TAXONOMY AND DIVERSITY OF SCARITINAE AND TRECHINAE (COLEOPTERA: CARABIDAE) OF KERALA

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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JUNE 2026

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This is to certify that the thesis entitled "**TAXONOMY AND DIVERSITY OF SCARITINAE AND TRECHINAE (COLEOPTERA: CARABIDAE) OF KERALA**" submitted to the University of Calicut for the award of the degree of Doctor of Philosophy in Zoology, is the record of the original work done by Ms. Shigina K in the PG & Research Department of Zoology, St. Joseph's College (Autonomous), Devagiri, Kozhikode, under my supervision and guidance. This work has not been previously formed the basis for any award of degree or diploma.

Ms. Shigina K has successfully completed the preliminary qualifying examination prescribed by the University of Calicut.

Place: Tenhipalam

Date: 23/06/2026

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I also certify that the adjudicators have not suggested any changes/ corrections in the thesis and recommend to accept in the present form.

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Place: Kozhikode

Date: 23/06/2026

Dr. Vineesh P. J

Co-Supervisor

DECLARATION

I hereby declare that the work presented in the thesis entitled "**TAXONOMY AND DIVERSITY OF SCARITINAE AND TRECHINAE (COLEOPTERA: CARABIDAE) OF KERALA**" is based on the original work done by me under the guidance of Dr. Sabu K Thomas 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.

SHIGINA K

Place: Kozhikode

Date: 23/06/2026

DR. SABU K THOMAS

Supervising teacher

Acknowledgements

I express my deep and sincere gratitude to my Supervisor, Prof (Dr). Sabu K Thomas, Malaviya Mission Teacher Training Centre- Calicut University (MMTTC), University of Calicut, Kerala. I am extremely thankful for his valuable guidance, constructive criticism, unwavering encouragement, and emotional support throughout this study. His constant motivation and insightful suggestions were instrumental in shaping the direction of my research and helping me complete it successfully.

I express my sincere gratitude to my Co-guide Prof (Dr). Vineesh P. J., Associate Professor, PG & Research Department of Zoology, St. Joseph's College (Autonomous), Devagiri, Kozhikode, for his valuable guidance, encouragement and for ensuring the availability of necessary facilities throughout my research.

I express my sincere gratitude to Fr. Dr. Biju Joseph, Principal, St. Joseph's College (Autonomous), Devagiri, Kozhikode, and to the former Principals Dr. Boby Jose, Dr. Sabu K. Thomas, Dr. Jose John Mallikasseri, and Dr. Sibichen M. Thomas for their generous provision of institutional support and research facilities throughout my research work.

I am deeply grateful to Dr. Jisha Jacob, Head of the PG & Research Department of Zoology, St. Joseph's College (Autonomous), Devagiri, Kozhikode, and Dr. Vineesh P. J., Dr. Boby Jose and Dr. George Mathew, former Heads of the Department, for their encouragement and for ensuring the availability of necessary facilities throughout my research. I wish to express all the faculty members of the department of Zoology (Dr. Arunaksharan Narayanankutty, Dr. Aswathi P., Mr. Joice Tom, Dr. Binsha P. and Dr. Jithumon V. A) for their valuable assistance and support during my research work.

I thank the Council for Scientific and Industrial Research (CSIR, Govt. of India), for the financial support provided.

I am grateful to Dr. Thomachan K. T, Dr. Vineesh P. J, Ms. Vineetha V. P and Ms Neethu V. P for their constructive suggestions and support in carrying out the statistical analyses essential for this study.

I sincerely express my heartfelt gratitude to the Kerala Forest and Wildlife Department (Government of Kerala) for granting me the necessary permission to conduct my research in the forest areas of Kerala.

I thank the Director, Zoological Survey of India (Govt. of India) for allowing me to work with specimens in the national repositories of Zoological Survey of India Western Ghats Regional Center, Kozhikode.

I am extremely thankful to all my colleagues, Vineetha V. P, Dr. Sobhana K. A., Dr. Akhil S.V., Dr. Jithmon V. A., Dr. Binsha P., Dr. Prameela K., Dr. Divya M., Dr. Sruthi M. C., Dr. Ashly Kurian, Aswathi S. B, Nijisha K, Neethu V. P, Anagha Sudhakar V. S, Mrs. Fahima P, Dr. Nikhitha D, Dr. Princy P, and other Research scholars, P.G. & Research Department of Zoology, St. Joseph's College (Autonomous), Devagiri, Kozhikode, for their help and support throughout my research work.

I wish to express my thanks to the lab assistants in the PG & Research Department of Zoology, St. Joseph's College (Autonomous), Kozhikode, for their valuable co-operation and help.

I am extremely thankful to my friend Vineetha V. P, for her immense emotional support, constant encouragement, and unwavering belief in me throughout my research journey

On a personal note, I extend my deepest gratitude to my beloved parents, sister and my nieces for their unconditional love, patience, and constant support. Their belief in me gave me the strength to overcome every hurdle. I am especially thankful to my father and mother for their valuable assistance during fieldwork, without which this study would not have been possible. I am also grateful to all my family members and my friends who supported throughout my journey. With heartfelt gratitude, I acknowledge the blessings and silent guidance of the departed souls, yet whose love continues to surround and strengthen me.

Above all, I thank the Almighty for providing me with the health, patience, and strength to complete this study.

Shigina K

Dedicated to my Family and Teachers.

TAXONOMY AND DIVERSITY OF SCARITINAE AND TRECHINAE (COLEOPTERA: CARABIDAE) OF KERALA

Abstract

Scaritinae Bonelli, 1810 and Trechinae Bonelli, 1810 are the two dominant subfamilies among the family Carabidae from Kerala (Divya, 2022; Ashly, 2023). Taxonomic research on the beetle subfamilies Scaritinae and Trechinae in Kerala is still very limited. This lack of detailed studies has left important gaps in our understanding of species boundaries, distribution patterns, and their systematic classification. To address these gaps, the present study undertakes a comprehensive taxonomic investigation of Scaritinae and Trechinae in Kerala. The aim is to strengthen baseline faunistic knowledge and provide a foundation for future ecological and conservation research.

