

**TAXONOMY AND ECOLOGY OF OXYTELINAE
(COLEOPTERA: STAPHYLINIDAE) IN NORTH
MALABAR**

Thesis submitted to the
UNIVERSITY OF CALICUT
For the award of the degree of
DOCTOR OF PHILOSOPHY IN ZOOLOGY
(Under the Faculty of Science)

By
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Under the Guidance of
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I hereby certify that all the suggestions and corrections recommended by the adjudicator have been duly incorporated in the thesis and recommended to be accepted in this present form.

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DECLARATION

I hereby declare that the work presented in the thesis entitled "**TAXONOMY AND ECOLOGY OF OXYTELINAE (COLEOPTERA: STAPHYLINIDAE) IN NORTH MALABAR**" 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 have undergone a plagiarism check using iThenticate software at C.H.M.K. Library, University of Calicut, and the similarity index was found within the permissible limit. I also declare that the thesis is free from AI-generated content.



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Vineetha V P

Dedicated to my Family and Teachers.



TAXONOMY AND ECOLOGY OF OXYTELINAE (COLEOPTERA: STAPHYLINIDAE) IN NORTH MALABAR

Abstract

Oxytelinae Fleming, 1821, is a subfamily of Staphylinidae, characterized by elongated bodies and distinctive morphological features. Members of this subfamily are widely distributed throughout the world (Herman, 1970). The taxonomic understanding of Oxytelinae in India, especially in Kerala, remains inadequate compared to research in other countries. Indian taxonomy of Oxytelinae is mainly based on the works of Cameron (1930) - the Fauna of British India. These works mainly concentrated on north and northeast India. Only 8 species have been identified in Kerala. There is a considerable research gap regarding the distribution and systematic classification of Oxytelinae beetles in the North Malabar region. Therefore, the present study provides valuable baseline information to support future taxonomic, ecological and conservation research.

Despite their ecological significance, the ecology of Oxytelinae beetles in India remains poorly understood, highlighting a substantial gap in current knowledge. To address this knowledge gap, the present study aimed to document the diversity, abundance, and seasonal occurrence of Oxytelinae beetles in selected forest and agricultural ecosystems in North Malabar, Kerala. Sampling was carried out in the Aralam Wildlife Sanctuary, Periya Reserve Forest, Malabar Wildlife Sanctuary, Badiyadukka Agricultural Field, and Ezhome Paddy Field during both rainy and non-rainy seasons.

A total of 31 species of Oxytelinae beetles, belonging to three tribes and seven genera, were documented from North Malabar, Kerala, revealing the rich diversity of this subfamily in the region. Among these, four species were recorded for the first time from India, nine species were newly reported from South India, and three species were newly

reported from Kerala, highlighting the taxonomic significance of the study. A comprehensive checklist, modified taxonomic keys, and a pictorial key for the identification of Oxytelinae beetles from forest and agricultural ecosystems are provided. The diversity, abundance, and seasonality of dung-associated Oxytelinae beetles were also analysed. High diversity was found in the Aralam Wildlife Sanctuary. Significant seasonal variations in species composition and abundance were observed in Aralam Wildlife Sanctuary and the Badiyadukka Agricultural Field. *Anotylus latiusculus* was the most abundant species in both forest and agricultural ecosystems.

Keywords: Oxytelinae, Taxonomy, Diversity, Abundance, Seasonality

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Research Guide

TAXONOMY AND ECOLOGY OF OXYTELINAE (COLEOPTERA: STAPHYLINIDAE) IN NORTH MALABAR

സംഗ്രഹം

ഓക്സിറ്റെലിനേ ഫ്ലൈമിംഗ്, 1821 എന്നത് സ്റ്റാഫിലിനൈഡേയുടെ ഒരു ഉപകുടുംബമാണ്, നീളമേറിയ ശരീരവും വ്യതിരിക്തമായ രൂപഘടനാ സവിശേഷതകളും ഇതിന്റെ സവിശേഷതയാണ്. ഈ ഉപകുടുംബത്തിലെ അംഗങ്ങൾ ലോകമെമ്പാടും വ്യാപകമായി കാണപ്പെടുന്നു (ഹെർമൻ, 1970). മറ്റ് രാജ്യങ്ങളിലെ ഗവേഷണങ്ങളുമായി താരതമ്യപ്പെടുത്തുമ്പോൾ ഇന്ത്യയിൽ, പ്രത്യേകിച്ച് കേരളത്തിൽ, ഓക്സിറ്റെലിനേയെക്കുറിച്ചുള്ള വർഗ്ഗീകരണ ധാരണ അപര്യാപ്തമായി തുടരുന്നു. ഓക്സിറ്റെലിനേയുടെ ഇന്ത്യൻ വർഗ്ഗീകരണം പ്രധാനമായും കാമറൂണിന്റെ (1930) കൃതികളെ അടിസ്ഥാനമാക്കിയുള്ളതാണ് - 3 ഫോണ ഓഫ് ബ്രിട്ടീഷ് ഇന്ത്യ. ഈ കൃതികൾ പ്രധാനമായും വടക്കും വടക്കുകിഴക്കൻ ഇന്ത്യയിലും കേന്ദ്രീകരിച്ചിരിക്കുന്നു. കേരളത്തിൽ 8 ഇനം മാത്രമേ തിരിച്ചറിഞ്ഞിട്ടുള്ളൂ. വടക്കൻ മലബാർ മേഖലയിലെ ഓക്സിറ്റെലിനേ വണ്ടുകളുടെ വിതരണത്തെയും വ്യവസ്ഥാപിത വർഗ്ഗീകരണത്തെയും കുറിച്ച് ഗണ്യമായ ഗവേഷണ വിടവ് ഉണ്ട്. അതിനാൽ, ഭാവിയിലെ ഓക്സോണമിക്, പാരിസ്ഥിതിക, സംരക്ഷണ ഗവേഷണങ്ങളെ പിന്തുണയ്ക്കുന്നതിന് ഈ പഠനം വിലപ്പെട്ട അടിസ്ഥാന വിവരങ്ങൾ നൽകുന്നു.

പാരിസ്ഥിതിക പ്രാധാന്യം ഉണ്ടായിരുന്നിട്ടും, ഇന്ത്യയിലെ ഓക്സിറ്റെലിനേ വണ്ടുകളുടെ പരിസ്ഥിതിശാസ്ത്രം മോശമായി മനസ്സിലാക്കപ്പെട്ടിരിക്കുന്നു, ഇത് നിലവിലെ അറിവിലെ ഗണ്യമായ വിടവ് എടുത്തുകാണിക്കുന്നു. ഈ അറിവിന്റെ വിടവ് പരിഹരിക്കുന്നതിനായി, കേരളത്തിലെ വടക്കൻ മലബാറിലെ തിരഞ്ഞെടുത്ത വന-കാർഷിക ആവാസവ്യവസ്ഥകളിലെ ഓക്സിറ്റെലിനേ വണ്ടുകളുടെ വൈവിധ്യം, സമൃദ്ധി, കാലാനുസൃതമായ സംഭവവികാസങ്ങൾ എന്നിവ രേഖപ്പെടുത്തുക എന്നതാണ് ഈ പഠനത്തിന്റെ ലക്ഷ്യം. ആറളം വന്യജീവി സങ്കേതം, പെരിയ റിസർവ്വ് ഫോറസ്റ്റ്, മലബാർ വന്യജീവി സങ്കേതം, ബദിയടുകൾ കാർഷിക മേഖല, ഏഴോം നെൽവയൽ എന്നിവിടങ്ങളിൽ മഴക്കാലത്തും അല്പാത്ത സമയത്തും സാമ്പിളുകൾ ശേഖരിച്ചു.

മൂന്ന് ഗോത്രങ്ങളിലും ഏഴ് ജനുസ്സുകളിലും പെട്ട 31 ഇനം ഓക്സിറ്റെലിനേ വണ്ടുകളെ കേരളത്തിലെ വടക്കൻ മലബാറിൽ നിന്ന് രേഖപ്പെടുത്തി, ഈ ഉപകുടുംബത്തിന്റെ സമ്പന്നമായ വൈവിധ്യം വെളിപ്പെടുത്തി. ഇതിൽ, ഇന്ത്യയിൽ നിന്ന് ആദ്യമായി നാല് ഇനം, ദക്ഷിണേന്ത്യയിൽ നിന്ന് ഒമ്പത് ഇനം, കേരളത്തിൽ നിന്ന് മൂന്ന് ഇനം എന്നിവ റിപ്പോർട്ട് ചെയ്യപ്പെട്ടു, ഇത് പഠനത്തിന്റെ വർഗ്ഗീകരണ പ്രാധാന്യം എടുത്തുകാണിക്കുന്നു. വന, കാർഷിക ആവാസവ്യവസ്ഥകളിൽ നിന്നുള്ള ഓക്സിറ്റെലിനേ വണ്ടുകളെ തിരിച്ചറിയുന്നതിനുള്ള ഒരു സമഗ്രമായ ചെക്ക്‌ലിസ്റ്റ്,

പരിഷ്കരിച്ച ടാക്സോണമിക് കീകൾ, ഒരു ചിത്ര കീ എന്നിവ നൽകിയിരിക്കുന്നു. ചാണകവുമായി ബന്ധപ്പെട്ട ഓക്സിറ്റേലിനേ വണ്ടുകളുടെ വൈവിധ്യം, സമൃദ്ധി, ഋതുത്വം എന്നിവയും വിശകലനം ചെയ്തു. ആറളം വന്യജീവി സങ്കേതത്തിൽ ഉയർന്ന വൈവിധ്യം കണ്ടെത്തി. ആറളം വന്യജീവി സങ്കേതത്തിലും ബദിയടക്കം കാർഷിക മേഖലയിലും സ്പീഷിസുകളുടെ ഘടനയിലും സമൃദ്ധിയിലും ഗണ്യമായ കാലാനുസൃതമായ വ്യതിയാനങ്ങൾ നിരീക്ഷിക്കപ്പെട്ടു. വനത്തിലും കാർഷിക ആവാസവ്യവസ്ഥയിലും ഏറ്റവും സമൃദ്ധമായി ഉണ്ടായിരുന്ന ഇനം അനോട്ടിലസ് ലാറ്റിയസ്കുലസ് ആയിരുന്നു.

പ്രധാന പദങ്ങൾ: ഓക്സിറ്റേലിനേ, വർഗ്ഗീകരണം, വൈവിധ്യം, സമൃദ്ധി, ഋതുഭേദം

വിനീത വി. പി.

ഗവേഷണ വിദ്യാർത്ഥിനി

പ്രൊഫ്. (ഡോ.) വിനീഷ് പി. ജെ.

ഗവേഷണ ഗൈഡ്

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Chapter 1

INTRODUCTION

1. INTRODUCTION

1.1. Staphylinidae; General notes

Insects are the most diverse group of animals on Earth, accounting for over 75% of all known animal species. The members of the Coleoptera order, commonly known as beetles, are the largest, making up nearly 25% of all documented life forms (Hunt et al., 2007). The family Staphylinidae beetles, which belong to the suborder Polyphaga and are commonly called “rove beetles,” is considered the second-largest family of beetles (Newton, 1990). Staphylinids are found in nearly all ecosystems worldwide, ranging from the Arctic to tropical regions, and from marine shorelines to high alpine zones, including areas with permanent snow cover. Despite their relatively uniform morphology, characterized by short elytra, their highly flexible bodies enable them to exploit a wide range of microhabitats. Among the Coleoptera, few groups have been as successful as the Staphylinidae in colonizing such a diverse array of habitats (Irmeler et al., 2018). Additionally, most species possess well-developed wings and are proficient fliers, enabling them to disperse effectively over both short and long distances.

Rove beetles can be easily distinguished from other insects as they have short elytra with 6 - 7 exposed abdominal segments. They are dominant in a wide variety of ecosystems and show several ecological interactions (Thayer, 2005). The majority are predators of other insects and invertebrates. However, all species within certain subfamilies and some members of others consume fungi or decaying organic matter. Casual observers often spot staphylinids on carrion or dung, yet most species inhabit forest leaf litter, mosses, and various forms of decaying plant material, making them difficult to find without specific searching efforts. These are also commonly found beneath stones and plant debris, in marshes and bogs, and along the shores of lakes,

ponds, and streams (Moore, 1964; Moore and Legner, 1976). Numerous species can be found beneath bark or within decaying logs, frequently residing in the burrows of bark beetles. Some wander or conceal themselves on the trunks or foliage of living plants. Certain species inhabit fungi, where many are fungivores, while others prey on flies and various fungus dwellers. Some species are found on flowers, feeding on pollen, while others inhabit caves or are restricted to high-altitude talus slopes. The most unique species often reside solely in ant and termite nests and may be highly adapted to coexist and move with their hosts (Hölldobler and Wilson, 1990; Kistner, 1979, 1982; Wilson, 1971; Seevers, 1965, 1957). Some staphylinids are subsocial, showing parental care of larvae in special "nests" or burrows (Oxytelinae: *Platystethus* (Hinton, 1944) and *Bledius* (Wyatt, 1993)). Staphylinids act as an effective agent in the biological control of certain rice pests, such as lepidopteran defoliators (Heinrichs and Barrion, 2004; Polaszek, 1998).

According to Newton (2021), the family Staphylinidae includes 35 subfamilies globally, with 25 of them recorded in India, such as Aleocharinae Fleming, 1821, Apateticinae Fauvel, 1895, Dasycerinae Reitter, 1887, Euaesthetinae Thomson, C. G., 1859, Habrocerinae Mulsant & Rey, 1876, Olisthaerinae Thomson, C. G., 1858, Omaliinae MacLeay, W. S., 1825, Osoriinae Erichson, 1839, Oxyporinae Fleming, 1821, Oxytelinae Fleming, 1821, Paederinae Fleming, 1821, Phloeocharinae Erichson, 1839, Piestinae Erichson, 1839, Proteininae Erichson, 1839, Pselaphinae Latreille, 1802, Pseudopsinae Ganglbauer, 1895, Scaphidiinae Latreille, 1806, Scydmaeninae Leach, 1815, Silphinae Latreille, 1806, Solieriinae Newton & Thayer, 1992, Staphylininae Latreille, 1802, Steninae MacLeay, W. S., 1825, Tachyporinae MacLeay, W. S., 1825, Trichophyinae Thomson, C. G., 1858, and Trigonurinae Reiche, 1866. Among these, Oxytelinae has been specifically studied for research.

1.2. Taxonomy of Oxytelinae, Fleming, 1821

Oxytelinae (Coleoptera: Staphylinidae) is a subfamily of rove beetles (Fleming, 1821), characterized by their elongated bodies and distinctive morphology. This group is widely distributed across the world (Herman, 1970). This subfamily is characterised by the transverse, more or less rectangular, flattened head with the antennae fixed to the sides of the head under a raised edge or tubercle. Several genera have a visible abdominal tergite II at the base of the abdomen. Another distinguishing morphological feature is tergite IX, which is divided into two parts by tergite X (Schülke, 2012a; Lott, 2009). Additionally, the presence of abdominal sternite II, either well-developed or poorly sclerotized, but lacking a mid-longitudinal carina, is also characteristic (Herman, 1970). They have a unique pair of defensive glands opening onto the ninth tergum (Dettner and Schwinger, 1982). The defensive secretions of Oxytelinae: *Bledius* were quite effective against predators in their natural habitat, though not completely foolproof. The specific ratio of components in the secretion proved more effective than other mixtures (Thayer, 2005). Additionally, Dettner and Schwinger (1982) discovered that varying solvent components in the secretions of Oxytelinae affected their overall effectiveness. Species of Oxytelinae are observed in two different habitats: (1) moss, sand and gravel on banks of waterbodies and (2) dung or decaying plant material (Schülke, 2012a; Makranczy, 2006). The subfamily Oxytelinae has most species belonging to three major lineages: (1) *Bledius* contains approximately 457 described species; (2) *Carpelimus* and *Thinodromus* combined have 599 (with approximately 412 and 187 described species in each of these genera, respectively); (3) *Oxytelus* and *Anotylus* have approximately 649 (219 and 430, respectively).

Oxytelinae is distributed worldwide (not all genera) and contains more than 2000 described taxa (Schülke, 2012a; Schülke and Smetana, 2015), and later Newton (2021)

described exactly 2263 named, extant species at the time of the last catalogue. Six important figures shaped the classification of Oxytelinae: Fauvel, Sharp, Bernhauer, Cameron, Scheerpeltz and Fagel. The volume and status of the subfamily were often debated; for example, Jeannel and Jarrige (1949) considered Oxytelinae as a separate family, while Tikhomirova (1973) maintained the Oxytelinae in a broad sense. The currently accepted phylogeny-based classification is the product of three very influential workers: Herman (1970), Hammond (1976a, b), and Newton (1982). It is a diverse subfamily of Staphylinidae, containing more than 2,000 living species in 38 genera (Makranczy, 2006; Löbl and Löbl, 2015). Today, Oxytelinae rove beetles are widespread and frequently found in a range of habitats (Makranczy, 2006; Lü and Zhou, 2012, 2015a, 2015b). In the past, the name “Oxytelinae” referred to a broader group that included the tribe Oxytelini along with at least eight other tribes, which are now treated as separate subfamilies (Sharp, 1887; Bernhauer and Schubert, 1911; Cameron, 1930; Scheerpeltz, 1933).

Oxytelinae Fleming, 1821 comprises 8 tribes, 55 genera and 2294 species worldwide (Newton, 2021). Indian taxonomy of Oxytelinae is mainly based on the works of Cameron (1930) - the Fauna of British India, which depends mostly on the keys and descriptions which dealt with 8 tribes and 354 species, including 37 species from South India. Herman (1970) revised the classification of the genera within the Oxytelinae subfamily worldwide. Research efforts of later workers, namely Biswas and Sen (1980, 1989); Biswas (1986); Herman (2001); Makhan (2013). The taxonomic research on rove beetles in Kerala remains largely unexplored. Only 8 species have been described from Kerala (Cameron, 1930; Gildenkov, 2018a, 2019, 2020a; Vineetha et al., 2024). These contributed to the taxonomic studies of Oxytelinae from South India.

1.3. Ecology of Oxytelinae, Fleming, 1821

Members of the Oxytelinae group are primarily saprophagous (Newton, 1984), feeding largely on decaying wood, leaves, and dung. This feeding habit is observed in several genera, including *Platystethus* (Hinton, 1944) and *Anotylus* (Hammond, 1976a; Smith et al., 1978). Additionally, certain species of *Bledius* (Leach, 1819) and *Thinobius* (Kiesenwetter, 1844) are known to consume algae and other organic matter, typically inhabiting muddy or sandy areas near water bodies (Hammond, 1976a). There are also a few records of carnivorous behaviour, such as *Deleaster trimaculatus*, which consumes the soft tissues of freshly killed insects (Herman, 1970).

Species such as *Anotylus* (Thomson, 1859), *Oxytelus* (Gravenhorst, 1806), and *Platystethus* (Mannerheim, 1830) are commonly found in habitats rich in decaying organic material, including litter, dung, and decomposing vegetation, particularly in temperate regions (Hammond, 1976a). Additional studies report the presence of Oxytelinae species in diverse habitats such as stream margins, forest floors, and areas containing dung and decomposing organic matter (Hammond, 1976a; Makranczy, 2006; Schülke, 2012a).

Phytophagy is absent in Staphylinidae. However, there is an early report by Chittenden (1915) documenting *Apocellus* Erichson, 1839 (Oxytelinae) feeding on the flowers and leaves of cultivated violets and other plants. Similarly, Good and Giller (1991) noted occasional records of foliage feeding by *Coprophilus* Latreille, 1829 and other Oxytelinae genera, including *Apocellus*. Overall, Oxytelinae species are not considered to have a major economic impact. Nevertheless, their saprophagous and occasionally predatory habits may play a beneficial role in agricultural ecosystems by regulating the pest populations (Porter, 2025).

Globally, ecological studies focusing on the subfamily Oxytelinae remain limited. To date, no study has been conducted in India. Davis (1993) found that *Anotylus caffer* (Erichson, 1840) showed notable dominance under wet but suboptimal, cool conditions during early spring. Additionally, Yamamoto et al. (2014) investigated the diversity of Staphylinidae within forest ecosystems.

The study of Oxytelinae beetles in North Malabar is significant due to their crucial ecological roles and the region's rich yet underexplored biodiversity. Ecological importance, there is a noticeable research gap in the region regarding the diversity, distribution, and ecological interactions of Oxytelinae beetles. Previous studies on insect fauna in Kerala have largely focused on more conspicuous groups like butterflies and beetles of agricultural importance, leaving detritivores like Oxytelinae underexplored. A detailed taxonomic and ecological assessment is necessary to document their diversity, understand their habitat preferences, and evaluate their ecological functions. The taxonomic understanding of Oxytelinae in India, especially in Kerala, remains inadequate compared to research in other countries. Fewer than nine species have been identified so far. Considering the area's rich species diversity, this study holds great importance and stands as a ground-breaking taxonomic investigation from North Malabar, Kerala, in the field of Staphylinidology.

OBJECTIVES

1. Taxonomic identification of Oxytelinae up to genus/species level in the selected agriculture ecosystem of North Malabar and preparation of a pictorial key
2. To study the abundance and diversity of Oxytelinae in the selected agricultural ecosystem of North Malabar
3. To study the seasonality of Oxytelinae in the selected agricultural ecosystem of North Malabar
4. Taxonomic identifications of Oxytelinae up to genus/species level in the selected forest ecosystem of North Malabar and preparation of a pictorial key
5. To study the abundance and diversity of Oxytelinae in the selected forest ecosystem of North Malabar
6. To study the seasonality of Oxytelinae in the selected forest ecosystem of North Malabar

Chapter 2

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

2.1. Taxonomy Subfamily Oxytelinae; Worldwide status

The term *Staphylinus* was first introduced by Linnaeus (1758) in his work *Systema Naturae*, where he grouped all related species of rove beetles. The subfamily Oxytelinae was later formally described by Fleming (1821).

Abdullah and Qadri (1970) described twelve new taxa of the Oxytelinae from material collected in Karachi, Pakistan. A significant revision of the subfamily was carried out by Herman (1970). In this work, he made two major taxonomic changes: he elevated *Anotylus* to the status of a full genus and reclassified species formerly placed in the genus *Trogophloeus* Mannerheim, 1830, distributing them into the genera *Carpelimus* Leach, 1819 and *Thinodromus* Kraatz, 1857.

Herman's second major contribution focused on the *Bledius* group within Oxytelinae. This long-term study, conducted over 16 years, led to four comprehensive revisions published in 1972, 1976, 1983a, and 1986 (Herman, 1972, 1976, 1983a, 1986). These works remain key references and are still considered the standard for research on the subfamily. Peter Hammond made significant contributions to the study of the genus *Anotylus* (Hammond, 1976a, 1976b; Hammond et al., 1979), although his research often included observations on the classification of the entire subfamily Oxytelinae. He redefined the genus *Anotylus* and carried out detailed studies on species belonging to the *Platystethus*, *Anotylus*, and *Oxytelus* lineages (Hammond, 1971, 1975). At a time when the species-group concept was not widely used, Hammond was one of the first researchers to apply this approach to the Oxytelinae, making his work especially influential in shaping modern taxonomic methods for the subfamily.

Frank and Thomas (1981) describe the first report of *Oxytelus incisus* Motschulsky, 1858 and *Oxytelus pennsylvanicus* Erichson 1840 from Florida. Newton

(1982) described a new genus and species of flightless litter-inhabiting staphylinid, *Oxyptus peckorum* Newton, 1982, from the extreme southwestern region of Australia. Campbell (1982) discovered a new genus and a new species of Oxytelinae in Kouchibouguac National Park, New Brunswick. Herman (1986) used species-groups to help organise the large and complex genus *Bledius*. In his monograph, he grouped more than 400 species into clearly defined species groups on a global scale. This work greatly improved the classification and understanding of the genus. Klimaszewski et al. (1996) explained that seven genera of Oxytelinae occur in New Zealand.

Gildenkov (2000) presented a comprehensive review of Palaearctic species of the genus *Thinodromus* Kraatz, encompassing 32 species and 2 subspecies. The study includes the description of seven new species, along with detailed accounts of 14 species and two subspecies within the subgenus *Thinodromus* (*Amisammus*). Herman (2001) provided a comprehensive account of the subfamily Oxytelinae, documenting a total of 48 genera and 2,008 species globally, excluding Antarctica. In the years that followed, numerous taxonomists further enriched the understanding of Oxytelinae diversity through the description of new taxa and documentation of regional faunal records. Paquin and Dupérré (2001) made a significant contribution to the North American fauna by describing eleven species from western Québec. Grebennikov (2002) expanded the known diversity of the genus *Deleaster* Erichson, 1839, with the description of two new species from Saint Petersburg. Herman (2003) continued his taxonomic contributions with the description of a new genus and species from the Democratic Republic of the Congo. In the same year, Peck and Thayer (2003) recorded five species of Oxytelinae from cave habitats in the United States. Further advancements were made by Stan and Chimişliu (2005), who described five new species, and by Makranczy (2006), who not only described five additional species but

also developed a revised identification key for the subfamily From the Iberian Peninsula, while Lee and Ahn (2007) documented seven species from Korea. In Colombia, Gutiérrez-Chacón et al. (2009) identified Oxytelinae as one of the predominant subfamilies in the Southwest and Central regions, with *Thinodromus* emerging as the most frequently encountered genus. Anlaş and Rose (2009) reported 25 species as new records in Turkey, including three species previously unrecorded for the Turkish fauna. Concurrently, Gontarenko (2009) documented 21 Oxytelinae species from Ukraine, of which two were newly recorded for the country. Schülke (2009) described two new species of the genus *Anotylus* from diverse geographic regions, including China, Great Britain, Switzerland, Germany, Slovakia, and the Caucasus.

Frank and Ahn (2011) described a comprehensive overview of the subfamily Oxytelinae, cataloguing 76 species and two tribes. In a regional faunistic study, Lü and Zhou (2012) described 21 species of Oxytelinae, including the description of four new species from China. In the same year, Makranczy (2012) addressed nomenclature inconsistencies by resolving cases of secondary homonymy within the genus *Oxytelus*. Khachikov (2012) contributed to the higher-level classification of the subfamily Oxytelinae by restoring three previously suppressed tribes. Gildenkov and Shavrin (2012) reported new records of *Ochtheophilus* (Mulsant and Rey, 1856), *Carpelimus* (Leach, 1819), and *Thinodromus* (Kraatz, 1857) from both Cis- and Transbaikalian regions. Yue et al. (2012) documented a new genus and three new species from the lower Cretaceous Yixian Formation in Liaoning Province, northeastern China. Cai et al. (2013) discovered the fossil rove beetle from the early Cretaceous Yixian Formation in Liaoning Province, northeastern China. it represents the oldest known member of the tribe Euphaniini.

Makranczy (2013) conducted a comprehensive revision of the *Thinodromus* species from southern Africa. Cuccodoro and Makranczy (2013) conducted a comprehensive revision of the Afrotropical representatives of the genus *Deleaster* Erichson, 1839, and described two new species. Makranczy (2014) revised the *Thinodromus circulus* Bernhauer, 1922 species group and described five additional species within the subfamily Oxytelinae, contributing to the taxonomy and systematics of the group.

Lü and Zhou (2015a) described a taxonomic revision of the genus *Oxytelus* in Southeast Asia. They examined 776 specimens and 203 type specimens, leading to the discovery of 30 species. Seven of these were new. This work filled a longstanding taxonomic gap and provided a foundation for future studies on the Southeast Asian *Oxytelus* genus. In the same year, Lü and Zhou (2015b) also described a detailed revision of the genus *Platystethus* in China, documenting 12 species, of which three were newly described.

Karimifam et al. (2015) described seven species from southern Iran. Additionally, Gildenkova (2015a) described 13 *Carpelimus* species in Taiwan, of which eight were newly recorded for the region. Gildenkova (2015c) described 17 *Carpelimus* Leach, 1819, species, of which 11 species were reported from the Philippines for the first time.

Castro et al. (2016) recorded two species of *Bledius* (Leach, 1819) from the northeastern coast of Brazil. Gamarra and Outerelo (2016) reported a species of Oxytelinae newly added to the fauna of the Iberian Peninsula. Wojas (2016) contributed four new species from southern Poland. Makranczy (2016) delivers a comprehensive revision of the genus *Paraploclerus* Herman, 1970 in both the Afrotropical and Oriental regions. The study described fifteen valid species, including eleven new species descriptions and two new synonymies. Continuing his taxonomic efforts, Makranczy

(2017) significantly expanded the subfamily's taxonomy by describing 15 new species. This review is focused on the Oriental region and the transitional Himalayan area (including the southern provinces of China. Wang et al. (2017) revised the *Anotylus sculpturatus* (Gravenhorst, 1806) group, documenting 13 species from China, including seven new species. In the same year, Lü et al. (2017) described a new genus and species, *Prajna tianmiaoe* gen. et sp. nov., based on a well-preserved specimen in Cretaceous amber from northern Myanmar.

