)* 13 (4): 3–424.
- Coiffait, H., & Saiz. F (1968). Les Staphylinidae (sensu lato) du Chili. In C. Delamare Deboutteville and E. Rapoport (editors), *Biologie de l'Amérique Australe. Études sur la faune du sol*, vol. 4: 339–468. Paris: Centre National de la Recherche Scientifique, 6 pp.
- Coondoo, A., & Nandy, J. (2013). *Paederus dermatitis*: an outbreak, increasing incidence or changing seasonal pattern? *Indian journal of dermatology*, 58(5), 410.
- Cox, H.E. 1874. A handbook of the Coleoptera or beetles of Great Britain and Ireland, 1: viii + 1–522. London: E.W. Janson.
- Crotch, G.R. (1863). A catalogue of British Coleoptera. Cambridge: Cambridge University Press, 45 pp.
- Crotch, G.R. (1873). Check list of the Coleoptera of America, north of Mexico. Salem: Salem Press, 136 pp.
- Curry, D. P. (1927). Blister Beetles of the Genus *Paederus* (Coleoptera: Staphylinidae) as a Cause of Dermatitis.
- Curtis J (1826) British entomology; being illustrations and descriptions of the genera of insects found in Great Britain and Ireland: containing coloured figures from nature of the most rare and beautiful species, and in many instances of the plants upon which they are found. 3, pp 99-146.
- Dallas, E. D. (1936). First Observations on Dermatitis due to *Paederus* in Argentina.
- Dehghani, R., Fathi, B., Dehghani, M., & Mohamadzadeh, N. (2025). Venomous and poisonous arthropods in Iran, West Asia, and the Middle East: an overview of their identification, bites, stings, behavior, biology and geographical distribution. *Iranian Journal of Veterinary Science & Technology*, 17 (1).

- Dejean, P.F.M.A. (1833) Catalogue des Coléoptères de la collection de M. le Comte Dejean. [2nd edition]. Méquignon-Marvis Père et Fils, Paris. Pp. 1-176.
- Dennis, P., Wratten, S. D., & Sotherton, N. W. (1991). Mycophagy as a factor limiting predation of aphids (Hemiptera: Aphididae) by staphylinid beetles (Coleoptera: Staphylinidae) in cereals. *Bulletin of Entomological Research*, 81 (1), 25-31.
- Denux, O. & Zagatti, P., (2010). Coleoptera families other than Cerambycidae, Curculionidae sensu lato, Chrysomelidae sensu lato and Coccinelidae. Chapter 8.5. *BioRisk*, 4, pp.315-406.
- Devi P.K. Yadav DN, Jha A., (2003) Biology of *Paederus fuscipes* Curtis (Coleoptera: Staphylinidae). *Pest Management and Economic Zoology*, 10 (2), 137-143.
- Downie, N.M., & R.H. Arnett, Jr. (1996). The beetles of Northeastern North America, vol. 1: Introduction; suborders Archostemata, Adephaga, and Polyphaga, thru Superfamily Cantharoidea. Gainesville, FL: Sandhill Crane Press, 880 pp.
- Drouet, G., Glaizal, M., Schmitt, C., Kervégant, M., Tichadou, L., & de Haro, L. (2013). Pédérose ou dermatite à *Paederus*: quatre observations en Provence [*Paederus dermatitis*: four cases in Provence, Southern France]. *Presse medicale* (Paris, France: 1983), 42 (3), 355–357.
- Drugmand, D., (1991) Révision générique des Cryptobiina afrotropicaux (Coleoptera Staphylinidae Paederinae). *Bulletin et Annales de la Société royale belge d'Entomologie* 127: 309-333.
- Drugmand, D., (1992). Révision des Monocrypta magaches (Coleoptera, Staphylinidae, Paederinae). *Bulletin et Annales de la Société royale belge d'Entomologie*, 128: 75-85.
- Drugmand, D., & Wauthy, G. (1992). Eléments De Morphologie Descriptive De L'exo-Et De L'endosquelette Des Cryptobiina Afrotropicaux (Coleoptera, Staphylinidae, Paederinae) *Bulletin De L'institut Royal Des Sciences Naturelles De Belgique, Entomologie*, 62, 5-31.
- Dugés, D.E., 1901. *Catálogo de la colección de coleópteros mexicanos del Museo Nacional*. Impr. del Museo Nacional.
- Duvivier, A. 1883. Énumération des Staphylinides, décrits depuis la publication du catalogue de M.M. Gemminger et de Harold. *Annales de la Société Entomologique de Belgique* 27: 91–215.
- Dvořák, M. 1979. Zajímavé nálezy drabčků na Slovensku III (Col., Staphylinidae). *Zborník Slovenského Národného Múzea* 15: 109–138.
- Edirisinghe, J. P., & Bambaradeniya, C. N. (2006). Rice fields: an ecosystem rich in biodiversity. *Journal of the National Science Foundation of Sri Lanka*, 34 (2).
- Egorov, L. V., Ruchin, A. B., Semenov, V. B., Semionenkov, O. I., & Semishin, G. B. (2020). Checklist of the Coleoptera of Mordovia State Nature Reserve, Russia. *ZooKeys*, 962, 13.

- Eppelsheim, E. (1885) Beitrag zur Staphylinenfauna West-Afrika's. *Deutsche Entomologische Zeitschrift*, 29 (1).
- Eppelsheim, E. (1890) Staphylinidarum species novae, a Domino Dr. Bomford in India orientali collectae, descriptae. *Wiener Entomologische Zeitung*, 9 (10).
- Eppelsheim, E. (1895) Zur Staphylinidenfauna Ostindiens. *Deutsche Entomologische Zeitschrift*, (2).
- Erber, D. (1990). New and little known Coleoptera from Madeira: results of excursions to Madeira in the years 1986-1990.
- Erichson, W.F. (1839) Die Käfer der Mark Brandenburg. Morin, F.H., Berlin.
- Erichson, W.F. (1840) Genera et species staphylinorum insectorum coleopterorum familiae. F. H. Morin, Berlin. pp. 401–954.
- Erichson, W.F. (1843) Beitrag zur Insecten-Fauna von Angola, in besonderer Beziehung zur geographischen Verbreitung der Insecten in Afrika. *Archiv für Naturgeschichte*, 9 (1).
- Fabricius, J.C. (1775) *Systema entomologiae, sistens insectorum classes, ordines, genera, species, adiectis synonymis, locis, descriptionibus, observationibus*. Libraria Kortii, Flensburgi et Lipsiae. 30 + 832 pp.
- Fagel G. (1958) Paederini (Coleoptera Polyphaga) Fam. Staphylinidae. in *Exploration du Parc National de YUemba*, Mission G.F. de Witte. Fasc. 51: 1-470. Institut des Parcs Nationaux du Congo Belge; Brussels.
- Fagel G. (1959) Paederini (Coleoptera Polyphaga) Fam. Staphylinidae. in *Exploration du Parc National de la Garamba*, Mission H. de Saeger. Fax. 16: 1-70. Institut des Parcs Nationaux du Congo Belge; Brussels.
- Fagel G. (1960) Mission zoologique de YLR.S.A.C. en Afrique orientale (R Basdewsky et N. Leleup 1957) X. Coleoptera Staphylinidae Paederinae. *Ann. Mus. Congo Belge, Zool.* 81: 114-131.
- Fagel, G. 1961a. Coleoptera (Staphylinidae): Paederinae. In B. Hanstrom, P. Brinck, & G. Rudebeck (editors), *South African animal life. Results of the Lund University Expedition in 1950–1951*, 8: 259–295. Göteborg: Almqvist & Wiksell.
- Fagel G. (1961b) Coleoptera (Staphylinidae): Paederinae (Results of the Lund University Expedition in 1950-1951). *South African Animal Life* 8: 258- 295
- Fagel, G. (1963a) Pinophilini I (Coleoptera Polyphaga), fam. Staphylinidae. *Exploration du Parc National de la Garamba*. Mission H. de Saeger, en collaboration avec P. Baert, G. Demoulin, I. Denisoff, J. Martin, M. Micha, A. Noirfalise, P. Schoemaker, G. Troupin et +. Fascicule 37: 1-325. Institut des Parcs Nationaux du Congo et du Rwanda, Bruxelles.
- Fagel, G. (1963b). Coleoptera Staphylinidae (Piestinae, Osoriinae, Oxytelinae, Paederinae). In *La réserve naturelle intégrale du Mont Nimba*, fasc. 5. Mémoire de l'Institut Française d'Afrique Noire 66: 337–356.

- Fagel, G. 1965. XCI. Coleoptera Staphylinidae Paederinae. Mission Zoologique de l'I.R.S.A.C. en Afrique orientale (P. Basilewsky et N. LeLeup, 1957). *Annales du Musée Royal de l'Afrique Centrale, Sciences Zoologiques* 138: 141–212.
- Fagel, G. (1966) Contribution à la connaissance des Staphylinidae XCV. Les Paederus éthiopiens. *Rev. Zool. Bot. Afr.* 73: 255- 272.
- Fagel, G. (1971) Révision des genres Procirrus Latreille, Palaminus Erichson, Oedichirus Erichson et voisins de la faune africaine (Coleoptera, Staphylinidae, Paederinae). *Musée Royal de l'Afrique Centrale Annales (série in 8u). Sciences Zoologiques* 186 (1970): 1–444.
- Fagel, G., 1977. Contribution à l'étude des Coléoptères Staphylinidae. Révision des Cryptobiina africains. *Annales du Musée royal d'Afrique centrale, Tervuren, Sciences zoologiques*, 219: 1-110.
- Fairmaire, L. (1849) Essai sur les Coléoptères de la Polynésie. *Revue et Magasin de Zoologie Pure et Appliquée*, (2) 1.
- Fairmaire L. & A. Laboulbène. (1856) Faune entomologique française ou descriptions des insectes qui se trouvent en France. *ColeoptPres.* 1, p. 371-665. Deyrolle; Paris.
- Fairmaire, L.& Germain P (1862) Révision des Coléoptères du Chili (suite). *Annales de la Société Entomologique de France*, (4) 1.
- Fall, H.C., (1901). List of the Coleoptera of Southern California: With Notes on Habits and Distribution and Descriptions of New Species (No. 8). California academy of Sciences.
- Fauvel, A. (1867). Faune du Chili. Insectes Coléoptères. *Staphylinides (suite et fin). Notices Entomologiques* 5: 1–61.
- Fauvel A. (1869) Remarques synonymiques sur les staphylinides du Catalogus Coleopterorum de Mm v. Harold et Gemminger. L'Abeille. *Mémoires d'Entomologie* 5:479–494.
- Fauvel A. (1872): Faune Gallo-Rhénane ou species des insectes qui habitent la France, la Belgique, la Hollande, le Luxembourg, la prusse Rhénane, la Nassau et la Valais avec tableaux synoptiques et planches gravées. — Caen. 214 pp.
- Fauvel, A. (1873a). Faune Gallo-Rhénane ou species des insectes qui habitent la France, la Belgique, la Hollande, le Luxembourg, la prusse Rhénane, la Nassau et la Valais avec tableaux synoptiques et planches gravées, 3, liv. 4: 215–390. Caen: Le Blanc-Hardel.
- Fauvel, A. (1873b). Faune Gallo-Rhénane ou descriptions des insectes qui habitent la France, la Belgique, la Hollande, le Luxembourg, les provinces Rhénanes et la Valais avec tableaux synoptiques et planches gravées. *Bulletin de la Société Linnéenne de Normandie* (2) 6: 8–136.
- Fauvel, A. (1873c). Faune Gallo-Rhénane. *Bulletin de la Société Linnéenne de Normandie* (2) 7: 8–131.
- Fauvel, A. (1875a) Fauna Gallo-Rhénane. Catalogue systématique des staphylinides de la Faune Gallo-Rhénane avec l'addition synonymique des espèces européennes,

- siberiennes, caucasiques et Mediterranéennes et descriptions nouvelles, 3, liv. 6: i–xxxviii, Caen: Le Blanc-Hardel.
- Fauvel, A. (1875b). Faune Gallo-Rhénane. Catalogue Bulletin de la Société Linnéenne de Normandie (2) 9: 202–236.
- Fauvel, A. (1878) Les staphylinides des Moluques et de la Nouvelle Guinée. *Annali del Museo Civico di Storia Naturale di Genova* 12: 171–315.
- Fauvel A. (1879) Les staphylinides des Moluques et de la Nouvelle Guinée (2e memoire). *Ann. Mus. Civ. Stor. Nat. Genova* 15: 63-121.
- Fauvel A. (1886a) Les staphylinides du nord de SAfrique. *Rev. Ent.*, Caen 5: 9-100.
- Fauvel A. (1886b) Staphylinides des fles Philippines. *Rev. Ent.*, Caen 5: 143-150.
- Fauvel, A. (1889). Les coléoptères de la Nouvelle-Calédonie et dépendances avec descriptions, notes et synonymies nouvelles. *Revue d'Entomologie* 8: 242–271.
- Fauvel, A. (1895) Staphylinides nouveaux de l'Inde et de la Malaisie. *Revue d'Entomologie*, 14 (6–7).
- Fauvel A. (1897) Catalogue des staphylinides de Barbbe et des nes Aqores, Maderes, Salvage et Canaries (4e edition). *Rev. Ent.*, Caen 16: 237-371.
- Fauvel, A. (1891) Voyage de M. E. Simon au Ve´ne´zuela (De´cembre 1887–Avril 1888). 11e Me´moire. *Revue d'Entomologie* 10: 87–127.
- Fauvel A. (1901): *Acanthoglossa* n. sp., de Tunisie. *Revue d'Entomologie* 20: 250.
- Fauvel A. (1903) Mission de M. Maurice Maindron dans YInde maridionale. Staphylinides. *Rev. Ent.*, Caen 22: 149-163.
- Fauvel A. (1904a) Staphylinides de Hindoustan et de la Birmanie. *Rev. Ent.*, Caen 23: 43-70.
- Fauvel A (1904b) Les staphylinides du Thierwelt Deutsch- OstAfrika: notes et descriptions. *Rev. Ent.*, Caen 23: 284-294.
- Fazal, S. (2012). Impact of abiotic factors on insect diversity of at Lawrence Garden, Lahore. *Pakistan Journal of Science*, 64 (2).
- Feldmann, B., & Hernando, C. (2005). Two new species of *Domene* Fauvel 1873 from Spain, with a new combination and a catalogue of the Iberian species of the genus (Coleoptera: Staphylinidae, Paederinae). na.
- Ferreira, R. N., (1962) Contribuiç6es para urn catalogo da fa& Staphylinidae da fauna Portuguesa I - Estado actual do conhecimento dos estafilinideos Portugueses. *Mem. Estudos Mus. Zool. Univ. Coimbra* 280: 1-21.
- Ferreira, R.N., (2021). Padre Ramiro dos Santos Ferreira Neves, o entomologista e a sua colecco esquecida de Staphylinidae (Coleoptera). *Arquivos Entomol6gicos*, (24), 205-235.

- Fleming, J. (1821) Insecta, pp. 41-56, pl. 85. In: Supplement to the Fourth, Fifth and Sixth Editions of the Encyclopaedia Britannica. 5. A. Constable, Edinburgh. 584 pp.
- Fowler, W.W. (1888). The Coleoptera of the British Islands. A descriptive account of the families, genera, and species indigenous to Great Britain and Ireland, with notes as to localities, habitat, etc., 2. Staphylinidae. London: L. Reeve & Co., 444 pp.
- Francia, H. E. (1986). Larvae of *Eustilicus* Sharp, *Rugilus* Leach, *Deroderus* Sharp, *Stilocharis* Sharp, and *Medon* Stephens (Coleoptera: Staphylinidae: Paederinae: Paederini), and their phylogenetic significance. *Canadian journal of zoology*, 64 (11), 2543-2557.
- Frank, J.H. (1982) The parasites of the Staphylinidae (Coleoptera). A contribution towards an encyclopedia of the Staphylinidae. University of Florida Agricultural Experiment Station Bulletin 824: vii + 1-118.
- Frank, J.H. (1986) A preliminary checklist of the Staphylinidae (Coleoptera) of Florida. The Florida Entomologist 69 (2): 363-382
- Frank J. H. (1988) *Paederus*, sensu lato (Coleoptera: Staphylinidae): An index and review of the taxa. *Insecta Mundi* 2: 97-159.
- Frank, J. H., & Kanamitsu, K. (1987). *Paederus*, sensu lato (Coleoptera: Staphylinidae): natural history and medical importance. *Journal of medical entomology*, 24(2), 155-191.
- Frank, JH, & Thomas MC. (1999). Rove beetles of the world. UF/IFAS Featured Creatures. EENY-114 (<http://edis.ifas.u.edu/IN271>).
- Frank, J.H., & Thomas, M.C. (2008). Rove Beetles (Coleoptera: Staphylinidae). In: Capinera, J.L. (eds) *Encyclopedia of Entomology*. Springer, Dordrecht. https://doi.org/10.1007/978-1-4020-6359-6_3471
- Frank, J. H., & Ahn, K. J. (2011). Coastal Staphylinidae (Coleoptera): A worldwide checklist, biogeography and natural history. *ZooKeys*, (107), 1.
- Frank J H, Klimaszewski J & D.S. Chandler. (2011) Additions to the Staphylinidae (Coleoptera) of the Cayman Islands. *Insecta Mundi*, 0185.
- Frisch, J. (1994). Neue Arten der Gattung *Scopaeus* Erichson aus Griechenland, Anatolien und dem Iran (Coleoptera, Staphylinidae, Paederinae). *Coleoptera* 2: 1-46.
- Frisch, J. (2003). A revision of the *Scopaeus laevigatus* species group, with descriptions of 10 new species from the east Palaearctic, the Oriental, and the Australian Regions (Coleoptera, Staphylinidae, Paederinae). In G. Cuccodoro and R.A.B. Leschen (editors), *Systematics of Coleoptera: papers celebrating the retirement of Ivan Löbl*. *Memoirs on Entomology, International* 17: 649-725.
- Frisch, J. (2005). *Scopaeu limbatus* Kraatz” of ancient authors—a monophyletic species group distributed in the Mascarene Islands, the South-East Palaearctic, the Oriental and Australian regions (Coleoptera, Staphylinidae, Paederinae). *Mitteilungen aus dem Museum für Naturkunde in Berlin, Deutsche Entomologische Zeitschrift* 52 (1): 73-96.

- Frisch, J. (2006 a). *Scopaeus hyrcanus* sp. n. from the Elburz-and Talish Mountains in Iran (Coleoptera, Staphylinidae, Paederinae). *Deutsche Entomologische Zeitschrift*, 53 (2), 264-270.
- Frisch, J. (2006b). The genus *Scopaeus* (Coleoptera, Staphylinidae, Paederinae) in Iran, with description of new species from the Zagros Mountains. *Mitteilungen aus dem Museum für Naturkunde in Berlin, Deutsche Entomologische Zeitschrift* 53 (1): 5–22.
- Frisch, J. (2007). A review of the *Scopaeus gracilis* species group (Coleoptera, Staphylinidae, Paederinae), with description of new species from Sardinia, southern Africa and Middle East. *Deutsche Entomologische Zeitschrift*, 54 (2), 195-218.
- Frisch, J. (2008). A new species of *Scopaeus* Erichson, 1839 (Staphylinidae, Paederinae) from the Qohrud Mountains in Iran. *Deutsche Entomologische Zeitschrift*, 55 (2), 285-289.
- Frisch, J. (2009). A revision of the *Scopaeus mutatus* species group (Staphylinidae, Paederinae), with description of new species from Anatolia and the Caucasus. *Deutsche Entomologische Zeitschrift*, 56 (2), 271-287.
- Frisch, J. (2010). On the taxonomy and biogeography of West Palaearctic *Scopaeina* Mulsant & Rey (Staphylinidae, Paederinae) with emphasis on the Middle East. *Deutsche Entomologische Zeitschrift*, 57 (2), 159-202.
- Frisch, J. (2011). The *Scopaeus paliferus* species group (Staphylinidae, Paederinae: *Scopaeina*) from the eastern Palaearctic, with exclusion of *Scopaeus anhuiensis* Li, 1993 from the *Scopaeina* Mulsant and Rey, 1878. *Zoosystematics and Evolution: Mitteilungen aus dem Museum für Naturkunde in Berlin* 87 (2): 361–369.
- Frisch, J. (2012a). A revision of the West Palaearctic *Scopaeus sericans* species group (Staphylinidae, Paederinae: *Scopaeina*), with description of two new species from Central Asia. *Deutsche Entomologische Zeitschrift* 59 (2): 277–295.
- Frisch, J. (2012b). Gattung *Scopaeus* Erichson, 1839. In V. Assing and S. Schülke (editors), *Freude-Harde-Lohse-Klausnitzer – Die Käfer Mitteleuropas. Band 4. Staphylinidae (exklusive Aleocharinae, Pselaphinae und Scydmaeninae). 2 Auflage. xii + 560. Heidelberg: Spektrum Akademischer Verlag. pp. 370–380.*
- Frisch, J. (2014). A revision of the Central Asian *Scopaeus similis* species group (Staphylinidae, Paederinae). *Soil Organisms* 86 (3): 199–220.
- Frisch, J. (2015a). On the taxonomy and phylogeography of the *Scopaeus obscuripes* species group from Central Asia and the Middle East (Coleoptera: Staphylinidae: Paederinae). *Stuttgarter Beiträge zur Naturkunde A (N.S.)* 8: 137–163.
- Frisch, J. (2015b). A new species of *Scopaeus* Erichson, 1839 (Coleoptera, Staphylinidae, Paederinae) from Socotra Island, with distributional and phylogeographical notes on related species. *Soil Organisms* 87 (1): 61–70.
- Frisch, J. (2016). On the *Scopaeina* Mulsant and Rey of Australasia (Staphylinidae, Paederinae): type revisions and new biogeographic data. *Soil Organisms* 88 (1): 55–88.

- Frisch, J., D. Burckhardt, and V. Wolters. (2002a). Rove beetles of the subtribe Scopaeina Mulsant and Rey (Coleoptera: Staphylinidae) in the West Palaearctic: Phylogeny, biogeography and species catalogue. *Organisms Diversity and Evolution* 2 (1): 27 - 53.
- Frisch, J., D. Burckhardt, & V. Wolters. (2002 b). Synonymic catalogue of West Palaearctic Scopaeina including biogeographic information. Electronic Supplement to: J. Frisch, D. Burckhardt, and V. Wolters. 2002 a. Rove beetles of the subtribe Scopaeina Mulsant and Rey (Coleoptera: Staphylinidae) in the West Palaearctic: phylogeny, biogeography and species catalogue. *Organisms Diversity and Evolution* 2 (1): 1 - 16.
- Frisch, J., D. Burckhardt, & V. Wolters. (2002c). Data matrix of characters used for the cladistic analysis. In J. Frisch, D. Burckhardt, and V. Wolters, Rove beetles of the subtribe Scopaeina Mulsant and Rey (Coleoptera: Staphylinidae) in the West Palaearctic: Phylogeny, biogeography and species catalogue. *Organisms Diversity and Evolution* 2: Electronic supplement 2 (2)
- Frisch, J., & P. Oromi. (2006). New species of subterranean *Micranops* Cameron from the Canary Islands (Coleoptera, Staphylinidae, Paederinae), with redescription of *Micranops bifossicapitatus* (Outerelo and Oromi, 1987). *Mitteilungen aus dem Museum für Naturkunde in Berlin, Deutsche Entomologische Zeitschrift* 53 (1): 23 - 37.
- Frisch, J., & Herman, L. (2014). A catalogue of *Micranops* Cameron, with description of a new species from Tanzania (Coleoptera, Staphylinidae: Paederinae). *Soil Organisms*, 86(1), 67-75.
- Frisch, J., & Narakusumo, R. P. (2023). Revision of *Scopaeus* Erichson, 1839 (Coleoptera, Staphylinidae, Paederinae) of Indonesia, with description of 19 new species. *Soil Organisms*, 95(1), 23-73.
- Fuldner, D. (1960). Beiträge zur morphologie und biologie von *Aleochara bilineata* Gyll. und *A. Bipustulata* L. (coleoptera: staphylinidae). *Zeitschrift für Morphologie und Ökologie der Tiere*, 49, 312-386.
- Ganglbauer, L. (1895) Die Käfer von Mitteleuropa. Die Käfer der österreichisch-ungarischen Monarchie, Deutschlands, der Schweiz, sowie des französischen und italienischen Alpengebietes. 2. Familienreihe Staphylinoidea. Theil I. Staphylinidae, Pselaphidae. 881 pp. Wien: Carl Gerold's Sohn.
- Gautier des Cottes, C. (1861) Caractères différentiels de trois espèces nouvelles de *Poederus* propres à la faune française. *Annales de la Société Entomologique de France*, (4) 1.
- Gemminger M. & Harold E (1868): *Catalogus Coleopterorum hucusque descriptorum synonymicus et systematicus*. — 2: 425-752 + 6. Monachii: E.H. Gummi.
- George, A. O., & Hart, P. D. (1990). Outbreak of *Paederus dermatitis* in southern Nigeria: Epidemiology and dermatology. *International journal of dermatology*, 29 (7), 500-501.
- Ghahari, H., Anlas, S., Sakenin, H., Ostovan, H., & Tabari, M. (2009). A contribution to the rove beetles (Coleoptera: Staphylinoidea: Staphylinidae) of Iranian rice fields and surrounding grasslands. *Linzer biologische Beiträge*, 41 (2), 1959-1968.