Ecological research on the subfamily Scaritinae and Trechinae in India remains sparse and geographically uneven, with no published studies to date from the North Malabar region of Kerala, a biogeographically distinct and ecologically rich zone that is addressed in the present study. The present study was designed for generating ecological data, abundance, richness, diversity, and seasonality of Scaritinae and Trechinae beetles in selected forest and agricultural habitats of North Malabar. These two subfamilies were chosen for focused ecological analysis based on the taxonomic expertise developed during the initial phase of the study, which dealt with the identification, classification, and documentation of Scaritinae and Trechinae species within the family Carabidae.

Taxonomic study includes comprehensive coverage of Kerala's entomofauna, and diversity study was conducted in selected forests and agricultural ecosystems of North Malabar region. Sampling was carried out in the Semi- evergreen Forest (Aralam Wildlife Sanctuary), Tropical- evergreen forest (Ranipuram Forest) and Agricultural habitat (Chambad Agricultural Field), during both rainy and non-rainy seasons.

A total of 28 species of Trechinae beetles belonging to three tribes and seven genera were documented from Kerala. Among these, one new species, three species newly recorded from India, 10 species newly reported from south India, and two species were newly reported from Kerala. A total of 22 species of Scaritinae beetles, belonging to three tribes and 11 genera, were documented from Kerala. Among these, two species newly recorded from India, two species newly reported from south India, and one species newly reported from Kerala. These findings highlights the taxonomic significance of the study. A comprehensive checklist, modified taxonomic keys, and a pictorial key for the identification up to species level are

provided. The diversity, abundance, and seasonality of Scaritinae and Trechinae beetles were also analysed. The study found that Tropical- evergreen forest indicating the highest species diversity, suggesting a balanced community and the overall abundance showed significant variations with in the Forest and Agricultural Ecosystem and also showed significant variations with seasons.

Keywords: Scaritinae, Trechinae, Taxonomy, diversity, Kerala, North Malabar

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Research Scholar

Prof. Dr. Sabu K Thomas

Research Guide

സംഗ്രഹം

കേരളത്തിൽ നിന്നുള്ള കാരാബിഡേ കുടുംബത്തിലെ രണ്ട് പ്രബല ഉപകുടുംബങ്ങളാണ് സ്കാരിറ്റിനേ ബോണെല്ലി, 1810, ട്രെക്കിനേ ബോണെല്ലി, 1810 എന്നിവ (ദിവ്യ, 2022; ആഷ്ലി, 2023). കേരളത്തിലെ വണ്ട് ഉപകുടുംബങ്ങളായ സ്കാരിറ്റിനേ, ട്രെക്കിനേ എന്നിവയെക്കുറിച്ചുള്ള വർഗ്ഗീകരണ ഗവേഷണം ഇപ്പോഴും വളരെ പരിമിതമാണ്. വിശദമായ പഠനങ്ങളുടെ അഭാവം ജീവിവർഗങ്ങളുടെ അതിരുകൾ, വിതരണ രീതികൾ, അവയുടെ വ്യവസ്ഥാപിത വർഗ്ഗീകരണം എന്നിവയെക്കുറിച്ചുള്ള നമ്മുടെ ഗ്രാഹ്യത്തിൽ പ്രധാനപ്പെട്ട വിടവുകൾ അവശേഷിപ്പിച്ചിരിക്കുന്നു. ഈ വിടവുകൾ പരിഹരിക്കുന്നതിനായി, ഈ പഠനം കേരളത്തിലെ സ്കാരിറ്റിനേ, ട്രെക്കിനേ എന്നിവയുടെ സമഗ്രമായ വർഗ്ഗീകരണ അന്വേഷണം നടത്തുന്നു. അടിസ്ഥാന ജന്തുജാല പരിജ്ഞാനം ശക്തിപ്പെടുത്തുകയും ഭാവിയിലെ പാരിസ്ഥിതിക, സംരക്ഷണ ഗവേഷണങ്ങൾക്ക് ഒരു അടിത്തറ നൽകുകയും ചെയ്യുക എന്നതാണ് ലക്ഷ്യം.

ഇന്ത്യയിലെ സ്കാരിറ്റിനേ, ട്രെക്കിനേ എന്നീ ഉപകുടുംബങ്ങളെക്കുറിച്ചുള്ള പാരിസ്ഥിതിക ഗവേഷണം വിരളവും ഭൂമിശാസ്ത്രപരമായി അസമവുമാണ്. ജൈവ ഭൂമിശാസ്ത്രപരമായി വ്യത്യസ്തവും പാരിസ്ഥിതികമായി സമ്പന്നവുമായ ഒരു മേഖലയായ കേരളത്തിലെ വടക്കൻ മലബാർ മേഖലയിൽ നിന്ന് ഇതുവരെ പ്രസിദ്ധീകരിച്ച പഠനങ്ങളൊന്നുമില്ല. വടക്കൻ മലബാറിലെ തിരഞ്ഞെടുത്ത വന-കാർഷിക ആവാസ വ്യവസ്ഥകളിലെ സ്കാരിറ്റിനേ, ട്രെക്കിനേ വണ്ടുകളുടെ പാരിസ്ഥിതിക ഡാറ്റ, സമൃദ്ധി, വൈവിധ്യം, ഘടുതുത്വം എന്നിവ സൃഷ്ടിക്കുന്നതിനാണ് ഈ പഠനം രൂപകൽപ്പന ചെയ്തിരിക്കുന്നത്. പഠനത്തിന്റെ പ്രാരംഭ ഘട്ടത്തിൽ വികസിപ്പിച്ചെടുത്ത വർഗ്ഗീകരണ വൈദഗ്ധ്യത്തെ അടിസ്ഥാനമാക്കി, കാരാബിഡേ കുടുംബത്തിലെ സ്കാരിറ്റിനേ, ട്രെക്കിനേ ഇനങ്ങളുടെ

തിരിച്ചറിയൽ, വർഗ്ഗീകരണം, രേഖപ്പെടുത്തൽ എന്നിവ കൈകാര്യം ചെയ്തിരുന്ന, കേന്ദ്രീകൃത പാരിസ്ഥിതിക വിശകലനത്തിനായി ഈ രണ്ട് ഉപകുടുംബങ്ങളെയും തിരഞ്ഞെടുത്തു.