Ryabukhin and Gildenkova (2018) recorded 11 species belonging to six genera from the Kamchatka region, while Makranczy et al. (2018) described a fossil specimen putatively belonging to the tribe Coprophilini from Cretaceous amber. Jenkins Shaw (2018a) documented *Deleaster wilhelmensis* sp. nov. from Mount Wilhelm, Papua New Guinea, marking the first record of the genus *Deleaster* in Oceania and extending its known distribution. López-García and Marín-Gómez (2018) described a new species, *Parosus amayae*, from Colombia, within the recently revised genus *Parosus*.

Lee and Ahn (2019) revised the Korean *Carpelimus*, recognising five distinct species. Gontarenko (2019) reported 12 species from Ukraine, while Smetana (2019) described two new species of *Syntomium* Curtis, 1828 from mainland China. Gildenkova (2019) described seven new species of the *Carpelimus* genus from the "*taprobanae*" species group within the Oriental biogeographic region. These include *Carpelimus (Trogophloeus) cachariensis*, *finelypunctus*, *khasiensis*, *keraliensis*, and *madrasiensis* from India; *Carpelimus (Trogophloeus) hoaensis* from Vietnam; and *Carpelimus (Trogophloeus) mustangensis* from Nepal. This work significantly expands the known diversity of the group across South and Southeast Asia. In the same year, he also described a new species belonging to the *Thinodromus arcuatus* group and introduced *Thinodromus lenisus* from Uttarakhand.

Çiftçi (2020) documented new and distributional records for 16 species of Oxytelinae across various districts in Turkey. In the same year, Wang and Zhou (2020) revised the *Anotylus nitidifrons* (Wollaston, 1871) group and described five new species from China. Gildenkov (2020a) conducted a review of 13 species of the genus *Carpelimus* Leach, 1819 from New Guinea, including seven new species recorded from this region. The study also described a new subspecies, *Carpelimus* (s.str.) *indicus wamenensis*, contributing to the expanding knowledge of the genus's diversity in New Guinea. Additionally, Gildenkov (2020b) described eight new species of the genus *Carpelimus* from Indonesia.

Koval et al. (2021a) described four species of Oxytelinae. Makranczy (2021a) conducted a comprehensive review of the *Anotylus rufus* and *Anotylus exasperatus* species groups, a total of 24 species, including 20 newly described taxa. Again, Makranczy (2021b) documented the *Anotylus exasperatus* species group, with particular emphasis on taxa lacking external sexual dimorphism. In the same year, *Deleaster bactrianus* Semenov was newly recorded for the Chinese fauna through a review of the genus by Wang and Lü (2021). Blinstein (2021) reported an interesting record of *Bledius mulsanti* Fauvel, 1872, in the Amur Region. Semionenkov and Gildenkov (2022) described a new species, *Oxytelus* (*Tanycraerus*) *ruthenus*, while Kacar et al. (2022) recorded ten species of the genus *Bledius* in Turkey.

Gildenkov (2023a) described and illustrated two new species from New Guinea: *Carpelimus* (*Trogophloeus*) *kwauensis* and *Carpelimus* (*Trogophloeus*) *nabireensis*, which belong to a group closely related to *Carpelimus notumus*. These discoveries expanded the known diversity of the genus *Carpelimus* in the Australian biogeographic region. Additionally, Gildenkov (2023b) identified and described a new species, *Thinodromus* (s. str.) *excisus* sp. n., from Pahang State, Malacca Peninsula,

Malaysia, assigning it to the *Thinodromus lunatus* species group based on its distinctive aedeagal structure. Blinsein (2023) described a new and previously little-known species of *Bledius* from Nepal, housed in the Erfurt Natural History Museum.

Several new species were described: *Oxytelus sishuishanus* from Hunan, China, by Ma et al. (2024), a new species of *Thinobius* from Myanmar by Gildenkov and Semionenkov (2024a). Additionally, *Oxytelus (Tanycraerus) jessoensis* was recorded from the Kamchatka region by Gildenkov and Semionenkov (2024b). *Thinodromus sabbangensis* from Sulawesi, Indonesia, by Gildenkov (2024); and *Oxytelus acriculiclypeatus* sp. nov. was described from Sabah, Borneo, by Lü (2024).

Gildenkov (2025) described a new species of *Thinodromus* from Sulawesi and *Carpelimus (Trogophloeus) parisimplex* sp. n. from Thailand and Vietnam. Sazhnev et al. (2025) provided faunistic data for the family Staphylinidae in Vologodskaya Oblast, Russia, documenting 11 species of Oxytelinae.

2.2. Ecology of Oxytelinae; Worldwide status

Qodri et al. (2016) investigated the diversity and abundance of Staphylinidae across four montane habitat types: agricultural area, pine forest, eucalyptus forest, and natural forest, resulting in the identification of six species. Belskaya and Kolesnikova (2011) surveyed the southern taiga of the Middle Ural region, identifying 76 species from 44 genera spanning nine subfamilies of Staphylinidae, including Oxytelinae. Nasir et al. (2011) studied the biodiversity of Staphylinids in cropped areas of Punjab, Pakistan, and recorded four species of Oxytelinae.

Méndez et al. (2012) evaluated the diversity and composition of rove beetles (Coleoptera: Staphylinidae) across a mosaic of habitat types within a high-Andean landscape undergoing ecological restoration in the Central Andes of Colombia. Among the recorded taxa, the genus *Anotylus* was identified. Yamamoto (2014) studied the

diversity of Staphylinidae in the forest ecosystem; among these, *Anotylus* sp. represented more than 90% of all individuals, and this species was also the most abundant. Frank and Thomas (2021) provided a comprehensive reference, *Rove Beetles of the World*, which offers a global overview of the Staphylinidae family (Insecta: Coleoptera).

Puspasari et al. (2025) explored the species diversity and abundance of rove beetles (Staphylinidae) across four vegetable agroecosystems. Among the Staphylinidae collected, eight species belonging to the subfamily Oxytelinae were recorded; however, only one species, *Oxytelus bengalensis*, was identified to the species level.

2.3. Taxonomy of Oxytelinae from India

Latreille (1829) was among the first to describe *Coprophilus maximus*, a species discovered in Uttarakhand, North India. Cameron (1930) seminal work, *The Fauna of British India*, offered extensive taxonomic insights into the subfamily Oxytelinae, identifying numerous new species across India. Following Cameron's contributions, the region saw limited research on Oxytelinae for more than five decades. Subsequently, Biswas and Sengupta (1980) described *Oxytelopsis bengalensis* sp. nov. from West Bengal and provided a key to the Indian species of *Oxytelopsis*. Biswas (1986) documented 21 species belonging to 12 genera, including four Oxytelinae species from Silent Valley National Park, located in the core area of the Nilgiri Hills in Kerala.

Gildenkov (2003) found one of the newly described species, *Th. (A.) tenebrius* from northern India. Additionally, the lectotype of *Trogophloeus ripicola* was designated in this study, contributing to the taxonomic clarity of the group. Gildenkov (2017) reviewed the *Thinodromus lunatus* species group and described five new

species, including *T. himalayensis* sp. n. from northern India. Again, Gildenkov (2018a) described six new species of the genus *Thinodromus* (Kraatz, 1857), all closely related to *Th. (Amisammus) ripicola* (Cameron, 1941) and *Th. (Amisammus) latus*. Additionally,

Three years later, Ferreira (2021) reported seven species of Staphylinidae from Goa, including first records of *Bledius brunnipennis* Fauvel, 1904 and *Bledius lucidus* Cameron, 1944, for the region. Further faunistic contributions were made by Gildenkov (2021), who recorded *Carpelimus (Trogophloeus) coriaceus* (Cameron, 1930) for the first time from southern India, specifically the province of Tamil Nadu. Additionally, *Carpelimus (Trogophloeus) magnicollis* Cameron, 1930, *C. taprobanae* Cameron, 1930, and *C. vagans* Sharp, 1871 were recorded for the first time from central India, in the province of Madhya Pradesh. Gildenkov (2022a) described a new *Coprophilus* species from North India. Subsequently, Gildenkov (2022b) described *Mendaxinus oblitus*, a new species from West Bengal.

Vineetha et al. (2024) reported six new records of Oxytelinae from southern India. Blinsein (2024) further expanded the knowledge of the genus *Bledius* Leach, 1819, through the description of new species, new distribution records, and taxonomic clarifications from various parts of the country.

Ecological studies of Oxytelinae in India remain largely unexplored. In contrast, ecological studies on other subfamilies of Staphylinidae have been carried out by researchers such as Kavyamol et al. (2024) and Vineesh et al. (2023).

Chapter 3

MATERIALS AND METHODS

3. MATERIALS AND METHODS

3.1. Study area

The present study focused on the forest and agricultural ecosystems of North Malabar, covering Kasargod, Kannur, Mananthavady taluk of Wayanad, and the Koyilandi Taluk of Kozhikode districts in Kerala. The forest ecosystem includes Aralam Wildlife Sanctuary, Periya Reserve Forest, and the Malabar Wildlife Sanctuary. The agricultural ecosystem consists of the Badiyadukka Agricultural Field and the Ezhome Paddy Field.

Aralam Wildlife Sanctuary, AWS (11.96044°N, 75.79675°E). Aralam Wildlife Sanctuary, located in the southeastern part of Kannur District, is the northernmost protected area in Kerala. It shares its borders with the Wayanad-Brahmagiri region, including the northern slopes of Wayanad and the protected areas of Karnataka, such as Brahmagiri Wildlife Sanctuary and the forests of Coorg (Kerala Forest and Wildlife Department, 2019). The sanctuary features diverse vegetation, including West Coast Tropical Semi-evergreen Forest, West Coast Tropical Evergreen Forest, South Indian Moist Deciduous Forest, Southern Hilltop Evergreen Forest (Champion and Seth, 1968), and plantations. For this study, the focus is on the West Coast Tropical Semi-evergreen Forest. Its varied habitats support a remarkable array of flora and fauna. Spanning across Aralam and Kottiyoor villages in Kannur District (Sreekumar and Balakrishnan, 2001), the sanctuary covers an area of 55 square kilometres. Its elevation ranges from 60 to 1,589 meters, influenced by climatic, altitudinal, and soil-related factors (Kerala Forest and Wildlife Department, 2019).

Periya Reserve Forest, PRF (11.84575° N, 75.80953° E) is located in the Wayanad district, in the northeastern part of Kerala. It spans approximately 2,132 sq. km and is bordered by the Nilgiris district of Tamil Nadu and the Mysore and Kodagu

districts of Karnataka to the north and east, Malappuram to the south, and Kozhikode and Kannur to the west. The forest has an average elevation of 15 meters. Periya is an evergreen forest with a climate influenced by the southwest and northeast monsoons.

Malabar Wildlife Sanctuary, MWS (11.56732° N, 75.91957° E) (MoEFCC, 2015).

Malabar Wildlife Sanctuary, part of the Western Ghats biodiversity hotspot, is the 16th wildlife sanctuary in Kerala. It falls under the Nilgiri Biosphere Reserve and is a part of the Wayanad Elephant Reserve. Covering a total area of 74.22 sq. km, the sanctuary is located in the Chakkittappara and Koorachundu revenue villages of Quilandy Taluk. The study was conducted in the Kakkayam Reserve Forest, part of the Malabar Wildlife Sanctuary, located along the boundary of the Kozhikode district. The vegetation includes West Coast tropical evergreen, West Coast semi-evergreen, Southern moist mixed deciduous, Southern hill-top evergreen forests, grasslands, and marshy grasslands (Kerala Forest and Wildlife Department, 2019). For this study, the focus is on the Southern moist mixed deciduous.

The selected agricultural ecosystems include the Badiyadukka Agricultural Field and the Ezhome Paddy Field. **Badiyadukka Agricultural Field (BAF)** (12.45671° N, 75.16231° E) is an agriculture-centred village in the Kasargod district (District Census Handbook: Kasaragod, 2011) characterised by mixed crops. Another site is **Ezhome Paddy Field, EPF** village (12.03622° N, 75.30262° E) in the Kannur district, where the agricultural landscape primarily consists of paddy fields.

3.2 Taxonomic Analysis and Ecological Studies

3.2.1 Sample Collection

Sampling for Oxytelinae beetles was carried out from 2019 to 2022 across selected forest and agricultural ecosystems using three methods: baited pitfall traps,

handpicking, and the flotation method. While all three methods were used for taxonomic analysis, only the flotation method was applied for diversity analysis.

The Specimens were collected using the flotation method (Moore, 1954). Collect fresh cow dung in a bucket with a lid. The dung should be very fresh so that it is not populated by dung beetles already. Its green colour, fresh smell, and physical appearance can easily differentiate it. Collect the dung best in the early morning when fewer beetles are active (Frank, 2007). Dung pats, each weighing 1 kg, were placed in the study area at 10-meter intervals. At each study site, 30 samples were placed during both the rainy season (June–November) and the non-rainy season (December–May). After 5 days, dung pats were collected and transferred into a plastic tray filled with water. Most of the beetles will float and can be collected with a brush and forceps and put into a vial containing 80% ethyl alcohol. The vials were tagged with labels providing information about the site, location, time and date.

Cow dung baited pitfall traps (Spector and Forsyth, 1998) are generally used to collect dung beetles. they are found to be useful for collecting rove beetles by Rachel (2011). Plastic containers measuring 15 cm in diameter and 20 cm in depth were used as pitfall traps. These were buried in the soil with their rims level with the soil surface to collect beetles that accidentally fell into them, following the general method described by Nyundo and Yaro (2007) and Skvarla et al. (2014). Each trap was half-filled with a preservative solution consisting of water, salt, and soap. Bait was placed on the surface of the liquid to attract insects, which subsequently fell into the trap. A total of 30 baited pitfall traps were deployed at the selected sites twice a year. After exposure, the traps were removed, and the collected rove beetles were rinsed with fresh water and transferred to sample containers containing 80% ethyl alcohol for preservation.

Hand-picking was done as a supplementary method for collecting rove beetles. The quadrat sampling technique was applied by walking in a straight line for 500 meters within the sampling site, stopping every 100 meters to place a 1-square-meter quadrat. Samples were then collected from within the defined area, following the protocol outlined by Yu et al. (2007). The rove beetles were collected mainly from under stones, litter, sand banks near rivers and streams, logs and grass patches.

3.2.2 Preservation and Identification

Oxytelinae beetles collected from the study area using the flotation method, baited pitfall trap, and Handpicking were sorted and preserved in 80% ethyl alcohol. The specimens were identified up to genus/species level in the laboratory using the existing taxonomic key of Cameron (1930) and also using modified and newly prepared taxonomic keys whenever necessary, with reference to additional literature (Makranczy, 2006; Lu and Zhou, 2012; and Lu and Zhou, 2015a). The higher classification, nomenclature and distribution followed in the present study are based on *StaphBase*, developed by Newton (2021).

Specimens from international museums such as the British Museum of Natural History, London (BMNH) and the Field Museum of Natural History (FMNH), Chicago, were analysed for taxonomic studies, verification, and consultation with staphylinidologists around the world, as well as type descriptions from the literature. Identification and images were made by using a Leica M205C stereo zoom microscope fitted with a Leica MC 170 HD microscope camera, and were enhanced with the help of Leica Application Suite (LAS) version 4.12. Body length was measured from the tip of the labrum to the apex of the abdomen (Lawrence et al., 1999). All of the measurements were provided in millimetres. Identified and labelled beetles were

deposited in the national repository of the Zoological Survey of India, Western Ghats Regional Centre (ZSI-WGRC), Kozhikode, Kerala.

3.2.3 Checklist and Pictorial Key

A checklist of species, along with a key to the tribes, genera, and species from selected agricultural and forest ecosystems, is provided. Additionally, a pictorial key to the Oxytelinae subfamily from the forest and agricultural ecosystems of North Malabar is included. The geographical distribution of the collected species was determined using the StaphBase website developed by Newton (2021)

3.3 Ecological Analysis

The ecological analysis of identified Oxytelinae beetles from selected forest and agricultural ecosystems in North Malabar, Kerala, was conducted. The data were utilised to determine relative abundance, generate a rank abundance curve, and assess diversity, richness, and evenness using PAST software, Version 3.15 (Hammer et al., 2001)

3.3.1 Diversity analysis

Alpha diversity indices (Richness, Evenness, and Diversity), Beta diversity index (Bray-Curtis similarity index), and Rank abundance plot were used to assess patterns of species diversity

To analyze species richness, Margalef's index (d) was calculated by using the formula (Magurran, 2004; Clifford and Stephenson, 1975)

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

$$S = \text{Total number of species}$$

$$N = \text{Total number of individuals}$$

The Shannon–Weaver diversity index (Shannon and Weaver, 1949) is one of the most widely used diversity indices, as it includes both species richness and evenness.

It provides a measure of heterogeneity (Rosenstock, 1998; Cheng, 1999) and allows for the comparison between two communities using a t-test (Magurran, 2004).

The Shannon–Weaver diversity index (H') was calculated by using the formula:

$$H' = - \sum_i P_i (\log (P_i))$$

Where:

$$P_i = \text{Proportion of individuals belonging to the } i^{\text{th}} \text{ species}$$

The Simpson's evenness index ($1-D$ or $1/D$) considers the equitability of species within a community (Simpson, 1949)

Simpson's evenness index was calculated by using the formula:

$$E_{1-D} = (1/D)/S$$

$$1/D = \text{Reciprocal form of Simpson's diversity index } (D)$$

$$S = \text{Total number of species in the sample}$$

$$D = \sum p_i^2$$

$$P_i = \text{The proportion of individuals in the } i^{\text{th}} \text{ species (Magurran 2004)}$$

The similarity in Oxytelinae beetle species composition across habitats was measured and compared using the Bray- Curtis similarity coefficient (Bray and Curtis, 1957).

The rank abundance plot was constructed by plotting the relative abundance of each species against its rank within each habitat (Whittaker, 1965)

3.3.2 Statistical analysis

The species abundance data used for statistical analysis were first tested for normality using the Anderson–Darling test. As the data were found to be normally distributed, parametric tests were subsequently applied to analyze the significance of variation. Statistical significance was determined at $P < 0.05$ for all analyses. All statistical and diversity analyses were performed using PAST software version 3.15 (Hammer et al., 2001). Individual-based rarefaction and extrapolation curves were

generated to compare species diversity across five selected agricultural and forest ecosystems. These analyses were conducted using R software (version 4.1.2; R Core Team, 2020) with the `ggplot2` (Wickham, 2009) and `iNEXT` (Hsieh et al., 2016) packages. Species were classified as ‘dominant’ if their relative abundance was 10% or higher, ‘minor’ if their relative abundance ranged from 0.5% to 4.99%, and ‘rare’ if their relative abundance was less than 0.5%.



Figure 1. Map showing the Study area A) Badiyadukka Agricultural Field, B) Ezhome Paddy Field, C) Periya Reserve Forest, D) Malabar Wildlife Sanctuary E) Aralam Wildlife Sanctuary.



Figure 2: Forest Ecosystems - A) Periya Reserve Forest, B) Malabar Wildlife Sanctuary, C) Aralam Wildlife Sanctuary.



Figure 3: Agricultural Ecosystems - A) Ezhome Paddy Field, B) Badiyadukka Agricultural Field



Figure 4: A) Baited Pitfall trap- B) Floatation Method, C) Hand Picking Method

Chapter 4

RESULTS

4. RESULTS

4.1. Taxonomy

The study conducted in North Malabar, Kerala, between 2019 and 2022 documented 31 species of Oxytelinae beetles, belonging to three tribes and seven genera, highlighting the region's rich beetle diversity. Within the tribe Blediini Ádám, 2001, the genus *Bledius* Leach, 1819 was represented by two species, *Bledius lucidus* Sharp, 1874 and *Bledius pulchellus* Kraatz, 1859.

The tribe Oxytelini Fleming, 1821, was the most diverse, featuring three genera: *Anotylus* Thomson, C. G., 1859, *Oxytelus* Gravenhorst, 1802, and *Platystethus* Mannerheim, 1830. The genus *Anotylus* included 10 identified species (*A. glareosus* (Wollaston, 1854), *A. disparatus* (Cameron, 1928), *A. latiusculus* (Kraatz, 1859), *A. micans* (Kraatz, 1859), *A. myrmecophilus* (Cameron, 1914), *A. nitidifrons* (Wollaston, 1871), *A. pusillimus* (Kraatz, 1859), *A. rubicundus* (Cameron, 1930), *A. rufus* (Kraatz, 1859), *Anotylus* sp.1. Similarly, the genus *Oxytelus* had 12 identified species, such as *O. barbatus* Fauvel, 1905, *O. bengalensis* Erichson, 1840, *O. dohertyi* Cameron, 1930, *O. incisus* Motschulsky, 1858, *O. lividus* Motschulsky, 1858, *O. megaceros* Fauvel, 1895, *O. migrator* Fauvel, 1904, *O. nigriceps* Kraatz, 1859, *O. nilgiriensis* Cameron, 1930, *O. piceus* (Linnaeus, 1767), *O. puncticeps* Kraatz, 1859, and one *Oxytelus* sp. 1). *Platystethus* is contained by *P. crassicornis* Motschulsky, 1858.

The tribe Thinobiini Sahlberg, J., 1876, included three genera: *Carpelimus* Leach, 1819, *Thinobius* Kiesenwetter, 1844, and *Xerophygus* Kraatz, 1859. Four species of *Carpelimus* were identified (*C. atomus* Saulcy, 1865, *C. finelypunctus*, Gildenkov, 2019, *C. indicus* (Kraatz, 1859), and *C. perigrinus* Cameron, 1919),

while *Thinobius simlaensis* Cameron, 1930 and *Xerophygus pallipes* (Motschulsky, 1858) were the only representatives of their respective genera. (Table 1).

Four species (*Oxytelus barbatus*, *Oxytelus migrator*, *Xerophygus pallipes* and *Oxytelus piceus*) were first reported from India. Nine species (*Anotylus glareosus*, *Oxytelus bengalensis*, *Oxytelus lividus*, *Oxytelus puncticeps*, *Thinobius simlaensis*, *Anotylus micans*, *Anotylus rubicundus*, *Anotylus pusillimus*, and *Anotylus disparatus*) were newly reported from South India. Three species (*Anotylus myrmecophilus*, *Anotylus nitidifrons*, and *Oxytelus nilgiriensis*) were newly reported from Kerala. (Table 1).

4.1.1. Oxytelinae, Fleming, 1821, recorded from the North Malabar, Kerala

Table 1: Oxytelinae beetles collected from North Malabar, Kerala.		
Tribe	Genus	Species
Blediini Ádám, 2001	<i>Bledius</i> , Leach, 1819	<i>B. lucidus</i> Sharp, 1874
		<i>B. pulchellus</i> Kraatz, 1859
Oxytelini, Fleming, 1821	<i>Anotylus</i> , Thomson, C. G., 1859	<i>A. glareosus</i> (Wollaston, 1854) **
		<i>A. disparatus</i> (Cameron, 1928) **
		<i>A. latiusculus</i> (Kraatz, 1859)
		<i>A. micans</i> (Kraatz, 1859) **
		<i>A. myrmecophilus</i> (Cameron, 1914) *
		<i>A. nitidifrons</i> (Wollaston, 1871) *
		<i>A. pusillimus</i> (Kraatz, 1859) **

		<i>A. rubicundus</i> (Cameron, 1930) **
		<i>A. rufus</i> (Kraatz, 1859)
		<i>Anotylus</i> sp1
	<i>Oxytelus</i> , Gravenhorst, 1802	<i>O. barbatus</i> Fauvel, 1905 ***
		<i>O. bengalensis</i> Erichson, 1840 **
		<i>O. dohertyi</i> Cameron, 1930
		<i>O. incisus</i> Motschulsky, 1858
		<i>O. lividus</i> Motschulsky, 1858 **
		<i>O. megaceros</i> Fauvel, 1895
		<i>O. migrator</i> Fauvel, 1904 ***
		<i>O. nigriceps</i> Kraatz, 1859
		<i>O. nilgiriensis</i> Cameron, 1930*

		<i>O. piceus</i> (Linnaeus, 1767) ***
		<i>O. puncticeps</i> Kraatz, 1859 **
		<i>Oxytelus</i> sp1
	<i>Platystethus</i> , Mannerheim, 1830	<i>P. crassicornis</i> Motschulsky, 1858
Thinobiini, Sahlberg, J., 1876	<i>Carpelimus</i> , Leach, 1819	<i>C. atomus</i> Saulcy, 1865
		<i>C. finelypunctus</i> , Gildenkova, 2019
		<i>C. indicus</i> (Kraatz, 1859)
		<i>C. perigrinus</i> Cameron, 1919
	<i>Thinobius</i> , Kiesenwetter, 1844	<i>T. simlaensis</i> Cameron, 1930 **
	<i>Xerophygus</i> , Kraatz, 1859	<i>X. pallipes</i> , (Motschulsky, 1858) ***
***First report from India; **First report from South India; * First report from Kerala		

First report from India	First report from South India	First report from Kerala
<i>Oxytelus barbatus</i>	<i>Anotylus glareosus</i>	<i>Anotylus myrmecophilus</i>
<i>Oxytelus migrator</i>	<i>Oxytelus bengalensis</i>	<i>Anotylus nitidifrons</i>
<i>Xerophygus pallipes</i>	<i>Oxytelus lividus</i>	<i>Oxytelus nilgiriensis</i>
<i>Oxytelus piceus</i>	<i>Oxytelus puncticeps</i>	
	<i>Anotylus micans</i>	
	<i>Anotylus rubicundus</i>	
	<i>Anotylus pusillimus</i>	
	<i>Anotylus disparatus</i>	
	<i>Thinobius simlaensis</i>	

4.1.2 Identification key to Oxytelinae Species from North Malabar (Modified from Cameron, 1930)

Key to the tribe of Oxytelinae

- 1. Small species (1 mm) **Thinobiini**
- Moderately larger species (Above 2 mm) **2**
- 2. Cylindrical species..... **Blediini**
- Not cylindrical species..... **Oxytelini**

Key to the genus of the tribe Thinobiini

- 1. Abdomen parallel..... **Carpelimus**
- Abdomen not Parallel..... **2**
- 2. Larger species (above 3mm) **Xerophygus**
- Smaller species (1mm) **Thinobius**

Key to the genus of the tribe Oxytelini

- 1. Sutural angle of elytra rounded..... **Platystethus**
- Sutural angle of elytra not rounded..... **2**
- 2. Sides of the thorax crenulate or denticulate..... **Oxytelus**
- Sides of the thorax even..... **Anotylus**

Genus *Bledius*, Leach, 1819

- 1. Elytra concolourous brown..... ***B. lucidus***
- Elytra Bicolourous ***B. pulchellus***

Genus *Anotylus*, Thomson, C. G., 1859

- 1. Body with dense coarse punctures..... ***A. glareosus***
- Body with fine punctures..... **2**
- 2. Intra-Ocular ridge distinct and continued back to the base of head..... ***A. latiusculus***

- Intraocular ridge indistinct and not continued to the base.....	3
3. Abdomen moderately punctured.....	<i>A. pusillimus</i>
- Abdomen impunctured.....	4
4. Body reddish medium brown.....	<i>A. rufus</i>
- Species more or less yellow.....	5
5. Head testaceous.....	<i>A. rubicundus</i>
- Head pitchy black.....	6
6. Thorax yellowish brown.....	<i>A. nitidifrons</i>
- Thorax dark brown.....	7
7. Head without striation.....	8
- Head densely striated.....	<i>A. myrmecophilus</i>
8. Elytra yellowish brown.....	<i>A. micans</i>
- Elytra dark brown.....	<i>A. disparatus</i>

Genus *Oxytelus*, Gravenhorst, 1802

1. Elytra punctuated	<i>O. barbatus</i>
- Elytra not punctuated.....	2
2. Labrum emarginate.....	<i>O. puncticeps</i>
- Labrum round.....	3
3. Clypeus protruding.....	4
- Clypeus not protruding.....	5
4. Mandible robust and curved.....	<i>O. dohertyi</i>
-Mandible stout, strongly not curved.....	<i>O. megaceros</i>
5. Sub opaque species.....	6
- Shining species.....	7
6. The last joint of antennae elongate	<i>O. lividus</i>

- Last joint of antennae short, conical *O. bengalensis*
- 7. Head brownish black.....8
- Head ferrugineous red.....*O. incisus*
- 8. Thorax testaceous.....*O. nigriceps*
- Thorax black or pitchy brown.....9
- 9. Legs brownish..... *O. piceus*
- Legs testaceous.....10
- 10. Head larger than pronotum.....*O. nilgiriensis*
- Head as wide as pronotum.....*O. migrator*

Genus *Carpelimus* Leach, 1819

- 1. Entirely black species.....*C. indicus*
- Pronotum brownish or reddish.....2
- 2. Moderately shining species.....3
- Moderately not shining species.....*C. finelypunctus*
- 3. Pronotum narrowed posteriorly.....*C. peregrinus*
- Pronotum not narrowed posteriorly.....*C. atomos*