- Glick, P.A. 1939. The distribution of insects, spiders, and mites in the air. United States Department of Agriculture Technical Bulletin 673: 1–150.
- Gnanaraj, P., Venugopal, V., Mozhi, M. K., & Pandurangan, C. N. (2007). An outbreak of *Paederus dermatitis* in a suburban hospital in South India: a report of 123 cases and review of literature. *Journal of the American Academy of Dermatology*, 57 (2), 297-300.
- Goff, M. L., M. Early, C. B. Odom, & K. Tullis. (1986) A preliminary checklist of arthropods associated with exposed carrion in the Hawaiian Islands, *Proc. Hawaiian Entomol. Soc.*, 26:53–57.
- Good, J. A., & Giller, P. S. (1991). The effect of cereal and grass management on staphylinid (Coleoptera) assemblages in south-west Ireland. *Journal of Applied Ecology*, 810-826.
- Good, J.A. & Anderson, R., (2017). Additions, deletions and corrections to the Staphylinidae in the Irish Coleoptera annotated list, with a revised checklist of Irish species. *Bulletin of the Irish Biogeographical Society*, 41, pp.178-234.
- Gopal, K. V. (2014). *Paederus dermatitis*: a clinical, epidemiological and therapeutic study of 417 cases. *Journal of Evolution of Medical and Dental Sciences*, 3, 4736-43.
- Gravenhorst, J. L. C. (1802). *Coleoptera microptera Brunsvicensia nec non exoticorum quotquot exstant in collectionibus entomologorum Brunsvicensium in genera familias et species distribuit JLC Gravenhorst. Apud Carolum Reichard.*
- Gravenorst, J. L. C., (1806). *Monographia Coleopterorum Micropteorum. Henricus Dieteric, Gottingae*, 236 pp.
- Gredler, P.V.M. (1863). *Die Käfer von Tirol nach ihrer horizontalen und vertikalen Verbreitung*, I: 1–234. Bozen: G. Ferrari.
- Gridelli, E. (1914) Ein neues Staphyliniden-Genus der europäischen Fauna. *Coleopterologische Rundschau*, 3 (4).
- Guseva, O. G. (2019). Investigation of biodiversity and distribution of rove beetles (Coleoptera, Staphylinidae) in the agrolandscape in Northwestern Russia. *Acta Biologica Sibirica*, 5(1), 12-18.
- Guseva, O. G., & Koval, A. G. (2020). The distribution of the surface-active beetles (Coleoptera: Carabidae, Staphylinidae, Elateridae) in the agricultural landscapes of Northwestern Russia. In *BIO Web of Conferences* 18, p. 00014. EDP Sciences.
- Guzman, Y. C., & Żyła, D. (2024). A New Eyeless Species of *Micranops* Cameron 1913 from Bolivia (Coleoptera: Staphylinidae: Paederinae). *Neotropical Entomology*, 53(1), 154-161.
- Hagen K. S., Mills N. J., Gordh, G., & Mcmurtry, J. A. (1999). *Terrestrial Arthropod Predators of Insect and Mite Pests*.
- Hammer Ø., Harper D.A.T & Ryan P. D. (2001) PAST: paleontological statistics software package for education and data analysis. *Palaeontologia. Electronica*, 4: 1–9.

- Hammond P.M. (1977). Staphylinidae [p. 2242, in] RD. Pope (ed.) A check list of British insects. Part 3, Coleoptera and Strepsiptera. *Handbk Ident. British Insects* (R Ent. Soc. Lond.) 11 (3): pp. 1-105.
- Hammond, P.M. (1984) An annotated check-list of Staphylinidae (Insecta: Coleoptera) recorded from Borneo. *Sarawak Museum Journal* (n.s.) 33 (54): 187–218
- Hansen V. (1951) Biller XV Rovbiller 1. Del. Danmarks Fauna *Dansk Naturhist. Foren.; Copenhagen*. 57, 274 p.
- Hansen, V., W. Hellén, A. Jansson, T. Munster, and A. Strand. (1939). Catalogus Coleopterorum Daniae et Fennoscandiae. *Helsinki: Societas Pro Fauna et Flora Fennica*, vii + 129 pp.
- Hansen, V., E. Klefbeck, O. Sjöberg, G. Stenius, & A. Strand. (1960). Catalogus Coleopterorum Fennoscandiae et Daniae. Lund: *Entomologiska Sällskapet*, 476 pp.
- Hansen, M. (1996). Katalog over Danmarks biller. Catalogue of the Coleoptera of Denmark. *Entomologiske Meddelelser* 64 (1): 1–112.
- Hansen, M., E. Palm, J. Pedersen, & J.B. Runge. (1998). Fund af biller i Danmark, 1997 (Coleoptera). *Entomologiske Meddelelser* 66 (3): 65–93.
- Hansen, M., V. Mahler, E. Palm, & J. Pedersen. (1996). Tillaeg til “Fortegnelse over Danmarks biller” (Coleoptera). *Entomologiske Meddelelser* 64 (3): 233–272.
- Hatch, M.H. (1957) The beetles of the Pacific Northwest. Part II: Staphyliniformia. *University of Washington Publications in Biology*, 16 (2).
- Heinrichs, E. A., & Barrion, A. T. (2004). Rice-feeding insects and selected natural enemies in West Africa. *Biology, ecology, identification*. IRRI/WARDA, Los Baños/Abidjan, 243.
- Herman, J., L. H. (1965) A revision of Orus Casey. I. Subgenus *Leucorus* Casey and a new subgenus (Coleoptera: Staphylinidae). *Coleopterists' Bulletin*, 18 (4).
- Herman, L. H. (1970). The ecology, phylogeny, and taxonomy of Stilicolina (Coleoptera, Staphylinidae, Paederinae). *American Museum novitates*; no. 2412.
- Herman, L. H. (1979). Revision of *Stereocephalus* (Coleoptera, Staphylinidae, Paederinae). *American Museum novitates*; no. 2683.
- Herman, L. H. (1981). Revision of the subtribe Dolicaonina of the New World, with discussions of phylogeny and the Old World genera (Staphylinidae, Paederinae). *Bulletin of the AMNH*; v. 167, article 6.
- Herman, L. H. (1986). Revision of *Bledius*. Part 4, Classification of species groups, phylogeny, natural history, and catalogue (Coleoptera, Staphylinidae, Oxytelinae). *Bulletin of the AMNH*; v. 184, article 1.
- Herman, L. H. (1991). Revision of the subtribe Cylindroxystina (Coleoptera, Staphylinidae, Paederinae). *Bulletin of the AMNH*; no. 203.

- Herman, L. H. (2003). Nomenclatural changes in the Paederinae (Coleoptera: Staphylinidae). *American Museum Novitates*, 2003 (3416), 1-28.
- Herman, L. (2010). Generic revision of the Procirrina (Coleoptera: Staphylinidae: Paederinae: Pinophilini). *Bulletin of the American Museum of Natural History*, 347, 1-78.
- Herman, L. H. (2013). Revision of the New World Species of Oedichirus (Coleoptera: Staphylinidae: Paederinae: Pinophilini: Procirrina). *Bulletin of the American Museum of Natural History*, 375, 1-137.
- Herman, L. (2023). Generic Revisions of the Scopaeina and the Sphaeronina (Coleoptera: Staphylinidae: Paederinae: Lathrobiini). *Bulletin of the American Museum of Natural History*, 460 (1), 1-194.
- Herman, L. H., Reddell, J. R., & Mitchell, R. W. (1969). A troglobitic staphylinid from Mexico (Coleoptera, Staphylinidae, Paederinae). *American Museum novitates*; no. 2367.
- Hernández J J, Outerelo R & Gamarra P (1994). A preliminary list of canarian Staphylinidae (Coleoptera)., *Vieraea*, 23 :183 –202.
- Von, H L(1880). Catalog der Coleopteren von Sibirien mit Einschluss derjenigen der Turanischen Länder, Turkestans und der chinesischen Grenzgebiete. Berlin: A.W. Schade's Buchdruckerei, xxiv + 224 pp.
- Von, H.L (1893). Catalog der Coleopteren von Sibirien, mit Einschluss derjenigen des östlichen Caspi-Gebietes, von Turcmenien, Turkestan, Nord-Thibet und des Amur-Gebietes. Berlin: A.W. Schade's Buchdruckerei, 217 pp.
- Von,.H.L (1896). Catalog der Coleopteren von Sibirien, mit Einschluss derjenigen des östlichen Caspi-Gebietes, von Turcmenien, Turkestan, Nord-Thibet und des Amur-Gebietes. Nachtrag II. Berlin: A.W. Schade's Buchdruckerei, 84 pp.
- Von, H L,. E. Reitter & J. Weise. (1891). *Catalogus Coleopterorum Europae, Caucasi et Armeniae rossicae: Auctoribus L. v. Von, E. Reitter & J. Weise cum aliis sociis coleopterologicis. Edidit Edmund Reitter.* Edmund Reitter..
- Von, H L., E. Reitter & J. Weise. (1906). *Catalogus Coleopterorum Europae, Caucasi et Armeniae rossicae.* Berlin: R. Friedländer & Sohn, 774 pp
- Hoebeke, E. R. (1995). Three Palearctic species of *Rugilus* Leach in North America (Coleoptera: Staphylinidae, Paederinae): redescrptions, new synonymy, and new records. *Insecta Mundi*, 69-80.
- Holland, J. M., Thomas, C. F. G., Birkett, T., & Southway, S. (2007). Spatio-temporal distribution and emergence of beetles in arable fields in relation to soil moisture. *Bulletin of Entomological Research*, 97(1), 89-100.
- Hollingsworth, J. P. & A. W. Hartstack Jr., (1972) Effect of components on insect light trap performance. *Transactions of the American Society of Agricultural Engineers* 15: 924-927.
- Horion, A. (1963). *Faunistik der mitteleuropäischen Käfer. 9, Staphylinidae, T. 1: Micropeplinae bis Euaesthetinae.*

- Horn, G.H. (1885) A study of the species of Cryptobium of North America. *Transactions of the American Entomological Society*, 12.
- House, P., Sabu, P. J., & Roy, D. (2024). Constraints Faced by Paddy Farmers in Palakkad District of Kerala.
- Hu, J. Y., Song, C. Z., & Li, L. Z. (2015). A new species and additional records of *Rugilus* Leach from Qinling, China (Coleoptera, Staphylinidae, Paederinae). *ZooKeys*, 505, 147.
- Hu, J., Li, L., & Zhao, M. (2011). Twelve new species of the genus *Nazeris* Fauvel from Zhejiang Province, China (Coleoptera, Staphylinidae, Paederinae). *Zootaxa*, 2797(1), 1-20.
- Huang C. Z., Y. Q. Liu, J. Yang, J. Tian, L. Y. Yang, J. Zhang, Y. Q. Li, J. W. Li, C. S. Wang, Y. T. Tu, & J. Tao. (2009). An outbreak of 268 cases of *Paederus* dermatitis in a toy-building factory in Central China. *Int. J. Dermatol.* 48: 128-131.
- Inbamani, A. P. D., Sundaram, G., & Ramalingam, R. (2024). Morphological and Clinical Patterns of *Paederus* Dermatitis. *Cureus*, 16(4).
- Irmeler, U. (2015). New species and new records of the Neotropical genera *Gnathymenus* SOLIER, 1849 and *Oedichirus* Erichson, 1839. *Koleopterologische Rundschau*, 85, 113-119.
- Irmeler, U., Klimaszewski, J., & Betz, O. (2018). Introduction to the biology of rove beetles, pp. 1–4. In: *Biology of Rove Beetles (Staphylinidae)* (ed. by O. Betz, U. Irmeler, & J. Klimaszewski) (Springer, Cham, 2018).
- Ivie, M.A., Marske, K.A., Foley, I.A., Guerrero, K.A. & Ivie, L.L., (2008). Invertebrates of the Centre Hills and Montserrat, with an emphasis on beetles. *A biodiversity assessment of the Centre Hills, Montserrat. Durrell Conservation Monograph*, (1), 243.
- Jacquelin, du Val, P.N.C. (1857). Famille des staphylinides. In *Manuel entomologique. Genera des coléoptères d'Europe*. 2: 41–128, pls. 1–67. Paris: Deyrolle.
- Jacquelin Du Val, P.N.C. (1868). Catalogue de la famille de staphylinides. In *Manuel entomologique. Genera des coléoptères d'Europe*. 2: 53–83. Paris: Deyrolle.
- Janák, J. (2021). Two new species of the genus *Palaminus* from Makay, Western Madagascar (Coleoptera: Staphylinidae: Paederinae: Pinophilini). *Studies & Reports-Taxonomical Series*, 17(1).
- Janák, J., & Baňář, P. (2021). Two new species and new records of the genus *Astenus* from Madagascar (Coleoptera: Staphylinidae: Paederinae). *Zootaxa*, 4980(1), 127141-127141.
- Jarrige J. (1944) Les Puerw de France. *Entomologiste* 1: 59.
- Jarrige J. (1971) Contribution à la faune de l'Iran. 21. Coléoptères Brachelytra. *Ann. Soc. Ent. France* (n.s.) 7: 483-502.

- Jayasree, S., Vismaya, R. S., SS, A., & Raju, A. M. (2023). Spider diversity (Arachnida: Araneae) in selected ten mixed agroecosystems of Palakkad District, Kerala, India. *Int. J. Adv. Res. Biol. Sci*, 10(8), 83-106.
- Jeannel, R., & Jarrige, J. (1949). Coléoptères Staphylinides, Première série. *Archives de Zoologie Experimentale et Générale*, 86, 255-932.
- Jeon, G. N., & Ahn, K. J. (2024). Taxonomy of Korean Scopaeus Erichson (Coleoptera: Staphylinidae: Paederinae). *Journal of Asia-Pacific Biodiversity*.
- Jiménez-Sánchez, E., S. Zaragoza-Caballero, & F.A. Noguera. (2009). Variación temporal de la diversidad de estafilínidos (Coleoptera: Staphylinidae) nocturnos en un bosque tropical caducifolio de México. *Revista Mexicana de Biodiversidad* 80: 157–168.
- Johansen, J.P. 1914. Danmarks rovbiller eller Billefam. Staphylinidae's danske Slaegter og Arter. Copenhagen: Bianco Lunos Bogtrykkeri, 660.
- Joy, N.H. 1932. A practical handbook of British beetles. London: H.F. & G. Witherby, 1: xxvii + 622; 2: 194.
- Kala, C & Leela (2018). Paddy Cultivation In Kerala A Case Study In Palakkad District. *Shanlax International Journal of Arts, Science and Humanities* 5. 45
- Kamaladasa, S. D., Perera, W. D. H., & Weeratunge, L. (1997). An outbreak of Paederus dermatitis in a suburban hospital in Sri Lanka. *International journal of dermatology*, 36(1), 34-36.
- Kambil S. M. (2018) A study of blister beetle dermatitis. *International Journal of Research in Dermatology*; 4: 72–74.
- Karthikeyan, K., & Kumar, A. (2017). Paederus dermatitis. *Indian Journal of Dermatology, Venereology and Leprology*, 83, 424.
- Kascheev V.A., Ishkov E.V (2001) List of beetles (Coleoptera) of Aksu-Dzhabagly Natural Reserve. *Tethys Entomological Research*, 3.
- Kasule, F. K. (1970). The larvae of Paederinae and Staphylininae (Coleoptera: Staphylinidae) with keys to the known British genera. *Transactions of the Royal entomological Society of London*, 122(2), 49-80.
- Kavyamol, P. M., Vineesh, P. J., & Vineetha, V. P. (2023). First record of vesicant beetles: *Paederus nigricornis* Bernhauer, 1911 from south India; *P. extraneus* Wiedemann, 1823 and *P. alternans* Walker, 1858 (Staphylinidae. Paederinae) from Kerala. *Entomon*, 48(1), 117-122.
- Kavyamol, P. M., Vineesh, P. J., & Vineetha, V. P. (2024). Species composition, abundance and seasonality of dermatitis causing Paederus rove beetles in paddy fields of Malabar region, Kerala, India. *Entomon*, 49(3), 363-372.
- Kellner, R. L., & Dettner, K. (1992). Comparative morphology of abdominal glands in Paederinae (Coleoptera: Staphylinidae). *International Journal of Insect Morphology and Embryology*, 21(2), 117-135.

- Kenward, H. & Hall, A. (2000). Technical Report: Plant and invertebrate remains from Anglo-Scandinavian deposits at the Queen's Hotel site, 1-9 Micklegate, York (site code 88-9.17). *Reports from the Environmental Archaeology Unit, York*, 14.
- Kerala Agricultural University, Package of Practices Recommendations: Crops, Kerala Agricultural University, Thrissur, 2011, 14th Edition, 360.
- Kerdel-Vegas, F., & Goihman-Yahr, M. (1966). Paederus Dermatitis. *Archives of Dermatology*, 94(2), 175-185.
- Khan, E. A., Hussain, I., & Ullah, M. N. (2023). A Preliminary Survey of Harmful Date Palm Fauna in DI Khan. *International Journal of Plant & Soil Science*, 35(10), 101-107.
- Kim, T. K., Cho, Y. B., & Ahn, K. J. (2011). Two Marine Littoral Species of the Genus Medon (Coleoptera: Staphylinidae: Paederinae) New to Korea. *Animal Systematics, Evolution and Diversity*, 27(1), 69-73.
- Kirschenblatt Y.D. (1932) Review of the beetles of the genus Pueoderus Fabr. occurring in the territories of the USSR [in Russian, part in German]. *Parazit. Sbom. Zool. Inst. Akad. Nauk USSR*, 3, 215-222.
- Klimaszewski, J. (1992). Systematics, evolution and phylogeny of Southern African Myllaena Erichson (Coleoptera: Staphylinidae: Aleocharinae). *Annals of the Transvaal Museum*, 35(29), 411-434.
- Klimaszewski, J. & Sturm, H. (1991). Four new species of the oxypodine genus Polylobus Solier (Coleoptera: Staphylinidae: Aleocharinae) collected on the flower heads of some high Andean giant rosette plants (Espeletiinae: Asteraceae). *Coleopterists bulletin*, 45, 1 – 13.
- Klimaszewski, J. & Jansen, R. E. (1993). Systematics, biology and distribution of Aleochara Gravenhorst from Southern Africa. Part 1: subgenus Xenochara Mulsant & Rey (Coleoptera: Staphylinidae). *Annals of the Transvaal Museum*, 36(7), 53-107.
- Klimaszewski J, Newton AF, Thayer MK. (1996). A review of the New Zealand rove beetles (Coleoptera: Staphylinidae). *New Zealand Journal of Zoology*. 23(2):143–160.
- Klimaszewski, J., Brunke, A. J., Work, T. T., & Venier, L. (2018). Rove beetles (Coleoptera, Staphylinidae) as bioindicators of change in boreal forests and their biological control services in agroecosystems: Canadian case studies. *Biology of Rove Beetles (Staphylinidae) Life History, Evolution, Ecology and Distribution*, 161-181.
- Kloet, G.S., and W.D. Hincks. 1945. A check list of British insects. Stockport, England: Kloet and Hincks, lix + 483.
- Koch C. (1934) Wienschaftliche Ergebnisse der entomologischen Expeditionen seiner Durchlaucht des Fuersten Alessandro della Tom e Tasso nach Aegypten und auf die Halbinsel Sinai. IV. Staphylinidae. (Coleoptera). *Bulletin of the Entomological Society of Egypt*, 33-91.
- Koch, K. (1989). *Die Kafer Mitteleuropas: Okologie Band 1*. Goecke & Evers.

- Kocher, L. (1958). Catalogue commenté des Coléoptères du Maroc, Fasc. II. Hydrocanthares, Palpicornes, Brachelytres. Travaux de L'Institut Scientifique Chérifien (Zoologie) 14 1–246.
- Kocian, M., & Hlaváč, P. (2018). Review of the genus *Pseudolathra* Casey, 1905 (Coleoptera: Staphylinidae: Paederinae) of Réunion Island. *Zootaxa*, 4531(3), 437–443.
- Koszela, K., Sarmiento, Y. C. G., & Ya, D. (2023). A new species of the genus *Paulianidia* Jarrige and a new combination in *Pseudolathra* Casey (Coleoptera, Staphylinidae, Paederinae). *Zootaxa*, 5343(6), 521–530.
- Kraatz, G. (1857). Naturgeschichte der Insecten Deutschlands. Abt. 1. Coleoptera. Zweiter Band. Lief. 3–4: 377–768; Lief. 5–6: 769–1080. Berlin: Nicolai.
- Kraatz, G. (1859) Die Staphylinen-Fauna von Ostindien, insbesondere der Insel Ceylan. *Archiv für Naturgeschichte*, 25 (1).
- Krinsky, W. L. (2019). Beetles (Coleoptera). In *Medical and veterinary entomology*, 129–143. Academic Press.
- Kuhnt, P. 1912. Illustrierte Bestimmungs-Tabellen der Käfer Deutschlands. Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung, 1138.
- Kuschel, G. (1990) in a suburban environment: a New Zealand case study.
- Küster, H.C. (1853) Die Käfer Europa's. Nach der Natur beschrieben. Sechszwanzigstes Heft. Bauer & Raspe Verlag, Nürnberg. 2 (unn.).
- Lacordaire, J.T. (1854) Histoire des insectes. Genera des cole'opte`res ou expose´ me´thodique et critique de tous les genres propose´s jusqu'ici dans cet ordre d'insectes. 2. Paris: Librairie Encyclope´dique de Roret, 548.
- Lakshminarayana, K. Saudi Journal of Medicine (SJM) ISSN 2518-3389 (Print).
- Laporte, F.L.de. (1835) Études Entomologiques, ou description d'insectes nouveaux, et observations sur la synonymie. Première Partie, Carnassiers, 95-159, pls. 1-4. Méquignon-Marvis Père et Fils, Paris. 159, 4 pls.
- Last, H.R. (1966) Family Staphylinidae. In: *Coleoptera from southeast Asia (IV)*. Memoirs of the Faculty of Liberal Arts and Education, Kagawa University, (2) 135.
- Lea, A.M. (1923) On Australian Staphylinidae (Coleoptera). *Transactions of the Royal Society of South Australia*, 47: 1-53.
- Leach, W.E. (1819) [New genera]. In: Samouelle, G. The entomologist's useful compendium, or an introduction to the knowledge of British Insects, comprising the best means of obtaining and preserving them, and a description of the apparatus generally used; together with +. Thomas Boys, London. 496, 12 pls.
- LeConte, J.L. (1861). Classification of the Coleoptera of North America. Part. 1. Prepared for the Smithsonian Institution. Smithsonian Miscellaneous Collections 3: xxv + 1–214.