കേരളത്തിലെ എന്റോമോഫൗണയുടെ സമഗ്രമായ കവറേജ് ടാക്സോണമിക് പഠനത്തിൽ ഉൾപ്പെടുന്നു, കൂടാതെ വടക്കൻ മലബാർ മേഖലയിലെ തിരഞ്ഞെടുത്ത വന-കാർഷിക ആവാസവ്യവസ്ഥകളിൽ വൈവിധ്യ പഠനം നടത്തി. അർദ്ധ-നിത്യഹരിത വനം (ആറളം വന്യജീവി സങ്കേതം), ഉഷ്ണമേഖലാ നിത്യഹരിത വനം (റാണിപുരം വനം), കാർഷിക ആവാസവ്യവസ്ഥ (ചാമ്പാട് കാർഷിക മേഖല)എന്നിവിടങ്ങളിൽ മഴക്കാലത്തും അല്ലാത്ത സമയത്തും സാമ്പിളുകൾ ശേഖരിച്ചു.

കേരളത്തിൽ നിന്ന് മൂന്ന് ട്രൈബുകളും ഏഴ് ജനുസുകളും ഉൾപ്പെടുന്ന ട്രെക്കിനേ ഉപകുടുംബത്തിലെ ആകെ 28 സ്പീഷിസുകൾ രേഖപ്പെടുത്തി. ഇവയിൽ ഒരു പുതിയ സ്പീഷിസ്, ഇന്ത്യയിൽ നിന്ന് ആദ്യമായി രേഖപ്പെടുത്തിയ മൂന്ന് സ്പീഷിസുകൾ, ദക്ഷിണേന്ത്യയിൽ നിന്ന് പുതുതായി റിപ്പോർട്ട് ചെയ്ത 10 സ്പീഷിസുകൾ, കേരളത്തിൽ നിന്ന് പുതുതായി റിപ്പോർട്ട് ചെയ്ത രണ്ട് സ്പീഷിസുകൾ എന്നിവ ഉൾപ്പെടുന്നു. കേരളത്തിൽ നിന്ന് മൂന്ന് ട്രൈബുകളും 11 ജനുസുകളും ഉൾപ്പെടുന്ന സ്കാരിറ്റിനേ ഉപകുടുംബത്തിലെ ആകെ 22 സ്പീഷിസുകൾ രേഖപ്പെടുത്തി. ഇവയിൽ ഇന്ത്യയിൽ നിന്ന് ആദ്യമായി രേഖപ്പെടുത്തിയ രണ്ട് സ്പീഷിസുകൾ, ദക്ഷിണേന്ത്യയിൽ നിന്ന് പുതുതായി റിപ്പോർട്ട് ചെയ്ത രണ്ട് സ്പീഷിസുകൾ, കേരളത്തിൽ നിന്ന് പുതുതായി റിപ്പോർട്ട് ചെയ്ത ഒരു സ്പീഷിസ് എന്നിവ ഉൾപ്പെടുന്നു. ഈ കണ്ടെത്തലുകൾ പഠനത്തിന്റെ ടാക്സോണോമിക് പ്രാധാന്യം വ്യക്തമാക്കുകയും കേരളത്തിലെ വണ്ടുകളുടെ വൈവിധ്യത്തെക്കുറിച്ചുള്ള അറിവ് വികസിപ്പിക്കുകയും ചെയ്യുന്നു. സമഗ്രമായ ഒരു ചെക്ക്ലിസ്റ്റ്,

പരിഷ്കരിച്ച ടാക്സോണമിക് കീകൾ, സ്പീഷീസ് തലം വരെ തിരിച്ചറിയുന്നതിനുള്ള ഒരു ചിത്ര കീ എന്നിവയും നൽകിയിരിക്കുന്നു. സ്കാരിറ്റിനേ, ട്രെക്കിനേ വണ്ടുകളുടെ വൈവിധ്യം, സമൃദ്ധി, സമതുലം എന്നിവയും വിശകലനം ചെയ്തു. ഉഷ്ണമേഖലാ നിത്യഹരിത വനത്തിൽ ഏറ്റവും ഉയർന്ന സ്പീഷിസ് വൈവിധ്യം രേഖപ്പെടുത്തിയതായി പഠനം കണ്ടെത്തി. ഇത് സന്തുലിതമായ ഒരു ജൈവസമൂഹത്തെ സൂചിപ്പിക്കുന്നു. കൂടാതെ, വന-കാർഷിക ആവാസവ്യവസ്ഥകളിൽ ആകെ സമൃദ്ധിയിൽ ഗണ്യമായ വ്യത്യാസങ്ങൾ കണ്ടെത്തിയതോടൊപ്പം, കാലാവസ്ഥാ സീസണുകൾക്കിടയിലും ഗണ്യമായ വ്യത്യാസങ്ങൾ രേഖപ്പെടുത്തി.

പ്രധാന പദങ്ങൾ: സ്കാരിറ്റിനേ, ട്രെക്കിനേ, വർഗ്ഗീകരണം, വൈവിധ്യം, കേരളം, വടക്കൻ മലബാർ

ഷിഗിന കെ
ഗവേഷണ വിദ്യാർത്ഥി നി

പ്രൊഫ്. ഡോ. സാബു കെ. തോമസ്
ഗവേഷണ ഗൈഡ്

CONTENTS

Chapter 1

INTRODUCTION

1. INTRODUCTION

1.1. Taxonomy of Family Carabidae

Insects represent the most diverse group of animals on earth, comprising more than 75% of all identified animal species, with the order Coleoptera, which is commonly known as beetles, accounts over 420,000 species and standing as the largest order within the animal kingdom (Slipinski et al., 2011). Among the order coleoptera, family Carabidae, known as ground beetles, one of the most diverse beetle families within the suborder Adephaga (Insecta: Coleoptera), with approximately 39,500 species described (Lorenz, 2024; Anichtchenko, 2024). These beetles are often found in diverse habitats, including forests, grasslands, and agricultural lands (Thiele, 1977). They are mainly carnivorous predators, feeding on insects such as caterpillars, aphids, slugs, and other small invertebrates (Larochelle & Larivière, 2003). This makes them beneficial for natural pest control in agricultural ecosystems. Some species are highly specialized in their diet, while others are generalist feeders (Lövei & Sunderland, 1996). Many species of Carabid beetles are nocturnal, hiding under rocks, logs, or leaf litter during the day and foraging at night (Thiele, 1977).