Genus *Thinobius*, Kiesenwetter, 1844

- 1. Elytra testaceous.....*T. similensis*

4.1.3 Key to the species recorded from the Forest ecosystem

Genus *Bledius*, Leach, 1819

- 1. Elytra concolourous brown.....*B. lucidus*
- Elytra Bicolourous*B. pulchellus*

Genus *Carpelimus* Leach, 1819

- 1. Moderately shining species.....2
- Not shining species.....*C. finelypunctus*

2. Pronotum greatly narrowed posteriorly.....*C. peregrinus*
 - Pronotum slightly narrowed posteriorly.....*C. atomos*

Genus *Anotylus*, Thomson, C. G., 1859

1. Intra-Ocular ridge distinct and continued back to the base of head.....*A. latiusculus*
 - Intra-ocular ridge indistinct and not continued to the base.....2
 2. Abdomen moderately punctured..... *A. pusillimus*
 -Abdomen impunctured.....3
 3. Body reddish medium brown..... *A. rufus*
 - Species more or less yellow.....4
 4. Head yellowish..... *A. rubicundus*
 - Head pitchy black.....6
 6. Elytra yellowish brown.....*A. myrmicophilus*
 - Elytra dark brown..... *A. disparatus*

Genus *Oxytelus*, Gravenhorst, 1802

1. Elytra punctuated*O. barbatus*
 - Elytra not punctuated.....2
 2. Labrum emarginate.....*O. puncticeps*
 - Labrum round.....3
 3. The last joint of the antennae elongate *O. megaceros*
 - Last joint of antennae short, conical4
 4. Pronotum with dark posterior and lateral margin.....*O. bengalensis*
 - Pronotum with light posterior and lateral margin.....5
 5. Head brownish black.....6
 - Head ferrugineous red.....*O. incisus*

6. Thorax testaceous.....*O. nigriceps*
- Thorax black or pitchy brown.....7
7. Legs brownish..... *O. piceus*
- Legs testaceous.....8
8. Head larger than pronotum.....*O. nilgiriensis*
- Head as wide as pronotum.....*O. migrator*

4.1.4 Key to the species recorded from the Agricultural ecosystem

Genus *Anotylus*, Thomson, C. G., 1859

1. Body with dense coarse punctures..... *A. glareosus*
- Body with fine punctures.....2
2. Intra-Ocular ridge distinct and continued back to the base of head.....*A. latiusculus*
- Intra-ocular ridge indistinct and not continued to the base.....3
3. Abdomen moderately punctured..... *A. pusillimus*
- Abdomen impunctured.....4
4. Body reddish medium brown..... *A. rufus*
- Species more or less yellow.....5
5. Head yellowish..... *A. rubicundus*
- Head pitchy black.....6
6. Thorax yellowish brown..... *A. nitidifrons*
- Thorax dark brown.....7
7. Head without striation.....8
- Head densely striated..... *A. myrmecophilus*
8. Elytra yellowish brown..... *A. micans*
- Elytra dark brown..... *A. disparatus*

Genus *Oxytelus*, Gravenhorst, 1802

- 1. Elytra punctuated *O. barbatus*
- Elytra not punctuated.....2
- 2. Labrum emarginate..... *O. puncticeps*
- Labrum round.....3
- 3. Labrum protruding..... *O. dohertyi*
- Labrum not protruding4
- 4. Pronotum with dark posterior and lateral margin.....5
- Pronotum with light posterior and lateral margin.....6
- 5. The last joint of antennae elongate *O. lividus*
- Last joint of antennae short, conical *O. bengalensis*
- 6. Head ferrugineous red..... *O. incisus*
- Head brownish..... *O. migrator*

4.1.5 Checklist of Oxytelinae recorded from the North Malabar, Kerala

Subfamily Oxytelinae Fleming, 1821

Tribe Blediini Ádám, 2001

Genus *Bledius*, Leach, 1819

***Bledius lucidus* Sharp, 1874**

= *Bledius fischeri* Bernhauer, 1903

= *Bledius capitalis* Fauvel, 1877

Sharp, 1874: 90; Fauvel, 1903: 152; id, 1904a: 46; Bernhauer and Schubert, 1911: 132; Bernhauer, 1920: 6; id, 1922a: 149; id, 1922b: 225; Winkler, 1925: 347, Bernhauer, 1926: 313; Cameron, 1928: 106; Scheerpeltz, 1929a: 116; Cameron, 1930: 279; id, 1930a: 186; Scheerpeltz, 1933: 1118; id, 1935: 636; Cameron, 1949: 462; Scheerpeltz, 1957a: 226; Last, 1961: 305; Watanabe, 1961: 350; Herman, 1970: 378; Abdullah and

Qadri, 1970: 120; Shibata, 1973: 34; Shibata, 1976: 136; Herman, 1986: 161, 316; Biswas and Sen Gupta, 1989: 19; Herman, 2001: 1574; Ferreira, 2021: 68.

Materials examined: (n=29). Aralam Wildlife Sanctuary, 21 ex., 'Flotation method', 05/10/2020, 05/03/2021; Malabar Wildlife Sanctuary, 8 ex., Flotation method, 12/08/2019, Coll.Vineetha V P

Distribution: India (Kerala, Tamil Nadu, Madhya Pradesh, Meghalaya (Cameron, 1930), Karnataka, Bihar, Punjab, Goa, UP (Ferreira, 2021)), Pakistan, China, Japan, Kenya, Congo, Madagascar, Bhutan, Thailand, Cambodia, Vietnam, Borneo, Singapore, Indonesia, New Guinea, Australia (Newton, 2021)

***Bledius pulchellus* Kraatz, 1859**

Kraatz, 1859: 169; Bernhauer, 1902a: 44; Fauvel, 1903: 151; Bernhauer and Schubert, 1911: 134; Cameron, 1930: 283; Scheerpeltz, 1933: 1120; Herman, 1970: 379; id, 1986: 233, 324; Biswas and Sen Gupta, 1989: 20; Herman, 2001: 1599.

Materials examined: (n=4). Aralam Wildlife Sanctuary, 4 ex, 'Flotation method', 05/03/2021.Coll. Vineetha V P

Distribution: India (Kerala, Odisha, Tamil Nadu) (Cameron, 1930), Sri Lanka, Chagos Archipelago (Newton, 2021).

Tribe Oxytelini, Fleming, 1821

Genus *Anotylus*, Thomson, C. G., 1859

***Anotylus glareosus* (Wollaston, 1854)**

≡ *Oxytelus glareosus* Wollaston, 1854

= *Oxytelus indicus* Bernhauer, 1926

Wollaston, 1854: 610; id. 1857: 201; id. 1864: 598; id. 1865:517; Fauvel, 1902a: 66; id.1905b: 80; Bernhauer and Schubert, 1911: 113; Bernhauer, 1928: 7; Blackwelder,

1943: 100; Smetana, 1963: 31; Herman, 1970: 418; Hammond, 1975: 158, 163; id.1976: 174; Coiffait, 1976: 221; Shibata, 1993: 318; Lecoq, 2017:760

Materials examined: (n=4). Badiyadukka Agricultural Field, 4 ex., ‘Flotation method’, 15/07/2019. Coll. Vineetha V P

Distribution: India (Kerala) (Vineetha, 2024), 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 (Newton, 2021)

***Anotylus disparatus* (Cameron, 1928)**

≡ *Oxytelus (Anotylus) disparatus* Cameron, 1928

Cameron, 1928: 103, 104; id, 1929: 444; Scheerpeltz, 1933: 1096; Herman, 1970: 418; Hammond, 1975: 158, 161

Materials examined: (n=95). Aralam Wildlife Sanctuary 5 ex., ‘Flotation method’ 05/10/2020, 05/03/2022; Malabar Wildlife Sanctuary, 46 ex., ‘Flotation method’ 12/08/2019, 14/10/2020, 2 ex., ‘Pitfall trap’15/03/2022, 1ex., ‘Handpicking’ 15/03/2022; Badiyadukka Agricultural Field 32 ex., ‘Flotation method’ 15/07/2019, 25/10/2020, 26/03/2021, 5 ex., ‘Pitfall trap’ 26/03/2021, 26/03/2022; Ezhome Paddy Field, 3 ex., ‘Flotation method’ 21/03/2022, 1 ex., ‘Pitfall trap’21/03/2022. Coll. Vineetha V P

Distribution: India (UP, Kerala) (Cameron, M. (1928), Pakistan, China, Nepal, India, Sri Lanka, Malaysia, Indonesia, Philippines (Newton, 2021)

***Anotylus latiusculus* (Kraatz, 1859)**

Kraatz, 1859: 176; Fauvel, 1902: 67; id, 1904: 46; id, 1907: 17; Bernhauer and Schubert, 1911: 115; Cameron, 1921a: 366, 400; Bernhauer, 1922b: 223; Cameron, 1928: 101, 103; id, 1929: 444; Scheerpeltz, 1929b: 212; Cameron, 1930: 250;

Scheerpeltz, 1933: 1099; Bernhauer, 1936a: 84; id, 1942c: 350; Cameron, 1950a: 18; Watanabe, 1961: 349; Scheerpeltz, 1962: 569; Herman, 1970: 418; Abdullah and Qadri, 1970: 121, 124; Hammond, 1975: 158, 159; id, 1976: 175; Scheerpeltz, 1978: 195; Ito, 1992: 63; Kashcheev, 1999: 57

Materials examined: (n=2460). Aralam Wildlife Sanctuary, 150 ex., ‘Flotation method’, 10 ex., ‘Pitfall trap’ 07/08/2019, 05/10/2020, 05/03/2021, 03/03/2022, 2ex., ‘Handpicking’ 03/03/2022; Badiyadukka Agricultural Field, 1236 ex., ‘Flotation method’, 10ex., ‘Pitfall trap’, 15/07/2019, 25/10/2020, 26/03/2021, 26/03/2022; Ezhome Paddy Field, 488 ex ‘Flotation method’, 8 ex ‘Pitfall trap’, 08/07/2019, 20/10/2020, 22/03/2021, 21/03/2022; Malabar Wildlife Sanctuary, 215 ex ‘Flotation method’ 12/08/2029, 14/10/2020, 15/03/2021, 09/03/2022, 2 ex ‘Pitfall trap’, 15/03/2021, 09/03/2022; Periya Reserve Forest, 327 ex ‘Flotation method’, 10 ex, ‘Pitfall trap’, 20/08/2019, 08/10/2020, 09/03/2021, 03/04/2022. Coll. Vineetha V P

Distribution: India (Kerala) (Cameron, 1930), Greece, Egypt, Cyprus, Lebanon, Israel, Syria, Kazakhstan, Pakistan, Japan (Hokkaido, Honshu, Shikoku), China, Taiwan, India, Oriental, Indonesia, Afrotropical, Namibia, South Africa, Madagascar, New Guinea, Australia (Newton, 2021)

***Anotylus Micans* (Kraatz, 1859)**

≡ *Oxytelus micans* Kraatz, 1859

Kraatz, 1859: 175; Fauvel, 1904a: 46; Bernhauer and Schubert, 1911: 116; Cameron, 1930: 228; Scheerpeltz, 1933: 1099; Paulian, 1941: 168; Herman, 1970: 410; Abdullah and Qadri, 1970: 122, 124; Hammond, 1975: 157, 164; id, 1976: 158; Coiffait, 1984: 118

Materials examined: (n=4). Badiyadukka Agricultural Field, 4 ex., ‘Flotation method’ 25/10/2020, Coll. Vineetha V P

Distribution: India (Maharashtra, Manipur, Sikkim, UP, West Bengal) (Cameron 1930), Pakistan, Bangladesh, Sri Lanka (Newton, 2021).

***Anotylus myrmecophilus* (Cameron, 1914)**

≡ *Oxytelus* (*Anotylus*) *myrmecophilus* Cameron, 1914

Cameron, 1914: 526; Cameron, 1930: 246; Scheerpeltz, 1933: 1100; Scheerpeltz, 1962: 570; Abdullah and Qadri, 1970: 121; Herman, 1970: 419

Materials examined: (n=192). Aralam Wildlife Sanctuary, 64 ex., ‘Flotation method’ 05/03/2021, 03/03/2022; Badiyadukka Agricultural Field, 53 ex., ‘Flotation method’ 15/07/2019, 25/10/2020, 26/03/2021, 26/03/2022 1ex., ‘Pitfall trap’ 15/07/2019; Ezhome Paddy Field, 11ex., ‘Flotation method’ 08/07/2019, 20/10/2020; Malabar Wildlife Sanctuary, 63ex., ‘Flotation method’, 14/10/2020. Coll. Vineetha V P

Distribution: India (Kerala, UP) (Cameron, 1930), Pakistan, China, Japan (Newton, 2021)

***Anotylus nitidifrons* (Wollaston, 1871)**

≡ *Oxytelus nitidifrons* Wollaston, 1871

= *Oxytelus advena* Sharp, 1880

Wollaston, 1877: 36; Fauvel, 1898: 115; id, 1902a: 65; id, 1904a: 45; Bernhauer and Schubert, 1911: 116; Cameron, 1921a: 367, 400; id, 1930: 256; Scheerpeltz, 1933: 1100; Bernhauer, 1936a: 82; Méquignon, 1942: 17; Fagel, 1956: 273; Jarrige, 1963: 120; Smetana, 1963: 32; Herman, 1970: 419; Abdullah and Qadri, 1970: 121; Smetana, 1970: 54; Fagel, 1972: 99; Hammond, 1975: 158, 164; id, 1976a: 176; Moore, 1978: 489; Nishida, 1994: 70; Lecoq, 2017: 760; Wang and Zhou, 2020: 4861.

Materials examined: (n=11). Badiyadukka Agricultural Field, 11ex., ‘Flotation method’, 15/07/2019, 25/10/2020, 26/03/2021, 26/03/2022. Coll. Vineetha V P

Distribution: India (UP s. India (Cameron 1930), Azores, Madeira, St. Helena, Gabon, Zanzibar, Madagascar, Mascarene Islands, Seychelles, Pakistan, India, Myanmar, Laos, Vietnam, Singapore, Indonesia, Philippines, Caroline Islands, China, Japan, Hawaii. (Newton, 2021)

***Anotylus pusillimus* (Kraatz, 1859)**

≡ *Oxytelus pusillimus* Kraatz, 1859

= *Oxytelus sauteri* Bernhauer, 1907

= *Oxytelus tenuis* Motschulsky, 1860

= *Oxytelus pygmaeus* Kraatz, 1859

Kraatz, 1859: 177; Bernhauer, 1902a: 44; Fauvel, 1904a: 46; Bernhauer and Schubert, 1911: 118; Cameron, 1930: 248; Scheerpeltz, 1962: 571; Hammond, 1975: 161; Herman, 2001: 4; Lecoq, 2017:760.

Materials examined: (n=21). Aralam Wildlife Sanctuary, 6 ex., 'Flotation method' 07/08/2019; Ezhome Paddy Field, 11 ex., 'Flotation method', 08/07/2019, 20/10/2020, 22/03/2021; Periya Reserve Forest, 4 ex., 'Flotation method' 09/03/2021. Coll. Vineetha V P

Distribution: India (Kerala, West Bengal) (Cameron,1930), Angola, South Africa, Tanzania, Uganda, Madagascar, Yemen, Pakistan, India, Sri Lanka, Nepal, Bangladesh, Myanmar, Vietnam, Borneo, Malaysia, Singapore, Indonesia, Australia, Fiji, Japan, Taiwan (Newton, 2021)

***Anotylus rubicundus* (Cameron, 1930)**

≡ *Oxytelus (Anotylus) rubicundus* Cameron, 1930

Cameron, 1930: 255; Scheerpeltz, 1933: 1102; Abdullah and Qadri, 1970: 121; Herman, 1970: 419

Materials examined: (n=12). Aralam Wildlife Sanctuary, 3 ex., ‘Flotation method’, 07/08/2019; Badiyadukka Agricultural Field, 6 ex., ‘Flotation method’, 15/07/2019; Periya Reserve Forest, 2 ex., ‘Flotation method’, 1 ex., ‘Pitfall trap, 09/03/2021, Coll. Vineetha V P

Distribution: India (Kerala, HP, UP) (Cameron, 1930), Pakistan (Cameron, 1930)

***Anotylus rufus* (Kraatz, 1859)**

≡ *Oxytelus rufus* Kraatz, 1859

= *Deinopsis henryi* Fernando, 1960

= *Oligota niobe* Fernando, 1959

Kraatz, 1859: 174; Bernhauer and Schubert, 1911: 118; Cameron, 1930: 254; Scheerpeltz, 1933: 1102; Herman, 1970: 419; Hammond, 1975: 159, 165; Biswas, 2003: 411; Makranczy, 2021a:123.

Materials examined: (n=104). Badiyadukka Agricultural Field, 9ex., ‘Flotation method’, 15/07/2019, 25/10/2020; Ezhome Paddy Field, 17 ex., ‘Flotation method’, 08/07/2019, 20/10/2020, 22/03/2021, 21/03/2022; Malabar Wildlife Sanctuary, 13 ex., ‘Flotation method’, 2ex., ‘Pitfall trap’ 12/08/2019,14/10/2020; Periya Reserve Forest. 63 ex., ‘Flotation method’ 20/08/2019, 08/10/2020, 03/04/2022. Coll. Vineetha V P

Distribution: India (Kerala, Madras, Sikkim) (Cameron, 1930), Sri Lanka (Cameron, 1930)

Genus *Oxytelus*, Gravenhorst, 1802

***Oxytelus barbatus* Fauvel, 1905**

Fauvel, 1905a: 113; Bernhauer and Schubert, 1911: 110; Cameron, 1928: 100; Scheerpeltz, 1933: 1094; Herman, 1970: 409; Lü and Zhou, 2015a: 3992

Materials examined: (n=89). Badiyadukka Agricultural Field, 6 ex., ‘Flotation method’, 15/07/2019, 26/03/2021, 26/03/2022, 26/03/2021, 26/03/2022; Malabar

Wildlife Sanctuary, 20 ex., 'Flotation method', 12/08/2019, 14/10/2020; Periya Reserve Forest, 63 ex., 'Flotation method' 20/08/2019, 08/10/2020, 09/03/2021, 03/04/2022. Coll. Vineetha V P

Distribution: India (Kerala) (Vineetha, 2024), Indonesia, China (Lü and Zhou, 2012)

***Oxytelus bengalensis* Erichson, 1840**

= *Oxytelus opacifrons* Sharp, 1874

= *Oxytelus bicolor* Walker, 1859

Erichson, 1840: 789; Kraatz, 1859: 171; Bernhauer and Schubert, 1911: 110; Cameron, 1921a: 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. 2015a: 3992

Materials examined: (n=86). Badiyadukka Agricultural Field, 8 ex., 'Flotation method', 25/10/2020; Ezhome Paddy Field, 12 ex., 'Flotation method', 08/07/2019, 20/10/2020; Periya Reserve Forest, 65 ex., 'Flotation method', 20/08/2019, 08/10/2020. 1ex., 'Pitfall trap', 20/08/2019. Coll. Vineetha V P

Distribution: India (Kerala (Vineetha, 2024), Sikkim, Tripura, UP (Cameron, 1930)), Bangladesh, China, Japan, Korea, Laos, Nepal, Malaysia, Myanmar, Pakistan, Singapore, Sri Lanka, Thailand, Vietnam, Taiwan (Lü and Zhou, 2012)

***Oxytelus dohertyi* Cameron, 1930**

≡ *Oxytelus (Tanycraerus) dohertyi* Cameron, 1930

Cameron, 1930: 223; Scheerpeltz, 1933: 1096; Herman, 1970: 409; Abdullah and Qadri, 1970: 124; Lü and Zhou, 2012: 19, 20.

Materials examined: (n=12). Badiyadukka Agricultural Field, 12 ex., 'Flotation method', 25/10/2022, Coll. Vineetha V P

DISTRIBUTION: India (Kerala, Manipur), Bangladesh, China

***Oxytelus incisus* Motschulsky, 1858**

= *Oxytelus cordovensis* Bernhauer, 1910

= *Oxytelus laxipennis* Fairmaire, 1893

= *Oxytelus bledioides* Blackburn, 1885

= *Oxytelus laevior* Sharp, 1874

= *Oxytelus ferrugineus* Kraatz, 1859

Motschulsky, 1857a: 504; Kraatz, 1859: 172; Bernhauer and Schubert, 1911: 114; Cameron, 1930: 263; Scheerpeltz, 1933: 1097; Cameron, 1934a: 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; Nishida, 1994: 73; id. 1997: 62, Hammond, 1998: 275, Lü and Zhou. 2012: 21-22; Frank and Somerby, 2011:399-400; Lü and Zhou, 2015a: 14-15; Lecoq, 2017:169-232.

Materials examined: (n=1461). Aralam Wildlife Sanctuary, 111 ex. ‘Flotation method’, 6 ex., ‘Pitfall trap’, 07/08/2019, 05/10/2020, 05/03/2021, 03/03/2022; Badiyadukka Agricultural Field, 215 ex., ‘Flotation method’, 15/07/2019, 25/10/2020, 26/03/2021, 26/03/2022, 2ex., ‘Pitfall trap’, 15/07/2019, 25/10/2020; Ezhome Paddy Field, 692 ex., ‘Flotation method’, 7 ex., ‘Pitfall trap’, 08/07/2019, 20/10/2020, 22/03/2021, 21/03/2022. Malabar Wildlife Sanctuary, 239 ex., ‘Flotation method’ 12/08/2019, 14/10/2020, 15/03/2021, 09/03/2022; Periya Reserve Forest, 189 ex., ‘Flotation method’, 20/08/2019, 08/10/2020, 09/03/2021, 03/04/2022. Coll. Vineetha V P

Distribution: India (Kerala) (Vineetha, 2024), Indonesia, Philippines (Newton, 2021)

***Oxytelus lividus* Motschulsky, 1858**

= *Oxytelus gigantulus* Fauvel, 1904

Kraatz, 1859: 171; Bernhauer, 1902a: 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, 2015a:18

Materials examined: (n=18). Badiyadukka Agricultural Field, 7ex., ‘Flotation method’, 15/07/2019, 25/10/2020; Ezhome Paddy Field, 9 ex., ‘Flotation method’, 08/07/2019, 20/10/2020, 2ex., ‘Pitfall trap’, 08/07/2019. Coll.Vineetha V P

Distribution: India (Kerala) (Vineetha, 2024), Cambodia, China (Hainan, Shanghai, Yunnan), Indonesia (Java, Sulawesi, Sumatra, Timor), Laos, Malaysia, Myanmar, Philippines (Negros, Palawan), Sri Lanka, Thailand, Vietnam (Newton, 2021)

***Oxytelus megaceros* Fauvel, 1895**

= *Oxytelus kalisi* Bernhauer, 1934

= *Oxytelus flavicollis* Bernhauer, 1912

Fauvel, 1895: 201; id, 1905b: 79; Bernhauer and Schubert, 1911: 116; Bernhauer, 1922b: 223; Cameron, 1928: 100; Bernhauer, 1928: 6; Cameron, 1930: 225; Scheerpeltz, 1933: 1099; Cameron, 1936: 31; Herman, 1970: 410; Abdullah and Qadri, 1970: 122; Zhu and Ling, 2007:36; Lü and Zhou, 2012:3576

Materials examined: (n=13). Malabar Wildlife Sanctuary, 7 ex., ‘Flotation method’12/08/2019, 15/03/2021, 09/03/2022, 1 ex. ‘Pitfall trap’, 12/08/2019; Periya Reserve Forest, 5 ex., ‘Flotation method’, 09/04/2022. Coll. Vineetha V P

Distribution: India (Kerala), Pakistan, Myanmar, Borneo, Malaysia, Indonesia, Philippines, Taiwan

***Oxytelus migrator* Fauvel, 1904**

= *Deinopsis butschlii* Fernando, 1960

= *Oxytelus akazawensis* Bernhauer, 1907

Fauvel, 1904: 100; Bernhauer and Schubert, 1911: 116; Cameron, 1928: 100; Scheerpeltz, 1933: 1100; Herman, 1970: 410; Hammond, 1975: 150, 152; Mahler and Pritzl, 1980: 122; Haghebaert and Bruge, 1988: 41; Schülke and Uhlig, 1988: 4, 5; Lohse and Lucht, 1989: 133; Wittwer, 1993: 248; Shibata, 1993: 317; Boháč, 1993: 43; Ikudome and Hayakawa, 1994: 187; Ciceroni and Zanetti, 1995: 12; Lecoq, 1996: 29; Owen, 1997: 303; Hammond, 1998: 273; Ødegaard, 1999: 71; Burakowski, Mroczkowski and Stefańska, 2000: 44; Assing, 2009:79; Lü and Zhou, 2015a: 3992

Materials examined:(n=6). Aralam Wildlife Sanctuary, 4ex., ‘Flotation method’, 03/03/2022;

Ezhome Paddy Field, 2ex., ‘Flotation method’, 21/03/2022, Coll. Vineetha V P

Distribution: India (Kerala), Sri Lanka, Thailand, Malaysia, Indonesia, Vietnam, China, Taiwan, South Korea, Japan, Europe, Russia (European), Turkey.

***Oxytelus nigriceps* Kraatz, 1859**

Kraatz, 1859: 171; Sharp, 1874: 93; Bernhauer, 1902: 44; Fauvel, 1904: 45; Bernhauer and Schubert, 1911: 116; Cameron, 1921a: 366; Bernhauer, 1922: 223; Cameron, 1928: 100; id. 1930: 233; Koch, 1932: 655; Scheerpeltz, 1933: 1100; Bernhauer, 1936: 81; Nakane and Kohei, 1960: A122; Nakane, 1963: 84; Herman, 1970: 410; Abdullah and Qadri, 1970: 122, 125; Watanabe and 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. 2015a:3992.