- LeConte, J.L. (1863). List of the Coleoptera of North America. Prepared for the Smithsonian Institution. *Smithsonian Miscellaneous Collections* 6 (140): 1–56.
- LeConte, J.L. (1880). Short studies of North American Coleoptera. *Transactions of the American Entomological Society* 8: 163–218.
- Lecoq, J.-C. (1986) Insectes Coleoptères Staphylinidae Paederinae, I. Pinophilini. In Faune de Madagascar, 67, 1–183. Paris: *Muséum national d'Histoire Naturelle*.
- Legosz-Owsiana, D. (1963) Przegląd krajowych gatunków z rodzaju *Pueh* Fabricius (Coleoptera, Staphylinidae). *Fragmenta Faunistica*. 10: 317-359.
- Leng, C.W. (1920). Catalogue of the Coleoptera of America, north of Mexico. Mt. Vernon, New York: J.D. Sherman, x + 470.
- Leng, C.W., & A.J. Mutchler. (1927). Supplement 1919 to 1924 (inclusive) to catalogue of the Coleoptera of America, north of Mexico. Mt. Vernon, New York: J.D. Sherman, 78.
- Leschen, R. A., & Allen, R. T. (1988). Immature stages, life histories and feeding mechanisms of three *Oxyporus* spp. (Coleoptera: Staphylinidae: Oxyporinae). *The Coleopterists' Bulletin*, 321-333.
- Levesque, C., & Levesque, G. Y. (2022). Complementarity of Blacklight Trap and Flight Interception Trap in a Multi-Year Study of Flying Coleoptera near a Farm Pond in Southern Québec (Canada). *Great lakes entomologist*, 55(3-4), 26.
- Li, X. Y., & Zhou, H. Z. (2007). Study on the subgenus *Harpopaederus* of the genus *Paederus* Fabricius (Coleoptera, Staphylinidae, Paederinae) from China. *Deutsche Entomologische Zeitschrift*, 54(2), 219-233.
- Li X.Y. & Zhou, H.Z. (2008) Taxonomy and biogeography of the subgenus *Eopaederus* of the genus *Paederus* Fabricius (Coleoptera: Staphylinidae: Paederinae) from China, *Annales de la Société Entomologique de France*, 44:3, 327-344.
- Li X. Y., & Zhou H. Z. (2009) A review of the Chinese species of the subgenus *Paederus* s.str. (Coleoptera, Staphylinidae, Paederinae) with description of a new species. *Zootaxa* 2083, 46–64.
- Li, X. Y., Solodovnikov, A., & Zhou, H. Z. (2013 a). Four new species of the genus *Lobrathium* Mulsant & Rey (Coleoptera: Staphylinidae: Paederinae) from China. *Zootaxa*, 3635(5), 569-578.
- Li, X. Y., Alexey.S. & Hong.-Z.Z (2013 b) The genus *Pseudolathra* Casey in China: new species and new records (Coleoptera: Staphylinidae: Paederinae). *ZooKeys*, 356.
- Li, W.-R., Dai, C.-C. & Li, L.-Z. (2013 c) A new species and additional records of *Lobrathium* Mulsant & Rey (Coleoptera, Staphylinidae, Paederinae) from China. *ZooKeys*, 326, 47–53. .
- Li, W. R., Zhao, M. J., Dai, C. C., & Li, L. Z. (2013 d). New species and records of *Lobrathium* Mulsant & Rey (Coleoptera, Staphylinidae, Paederinae) from China. *ZooKeys*, 304, 49.

- Li X.Y., Zhou H.Z. & Solodovnikov A. (2013 d) Five NewSpecies of the Genus *Paederus* from MainlandChina, with a Review of the Chinese Fauna of theSubtribe Paederina (Coleoptera: Staphylinidae:Paederinae). *Annals of the Entomological Societyof America* ,106(5), 562–574.
- Li, X. Y., Solodovnikov, A., & Zhou, H. Z. (2014 a). Three new species of the genus *Paederus* Fabricius (Coleoptera: Staphylinidae: Paederinae) from China. *Zootaxa*, 3765(4), 382-388.
- Li, X. Y., Solodovnikov, A., & Zhou, H. Z. (2014 b). Two new species and a new synonym of the genus *Paederus* Fabricius (Coleoptera: Staphylinidae: Paederinae) from China. *Zootaxa*, 3847(3), 431-436.
- Li, W. R., Xie, N. N., & Li, L. Z. (2015). Redescription of *Oedichirus flammeus* Koch, and description of two new *Oedichirus* species from China (Coleoptera, Staphylinidae, Paederinae, Pinophilini). *Zootaxa*, 3911(1), 81-90.
- Li, Q. L., Li, L. Z., Gu, F. K., & Peng, Z. (2016). New data on brachypterous *Paederus* (Coleoptera, Staphylinidae) of mainland China. *Zootaxa*, 4184(3).
- Li, X., Cai, Y., & Zhou, H. (2021). New species of the genus *Pseudolathra* Casey, 1905 (Coleoptera, Staphylinidae, Paederinae) from the Northwestern District of China. *ZooKeys* 1036: 39–45.
- Lima, D. C. B., Costa, A. A. V., & Silva, F. S. (2015). Abundance and night hourly dispersal of the vesicating beetles of the genus *Paederus* (Coleoptera: Staphylinidae) attracted to fluorescent, incandescent, and black light sources in the Brazilian savanna. *Journal of Medical Entomology*, 52(1), 50-55.
- Linnaeus, C. 1758 *Systema Naturae* [System of Nature], 10th edn. Leiden.
- Löbl I & Smetana A. (2004) Family Staphylinidae Latreille, 1802, p. 579–624 in: Löbl I., Smetana A. (eds), *Catalogue of Palaearctic Coleoptera*. 2. Apollo Books, Stenstrup, 942 p.
- Löbl I. & Löbl D. (2015) *Catalogue of PalaearcticColeoptera. Hydrophiloidea- Staphylinidea*. Vol.2. Revised and updated edition. Brill, Leiden, Boston, xxvi + 1702. ISBN 978-90-04-28992-5.
- Lohse GA, Klimaszewski J, Smetana A (1990) Revision of Arctic Aleocharinae of North America (Coleoptera: Staphylinidae). *e Coleopterists Bulletin* 44: 121–202.
- Lü, Z. K., & Li, L. Z. (2014). Two new species of *Lobrathium* Mulsant & Rey (Coleoptera, Staphylinidae, Paederinae) from China. *ZooKeys*, 447, 125.
- Lundgren, R.W. (1998) Family Staphylinidae. The rove beetles. In S. Peck and M. Thomas (editors), *A distributional checklist of the beetles (Coleoptera) of Florida*, in *Arthropods of Florida and Neighboring Land Areas* 16(37), 41–54
- Lynch A. F. (1884) Los estafilinos de Buenos Aires. *Boletin de la Academia Nacional de Ciencias, Co´rdoba*, 7, 5–392.

- MacLeay, W. (1871) Notes on a collection of insects from Gayndah. *Transactions of the Entomological Society of New South Wales*, 2.
- Maher GM, Johnson GA, Burdine JD (2022) Impervious surface and local abiotic conditions influence arthropod communities within urban greenspaces *PeerJ* 10:e12818 <https://doi.org/10.7717/peerj.12818>
- Mank HG. (1923) The biology of the Staphylinidae. *Annals of the Entomological Society of America* 16: 220–237. <https://doi.org/10.1093/aesa/16.3.220>
- Manley, G.V. (1977) *Paederus fuscipes* (Col.: Staphylinidae): A predator of rice fields in West Malaysia. *Entomophaga* 22, 47-59.
- Mannerheim, C. G., 1830, Précis d'un nouvel arrangement de la famille des brachélytres de l'ordre des insectes coléoptères, Extract from ' Mémoires présentés à l'Académie impériale des Sciences de St. Petersbourg t. 1
- Manoj, K., Rajesh, T. P., Prashanth Ballullaya, U., Meharabi, K. M., Shibil, V. K., Rajmohana, K., & Sinu, P. A. (2017). Diversity of Platygastriidae in leaf litter and understory layers of tropical rainforests of the Western Ghats Biodiversity Hotspot, India. *Environmental Entomology*, 46(3), 685-692.
- Martins, I. C. F., Cividanes, F. J., Ide, S., & Haddad, G. Q. (2012). Diversity and habitat preferences of Carabidae and Staphylinidae (Coleoptera) in two agroecosystems. *Bragantia*, 71, 471-480.
- Maryam S., Fadzly N and Zuharah W. F. (2017) Abundance, distribution and dispersal time of *Paederus fuscipes* (Coleoptera: Staphylinidae) and its association to human settings. *Tropical Biomedicine*, 34: 224–236.
- Matějček, J.& Bohac.J (2020) New and additional records of the staphylinid beetles from Pakistan collected by Guido Sabatinelli with check-list of staphylinids of Pakistan (Coleoptera, Staphylinidae). *Munis Entomology & Zoology*, 15 (2) 655–689.
- Mathews, J., Sreedevi, A., John, J., & Varghese, S. M. (2021). An outbreak of *Paederus* dermatitis in a hostel in central Kerala: a cross-sectional study. *Clinical and Experimental Dermatology*, 46(5), 953-956.
- Matthews, E.G. (1982). A guide to the genera of beetles of South Australia. Part 2 Polyphaga: Staphylinoidea and Hydrophiloidea. Special Education Bulletin Series. Adelaide: South Australia Museum, 64.
- McColl, H. P. (1982). Osoriinae (Insecta: Coleoptera: Staphylinidae). *Fauna of New Zealand*, 2.
- McCrae, A. W. R., & Visser, S. A. (1975). *Paederus* (Coleoptera: Staphylinidae) in Uganda: I: Outbreaks, clinical effects, extraction and bioassay of the vesicating toxin. *Annals of Tropical Medicine & Parasitology*, 69(1), 109-120.
- McGrath, L., Piliouras, P., & Robertson, I. (2013). Irritant bullous contact dermatitis caused by a rove beetle: an illustrated clinical course. *Australasian Journal of Dermatology*, 54(2), 136-138.

- Metin, M. S., & Elmas, O. F. (2019). Paederus dermatitis: an observational study.
- Meurgey, F. & Ramage, T., (2020). Challenging the Wallacean shortfall: A total assessment of insect diversity on Guadeloupe (French West Indies), a checklist and bibliography. *Insecta Mundi*, (0786), 1-183.
- Mittal, A., Mehta, S., Garg, A., Gupta, L., Kuldeep, C. M., Khare, A. K., & Nistha, S. (2013). A Study of Beetle Dermatitis.
- Mnguni, S., McKay, I. & Badenhorst, S., 2022. Afrinophilina orapa: a new genus and species of Paederinae (Coleoptera: Staphylinidae) from Cretaceous lacustrine deposits at Orapa Diamond Mine, Botswana. *Authorea Preprints*.
- Mokhtar N, Singh R, Ghazali W, (1993) Paederus dermatitis among medical students in USM, Kelantan. *Med J Malaysia*, 48 (4), 403-406.
- Moore. I., (1954) An efficient method of collecting dung beetles. *Pan Pacific Entomologist*. 30-208.
- Moore, I., & E.F. Legner. (1974) Keys to the genera of the Staphylinidae of America north of Mexico exclusive of the Aleocharinae (Coleoptera: Staphylinidae). *Hilgardia* 42 (16): 548–563.
- Moore, I., & Legner, E. F. (1975). A catalogue of the Staphylinidae of America North of Mexico (Coleoptera). Division of Agricultural Sciences, University of California Special Publication 3015, 1–514.
- Moore, I., & Legner, E. F (1976). Intertidal rove beetles (Coleoptera: Staphylinidae), 521-552. In: Cheng, L. (Ed.) *Marine insects*. North Holland Publ. Co., Amsterdam and New York. xii+ 581.
- Moore, I., & Legner, E. F. (1979). An illustrated guide to the genera of the Staphylinidae of America North of Mexico exclusive of the Aleocharinae (Coleoptera). Division of Agricultural Sciences, University of California Publication 4093, 1–332.
- Morris, F.O., (1865). A Catalogue of British Insects: In All Orders. Longmans.
- Motschulsky, V. (1858) Énumération des nouvelles espèces de Coléoptères rapportés de ses voyages. 2-d. Article (continuation).: *Bulletin de la Société Impériale des Naturalistes de Moscou*, 31 (2): 634-670.
- Mulsant, E., & Rey, C. (1855). Essai spécifique sur les Scopaeus des environs de Lyon. *Opuscles Entomologiques*, 6, 49-78.
- Mulsant, E., & Rey, C. (1877). Histoire naturelle des Coléoptères de France. Brévipennes. [Staphyliniens] 1–712. Paris: Deyrolle.
- Mulsant, E. & C.R. (1878) Tribu des brévipennes: Troisième famille: Pédériens. Quatrième famille: Évesthétiens. *Annales de la Société Linnéenne de Lyon*, (N.S.) 24.
- Muona, J. (1979). Staphylinidae. In H. Silfverberg, *Enumeratio Coleopterorum Fennoscandiae et Daniae*: 14–28. Helsinki: Helsingfors Entomologiska Bytesförening.

- Nasir, S., Akram, W., & Ahmed, F. (2012). The population dynamics, ecological and seasonal activity of *Paederus fuscipes* Curtis (Staphylinidae; Coleoptera) in the Punjab, Pakistan. *Apcombe Procedia*, 4, 36-41.
- Nasir S, Akram W, Khan R. R, Arshad M, Nasir I. (2015) *Paederus* beetles: the agent of human dermatitis. *J Venom Anim Toxins Incl Trop Dis.*; 21: 5. doi: 10.1186/s40409-015-0004-0. PMID: 25767507; PMCID: PMC4357090.
- Nasir, S., Nasir, I., Hafeez, F., & Yousaf, I. (2019). Comparison of attractive and intercept traps for sampling rove beetles (Coleoptera: Staphylinidae). *Journal of the Entomological Research Society*, 21(3), 257-269.
- Navarrete-Heredia, J.L., & J. Márquez-Luna. (1993). Notas sobre los Staphylinidae (Insecta: Coleoptera) de cuevas en Mexico. *Mundos Subterráneos* 4: 43–52.
- Navarrete-Heredia, J.L., A.F. Newton, M.K. Thayer, J.S. Ashe, & D.S. Chandler. (2002). Guía ilustrada para los géneros de Staphylinidae (Coleoptera) de México. Guadalajara, Jalisco, México: Universidad de Guadalajara y CONABIO, xii + 401.
- Newton, A. F. Jr. (1984). "Mycophagy in Staphylinidae (Coleoptera)". In *Fungus-insect relationships: perspectives in ecology and evolution*, Edited by: Wheeler, Q. and Blackwell, M. 302 – 353. New York: Columbia University Press.
- Newton, A. F. Jr. (1990a). "Insecta: Coleoptera Staphylinidae adults and larvae". In *Soil biology guide*, Edited by: Dindal, D. L. 1137 – 1174. New York: John Wiley & Sons, Inc.
- Newton, A. F. Jr. (1990b). Myrmelibia, a new genus of myrmecophile from Australia, with a generic review of Australian Osoriinae (Coleoptera: Staphylinidae). *Invertebrate taxonomy*, 4: 81 – 94.
- Newton, A. F. (2017). Nomenclatural and taxonomic changes in Staphyliniformia (Coleoptera). *Insecta Mundi*.
- Newton, A.F. (2021) StaphBase: Staphyliniformia world catalog database (version Oct 2021). In: The Catalogue of Life, 2022. Digital resource at www.catalogueoflife.org. Species 2000: Naturalis, Leiden, the Netherlands.
- Newton, A. F., Thayer, M. K., Ashe, J. S., & Chandler, D. S. (2000). 22. Staphylinidae Latreille, 1802. *American beetles*, 1, 272-418.
- Nikbakhtzadeh, M., & Tirgari, S. (1999). Two medically important beetles of Fars province (Iran): *Paederus* spp. (Col: Staphylinidae) and linear dermatitis.
- Nikbakhtzadeh, M. R., & Tirgari, S. (2008). Medically important beetles (insecta: coleoptera) of Iran. *Journal of Venomous Animals and Toxins including Tropical Diseases*, 14, 597-618.
- Nikbakhtzadeh M. R, Naderi M, Safa P. (2012) Faunal diversity of *Paederus fabricius* 1775 (Coleoptera: Staphylinidae) in Iran. *Insecta Mundi*. 267: 1–9.

- Nikhita, R., R. Srithilak, & M. V. Radhakrishnan (2014). Prevalence of *Paederus* spp. (Coleoptera; staphylinidae) and dermatitis in Annamalaiagar, Chidambaram, Tamilnadu. *Journal of Entomology and Zoology Studies* 2, 4, 194-196.
- Nordmann [as Nordmannus], A. (1837) *Symbolae ad monographiam staphylinorum. Academiae Caesareae Scientiarum, Petropoli* [St. Petersburg]. 167, 2 pls
- Örgel, S., Çiçek, K., & Anlaş, S. (2021). Faunistic Studies on the Genus *Medon* Stephens, 1833 (Coleoptera: Staphylinidae: Paederinae) in Turkey. *Kahramanmaraş Sütçü İmam Üniversitesi Tarım ve Doğa Dergisi*, 24(2), 414-424.
- Örgel, S., Anlaş, S., & Cicek, K. (2023). Contributions to *Medon* Stephens (Coleoptera: Staphylinidae) fauna of Turkey; a new species and additional records. *Journal of Insect Biodiversity*, 42(2), 50-55.
- Outerelo, R., & P. Gamarra. (1985). Las familias y géneros de los estafilínidos de la Península Ibérica. 10: 1–139. In *Claves para la identificación de la fauna Española*. Madrid: Universidad Complutense.
- Özgen, I., Anlaş, S. & Eren, S., (2010) Contribution to the knowledge of Staphylinidae (Coleoptera) fauna of cotton and pistachio fields in Southeastern Anatolia. *Journal of Anatolian Natural Sciences*, 1(1), 20-26.
- Özgen, İ. & Örgel S (2021) Some additional notes on the family Staphylinidae (Insecta: Coleoptera) in Turkey. *International Journal of Fauna and Biological Studies*, 8 (4).
- Padhi, T., Mohanty, P., Jena, S., Sirka, C. S., & Mishra, S. (2007). Clinicoepidemiological profile of 590 cases of beetle dermatitis in western Orissa. *Indian Journal of Dermatology, Venereology and Leprology*, 73, 333.
- Palm, T. (1963). *Svensk Insekfauna*. 9. Skalbagg. Coleoptera. Kortvingar: Fam. Staphylinidae. Unterfam. Paederinae, Staphylininae. Häfte 3. Uppsala: Almqvist and Wiksells, 168.
- Palot, M. J., Radhakrishnan, C., & Soniya, V. P. (2005). Odonata (Insecta) diversity of rice field habitat in Palakkad district, Kerala. *Records of the zoological Survey of India*, 71-77.
- Pavithran, S., Chitra, N., Arulprakash, R., & Sugumaran, M. (2020). Diversity of Odonata in the rice fields of Tamil Nadu. *Journal of Entomology and Zoology Studies*, 8, 2115-2118.
- Peck, S. B. (2009). The beetles of St. Lucia, Lesser Antilles (Insecta: Coleoptera): diversity and distribution. *Insecta Mundi* 0106: 1-34.
- Peck, S. B. (2010). 0144. The beetles of the island of St. Vincent, Lesser Antilles (Insecta: Coleoptera); diversity and distributions. *Insecta Mundi*, 1-77.
- Peck, S.B., Thomas, M.C. & Turnbow Jr, R.H., (2014) The diversity and distributions of the beetles (Insecta: Coleoptera) of the Guadeloupe Archipelago (Grande-Terre, Basse-Terre, La Désirade, Marie-Galante, Les Saintes, and Petite-Terre), Lesser Antilles.

- Peitzmeier, B.A., Campbell, J.B. and Thomas, G.D., (1992). Insect fauna of bovine dung in northeastern Nebraska and their possible effect on the face fly, *Musca autumnalis* (Diptera: Muscidae). *Journal of the Kansas Entomological Society*, 267-274.
- Peng, Z., Li, L. Z., & Zhao, M. J. (2012). Taxonomic study on *Lathrobium Gravenhorst* (Coleoptera, Staphylinidae, Paederinae) from Longwangshan Mountain, East China. *ZooKeys*, (165), 21.
- Peng, Z., Li, L. Z., & Zhao, M. J. (2014). A new species and additional records of *Pseudolathra Casey* (Coleoptera: Staphylinidae: Paederinae) from southern China. *Zootaxa*, 3878(6), 597-600.
- Peng, Z., Li, L. Z., & Zhao, M. J. (2016). A new species and additional records of *Lobrathium Mulsant & Rey* (Coleoptera, Staphylinidae, Paederinae) from South China. *ZooKeys*, (568), 51.
- Petri, K. (1912). *Siebenbürgens Käferfauna auf Grund ihrer Erforschung bis zum Jahre 1911*. Berlin: Friedländer & Sohn, ix + 1 unnumbered page + 1–376. [There are two numbered columns per page; each column is cited as a page]
- Pirajá Da Silva, M. A. 1912. *Le Paederus columbinus est vésicant*. *Archives de Parasitologie*, 15, 429-431.
- Pope, R.D. (1977). In G. Kloet & W. Hincks, *A check list of British insects*, 2nd ed. (completely revised). Part 3: Coleoptera and Strepsiptera. In *Handbooks for the Identification of British Insects*. Vol. 11 (3). London: Royal Entomological Society of London, xiv + 105.
- Porta, A. (1926). *Fauna coleopterorum italica*. II. Staphylinidea. Piacenza: Stalilimento Tipografico Piacentino, 405.
- Porta, A. (1949). *Fauna coleopterorum italica*. Supplementum II. San Remo: G. Gandolfi, 386.
- Portevin, G. (1929). *Histoire naturelle des Coléoptères de France*. I. Adephaga. Polyphaga: Staphylinidea. *Encyclopédie Entomologique* 12: xii + 649. Paris: P. Lechevalier.
- Prajeesh, P., Narayanan, M. R., & Kumar, N. A. (2014). Diversity of vascular plants associated with wetland paddy fields (vayals) of Wayanad district in Western Ghats, India. *Annals of Plant Sciences*, 3 (05), 704-714.
- Pramod, K. M. (2013). *Education and development among tribals in Kerala: A study with special reference to wayanad district* (Doctoral dissertation, Department of Education, University of Calicut, 2013).
- Prasad, B.C., (2010). *Land resources inventory of the Fiji Islands*.
- Prasad, A., & Kuruvila, A. (2024). Vanishing Paddies: Tracing the Transformation of Rice Cultivation in Kerala, India. *Asian Journal of Agricultural Extension, Economics and Sociology*, 42 (11), 284-296.
- Qadir, S. N. R., Raza, N., & Rahman, S. B. (2006). *Paederus dermatitis* in Sierra Leone. *Dermatology online journal*, 12(7).