Family Carabidae includes 34 subfamilies in the world (Lorenz, 2024), out of these, 24 subfamilies are present in India (Akhil, 2020; Jithmon, 2020; Divya, 2022; Ashly, 2023). Indian Carabidae is represented by about ~1,898 species under 58 tribes of 24 subfamilies (Anthiinae, Apotominae, Brachininae, Broscinae, Carabinae, Ctenodactylinae, Dryptiinae, Harpalinae, Lebiinae, Licininae, Loricerinae, Melaeninae, Nebriinae, Omophroinae, Orthogoniinae, Panagaeinae, Platyninae, Pseudomorphinae, Psydrinae, Pterostichinae, Rhysodinae, Scaritinae, Siagoninae and Trechinae) (Akhil, 2020; Jithmon, 2020; Divya, 2022; Ashly, 2023).

Scaritinae Bonelli, 1810 and Trechinae Bonelli, 1810 are the two dominant subfamilies among the family Carabidae from Kerala (Divya, 2022; Ashly, 2023). Historical taxonomic work on Indian Scaritinae and Trechinae was pioneered by Andrewes in the early 20th century in his foundational works "*Fauna of British India including Burma and Ceylon, Part I &II*" (Andrewes, 1929, 1935). Since these foundational works, subsequent studies on Indian Scaritinae and Trechinae have been sporadic and largely focused on other regions of north India, east India, and north-eastern India, including Indian Himalayan regions (Bänninger, 1931; Jedlicka, 1938; Kult, 1951; Jeannel, 1954; Ueno, 1965; Casale, 1980; Deuve, 1980; 1982a,b; Perrault, 1985; Saha & Biswas, 1985; Balkenohl, 1994; Fedorenko, 1997; Deuve, 2001; Balkenohl, 2001; Bulirsch, 2009; Dostal & Bulirsch, 2016; Fedorenko, 2016; Belousov et al., 2019; Shigina & Sabu, 2024a). In Kerala, taxonomic studies on the subfamilies Scaritinae Bonelli, 18010 and Trechinae Bonelli, 1810 remain scarce, with only a few contributions reported (Saha & Biswas, 1985; Saha, 1986; Balkenohl, 1999, 2001, 2021b; Abhitha & Sabu, 2009; Neethu & Sabu, 2023; Shigina & Sabu, 2024a; Neethu et al., 2024; Aswathi et al., 2024).

1.2. Taxonomy of Subfamily Scaritinae Bonelli, 1810

Subfamily Scaritinae comprises 2407 species, 146 genera and five tribes all over the world (Lorenz, 2024) and 177 species within 23 genera and four tribes (Clivinini, Dyschiriini, Salcediini and Scaritini) in India (Aswathi et al., 2024). Forty-two species of Scaritinae, belonging to 13 genera and three tribes, have been reported from Kerala (Andrewes, 1929, 1930b; Bänninger, 1938; Saha & Biswas, 1985; Saha, 1986; Rajagopal & Kumar, 1992; Balkenohl, 1999; Balkenohl, 2001; Abhitha & Sabu, 2009; Abhitha, 2010; Kushwaha & Hegde, 2015; Akhil, 2020; Jithmon, 2020;

Balkenohl, 2021b; Divya, 2022; Sruthi & Sabu, 2022; Ashly, 2023; Neethu & Sabu, 2023). Among these forty-two species, five species were described from Kerala (Andrewes 1929; Saha 1986; Abitha & Sabu 2009; Balkenohl 2021b; Neethu & Sabu, 2023). Thirty-six species of the Subfamily Scaritinae verified by Andrewes and Chaudoir are present in the FRI, and all the verified species are from the north and north eastern regions of India (National Forest Insect Collection).

1.3. Taxonomy of Subfamily Trechinae Bonelli, 1810

Trechinae is one of the speciose subfamilies of the ground beetles (Carabidae) represented by five tribes (Bembidiini Stephens, 1827; Horologionini Jeannel, 1949; Pogonini Laporte, 1834; Trechini Bonelli, 1810 and Zolini Sharp, 1886) with 431 genera and 6784 species at global level (Lorenz, 2024). They are small sized ground beetles having 1.5 to 5.5 mm size range and are characterized by the presence of subulate mandibles in all Indian tribes except Pogonini (Andrewes, 1935). The tribe Pogonini is distinguished by the presence of four to seven pores on the third elytral interval, a feature absents in other tribes (Andrewes, 1935).

A taxonomic key to 168 species with detailed descriptions and literature references were recorded in "*Fauna of British India including Burma and Ceylon, Part II*" (Andrewes, 1935). Currently, the subfamily Trechinae in India comprises 185 species within 23 genera and three tribes (Andrewes, 1930a, 1935, 1936; Netolitzky, 1934, 1935b; Jedlicka, 1938; Jeannel, 1954; Ueno, 1965, 1977; Perrault, 1985; Deuve, 1980, 1982, 2001; Belousov et al., 2019; Shigina & Sabu, 2024a). The subfamily Trechinae has been less studied in Kerala, with records indicating the presence of 16 species distributed across five genera (*Bembidion*, *Elaphropus*, *Perileptus*, *Tachys* and

Pogonus) and three tribes (Bembidiini, Trechini and Pogonini) (Andrewes, 1924a, b,1925a, b, 1935; Kushwaha & Hegde 2015; Divya, 2022; Sruthi & Sabu, 2022; Ashly, 2023; Shigina & Sabu, 2024a, b; Neethu et al., 2024). One hundred and three verified species from Subfamily Trechinae was deposited in the FRI, Dehradun by Andrewes, and all the verified species are from north and north-eastern regions of India (National Forest Insect Collection). Records of the subfamily Trechinae are limited to only one confirmed species (*Elaphropus politus*) in the National Insect Collection of ZSI, Kozhikode.

Taxonomic research on the beetle subfamilies Scaritinae and Trechinae in Kerala is still very limited. This lack of detailed studies has left important gaps in our understanding of species boundaries, distribution patterns, and their systematic classification. To fill these gaps, the present study carries out a thorough taxonomic investigation of Scaritinae and Trechinae in Kerala. The aim is to strengthen baseline faunistic knowledge and provide a foundation for future ecological and conservation research.