Materials examined: (n=4). Aralam Wildlife Sanctuary, 4 ex., ‘Flotation method’, 05/10/2020. Coll.Vineetha V P

Distribution: India (UP, West Bengal (Cameron, 1930), Kerala (Vineetha, 2024)), Bangladesh, China, Indonesia, Japan, Korea, Malaysia, Nepal, New Guinea, New

Britain, New Ireland; Vanuatu, Myanmar, Pakistan, Philippines, Ryukyus, Sri Lanka, Taiwan, Thailand, Vietnam (Newton, 2021)

***Oxytelus nilgiriensis* Cameron, 1930**

Cameron, 1930: 227; Scheerpeltz, 1933: 1100; Herman, 1970: 410

Materials examined (n=3). Malabar Wildlife Sanctuary, 3 ex., 'Flotation method', 12/08/2019. Coll. Vineetha V P

Distribution: India (Kerala), China (Cameron, 1930)

***Oxytelus piceus* (Linnaeus, 1767)**

≡ *Staphylinus piceus* Linnaeus, 1767

= *Oxytelus defectivus* Normand, 1947

= *Oxytelus japonicus* Motschulsky, 1861

= *Oxytelus mamillatus* Hochhuth, 1851

= *Oxytelus sulcatus* Gebler, 1848 (Ambiguous)

= *Oxytelus humilis* Heer, 1839 (Ambiguous)

= *Staphylinus sulcatus* Müller, O. F., 1776

Linné, 1767: 686; Fabricius, 1775: 267; Goeze, 1777: 722; Fabricius, 1781: 338; Herbst, 1784: 151; Fabricius, 1787: 222; Villers, 1789: 418; Rossi, 1790: 252; Gmelin, 1790: 2031; Fabricius, 1793: 530; Panzer, 1795: 358; Schrank, 1798: 648; Paykull, 1800: 384; Fabricius, 1801: 601; Turton, 1802: 515; Gravenhorst, 1802: 105; Marsham, 1802: 506; Latreille, 1804: 363; Gravenhorst, 1806: 191; Panzer, 1808: 12; Gyllenhal, 1810: 454; Olivier, 1811: 614; Zetterstedt, 1828: 93; Curtis, 1829: 30; Mannerheim, 1830: 47; id, 1831: 461; Ménétriés, 1832: 147; Sahlberg, 1832: 414; Stephens, 1834: 317; Runde, 1835: 20; Lacordaire, 1835: 461; Westwood, 1838: 17; Zetterstedt, 1838: 73; Costa, 1839: 46; Erichson, 1839: 590; Heer, 1839: 204; Stephens, 1839: 419; Erichson, 1840: 788; Laporte, 1840: 188; Dufour, 1843: 37; Westwood, 1845: 54;

Kolenati, 1846: 26; Boheman, 1848: 295; Hochhuth, 1849: 189; Redtenbacher, 1849: 737; Wollaston, 1854: 606; Rosenhauer, 1856: 81; Fairmaire and Laboulbène, 1856: 610; Wollaston, 1857: 199; Redtenbacher, 1857: 232; Kraatz, 1857: 853; Peyron, 1858: 433; Thomson, 1859: 43; id, 1861: 128; Hochhuth, 1862: 92; Wollaston, 1864: 596; Fauvel, 1865: 311; Wollaston, 1865: 516; Fauvel, 1872: 168; Redtenbacher, 1874: 253; Solsky, 1874: 205; Fauvel, 1876: 57; Seidlitz, 1875: 248; Fauvel, 1878: 94; Mulsant and Rey, 1878: 502; Fauvel, 1886: 21; Fowler, 1888: 379; Eppelsheim, 1892: 342; Ganglbauer, 1895: 639; Fauvel, 1902a: 64; id, 1907: 16; Sainte-Claire Deville, 1906: 77; Montandon, 1908: 78; Reitter, 1909: 170; Bernhauer and Schubert, 1911: 117; Johansen, 1914: 558; Eichelbaum, 1914: 226; Portevin, 1929: 417; Bernhauer, 1931: 568; Koch, 1932: 655; Scheerpeltz, 1933: 1101; Adachi, 1937: 52; Cameron, 1949: 461; id, 1950a: 15; Watanabe, 1961: 349; Palm, 1961: 32; Nakane, 1963: 84; Smetana, 1963: 32; id, 1963a: 292; Horion, 1963: 227; Lohse, 1964: 84; Scheerpeltz, 1964: 27; Smetana, 1965: 168; id, 1967: 317; id, 1968: 234; Szujewski, 1968: 714; Herman, 1970: 410; Jarrige, 1971: 499; Coiffait, 1974: 197; Scheerpeltz, 1974: 65; id, 1974a: 7; Smetana 1975: 166; Pope, 1977: 25; Coiffait, 1981a: 237; Dettner and Schwinger, 1982; Frank, 1982: 14; Yuh et al., 1985: 227; Tóth, 1987: 227; Lucht, 1987: 93; Schülke and Uhlig, 1988: 5; Kashcheev, 1989: 285; Gusarov, 1991: 4; Staniec, 1993: 241; Boháč, 1993: 43; Sparacio, 1995: 145; Ciceroni and Zanetti, 1995: 12; Czarniawski and Staniec, 1997: 40; Kashcheev, 1999: 155; id, 1999a: 57; Marchal and Chardonnet, 2000: 71; Lü, and Zouh, 2012: 42-43; Ramírez-Hernández and González, 2014: 18, Lü and Zouh, 2015a:27

Materials examined: (n=135). Aralam Wildlife Sanctuary, 69 ex., ‘Flotation method’, 07/08/2019, 05/10/2020, 05/03/2021, 03/03/2022; Periya Reserve Forest, 64 ex.,

‘Flotation method’, 09/03/2021, 03/04/2022; Malabar Wildlife Sanctuary, 2 ex.,
‘Flotation method’, 14/10/2020. Coll. Vineetha V P

Distribution: India (Kerala), Madagascar, Lesotho, South Africa, Namibia, Angola, Congo, Ethiopia, Sudan, Egypt, Tunisia, Algeria, Morocco, Canary Islands, Madeira, Europe, Russia, Azerbaijan, Georgia, Turkey, Syria, Saudi Arabia, Iran, Kyrgyzstan, “Turkestan”, Mongolia, China, Korea, Japan, China (Newton, 2021)

***Oxytelus puncticeps* Kraatz, 1859**

Kraatz, 1859: 176; Bernhauer, 1902: 44, Fauvel; 1904: 46, Bernhauer and Schubert, 1911: 116; Bernhauer, 1922: 223; Cameron, 1930: 228; Bernhauer, 1936: 81; id. 1942: 350; Cameron, 1950: 10; Scheerpeltz, 1974: 65; Hammond, 1975: 150; Lü and Zou. 2012: 42-43; id. 2015a: 27

Materials examined: (n=58). Labelled ‘India: Kerala: Aralam Wildlife Sanctuary, 18 ex., ‘Flotation method’, 05/03/2021; Badiyadukka Agricultural Field, 22 ex., ‘Flotation method’, 25/10/2020, 26/03/2021, 26/03/2022; Periya Reserve Forest, 12 ex., ‘Flotation method’, 09/03/2021, 03/04/2022; Malabar Wildlife Sanctuary, 6 ex., ‘Flotation method’, 15/03/2021, 09/03/2022. ‘Coll.Vineetha V P

Distribution: India (Kerala (Vineetha, 2024), Meghalaya, UP (Lü and Zhou, 2015)), Afrotropical, China (Fujian, Hainan, Hong Kong, Jiangxi), Comoros, Indonesia, Madagascar, Philippines, Ryukyu Is. (Okinawa, Iriomote, Ishigaki), Sri Lanka, South Africa, Vietnam, Taiwan (Newton, 2021)

Genus *Platystethus*, Mannerheim, 1830

***Platystethus crassicornis* Motschulsky, 1857**

= *Platystethus indicus* Cameron, 1930

= *Platystethus robustus* Cameron, 1918

Motschulsky, 1857: 506; Kraatz, 1859: 171; Fauvel, 1904: 46; id, 1905b: 80; Bernhauer and Schubert, 1911: 123; Bernhauer, 1922b: 223; Cameron, 1928: 106; id, 1930: 269; Scheerpeltz, 1933: 1107; Cameron, 1936: 33; Herman, 1970: 402; Abdullah and Qadri, 1970: 119; Hammond, 1975: 147, 148; id, 1984: 200; Biswas and Biswas, 1985: 144, Lü and Zou, 2015b: 3915

Materials examined: (n=5). Aralam Wildlife Sanctuary, 5 ex., 'Flotation method', 03/03/2022f. Coll. Vineetha V P

Distribution: India (Kerala, Tamil Nadu, Uttarakhand (Cameron, 1930), Arunachal Pradesh, Meghalaya, Uttar Pradesh) (Newton, 2021), Pakistan, Myanmar, Borneo, Indonesia, Taiwan (Newton, 2021)

Tribe Thinobiini, Sahlberg, J., 1876

Genus *Carpelimus*, Leach, 1819

***Carpelimus atomus* Saulcy, 1865**

= *Trogophloeus atomarius* Coiffait, 1983

= *Trogophloeus discolor* Baudi di Selve, 1870

Saulcy, 1864: 658; Fauvel, 1871: 183; Klima, 1904: 65; Bernhauer and Schubert, 1911: 105; Cameron, 1930: 199; Gusarov, 1997: 280; Gildenkov, 2007: 86; id.2009, id, 2011: 19, id, 2012:2; Assing, 2012: 44; id. 2013: 6; Gildenkov, 2014:14; id, 2015a: 414,15; id. 2016:320; Lee and Ahn, 2019:12; Gildenkov, 2021:53.

Materials examined: (n=9). Malabar Wildlife Sanctuary, 9 ex. 'Flotation method'. 15/03/2021, 09/03/2022. Coll. Vineetha V P

Distribution: India (Kerala) (Gildenkov, 2014), Syria, Cyprus, Libya, Egypt, Yemen, Saudi Arabia (Newton,2021)

***Carpelimus finelypunctus* Gildenkov, 2019**

Gildenkov, 2019: 28 (2).

Materials examined: (n=71). Aralam Wildlife Sanctuary, 71 ex., ‘Flotation method’, 07/08/2019, 05/10/2020, 05/03/2021, 03/03/2022. Coll. Vineetha V P

Distribution: India (Kerala) (Gildenkov, 2019)

***Carpelimus indicus* (Kraatz, 1859)**

Kraatz, 1859: 179; Fauvel, 1886a: 144; id, 1889: 247; id, 1903: 150; id, 1903a: 259; Bernhauer and Schubert, 1911: 101; Bernhauer, 1922a: 149; Cameron, 1928: 99; Bernhauer, 1928: 5; Cameron, 1930: 186; Scheerpeltz, 1933: 1085; Cameron, 1936: 30; Scheerpeltz, 1954: 110; id, 1957a: 224; id, 1960: 2; Last, 1961: 305; Scheerpeltz, 1965: 100; Herman, 1970: 392; Scheerpeltz, 1971: 202; Watanabe and Shibata, 1976: 328; Coiffait, 1981c: 332; Gildenkov, 2012:2; id. 2014:14,6,66-73; id. 2015a:7,15, 414; id. 2015b:15,7; id. 2016:8,320; id.2020a: 12; id. 2021:52.

Materials examined: (n=166). Aralam Wildlife Sanctuary, 71 ex., ‘Flotation method’, 05/10/2020, 05/03/202; Badiyadukka Agricultural Field, 12 ex., ‘Flotation method’, 26/03/2021; Ezhome Paddy Field, 18ex., ‘Flotation method’, 22/03/2021, 21/03/2022; Malabar Wildlife Sanctuary, 62 ex., ‘Flotation method’, 15/03/2021, 09/03/2022; Periya Reserve Forest, 3 ex., ‘Flotation method’, 20/08/2019, 03/04/2022. Coll. Vineetha V P

Distribution: India (Kerala) (Cameron,1930), Afghanistan, Pakistan, Japan, Ryukyu, Nepal, Sri Lanka, Myanmar, Thailand, Laos, Cambodia, Vietnam, Malaysia, Andaman Is., China, Taiwan, Philippines, Indonesia, Papua New Guinea, New Caledonia (Newton, 2021)

***Carpelimus perigrinus* Cameron, 1919**

Cameron, 1919: 225; Cameron, 1930: 187; Scheerpeltz, 1933: 1086; Herman, 1970: 393

Materials examined: (n=18). Periya Reserve Forest, 6 ex., ‘Flotation method’, 20/08/2019, 08/10/2020; Malabar Wildlife Sanctuary, 12 ex., ‘Flotation method’, 15/03/2021, 09/03/2022. Coll. Vineetha V P

Distribution: India (Kerala), Sri Lanka (Cameron, 1930)

Genus *Thinobius*, Kiesenwetter, 1844

***Thinobius simlaensis* Cameron, 1930**

Cameron, 1930: 289; Scheerpeltz, 1933: 1127; id, 1959: 67; Herman, 1970: 397; Abdullah and Qadri, 1970: 119; Coiffait, 1981b: 325.

Materials examined: (n=10). Ezhome Paddy Field, 10 ex., ‘Flotation method’, 08/07/2019, 20/10/2020. Coll. Vineetha V P

Distribution: India (Kerala, HP), Pakistan, Nepal.

Genus *Xerophygus*, Kraatz, 1859

***Xerophygus pallipes* (Motschulsky, 1857)**

Motschulsky, 1857: 505; Kraatz, 1859: 178; Bernhauer and Schubert, 1911: 106; Bernhauer, 1928; Cameron, 1930: 200; Scheerpeltz, 1933: 1090 (*Xerophygus*; catalog); Cameron, 1934a: 78; Herman, 1970: 385.

Materials examined: (n=4). Aralam Wildlife Sanctuary, 4 ex., ‘Flotation method’, 07/08/2019. Coll. Vineetha V P

Distribution: India (Kerala), East Indies, Indonesia (Newton, 2021)

Key to the Oxytelinae species recorded from the agricultural ecosystem

Key to the Species of the Genus *Anotylus* Thomson, C. G., 1859

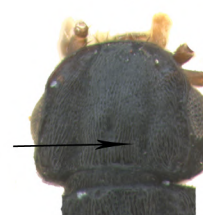
1. Body with dense coarse punctures.....*A. glareosus* →



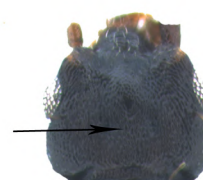
- Body with fine punctures.....2 →



2. Intra-Ocular ridge distinct and continued back to the base of head.....*A. latiusculus*



- Intra-ocular ridge indistinct and not continued to the base.....3



3. Abdomen moderately punctured.....*A. pusillimus* →



- Abdomen impunctured.....4 →



4. Body reddish medium brown.....*A. rufus* →



- Species more or less yellow.....5 →



5. Head yellowish.....*A. rubicundus*



- Head pitchy black.....6



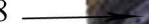
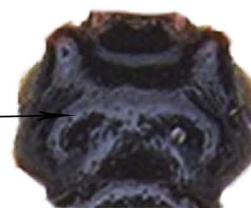
6. Thorax yellowish brown.....*A. nitidifrons*



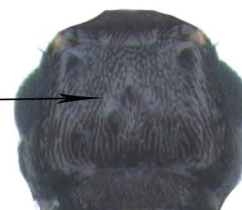
- Thorax dark brown.....7



7. Head without striations.....8



-Head densely striated.....*A. myrmecophilus*



8. Elytra yellowish brown.....*A. micans*



- Elytra dark brown..... *A. disparatus*



Species Key to the Genus *Oxytelus* Gravenhorst, 1802

1. Elytra punctuated*O. barbatus*



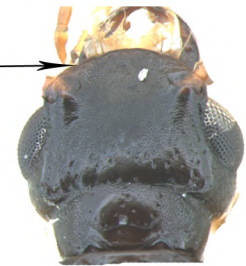
- Elytra not punctuated.....2



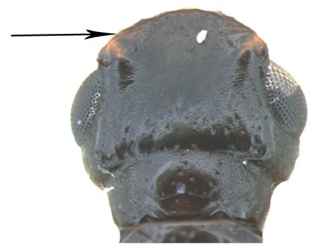
2. Labrum emarginate.....*O. puncticeps*



- Labrum round.....3



3. Labrum protruding..... *O. dohertyi*.



- Labrum not protruding.....4



4. Pronotum with dark posterior and lateral margins.....5



- Pronotum with light posterior and lateral margins.....6



5. The last joint of the antennae elongate *O. lividus*



- Last joint of antennae short, conical *O. bengalensis*



6. Head ferrugineous red..... *O. incisus*



- Head brownish..... *O. migrator*



Species Key to the Genus *Carpelimus* Leach, 1819

1. Entirely black species..... *C. indicus*



Species Key to the Genus *Thinobius* Kiesenwetter, 1844

1. Elytra testaceous..... *T. similensis*



Pictorial Key to the Oxytelinae beetles recorded from the Forest ecosystem
Species Key to the Genus *Bledius*, Leach, 1819

1. Elytra concolourous brown.....*B. lucidus* →



- Elytra Bicolourous.....*B. pulchellus* →



Species Key to the Genus *Carpelimus* Leach, 1819

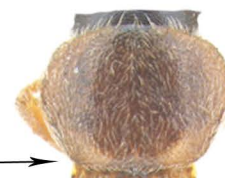
1. Moderately shining species.....2 →



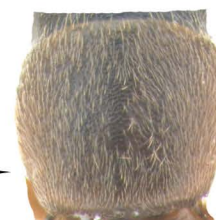
- Not shining species.....*C. finelypunctus* →



2. Pronotum greatly narrowed posteriorly.....*C. peregrinus* →



- Pronotum slightly narrowed posteriorly.....*C. atomos* →



Species Key to the Genus *Xerophygus* Kraatz, 1859

1. Head black.....*X. pallipes* →



Key to the Species of the Genus *Anotylus* Thomson, C. G., 1859

1. Intra-Ocular ridge distinct and continued back to the base of head.....*A. latiusculus*



- Intra-ocular ridge indistinct and not continued to the base.....2



2. Abdomen moderately punctured.....*A. pusillimus*



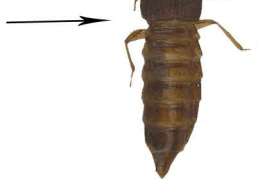
-Abdomen impunctured.....3



3. Body reddish medium brown.....*A. rufus*



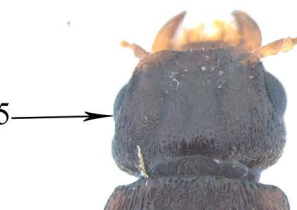
- Species more or less yellow.....4



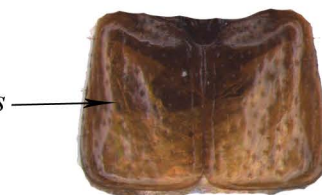
4. Head yellowish.....*A. rubicundus*



- Head pitchy black.....5



5. Elytra yellowish brown.....*A. myrmicophilus*



- Elytra dark brown.....*A. disparatus*



Species Key to the Genus *Oxytelus* Gravenhorst, 1802

1. Elytra punctuated*O. barbatus* →



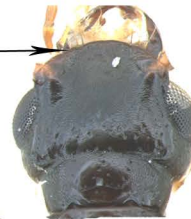
- Elytra not punctuated.....2 →



2. Labrum emarginate.....*O. puncticeps* →



- Labrum round.....3 →



3. The last joint of the antennae elongate*O. megaceros* →



- Last joint of antennae short, conical4 →



4. Pronotum with dark posterior and lateral margin.....*O. bengalensis* →



-Pronotum with light posterior and lateral margin.....5 →



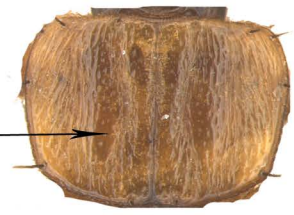
5. Head brownish black.....6 →



- Head ferrugineous red.....*O. incisus*



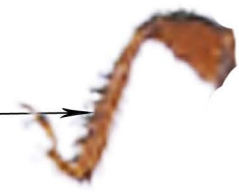
6 Thorax testaceous.....*O. nigriceps*



- Thorax black or pitchy brown.....7



7. Legs brownish.....*O. piceus*



- Legs testaceous.....8



8. Head larger than pronotum.....*O. nilgiriensis*



- Head as wide as pronotum.....*O. migrator*



Key to the Species of the Genus *Platystethus* Mannerheim, 1830

1. Elytra finely and sparingly punctured.....*P. crassicornis*



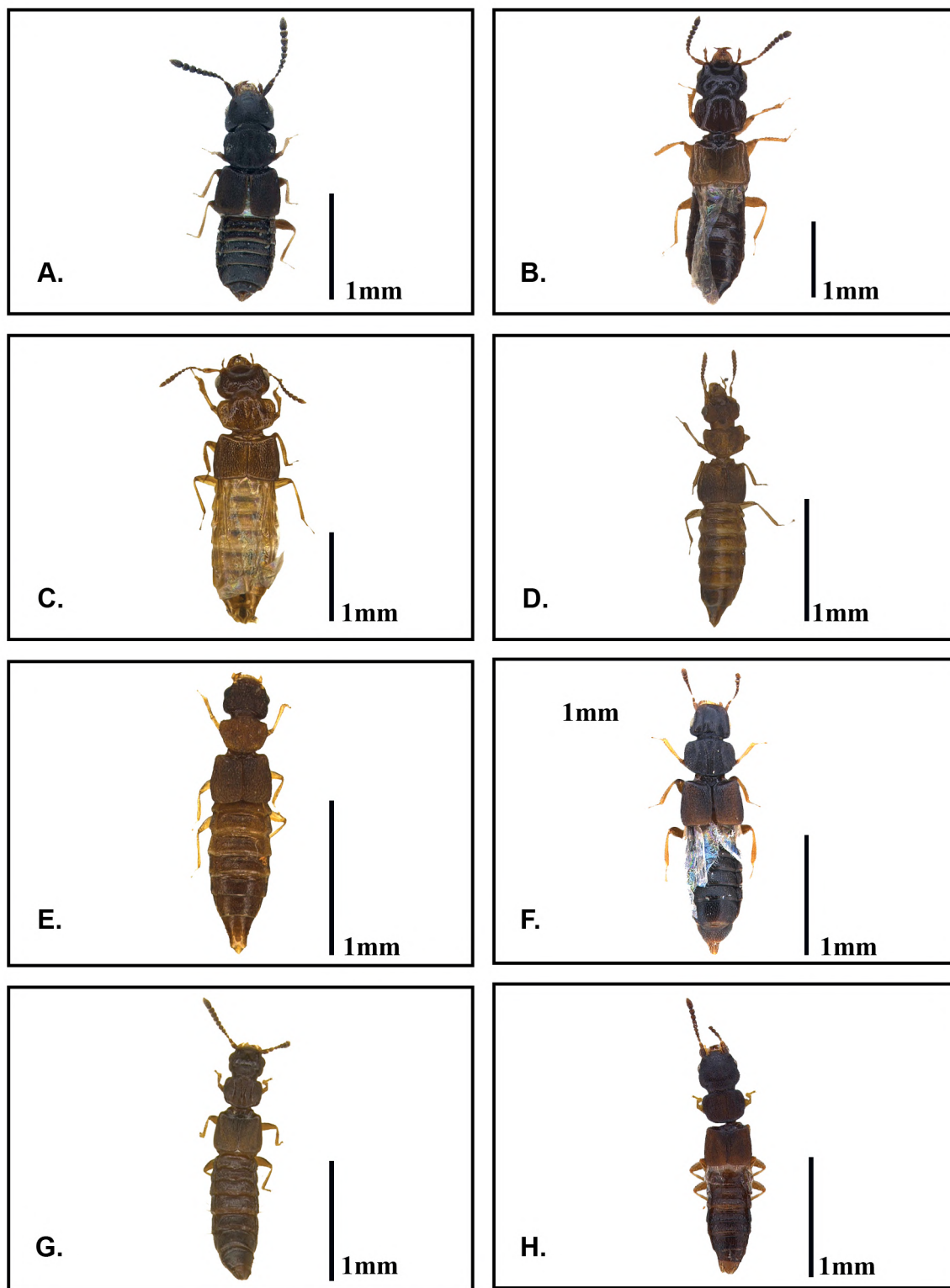


Plate 1: Dorsal habitus of A) *Anotylus disparatus* Cameron, 1928 B) *Anotylus micans* Kraatz, 1859 C) *Anotylus nitidifrons* Wollaston, 1871 D) *Anotylus rubicundus* Cameron, 1930 E) *Anotylus glareosus* Wollaston, 1854 F) *Anotylus latiusculus* Kraatz, 1859, G) *Anotylus myrmecophilus* Cameron, 1914, H) *Anotylus pusillimus* Kraatz, 1859..

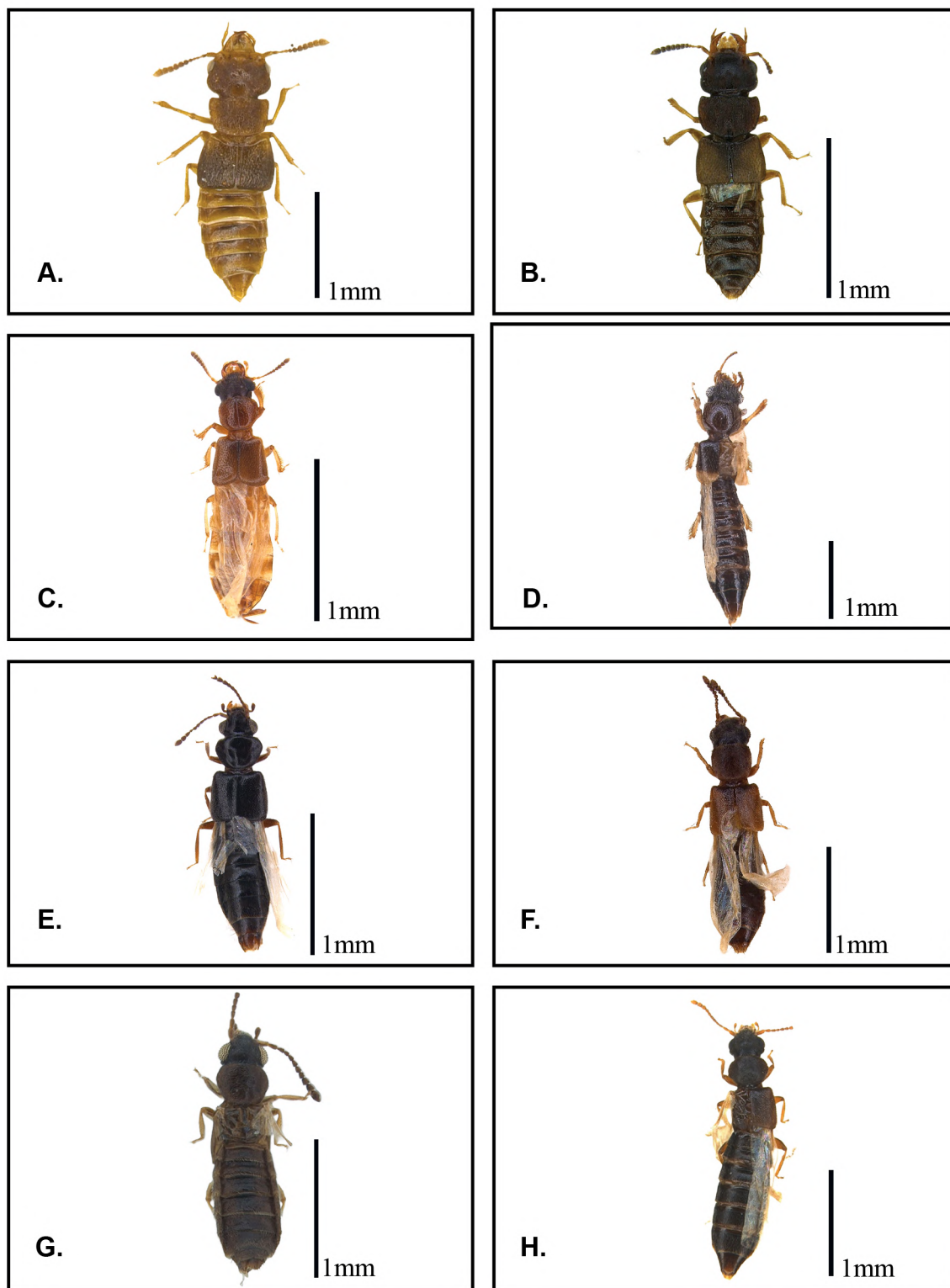


Plate 2: Dorsal habitus of: A) *Anotylus rufus* Kraatz, 1859 B) *Anotylus sp1* C) *Bledius lucidus* Sharp, 1874 D) *Bledius pulchellus* Kraatz, 1859 E) *Carpelimus indicus* Kraatz, 1859 F) *Carpelimus atomus* Saulcy, 1865 G) *Carpelimus finelypunctus* H) *Carpelimus perigrinus* Cameron, 1919.

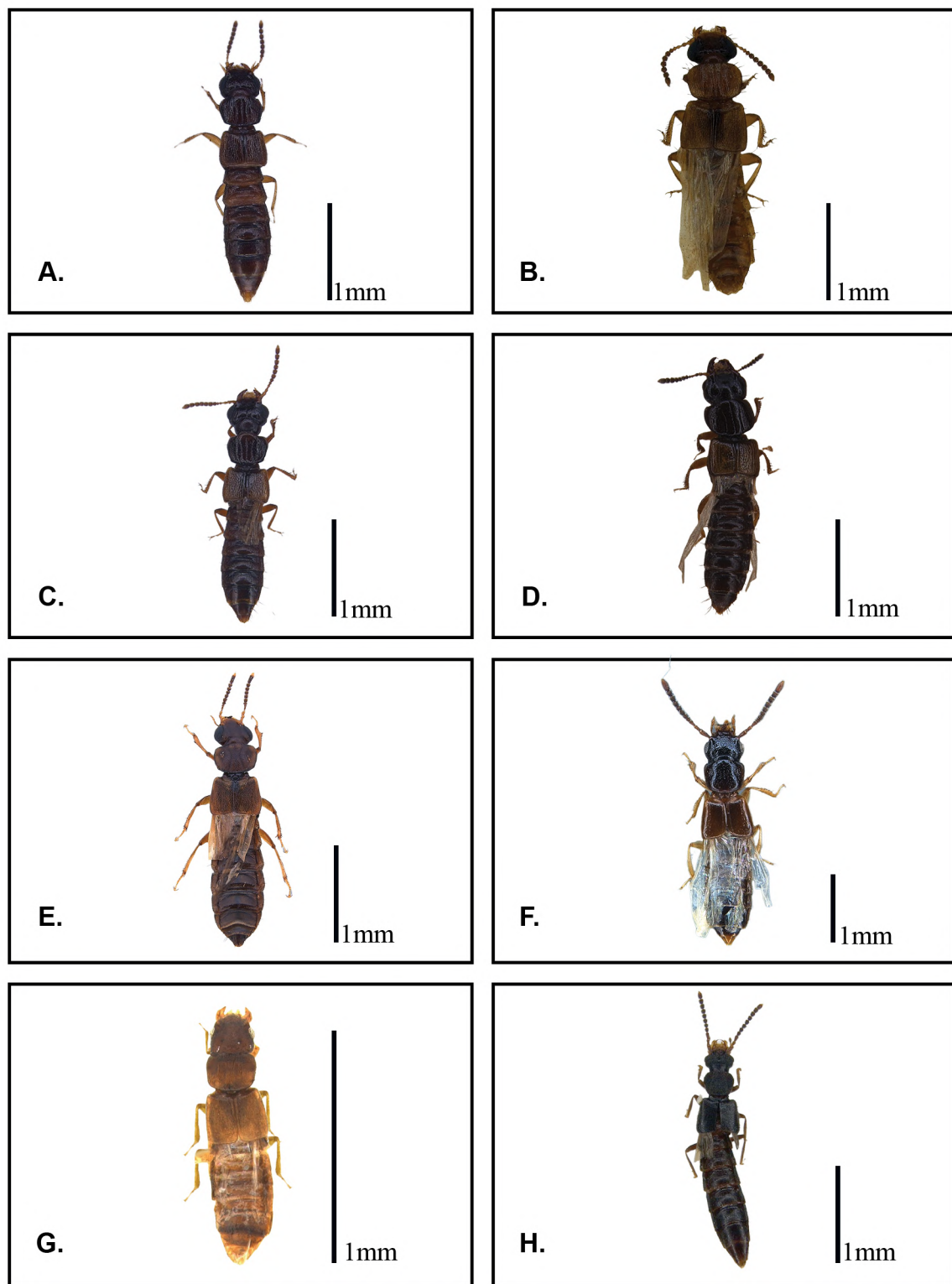


Plate 3: Dorsal habitus of : **A)** *Oxytelus migrator* Fauvel, 1904 **B)** *Oxytelus nigriceps* Kraatz, 1859 **C)** *Oxytelus piceus* Linné, 1767 **D)** *Oxytelus sp1* **E)** *Oxytelus lividus* Motschulsky, 1858 **F)** *Platystethus crassicornis* Motschulsky, 1857 **G)** *Thinobius simlaensis* Cameron, 1930 **H)** *Xerophygus pallipes*, Motschulsky, 1857.