- Rabil, J., (1991) Ah, cette Grésigne! Catalogue des coléoptères de la forêt de la Grésigne (Tarn). *Publications du musée des Confluences*, 29(1), 3-174.
- Raffray, A. (1873) Deuxième partie, In: Fairmaire, L. & A. Raffray. Coléoptères du Nord de l'Afrique. *Revue et Magasin de Zoologie Pure et Appliquée*, (3) 1. 360-385.
- Rafinejhad, J., Asgarian, F., Nikookar, S. H., Ziapour, S. P., Fazeli-Dinan, M., Serri, S., & Enayati, A. (2018). Occurrence of *Paederus fuscipes* (Coleoptera: Staphylinidae) in the sandy tidal zone of the Caspian seashore. *International Journal of Tropical Insect Science*, 38(1), 33-38.
- Rahmah E, Norjaiza MJ., (2008) An outbreak of *Paederus dermatitis* in a primary school, Terengganu, Malaysia, *Malaysian Journal of Pathology*, 30: 53.
- Ramakrishnan, D., George, L. S., Jacob, A., Lais, H., Rajeev, M., Panicker, K. N., & Marwaha, V. (2019). Outbreak investigation of acid fly attack among residential students in a tertiary care centre in South India. *Int J Community Med Public Health*, 6, 5355-8.
- Ramzan, U., Majeed, W., Rana, N., & Nargis, S. (2021). Occurrence of different insect species with emphasis on their abundance and diversity in different habitats of Faisalabad, Pakistan. *International Journal of Tropical Insect Science*, 41(2), 1237-1244.
- Reboleira, A. S. P. S., Gonçalves, F., & Oromí, P. (2011). On the Iberian endemic subgenus *Lathromene* Koch (Coleoptera: Staphylinidae: Paederinae): description of the first hypogean *Domene* Fauvel, 1872 from Portugal. *Zootaxa*, 2780(1), 48-56.
- Redtenbacher, L. (1849): Fauna Austriaca. Die Käfer. Nach der analytischen Methode bearbeitet. Ed.1.. 641-883. Wien.C. Gerold.
- Redtenbacher, L. (1857). Fauna austriaca. Die Käfer, ed. 2. 129–976. Wien: C. Gerold's Sohn.
- Redtenbacher, L. (1874). Fauna austriaca. Die Käfer, ed. 3. 1: clii + 564. Wien: C. Gerold's Sohn.
- Reitter, E. (1906) Übersicht der mir bekannten, palaearktischen Arten der Coleopteren-Gattung *Oedichirus* Er. *Wiener Entomologische Zeitung*, 25 (8-9).
- Reitter, E. (1909). Fauna germanica. Die Käfer des Deutschen Reiches. Nach der Analytischen Methode Bearbeitet, 2, 1–392. Stuttgart: K.G. Lutz.
- Rottenberg, A.von. (1870) Beiträge zur Coleopteren-Fauna von Sicilien. *Berliner Entomologische Zeitschrift*, 14 (1–2).
- Roubal, J. (1930). Katalog coleopter (Brouků) Slovenska a Podkarpatska, na základě bionomického a zoogeografického a spolu systematického doplněk Ganglbauerových “Die Käfer von Mitteleuropa” a Reitterovy “Fauna germanica.” Svazek 3. Prague: Učené Společnosti Šarfařkovy v Bratislavě, 527.
- Roubal J. (1932) Sur quelques coléoptères des environs de Bagdad. *BuU Soc. Ent. France* 37, 59-64.
- Rougemont, G.de. (2015) New Oriental and Papuan *Pseudolathra* (Coleoptera, Staphylinidae, Paederinae). *Linzer Biologische Beiträge*, 47 (2).

- Rougemont, G.de. (2018) New oriental Oedichirus (Staphylinidae, Paederinae, Pinophilini). *Linzer Biologische Beiträge*, 50 (1).
- Rudd, W. G. & R. L. Jensen., (1977). Sweep net and ground cloth sampling for insects in soybeans. *J. Econ. Entomol.*, 70: 301-304.
- Ryabukhin, A. S. (2007). First record of the genus *Rugilus* Leach, 1819 (Coleoptera: Staphylinidae: Paederinae) in the North-East Asia with a description of a new species. *Far Eastern Entomologist*, (172), 1-4.
- Rye, E.C. (1866). British beetles: an introduction to the study of our indigenous Coleoptera. London: Lovell Reeve & Co., xv + 280.
- Sabu, T. K., Vineesh, P. J., & Vinod, K. V. (2008). Diversity of forest litter-inhabiting ants along elevations in the Wayanad region of the Western Ghats. *Journal of Insect Science*, 8(1), 69.
- Sahlberg, J. (1876) Enumeratio Coleopterorum brachelytrorum Fenniae. Systematisk förteckning öfver de inom Finlands naturalhistoriska område hittills funna Coleoptera Brachelytra jemte uppgift om arternas utbredning och beskrifningar af nya och mindre kända species. I. +. Acta Societatis pro Fauna et Flora Fennica, 1 (3).
- Sainte, C. D, J. (1935). Catalogue raisonné des coléoptères de France. L'Abeille. *Memoires d'Entomologie* 36 (1, 2): 1–264.
- Sainte, C. D., J. (1910). Faune des Coléoptères du Bassin de la Seine. II. Staphylinoidea. 93–160. Paris: Société Entomologique de France.
- Saloña, M.I., Moraza, M.L., Carles-Tolrá, M., Iraola, V., Bahillo, P., Yélamos, T., Outerelo, R. & Alcaraz, R., (2010). Searching the soil: forensic importance of edaphic fauna after the removal of a corpse. *Journal of forensic sciences*, 55(6), 1652-1655.
- Samin, N., Zhou, H. & Imani, S., (2011) Iranian rove beetles (Coleoptera: Staphylinidae). *Amurian zoological journal*, 3(2), 128-162.
- Sanderson, M. W. (1967). Revision of the Greater Antillean species of *Paederus* (Coleoptera: Staphylinidae). *The Coleopterists' Bulletin*, 59-62.
- Sanyal A K, Alfred J R B , Venkataraman K., Tiwari, S.K. & Mitra, Sangeeta, (2012) Status of Biodiversity of West Bengal: 1-969 .
- Sar A. & Hegde V.D. (2015) New records of rove beetles (Coleoptera: Staphylinidae: Paederinae) fromUttar Pradesh, India. *Records of the Zoological Survey of India* 115(1): 101–103.
- Sar, A. & Ilango, K. (2016). New Records of Rove Beetles (Coleoptera: Staphylinidae: Paederinae) from Mizoram, India. *Records of the Zoological Survey of India*, 233-240.
- Sar A, Chakraborti U, Roy S, Biswas O & Mitra B (2016) An Account of the Rove Beetles (Coleoptera: Staphylinidae) chanfrom the Sunderban Biosphere Reserve, West Bengal. *Bionotes*, 18(2). 52.

- Sasidharan, K. R., Ratheesh R & Kunhikannan. C. (2020). Butterfly diversity of Walayar valley, the Western ghats, India and its conservation. *Uttar pradesh journal of zoology* 41 (6):29-41. <https://mbimph.com/index.php/upjoz/article/view/1519>.
- Schaum, H. (1852). *Catalogus Coleopterorum Europae*. Herausgegeben vom Entomologischen Verein in Stettin. Vierte Auflage. Berlin: Schaum, v + 96.
- Schaum, H. (1859). *Catalogus Coleopterorum Europae*. Berlin: Nicolaische Verlagsbuchhandlung, iv + 121.
- Scheerpeltz O. (1933) Staphylinidae II. In: *Coleopterorum Catalogus*. 129, W. Junk, Berlin, 989–1500.
- Scheerpeltz O. (1935) Staphyliniden aus dem Sundainseln und Nordaustralien. *Revue suisse de Zoologie*. 42: 593–659.
- Scheerpeltz, O. (1957) Vorläufige Diagnosen einiger neuen palaarktischen Arten und Formen der Gattungen *Paederus* Muls. Rey, *Paederus* Fabr. (mit den neuen Untergattungen *Eupaederus*, *Paederus* s. str. nov., *Heterupaederus*, *Dionopederus* und *Oedopederus*), *Paramerupaederus* nov. gen., *Lidopederus* nov. gen. und *Megalopederus* nov. gen. *Mem. Museo Tridentino di Scienze Naturali*, 11, 447-475.
- Scheerpeltz, O. (1961) Die von den Herren W. Richter und Dr. F. Schäuffele in den Jahren 1954 und 1956 im Südiran aufgefundenen Staphyliniden (Col.). *Stuttgarter Beiträge zur Naturkunde* 50: 1–31.
- Scheerpeltz, O. (1963) Coleoptera, Staphylinidae. 116. Beitrag zur Kenntnis der palaarktischen Staphyliniden. *Lunds UNV. Arsskr. (N.F. 2)* 58, 1-38
- Scheerpeltz, O. (1965) Wissenschaftliche Ergebnisse der Schwedischen Expedition 1934 nach Indien und Burma. Coleoptera Staphylinidae (except. Megalopsidiinae et Steninae). *Arkiv för Zoologi*, 17: 93-371
- Scheerpeltz O. (1968) Coleoptera - Staphylinidae [pt. xvfa, p. 1- 279, in] *Catalogus faunae Austriae*. Österreichische Staatsdruckerei; Vienna.
- Scheerpeltz O. (1976) Wissenschaftliche Ergebnisse entomologischer Aufsammlungen in Nepal (Col. Staphylinidae). *Khumbu Hirnal* 5, 77-173.
- Scheerpeltz, O. (1978) Wissenschaftliche Ergebnisse der von Dr. Raul do Nascimento Ferreira-Coimbra, Portugal während seines Aufenthaltes von Ende des Jahres 1964 bis zum Anfang des Jahres 1966 auf der Insel Tior, der östlichsten der kleinen Sundainseln, durchgeführten Aufsammlungen von Staphyliniden (Coleoptera). *Eos, Madrid*, 52, 185–232.
- Schmidt, D. A. (1999). Materials and methods for rearing selected species of the subfamilies Paederinae and Staphylininae (Coleoptera: Staphylinidae). *The Coleopterists' Bulletin*, 104-114.
- Scholz, P., Jung, M., Schöne, A. and Lübke-Al Hussein, M., (2002) Kurzflügler (Coleoptera: Staphylinidae). *Pflanzen und Tiere in Sachsen-Anhalt*, p.776.

- Schomann, A. M., & Solodovnikov, A. (2017). Phylogenetic placement of the austral rove beetle genus *Hyperomma* triggers changes in classification of Paederinae (Coleoptera: Staphylinidae). *Zoologica Scripta*, 46(3), 336-347.
- Seevers, C.H. (1971) Fossil Staphylinidae in Tertiary Mexican amber (Coleoptera). In Studies of fossiliferous amber arthropods of Chiapas, Mexico. Part II. University of California Publication in Entomology, 63, 77–86
- Segers, R. (1986). Catalogus Staphylinidarum Belgicae (Coleoptera). Institut Royal des Sciences Naturelles de Belgique. Document de Travail 32, 1–104.
- Seidlitz, G. (1889a). Fauna Baltica. Die Kaefer (Coleoptera) der Deutschen Ostseeprovinzen Russlands. Zweite neu bearbeitete Auflage: 81–128 (Gattungen), 337–512 (Arten). Königsberg: Hartungsche Verlagsdruckerei.
- Seidlitz, G. (1889b). Fauna Transsylvanica. Die Kaefer (Coleoptera) Siebenbürgens. Königsberg: Hartungsche Verlagsdruckerei, xli–xlviii + 49–128 + 241–544.
- Senda Y & Nakamura R (2020). A Contribution to the Knowledge of the Staphylinid Fauna of Kume-jima Island, the Ryukyus, Japan (Coleoptera, Staphylinidae). *Elytra*, Tokyo, New Series, 10 (1): 203–210.
- Sengupta, S. R., & Lahiri, K. (1997). Blister beetle dermatitis in West Bengal. *Indian Journal of Dermatology, Venereology and Leprology*, 63, 69.
- Sert, O., Turan, Y., Şabanoğlu, B., Anlaş, S., & Fırat, S. (2013). Faunistical, ecological and zoogeographical evaluations on the subfamily Paederinae (Coleoptera: Staphylinidae) in the Central Anatolian Region of Turkey. *Turkish Journal of Entomology*, 37(4), 477-492.
- Sharp, D. (1871). Catalogue of British Coleoptera. London: Janson, 37.
- Sharp, D. (1874) The Staphylinidae of Japan. Transactions of the Entomological Society of London, 1874 (1).
- Sharp, D. (1876). Contribution to an insect fauna of the Amazon Valley. Coleoptera-Staphylinidae. *Transactions of the Entomological Society of London 1876*: 27–424.
- Sharp, D.S. (1885). Staphylinidae. In *Biologia Centrali-Americana. Insecta. Coleoptera*. 1(2): 393– 536. London: Taylor & Francis.
- Sharp, D. (1886) Staphylinidae. In F.D. Godman & O. Salvin (editors), *Biologia Centrali-Americana. Insecta. Coleoptera*. 1 (2): 537–672. London: Taylor & Francis.
- Sharp, D. S. (1887). Staphylinidae. *Biologia Centrali-Americana. Insecta. Coleoptera*, 1(2), 673-824.
- Sharp, D. (1889). XXXVII.—The Staphylinidae of Japan. *Journal of Natural History*, 3(16), 319-334.
- Sharp, D., & W.W. Fowler. (1893). Catalogue of British Coleoptera. London: L. Reeve & Co., 46.

- Sharp, D.S. (1876) Contribution to an insect fauna of the Amazon Valley. Coleoptera-Staphylinidae. *Transactions of the Entomological Society of London* 1876: 27–424.
- Shibata, Y. (1973). Preliminary check list of the family Staphylinidae of Taiwan (Insecta: Coleoptera). *AnnL Bull. Nichidai Sanko*, 16, 21-88.
- Shibata, Y. (1977) Provisional check list of the family Staphylinidae of Japan. II (Insecta: Coleoptera). *AnnL Bull. Nichidai Sanko u*, 16-83.
- Shibata Y., Maruyama M., Hoshima H., Kishimoto T., Naomi S.-I., Nomura S., Puthz V., Shimada T., Watanabe Y & S. Yamamoto (2013): Catalogue of Japanese Staphylinidae (Insecta, Coleoptera). — *Bulletin of the Kyushu University Museum* 11: 69-218.
- Shibata, Y., & Fujimoto, H. (2017). A new intertidal species of the genus *Medon* (Coleoptera, Staphylinidae, Paederinae) from Kagawa, Japan. *Elytra New Series*, 7(1), 55-60.
- Silfverberg, H. (1992). Enumeratio Coleopterorum Fennoscandiae, Daniae, et Baltiae. Helsingfors: Helsingfors Entomologiska Bytesförening, v + 94.
- Silva, F. S., Lima, D. C. B., Costa, A. A. V., & Campos, D. S. L. (2014) An ethno-entomological study of rove beetles of the genus *Paederus* (Coleoptera, Staphylinidae) in the municipality of Chapadinha, Maranhão state, northeastern Brazil.
- Silva, F. S., Lobo, S. E. P. D., & da Silva, A. A. (2017). Seasonal abundance and the effect of light trap height on the captures of the vesicating beetles of the Genus *Paederus* (Coleoptera: Staphylinidae) in Brazil. *Entomological News*, 127(1), 21-27.
- Singh G & Yousuf Ali S (2007). *Paederus dermatitis*. *Indian Journal of Dermatology, Venereology and Leprology*. 73(1) 13-15.
- Smetana A. (1959). Zur Kenntnis der Staphyliniden-Fauna Albaniens (CoL, Staphylinidae). *Ada Ent. Mus. Natn. Praeae* 33: 195-218,
- Smetana A. (2004): Family Staphylinidae (except subfamilies Pselaphinae and Scaphidiinae). — In: Löbl I. & A. Smetana (eds), Catalogue of Palaearctic Coleoptera. 2. Hydrophiloidea, Histeroidea, Staphylinoidea. — Apollo Books, Stenstrup: 237-698.
- Somers, E. J. (1961). “Spider lick”: an epidemic ophthalmo-dermatozoosis due to beetles of the genus *Paederus*. *The British Journal of Ophthalmology*, 45(6), 395.
- Spahr, U. (1981) Systematischer Katalog der Bernstein- und Kopal-Käfer (Coleoptera). *Stuttgarter Beiträge zur Naturkunde* (Serie B, Geologie und Paläontologie), 80, 1–107.
- Spector S, Forsyth A., (1998) Indicator taxa for biodiversity assessment in the vanishing tropics. In: GM MaceA. BalmfordJR Ginsberg. Conservation in a changing world. Cambridge: Cambridge University Press. 181–209.
- Sreevidhya P. & Sebastian C.D. (2020) DNA barcoding and phylogenetic analysis of paederinae (Coleoptera: staphylinidae) in relation tomorphological data using cox I sequences. *International Journal of Entomology Research* 5:191–194.

- Sreevidhya, P., Akhil, S. V., & Sebastian, C. D. (2021). Two new light attracted rove beetle species of *Astenus* Dejean, 1833 (Coleoptera: Staphylinidae: Paederinae) from Kerala, India. *Journal of Threatened Taxa*, 13(5), 18215-18226.
- Srihari, S., Kombettu, A. P., Rudrappa, K. G., & Betkerur, J. (2017). *Paederus dermatitis*: a case series. *Indian dermatology online journal*, 8(5), 361-364.
- Stan M. (2004): Checklist of staphylinids (Coleoptera: Staphylinidae) of Romania. Travaux du Muséum National d'Histoire Naturelle "Grigore Antipa" XLVI: 83-108.
- Staniec, B., Pietrykowska-Tudruj, E., Wagner, G. K., Mazur, A., & Kowalczyk, M. (2022). Synthesis of Current Knowledge of the Morphology of the Larval Stages of Paederinae (Coleoptera; Staphylinidae), with a First Insight into the Mature Larva of *Pseudomedon* Mulsant & Rey, 1878, in the Light of a New Systematic Division. *Insects*, 13(11), 982.
- Stašiov S., Litavský J., Majzlan O., Svitok M. & Fedor P. (2021): Influence of selected environmental parameters on rove beetle (Coleoptera: Staphylinidae) communities in Central European floodplain forests. - *Wetlands* 41, 115, 28.
- Steel, W. O. 1970. The larvae of the genera of Omaliinae with particular reference to the British fauna. *Transactions of the Royal Entomological Society of London*, 122, 1 – 47.
- Stephens, J. F. (1829). The nomenclature of British insects : being a compendious list of such species as are contained in the systematic catalogue of British insects, and forming a guide to their classification. Baldwin and Cradock, London 1-68.
- Stephens, J.F. (1832) Illustrations of British entomology; or, a synopsis of indigenous insects; containing their generic and specific distinctions; with an account of their metamorphoses, times of appearance, localities, food, and economy, as far as practicable. Mandibulata, Vol. 5. Baldwin & Cradock, London. 1-240.
- Stephens, J.F. (1833) The nomenclature of British insects; together with their synonymies: being a compendious list of such species as are contained in the Systematic Catalogue of British Insects, and of those discovered subsequently to its publication; forming a guide to +. Baldwin and Cradock, London. iv + 134.
- Stocker, B., Barthold, S., & Betz, O. (2022). Mouthpart ecomorphology and predatory behaviour in selected rove beetles of the “Staphylinine group”(Coleoptera: Staphylinidae: Staphylininae, Paederinae). *Insects*, 13(8), 667.
- Székey, V. 1963. Holyvák I.—Staphylinidae I. VII kötet (Coleoptera II) 5. Füzet. 172 Ábrával. Magyarország Állatvilága [Fauna Hungariae] 66: 1–117. Budapest: Akadémiai Kiadó.
- Szujecki, A. (1965) Klucze do oznaczania owadów polski. *Polski Związek Entomologiczny* 19(24c): 1-74.
- Taneja, A., UK, S. N., & Sheno, S. D. (2013). Clinical and epidemiological study of *Paederus dermatitis* in Manipal, India. *Journal of Pakistan Association of Dermatologists*, 23(2), 133-138.

- Terlutter, H. 1995. Coleoptera Westfalica: Familia Staphylinidae Subfamiliae Oxytelinae, Oxyporinae, Steninae, Euaesthetinae, Paederinae. *Abhandlungen aus dem Westfälischen Museum für Naturkunde* 57 (1): 1–83.
- Thapa V.K., (2000) An Inventory of Nepal's Insects, Vol. III. IUCN Nepal, Kathmandu, 475.
- Thayer, M. K. (1977). Redescription of Xenicopoda Moore and Legner (Coleoptera: Staphylinidae, Omaliinae), With Supplementary Notes. *Psyche: A Journal of Entomology*, 84(2), 142-149.
- Thayer, M.K. (2005) Staphylinidae Latreille, 1802. Handbook of Zoology, Vol. IV, Part 38, Coleoptera, Beetles, Vol. I: Morphology and Systematics (Archostemata, Adephaga, Myxophaga, Polyphaga partim) (ed. by R.G. Beutel and R.A.B. Leschen), 296–344. Walter de Gruyter, Berlin.
- Thomson, C. G. (1858). Forsök till uppställning af Sveriges Staphylininer. Ofversigt af Kongl. Vetenskaps-Akademiens Förhandlingar, 15, 27-40.
- Thomson, C. G. (1859). Skandinaviens Coleoptera (Vol. 1). Berlingska Boktryckeriet.
- Thomson, C.G. (1860) Skandinaviens Coleoptera, synoptiskt bearbetade. 2: 1–304. Lund: Berlingska Boktryckeriet.
- Thomson, C. G. (1867). Skandinaviens Coleoptera, synoptiskt bearbetade. Tom. IX.
- Thomson, J. (1860). Rectification synonymique: Genre Neoclytus, Thomson. Musée Scientifique ou Recueil d'Histoire Naturelle. Paris, 1-67.
- Tikhomirova A.L. (1973) Morpho-ecological characteristics and phylogeny of Staphylinidae (with a catalogue of the fauna of the U.S.S.R.). Nauka; Moscow. [in Russian], 191.
- Toppo, N. A., Bhadoria, A. S., Kasar, P. K., & Trivedi, A. (2013). Paederus dermatitis among residents of nursing hostel in central India: An outbreak investigation. *Indian dermatology online journal*, 4(2), 153-155.
- Tóth, L. (1983). Holyvák V.—Staphylinidae V. VII kötet (Coleoptera II) 9. Füzet. 38 Ábrával. Magyarország Állatvilága [Fauna Hungarica]: 155: 1–69. Budapest: Akadémiai Kiadó.
- Tottenham, C.E. (1940). Some notes on the nomenclature of the Staphylinidae (Coleoptera). *Proceedings of the Royal Entomological Society of London* 9 (3): 49–53.
- Tottenham, C.E. (1949). The generic names of the British Staphylinidae with a check list of the species. Part 9. *In* The generic names of British insects: 345–466. London: Royal Entomological Society of London.
- Tronquet M. (1981) Staphylinidae d'Afghanistan (Coleoptera) *Rev.Francaise Ent* (n.s.) 3, 69-83.
- Turan, E. (2014). Paederus dermatitis in Southeastern Anatolia, Turkey: a report of 57 cases. *Cutaneous and ocular toxicology*, 33(3), 228-232.