1.4. Ecology of Family Carabidae

Carabidae beetles are mainly nocturnal predators, being essential in regulating populations of soil- dwelling pests and contributing to natural pest control in agro-ecosystems (Kromp, 1999). Many species show habitat specificity, preferring environments such as forests, grasslands or agricultural fields, which makes them beneficial bioindicators of environmental change (Rainio & Niemelä, 2003). They are also sensitive to soil moisture, vegetation structure and human disturbance, influencing their abundance and diversity (Thiele, 1977). In agricultural landscapes, maintenance of field margins has been shown to support carabid diversity and

ecosystem services (Holland & Luff, 2000). Ground beetles respond quickly to environmental changes due to their short generation times and high mobility which making them effective for monitoring habitat restoration or degradation (Pearce & Venier, 2006). Some species have specific overwintering strategies, like burrowing into soil or leaf litter, and are influenced by microclimatic conditions and land use practices (Luff, 1987). Their diet varies widely, with many preying on insects, snails, and even weed seeds, contributing to weed seed predation in crop systems (Tooley & Brust, 2002). Additionally, climate change is expected to alter the distribution patterns of Carabidae, especially in alpine and northern habitats, where species are already used to narrow thermal ranges (Kotze & Hara, 2003).

1.5. Ecology of Subfamily Scaritinae Bonelli, 1810

Scaritinae beetles occur in a wide variety of habitats, from lowland tropical forest to semi-desert and from ocean beaches to the tops of mountains. Scaritinae beetles are specialised for burrowing and are easily distinguished from other ground beetles both by their distinctive body shape and by their front legs modified for digging (Hogan, 2012). Scaritinae beetles are one of the local scale indicators of disturbance effects (Thiele, 1977). In forest ecosystems, Scaritinae beetles play important roles in soil food chain being predators, decomposers, and phytophagous. As a generalist predator, they serve as seed eaters and pollen feeders (Lövei & Sunderland, 1996). Many Scaritinae species are nocturnal, reducing predation risks while increasing hunting efficiency. Their elongated bodies and strong mandibles enable them to prey on soft-bodied invertebrates, including insect larvae and worms (Thiele, 1977).

The ecological study of the subfamily Scaritinae in forests and agricultural habitats is important, since these beetles are key soil-dwelling predators which help in control pest populations, especially soil-borne insect larvae. Their burrowing activity improves soil aeration and nutrient cycling, which in turn benefits plant growth (Hogan, 2012). In forests, they contribute to maintaining ecological balance by regulating populations of invertebrates, while in agricultural habitats, they support sustainable pest management and reduce reliance on chemical pesticides. Understanding their diversity and distribution also helps in evaluating the habitat health and effects of environmental changes.

Ecological research on the subfamily Scaritinae (Coleoptera: Carabidae) in India remains limited and geographically uneven, with no published studies since the date from the North Malabar region of Kerala, a biogeographically distinct and ecologically rich zone that is addressed in the current study. Existing investigations are concentrated in a few localized habitats, including the moist forest belts of the Wayanad and Kozhikode region in the southern Western Ghats (Abhitha, 2010; Akhil, 2020; Jithmon, 2020), the dry deciduous forests of the Chinnar region (Sruthi, 2022) and the Walayar Reserve Forest and Chulanur Peafowl Sanctuary (Divya, 2022). Further studies have emerged from agricultural belts in Wayanad (Ashly, 2023) and rice paddy fields in the Palakkad region (Divya, 2022). These studies remain isolated and not sufficient to capture the ecological diversity and habitat-specific dynamics of Scaritinae across Kerala. More critically, there are no ecological studies from the rest of India on Scaritinae or on Carabidae in general highlighting a profound national-level gap in understanding the distribution, functional roles, and conservation relevance of this ecologically important beetle group.

1.6. Ecology of Subfamily Trechinae Bonelli, 1810

Trechinae beetles have developed various ecological adaptations that help them thrive in forest and agricultural environments. Many species have elongated bodies and strong legs, providing swift movement through leaf litter and soil. Some species, especially which are inhabiting caves or deep forest leaf litter, have reduced or absent eyes depend on tactile and chemical signals for navigation (Thiele, 1977). They have highly sensitive antennae which help them to detect prey, mates and environmental changes (May & Kermode, 1972). These beetles act as efficient predators of pests often found in rice fields and act as natural pest control agent (Gahari et al., 2009).

Importance of the ecological study of the subfamily Trechinae in forests and agricultural habitats is to understand their role as bioindicators of habitat and also their sensitivity to environmental changes (Thiele, 1977). Ecological records on the subfamily Trechinae (Coleoptera: Carabidae) in India are extremely less. All the known studies are confined to the Kerala state. One investigation from the Palghat Gap zone, documented Trechinae assemblages across the Chulanur Peafowl Sanctuary, Walayar Reserve Forest, and Pudussery paddy fields (Divya, 2022), one from the dry deciduous forests of the Chinnar region (Sruthi, 2022) and the other study focused on rice agro-ecosystems in Pattambi (central Kerala) and Ambalavayal in the Wayanad region (Ashly, 2023). These limited and regionally congregate efforts emphasize the need for broader ecological surveys to understand the distribution and habitat specificity of Trechinae across diverse Indian landscapes.

1.7. Importance of study Area

Kerala located by the side of southwestern coast of India, lies within the Western Ghats & Sri Lanka hotspot of biodiversity, one of the 25 global regions identified for conservation priority due to unique levels of species endemism and habitat loss (Myers et al., 2000). Kerala's diverse topography from coastal plains to highland forests supports multiple type of ecosystems including tropical rain forests, wetlands, grasslands and mangroves (Ramesh & Pascal, 1997) and also consisting rich insect communities (Chandrasekhara & Radhakrishnan, 2002). Endemism is especially high among insect taxa like butterflies, ants and beetles, in which many are confined to microhabitats within the state (Kunte, 2008). The forest and agricultural habitats of the North Malabar region of Kerala display distinct ecological and biogeographic characteristics while compared to other parts of the state (Nair & Sreedharan, 1986). The North Malabar region consisting Kannur, Kasaragod and pars of Kozhikode which are different from central and southern Kerala in its ecological and biogeographic sketch. North Malabar region is positioned at the interface of the Western Ghats and coastal plains. So, it features a mosaic of lateritic hillocks, midland valleys, and lowland wetlands, interspersed with sacred groves, scrub forests, and mixed agroforestry systems. These transitional landscapes are less disturbed and more structurally diverse, which provide unique microhabitats for soil and litter-dwelling arthropods. Numerous intensively farmed zones are present in central and southern Kerala. While in North Malabar region, relatively higher proportion of mixed agroforestry and fallow lands are present which providing diverse microhabitats for soil and litter-dwelling fauna (Sheeba, 2023). Despite its ecological richness, North Malabar region remains underrepresented in biodiversity assessments, making it a