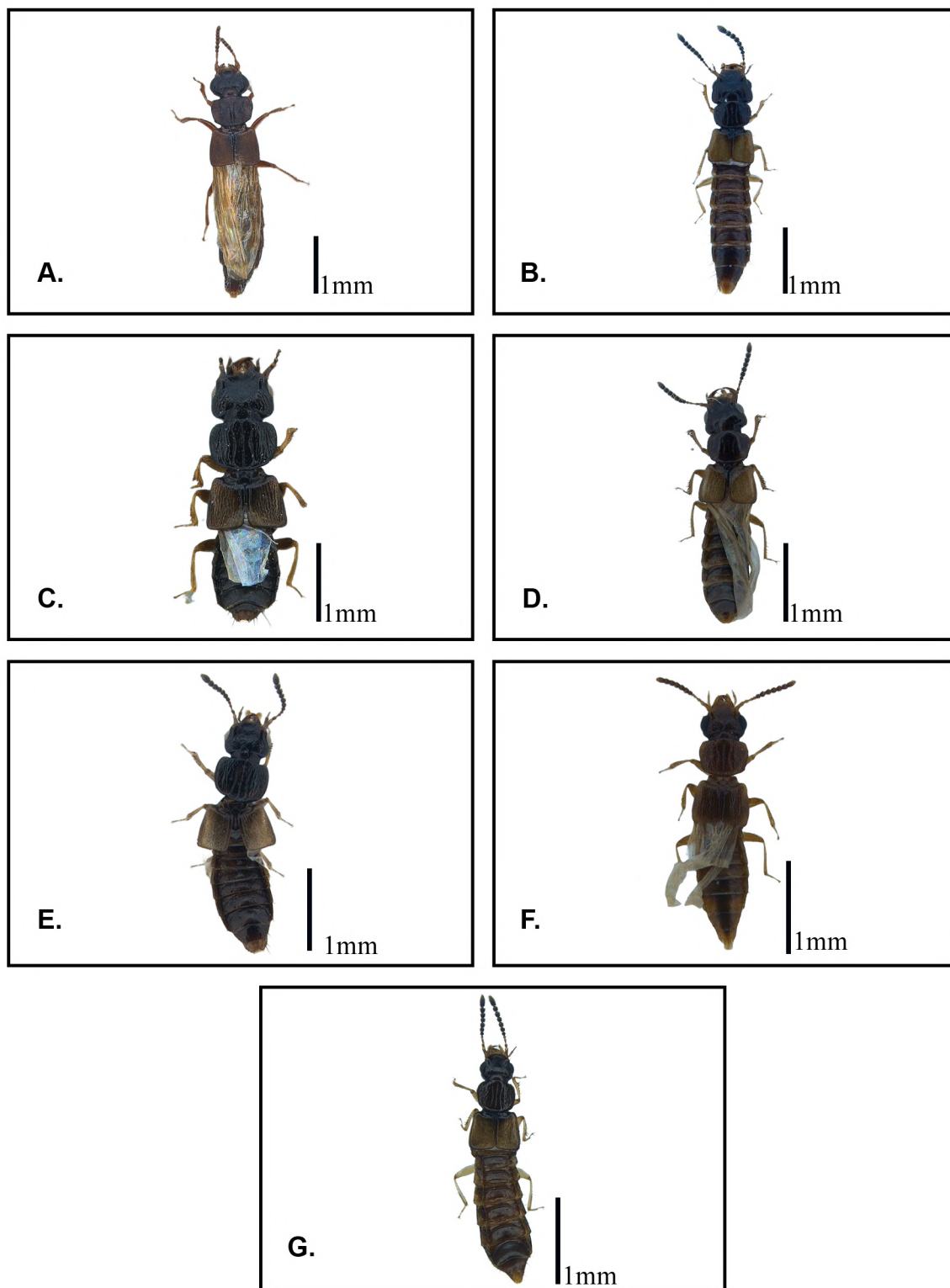


Plate 4: Dorsal habitus of A) *Oxytelus bengalensis* Erichson, 1840 B) *Oxytelus nilgiriensis* Cameron, 1930 C) *Oxytelus puncticeps* Kraatz, 1859 D) *Oxytelus barbatus* Fauvel, 1905 E) *Oxytelus dohertyi* Cameron, 1930 F) *Oxytelus incisus* Motschulsky, 1858 G) *Oxytelus megaceros* Fauvel, 1895.

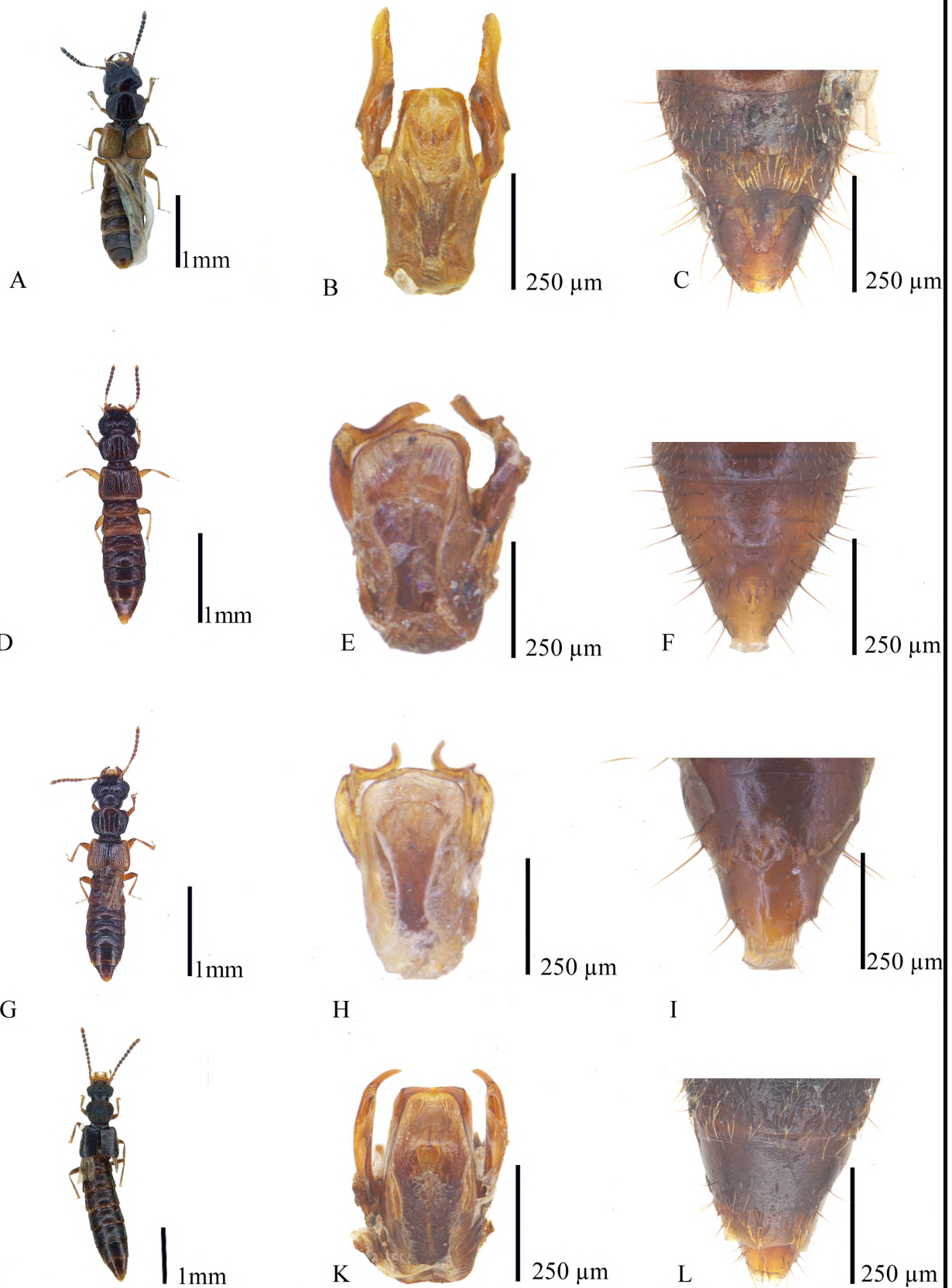


Plate 5: A) *Oxytelus barbatus* dorsal view B) *O. barbatus* aedeagus dorsal view C) *O. barbatus* sternite D) *Oxytelus migrator* dorsal view, E) *O. migrator* aedeagus dorsal view, F) *O. migrator* sternite G) *Oxytelus piceus* dorsal view, H) *O. piceus* aedeagus dorsal view; I) *O. piceus* sternite J) *Xerophygus pallipes* dorsal view, K) *X. pallipes* aedeagus dorsal view L) *X. pallipes* sternite

4.2. Ecology

4.2.1. Forest ecosystem

A total of 24 species of Oxytelinae beetles, representing six genera (*Anotylus*, *Bledius*, *Carpelimus*, *Oxytelus*, *Platystethus*, and *Xerophygus*) and three tribes (Blediini, Oxytelini, and Thinobiini), were documented from the selected forest ecosystems (Table 2). *Anotylus latiusculus* (34.33%) was the most dominant species, followed by *Oxytelus incisus* (25.07%) (Table 2).

The diversity indices of Oxytelinae beetles in the forest ecosystem showed significant seasonal variation during the study period. The Shannon-Weaver diversity index (H') during the non-rainy season was 2.14, with a Margalef's richness index (d) of 2.73 and Simpson's evenness ($1-\lambda$) of 0.27. In contrast, during the rainy season, the values slightly declined, with H' at 2.02, d at 2.7, and $1-\lambda$ at 0.24 (Table 3).

The rank abundance plot (Figure 13) highlighted clear differences in species dominance across the three sites of forest ecosystems: Malabar Wildlife Sanctuary (MWS), Aralam Wildlife Sanctuary (AWS), and Periya Reserve Forest (PRF). In Malabar Wildlife Sanctuary, *Oxytelus incisus* was the most dominant species, showing the highest relative abundance among all taxa. Conversely, *Anotylus latiusculus* dominated the beetle communities in both Aralam Wildlife Sanctuary (AWS) and Periya Reserve Forest (PRF).

4.2.1.1. Aralam Wildlife Sanctuary

A total of 16 species of Oxytelinae beetles, belonging to six genera, *Anotylus* Thomson, 1859; *Bledius* Leach, 1819; *Carpelimus* Leach, 1819; *Oxytelus* Gravenhorst, 1802; *Platystethus* Mannerheim, 1830; and *Xerophygus* Kraatz, 1859 and three tribes, Blediini Ádám, 2001; Oxytelini Fleming, 1821; and Thinobiini Sahlberg, 1876, were recorded from Aralam Wildlife Sanctuary (AWS) (Table 4).

Among the 16 species, six were categorised as major: *Anotylus latiusculus*, *Anotylus myrmecophilus*, *Carpelimus finelypunctus*, *Carpelimus indicus*, *Oxytelus incisus*, and *Oxytelus piceus* (Figure 5). Nine species were minor: *Anotylus disparatus*, *Anotylus pusillimus*, *Bledius lucidus*, *Oxytelus puncticeps*, *Platystethus crassicornis*, *Bledius pulchellus*, *Oxytelus nigriceps*, *Oxytelus migrator* and *Xerophygus pallipes*. The remaining species, *Anotylus rubicundus*, was rare.

Anotylus latiusculus (26.03%) was the most dominant species, followed by *Oxytelus incisus* (18.57%) (Table 4). The diversity analysis of Aralam Wildlife Sanctuary (AWS) revealed a Shannon-Weaver diversity index (H') of 2.12, a Margalef richness index (d) of 2.33, and a Simpson's evenness value ($1-\lambda$) of 0.41, indicating relatively high species diversity, moderate species richness, and a well-balanced distribution of individuals across species (Table 5).

Seasonality

A total of 16 species of Oxytelinae beetles were recorded, with two species, *Carpelimus finelypunctus* and *Carpelimus indicus*, showing significant seasonal variation ($p \leq 0.05$), exhibiting higher mean abundance during the rainy season (Table 6).

4.2.1.2 Periya Reserve Forest

A total of 12 species of Oxytelinae beetles, belonging to three genera, *Anotylus*, *Carpelimus*, and *Oxytelus*, and two tribes, Oxytelini and Thinobiini, were recorded from Periya Reserve Forest (PRF) (Table 7). Among the twelve species, six (*Anotylus latiusculus*, *Anotylus rufus*, *Oxytelus barbatus*, *Oxytelus bengalensis*, *Oxytelus piceus* and *Oxytelus incisus*) were classified as major (Figure 6), three (*Carpelimus perigrinus*, *Oxytelus megaceros* and *Oxytelus puncticeps*) as minor, and three (*Anotylus rubicundus*, *Anotylus pusillimus* and *Carpelimus indicus*) as rare.

Anotylus latiusculus (41.35%) was the most dominant species, followed by *Oxytelus incisus* (23.19%) (Table 7). The diversity indices for PRF were: Shannon-Weaver diversity (H') = 1.7, Margalef richness index (d) = 1.64, and Simpson's evenness index ($1-\lambda$) = 0.33 (Table 5).

Seasonality

The species composition in the Periya Reserve Forest doesn't exhibit any significant seasonal variation, despite the presence of 12 recorded species (Table 8).

4.2.1.3 Malabar Wildlife Sanctuary

A total of 15 species of Oxytelinae beetles, belonging to four genera, *Anotylus*, *Carpelimus*, *Oxytelus*, and *Bledius*, and two tribes, Oxytelini and Thinobiini, were recorded from Malabar Wildlife Sanctuary (MWS) (Table 9). Among the fifteen species, five were categorised as major: *Anotylus disparatus*, *Anotylus latiusculus*, *Anotylus myrmecophilus*, *Carpelimus indicus*, and *Oxytelus incisus* (Figure 7). Eight species were considered minor: *Anotylus rufus*, *Bledius lucidus*, *Carpelimus atomos*, *Carpelimus perigrinus*, *Oxytelus barbatus*, *Oxytelus megaceros*, *Oxytelus* sp. 1, and *Oxytelus puncticeps*. The remaining two species, *Oxytelus nilgiriensis* and *Oxytelus piceus*, were classified as rare.

Oxytelus incisus (33.33%) was the most dominant species, followed by *Anotylus latiusculus* (30.26%) (Table 9). Diversity indices were: Shannon-Weaver diversity (H') = 1.9, Margalef richness index (d) = 2.13, and Simpson's evenness ($1-\lambda$) = 0.3 (Table 5).

Seasonality

At Malabar Wildlife Sanctuary, a total of 15 Oxytelinae species were recorded, with no significant seasonal variation observed in overall species composition (Table 10).

4.2.2. Agricultural Ecosystem

A total of 19 species of Oxytelinae beetles, representing four genera (*Anotylus*, *Carpelimus*, *Oxytelus*, and *Thinobius*) and two tribes (Oxytelini and Thinobiini), were recorded from the selected agricultural ecosystems. (Table 11). *Anotylus latiusculus* (58.92%) was the most dominant species, followed by *Oxytelus incisus* (30.87%) (Table 11).

The diversity indices of Oxytelinae beetles in the agricultural ecosystem showed significant seasonal variation during the study period. The Shannon-Weaver diversity index (H') during the non-rainy season was 0.90, with a Margalef's richness index (d) of 1.2 and Simpson's evenness ($1-\lambda$) of 0.21. In the rainy season, these values increased to $H' = 1.33$, $d = 2.6$, and $1-\lambda = 0.11$ (Table 3).

The rank abundance plot (Figure 14) showed clear variation in species dominance between the two agricultural ecosystems studied: Ezhome Paddy Field (EPF) and Badiyadukka Agricultural Field (BAF). In EPF, *Oxytelus incisus* was the most dominant species, exhibiting the highest relative abundance among all recorded species. In contrast, *Anotylus latiusculus* was the dominant species in BAF.

4.2.2.1. Ezhome Paddy Field

A total of 11 species of Oxytelinae beetles, belonging to four genera, *Anotylus*, *Carpelimus*, *Oxytelus*, and *Thinobius*, and two tribes, Oxytelini and Thinobiini, were recorded from the Ezhome Paddy Field (Table 12).

Among these, two species (*Anotylus latiusculus* and *Oxytelus incisus*) were identified as major (Figure 8). Seven species (*Anotylus myrmecophilus*, *Anotylus pusillimus*, *Anotylus rufus*, *Carpelimus indicus*, *Oxytelus bengalensis*, *Oxytelus lividus*, and *Thinobius simlaensis*) were categorised as minor, while two species (*Anotylus disparatus* and *Oxytelus migrator*) were considered rare.

Oxytelus incisus (54.19%) was the most dominant species, followed by *Anotylus latiusculus* (38.45%) (Table 12). The diversity indices from the Ezhome Paddy Field were as follows: Shannon-Weaver diversity index (H') = 1.04, Margalef richness index (d) = 1.4, and Simpson's evenness value ($1-\lambda$) = 0.21 (Table 5).

Seasonality

A total of 11 Oxytelinae species were recorded from the Ezhome Paddy Field across the rainy and non-rainy seasons. Although several species exhibited seasonal variation in mean abundance, none showed statistically significant differences ($p > 0.05$) based on the t-test results (Table 13).

4.2.2.2. Badiyadukka Agricultural Field

A total of 16 species of Oxytelinae beetles, belonging to three genera, *Anotylus*, *Carpelimus*, and *Oxytelus*, and two tribes, Oxytelini and Thinobiini, were recorded from the Badiyadukka Agricultural Field (Table 14).

Among the 16 species, two (*Anotylus latiusculus* and *Oxytelus incisus*) were categorised as major (Figure 9). Seven species (*Anotylus disparatus*, *Anotylus myrmecophilus*, *Anotylus rufus*, *Anotylus nitidifrons*, *Carpelimus indicus*, *Oxytelus dohertyi* and *Oxytelus puncticeps*) were classified as minor, while nine species (*Anotylus glareosus*, *Anotylus micans*, *Anotylus rubicundus*, *Anotylus sp. 1*, *Oxytelus barbatus*, *Oxytelus bengalensis*, and *Oxytelus lividus*) were considered rare.

Anotylus latiusculus (75.06%) was the dominant species in the assemblage, followed by *Oxytelus incisus* (13.07%) (Table 14). The diversity indices were: Shannon-Weaver diversity (H') = 1.004, Margalef richness index (d) = 2.02, and Simpson's evenness ($1-\lambda$) = 0.11 (Table 5).

Seasonality

In the Badiyadukka Agricultural Field, 16 species were identified, with *Anotylus latiusculus* exhibiting significant seasonal variation ($p \leq 0.05$), being slightly more abundant in the non-rainy season. This species also showed high mean values in both seasons. *Oxytelus incisus* showed a substantial numerical decrease from the non-rainy (2.9 ± 1.8) to the rainy season (0.8 ± 0.9), although the variation did not show significant seasonal variations (Table 15).

4.2.3. Seasonality of Oxytelinae in the Agricultural and Forest Ecosystems

The overall abundance of Oxytelinae beetles, as estimated during the study period, did not exhibit significant seasonal variation between the rainy and non-rainy seasons (Table 16). Similarly, no significant seasonal differences were observed in Oxytelinae beetle abundance within forest and agricultural ecosystems (Table 17)

During the rainy season, the highest species diversity ($H' = 1.81$) and Margalef richness index ($d = 3.5$) were recorded. The evenness value ($1-\lambda = 0.12$) indicated a moderately balanced distribution of individuals across species. In the non-rainy season, a slight reduction in diversity ($H' = 1.5$) and richness ($d = 2.52$) was observed, while the evenness value ($1-\lambda = 0.14$) remained stable (Table 18)

4.2.4. Analysis of Oxytelinae Beetles in Forest and Agricultural Ecosystems

A total of 31 species, belonging to 7 genera and 3 tribes, were recorded from the selected sites of forest and agricultural ecosystems (Table 1). According to the Bray-Curtis similarity coefficient, the highest similarity in species assemblages was observed between Ezhome Paddy Field (EPF) and Periya Reserve Forest (PRF), followed by Aralam Wildlife Sanctuary (AWS) and Malabar Wildlife Sanctuary (MWS); the lowest similarity occurred between Malabar Wildlife Sanctuary (MWS) and Badiyadukka

Agricultural Field (BAF), followed by Ezhome Paddy Field (EPF) and Badiyadukka Agricultural Field (BAF) (Table 19, Figure 10).

In the present study, a total of 12 common species were recorded from both forest and agricultural ecosystems. These include *Anotylus disparatus*, *Anotylus latiusculus*, *Anotylus mymecophilus*, *Anotylus pusilimus*, *Anotylus rubicundus*, *Anotylus rufus*, *Carpelimus indicus*, *Oxytelus barbatus*, *Oxytelus bengalensis*, *Oxytelus incisus*, *Oxytelus migrator*, and *Oxytelus puncticeps*. On the other hand, 12 species were found exclusively in forest ecosystems. These forest-restricted species include *Bledius lucidus*, *Bledius pulchellus*, *Carpelimus atomos*, *Carpelimus perigrinus*, *Carpelimus finelypunctus*, *Oxytelus megaceros*, *Oxytelus nigriceps*, *Oxytelus nilgiriensis*, *Oxytelus piceus*, *Oxytelus* sp. 1, *Platystethus crassicornis*, and *Xerophygus pallipes*. Additionally, seven species were exclusively recorded from agricultural fields. These include *Anotylus glareosus*, *Anotylus micans*, *Anotylus nitidifrons*, *Anotylus* sp. 1, *Oxytelus dohertyi*, *Oxytelus lividus*, and *Thinobius simlaensis* (Table 20)

The rarefaction and extrapolation curves depict the species diversity of Oxytelinae beetles sampled from three forest ecosystems: Aralam Wildlife Sanctuary (AWS), Malabar Wildlife Sanctuary (MWS), and Periya Reserve Forest (PRF). The solid lines represent observed species richness based on rarefaction, while the dashed lines project expected richness with increased sampling effort (extrapolation). All three curves show a clear plateau, particularly those for Aralam Wildlife Sanctuary and Malabar Wildlife Sanctuary, indicating that the sampling effort was sufficient to capture the majority of species present. Among the sites, Aralam Wildlife Sanctuary showed the highest species richness (16 species), followed by Malabar Wildlife Sanctuary (15 species) and Periya Reserve Forest (12 species). These findings suggest that the

sampling effort was adequate across all forest sites, providing a comprehensive representation of Oxytelinae diversity (Figure 11).

Similarly, rarefaction and extrapolation analyses for the agricultural ecosystems, the Badiyadukka Agricultural Field and the Ezhome Paddy Field, also indicate sufficient sampling effort, as evidenced by the plateauing of the diversity curves. Badiyadukka Agricultural Field exhibited greater species richness (16 species) than the Ezhome Paddy Field (11 species). These results imply that most species present at both agricultural sites were effectively captured during the survey (Figure 12).

Table 2: Abundance (Mean $\pm$ SD; percentage) of dung - associated Oxytelinae beetles collected from the Forest ecosystem

No	Species	Mean $\pm$ SD	Percentage
1.	<i>Anotylus disparatus</i>	0.46 $\pm$ 0.58	2.45
2.	<i>Anotylus latiusculus</i>	6.43 $\pm$ 2.4	34.33
3.	<i>Anotylus mymecophilus</i>	1.06 $\pm$ 0.24	5.65
4.	<i>Anotylus pusilimus</i>	0.1 $\pm$ 0.4	0.45
5.	<i>Anotylus rubicundus</i>	0.1 $\pm$ 0.24	0.31
6.	<i>Anotylus rufus</i>	0.7 $\pm$ 0.8	3.74
7.	<i>Bledius lucidus</i>	0.2 4 $\pm$ 0.43	1.29
8.	<i>Bledius pulchellus</i>	0.03 $\pm$ 0.2	0.18
9.	<i>Carpelimus atomos</i>	0.1 $\pm$ 0.3	0.40
10.	<i>Carpelimus perigrinus</i>	0.2 $\pm$ 0.4	0.80
11.	<i>Carpelimus finelypunctus</i>	0.6 $\pm$ 0.6	3.16
12.	<i>Carpelimus indicus</i>	1.13 $\pm$ 0.8	6.06
13.	<i>Oxytelus barbatus</i>	0.7 $\pm$ 0.82	3.74

14.	<i>Oxytelus bengalensis</i>	0.6 ± 0.6	3.07
15.	<i>Oxytelus incisus</i>	4.7 ± 2.98	25.07
16.	<i>Oxytelus megaceros</i>	0.12 ± 0.4	0.62
17.	<i>Oxytelus migrator</i>	0.03 ± 0.2	0.18
18.	<i>Oxytelus nigriceps</i>	0.03 ± 0.2	0.18
19.	<i>Oxytelus nilgiriensis</i>	0.03 ± 0.2	0.13
20.	<i>Oxytelus piceus</i>	1.13 ± 0.4	6.01
21.	<i>Oxytelus puncticeps</i>	0.3 ± 0.5	1.60
22.	<i>Oxytelus spl</i>	0.03 ± 0.2	0.18
23.	<i>Platystethus crassicornis</i>	0.04 ± 0.2	0.22
24.	<i>Xerophygus pallipes</i>	0.03 ± 0.2	0.18

Table 3: Diversity, Richness, and Evenness of dung - associated Oxytelinae Beetles Collected from Forest and Agricultural Ecosystems during the rainy and non-rainy Seasons

Study site	Seasons	Shannon- Weaver diversity index(H')	Margalef 's richness index(d)	Simpson's evenness index (1-λ)
Forest	Rainy	2.02	2.7	0.24
	Non-rainy	2.14	2.73	0.27
Agriculture	Rainy	1.33	2.6	0.11
	Non-rainy	0.9	1.2	0.21

Table 4: Abundance (Mean $\pm$ SD; percentage) of dung - associated Oxytelinae beetles collected from Aralam Wildlife Sanctuary

No	Species	Mean $\pm$ SD	Percentage
1.	<i>Anotylus disparatus</i>	0.04 $\pm$ 0.27	0.79
2.	<i>Anotylus latiusculus</i>	1.4 $\pm$ 1.31	26.03
3.	<i>Anotylus myrmecophilus</i>	0.53 $\pm$ 0.52	10.16
4.	<i>Anotylus rubicundus</i>	0.03 $\pm$ 0.16	0.48
5.	<i>Anotylus pusillimus</i>	0.05 $\pm$ 0.31	0.95
6.	<i>Bledius lucidus</i>	0.18 $\pm$ 0.38	3.33
7.	<i>Bledius pulchellus</i>	0.03 $\pm$ 0.18	0.63
8.	<i>Carpelimus finelypunctus</i>	0.59 $\pm$ 0.58	11.27
9.	<i>Carpelimus indicus</i>	0.59 $\pm$ 0.58	11.27
10.	<i>Oxytelus incisus</i>	0.98 $\pm$ 0.96	18.57
11.	<i>Oxytelus nigriceps</i>	0.03 $\pm$ 0.18	0.63
12.	<i>Oxytelus migrator</i>	0.03 $\pm$ 0.18	0.63
13.	<i>Oxytelus piceus</i>	0.58 $\pm$ 0.51	10.95
14.	<i>Oxytelus puncticeps</i>	0.15 $\pm$ 0.35	2.86
15.	<i>Platystethus crassicornis</i>	0.04 $\pm$ 0.2	0.79
16.	<i>Xerophygus pallipes</i>	0.03 $\pm$ 0.18	0.63

Table 5: Diversity of dung - associated Oxytelinae Beetles Collected from Forest and Agricultural Ecosystems

Study site	Shannon-Weaver diversity index(H')	Margalef's richness index(d)	Simpson's evenness index (1-λ)
Periya Reserve Forest	1.7	1.64	0.33
Aralam Wildlife Sanctuary	2.12	2.33	0.41
Malabar Wildlife Sanctuary	1.9	2.13	0.3
Badiyadukka Agricultural Field	1.004	2.02	0.11
Ezhome Paddy Field	1.04	1.4	0.21