- Uhlig, M. (1979). Beiträge zur Faunistik der Staphylinidae (Coleoptera). 2. Funde aus dem Frohberger Raum, Bezirk Leipzig. Abhandlungen und Berichte des Naturkundlichen Museums "Mauritianum" Altenburg 10(3): 239–268.
- Uhlig, M., J. Vogel, & M. Sieber. (1980). Beiträge zur Faunistik und systematik der Staphylinidae (Coleoptera). 3. Sammelsergebnisse aus dem Bezirk Schwerin (Mecklenburg). *Faunistische Abhandlungen* 7 (27): 239–257.
- Uzunoglu, E., Oguz, I. D., Kir, B., & Akdemir, C. (2017). Clinical and epidemiological features of *Paederus dermatitis* among nut farm workers in Turkey. *The American Journal of Tropical Medicine and Hygiene*, 96(2), 483.
- Varada, V. K., Sreerama Naik, S. R., Vishwambaran, S., & Balakrishnan, P. (2022). Impact of Urban Growth on Landuse and Land cover change. A case study of Pudusserri Gramapanchayat in Palakkad Gap using Geospatial Techniques. *Geographical Analysis*, 11(1), 33-38.
- Veraldi S, E. uka, Chiaratti A, Nazzaro G, Gianotti R, & Süß L. (2013). *Paederus fuscipes* dermatitis: a report of nine cases observed in Italy and review of the literature. *European Journal of Dermatology*, 23, 387–391.
- Verma, S., & Gupta, S. (2012). Ocular manifestations due to econda (*Paederus sabaeus*). *Medical journal armed forces india*, 68(3), 245-248.
- Vieira, J. S., Ribeiro-Costa, C. S., & Caron, E. (2014). Rove beetles of medical importance in Brazil (Coleoptera, Staphylinidae, Paederinae). *Revista Brasileira de Entomologia*, 58, 244-260.
- Vineesh, P. J., Mathew, A., Kavyamol, P. M., Vineetha, V. P., Rajagopal, R., Alfarhan, A., & Ramesh, V. (2023). Essential oils of cinnamon, turmeric and neem as potential control agents against home-invading acid flies (*Paederus fuscipes*) and darkling beetles (*Luprops tristis*). *Journal of King Saud University-Science*, 35(1), 102363.
- Vizitiu, D. E., Sărdărescu, I. D., Tița, A., & Buciumeanu, E. C. (2022). Seasonal abundance of insects from a vineyard in southern Romania.
- Vorderman, A. G. 1901. Huiduitslag veroorzaakt door *Paederus peregrinus* Fabr. Geneesk. Tijdschr. Ned. Indie. 41, 282-284.
- Voris, R. ((1934). Biologic investigations on the Staphylinidae (Coleoptera). Transactions of the Academy of Science of St Louis, 28, 231 – 261.
- Vorst, O. (1995). The genus *Ochtheophilum* in the Netherlands (Coleoptera: Staphylinidae).
- Walker F. (1858) Characters of some apparently undescribed Ceylon insects. *Ann. Mag. Nat. Hist. (ser. 3)* 2: 202-209.
- Walker, F. (1859) Characters of some apparently undescribed Ceylon insects (continued). *Annals and Magazine of Natural History* 3: 50-56.
- Watanabe, Y. (1979) Two New Species of the Genus *Ochtheophilum* (Coleoptera).

- Watanabe Y (2011) Three New Species of Brachypterous *Lathrobium* (Coleoptera, Staphylinidae) from Central China. *Elytra*, New Series, 1 (2): 177-186.
- Watanabe & Ning-nian, X. I. A. (1994) A New Apterous Ochtheophilum (Coleoptera, Staphylinidae) from Yunnan Province, Southwest China.
- Waterhouse, G. R. (1858). Catalogue of British Coleoptera. London: Taylor & Francis, iv + 3–117.
- Webster RP. (2016). Checklist of the Coleoptera of New Brunswick, Canada. *Zookeys*, 573, 387-512. doi: 10.3897/zookeys.573.8022. PMID: 27110174; PMCID: PMC4829933.
- Webster, R. P., & DeMerchant, I. (2012). New Staphylinidae (Coleoptera) records with new collection data from New Brunswick, Canada: Paederinae. *ZooKeys*, 186, 273.
- Wencker, J., & G. Silbermann. (1866). Catalogue des coléoptères de l'Alsace et des Vosges. Strasbourg: G. Silbermann, vi + 142.
- Wendeler, H. (1926) Fauna Buruana. Genus Puoderus Fabricius (Col. Staph.). (6. Beitrag zur Kenntnis der Staphyliniden). *Treubia*, 7, 328-330.
- Wiedemann C. R. W. (1823). Zweihundert neue Wer von Java, Bengalen und dem Vorgebirge der guten Hoffnung. *Zoological Magazine*, 2(1), 1–135.
- Willers J. (1999) Der Artenbestand der Gattung *Paederus* Fabricius s. l. (Coleoptera, Staphylinidae) von Nepal. *Veröffentlichungen des Naturkundemuseums Erfurt*, 18, 121-162.
- Willers J. (2001 a). Neue asiatische Arten der Gattung *Paederus* Fabricius s. l. aus der Sammlung des Naturhistorischen Museums Basel (Coleoptera, Staphylinidae). *Entomologica Basiliensia*, 23, 287-309.
- Willers J. (2001 b). Neubeschreibungen und Synonyme chinesischer Arten der Gattung *Paederus* s. l. (Coleoptera: Staphylinidae). *Stuttgarter Beiträge zur Naturkunde, Serie A (Biologie)* 625(22): 1–22.
- Willers, J. (2002). Three new species of *Paederus* and related genera from Thailand, Vietnam and South China (Coleoptera: Staphylinidae). *Zoosystematica Rossica*, 11(1), 155-162.
- Willers, J. (2018) Bestimmungsschlüssel für die *Paederus*-Arten von Nepal mit zwei Neubeschreibungen (Insecta: Coleoptera: Staphylinidae: Paederinae). *Vernate*, 37.
- Williams, S. A. (1979). The genus *Oligota* Mannerheim (Col., Staphylinidae) in the Ethiopian region. *Entomologist's monthly magazine*, 114, 177 – 190.
- Winkler, A. (1925). Catalogus Coleopterorum regionis palaearcticae. Vienna: Winkler & Wagner.
- Wollaston, T.V., (1864). Catalogue of the Coleopterous Insects of the Canaries in the Collection of the British Museum. order of the Trustees. 587.
- Wollaston, T.V. (1867) Coleoptera Hesperidum, being an enumeration of the coleopterous insects of the Cape Verde archipelago. J. Van Voorst, London. xxxix + 285.

- Wyatt, T. D (1993): Submarine beetles: when the tide comes in, they batten down the hatches. – *Natural History*, 102 (7), 6, 8–9.
- Xiao-Yan Li, Alexey Solodovnikov, Hong-Zhang Zhou (2013) The genus *Pseudolathra* Casey in China: new species and new records (Coleoptera: Staphylinidae: Paederinae). *ZooKeys*, 356.
- Yan, X. R., Wang, Z. Y., Feng, S. Q., Zhao, Z. H., & Li, Z. H. (2022). Impact of temperature change on the fall armyworm, *Spodoptera frugiperda* under global climate change. *Insects*, 13(11), 981.
- You, D. O., Kang, J. D., Youn, N. H., & Park, S. D. (2003). Bullous contact dermatitis caused by self-applied crushed *Paederus fuscipes* for the treatment of vitiligo. *Cutis-New York*, 72(5), 385-390.
- Zakqy N. & Wiyatiningsih S. (2023). Diversity of important pests and natural enemies in rice plants. Seminar Nasional Agroteknologi. *NST Proceedings*. pages 82-/86. doi: 10.11594/ nstp.2023.3117.
- Zargari, O., Kimyai-Asadi, A., Fathalikhani, F., & Panahi, M. (2003). *Paederus* dermatitis in northern Iran: a report of 156 cases.
- Zerche, L. (1990) Monographie der paläarktischen Coryphiini (Coleoptera, Staphylinidae, Omaliinae). Akademie der Landwirtschaftswissenschaften der Deutschen Demokratischen Republik, Berlin, 413.
- Żyła, D., Yamamoto, S., & Jenkins Shaw, J. (2019). Total-evidence approach reveals an extinct lineage of Paederinae rove beetles from Cretaceous Burmese amber. *Palaeontology*, 62(6), 935-949.
- Żyła, D., Bogri, A., Heath, T. A., & Solodovnikov, A. (2021). Total-evidence analysis resolves the phylogenetic position of an enigmatic group of Paederinae rove beetles (Coleoptera: Staphylinidae). *Molecular phylogenetics and evolution*, 157, 107059.

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**First record of vesicant beetles:
Paederus nigricornis Bernhauer, 1911 from south India;
P. extraneus Wiedemann, 1823 and *P. alternans* Walker, 1858
(Staphylinidae, Paederinae) from Kerala**

P.M. Kavyamol, P.J. Vineesh* and V.P. Vineetha

PG and Research Department of Zoology, St. Joseph's College (Autonomous), Devagiri, Kozhikode, Kerala, India.

Email: kavyamohan5540@gmail.com; vineeshpj@gmail.com; vineethavpnambiar@gmail.com

ABSTRACT: Three vesicant beetles were reported. *Paederus nigricornis* Bernhauer, 1911 from south India and, occurrence of *P. extraneus* Wiedemann, 1823 and *P. alternans* Walker, 1858 in Kerala. Taxonomic description of each species with remarks is presented. © 2023 Association for Advancement of Entomology

KEYWORDS: *Paederus dermatitis*, geographical distribution, taxonomic description

The genus *Paederus* is a medically important group of rove beetles and a threat to human beings. Around fifty species of *Paederus* are known to cause *Paederus dermatitis*. Even though a number of *Paederus dermatitis* cases have been reported from various parts of India, taxonomic work on this group in India is insufficient. *Paederus* Fabricius, 1775 is a genus of beetles under the subfamily Paederinae of the family Staphylinidae (rove beetles). More than 600 species of *Paederus* have been described so far, among which 50 species of *Paederus* beetles are known to cause *Paederus dermatitis* (Veraldi *et al.*, 2013). *Paederus* beetles produce vesicant toxin, pederin causing skin irritation (Uzunođlu *et al.*, 2017). These beetles are predators and are commonly found in paddy fields and other plantations (Vineesh *et al.*, 2022). Most of them live in moist areas, such as at the edges of freshwater lakes, riverine floodplains, marshes and rice fields (Frank and Kanamistu, 1987). They are beneficial to agriculture as they eat crop pests

(Mammino, 2011). At the same time they are harmful to humans as they cause *Paederus dermatitis*. When crushed against the skin, they release the haemolymph toxin Pederin that causes *Paederus dermatitis* which is also known as spider lick, night burn and dermatitis linearis (Nasir *et al.*, 2015). Thirty five species of the *Paederus* are reported from India which includes thirty one species listed by Cameron (1931) and the four species by Löbl and Löbl (2015) and Biswas and Sen Gupta (1982) and this 20 species are from south India. *Paederus dermatitis* is very common in tropical regions like Kerala (Kambil, 2018). Identification of the dermatitis causing *Paederus* species is necessary, prior to taking preventive measures against them. But taxonomic studies on this genus are inadequate at the subgeneric and species levels (Nikbakhtzadeh *et al.*, 2012).

Specimens were collected during the period 2018–2020 using Light traps from the paddy fields at

* Author for correspondence

Ambalavayal (11.6165° N; 76.2140° E) and Theneri (11.6386° N; 76.1407° E), Wayanad district. Collected beetles were transferred into vials (containing 70% alcohol). All the collected beetles were examined using Stereo Zoom Trinocular Microscope (LABOMED – 200 MAR, CODE:- ZM 45 TM). Specimens were identified using the taxonomic key available in Cameron, 1931 and verified by the photograph given in Sar and Ilango, 2016. Photographs of the specimens were taken with a Leica MC170HD camera attached to a Leica M205C stereomicroscope. Identified specimens are deposited to the insect collections of Zoological Survey of India, Western Ghats Regional Centre, Kozhikode station.

Abbreviations used: Measurements -

TL: Total length of the specimen; AL: Antennal Length; HL: Head length i.e., from the anterior margin of clypeus to posterior margin of head; HW: Head Width including eyes; PL: Pronotal length; PW: Pronotal width; EL: Length of elytra; EW: Width of elytra.

***Paederus nigricornis* Bernhauer, 1911 (Fig. 1)**

Paederus nigricornis Bernhauer 1911: 61; Bernhauer and Schubert 1912: 209; Cameron 1925: 36; id. 1928: 560; id. 1931: 47; Scheerpeltz 1933:1226; Blackwelder 1939: 112; Scheerpeltz 1957: 474; Coiffait 1978: 553; id. 1982: 33; Frank 1988: 123; Thapa 2000: 260; Willers 2001: 21; Löbl and Smetana 2004: 611; Li *et al.*, 2013; Nikbakhtzadeh *et al.*, 2012: 5; Sar and Hedge 2015: 102; Löbl and Löbl 2015: 987; Sar and Ilango 2016: 234.

Specimen examined: 1♀, 19.ii.2020, Theneri, Wayanad district (11.6386° N; 76.1407° E), Coll. Kavyamol P M, Light trap.

Diagnosis: Measurements: TL: 7.13 mm; AL: 2.26 mm; HL: 0.91 mm; HW: 0.98 mm; PL: 0.93 mm; PW: 0.74 mm; EL: 1.26 mm; EW: 1.22 mm

Colour: Head, first visible and last two segments of the abdomen black in colour; thorax and second to fourth abdominal segments red; elytra blue; antennae black coloured with the first two joints

slightly testaceous; palpi and legs, including the coxae black.

Head: Elongate, longer than broad and broader than the thorax. The eyes prominent and the post - ocular region almost straightly converge to the neck. Sculpture consists of big and small punctures, the post-ocular region with a few setae, otherwise smooth.

Thorax: Narrow, oval and longer than broad, impunctate at the middle, the sides sparingly and very finely punctured with a few erect black setae.

Elytra: Slightly longer and broader than the thorax, parallel, rather finely and not very closely punctured, with fairly long, semi-erect, black pubescence.

Abdomen: Closely punctured at the base of the first visible segment, elsewhere sparingly punctured, the pubescence yellow with a few longer black setae.

Distribution: India (Kerala: Wayanad, Theneri; Himachal Pradesh: Simla Hills; Uttarakhand: Chakrata district Garhwal hills; Sikkim; Uttar Pradesh: Allahabad-Ramghat; Mizoram; West Bengal: Darjeeling, Nurbong and Mahanadi Valleys). Elsewhere: Nepal: Sundarijal, Ramechhap: Khimti Khola, Shivalaya; Iran (Mt. Taftan); China (Hubei, Sichuan, Xizang,); Afghanistan; Pakistan.

Remarks: First record of dermatitis causing *Paederus nigricornis* from south India.

***Paederus extraneus* Wiedemann, 1823 (Fig. 2)**

Paederus extraneus Wiedemann 1823:13; Dejean 1833: 65; Erichson 1840: 661; Kraatz 1859: 152; Gemminger and Harold 1868: 627; Bernhauer and Schubert 1912: 206; Cameron 1925: 35; id.1931: 41; Scheerpeltz 1933: 1223; Frank 1988: 110; Taneja *et al.*, 2013:135; Gopal 2014: 4736.

Specimens examined: 2♂♀, 19.ii.2020, Theneri, Wayanad district (11.6386° N; 76.1407° E), Coll. Kavyamol P M, Light trap.

Diagnosis: Measurements: TL: 6.28 mm; AL: 2.51 mm; HL: 0.92 mm; HW: 0.96 mm; PL: 1.15 mm; PW: 1.05 mm; EL: 1.62 mm; EW: 1.44 mm

Colour: Head black, elytra blue, thorax and first four segments of the abdomen red; antennae and palpi dark at base; first two joints of the antennae slightly yellowish below and dark above, the rest black; palpi dark testaceous, the third joint black and the mandibles black; thorax red and black coloured scutellum; abdomen black with the first four segments red and sternum black; legs with black coxae.

Head: Orbicular and as broad as the thorax, rather convex above, shining, closely and finely punctured.

Thorax: Somewhat oval and almost as broad as the elytra, a little longer than broad, the sides a bit rounded, narrowed behind, convex, closely and finely punctured, middle portion without punctures.

Elytra: Hardly a fourth longer than the thorax, closely, not very strongly punctured, slightly shining and covered with white pubescence.

Abdomen: Abdomen with fine punctures, pubescence long and white.

Distribution: India (Kerala: Wayanad; Theneri; West Bengal; Andhra Pradesh; Karnataka: Manipal). Elsewhere: Nepal.

Remarks: First record of dermatitis causing *Paederus extraneus* from Kerala.

***Paederus alternans* Walker, 1858 (Fig. 3)**

Paederus alternans Walker 1858: 205; Gemminger and Harold 1868: 626; Cameron 1925: 34; id. 1930: 332; id. 1931: 41; Scheerpeltz 1933: 1220; id. 1935: 607; id. 1965: 103; id. 1978: 196; Biswas and Sen Gupta 1982: 150; Frank 1988: 100; Willers 2001: 21; Löbl and Smetana 2004: 614; Li *et al.*, 2013: 336; Löbl and Löbl 2015: 986.

Specimens examined: 1♂, 10.iii.2018, Ambalavayal, Wayanad district (11.6165° N; 76.2140° E), Coll. Kavyamol P M, Light trap, 1♀, 19.ii.2020, Theneri, Wayanad district (11.6386° N; 76.1407° E), Coll. Kavyamol P M, Light trap.

Diagnosis: Measurements: TL: 6.37 mm; AL: 2.08 mm; HL: 0.908 mm; HW: 0.95 mm; PL: 0.91 mm; PW: 0.73 mm; EL: 1.3 mm; EW: 1.2 mm

Colour: Head black. Elytra blue. Last two abdominal segments black, thorax and first four visible segments red; antennae black, the first three segments slightly testaceous; palpi with the third joint black; legs black, the coxae and extreme base of the femora testaceous.

Head: Orbicular, the post-ocular region slightly rounded to the neck, a little broader than the thorax, with a few small setiferous punctures.



Fig. 1 *Paederus nigricornis*

Fig. 2 *Paederus extraneus*Fig. 3 *Paederus alternans*

Thorax: Convex, ovate and longer than broad, not much narrowed behind, smooth along the middle, the sides with fine setiferous punctures.

Elytra: Slightly broader and about a third longer than the thorax, parallel, rather finely and not very closely punctured having fine greyish semi-erect pubescence.

Abdomen: Finely and scarcely punctured, finely and sparingly pubescent with a few long black setae.

Distribution: India (Kerala: Wayanad; Ambalavayal, Theneri; Himalaya; Karnataka: Kanara; Tamil Nadu: Nilgiri Hills). Elsewhere: Sri Lanka (Colombo, Maskeliya); Myanmar (Kawkareik: Pegu, Annam, Tonkin); China (Guangxi, Hainan); Vietnam (Tonkin).

Remarks: First record of dermatitis causing *Paederus alternans* from Kerala.

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REFERENCES

- Bernhauer M. (1911) Zur Staphylinidenfauna Ostindiens und der Sundainseln. *Entomologische Blätter* 7: 55–93.
- Bernhauer M. and Schubert K. (1912) Staphylinidae. In: *Coleopterorum Catalogus*. 40, W. Junk, Berlin. pp 191–288.
- Biswas D.N. and Sen Gupta T. (1982) New species and new records of Staphylinidae (Coleoptera) from India and Sri Lanka. *Revue suisse de zoologie* 89: 135–154.
- Blackwelder R.E. (1939) A generic revision of the staphylinid beetles of the tribe Paederini. *Proceedings of the United States National Museum* 87: 93–125.
- Cameron M. (1925) Catalogue of Indian insects. Part 6 - Staphylinidae. Government of India, Central. Publications Branch, Calcutta. 126 pp.
- Cameron M. (1928) The Staphylinidae (Coleoptera) of the Third Mount Everest Expedition. *The Annals and magazine of natural history; zoology, botany, and geology (series 10)* 2: 558–569.
- Cameron M. (1930) Fauna Sumatrensis (Bijdrage Nr. 67). Staphylinidae (Col.). *Tijdschrift voor entomologie* 73: 325–348.
- Cameron M. (1931) The fauna of British India including Ceylon and Burma. *Coeloptera, Staphylinidae*, Vol.2, (Paederinae). Taylor and Fancis, London. pp 1–250.
- Coiffait H. (1978) Staphylinides du Nouristan (Afghanistan). *Annales de la Société entomologique de France (n.s.)* 14: 551–569.
- Coiffait H. (1982) Coléoptères Staphylinidae de la région paléarctique occidentale IV. Sous famille Paederinae tribe Paederinae 1 (Paederi, Lathrobii). *La Nouvelle Revue d'Entomologie* 12(4) suppl.: 1–440.
- Dejean P.F.M.A. (1833) Catalogue des coléoptères de la collection de M. le comte Dejean [2nd. ed.]. Mequignon-Marvis, Paris. pp 4–43.
- Erichson W.F. (1840) Genera et species Staphylinorum *Coleopterorum familiae*. Pt. Morin; Berlin. pp 401–954.
- Frank J.H. (1988) *Paederus*, sensu lato (Coleoptera: Staphylinidae): An index and review of the taxa. *Insecta Mundi* 2: 97–159.
- Frank J.H. and Kanamitsu K. (1987) *Paederus*, sensu lato (Coleoptera: Staphylinidae): natural history and medical importance. *Journal of Medical Entomology* 24:155–191.
- Gemminger and Harold E. von (1868) *Catalogus Coleopterorum hucusque descriptorum synonymicus et systematicus* 2: 425–752.
- Gopal K.V.T. (2014) *Paederus* Dermatitis: A Clinical, Epidemiological and Therapeutic Study of 417 Cases. *Journal of Evolution of Medical and Dental Sciences* 3: 4736–4743.
- Kambil S.M. (2018) A study of blister beetle dermatitis. *International Journal of Research in Dermatology* 4: 72–74.
- Kratz G. (1859) Die Staphylinen-Fauna von Ostindien, insbesondere der Insel Ceylan. *Archiv für Naturgeschichte* 25(1): 1–198.
- Li X.Y., Zhou H.Z. and Solodovnikov A. (2013) Five New Species of the Genus *Paederus* from Mainland China, with a Review of the Chinese Fauna of the Subtribe Paederina (Coleoptera: Staphylinidae: Paederinae). *Annals of the Entomological Society of America* 106(5): 562–574.
- Löbl I. and Löbl D. (2015) Catalogue of Palaearctic Coleoptera. Hydrophiloidea- Staphyloidea. Vol. 2. Revised and updated edition. Brill, Leiden, Boston, xxvi + 1702 pp. ISBN 978-90-04-28992-5.
- Löbl I. and Smetana A. (2004) Family Staphylinidae Latreille, 1802. In: *Catalogue of Palaearctic Coleoptera*. 2. Apollo Books, Stenstrup. pp. 579–624.
- Mammino J.J. (2011) *Paederus* dermatitis: An outbreak on a medical mission boat in the Amazon. *Journal of Clinical and Aesthetic Dermatology* 4: 44–46.
- Nasir S., Akram W., Khan R.R., Arshad M and Nasir I. (2015) *Paederus* beetles: the agent of human dermatitis. *Journal of Venomous Animals and Toxins including Tropical Diseases* 21: 5. doi: 10.1186/s40409-015-0004-0.
- Nikbakhtzadeh M.R., Naderi M. and Safa P. (2012) Faunal diversity of *Paederus fabricius* 1775 (Coleoptera: Staphylinidae) in Iran. *Insecta Mundi* 267: 1–9.
- Sar A. and Hegde V.D. (2015) New records of rove beetles (Coleoptera: Staphylinidae: Paederinae) from Uttar Pradesh, India. *Records of the Zoological Survey of India* 115(1): 101–103.
- Sar A. and Ilango K. (2016) New records of rove beetles

- (Coleoptera: Staphylinidae: Paederinae) from Mizoram, India. Records of the Zoological Survey of India 116 (3): 233–240.
- Scheerpeltz O. (1933) Staphylinidae II. In: Coleopterorum Catalogus. 129, W. Junk, Berlin, pp 989–1500.
- Scheerpeltz O. (1935) Staphyliniden aus dem Sundainseln und Nordaustralien. Revue suisse de zoologie 42: 593–659.
- Scheerpeltz O. (1957) Vorläufige Diagnosen einiger neuen palataktischen Arten und Formen der Gattungen *Paederidus* Muls. Rey, *Paederus* Fabr. (mit den neuen Untergattungen *Eopaederus*, *Paederus* s. str. nov., *Heteropaederus*, *Dioncopaederus* und *Oedopaederus*), *Parameropaederus* nov. gen., *Lobopaederus* nov. gen. und *Megalopaederus* nov. gen. Memorie del Museo di Storia Naturale della Venezia Tridentina 11: 447–475.
- Scheerpeltz O. (1965) Wissenschaftliche Ergebnisse der Schwedischen Expedition 1934 nach Indien und Burma. Coleoptera Staphylinidae (except. Megalopsidiinae et Steninae). Arkiv för zoologi 17: 93–371.
- Scheerpeltz O. (1978) Wissenschaftliche Ergebnisse der von Dr. Raul do Nascimento Ferreira-Coimbra, Portugal während seines Aufenthaltes von Ende des Jahres 1964 bis zum Anfang des Jahres 1966 auf der Insel Tior, der ostlichsten der kleinen Sundainseln, durchgeführten Aufsammlungen von Staphyliniden (Coleoptera). Eos, Madrid 52: 185–232.
- Taneja A., Nayak S. and Shenoi S.D. (2013) Clinical and epidemiological study of *Paederus* dermatitis in Manipal, India. Journal of Pakistan Association of Dermatologists 23: 133–138.
- Thapa V.K. (2000) An Inventory of Nepal's Insects. Vol. III. IUCN Nepal, Kathmandu. 475 pp.
- Uzunodlu E., Oguz I.D., Kir B. and Akdemir C. (2017) Clinical and epidemiological features of *Paederus* dermatitis among nut farm workers in Turkey. American Journal of Tropical Medicine and Hygiene 96(2): 483–487.
- Veraldi S., Cuka E., Chiaratti A., Nazzaro G., Gianotti R. and Süß L. (2013) *Paederus fuscipes* dermatitis: a report of nine cases observed in Italy and review of the literature. European Journal of Dermatology 23: 387–391.
- Vineesh P.J., Athira M., Kavyamol P.M., Vineetha V.P., Rajakrishnan R., Ahmed A., Sameh M.H. and Varsha R. (2022) Essential oils of cinnamon, turmeric and neem as potential control agents against home-invading acid flies (*Paederus fuscipes*) and darkling beetles (*Luprops tristis*). Journal of King Saud University - Science 35: 102363.
- Walker F. (1858) Characters of some apparently undescribed Ceylon Insects. The Annals and Magazine of Natural History 2(3): 202–209.
- Wiedemann C.R.W. (1823) Zweihundert neue Wer von Java, Bengalen und dem Vorgebirge der guten Hoffnung. Zoologisches Magazin 2(1): 1–135.
- Willers J. (2001) Neubeschreibungen und Synonyme chinesischer Arten der Gattung *Paederus* s.l. (Coleoptera: Staphylinidae). Stuttgarter Beiträge zur Naturkunde, Serie A (Biologie) 625(22): 1–22.