strategically important region for ecological studies, especially on poorly documented insect groups such as ground beetles (Carabidae). The present study was designed for generating ecological data, abundance, richness, diversity, and seasonality of Scaritinae and Trechinae beetles in selected forest and agricultural habitats of North Malabar. These two subfamilies were chosen for focused ecological analysis based on the taxonomic expertise developed during the initial phase of the study, which dealt with the identification, classification, and documentation of Scaritinae and Trechinae species within the family Carabidae.

OBJECTIVES

- Taxonomic study of Scaritinae and Trechinae of Kerala.
- Preparation of faunal inventory of Scaritinae and Trechinae and pictorial key for the identification up to species level.
- Diversity of Scaritinae and Trechinae (Coleoptera: Carabidae) of the Selected Forest and Agricultural habitats of North Malabar region.

Chapter 2

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

2.1. Taxonomy of Subfamily Scaritinae from India

The taxonomic ground work for Subfamily Scaritinae was initiated during the 18th and 19th centuries. Early classifications of the Subfamily were done by Linnaeus and Fabricius forming the basis for later systematic works. Dejean (1825) provided the first comprehensive species list, followed by contributions from Chaudoir who described numerous species and proposed generic groupings within Sacritinae. These early efforts were foundational but lacked consistency in diagnostic characters and were based on external morphology.

Chaudoir made significant contributions to the taxonomy of Indian Scaritinae during the 19th century. In his initial work (1848a), he described four species from India: *Scarites inconspicuous*, *S. mancus*, *S. indus*, and *S. subnitens*. In a subsequent publication (1848b), he provided descriptions of nine additional species, including *Oxylobus lateralis*, *Scarites orthomus*, *S. bengalensis*, *S. rugipennis*, and *S. opacus*, along with reiterations of the previously described *S. inconspicuous*, *S. mancus*, *S. indus*, and *S. subnitens*. Later, further expanded the knowledge of Indian Scaritinae by describing five more species: *Oxylobus quadricollis*, *O. foveiger*, *O. alveolatus*, *O. costatus*, and *Haplogaster ovatus*. Among this *Oxylobus costatus* is from Malabar region of Kerala (Chaudoir, 1879). In a subsequent contribution, he further expanded the list by describing twelve species (*Distichus modestus*, *D. puncticollis*, *D. striaticeps*, *Scarites subnitens*, *S. opacus*, *S. liopterus*, *S. orthomus*, *S. bengalensis*, *S. barbarus*, *S. mancus*, *S. boysi*, and *S. cycloderus*) from India (Chaudoir, 1880). Bates made notable contributions to the taxonomy of Indian Scaritinae in the late 19th century. He described *Clivina lata* from Mumbai (Bates, 1873). Later, five species

(*Clivina attenuata*, *C. indica*, *Dyschirius sp*, *Oxylobus costatus* and *Scarites indus*) were described from Konbir, Tetara and one species (*Oxylobus punctatosulcatus*) was described from Southern India (Bates, 1891a). In a subsequent publication he also documented *Dyschirius ordinatus* and *Scarites inconspicuous* from the Jhelum Valley and Pamir region of Kashmir (Bates, 1891b).

Between 1920 and 1936, Andrewes made significant contributions to the taxonomy of the subfamily Scaritinae in India, describing a total of 138 species. His earliest work in this series includes, a new species (*Zelma miranda*) was described from West Bengal: Kolkata (Andrewes, 1920). In his work "The Carabidae of Barkuda Island*"*, six species were described from Barkuda Island in the Puri district of Odisha, including *Clivina attenuata*, *C. lobata*, *C. mordax, Oxylobus costatus, Scarites terricola*, and *S. indus* (Andrewes, 1921a). In a subsequent study, two additional species, *Oxylobus porcatus* and *Scarites punctum*, were recorded from West Bengal (Andrewes, 1921b). Further expanding his work, described 11 species (*Clivina attenuata*, *C.lobata*, *C. mordax*, *Distichus parvus, D. puncticollis, Oxylobus porcatus, O. amyntas, Scarites sulcatus, S. praedator, S. inconspicuous* and *S. indus*) from India (Andrewes, (1924b). In his monumental monograph on the Carabinae, he provided a comprehensive taxonomic treatment of ten tribes of the subfamily Carabinae in the first volume of the "*Fauna of British India, Including Burma and Ceylon"*, with diagnostic keys and species descriptions (Andrewes, 1929). This was followed by the Catalogue of Indian Insects which compiled all known Carabidae species from India up to that time, including distributional data and literature references (Andrewes, 1930a). Total 136 species of Subfamily Scaritinae were documented with distributional data and literature references (Andrewes, 1929, 1930a). A new species, *Scarites raptor*, was described from the Indian Himalayan

region (Uttarakhand: Dehradun) in the work “Papers on Oriental Carabidae” (Andrewes, 1932). Also, described a new species (*Dyschirius stellula*) from Indian Himalayan region (Uttarakhand: Dehradun) in his work “Papers on Oriental Carabidae” (Andrewes, 1936a). These works attribute a critical foundation for the taxonomic understanding of Indian Scaritinae and remain key references for subsequent studies in the region.