Table 6. Seasonal abundance (mean ± SD) of dung - associated Oxytelinae assemblages in Aralam Wildlife Sanctuary

Sl No	Species	Non rainy	Rainy	t-test (P value)
		(Mean ± SD)	(Mean ± SD)	
1.	<i>Anotylus disparatus</i>	0.05 ± 0.287	0.03 ± 0.26	NS
2.	<i>Anotylus latiusculus</i>	1.2 ± 0.9	1.6 ± 1.62	NS
3.	<i>Anotylus myrmecophilus</i>	1.02 ± 0.13	0.1 ± 0.22	NS
4.	<i>Anotylus rubicundus</i>	0.00 ± 0.00	0.1 ± 0.22	NS
5.	<i>Anotylus pusillimus</i>	0.00 ± 0.00	0.1 ± 0.44	NS
6.	<i>Bledius lucidus</i>	0.13 ± 0.34	0.22 ± 0.42	NS
7.	<i>Bledius pulchellus</i>	0.1 ± 0.3	0.00 ± 0.00	NS
8.	<i>Carpelimus finelypunctus</i>	0.6 ± 0.5	0.66 ± 0.7	*

9.	<i>Carpelimus indicus</i>	0.6±0.5	0.6±0.7	*
10.	<i>Oxytelus incisus</i>	0.8±0.84	1.2±1.03	NS
11.	<i>Oxytelus nigriceps</i>	0.00±0.00	0.1±0.3	NS
12.	<i>Oxytelus migrator</i>	0.1±0.3	0.00±0.00	NS
13.	<i>Oxytelus piceus</i>	0.2±0.4	0.00±0.00	NS
14.	<i>Oxytelus puncticeps</i>	0.2±0.4	0.1±0.3	NS
15.	<i>Platystethus crassicornis</i>	0.1±0.3	0.00±0.00	NS
16.	<i>Xerophygus pallipes</i>	0.00±0.00	0.1±0.3	NS

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$; ****; $p \leq 0.0001$; NS– not significant

Table 7: Abundance (Mean $\pm$ SD; percentage) of dung - associated Oxytelinae beetles collected in Periya Reserve Forest

Sl. No	Species	Mean $\pm$ SD	Percentage
1.	<i>Anotylus latiusculus</i>	2.81± 2.03	41.35
2.	<i>Anotylus pusilimus</i>	0.03±0.18	0.49
3.	<i>Anotylus rufus</i>	0.53±0.5	7.73
4.	<i>Anotylus rubicundus</i>	0.03±0.15	0.37
5.	<i>Carpelimus indicus</i>	0.03±0.16	0.37
6.	<i>Carpelimus perigrinus</i>	0.05±0.21	0.74
7.	<i>Oxytelus barbatus</i>	0.53±0.52	7.73
8.	<i>Oxytelus bengalensis</i>	0.55±0.54	8.10
9.	<i>Oxytelus incisus</i>	1.6±1.5	23.19
10.	<i>Oxytelus megaceros</i>	0.04±0.2	0.61
11.	<i>Oxytelus piceus</i>	0.53±0.51	7.85

12.	<i>Oxytelus puncticeps</i>	0.1±0.3	1.47
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Table 8: Seasonal abundance (Mean ± SD) of dung - associated Oxytelinae assemblage in Periya Reserve Forest

Sl No	Species	Non rainy (Mean ± SD)	Rainy (Mean ± SD)	t-test (P value)
1.	<i>Anotylus latiusculus</i>	3.52±2.2	2.1±1.6	NS
2.	<i>Anotylus pusilimus</i>	0.1±0.3	0.00 ± 0.00	NS
3.	<i>Anotylus rufus</i>	0.5±0.5	0.6±0.5	NS
4.	<i>Anotylus rubicundus</i>	0.1±0.22	0.00 ± 0.00	NS
5.	<i>Carpelimus indicus</i>	0.03±0.2	0.02±0.13	NS
6.	<i>Carpelimus perigrinus</i>	0.00 ± 0.00	0.1±0.3	NS
7.	<i>Oxytelus barbatus</i>	0.5±0.6	0.6±0.53	NS
8.	<i>Oxytelus bengalensis</i>	0.83±0.38	0.3±0.55	NS
9.	<i>Oxytelus incisus</i>	1.22±0.9	1.93±1.84	NS
10.	<i>Oxytelus megaceros</i>	0.1±0.28	0.00 ± 0.00	NS
11.	<i>Oxytelus piceus</i>	1.02±0.13	0.1±0.22	NS
12.	<i>Oxytelus puncticeps</i>	0.2±0.4	0.00 ± 0.00	NS

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$; ****; $p \leq 0.0001$; NS – not significant

Table 9: Abundance (Mean ± SD; percentage) of dung - associated Oxytelinae beetles collected in Malabar Wildlife Sanctuary

Sl No	Species	Mean ± SD	Percentage
1.	<i>Anotylus disparatus</i>	0.41±0.51	6.83
2.	<i>Anotylus latiusculus</i>	1.81±1.43	30.26

3.	<i>Anotylus myrmecophilus</i>	0.53±0.52	8.79
4.	<i>Anotylus rufus</i>	0.13±0.56	2.09
5.	<i>Bledius lucidus</i>	0.07±0.25	1.12
6.	<i>Carpelimus atomos</i>	0.08±0.26	1.26
7.	<i>Carpelimus perigrinus</i>	0.1±0.35	1.67
8.	<i>Carpelimus indicus</i>	0.52±0.5	8.65
9.	<i>Oxytelus barbatus</i>	0.2±0.6	2.79
10.	<i>Oxytelus incisus</i>	1.9±1.88	33.33
11.	<i>Oxytelus megaceros</i>	0.07±0.34	1.12
12.	<i>Oxytelus nilgiriensis</i>	0.03±0.16	0.42
13.	<i>Oxytelus piceus</i>	0.02±0.13	0.28
14.	<i>Oxytelus puncticeps</i>	0.05±0.21	0.84
15.	<i>Oxytelus spl</i>	0.03±0.18	0.56

Table 10: Seasonal abundance (Mean ± SD) of dung - associated Oxytelinae assemblage in Malabar Wildlife Sanctuary

Sl No	Species	Non-Rainy	Rainy	t-test (P value)
		(Mean ± SD)	(Mean ± SD)	
1.	<i>Anotylus disparatus</i>	0.00 ± 0.00	0.81±0.43	NS
2.	<i>Anotylus latiusculus</i>	1.42±0.7	2.2±1.82	NS
3.	<i>Anotylus myrmecophilus</i>	0.03±0.2	1.02±0.13	NS
4.	<i>Anotylus rufus</i>	0.00 ± 0.00	0.3±0.8	NS
5.	<i>Bledius lucidus</i>	0.00 ± 0.00	0.13±0.34	NS
6.	<i>Carpelimus atomos</i>	0.2±0.4	0.00 ± 0.00	NS

7.	<i>Carpelimus perigrinus</i>	0.2±0.5	0.00 ± 0.00	NS
8.	<i>Carpelimus indicus</i>	0.83±0.4	0.2±0.4	NS
9.	<i>Oxytelus barbatus</i>	0.2±0.8	0.13±0.4	NS
10.	<i>Oxytelus incisus</i>	1.4±0.6	2.63±2.43	NS
11.	<i>Oxytelus megaceros</i>	0.1±0.4	0.1±0.3	NS
12.	<i>Oxytelus nilgiriensis</i>	0.00 ± 0.00	0.1±0.22	NS
13.	<i>Oxytelus piceus</i>	0.00 ± 0.00	0.03±0.2	NS
14.	<i>Oxytelus puncticeps</i>	0.1±0.3	0.00 ± 0.00	NS
15.	<i>Oxytelus sp1</i>	0.00 ± 0.00	0.1±0.3	NS

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$; ****; $p \leq 0.0001$; NS – not significant

Table 11: Abundance (Mean ± SD; percentage) of dung - associated Oxytelinae beetles collected from the Agricultural ecosystem

No	Species	Mean ± SD	Percentage
1.	<i>Anotylus disparatus</i>	0.4 ± 0.72	1.49
2.	<i>Anotylus glareosus</i>	0.03 ± 0.18	0.13
3.	<i>Anotylus latiusculus</i>	15.11 ± 10.11	58.92
4.	<i>Anotylus micans</i>	0.03 ± 0.2	0.13
5.	<i>Anotylus mymecophilus</i>	0.6 ± 0.74	2.14
6.	<i>Anotylus nitidifrons</i>	0.1 ± 0.32	0.36
7.	<i>Anotylus rubicundus</i>	0.1 ± 0.22	0.19
8.	<i>Anotylus rufus</i>	0.32 ± 0.53	1.23
9.	<i>Anotylus sps1</i>	0.04 ± 0.3	0.16
10.	<i>Carpelimus indicus</i>	0.3 ± 0.9	0.97

11.	<i>Oxytelus barbatus</i>	0.1 ± 0.22	0.19
12.	<i>Oxytelus bengalensis</i>	0.2 ± 0.54	0.65
13.	<i>Oxytelus dohertyi</i>	0.1 ± 0.4	0.39
14.	<i>Oxytelus incisus</i>	7.92 ± 6.33	30.87
15.	<i>Oxytelus lividus</i>	0.2 ± 0.6	0.68
16.	<i>Oxytelus puncticeps</i>	0.2 ± 0.4	0.71
17.	<i>Oxytelus migrator</i>	0.02 ± 0.13	0.06
18.	<i>Thinobius simlaensis</i>	0.1 ± 0.3	0.32
19.	<i>Anotylus pusilimus</i>	0.1 ± 0.34	0.36

Table 12: Abundance (Mean ± SD; percentage) of dung - associated Oxytelinae beetles collected in Ezhome Paddy Field

No	Species	Mean ± SD	Percentage
1.	<i>Anotylus disparatus</i>	0.03±0.2	0.23
2.	<i>Anotylus latiusculus</i>	4.13±4.02	38.45
3.	<i>Anotylus mymecophilus</i>	0.09±0.45	0.85
4.	<i>Anotylus pusilimus</i>	0.09±0.34	0.85
5.	<i>Anotylus rufus</i>	0.14±0.4	1.32
6.	<i>Carpelimus indicus</i>	0.2±0.8	1.40
7.	<i>Oxytelus bengalensis</i>	0.1±0.46	0.93
8.	<i>Oxytelus incisus</i>	5.82± 5.62	54.19
9.	<i>Oxytelus lividus</i>	0.09±0.34	0.85
10.	<i>Oxytelus migrator</i>	0.02±0.13	0.16
11.	<i>Thinobius simlaensis</i>	0.08±0.3	0.78

Table 13: Seasonal abundance (Mean $\pm$ SD) of dung - associated Oxytelinae assemblage in Ezhome Paddy Field

Sl No	Species	Non rainy	Rainy	t-test
		(Mean $\pm$ SD)	(Mean $\pm$ SD)	(P value)
1.	<i>Anotylus disparatus</i>	0.1 $\pm$ 0.3	0.00 $\pm$ 0.00	NS
2.	<i>Anotylus latiusculus</i>	5.2 $\pm$ 4.94	3.1 $\pm$ 2.5	NS
3.	<i>Anotylus mymecophilus</i>	0.00 $\pm$ 0.00	0.2 $\pm$ 0.62	NS
4.	<i>Anotylus pusilimus</i>	0.03 $\pm$ 0.2	0.2 $\pm$ 0.44	NS
5.	<i>Anotylus rufus</i>	0.2 $\pm$ 0.4	0.13 $\pm$ 0.4	NS
6.	<i>Carpelimus indicus</i>	0.00 $\pm$ 0.00	0.3 $\pm$ 1.1	NS
7.	<i>Oxytelus bengalensis</i>	0.00 $\pm$ 0.00	0.2 $\pm$ 0.63	NS
8.	<i>Oxytelus incisus</i>	10.2 $\pm$ 4.9	1.5 $\pm$ 0.99	NS
9.	<i>Oxytelus lividus</i>	0.00 $\pm$ 0.00	0.2 $\pm$ 0.5	NS
10.	<i>Oxytelus migrator</i>	0.00 $\pm$ 0.00	0.03 $\pm$ 0.2	NS
11.	<i>Thinobius simlaensis</i>	0.00 $\pm$ 0.00	0.2 $\pm$ 0.4	NS

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$; ****; $p \leq 0.0001$; NS – not significant

Table 14: Abundance (Mean $\pm$ SD; percentage) of dung - associated Oxytelinae beetles collected in Badiyadukka Agricultural Field

No	Species	Mean $\pm$ SD	Percentage
1.	<i>Anotylus disparatus</i>	0.31 $\pm$ 0.7	2.23
2.	<i>Anotylus glareosus</i>	0.03 $\pm$ 0.2	0.24
3.	<i>Anotylus latiusculus</i>	10.4 $\pm$ 9.9	75.06
4.	<i>Anotylus micans</i>	0.03 $\pm$ 0.2	0.24

5.	<i>Anotylus myrmecophilus</i>	0.45±0.5	3.25
6.	<i>Anotylus nitidifrons</i>	0.1±0.32	0.66
7.	<i>Anotylus rubicundus</i>	0.05±0.22	0.36
8.	<i>Anotylus rufus</i>	0.1±0.3	0.54
9.	<i>Anotylus sps1</i>	0.04±0.3	0.30
10.	<i>Carpelimus indicus</i>	0.1±0.44	0.72
11.	<i>Oxytelus barbatus</i>	0.1±0.22	0.36
12.	<i>Oxytelus bengalensis</i>	0.1±0.3	0.48
13.	<i>Oxytelus dohertyi</i>	0.1±0.4	0.72
14.	<i>Oxytelus incisus</i>	1.81±1.8	13.07
15.	<i>Oxytelus lividus</i>	0.1±0.4	0.42
16.	<i>Oxytelus puncticeps</i>	0.2±0.4	1.33

Table 15: Seasonal abundance (Mean ± SD) of dung - associated Oxytelinae assemblage in Badiyadukka Agricultural Field

Sl No	Species	Non-rainy	Rainy	t-test (<i>P</i> value)
		(Mean ± SD)	(Mean ± SD)	
1.	<i>Anotylus disparatus</i>	0.03±0.2	0.6±0.9	NS
2.	<i>Anotylus glareosus</i>	0.00 ± 0.00	0.1±0.3	NS
3.	<i>Anotylus latiusculus</i>	10.6±0.4	10.13±13	*
4.	<i>Anotylus micans</i>	0.00 ± 0.00	0.1±0.3	NS
5.	<i>Anotylus myrmecophilus</i>	0.2±0.4	0.73±0.45	NS
6.	<i>Anotylus nitidifrons</i>	0.2±0.4	0.03±0.2	NS
7.	<i>Anotylus rubicundus</i>	0.00 ± 0.00	0.1±0.3	NS

8.	<i>Anotylus rufus</i>	0.00 ± 0.00	0.2±0.4	NS
9.	<i>Anotylus sps1</i>	0.00 ± 0.00	0.1±0.4	NS
10.	<i>Carpelimus indicus</i>	0.2±0.6	0.0 0.00	NS
11.	<i>Oxytelus barbatus</i>	0.1±0.24	0.03±0.2	NS
12.	<i>Oxytelus bengalensis</i>	0.00 ± 0.00	0.13±0.34	NS
13.	<i>Oxytelus dohertyi</i>	0.00 ± 0.00	0.2±0.5	NS
14.	<i>Oxytelus incisus</i>	2.9±1.8	0.8±0.9	NS
15.	<i>Oxytelus lividus</i>	0.00 ± 0.00	0.12±0.5	NS
16.	<i>Oxytelus puncticeps</i>	0.1±0.3	0.3±0.45	NS

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$; ****; $p \leq 0.0001$; NS – not significant

Table 16: Statistical Analysis of Seasonal Variation in dung - associated Oxytelinae Beetle Abundance Between Rainy and Non-Rainy Seasons

Season	t value	P value
Non rainy	0.26	NS
Rainy		
Non rainy	0.32	NS
Rainy		

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$; ****; $p \leq 0.0001$; NS. – not significant

Table 17: Statistical Analysis of Seasonal Variation in dung - associated Oxytelinae Beetle Abundance in Agricultural and Forest Ecosystems

Site	t value	P value
Forest ecosystem	0.37	NS
Agricultural ecosystem		

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$; ****; $p \leq 0.0001$; NS. – not significant

Table 18: Diversity, richness, and evenness of dung - associated Oxytelinae beetles collected during the Rainy and Non-rainy seasons.

Season	Shannon-Weaver diversity index(H')	Margalef 's richness index(d)	Simpson's evenness index (1-λ)
Rainy	1.81	3.5	0.12
Non rainy	1.5	2.52	0.14

Table 19: Bray-Curtis similarity coefficient values of dung - associated Oxytelinae beetle's assemblage associated with Periya Reserve Forest, Aralam Wildlife Sanctuary, Malabar Wildlife Sanctuary, Ezhome Paddy Field, and Badiyadukka Agricultural Field during the 2019–2022 period (PRF- Periya Reserve Forest; AWS- Aralam Wildlife Sanctuary; MWS- Malabar Wildlife Sanctuary; EPF- Ezhome Paddy Field; BAF- Badiyadukka Agricultural Field).

Habitat	PRF	AWS	MWS	EPF	BAF
PRF	-				
AWS	0.905	-			
MWS	0.914	0.932	-		
EPF	0.942	0.926	0.91	-	
BAF	0.926	0.925	0.88	0.89	

Table 20: Classification of Oxytelinae beetles into Agriculture-associated, Forest-associated and Shared groups in North Malabar, Kerala

Agriculture-associated Species	Forest-associated Species	Shared species
<i>Anotylus glareosus</i>	<i>Bledius lucidus</i>	<i>Anotylus disparatus</i>
<i>Anotylus micans</i>	<i>Bledius pulchellus</i>	<i>Anotylus latiusculus</i>
<i>Anotylus nitidifrons</i>	<i>Carpalimus atomos</i>	<i>Anotylus mymecophilus</i>
<i>Anotylus</i> sp. 1	<i>Carpalimus perigrinus</i>	<i>Anotylus pusilimus</i>
<i>Oxytelus dohertyi</i>	<i>Carpelimus finelypunctus</i>	<i>Anotylus rubicundus</i>
<i>Oxytelus lividus</i>	<i>Oxytelus megaceros</i>	<i>Anotylus rufus</i>
<i>Thinobius simlaensis</i>	<i>Oxytelus nigriceps</i>	<i>Carpelimus indicus</i>
	<i>Oxytelus nilgiriensis</i>	<i>Oxytelus barbatus</i>
	<i>Oxytelus piceus</i>	<i>Oxytelus bengalensis</i>
	<i>Oxytelus</i> sp. 1	<i>Oxytelus incisus</i>
	<i>Platystethus crassicornis</i>	<i>Oxytelus migrator</i>
	<i>Xerophygus pallipes</i>	<i>Oxytelus puncticeps</i>

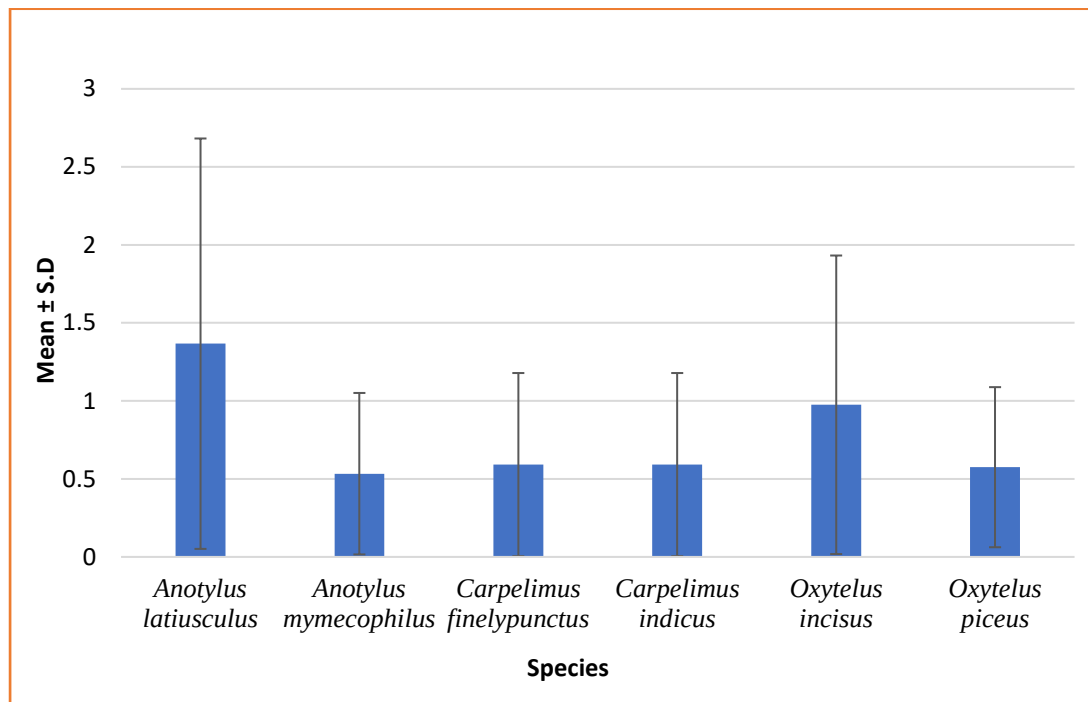


Figure 5: Abundance (Mean $\pm$ SD) of major dung - associated Oxytelinae species in Aralam Wildlife Sanctuary.

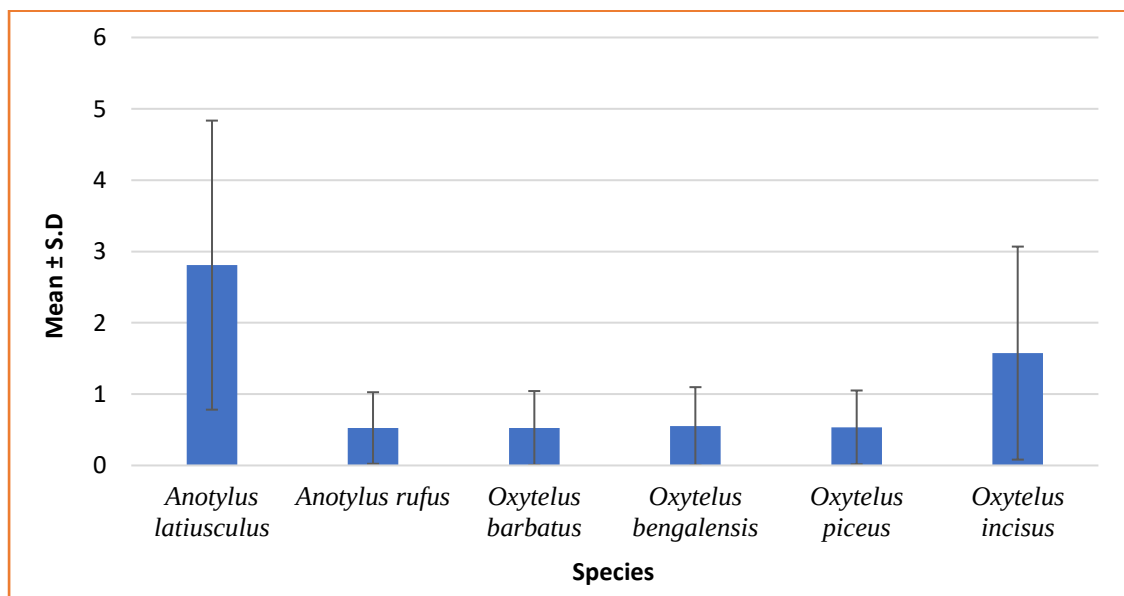


Figure 6: Abundance (Mean $\pm$ SD) of major dung - associated Oxytelinae species in Periya Reserve Forest

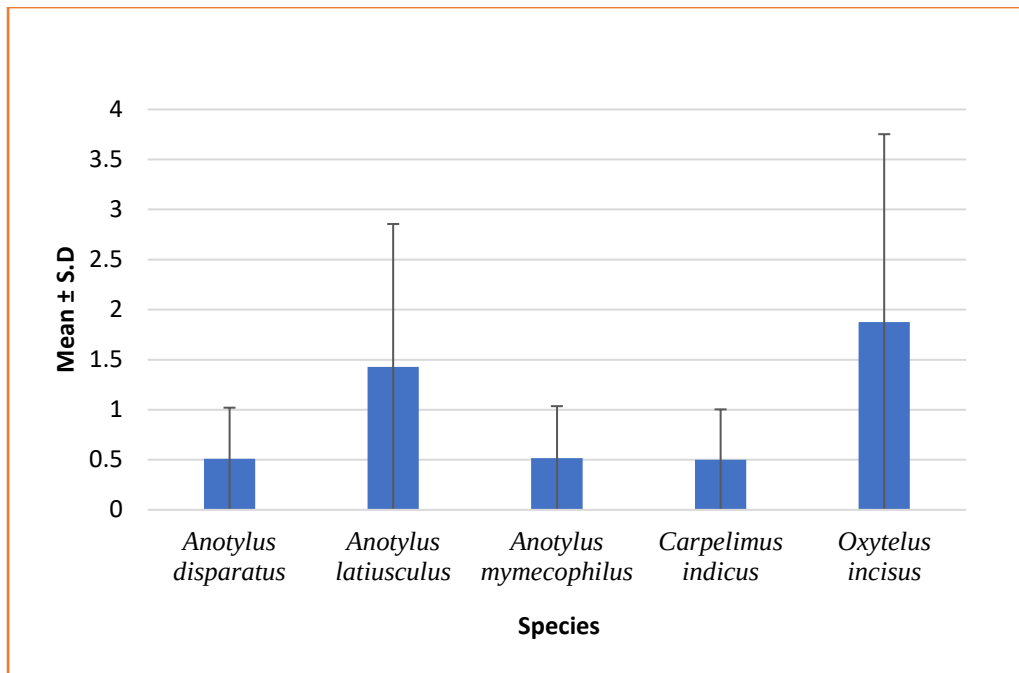


Figure 7: Abundance (Mean ± SD) of major dung - associated Oxytelinae species in Malabar Wildlife Sanctuary

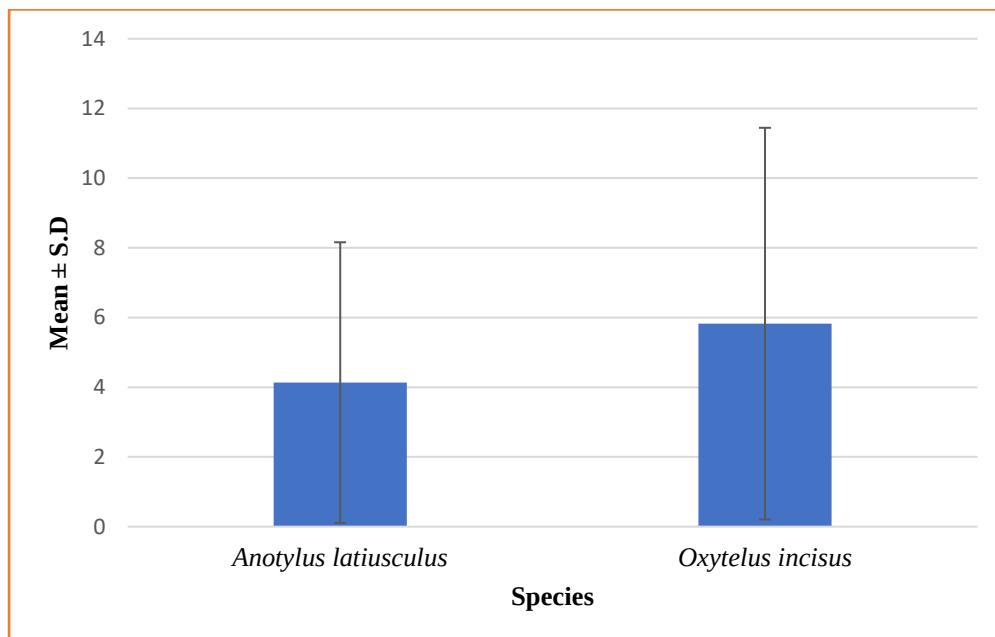


Figure 8: Abundance (Mean ± SD) of major dung - associated Oxytelinae species in Ezhome Paddy Field