Species composition, abundance and seasonality of dermatitis causing *Paederus* rove beetles in paddy fields of Malabar region, Kerala, India

P.M. Kavyamol, P.J. Vineesh* and V.P. Vineetha

PG and Research Department of Zoology, St. Joseph's College (Autonomous), Devagiri, Kozhikode, Kerala, India.

Email: kavyamohan5540@gmail.com; vineeshpj@gmail.com, vineethavpnambiar@gmail.com

ABSTRACT: Species composition, abundance, and seasonality of *Paederus* in the paddy fields of the Malabar region, Kerala, India, are analysed. Among the five species of *Paederus* beetles collected from Malabar, four are known to cause dermatitis. *Paederus sondaicus* Fauvel 1895 was the dominant species in the paddy fields of the Malabar region. Regional variation in the species composition, abundance, and seasonality of species was observed. *P. sondaicus* was dominant in Wayanad and Palakkad, *P. fuscipes* Curtis, 1826 in Malappuram and Kozhikode and *P. extraneus* Wiedemann, 1823 in Kannur. A modified taxonomic key for identification of *Paederus* beetles in Kerala is provided.

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KEY WORDS: Rove beetles, regional variation, rice ecosystem, pederin, linear dermatitis

INTRODUCTION

Paederus Fabricius, 1775 is a genus of Rove beetle belonging to the subfamily Paederinae of the family Staphylinidae, with more than 622 species distributed in all continents except Antarctica (Zargari *et al.*, 2003; Mammino, 2011). In general, species of *Paederus* inhabit moist environments such as marshes, edges of freshwater lakes, river banks, and crop fields (Frank and Kanamitsu, 1987). *Paederus* species are nocturnal in habit, remain under bark, stones, soil, litter during day time (Frank and Kanamitsu, 1987; Nasir *et al.*, 2012; Bong *et al.*, 2012). There are predators on soft bodied insects; soil nematodes and hence act as biological control agents (Frank and Kanamitsu, 1987, Bong *et al.*, 2015, Maruthadurai *et al.*, 2022). Large

populations of *Paederus* have been recorded from agricultural habitats which make them beneficial due to their feeding on insect pests of major crops and fodders (Devi *et al.*, 2003), particularly insect pests like *Heliothis armigera* Hübner, 1808; *Aphis gossypii* Glover, 1877; *Earias vittella* Fabricius, 1794; *Spodoptera litura* Fabricius, 1775; *Marasmia patnalis* Bradley, 1981; *Aphis glycines* Matsumura, 1917 and many dipterous and other arthropods (Berglind *et al.*, 1997; Krakerb *et al.*, 2000; Devi *et al.*, 2003). However, the benefits provided by species of *Paederus* are annulled by the problems they cause for humans (Bong *et al.*, 2015). When a beetle is brushed vigorously over the skin or crushed, a toxic haemolymph containing Pederin is released those leads to localized blistering (Kitisin and Sukphopetch, 2021) and inflammation

* Author for correspondence

referred as *Paederus* mediated dermatitis also called linear dermatitis, dermatitis linearis, Nairobi fly dermatitis, spider-lick, whiplash, Blister beetle dermatitis (Zargari *et al.*, 2003; Mullen and Durden, 2009). *P. fuscipes* is reported to cause *Paederus* dermatitis in Kerala (Ramakrishnan *et al.*, 2019). Eleven species of *Paederus* are recorded till now from Kerala including three species recorded by Cameron (1931) and Kavyamol *et al.* (2023), and there is no recent taxonomic analysis of the *Paederus* beetles in the paddy fields of the Malabar region. Present study was undertaken to identify the species of *Paederus* beetles in Malabar region and to generate baseline ecological data of *Paederus* beetles in Malabar region.

MATERIALS AND METHODS

Sampling for ecological studies: During 2018–2019 light traps (SAFS ltrap 01 B) were used to sample *Paederus* beetles. Ten light traps were placed at a distance of 100 meters within a paddy field and monthly collections were made from Palakkad (10.6726° N, 76.7531° E), Malappuram (10.9015° N, 76.1904° E), Wayanad (11.6165° N, 76.2140° E), Kozhikode (11.4146° N, 75.9363° E) and Kannur (11.7481° N, 75.4929° E). Thus, thirty samples were collected from each site during Pre-summer (December, January, February/Pre-harvesting), Summer (March, April, May/Harvesting) and Monsoon (September, October, November/ Post-harvesting) seasons. Traps were operated from 6pm to 7am the next day. Trapped beetles were collected and transferred into vials containing 70% alcohol. Beetles collected were examined under a Stereo Zoom Trinocular Microscope (LABOMED – 200 MAR, CODE:- ZM 45 TM). Specimens were identified with the help of keys provided by Cameron (1931). Photographs were taken with a Leica MC170HD camera attached to a Leica M205C stereomicroscope.

Species abundance data was tested for normality with Anderson-Darling test and opted parametric tests for further analysis. Shannon diversity index was calculated to analyse the diversity of *Paederus* beetles in different seasons at different collection

sites. Two-way ANOVA followed by Tukey's test was done to compare the species abundance between habitats and seasons. All statistical analyses were done using PAST software version 3.15 (Hammer *et al.*, 2001). For all analyses, significance was determined at $P < 0.05$.

RESULTS AND DISCUSSION

Overall Species composition, abundance and distribution: Five species of *Paederus* were recorded in the paddy fields of Malabar region (Plate 1). Among these, *P. sondaicus* Fauvel 1895 was the dominant ($F = 97.72$; $P < 0.0001$) (Fig. 1). Tukey's comparison examined whether there is any possible difference between the mean of all possible pairs and found that, *P. sondaicus* showed difference in abundance with that of *P. alternans* Walker, 1858, *P. extraneus* Wiedemann, 1823, *P. nigricornis* Bernhauer, 1911 and *P. fuscipes* Curtis, 1826 (Table 1).

Site wise Species composition, abundance and distribution: Variation in species composition and abundance in different localities was recorded. Highest diversity was recorded in Wayanad. Five species were recorded from Wayanad and *P. sondaicus* as the dominant there ($F = 89.07$; $P < 0.0001$). Comparison of the abundance of species collected from Wayanad found that *P. fuscipes* showed difference in abundance with that of *P. sondaicus* ($P < 0.05$), *P. alternans* ($P < 0.0001$), *P. extraneus* ($P < 0.0001$), *P. nigricornis* ($P < 0.0001$); *P. sondaicus* showed difference in abundance with that of *P. alternans* ($P < 0.0001$), *P. extraneus* ($P < 0.0001$), *P. nigricornis* ($P < 0.0001$) (Table 2, 3).

Three species of *Paederus* were recorded from Malappuram and *P. fuscipes* was dominant here ($F = 125.8$; $P < 0.0001$). Tukey's comparison indicates that in Malappuram, *P. fuscipes* showed difference in abundance with *P. sondaicus* ($P < 0.0001$) and *P. alternans* ($P < 0.0001$); *P. sondaicus* showed difference in abundance with that of *P. alternans* ($P < 0.0001$). Two species of *Paederus* were recorded from Palakkad and *P. sondaicus* was the dominant species ($F = 691.9$; $P < 0.0001$). Tukey's test compared the abundance of that species and found that in this site, there is a difference in abundance of *P. fuscipes* with that of

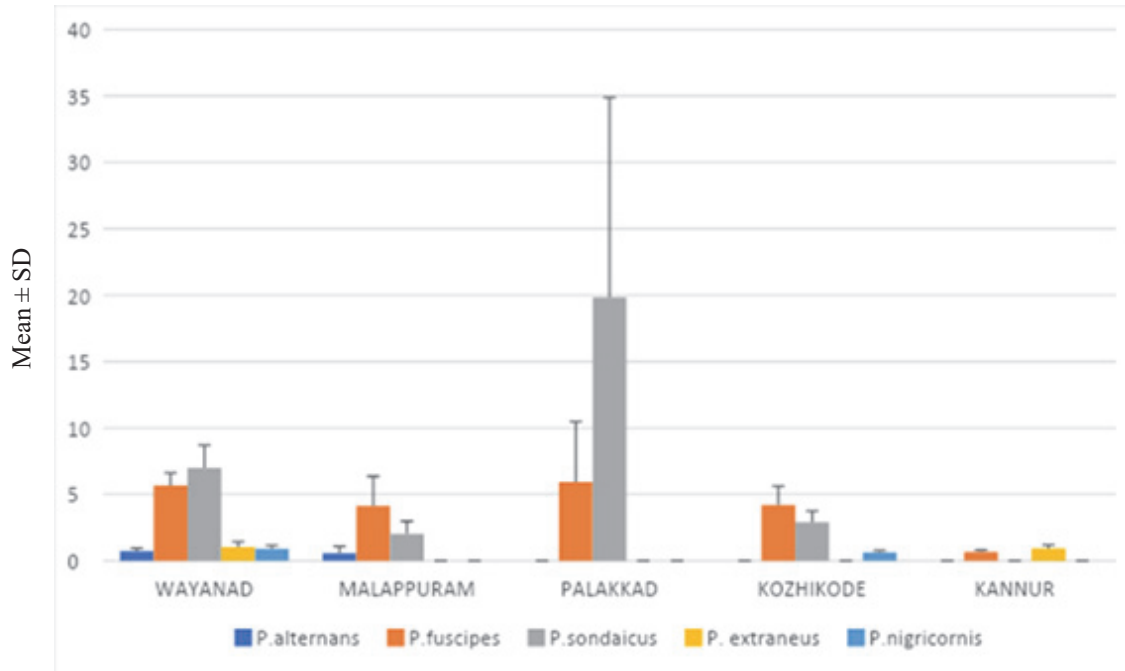


Fig. 1 Abundance of *Paederus* beetles collected from Malabar region

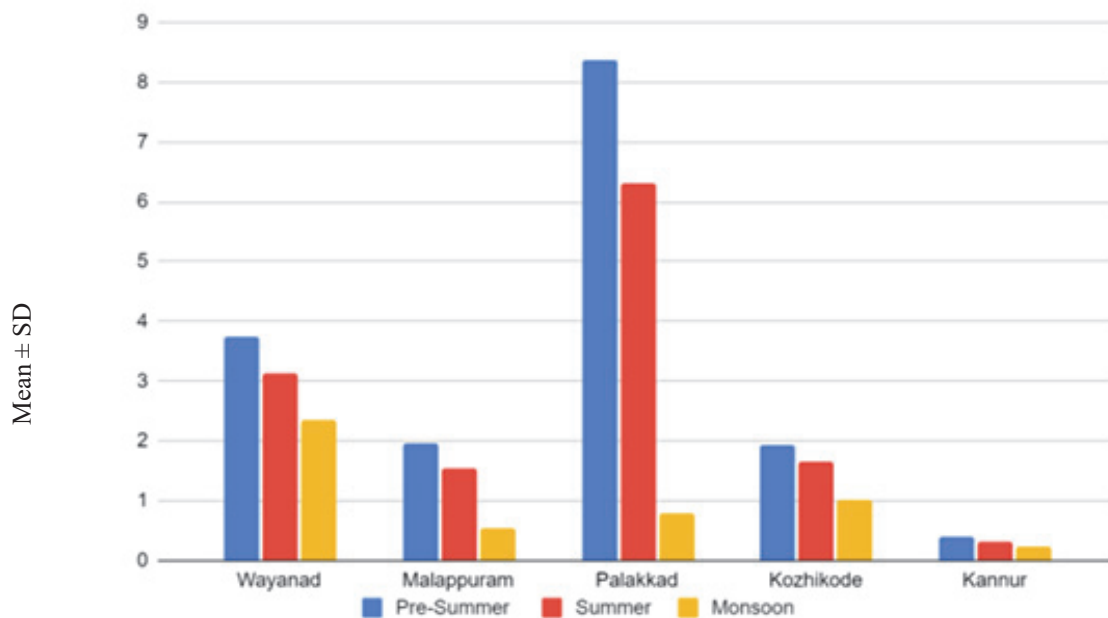


Fig. 2 Seasonality of *Paederus* beetles collected from Malabar region Pre-summer (December, January, February); Summer (March, April, May); Monsoon (September, October, November)

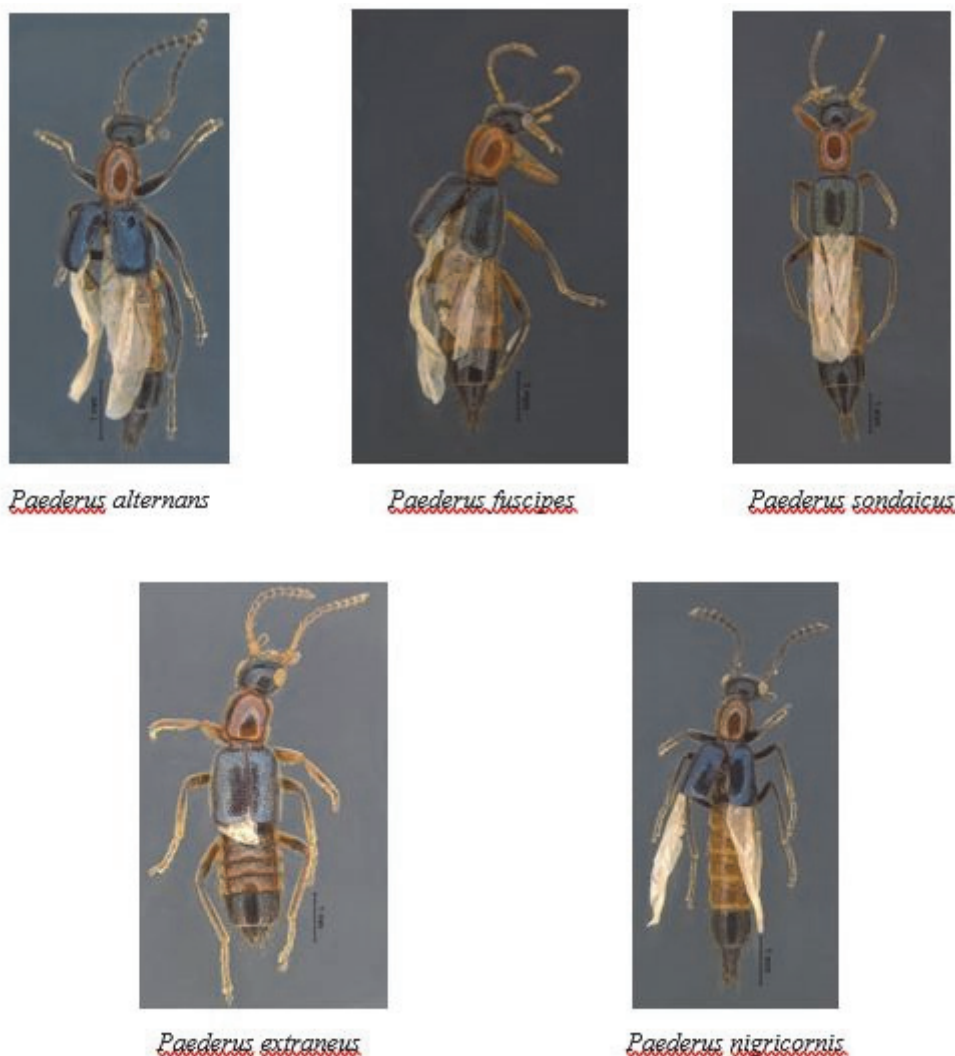


Plate 1. Species recorded in paddy fields of Malabar region

P. sondaicus ($P < 0.0001$). Three species of *Paederus* were recorded from Kozhikode and *P. fuscipes* was the dominant species ($F=167.8$; $P < 0.0001$). Tukey's comparison results that, *P. fuscipes* has shown a difference in abundance with *P. sondaicus* ($P < 0.0001$), *P. nigricornis* ($P < 0.0001$); *P. sondaicus* has shown a difference in abundance with *P. nigricornis* ($P < 0.0001$). Two species of *Paederus* were recorded from Kannur with *P. extraneus* as the dominant one ($F= 5.987$; $P < 0.05$). Comparison of abundance of species collected from Kannur indicated that there is a difference in abundance between *P. extraneus* and *P. fuscipes* ($P < 0.05$).

All species were not recorded from all collection sites. *P. alternans* was recorded only from Wayanad and Malappuram; *P. fuscipes* were captured from all the five collection sites *i.e.*, Palakkad, Malappuram, Kozhikode, Kannur and Wayanad; *P. sondaicus* from all the collection sites except Kannur region; *P. extraneus* from Wayanad and Kannur; *P. nigricornis* from Kozhikode and Wayanad. The highest overall abundance (Mean $\pm$ SD) of the total *Paederus* beetles was recorded at Palakkad followed by Wayanad.

Overall Seasonality: *P. fuscipes* ($P < 0.0001$), *P. sondaicus* ($P < 0.0001$), and *P. alternans* ($P <$

0.001) showed high dominance during pre- summer (December, January and February) in Malabar region. Tukey's test for seasonal comparison of the dominant *Paederus* species indicated that, there was a significant variation of the abundance of *P. fuscipes* between all the three seasons (Table 4).

Site-wise Seasonality: *Paederus* beetles showed seasonality in abundance with high dominance during pre- summer season in all the collection sites (Fig. 2). *P. sondaicus* ($P < 0.05$), *P. extraneus* ($P < 0.001$) and *P. nigricornis* ($P < 0.01$) showed seasonality with high abundance during the pre-summer in Wayanad. Likewise, among the three species recorded from Malappuram, *P. fuscipes* ($P < 0.0001$) and *P. sondaicus* ($P < 0.001$) showed seasonality in abundance. The average number of all species collected from Palakkad has shown significant seasonal variation *i. e.*, *P. fuscipes* ($P < 0.0001$) and *P. sondaicus* ($P < 0.0001$) have shown seasonality in abundance. Similarly, in Kozhikode *P. fuscipes* ($P < 0.0001$) and *P. sondaicus* ($P < 0.0001$) showed seasonality in abundance. From Kannur, *P. extraneus* showed seasonality in abundance ($P < 0.05$). Two-way ANOVA was done to compare the abundance of *Paederus* beetles irrespective of species, between different habitat (collection sites) and seasons. There was a significant variation in *Paederus* beetle abundance between different habitats ($F=4.41$; $P < 0.05$) but there was no significant variation between the seasons ($F=2.87$; $P > 0.05$).

As per literature references, a total of 11 species of *Paederus* are reported till now from Kerala (Table 5). A taxonomic key for the identification of these species is prepared.

Key to the *Paederus* species of Kerala (modified from Cameron, 1931)

- 1 Unicolorous species with reddish yellow colour.....*P. pallidus*
Species multicolored.....2
- 2 Elytra reddish.....*P. mussardi*
Elytra bluish or blackish.....3
- 3 Elytra vertically impressed near lateral

Table 1. Tukey's table (Studentized range statistic) the comparison of total *Paederus* species collected from Malabar region

Species name	Q value	P value
<i>P. fuscipes</i> / <i>P. sondaicus</i>	7.87	<0.0001
<i>P. fuscipes</i> / <i>P. alternans</i>	13.56	<0.0001
<i>P. fuscipes</i> / <i>P. extraneus</i>	13.15	<0.0001
<i>P. fuscipes</i> / <i>P. nigricornis</i>	13.44	<0.0001
<i>P. sondaicus</i> / <i>P. alternans</i>	21.43	<0.0001
<i>P. sondaicus</i> / <i>P. extraneus</i>	21.02	<0.0001
<i>P. sondaicus</i> / <i>P. nigricornis</i>	21.31	<0.0001
<i>P. alternans</i> / <i>P. extraneus</i>	0.42	>0.05
<i>P. alternans</i> / <i>P. nigricornis</i>	0.12	>0.05
<i>P. extraneus</i> / <i>P. nigricornis</i>	0.29	>0.05

- margins.....*P. loebli*
- Elytra without vertical impression.....4
- 4 Apterous, head red.....*P. hingstoni*
Winged, head black, blue or blueblack.....5
- 5 Head black.....7
Head blueblack.....6
- 6 Legs including the coxae entirely black.....*P. kuluensis*
Legs with at least the coxae reddish brown.....*P. variicornis*
- 7 Legs wholly dark brownish black including the coxae.....8
Legs in part at least testaceous.....9
- 8 Post-ocular region almost rounded.....*P. extraneus*
Post-ocular region straightly converging to the neck.....*P. nigricornis*
- 9 Legs black, the coxae and extreme base of the femora reddish yellow.....*P. alternans*
Legs almost yellowish and anterior femora entirely testaceous.....10
- 10 Larger (>9mm). Last joint of antennae testaceous..... *P. sondaicus*

Smaller (<7.5mm). Last joint of antennae concolorous.....*P. fuscipes*

The high abundance of *Paederus* beetles, in paddy fields, is closely linked to their role as natural predators that coexist with numerous agricultural pests (Bong *et al.*, 2015). Specifically, proximity to paddy fields is a pivotal factor in the outbreak of *Paederus* beetle dermatitis (Coondoo and Nandy, 2013). The current study further revealed that paddy fields serve as the optimal habitat for *Paederus* beetles (Frank and Kanamitsu, 1987; Bong *et al.*, 2015), indicating their preference for this particular ecological niche.