Thirty-eight new species of the subfamily Scaritinae have been described from India after Andrewes (1936), contributing significantly to the taxonomic understanding of this group. Two new species of the genus *Haplogaster* were reported from north-eastern India, namely *Haplogaster elongata* from the Khasi Hills in Meghalaya and *H. manipurensis* from Manipur (Bänninger, 1931). Later, *Haplogaster himalayica* was described from Darjeeling and Sikkim (Bänninger, 1935). In the revision of the Oriental *Clivina* species, five new species were added to the Indian fauna, namely *Clivina balfourbrownei* from Karnataka (Mysore, Belgaum, Kanara), *C. championi* from Uttarakhand (West Almora, Kumaon), *C. obenbergeri* from Karnataka (Shivamogga, Belgaum), *C. pfefferi* from Goa, and *C. kapuri* from Puducherry (Karikal). In the same study, three additional species were reported from India: *Clivina semicarinata* from the banks of the Narmada River, Mangaldoi in Assam, and Kolkata in West Bengal; *C. mordax* from West Bengal; and *C. pluridentata* from Kolkata, West Bengal (Kult, 1951). A new species, *Clivina karikali*, was described from the Anamalai Hills in Tamil Nadu and Karikal in Puducherry (Jedlička, 1964). Based on material collected during the 1972 Bhutan expedition of the Naturhistorisches Museum in Basel, *Parathlibops wittmeri* was described from Pedong, Darjeeling (West Bengal), in the treatment of the tribe Scapterini under the subfamily Scaritinae (Casale, 1980). A new species, *Clivina*

arunachalensis (Arunachal Pradesh: Tirap, Namdhapa), was described from India, and three other species (*Clivina westwoodi, Pseudoclivina memnonia* and *Scarites indus*) were also reported in the work "Records of the Zoological Survey of India" (Saha & Biswas, 1985). In the Special Issue on the "Fauna of Silent Valley, Kerala", a new species, *Oxylobus silenticus*, was described from Silent Valley in Palakkad, Kerala, and two additional species, *O. montanus* and *O. quadricollis*, were reported from the same region (Saha, 1986). Two species, *Scarites indus* (Karnataka; West Bengal: Kolkata) and *S. punctum* (West Bengal: Kolkata), were reported from India in the work "Records of the Zoological Survey of India: Carabidae (Coleoptera: Insecta) of Kolkata" (Saha et al., 1992).

Two new species, *Dyschirius sonamargensis* (Jammu & Kashmir: Sonemarg) and *Reicheiodes convexipennis* (West Bengal: Darjeeling: Tonglu), were described from India, and ten species, *Sulciclivina attenuata* (West Bengal: Darjeeling), *Pseudoclivina assamensis* (Rishikesh), *Dyschirius speculifer* (Assam: Guwahati), *Parathlibops wittmeri* (West Bengal: Darjeeling, Pedong), *Distichus rectifrons* (Sikkim), *D. picicornis* (West Bengal: Darjeeling, Kalimpong, Purbong), *Scarites inconspicuous* (Rishikesh), *S. indus* (Rishikesh; Jammu), *S. punctum* (Rishikesh), and *S. subnitens* (Rishikesh) were reported from India in the same work (Balkenohl, 1994). Two new species, *Dyschirius contortus* and *D. himalaicus* (Haldwani: Kumaon), were described from India in the work "*Review of the Dyschiriodes (Eudyschirius) of the species group Orientalis (Coleoptera, Carabidae) with a revision of Indo-Malayan species*" (Fedorenko, 1997a). Also reported two species (*Dyschirius nitens* and *D. orientalis*) from India in the same work. Two species, *Dyschirius bifrons* (Kumaon) and *D. tenuescens* (Haldwani), were reported from India in the work "*Revision of Palearctic and Paleotropical species of the substriatus group*

of the genus Dyschiriodes Jeannel, 1941 (Coleoptera, Carabidae)" (Fedorenko, 1997b). Seven new species, *Trilophus ellipticus* (Meghalaya: Shillong: Khasi Hills, East Khasi Hills: Mawphlang), *T. hirsutus* (Kerala: Malampuzha Dam; Palghat Hills), *T. lompei* (Northwest Pathanamthitta; Kottayam: Mundakkayam), *T. parallelus* (Darugiri: Garo Hills), *T. schawalleri* (West Bengal: Darjeeling), *T. serratus* (West Bengal: Darjeeling), and *T. weberi* (Uttarakhand: Kumaon) were described from India, and three previously known species, *T. birmanicus* (West Bengal: Kolkata; Meghalaya: Khasi Hills, Cherrapunji; Assam: Jorhat, Manas, Kaziranga), *T. hispidulus* (West Bengal: Kolkata), and *T. weberi* (West Bengal: Kolkata), were recorded from India in the same work (Balkenohl, 1999).

Six species of Scaritinae were documented from various regions of India: *Clivina semicarinata* (Bihar: Pusa; Uttar Pradesh; Meghalaya: Garo Hills), *Parathlibops puncticollis* (Meghalaya: Khasi Hills), *Distichus laticeps* (Meghalaya: West Garo Hills), *Haplogaster ovata* (Shillong), *Scarites selene* (Meghalaya: Ri-Bhoi, Shillong: Khasi Hills), and *S. parallelus* (Meghalaya: Garo Hills; West Bengal) in the contribution "Fauna of Meghalaya, Part-5" (Saha & Halder, 2000). Two new species [*Trilophidius fastigatus* from Kolkata, West Bengal, and *Thliboclivina bartolozzii* from Umroi in the East Khasi Hills, North East Shillong, Meghalaya from India were described in the work "Key and catalogue of the tribe clivinini from the oriental realm". Additionally, reported the occurrence of five other species from various parts of India: *Clivina semicarinata* from Northern India, *C. gamma* from Siddharth Nagar in Uttar Pradesh, *C. karikali* from Anamalai Hills in Tamil Nadu and Karaikal in Puducherry, *Trilophus lompei* from Kerala, and *Sparostes brevicollis* from Central India from the same work (Balkenohl, 2001). In the publication "Faunal diversity of

Jabalpur District, Madhya Pradesh, Kolkata" reported the presence of a single species, *Oxylobus porcatus* from Satna, India (Chandra, 2008).