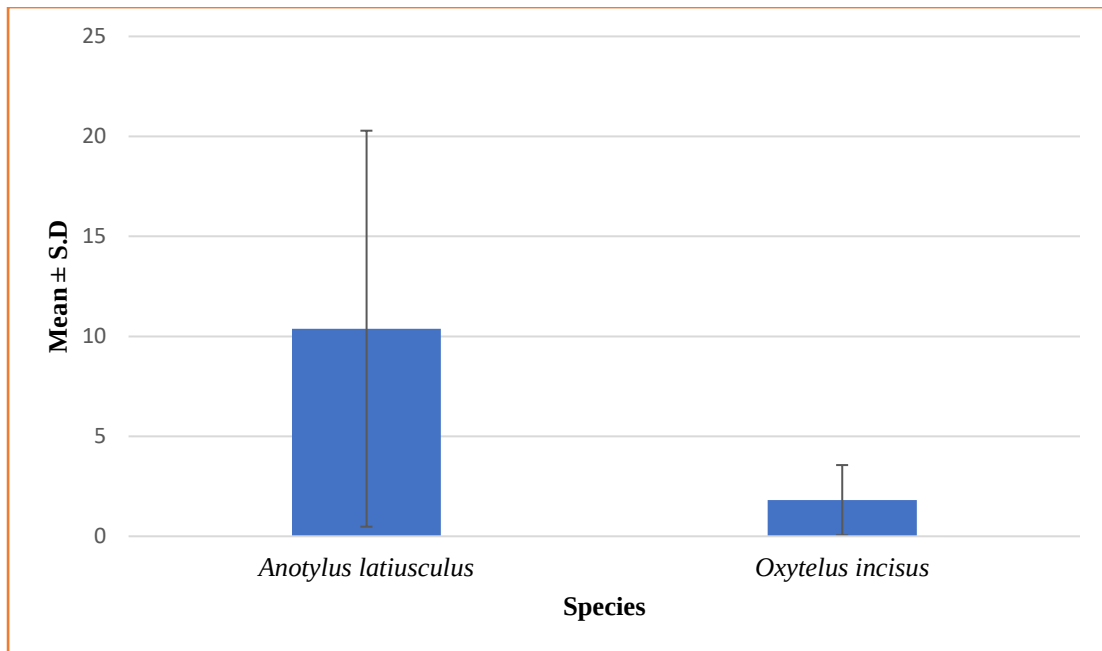


Figure 9: Abundance (Mean $\pm$ SD) of major dung - associated Oxytelinae species in Badiyadukka Agricultural Field

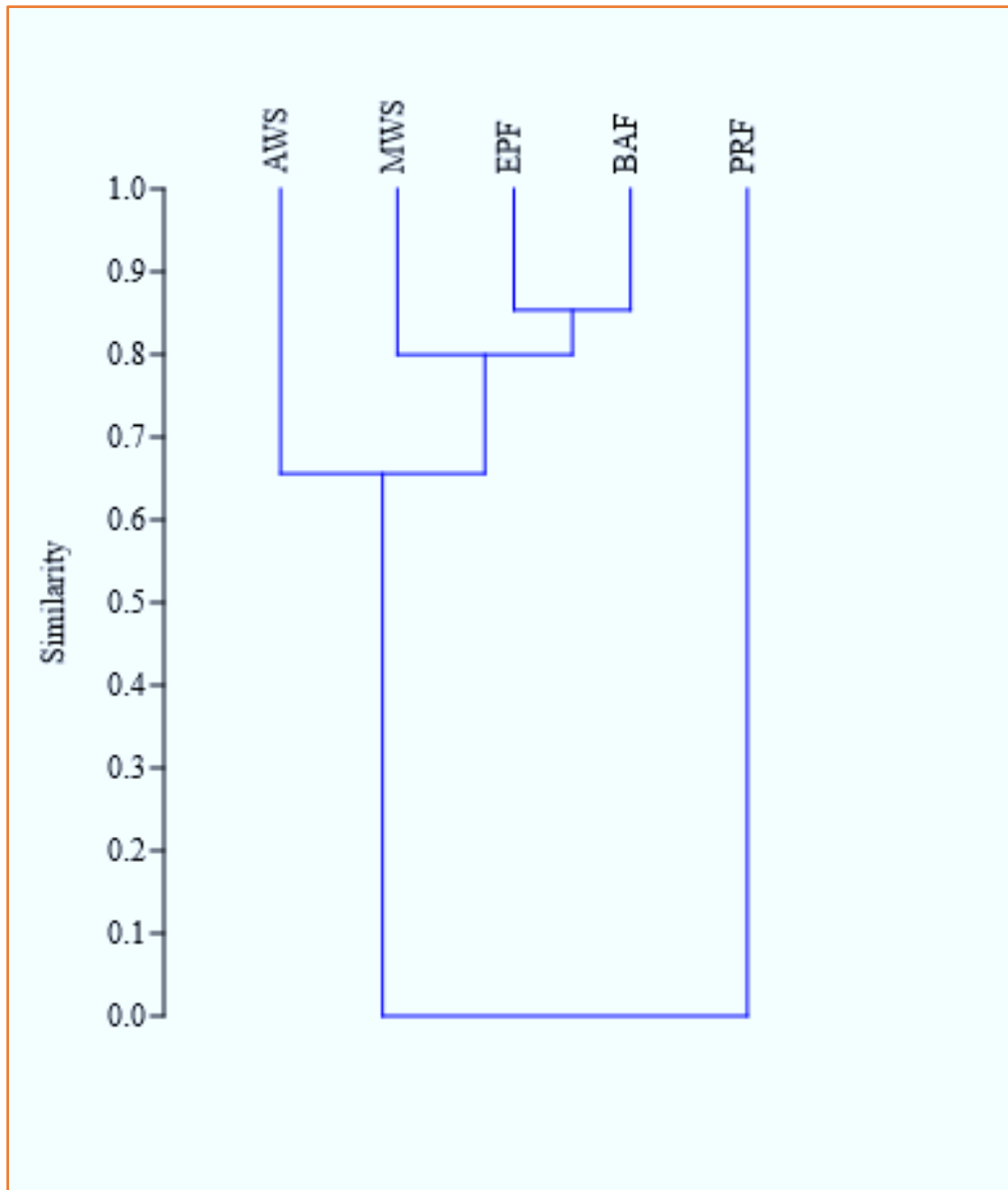


Figure 10: Dendrogram Showing Hierarchical Clustering (Paired Group) of dung - associated Oxytelinae Beetle Assemblages from Periya Reserve Forest (PRF); Aralam Wildlife Sanctuary (AWS); Malabar Wildlife Sanctuary (MWS); Ezhome Paddy Field (EPF) and Badiyadukka Agricultural Field (BAF) in the North Malabar Region

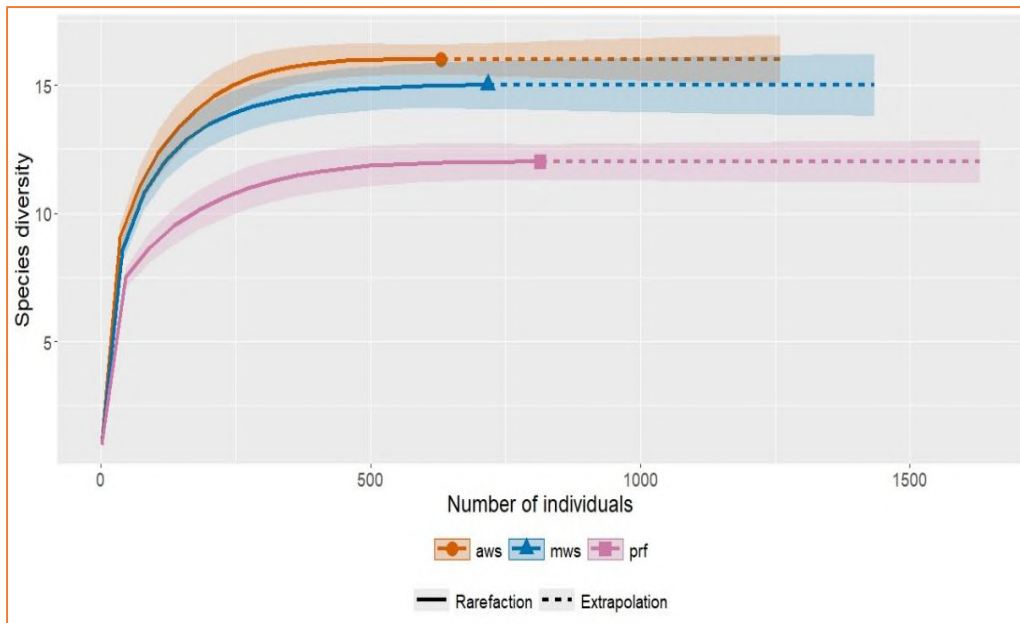


Figure 11: Rarefaction and Extrapolation Curves Showing Species Diversity of Oxytelinae Beetles in AWS, MWS, and PRF Based on the Number of Individuals Collected

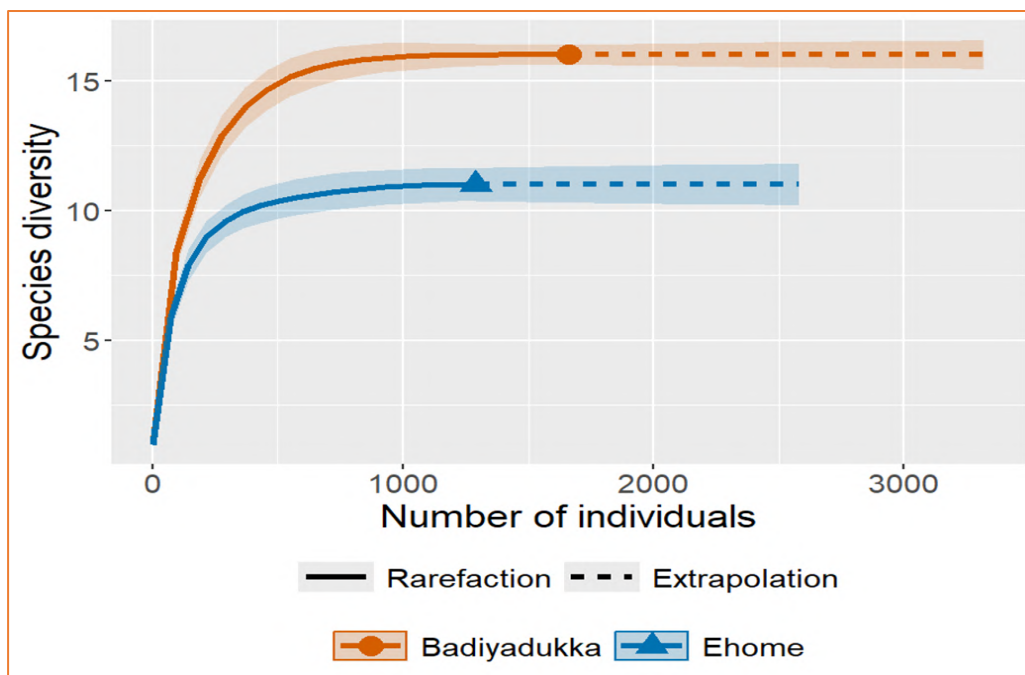


Figure 12: Rarefaction and Extrapolation Curves Showing Species Diversity of Oxytelinae Beetles in BAF and EPF Based on the Number of Individuals Collected

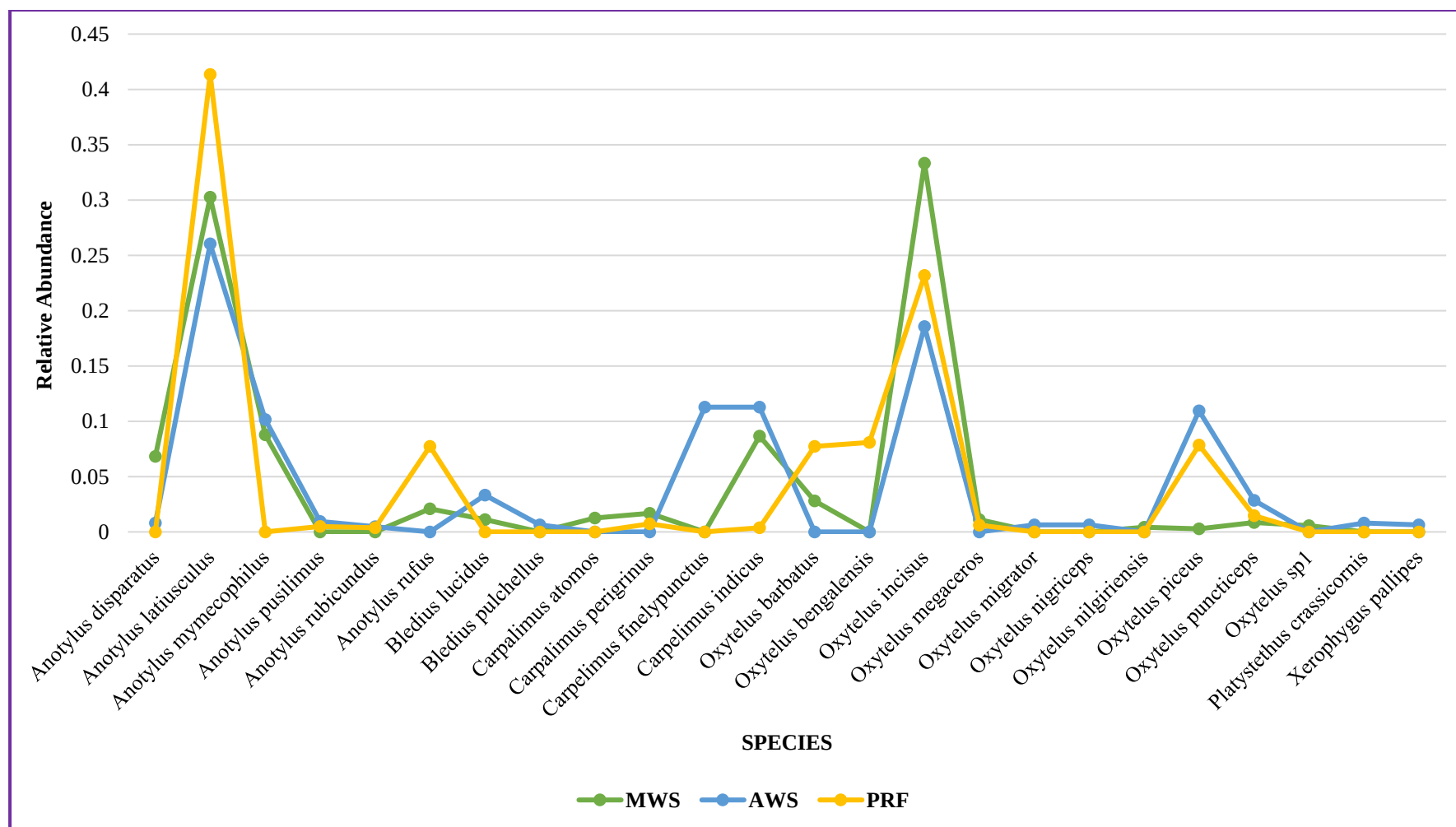


Figure 13: Rank-Abundance Plot for the dung - associated Oxytelinae beetles collected from Malabar Wildlife Sanctuary (MWS), Aralam Wildlife Sanctuary (AWS) and Periya Reserve Forest (PRF)

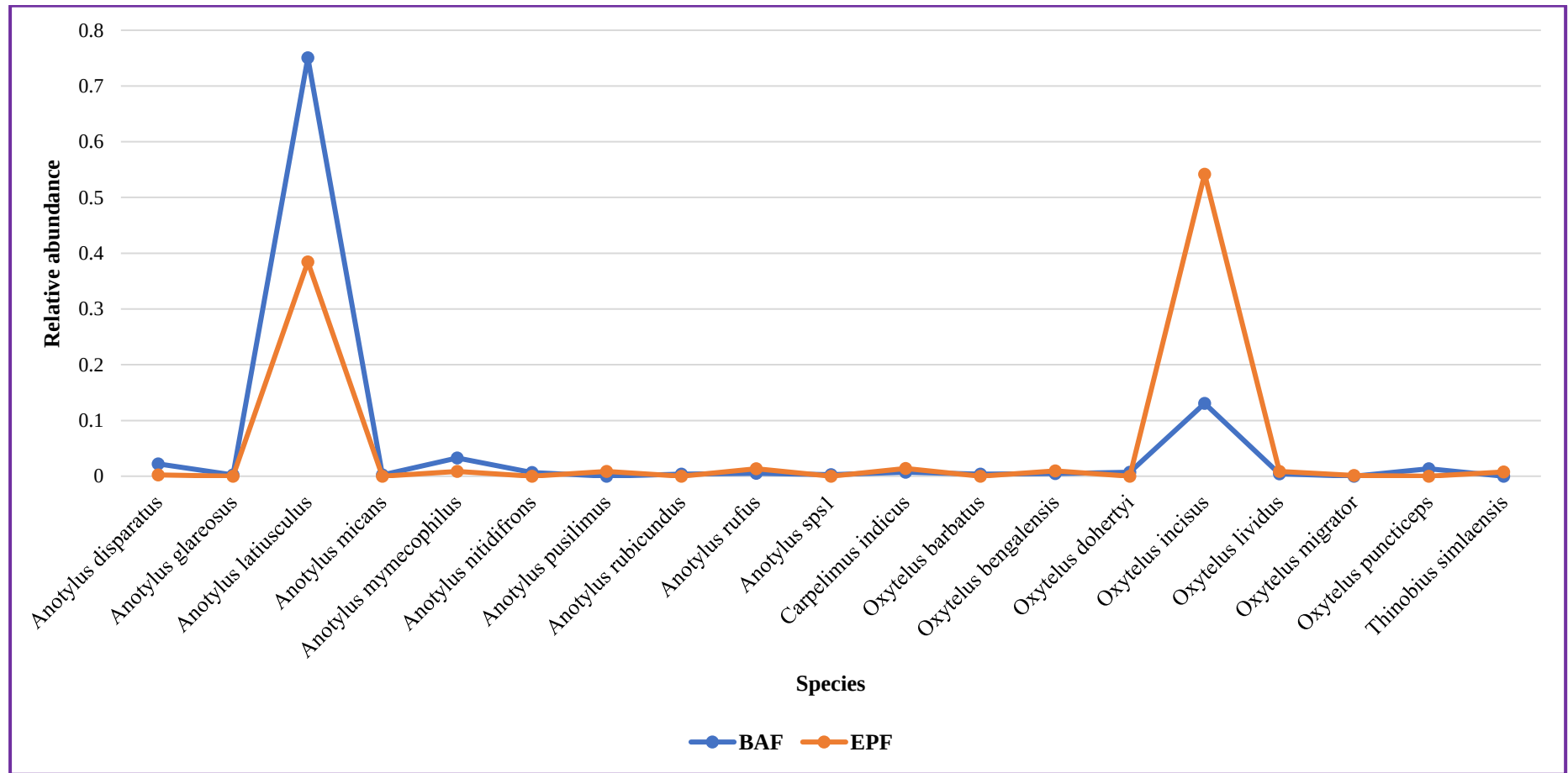


Figure 14: Rank-Abundance Plot for the dung - associated Oxytelinae beetles collected from Ezhome Paddy Field (EPF) and Badiyadukka Agricultural Field (BAF)

Chapter 5

DISCUSSION

5. DISCUSSION

5.1. Taxonomy of Subfamily Oxytelinae (Fleming, 1821)

5.1.1. Distribution of Oxytelinae beetles

The present study offers the first comprehensive report on the composition of the Oxytelinae subfamily from selected forest and agricultural ecosystems in North Malabar. It includes a checklist of recorded species, accompanied by images and a pictorial key for species identification. The survey was conducted across the two different ecosystems, including the Semi-evergreen Forest of Aralam Wildlife Sanctuary (AWS), the evergreen forest of Periya Reserve Forest (PRF), the southern moist mixed deciduous forest of Malabar Wildlife Sanctuary (MWS), and the agricultural regions of Ezhome Paddy Field (EPF) and Badiyadukka Agricultural Field (BAF), characterised by mixed crops in the North Malabar region of Kerala.

A total of 31 species, three tribes, and seven genera were recorded from the study sites of North Malabar. (Table 1). Out of the 31 species, four species (*Oxytelus barbatus* Fauvel, 1905; *Oxytelus migrator* Fauvel, 1904; *Xerophygus pallipes* (Motschulsky, 1857); and *Oxytelus piceus* (Linnaeus, 1767)) were first reported from India. *Oxytelus barbatus* was previously documented only in Indonesia (Lü and Zhou, 2015a). *Oxytelus migrator* was previously documented from Sri Lanka, China, Japan, Thailand, and Indonesia (Newton, 2021). *Xerophygus pallipes* was earlier recorded from Indonesia (Sumatra) and the Indes orientales (Kraatz, 1859; Bernhauer and Schubert, 1911; Bernhauer, 1928; Cameron, 1930; Scheerpeltz, 1933; Cameron, 1934b; Herman, 1970; Newton, 2021), and *Oxytelus piceus* is widely distributed throughout the world (Lü and Zhou, 2015a).

A total of nine species (*Anotylus glareosus* (Wollaston, 1854); *Oxytelus bengalensis* Erichson, 1840; *Oxytelus lividus* Motschulsky, 1858; *Oxytelus puncticeps*

Kraatz, 1859; *Thinobius simlaensis* Cameron, 1930; *Anotylus micans* (Kraatz, 1859); *Anotylus rubicundus* (Cameron, 1930); *Anotylus pusillimus* (Kraatz, 1859); and *Anotylus disparatus* (Cameron, 1928) were newly reported from South India. *Thinobius simlaensis*, previously known to be endemic to the Himalayan biodiversity hotspot with a distribution limited to Nepal, Himachal Pradesh, and northern Pakistan (Newton, 2021), has now been confirmed to also occur in Southern India. *Anotylus glareosus* was previously reported from Uttarakhand (Mussoorie) (Hammond, 1975; Bernhauer and Schubert, 1911); *Oxytelus bengalensis* from Bengal, Dehra Dun, Sikkim, Tripura, and Uttar Pradesh (Bernhauer and Schubert, 1911; Cameron, 1921, 1930; Scheerpeltz, 1933; Paulian, 1941; Abdullah and Qadri, 1970; Hammond, 1975; Yuh et al., 1985; Lü and Zhou, 2012, 2015a); *Oxytelus lividus* from Goa (Bernhauer, 1902a; Bernhauer and Schubert, 1911; Cameron, 1928, 1930; Hammond, 1975; Lü and Zhou, 2012, 2015b); *Oxytelus puncticeps* from Uttar Pradesh and Mussoorie (Bernhauer, 1902; Fauvel, 1904; Bernhauer and Schubert, 1911; Bernhauer, 1922; Cameron, 1930; Hammond, 1975; Lü and Zhou, 2012, 2015b); *Anotylus micans* from Maharashtra, Manipur, Sikkim, Uttar Pradesh, and West Bengal (Fauvel, 1904a; Bernhauer and Schubert, 1911; Cameron, 1930; Scheerpeltz, 1933; Paulian, 1941; Abdullah and Qadri, 1970; Hammond, 1975, 1976; Coiffait, 1984); *Anotylus pusillimus* from West Bengal (Newton, 2021); *Anotylus rubicundus* from Himachal Pradesh and Uttar Pradesh (Cameron, 1930; Newton, 2021); and *Anotylus disparatus* from Dehra Dun (Cameron, 1930). This species was previously described as *Anotylus intermedius* by Cameron (1928), but was later synonymised with *Anotylus disparatus* by Hammond (1975).

Three species (*Anotylus myrmecophilus* (Cameron, 1914); *Anotylus nitidifrons* (Wollaston, 1871); and *Oxytelus nilgiriensis* Cameron, 1930) have been newly reported from Kerala. In South India, *Anotylus myrmecophilus* has been observed in Tamil Nadu

(Cameron, 1930); *Anotylus nitidifrons* has also been noted from Tamil Nadu (Cameron, 1930); and *Oxytelus nilgiriensis* has been recorded from Tamil Nadu (Cameron, 1930).

A total of 16 species from Aralam Wildlife Sanctuary, 12 species from Periya Reserve Forest, 15 species from Malabar Wildlife Sanctuary, 11 species from Ezhome Paddy Field, and 16 species from Badiyadukka Agricultural Field were recorded from the selected agriculture and forest ecosystems of North Malabar, Kerala. Previously, only three species, *Bledius pulchellus*, *Bledius maindroni* and *Bledius tuberculatus* were recorded in the North Malabar region by Cameron (1930), followed by the addition of six more species by Vineetha et al. (2024).

Since Cameron's work in 1930, only a few studies have focused on the subfamily Oxytelinae in India, including those by Biswas and Sen (1980, 1989), Biswas (1986), Herman (2001), and Makhan (2013). However, these studies are primarily concentrated in the northern and northeastern regions of the country. Due to the limited research in South India, the number of documented species from this region remains relatively low. Species identification remains problematic for some groups, especially within Oxytelinae (Pohl et al., 2008). Research on Oxytelinae beetles in Kerala has also been limited. Noteworthy contributions include the early work of Cameron (1930), followed by studies by Gildenkova (2007, 2014, 2018a, 2019, 2020b) and more recent publications by Makranczy (2021a). Despite these efforts, only eight species of Oxytelinae had been recorded from Kerala before the present study. However, the present investigation reveals significantly greater diversity, documenting 31 species from the North Malabar region alone. Excluding two species previously recorded by Cameron (1930), *Bledius maindroni* and *Bledius tuberculatus*, which were not encountered in the current survey, only *Bledius pulchellus* was found in the North Malabar region. *Anotylus rufus* had already been reported by Makranczy (2006), while

Carpelimus indicus and *Anotylus latiusculus* are widely distributed throughout India (Cameron, 1930). Other species, including *Carpelimus atomus* Saulcy, 1865, *Carpelimus finelypunctus* (Gildenkov, 2019), and *Carpelimus perigrinus* Cameron, 1919, were reported by Gildenkov (2014, 2015a, 2016 and 2019).

Oxytelus species are found on every continent except Antarctica. These beetles are medium-sized, ranging from 1.5 mm to 7 mm in length, and are characterized by distinctly diamond-shaped scutellar impressions (Makranczy, 2006). According to Herman (2001), the most recent catalogue of the Staphylinidae family documented 193 extant species. However, due to generic synonymies established by Makranczy (2006) and subsequent taxonomic revisions based on recent research (Makranczy, 2006, 2012; Schülke, 2009, 2012a; Lü and Zhou, 2012, 2015a), the number of recognized species has increased to 218. The genus has historically been underrepresented in India, particularly in the southern part of the country. Cameron (1930) reported only a single species, *Oxytelus nilgiriensis*, from South India. The present study, however, documents 12 species from this region, revealing a far greater diversity than previously recognised. This substantial increase not only underscores the paucity of earlier surveys but also highlights the importance of targeted regional sampling in uncovering hidden diversity within relatively understudied beetle groups such as the Oxytelinae.

The genus *Anotylus* Thomson, 1859 comprises small to medium-sized beetles, measuring between 2 mm and 5 mm in length. A key morphological trait is that the neck is broader than half the width of the head at the temples (Makranczy, 2006). The genus includes over 400 documented species worldwide and is recognised for its remarkable diversity (Makranczy, 2021a). In earlier studies, Cameron (1930) documented the presence of three *Anotylus* species (*A. myrmecophilus*, *A. nitidifrons*, and *A. andrewesi*) from the state of Tamil Nadu in South India. Subsequently, *Anotylus*

rufus was reported from Kerala by Makranczy (2021a), suggesting that the genus may be more widespread and diverse in southern India than previously assumed. The present study significantly expands the known diversity of *Anotylus* in this part of the country by documenting ten species from the North Malabar region of Kerala. This not only underscores the rich but understudied beetle fauna of the Western Ghats and adjacent lowland ecosystems, but also highlights the need for more focused faunistic and taxonomic surveys in the region. The findings contribute to filling a long-standing gap in our understanding of Oxytelinae diversity in southern India and provide a valuable baseline for future ecological and systematic research.

The genus *Bledius* is characterised by a cylindrical body and geniculate antennae, with a size range of 2 mm to 7 mm (Cameron, 1930). It includes 462 species worldwide (Herman, 2001), with three species from North Malabar, Kerala, previously attributed to this genus (Cameron, 1930). The present study recorded two species from the North Malabar region. The genus *Thinobius* consists of very small species compared to other genera, measuring between 1.5 mm and 2 mm in length (Cameron, 1930). Currently, only five species of *Thinobius* are known from the Oriental Biogeographic Region: *T. himalayicus* Cameron, 1924; *T. orientalis* Herman, 1970 (formerly *T. antennarius* Cameron, 1924); and *T. pruinosis* Cameron, 1924, all described from Uttarakhand in Northern India; *T. simlaensis* Cameron, 1930, described from Himachal Pradesh; and *T. marinus* Cameron, 1917, described from Singapore. A newly discovered species of *Thinobius* has recently been reported from Myanmar (Gildenkov and Semionenkov, 2024a). In the present study, only one species of *Thinobius* was recorded.

The genus *Platystethus* was established by Mannerheim (1830) and is characterised by a depressed body. Its size ranges from 2 mm to 5 mm, with the clypeus

often bearing spines or teeth along the anterior margin (Lü and Zhou, 2015b). Previously, two species were recorded from southern India; however, only one species, *Platystethus crassicornis*, was obtained in the present study.