Among the five species of *Paederus* collected from paddy fields of Malabar region, the following species are known to cause dermatitis in different parts of the world: *P. fuscipes* (Frank and Kanamitsu 1987; Verma and Agarwal 2006; Toppo *et al.*, 2013; Ramakrishnan *et al.* 2019); *P. alternans* (Frank and Kanamitsu, 1987), *P. extraneus* (Taneja *et al.*, 2013; Gopal 2014) and *P. nigricornis* (Nikbakhtzadeh and Tirgari, 2008).

Of the five different study areas of Malabar, the highest abundance was recorded in Palakkad and the highest diversity was recorded in Wayanad, as these two places have the largest area under paddy cultivation as compared to other collection sites (Agricultural Statistics, 2020; Jankielsohn, 2023). According to the Kerala Water Resource Information System (KWRIS 2018-2019), the annual rainfall of Palakkad and Wayanad is less compared to Kannur, Kozhikode and Malappuram, which is the second possible reason for the high

abundance of *Paederus* beetles in Palakkad and high diversity in Wayanad since heavy rainfall adversely affect the survival of *Paederus* beetles (Nasir *et al.*, 2012).

During the pre-summer season with mild and moderate weather, there was a noticeable rise in the number of *Paederus* beetles (personal observation). The amount of rainfall significantly affects the *Paederus* beetle population. There is a noticeable decrease in *Paederus* beetles in summer and monsoon with extreme climatic conditions. Intense heat and dryness were noticed during the summer season, which lead to low abundance of *Paederus* beetles in this period of collection. Previous study results from Pakistan, recorded that, heavy rainfall in the monsoon season causes suffocation of larvae and pupae in the soil, and it reduces the population of *Paederus* beetles during the months of heavy rain (Nasir *et al.*, 2012). This study results also substantiate the negative influence of heavy rainfall on abundance of *Paederus* beetles.

The abundance of *Paederus* beetles was strongly influenced by the various stages of Paddy cultivation (Maryam *et al.*, 2017). Similarly, this study reaffirmed that the different paddy cultivation stages significantly impact the number of *Paederus* beetles, as they were prevalent during the milky grain stage of rice crop (pre-summer season), when insect pests like planthoppers and leafhoppers pose a significant threat to rice plant. *Paederus* beetles are predators of these insect pests (Frank and Kanamitsu 1987; Kartohardjono, 1988) and the availability of their food sources increased their population density at this

Table 2. Seasonal Abundance data (mean $\pm$ SD) of *Paederus* species from the study sites

Species name	WAYANAD			MALAPPURAM			PALAKKAD			KOZHIKODE			KANNUR		
	PS	S	M	PS	S	M	PS	S	M	PS	S	M	PS	S	M
<i>P. alternans</i>	0.9 $\pm$ 0.7	0.8 $\pm$ 0.7	0.5 $\pm$ 0.6	1 $\pm$ 0.9	0.7 $\pm$ 0.6	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0
<i>P. fuscipes</i>	6.7 $\pm$ 4.0	5.5 $\pm$ 3.7	4.8 $\pm$ 3.2	5.8 $\pm$ 2.8	5 $\pm$ 2.2	1.6 $\pm$ 0.9	10.1 $\pm$ 3.4	6.6 $\pm$ 2.3	1.1 $\pm$ 1.1	5.3 $\pm$ 1.9	4.7 $\pm$ 1.5	2.6 $\pm$ 1.3	0.8 $\pm$ 0.5	0.7 $\pm$ 0.5	0.5 $\pm$ 0.5
<i>P. sondaicus</i>	8.6 $\pm$ 5.1	7.2 $\pm$ 4.2	5.2 $\pm$ 3.7	3 $\pm$ 2.21	2 $\pm$ 1.4	1.1 $\pm$ 0.7	31.7 $\pm$ 3.4	24.9 $\pm$ 4.3	2.9 $\pm$ 1.7	3.7 $\pm$ 1.2	3 $\pm$ 1.4	2 $\pm$ 1.1	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0
<i>P. extraneus</i>	1.4 $\pm$ 0.9	1.1 $\pm$ 0.6	0.6 $\pm$ 0.5	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	1.2 $\pm$ 0.7	0.9 $\pm$ 0.7	0.7 $\pm$ 0.5
<i>P. nigricornis</i>	1.1 $\pm$ 0.6	1 $\pm$ 0.5	0.6 $\pm$ 0.5	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0	0.8 $\pm$ 0.6	0.6 $\pm$ 0.5	0.5 $\pm$ 0.5	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0

PS= Pre- summer, S= Summer and M=Monsoon

Table 3. Shannon Diversity Index of different sites in different seasons

Seasons	Wayanad	Malappuram	Palakkad	Kozhikode	Kannur
Overall	1.219	0.8709	0.5403	0.9071	0.6809
Pre-summer	1.229	0.9044	0.5529	0.9013	0.6768
Summer	1.239	0.8551	0.5141	0.8854	0.6829
Monsoon	1.167	0.673	0.5939	0.947	0.684

stage (Bong *et al.*, 2013). The lowest number of *Paederus* beetles during the monsoon season may be due to the aftermath of the Kerala flood in August 2018. *P. fuscipes* was the only species found in each of the five collection sites. According to Frank and Kanamistu 1987, *P. fuscipes* is a widely distributed species, and from central Asia its range extends west to the British Isles, east to Japan, and southeast to Australia. Its habitats range from cultivated, irrigated fields to marshes and riverbanks. The results of this study are consistent with the especially wide distribution of *P. fuscipes* and its adaptability to nearly every environment. *P. fuscipes*, *P. sondaicus* and *P. alternans* have shown seasonality in abundance in Malabar region, however, *P. nigricornis* and *P. extraneus* showed no seasonality. It might be because of the fewer number of *P. nigricornis* and *P. extraneus* in the collection.

Table 4. Tukey's table showing the seasonal comparison of species collected from Malabar

Species	Seasons	Q value	P value
<i>P. fuscipes</i>	Pre-Summer/Summer	4.677	<0.01
	Pre-Summer/Monsoon	13.75	<0.0001
	Summer/Monsoon	9.07	<0.0001
<i>P. sondaicus</i>	Pre-Summer/Summer	2.69	>0.05
	Pre-Summer/Monsoon	9.77	<0.0001
	Summer/Monsoon	7.08	<0.0001
<i>P. alternans</i>	Pre-Summer/Summer	1.51	>0.05
	Pre-Summer/Monsoon	5.76	<0.001
	Summer/Monsoon	4.26	<0.01

Pre-summer (December, January, February); Summer (March, April, May); Monsoon (September, October, November)

According to reports (Singh and Ali, 2007; Kumaraguru *et al.*, 2022) *P. melampus* is the most common species found in India. Contrary to the former report, *P. sondaicus* was found to be the predominant species in the Malabar region. Although *P. sondaicus* was already reported from Silent Valley, Kerala (Biswas, 1986), additional research on the abundance and seasonality of *Paederus* species need to be conducted in Kerala.

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REFERENCES

Agricultural Statistics 2018-2019 (2020). Annual publications of the Department of Economics and Statistics. Government of Kerala. <https://ecostat.kerala.gov.in>. Accessed on 12 November 2023.

Table 5. Table showing the distribution of *Paederus* species in Kerala, India.

No	Species name	Distribution	Reference	Authors' observation
1	<i>P. alternans</i> Walker, 1858	Tamil nadu: Nilgiri Hills; Karnataka: Kanara; Himalayas	Cameron, 1931; Biswas & Sengupta, 1982	Kerala: Malappuram, Wayanad
2	<i>P. fuscipes</i> Curtis, 1826	Central Kerala; Tamil Nadu: Annamalainagar, Chidambaram; Karnataka; Uttar Pradesh: Rampur, Ballia, Mirzapur, Allahabad; Gujarat; Uttarakhand; Himachal Pradesh; Bihar; Kashmir, Madhya Pradesh; West Bengal: Sikkim, Darjeeling District; Meghalaya and Tripura	Cameron, 1931; Kamaladasa <i>et al.</i> , 1997; Varma and Agarwal, 2006; Toppo <i>et al.</i> , 2013; Sar and Hedge, 2015; Ramakrishnan <i>et al.</i> , 2019; Vineesh <i>et al.</i> , 2023	Kerala: Palakkad, Malappuram, Kozhikode, Kannur, Wayanad
3	<i>P. sondaicus</i> Fauvel, 1895	Kerala: Silent Valley (Palakkad); Tamil nadu: Nilgiri Hills; Karnataka: Belgaum, Nagargali, Khanapur, Sampgaon; Meghalaya: Khasia Hills, Maharashtra	Cameron, 1931; Biswas, 1986	Kerala: Palakkad, Malappuram, Kozhikode, Wayanad
4	<i>P. extraneus</i> Wiedemann, 1825	Karnataka: Manipal; Andra Pradesh; Bengal	Cameron, 1931; Taneja <i>et al.</i> , 2013; Gopal, 2014	Kerala: Wayanad, Kannur
5	<i>P. nigricornis</i> Bernhauer, 1911	Uttar Pradesh: Allahabad- Ramghat; Mizoram; Uttaranchal; Uttarakhand: Chakrata district Garhwal hills; West Bengal: Darjeeling, Nurbong and Mahanadi Valleys; Sikkim; Himachal Pradesh: Simla Hills	Cameron, 1931; Sar and Hedge, 2015; Sar and Ilango, 2016	Kerala: Kozhikode, Wayanad
6	<i>P. mussardi</i> Biswas and Gupta, 1982	Kerala: Silent Valley (Palakkad); Peermade, Munnar	Biswas & Sengupta, 1982; Biswas, 1986	-
7	<i>P. pallidus</i> Scheerpeltz, 1933	Kerala: Munnar; Tamil nadu: Madura, Palani Hills, Kodaicanal, Madras	Cameron, 1931; Biswas & Sengupta, 1982	-
8	<i>P. loebli</i> Biswas and Gupta, 1982	Kerala: Munnar	Biswas & Sengupta, 1982	-
9	<i>P. variicornis</i> Fauvel, 1903	Kerala: Silent valley (Palakkad); Tamil nadu: Nilgiris: Coonoor. Ghozeh. Madura; Karnataka: Kanara).	Cameron, 1931; Biswas and Sengupta, 1982; Biswas, 1986	-
10	<i>P. kuluensis</i> Bernhauer, 1911	Kerala: Silent Valley; Himachal Pradesh	Cameron, 1931; Biswas, 1986	-
11	<i>P. hingstoni</i> Cameron, 1928	Kerala: Calicut; Sikkim: Darjeeling	Cameron, 1931; Sreevidhya and Sebastian, 2020	-

- Berglund S.A., Ehnstram B. and Ljungberg H. (1997) Riparian beetles biodiversity and stream flow regulation- the example of svartan and Mjallan streams, Central Sweden. *Entomologisk Tidskrift* 118(4): 137–154.
- Biswas D.N. and Sengupta T. (1982) New species and new records of Staphylinidae (Coleoptera) from India and Sri Lanka. *Revue Suisse de Zoologie*, 89(1): 135–154.
- Biswas D.N. (1986) Staphylinidae (Coleoptera) of Silent Valley, Kerala, India. *Records of the Zoological Survey of India* 84(1-4): 121–129.
- Bong L.J., Neoh K.B., Jaal Z. and Lee C.Y. (2012) Life table of *Paederus fuscipes* (Coleoptera: Staphylinidae). *Journal of Medical Entomology* 49: 451–460.
- Bong L.J., Neoh K.B., Lee C.Y. and Jaal, Z. (2013) Dispersal pattern of *Paederus fuscipes* (Coleoptera: Staphylinidae: Paederinae) in relation to environmental factors and the annual rice crop cycle. *Environmental entomology* 42(5): 1013–1019.
- Bong L.J., Neoh K. B., Jaal Z. and Lee C.Y. (2015) *Paederus* outbreaks in human settings: A review of current knowledge. *Journal of Medical Entomology* 52: 517–526.
- Cameron M. (1931) The fauna of British India including Ceylon and Burma. *Coleoptera, Staphylinidae, Vol.2, (Paederinae)*. Taylor and Fancis, London. 257pp.
- Coondoo A. and Nandy J. (2013) *Paederus* dermatitis: an outbreak, increasing incidence or changingmull seasonal pattern. *Indian Journal of Dermatology* 58: 410.
- Devi P.K., Yadav D.N. and Jha A. (2003) Biology of *Paederus fuscipes* Curtis (Coleoptera: Staphylinidae). *Pest Management and Economic Zoology* 10(2): 137–143.
- Frank J.H. and Kanamitsu K. (1987). *Paederus*, sensu lato (Coleoptera: Staphylinidae): natural history and medical importance. *Journal of Medical Entomology* 24: 155–191.
- Gopal K.V.T. (2014) *Paederus* Dermatitis: A Clinical, Epidemiological and Therapeutic Study of 417 Cases. *Journal of Evolution of Medical and Dental Sciences* 3: 4736–4743.
- Hammer Ø., Harper D.A.T. and Ryan P.D. (2001) PAST: paleontological statistics software package for education and data analysis. *Palaeontologia Electronica* 4: 1–9.
- Jankielsohn A. (2023) Sustaining insect biodiversity in agricultural systems to ensure future food security. *Frontiers in Conservation Science*. doi:10.3389/fcsc.2023.1195512.
- Kamaladasa S. D., Perera W. D. and Weeratunge L. (1997) An outbreak of *Paederus* dermatitis in a suburban hospital in Sri Lanka. *The International Journal of Dermatology* 36: 34–36.
- Kavyamol P.M. ., Vineesh P.J. and Vineetha V.P. (2023) First record of vesicant beetles: *Paederus nigricornis* Bernhauer, 1911 from south India; *P. extraneus* Wiedemann, 1823 and *P. alternans* Walker, 1858 (Staphylinidae. Paederinae) from Kerala. *ENTOMON* 48(1): 117–122. doi:10.33307/entomon.v48i1.853.
- Kartohardjono A. (1988). Role of some predators (spiders, *Paederus* sp., *Ophionea* sp., *Cyrtorhinus* sp. and *Coccinella* sp.) to reduce population of brown planthopper (*Nilaparvata lugens* Stal.) in rice plant. *Penelitian Pertanian (Indonesia)* 8:1.
- Kerala Water Resource Information System. District wise Rainfall for Kerala from 2018-2019.
- Kitisin T. and Sukphopetch P. (2021). Erythroderma and Skin Desquamation in *Paederus* Dermatitis. *Case Reports in Medicine*. doi: 10.1155/2021/7257288.
- Krakerb D.J., Van Huis I.A., Van Lenterenb J.C., Heonge K.L. and Rabbingea R. (2000) Identity and relative importance of egg predators of rice leafhoppers (Lepidoptera: Pyralidae). *Biological Control* 19: 215–222.
- Kumaraguru A., Ramalingam R., Thangaraj P., Seethalakshmi R.S. and Balasubramanian N. (2022) Clinico-dermatologic patterns of *Paederus* dermatitis in a teaching hospital, South India. *Journal of Family Medicine and Primary Care* 8: 4357–4362.
- Mammino J. J. (2011) *Paederus* dermatitis: An outbreak on a medical mission boat in the Amazon. *Journal of Clinical and Aesthetic Dermatology* 4: 44–48.
- Maruthadurai R., Ramesh R. and Veershetty C. (2022) Prevalence and predation potential of rove beetle *Paederus fuscipes* Curtis (Coleoptera: Staphylinidae) on invasive fall armyworm *Spodoptera frugiperda* in fodder maize. *National Academy Science Letters* 45: 119–121.
- Maryam S., Fadzly N. and Zuharah W. F. (2017) Abundance, distribution and dispersal time of *Paederus fuscipes* (Coleoptera: Staphylinidae) and its association to human settings Tropical

- Biomedicine 34: 224–236.
- Mullen G. and Durden L. (2009) Medical and Veterinary Entomology. Academic Press. London, UK. 102pp.
- Nasir S., Akram W. and Ahmed F. (2012) The population dynamics, ecological and seasonal activity of *Paederus fuscipes* Curtis (Staphylinidae; Coleoptera) in the Punjab, Pakistan. *Apcbee Procedia* 4: 36–41.
- Nikbakhtzadeh M.R. and Tirgari S. (2008) Medically important beetles (Insecta: Coleoptera) of Iran. *Journal of Venomous Animals and Toxins including Tropical Diseases* 14: 597–618.
- Ramakrishnan D., George L.S., Jacob A., Lais H., Rajeev M., Panicker K.N. and Marwaha V. (2019) Outbreak investigation of acid fly attack among residential students in a tertiary care centre in South India. *International Journal of Community Medicine and Public Health* 6: 5355–5358.
- Sar A. and Hegde V.D. (2015) New records of rove beetles (Coleoptera: Staphylinidae: Paederinae) from Uttar Pradesh, India. *Records of the Zoological Survey of India* 115(1): 101–103.
- Sar A. and Ilango. K. (2016) New records of rove beetles (Coleoptera: Staphylinidae: Paederinae) From Mizoram, India. *Records of the Zoological Survey of India* 116(3): 233–240.
- Singh G. and Ali Y.S. (2007) *Paederus* dermatitis. *Indian Journal of Dermatology, Venereology and Leprology* 73: 13.
- Sreevidhya P. and Sebastian C.D. (2020) DNA barcoding and phylogenetic analysis of paederinae (Coleoptera: staphylinidae) in relation to morphological data using cox I sequences. *International Journal of Entomology Research* 5: 191–194.
- Taneja A., Nayak S. and Shenoi S.D. (2013) Clinical and epidemiological study of *Paederus dermatitis* in Manipal, India. *Journal of Pakistan Association of Dermatologists* 23: 133–138.
- Toppo N.A., Bhadoria A.S., Kasar P.K. and Trivedi A. (2013) *Paederus dermatitis* among residents of nursing hostel in Central India: An outbreak investigation. *Indian dermatology online journal* 4(2): 153–155.
- Verma C.R. and Agarwal S. (2006). Blistering beetle dermatitis: an outbreak. *Medical Journal Armed Forces India* 62(1): 42–44.
- Vineesh P.J., Mathew A., Kavyamol P.M., Vineetha V.P., Rajagopal R., Alfarha A. and Ramesh V. (2023) Essential oils of Cinnamon, Turmeric and Neem as potential control agents against home-invading Acid flies (*Paederus fuscipes*) and Darkling beetles (*Luprops tristis*). *Journal of King Saud University-Science* 35: 1–7.
- Zargari O., Kimyai-Asadi A., Fathalikhani F. and Panahi M. (2003) *Paederus dermatitis* in northern Iran: A report of 156 cases. *International Journal of Dermatology* 42: 608.

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Effect of Kleptoparasitic Ants on the Foraging Behavior of a Social Spider (*Stegodyphus sarasinorum* Karsch, 1891)

Ovatt Mohanan Drisya-Mohan*, Pallath Kavyamol, and Ambalaparambil Vasu Sudhikumar

Centre for Animal Taxonomy and Ecology, Department of Zoology, Christ College, Irinjalakuda, Kerala, India.

*Correspondence E-mail: drisyamohan2@gmail.com. (Drisya-Mohan) E-mail (other authors): kavyamohan5540@gmail.com (Kavyamol); avsudhi@rediffmail.com (Sudhikumar)

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The term kleptoparasitism is used to describe the stealing of nest material or prey of one animal by another. Foraging and food handling behaviors of social spiders increase the vulnerability to kleptoparasitism. Kleptoparasites of the social spider *Stegodyphus sarasinorum* Karsch 1891 were identified based on the observations done in the field. Four species of spiders and two species of ants were observed as kleptoparasites and collected from the nest and webs of this social spider. The ants were found to be the most dominant among them. The influence of a facultative kleptoparasitic ant, *Oecophylla smaragdina* on the foraging behavior of *S. sarasinorum* was studied in laboratory conditions. The experiments suggested that the web building behavior of *S. sarasinorum* was influenced by the exposure to ants. However, exposure to ants caused no significant effect in the prey capture, handling time of prey and prey ingestion behaviors of the spider.

Key words: Social spider, Ecology, Kleptoparasites, Ants, Prey capturing behavior.

BACKGROUND

Kleptoparasitism is a type of feeding behavior, in which one animal steals the food or prey captured by another animal. Kleptoparasites feed on prey which could not be obtained by themselves without time and effort. There are chances for the kleptoparasites to be injured by the host organism (one being stolen from) when the latter defends its prey. Kleptoparasitic behavior is seen in a diverse array of taxa including marine invertebrates (Zamora and Gomez 1996; Morrisette and Himmelman 2000), spiders and insects (Higgins and Buskirk 1988; Field 1992), birds (Brockmann and Barnard 1979), large carnivores (Packer and Rutten 1988) and primates (Di Bitetti and Janson 2001).

Susceptibility to kleptoparasitism is affected by various characteristics of the organism's behaviors include foraging and food-handling behaviors (Brockman and Barnard 1979; Giraldeau and Caraco

2000). Kleptoparasites depend on high-quality food and it is available to them due to prolonged handling (Giraldeau and Caraco 2000). Lastly, the more conspicuous the hunting and food handling behaviors, the easier it is for the potential thieves to identify the opportunities for exploitation.

Among spiders, web-building spiders are frequent targets of kleptoparasites (Vollrath 1987). Web-building spiders are relatively sedentary, sit-and-wait type of predators and capture prey that is often larger than themselves and that takes time to consume. They usually store many prey items in the web or nest for future consumption (Champion de Crespigny et al. 2001). Social spiders built large sized web and capture large sized prey cooperatively. Due to these behaviors, social spiders are also an attractive resource for kleptoparasites.

A few species of spiders act as kleptoparasites along with insects like some scorpionflies (Thornhill 1975) and ants (Henschel and Lubin 1992; Pasquet et

al. 2007). The spiders which regularly steal food from other species of spiders, *i.e.*, kleptoparasitic spiders, are known to occur in five families. As ants can rapidly recruit a large number of individuals and by patrolling, ants are likely to be the most prominent kleptoparasites (Henschel 1998; Hölldobler and Wilson 1983). Moreover, ants can also become predators, particularly in spider broods (Schneider and Lubin 1997). If kleptoparasitism shown by ants is a sufficiently serious risk to spiders, adaptive responses by spiders should be observed to lower the risk.

Although most of the studies have dealt with the diversity, evolution, and behavior of kleptoparasites, the knowledge about its effect on the web-building and foraging behavior of social spiders are insufficient, due to lack of studies except a few (Cangialosi 1990; Leborgne et al. 2011). A pioneering study conducted by Leborgne et al. (2011), showed that in Eresid sub-social spider, *Stegodyphus lineatus* kleptoparasites negatively influenced the web building behavior and was independent of the success in the spider's previous foraging. According to the accepted theory in spiders, non-territorial permanent-sociality is derived evolutionarily from a sub-social state and is evolutionarily restricted by genetic or ecological factors (Aviles 1997). Since there is a difference between social and sub-social spiders a detailed examination was done on the influence of kleptoparasites on web building as well as foraging behavior of social spiders. So this study was conducted on the social spider, *Stegodyphus sarasinorum*, Karsh 1891 (Araneae: Eresidae) which is commonly known as the Indian cooperative spider. This spider exhibits communal predation and feeding, where individual spiders live in large cooperatively built colonies with a nest or retreat made of silk, and woven using twigs, leaves, food carcasses and a sheet web for prey capture.

The present study identifies the kleptoparasites of *S. sarasinorum* in the natural colonies at Christ College, Irinjalakuda, Kerala, India. The influence of facultative kleptoparasitic ants on web-building and prey capturing behaviors of *S. sarasinorum* was also studied.

MATERIALS AND METHODS

Study Area

The study site was in the Christ College campus (10°21'N 76°12'E), located in Irinjalakuda town of Thrissur district, Kerala, India. Colonies of *Stegodyphus sarasinorum* are widely distributed in the campus (Fig. 1) and are found on the branches of plants such as *Eugenia uniflora* (Fig. 2A), *Acacia disparrima*, *Acacia*

sp., *Tamarindus indica*, *Artocarpus heterophyllus* and Nigeria grass (*Pennisetum pedicellatum*).