The genus *Xerophygus* Kraatz, 1859 comprises relatively large and slender beetles (Cameron, 1930), ranging in size from 3.0 to 5.8 mm. These beetles are typically dark brown, although some species may exhibit a slightly reddish hue. *Xerophygus* is currently known from the Afrotropical and Oriental regions and comprises 10 species (Makranczy, 2006). The present study confirmed the presence of *Xerophygus pallipes*, which remains the only species of the genus recorded from India.

The genus *Carpelimus* Leach, 1819 includes small to medium-sized beetles, measuring between 1.2 and 3.8 mm in length. They are typically dark brown, although some species exhibit a reddish colouration. The elytra are parallel-sided, the temples are usually distinct, and the abdomen is widest at or near the sixth segment. *Carpelimus* is a globally distributed and highly diverse genus within the subfamily Oxytelinae, comprising 400 validly described species (Makranczy, 2006). In India, seven species have been documented to date (Gildenkova, 2020a, 2021), of which four have been reported from the state of Kerala (Gildenkova, 2019). The present study records four species of *Carpelimus* from the North Malabar region of Kerala, confirming previous records and reinforcing the region's significance as a habitat for Oxytelinae diversity.

This study significantly expands the known diversity of Oxytelinae in Kerala. The taxonomic study of the subfamily Oxytelinae (Coleoptera: Staphylinidae) in India remains markedly limited compared to other beetle groups. Despite their ecological importance and widespread occurrence, Oxytelinae beetles have historically received limited attention from Indian entomologists. Early taxonomic work on this subfamily was initiated by Cameron (1930), who described several species based on collections

from South India, particularly the Nilgiri Hills and parts of Kerala. However, these early descriptions were based on limited morphological characters and lacked the diagnostic clarity expected by modern taxonomic standards. Few contemporary studies have focused on Oxytelinae beetles in Kerala, and some older specimens recorded by Cameron (1930) are no longer available. This loss may be attributed in part to natural disasters, particularly the catastrophic 2018 flood in Kerala. According to Joshi et al. (2018), the floods and associated landslides caused severe damage to biodiversity infrastructure across the state, including the destruction of insect collections, museum holdings, and local biodiversity documentation.

5.2. Ecology

5.2.1. Forest ecosystem

This study explores the diversity and abundance of Oxytelinae beetles in the semi-evergreen forests of Aralam Wildlife Sanctuary (AWS), the Tropical Evergreen Forest of Periya Reserve Forest (PRF), and the Deciduous Forest of Malabar Wildlife Sanctuary (MWS) in the North Malabar region of Kerala. The present study highlights that forest ecosystems provide the most favourable habitat for Staphylinidae beetles, particularly members of the subfamily Oxytelinae. These results are similar to the findings of Koval et al. (2021a), who reported high species richness of Staphylinidae in forest environments.

A total of 24 species, namely *Anotylus latiusculus*, *Oxytelus incisus*, *Carpelimus indicus*, *Oxytelus piceus*, *Anotylus mymecophilus*, *Anotylus rufus*, *Oxytelus barbatus*, *Carpelimus finelypunctus*, *Oxytelus bengalensis*, *Anotylus disparatus*, *Oxytelus puncticeps*, *Bledius lucidus*, *Carpelimus perigrinus*, *Oxytelus megaceros*, *Anotylus pusilimus*, *Carpelimus atomos*, *Anotylus rubicundus*, *Platystethus crassicornis*, *Bledius pulchellus*, *Oxytelus migrator*, *Oxytelus nigriceps*, *Oxytelus* sp1,

Xerophygus pallipes, *Oxytelus nilgiriensis* were recorded from the selected sites of forest ecosystem. Previously, Yamamoto et al. (2014) studied rove beetles and reported the presence of one species of *Anotylus* in forests of Japan.

The study reveals that Aralam Wildlife Sanctuary and Periya Reserve Forest showed *Anotylus latiusculus* was the most abundant species (Table 4,7), largely attributed to the widespread distribution of the species across India (Cameron, 1930). They are commonly found in leaf litter, decomposing wood, and soil, where they decompose organic matter and contribute to nutrient cycling, enhancing soil fertility (Makrancy, 2006). The diversity and abundance of Oxytelinae beetles in the deciduous forest of Malabar Wildlife Sanctuary (MWS), located in the North Malabar region, were analysed in this study. *Oxytelus incisus* emerged as the dominant species (Table 9). The genus *Oxytelus* (Gravenhorst, 1802) is the fourth most species-rich genus within the subfamily Oxytelinae (Coleoptera: Staphylinidae), and its members are widespread across all continents except Antarctica (Lü and Zhou, 2015a). In deciduous forests, the abundance of leaf litter and decomposing organic material creates ideal conditions for *O. incisus*. Members of the genus *Oxytelus* typically inhabit organic litter and other decaying habitats, where they may play significant roles in decomposition processes and contribute to forest soil health (Lü and Zhou, 2012).

These two dominant species belong to the tribe Oxytelini and are saprophagous, inhabiting forest litter or being attracted to dung and carrion. Some species within this group are subsocial (Hinton, 1944; Wyatt, 1993). The presence and dominance of Oxytelinae beetles in forest ecosystems are closely linked to the composition of forest assemblages and are likely influenced by environmental properties such as moisture, soil texture, and the type and quantity of leaf litter (Chandler, 1987; Buse and Good,

1993). Oxytelinae show a preference for habitats with abundant leaf litter (Lassau et al., 2005).

A total of 16 species of Oxytelinae beetles, belonging to six genera, were recorded from the Aralam Wildlife Sanctuary (AWS), which is characterised by West Coast Tropical Semi-evergreen Forest habitat. Two of these genera, *Platystethus* and *Xerophygus*, were found exclusively in AWS and were not recorded at any of the other surveyed sites. Species of the genus *Platystethus* are most commonly found in dung and other decaying plant materials, and occasionally along stream banks (Lü and Zhou, 2015b), habitats that are well-represented in the moist, litter-rich West Coast Tropical Semi-evergreen forests of AWS. The genus *Xerophygus*, currently known from the Afrotropical and Oriental regions and comprising 10 species (Makranczy, 2006). However, available records suggest that some species inhabit stream banks in rainforest environments, living in mud and plant debris that accumulates along the banks (Makranczy, 2006). The Semi-evergreen forest conditions of AWS, with its combination of moist leaf litter and intermittent stream habitats, may offer an ideal microhabitat for such species, thus explaining their restricted occurrence at this site.

A total of 12 species were recorded from the evergreen forest of Periyar Reserve Forest (PRF), and 15 species were recorded from the southern moist mixed deciduous forest, Malabar Wildlife Sanctuary (MWS) in the north Malabar region, Kerala. In all the sites, one of the genera, *Carpelimus*, was present. *Carpelimus* is a globally distributed genus comprising 400 validly described species. Despite its vast number of species, it is generally characterised by relatively low diversity at local scales and a wide range of ubiquitous life habits (Newton, 2021). Rove beetles, including members of Oxytelinae, are known predators of other invertebrates such as mites and springtails. Some Oxytelinae species exhibit predatory behaviour that contributes to the regulation

of potential pest populations, thereby maintaining ecological balance within forest ecosystems (Irmiler et al., 2018).

The present study identified *Anotylus* and *Oxytelus* as the most dominant genera across all three forest ecosystems, Semi-evergreen, evergreen, and moist deciduous, highlighting their adaptability and ecological importance in diverse habitats. Both genera belong to the tribe Oxytelini and were frequently encountered in organic-rich substrates such as leaf litter and decaying wood. Species of *Anotylus* are particularly integral to decomposition processes; by feeding on decaying organic matter, they facilitate nutrient cycling and soil formation, thus enhancing soil fertility in forest ecosystems (Porter, 2025). Similarly, *Oxytelus* species are known to occupy a wide range of terrestrial habitats and contribute to the decomposition of organic material while also exhibiting predatory behaviour that helps regulate populations of smaller invertebrates (Porter, 2025). Their widespread occurrence in the present study across all three forest types aligns with their known ecological plasticity and functional roles in nutrient cycling.

Among the three surveyed sites, the semi-evergreen forest of Aralam Wildlife Sanctuary exhibited the highest diversity of Oxytelinae beetles, with a Shannon-Weaver diversity index of 2.12. Semi-evergreen forests are ecotonal in nature, forming transitional zones between evergreen and deciduous forest systems. These habitats often support a higher diversity of flora and fauna due to the presence of heterogeneous microhabitats and varying environmental conditions (Pascal, 1988). So, it may be the reason for the high diversity of Oxytelinae in the Aralam Wildlife Sanctuary. In comparison, the southern moist mixed deciduous forest of Malabar Wildlife Sanctuary recorded an intermediate Shannon-Weaver index of 1.9. This level of diversity is consistent with the known ecological dynamics of deciduous forests,

which are subject to pronounced seasonal fluctuations in canopy density and soil moisture availability (Murali and Sukumar, 1994).

The lowest beetle diversity was observed in the Periya Reserve Forest, an evergreen forest site, with a Shannon-Weaver index of 1.7 (Table 5). Although tropical evergreen forests are typically associated with high levels of biodiversity due to their stable microclimate and consistently moist conditions (Whitmore, 1998), the reduced diversity observed in this study may be attributed to recent ecological disturbances. Both natural factors, such as wildfires, and anthropogenic disturbances (Zúñiga et al., 2022) may have significantly altered the forest structure and habitat quality, thereby influencing beetle assemblages and reducing species richness (McRae et al., 2001). These findings underscore the sensitivity of rove beetle communities to habitat disturbance and highlight the importance of preserving semi-natural and structurally complex habitats to maintain invertebrate diversity.

The rank abundance curve of Oxytelinae beetles in the Aralam Wildlife Sanctuary (AWS) and Periya Reserve Forest (PRF) showed the high dominance of *Anotylus latiusculus* (Figure 13). This graph shows a moderate level of species richness but low evenness, suggesting that although numerous species exist, a select few prevail in the ecosystem. The dominance of *A. latiusculus* in AWS and PRF may be attributed to the thick and continuous litter layer typical of semi-evergreen and evergreen forests. These habitats maintain higher moisture levels, reduced temperature fluctuations, and greater accumulation of organic matter, conditions that affect the high diversity of Staphylinidae (Weithmann et al., 2020) that favour saprophagous beetles such as *Anotylus* as members of the Oxytelini tribe, *A. latiusculus* are associated with decaying organic substrates like leaf litter, dung, and carrion and may display subsocial

behaviour, enhancing their ability to exploit patchy resources (Hinton, 1944; Wyatt, 1993).

In the moist deciduous forest of Malabar Wildlife Sanctuary (MWS), the rank-abundance curve was driven by the dominance of *Oxytelus incisus*, indicating moderate species richness but low evenness (Figure 13). This dominance may result from seasonal litter accumulation and decomposition, which favour opportunistic decomposers like *Oxytelus* (Chandler, 1987; Lassau et al., 2005). Forests support diverse litter-dwelling Staphylinidae by offering structural complexity and stable microhabitats (Lassau et al., 2005; Pohl et al., 2008).

Seasonality

The overall abundance did not show significant variation between the non-rainy and rainy seasons, except for two species, *Carpelimus indicus* and *Carpelimus finelypunctus*, which exhibited significant seasonal variations from Aralam Wildlife Sanctuary (Table 6). The Periya Reserve Forest and Malabar Wildlife Sanctuary don't show any significant seasonal variations. The findings are similar to earlier studies by Buse and Good (1993) and Chandler (1987), who highlighted the importance of abiotic factors, particularly moisture levels, and the quality and depth of leaf litter, which influence the distribution and community composition of rove beetles. In the context of Aralam's semi-evergreen forest, where leaf litter remains moist for longer periods, seasonal changes may have a more pronounced effect on microhabitats, thus impacting specific species like *Carpelimus indicus* and *C. finelypunctus* more visibly than in evergreen forests.

5.2.2. Agricultural ecosystem

The diversity and abundance of Oxytelinae beetles in the Ezhome Paddy Field (EPF) and Badiyadukka Agriculture Field (BAF) in the North Malabar region were analysed.

A total of 19 species, namely *Anotylus latiusculus*, *Oxytelus incisus*, *Anotylus mymecophilus*, *Anotylus disparatus*, *Anotylus rufus*, *Carpelimus indicus*, *Oxytelus puncticeps*, *Oxytelus lividus*, *Oxytelus bengalensis*, *Oxytelus dohertyi*, *Anotylus nitidifrons*, *Anotylus pusilimus*, *Thinobius simlaensis*, *Anotylus rubicundus*, *Oxytelus barbatus*, *Anotylus* sps1, *Anotylus glareosus*, *Anotylus micans* and *Oxytelus migrator*, were recorded in the selected sites of the agricultural ecosystem (Table 11). Recently, Puspasari et al. (2025) also recorded eight species of Oxytelinae from the agricultural ecosystems of Indonesia.

The current study reveals that *Oxytelus incisus* was the dominant species from the Ezhome Paddy Field (Table 12). And *Anotylus latiusculus* was the dominant species in the Badiyadukka Agricultural Field (Table 14). Similar works have been reported in other regions; for instance, *Oxytelus bengalensis* was identified as the most abundant staphylinid species in Indonesian agricultural systems (Puspasari et al., 2025). The findings reinforce the idea that particular Oxytelinae species may be well-adapted to specific agricultural environments, potentially influenced by factors such as moisture levels, crop type, or agricultural practices. Understanding these species-habitat associations is crucial for assessing the ecological roles of Staphylinidae in agroecosystems and for developing conservation or pest management strategies that leverage their presence.

The Ezhome Paddy Field (EPF) recorded a higher Shannon diversity index (1.04) compared to the Badiyadukka Agricultural Field (BAF), suggesting that paddy

ecosystems support greater Oxytelinae species diversity compared to a mixed-crop agricultural field (Table 5). This elevated diversity in EPF can be attributed to the unique ecological characteristics of paddy fields, which differ markedly from mixed-crop systems like those in BAF. Paddy fields offer greater habitat heterogeneity, consistently high moisture levels, and continuous input of organic matter from decaying plant residues and irrigation runoff. These features create a range of microhabitats that support diverse food resources and favourable conditions for the survival of saprophagous and predatory beetle species (Heinrichs and Barrion, 2004; Ghahari et al., 2009). In contrast, mixed-crop agricultural fields often undergo more frequent soil disturbance, greater variation in vegetation structure, and intermittent moisture availability, all of which can limit habitat stability and reduce beetle diversity. Kavyamol et al. (2024) also emphasized that rice field ecosystems maintain biodiversity through the persistent presence of moist and nutrient-rich microhabitats, which promote high insect activity and support species that are sensitive to habitat quality and continuity. Therefore, the ecological stability and structural complexity of the Ezhome Paddy Field likely provide more suitable and continuous resources for Oxytelinae beetles, explaining the higher diversity observed in comparison to the mixed-cropping system at Badiyadukka Agricultural Field.

The rank abundance curve of Oxytelinae beetles in the Ezhome Paddy Field shows the high dominance of *Oxytelus incisus* (Figure 14). The dominance of *Oxytelus incisus* in the Ezhome Paddy Field reflects its ecological plasticity and ability to exploit the moist, organic-rich conditions typical of rice agroecosystems (Puspasari et al., 2025). Paddy fields serve as ideal habitats for Staphylinidae due to their structural complexity and decaying organic matter (Heinrichs and Barrion, 2004; Ghahari et al., 2009). Similarly, in the Badiyadukka Agricultural Field, the rank abundance plot

showed the dominance of *Anotylus latiusculus* (Figure 14). The genus *Anotylus* is highly diverse (Herman, 1970; Makranczy, 2011), and *Oxytelus* species are widely distributed across various ecosystems globally (Lu and Zhou, 2015a). Both genera are known to prefer moist environments, which supports their abundance and dominance in these agricultural landscapes. The observed patterns in both fields may be the ecological adaptability and habitat preference of Oxytelinae beetles, reinforcing their functional importance in decomposition and pest regulation within cultivated ecosystems.

Seasonality

The overall abundance measured no significant seasonal variation in the Ezhome Paddy Field. But the Badiyadukka Agricultural Field shows significant seasonal variation for one species (*Anotylus latiusculus*), which displayed notable fluctuations. *A. latiusculus* lives in moist and organically rich substrates such as decomposing plant debris and manure. Similar patterns of fluctuation have been documented in other saprophagous Staphylinidae species, where climatic factors like temperature, rainfall, and humidity significantly influence beetle activity, reproduction, and availability of decaying resources (Büchner et al., 2024).

Bray-Curtis similarity values of the collection sites show the highest similarity between Periya Reserve Forest and Ezhome Paddy Field. Caballero et al. (2007) also reported moderate taxonomic overlap among distinct habitat types, such as oak forests and ravines, indicating that Staphylinid beetle communities can exhibit substantial similarity even across structurally different environments. Moreover, Anderson and Ashe (2000) emphasized that leaf-litter-inhabiting beetles, including Staphylinidae, may show overlapping species compositions across adjacent habitats when microhabitat conditions are favourable. These findings support the notion that

landscape connectivity or ecological plasticity in certain taxa, such as Oxytelinae, may drive such patterns of community similarity.

The present study reveals the highest diversity and species richness recorded during the rainy season in both forest and agricultural ecosystems (Table 18), under the influence of seasonal moisture on Staphylinidae diversity. Seasonal patterns of abundance in Oxytelinae species have also been documented in other studies. For instance, Caballero et al. (2007) reported a significant increase in necrophilous beetle diversity during the rainy season compared to the dry season in Southern Mexico, attributing this to increased carrion decomposition and resource availability. These findings align with the current study, reinforcing the role of rainfall in shaping Staphylinid community composition, particularly in groups such as Oxytelinae, which thrive in decomposing organic substrates that are more prevalent or accessible in wetter periods.

At present, species-specific information on biology, ecological requirements, food resources, and feeding preferences of the recorded Oxytelinae species is largely unavailable. Furthermore, no published studies on Habitat-wise association of Oxytelinae beetles are available for comparison. Therefore, further species-specific ecological investigations are required to understand the environmental and biological factors influencing their occurrence, habitat association and population dynamics.

Chapter 6

CONCLUSION

6. CONCLUSIONS

6.1. Taxonomy

- A total of 31 species of Oxytelinae beetles belonging to three tribes and seven genera were recorded from the study sites of North Malabar
- A total of 16 species were recorded from Aralam Wildlife Sanctuary (Semi-evergreen forest), 12 from Periya Reserve Forest (Evergreen Forest), 15 from Malabar Wildlife Sanctuary (Semi-deciduous forest), 11 from the Ezhome Paddy Field, and 16 from the Badiyadukka Agricultural Field.
- This study provided a checklist and pictorial key for identifying Oxytelinae beetles, along with a modified taxonomic key for the species found in forest and agricultural ecosystems.
- Four species (*Oxytelus barbatus*, *Oxytelus migrator*, *Oxytelus piceus* and *Xerophygus pallipes*) were first reported from India.
- Nine species (*Anotylus glareosus*, *Oxytelus bengalensis*, *Oxytelus lividus*, *Oxytelus puncticeps*, *Thinobius simlaensis*, *Anotylus micans*, *Anotylus rubicundus*, *Anotylus pusillimus* and *Anotylus disparatus*) were first reported from South India.
- Three species (*Anotylus myrmecophilus*, *Anotylus nitidifrons*, and *Oxytelus nilgiriensis*) were newly reported from Kerala.
- All identified species in this study were deposited in the National Insect Collection at the Zoological Survey of India, Kozhikode (ZSIK).

6.2. Ecology

- 24 species of Oxytelinae beetles were documented from the selected sites of Aralam Wildlife Sanctuary (Semi-evergreen forest), Periya Reserve Forest (Evergreen Forest), and Malabar Wildlife Sanctuary (Semi-deciduous forest) in the North Malabar.

- A total of 19 species of Oxytelinae beetles were recorded from the selected sites of Ezhome Paddy Field and Badiyadukka Agricultural Field in the North Malabar.
- *Anotylus latiusculus* was the most dominant species in the agricultural and forest ecosystems
- The study found that Overall, species diversity was greater in the rainy season. Similar patterns were noted by Caballero et al. (2007)
- The highest similarity in species assemblages was observed between Ezhome Paddy Field and Periya Reserve Forest.
- The study reveals that Aralam Wildlife Sanctuary, Periya Reserve Forest, and Badiyadukka Agricultural Field showed *Anotylus latiusculus* was the most abundant species
- The diversity and abundance of Oxytelinae beetles were analysed in the deciduous forest of Malabar Wildlife Sanctuary (MWS), North Malabar, and the Ezhome Paddy Field. *Oxytelus incisus* was the dominant species.
- The semi-evergreen forest of Aralam Wildlife Sanctuary shows the highest diversity compared to the other three sites of the forest ecosystem
- The Ezhome Paddy Field (EPF) shows a high Shannon diversity compared to the Badiyadukka Agricultural Field (BAF)

Chapter 7

RECOMMENDATIONS

7. RECOMMENDATIONS

- The present study reveals high Oxytelinae diversity in selected ecosystems, but knowledge in India remains limited due to a lack of specialists and recent taxonomic revisions. Comprehensive surveys and taxonomic studies across diverse habitats are recommended to complete the faunal inventory.
- There is an urgent need for taxonomic surveys using standardized methods across different habitats of India to improve species inventories and update distributional records.
- The present study was limited to the rainy and non-rainy seasons; however, future research should include monthly data to gain a more comprehensive understanding of beetle diversity and distribution.
- In this study, some Oxytelinae specimens were identified only up to the genus level due to limitations in visible morphological features. To improve accuracy, it is recommended to use DNA barcoding (e.g., COI gene) in future studies.
- During the study, traps were frequently destroyed by wild animals, particularly elephants in forest areas, resulting in significant sample loss and reduced effectiveness. It is recommended to use alternative or complementary sampling methods in future studies.
- Detailed study on the biology of Oxytelinae beetles in the forest and agricultural ecosystem.
- Conduct ecological and taxonomical studies in underexplored habitats of North Malabar, such as: Coastal belts, Sacred groves, and wetlands.
- The present study investigated Oxytelinae beetles during both the rainy and non-rainy seasons. However, to gain a better understanding of their diversity and ecological roles within forest and agricultural ecosystems, further research is

essential. It is recommended that future studies focus on assessing the influence of various abiotic factors, such as temperature, humidity, soil pH, moisture content, and rainfall, as well as biotic factors like vegetation cover and prey availability, on the distribution, abundance, and seasonal dynamics of Staphylinidae beetles. Such investigations will provide deeper insights into the ecological requirements and functional roles of this group across different habitats.

- The effect of habitat modification and natural disasters like floods on the Oxytelinae community needs to be assessed.
- Evaluating the effects of land-use changes, pesticide application, habitat fragmentation, and climate change on Oxytelinae populations is crucial for developing conservation strategies for sensitive or endemic species.
- Further species-specific studies on the ecological and behavioural characteristics of Oxytelinae are recommended to understand the population dynamics of the group, which will aid in the efforts to conserve natural fauna in the selected agricultural and forest ecosystems of North Malabar, Kerala.
- It is recommended that future research explore the ecological roles and potential impacts of Oxytelinae beetles on agriculture, human health, and the environment. While these beetles contribute positively to nutrient cycling, decomposition, and possible pest control, their association with decaying matter also raises concerns about their role in disease transmission and forensic misinterpretation. Comprehensive studies are needed to assess their economic and ecological significance, particularly in the Indian context, where such research is currently lacking.
- Long term monitoring of Oxytelinae beetles should be conducted to assess changes in diversity and distribution over time

- Integrative taxonomic approaches combining morphological and molecular data should be used for accurate species identification and classification.

Chapter 8

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8. REFERENCES

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LIST OF ABBREVIATIONS

AWS:	Aralam Wildlife Sanctuary
PRF:	Periya Reserve Forest
MWS:	Malabar Wildlife Sanctuary
EPF:	Ezhome Paddy Field
BAF:	Badiyadukka Agricultural Field



NEW REPORTS OF SUBFAMILY OXYTELINAE FROM SOUTH INDIA (COLEOPTERA: STAPHYLINIDAE)

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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. 1C)**

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. 1D)**

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

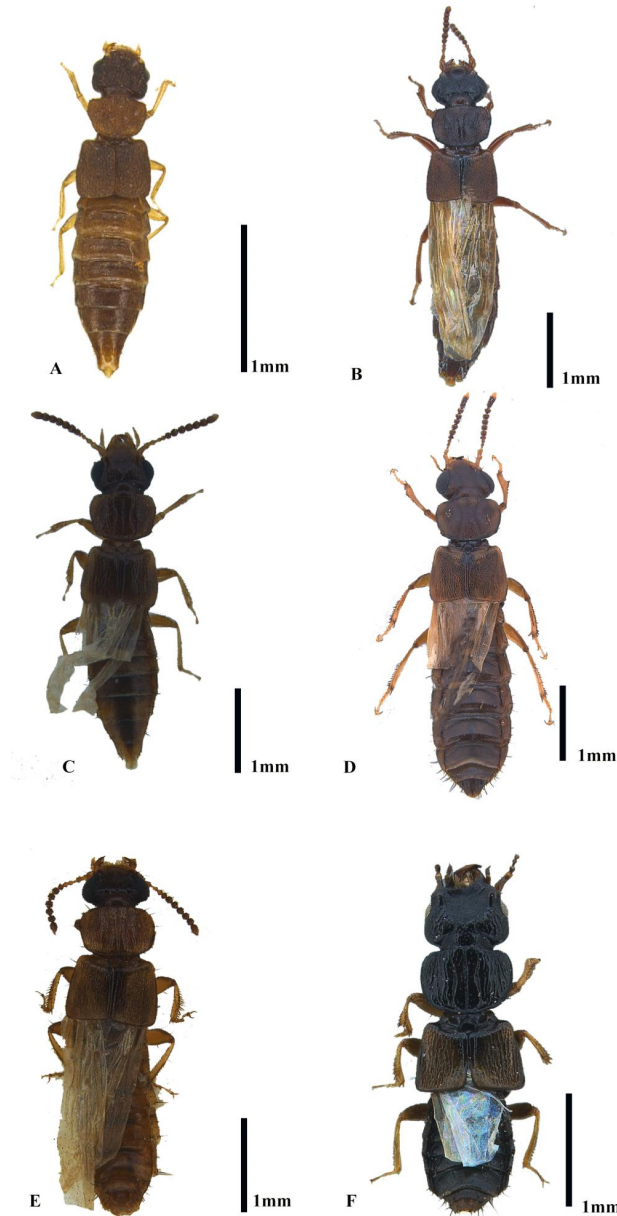


Fig. 1. Dorsal habitus of A-F: A- *Anotylus glareosus* (Wollaston, 1854); B- *Oxytelus bengalensis* (Erichson, 1840); C- *Oxytelus incisus* (Motschulsky, 1858); D- *Oxytelus lividus* (Motschulsky, 1858); E- *Oxytelus nigriceps* (Kraatz, 1859) and F- *Oxytelus puncticeps* (Kraatz, 1859)

***Oxytelus puncticeps* (Kraatz, 1859) (Fig. 1F)**

Bernhauer, 1902: 44, Fauvel, 1904: 46, Bernhauer and Schubert, 1911: 116 Bernhauer, 1922: 223, Cameron, 1930: 228, Bernhauer, 1936: 81; id. 1942: 350, Cameron, 1950: 10, Scheerpeltz, 1974: 65, Hammond, 1975: 150, Lü, L. and H.-Z.Z. 2012: 42-43; id. 2015: 27

Material examined: 2, Labelled 'India: Kerala:

Periya reserve forest (11.7768° N, 75.8476° E); 'Flotation method', 19.iv.2022, Coll. Vineetha V P

Measurements: TLA=2.14, TLB= 1.97; PL=0.42, PW=0.53, EL=0.589, EW=0.58

Distribution: India: Kerala: Wayanad: Periya reserve forest. Elsewhere: Afrotropical, China (Fujian, Hainan, Hong Kong, Jiangxi), Comoros, India (Meghalaya, UP), Indonesia, Madagascar, Philippines, Ryukyu Is. (Okinawa, Iriomote, Ishigaki), Sri Lanka, South Africa, Vietnam, Taiwan

Remarks: Most of the Indian species of the subfamily Oxytelinae are distributed in the Northern region of the country. This study reveals first time occurrence of species [*O. bengalensis* (Erichson, 1840), *O. incisus* (Motschulsky, 1858), *O. lividus* (Motschulsky, 1858), *O. nigriceps* (Kraatz, 1859, *O. puncticeps* (Kraatz, 1859)] in the Western Ghats hotspot of biodiversity.

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AUTHOR CONTRIBUTION STATEMENT

Vineetha V P, Vineesh P. J, Kavyamol P M and Jerin George analyzed the specimens, verified the review and drafted the manuscript.

CONFLICT OF INTEREST

No conflict of interest.

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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

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Species composition, abundance and seasonality of dermatitis causing *Paederus* rove beetles in paddy fields of Malabar region, Kerala, India

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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

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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**

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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

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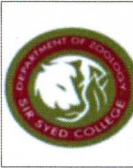
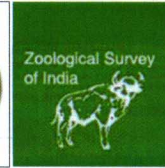


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