Kleptoparasites of *S. sarasinorum*

The nests of the spiders were examined in its habitat at different locations of Christ College campus; covering both winter and summer seasons. *S. sarasinorum* thrives on shrubs and the lower branches of tall plants. Kleptoparasites were collected by hand as follows. The specimens were collected by leading them into glass tubes containing alcohol with the help of a brush dipped in alcohol. The collected spiders and non-spider kleptoparasites were preserved in 70% alcohol.

The collected specimens were then taken to the laboratory and examined under Magnus MSZ TR stereo microscope for taxonomic identification. Kleptoparasitic spiders were identified with the help of available literature (Sebastian and Peter 2009; WSC 2018) and kleptoparasitic ants were identified using the catalogue of ants (Bolton et al. 2007) and AntWeb online database (2017, <http://www.antweb.org>). The specimens are housed in the reference collection maintained at the Centre for Animal Taxonomy and Ecology, Department of Zoology, Christ College, Irinjalakuda, Kerala, India (ID – CATE0306).

Effect of exposure of ants on web building behavior of *S. sarasinorum*

S. sarasinorum was collected from Christ College campus. Adult and subadult females were used for this study. Spiders (two groups, 30 spiders each) were introduced into the 45 × 30 × 30 cm enclosures (Fig. 2B) made up of nylon mesh and wooden reapers (Wooden sticks used for making the frame of the enclosure). Twigs and wet cotton were placed in the enclosure which facilitates web building and maintains moisture content in the enclosure respectively. Grasshoppers (*Chortopaga viridifasciata* (0.22 ± 0.008 g), *Oxya hyla intricata* (0.13 ± 0.007 g), and *Neorthacris simulans* (0.28 ± 0.014 g)) were collected from the field and grown in an artificial terrarium (60 × 30 × 30 cm) and they were used as prey for the spiders. Two similar-sized grasshoppers were given to each group daily in order to homogenize the feeding status (We observed the influence of feeding status and exposure of ants). After 5 days, the first group received two grasshoppers ("fed") while the second group received no prey ("fasted") over the next 4 days.

These two groups were again subdivided into two sub-groups (15 spiders each). The facultative kleptoparasitic ants, *Oecophylla smaragdina* (K) were collected from Christ College campus and 10

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Original article

Essential oils of cinnamon, turmeric and neem as potential control agents against home-invading acid flies (*Paederus fuscipes*) and darkling beetles (*Luprops tristis*)P.J. Vineesh^{a,*}, Athira Mathew^a, P.M. Kavyamol^a, V.P. Vineetha^a, Rajakrishnan Rajagopal^b, Ahmed Alfarhan^b, Sameh M. Hisham^c, Varsha Ramesh^d^a PG and Research Department of Zoology, St. Joseph's College (Autonomous), Devagiri, Calicut- 673008, Kerala, India^b Department of Botany and Microbiology, College of Science, King Saud University, P.O. Box 2455, Riyadh 11451, Saudi Arabia^c Faculty of Biotechnology, October University for Modern Sciences & Arts (MSA University), 6th October City 12566, Egypt^d Department of Biotechnology, Deakin University, Victoria, Australia

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ABSTRACT

Objectives: *Paederus fuscipes* and *Luprops tristis* constitute Kerala's two most notorious home-invading arthropod pests. To control their infestations, indoor application of pesticides is commonly practiced, which is detrimental to human health and the environment. This study explores the bioactive properties of plant essential oils as a control agent against them.

Methods: We analyzed the constituents of oils, their repellence, and fumigant toxicity against *P. fuscipes* and *L. tristis*. The constituents and the bioactive compounds in oils were analyzed using Gas Chromatography-Mass spectroscopy analysis. For the evaluation of the repellence activity of the plant essential oils- two choice bioassays were performed, where the control was treated with acetone, and the test contained a mixture of oil in acetone (0.1 µl/cm²). Fumigant toxicity of oils was done by no choice bioassay (0.1 µl/ml air). To determine the potency of the oils, lethal concentration 50 (LC₅₀) was determined; LC₅₀ refers to the concentration of a substance in the air required to kill 50 % of the test animals over a period of time. LC₅₀ of cinnamon oil no choice assay with 0.04 µl/ml, 0.06 µl/ml, 0.08 µl/ml, 0.1 µl/ml and 1.2 µl/ml concentration was performed.

Results: Of the three plant essential oils, turmeric oil was the best repellent against both *P. fuscipes* (86.66 ± 11.54) and *L. tristis* (40 ± 20). Cinnamon oil showed the highest activity as a fumigant with 100 % and 73.33 ± 46.18 % mortality in *P. fuscipes* and *L. tristis* after 8 h of exposure. The analysis of the constituents indicated the presence of over 63 different chemical compounds in the three oils. The three plant essential oils tested showed insect deterrent activity, with turmeric oil as the best repellent and cinnamon oil as the best fumigant against pests.

Conclusions: The activities shown were significant enough to be used to replace/add to the conventionally used pesticides, especially in indoor settings. These oils in themselves or by isolating the specific compounds could pave the way to developing more effective and greener pest control methods.

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1. Introduction

The Malabar region in Kerala, which forms a part of the global biodiversity hotspot of Western Ghats has been undergoing radical changes in its land-use patterns and consequent loss of biodiversity and ecological balance of the system (Shochat et al., 2010; Jha et al., 2000). With the increased invasion of human settlements and land conversion, the disruption in the balance is manifested in many evident patterns; a prominent one is the increased invasion of pests. Even though humans and arthropods have been sharing homes since ancient times, the unprecedented encroachment of

* Corresponding author.

E-mail address: vineeshpj@devagiricollege.org (P.J. Vineesh).

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human settlements into the wild has resulted in the reciprocal invasion of arthropod pests into human houses (Bertone et al., 2016). The darkling beetles (*Luprops tristis*) and the acid fly (*Paederus fuscipes*) are the most notorious arthropod pests that have invaded human residents in the Malabar region. The former is a nuisance pest invading the residential areas close to rubber plantations, whereas the latter is a health pest associated with a dermatological condition called Paederus dermatitis (Sabu et al., 2008; Bong et al., 2012).

Luprops tristis (Coleoptera: Tenebrionidae) is a litter-dwelling darkling beetle, which has been reported to invade the residential areas close to rubber plantations in large numbers following short spells of summer rains (Abhitha et al., 2010). The invasion occurs in numbers ranging from 0.5 million to 4.5 million, after which they enter into an extended period of dormancy lasting up to 9 months (Sabu et al., 2008). Although the beetle in itself is harmless when stressed, it releases an odorous phenolic substance which, if it comes in contact with skin can cause burns. The heavy infestation has also caused many residents to abandon their homes because of the invasion of *L. tristis*.

P. fuscipes or the acid fly is a health pest. It neither bites nor stings, but accidental brushing or crushing causes them to release the toxin Pederin, and this potent vesicant causes *Dermatitis linearis* in humans (Frank & Kanamitsu, 1987). This toxin is more potent than cobra venom and belongs to a class of anti-tumor compounds produced by an uncultivable strain of *Pseudomonas aeruginosa* (Frank & Kanamitsu, 1987). These beetles are voracious predators found in paddy, rice, and other plantations. They exhibit positive phototaxis and invade houses and residential areas in academic buildings (Frank & Kanamitsu, 1987). Recently these infestations are on the rise and have even caused the temporary closure of educational campuses in Malabar (Personal observation).

Management of these pests at their breeding grounds is complex and hence mostly, control at the site of infestation is mainly practiced by indoor application of broadscale pesticides. In most cases, these only provide temporary relief lasting hardly a week but affect the long-term health of the residents and the environment through pesticide accumulation. Pesticide poisoning is blamed for the death of thousands every year, not only do they cause direct mortality but has been associated with various types of cancer and neurological diseases such as Alzheimer's, Parkinson's, metabolic syndromes like- malnutrition, atherosclerosis, inflammation, pathogen invasion and susceptibility to infectious diseases (Lushchak et al., 2018). So more often than not for the control of nuisance pests, applying pesticides does nothing more than deteriorate the health of the residents. India is a country with abundant traditional ecological knowledge and efficient traditional medicinal practices and medicines (Kumar et al., 2007). Several such plants endemic to the Indian subcontinents are now being explored for their bioactive properties (Mukherjee et al., 2007). Although in the literature, there have been a few attempts at evaluating the insect deterrent properties of plant essential oils against *P. fuscipes*, which have produced promising results (Zhang et al., 2016; Gaffari et al., 2016). But these studies have not incorporated the endemic plants from Indian subcontinent. And there have been no published records for the same in the case of *L. tristis*.

The current study aims to explore the insect deterrent activity of three traditional medicinally used plants Neem (*Azadirachta indica*), Cinnamon (*Cinnamomum zeylanicum*), and Turmeric (*Curcuma longa*) against the home invading nuisance pests of Kerala, *Paederus fuscipes* and *Luprops tristis*. We focus mainly on the repellence and fumigant toxicity properties of three traditional medicinally used plants Neem (*Azadirachta indica*), Cinnamon (*Cinnamomum zeylanicum*), and Turmeric (*Curcuma longa*) against the home invading nuisance pests of Kerala, *Paederus fuscipes* and *Luprops tristis*. The analysis of the bioactive constituents of the

essential oils of these plants could further be used to improve the formulation of the currently used pesticides making them less toxic to humans and increasing their efficacy against the target organisms.

2. Methodology

2.1. Plant essential oils

Hydro-distillate plant essential oils were procured from Akay Flavours and Aromatics Pvt. Ltd., Kerala, India. The plant's essential oils included Neem (*Azadirachta indica*), Cinnamon (*Cinnamomum zeylanicum*), and Turmeric (*Curcuma longa*).

2.2. Insect sampling

2.2.1. *Paederus fuscipes*

The live specimens of *Paederus fuscipes* were collected by hand picking from banana plantations in Kodyammal, Malappuram (11°13'N 75°55'E), located 925 m from Chaliyar River. The collected samples were kept in an insectarium in the Entomology lab of PG and the Research Department of Zoology, St Joseph's College, Devagiri. The dimensions of the glass insectarium were 70 × 30 × 35 cm, maintained at a temperature of 29 ± 3 °C and relative humidity of 72 ± 4 %. A 12 h: 12 h (L:D) photoperiod was observed. The rearing method was adopted by Schmidt, (1999). The rearing container was lined with soil up to a height of 3 cm, and about 500 g of dried litter was placed over it. The container was also provisioned with a test tube (20 ml) filled with water, plugged with cotton, and placed horizontally to act as a water source for the beetles. A 5 ml mixture of honey and water (1:1) and killed American cockroaches (*Periplaneta americana*) were provided as a food source (Bong et al., 2012). New food was provided every-three days.

2.2.2. *Luprops tristis*

Live specimens of newly invaded predormancy of *Luprops tristis* were collected from St Joseph's College, Devagiri (11°15'N 75°50'E). Insects were maintained at optimum conditions in an earthen pot at temperature (27 + 0.5°C) and relative humidity (70 + 5 %) (Vinod et al., 2010).

2.3. Analysis of components of essential oils

GCMS analysis has been carried out in GC-MS (Thermo Fisher Scientific, Austria); the GC measurement was started after 3 min of sample injection. The column temperature was maintained at 40 °C for 3 min and gradually elevated with a gradient of 8 °C and a temperature of 230 °C was maintained. The carrier gas used was helium at a flow rate of 0.5 mL/min. The mass spectrometric temperature was 200 °C and mass range of 20–300 *m/z*. The compounds were identified by comparing their Relative Strength Index (RSI) and *m/z* ratio by using the NIST library and comparing the literature reports.

2.4. Test for repellence

A binary choice bioassay for essential oils to test repellence activity was performed by using the methods described by Zapata et al. (2010). The vertical wall inside of a cylindrical glass chamber was coated with petroleum jelly emulsion and allowed to dry for 2 h to prevent the beetles from climbing to the top cover and moving away from the test area. Half filter paper disks (Whatman No. 1) were used as test areas. Test solutions of essential oils were prepared by dissolving 2.5 ml of each essential oil in 0.5 ml of acetone.



NEW REPORTS OF SUBFAMILY OXYTELINAE FROM SOUTH INDIA (COLEOPTERA: STAPHYLINIDAE)

V P VINEETHA¹, P J VINEESH^{1*}, P M KAVYAMOL¹ AND GEORGE JERIN¹

¹Post Graduate and Research Department of Zoology,

St. Joseph's College (Autonomous) Devagiri, Calicut, Kerala 673008, India

*Email: vineeshpj@devagiricollege.org (corresponding author); ORCID ID 0000-0002-2104-6580

ABSTRACT

Six new reports of staphylinids viz., *Anotylus glareosus* (Wollaston, 1854); *Oxytelus bengalensis* (Erichson, 1840); *Oxytelus incisus* (Motschulsky, 1858); *Oxytelus lividus* (Motschulsky, 1858); *Oxytelus nigriceps* (Kraatz, 1859) and *Oxytelus puncticeps* (Kraatz, 1859) are recorded for the first time from south India. The current geographical distribution of these are provided.

Key words: Oxytelini, *Oxytelus*, *Anotylus*, Periya reserve forest, Badiyadukka, light trap, flotation method, Aralam Wildlife Sanctuary, rove beetle, Kerala

The subfamily Oxytelinae (Coleoptera: Staphylinidae) are distributed worldwide and contains more than 2000 described species (Schülke, 2012, Schülke and Smetana, 2015) and is one of the more ancient groups of Staphylinidae. Oxytelinae, as a well-defined monophyletic group of staphylinids, is readily distinguished from all other staphylinid subfamilies by the unique presence of paired secretory openings of non-eversible abdominal defensive glands on tergum IX, which is divided by tergum X or nearly so (Czarniawski and Staniec, 1997; Dettner, 1993; Dettner et al., 1985; Hansen, 1997; Herman, 1970; Newton, 1982; Newton et al., 2000; Thayer, 2005). Oxytelinae is represented by eight tribes viz., (Blediini Ádám, 2001; Coprophilini Heer, 1839; Deleasterini-Reitter, 1909; Euphaniini Reitter, 1909; Oxytelini-Fleming, 1821; Planeustomini-Jacquelin du Val, 1857; Syntomiini Böving and Craighead, 1931; and Thinobiini-Sahlberg, 1876) with 54 genera and 2263 species (Newton, Alfred, 2021). The present study reports six species [*Anotylus glareosus* (Wollaston, 1854); *Oxytelus bengalensis* (Erichson, 1840); *O. incisus* (Motschulsky, 1858); *O. lividus* (Motschulsky, 1858); *O. nigriceps* (Kraatz, 1859) and *O. puncticeps* (Kraatz, 1859)] belonging to two genera namely *Anotylus* Thomson, 1859 and *Oxytelus* Gravenhorst, 1806. *Anotylus* Thomson, 1859 and *Oxytelus* Gravenhorst, 1806 are found in litter, dung or decaying material in temperate regions (Hammond, 1976). *Oxytelus* spp. are widespread over all continents except Antarctica (Lü and Zhou, 2015). *Anotylus* is a speciose genus with 430 species (Newton, 2021). The present study also provides

the current geographical distribution and literature references of the six new reports from south India.

MATERIALS AND METHODS

The collection of beetles was done using the flotation and light trap method from Periya Reserve Forest (11.7768°N, 75.8476°E), Badiyaduka agricultural ecosystem (12.5851°N, 75.0757°E) and Aralam Wildlife Sanctuary (11°50' - 11°52'N and 75°57' - 75°59'E) from the north Malabar region of Kerala during 2019 - 2022. The classification provided in Newton, Alfred (2021) was followed. Species-level identification was done with taxonomic keys in Cameron's (1930) description. Images were taken using Leica M205C stereozoom microscope fitted with Leica MC170HD digital camera. Measurements were taken with Leica LAS V4.5 software— TLA: body length from apex of mandible to pygidium; TLB: body length from apex of labrum to apex of abdomen; PL: length of pronotum along median line; PW: maximum width of pronotum; EL: maximum length of closed elytra; and EW: maximum width of elytra.

RESULTS AND DISCUSSION

Anotylus glareosus (Wollaston, 1854) (Fig. 1A)

Wollaston, 1854: 610; id. 1857: 201; id. 1864: 598; id. 1865; Fauvel, 1902b: 66; id.1905e: 80, Bernhauer and Schubert, 1911: 113, Bernhauer, 1928: 7, Blackwelder, 1943: 100, 1963b: 31, Herman, 1970: 418, Hammond, 1975: 158, 163; id.1976: 174, Coiffait, 1976: 221, Shibata, 1993a: 318, Lecoq, J.C. 2017:760

Material examined: 2, Labelled 'India: Kerala: Badiyaduka agricultural ecosystem (12.5851°N, 75.0757°E); 'Light trap', 19.iii.2021, Coll. Vineetha V P

Measurements: TLA=2.04, TLB=1.86, PL=0.301, PW=0.356, EL=0.464, EW=0.47

Distribution: India: Kerala: Kasargod, Badiyaduka. Elsewhere: Bangladesh, China, Cuba, Dominica, Ghana, Grenada, Guatemala, Jamaica, Haiti, Indonesia, Iwo Jima, Madeira, Malaysia, Mauritius, Montserrat, Pakistan, Panama, Réunion, Sierra Leone, Sri Lanka, Tahiti, Taiwan, Thailand

***Oxytelus bengalensis* (Erichson, 1840) (Fig. 1 B)**

Kraatz, 1859: 171, Bernhauer and Schubert, 1911: 110, Cameron, 1921: 366, 400, Cameron, 1930: 232, Scheerpeltz, 1933: 1094, Paulian, 1941: 168, Herman, 1970: 409, Abdullah and Qadri, 1970: 122, 125, Hammond, 1975: 149, 155, Yuh et al., 1985: 227, Lü and Zhou. 2012: 3576; id. 2015: 3992

Material examined: 2, Labelled 'India: Kerala: Aralam Wildlife Sanctuary; (11°50' - 11°52'N and 75°57' - 75°59'E), 'Flotation method', 19.iv.2022, Coll. Vineetha V P

Measurements: TLA=6.34, TLB=6.13, PL=0.916, PW=1.1, EL=0.906, EW=1.42

Distribution: India: Kerala: Kannur: Aralam wildlife sanctuary. Elsewhere: Bangladesh, China (Gansu, Guangxi, Guizhou, Hong Kong, Hubei, Jiangsu, Jiangxi, Liaoning, Shanghai, Sichuan, Zhejiang), India (Sikkim, Tripura, UP), Japan, Korea, Laos, Nepal, Malaysia, Myanmar, Pakistan, Singapore, Sri Lanka, Thailand, Vietnam, Taiwan.

***Oxytelus incisus* (Motschulsky, 1858) (Fig. 1 C)**

Kraatz, 1859: 172, Bernhauer and Schubert, 1911: 114, Cameron, 1930: 263, Scheerpeltz, 1933: 1097, Cameron, 1934: 78, Bernhauer, 1936: 81, Blackwelder, 1943: 96, Ramos, 1946: 32, Scheerpeltz, 1957: 225, Herman, 1970: 410, Jarrige, 1971: 499, Hammond, 1975: 150, 152, Moore, 1978: 489, Scheerpeltz, 1978: 190, Frank and Thomas, 1981: 400, 403, J. Li, 1993: 20, Nishida, 1994: 73; id. 1997: 62, Hammond, 1998: 275, Lü and Zhou. 2012: 21-22, Frank, J.K. and D.S.C., J. H., 2011: 399-400, Lü & Zhou. 2015: 14-15, Lecoq, J.C. 2017: 169-232.

Material examined: 4, Labelled 'India: Kerala: Periya reserve forest (11.7768°N, 75.8476°E); 'Flotation method', 19. iv. 2022, Coll. Vineetha V P

Measurements: TLA=3.51, TLB=3.24, PL=0.561, PW=0.728, EL=0.544, EW=0.828

Distribution: India: Kerala: Wayanad: Periya reserve forest. Elsewhere: Indonesia (Java, Sumatra, Sumbawa, Sulawesi), Philippines (Leyte, Luzon, Mindanao)

***Oxytelus lividus* (Motschulsky, 1858) (Fig. 1 D)**

Kraatz, 1859: 171, Bernhauer, 1902b: 44, Bernhauer and Schubert, 1911: 115; Cameron, 1928: 100; id. 1930: 231, Koch, 1932: 655, Scheerpeltz, 1933: 1099, Scheerpeltz, 1965: 100, Herman, 1970: 410, Hammond, 1975: 149, 156, Lü and Zhou. 2012: 24-26; id. 2015: 18

Material examined: 8, Labelled 'India: Kerala: Periya reserve forest (11.7768°N, 75.8476°E) 'Flotation method', 10.x.2019, 19.iv.2022, Coll. Vineetha V P

Measurements: TLA=4.5, TLB=4.3, PL=1, PW=1.5, EL=1.1, EW=1.5

Distribution: India: Kerala: Wayanad: Periyar reserve forest. Elsewhere: Cambodia, China (Hainan, Shanghai, Yunnan), Indonesia (Java, Sulawesi, Sumatra, Timor), Laos, Malaysia, Myanmar, Philippines (Negros, Palawan), Sri Lanka, Thailand, Vietnam

***Oxytelus nigriceps* (Kraatz, 1859) (Fig. 1 E)**

Sharp, 1874: 93, Bernhauer, 1902: 44, Fauvel, 1904: 45, Bernhauer and Schubert, 1911: 116, Cameron, 1921: 366, Bernhauer, 1922: 223, Cameron, 1928: 100; id. 1930: 233, Koch, 1932: 655, Scheerpeltz, 1933: 1100, Bernhauer, 1936: 81, Nakane Sawada, 1960: A122, Nakane, 1963: 84, Herman, 1970: 410, Abdullah and Qadri, 1970: 122, 125, Watanabe Shibata, 1972: 61, Hammond, 1975: 149, 150, 153, Scheerpeltz, 1976: 79, Yuh et al., 1985: 227, Ikudome and Hayakawa, 1994: 187, Lü and Zhou. 2012: 3576; id. 2015: 3992

Material examined: 2, Labelled 'India: Kerala: Aralam Wildlife Sanctuary (11°50' - 11°52'N and 75°57' - 75°59'E), 'Flotation method', 19. iv. 2022, Coll. Vineetha V P

Measurements: TLA=4.24, TLB=4.01, PL=0.71, PW=0.877, EL=0.611, EW=1.15

Distribution: India: Kerala: Kannur: Aralam Wildlife Sanctuary. Elsewhere: Bangladesh, China (Fujian, Zhejiang), India (UP, West Bengal), Indonesia, Japan (Honshu, Kyushu, Shikoku), Korea, Malaysia, Nepal, New Guinea, New Britain, New Ireland; Vanuatu, Myanmar, Pakistan, Philippines, Ryukyu, Sri Lanka, Taiwan, Thailand, Vietnam

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Wayanad District.

.....in the International Seminar on 'Reiterating Biodiversity' held

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Convenor


Soumya K. C
Coordinator

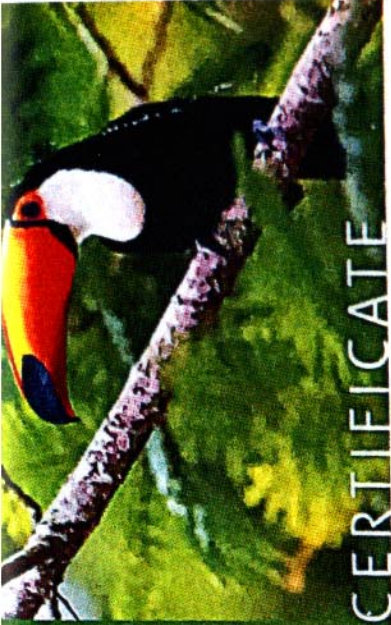

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