A new species *Leleuporella devagiriensis* was described from Kunnamangalam in Kozhikode district of Kerala from Indian sub-continent" (Abhitha & Sabu, 2009). A new species, *Dyschirius kadleci*, was described from Maharashtra (Pune: Bushi Dam), and a single species, *Dyschirius disjunctus*, was reported from Nainital in the work "Contribution to the Asian and Afrotropical species of the genus *Dyschiriodes* (Coleoptera: Carabidae: Scaritinae)" (Bulirsch, 2009). In the work titled "A Compendium on the Faunal Resources of Narmada River Basin in Madhya Pradesh", documented seven species of Scaritinae from various localities within the state. These include *Clivina semicarinata* from Hoshangabad, *Oxylobus porcatus* from Seoni (Barelipar) and Jabalpur, *Distichus laticeps* from Mandla, *D. mahratta* from Pune, Nagpur, and Mandla, and *Scarites indus* from Hoshangabad (Chandra et al., 2010). Seven species of Scaritinae were reported from Kerala, including *Clivina arunachalensis* from Kozhikode (Kuttikkattoor, Poonoor, Thamarassery), *C. brevior* from Kuttikkattoor, Medical College, and Thamarassery, *C. lobata* from Thamarassery (Kozhikode) and Thirunelli (Wayanad), *C. forcipata* from Chalakudi (Thrissur) and Thamarassery (Kozhikode), *Trilophus interpunctatus* from Thamarassery, and *Pseudoclivina memnonia* from Thamarassery and Engapuzha (Kozhikode), as well as Periya, Sultan Bathery, Panamaram, and Thirunelli (Wayanad) (Abhitha, 2010). A single species, *Scarites parallelus* was reported from Karnataka: North Kanara, Kadatoka, in his work "New record of *scarites semirugosus* Chaudoir (Fabricius) (Insecta: Coleoptera: Carabidae) from Karnataka, India" (Kushwaha & Hegde, 2012). Two new species of the genus *Clivina* were described, namely *C. kirschenhoferi* from Bhalukpong in Arunachal Pradesh and *C. donabaueri*

from Chilla in Haridwar, Uttarakhand. In the same work, a single species, *C. semicarinata*, was also reported from West Kolkata in West Bengal (Dostal, 2012b). A total of 18 species were reported from various regions of India, with a significant representation from Uttar Pradesh. These include *Clivina tranquebarica* from Uttar Pradesh (Deoria, Hardoi, Siddharth Nagar, Sitapur, Lalitpur, Mirzapur), C. gamma from Uttar Pradesh (Siddharth Nagar), *C. lobata* from Gujarat and Uttar Pradesh (Prayagraj, Ramnagar), *Sulciclivina attenuata* from Uttar Pradesh (Mau), *S. striata* from Uttar Pradesh (Ghazipur, Prayagraj), *Dyschirius mahratta* from Maharashtra and Uttar Pradesh (Lakhimpur Kheri, Salukapur: Dudhwa National Park, Salukapur), *D. hingstoni* from Jamui and Uttar Pradesh (Agra, Auraiya), Oxylobus porcatus from Uttar Pradesh, *Distichus laticeps* from Tamil Nadu and Uttar Pradesh (Mau), *D. planus* from Uttar Pradesh (Ajnari, Chitrakoot, Jalaun, Orai, Pahari), *D. puncticollis* from Maharashtra and Uttar Pradesh (Barabanki, Hardoi: Sandi Bird Sanctuary, Lakhimpur Kheri, Dudhwa National Park, Salukapur), *D. striaticeps* from Uttar Pradesh (Lakhimpur Kheri, Dudhwa FRH), Assam, and Jharkhand, Haplogaster ovata from Khasi Hills and Uttar Pradesh, Scarites punctum from Uttar Pradesh (Sultanpur), *S. semicircularis* from Uttar Pradesh (Lakhimpur Kheri), *S. dyschromus* from Uttar Pradesh (Sultanpur, Payagpur), *S. selene* from Uttar Pradesh (Lucknow), and *S. sulcatus* from Uttar Pradesh (Lakhimpur Kheri, Dudhwa National Park, Shahjahanpur) (Kushwaha & Hegde, 2015). Three species were reported from India, namely *Clivina lobata* (Chhattisgarh: Raipur), *Pseudoclivina assamensis* (Chhattisgarh: Raipur: Barnawapara, Lalbandha), and *Oxylobus ovalipennis* (Chhattisgarh: Raipur, Barnawapara) (Kushwaha et al., 2015).

One new species, Clivina *pacholatkoi,* was newly described from the valley of the Kosi River and Bhalukpong in Arunachal Pradesh in the work “Two new species

of the *Clivina semicarinata* group (Coleoptera: Carabiade: Scaritinae) from Asia". In the same work, two species, *C. kirschenhoferi* and *C. donabaueri*, were also reported from Northern India (Dostal & Bulirsch, 2016). A single new species *Parathlibops bulirschi,* was descried from Tamil Nadu (Tuticorin/Thoothukudi) and a new species, *P. glaber,* was also reported from Karnataka in the work "A new subgenus and new species of *Parathlibops*, with notes on morphology and taxonomy of Scapterina (Coleoptera: Carabidae: Scaritini)" (Fedorenko, 2016). A total of 35 species of Scaritinae beetles were reported from the Northern Himalayan region of India in the work "*Subfamily Scaritinae Bonelli, 1810. In: Löbl I Löbl D, editors. Catalogue of palaearctic Coleoptera-volume 1 Archostemata – myxophaga – Adephaga*" (Balkenohl, 2017c). Two species were reported from India, namely *Clivina helferi* (Gosaba: Pakhirala) and *C. lobata* (West Bengal, Sundarban, Gosaba: Pakhirala) in the work "Diversity of ground beetles (Insecta: Coleoptera: Carabidae) from Indian Sundarban with seven new records" (Kushwaha et al., 2017). Two species were reported from India, namely *Dyschirius mahratta* (Uttar Pradesh: Lakhimpur Kheri, Salukapur: Dudhwa National Park, Salukapur) and *Scarites sulcatus* (Arunachal Pradesh) in the work "Ground beetles: from Dudhwa National Park, Uttar Pradesh, India" (Kushwaha & Hegde, 2017). Four species, *Coryza semirubra*, *Scarites praedator*, *S. stenodes*, *and S. sulcatus*, were reported from Punjab in the work *"Fauna of Punjab, State Fauna Series, 23"* (Gupta et al., 2019). A single species (*Scarites guineensis*) was reported from Haryana: Kalesar N.P., Kalesar range, in the work "Fauna of Haryana, State Fauna Series, 24*"* (Ghosh et al., 2020).

A total of 15 species of Scaritinae were reported from various locations across Kerala, Tamil Nadu, and Karnataka. These include *Clivina tranquebarica* (Kerala: Tholpetty), *C. arunachalensis* (Kerala: Tholpetty, Muthanga, Ambalavayal), *C.*

brevior (Kerala: Muthanga, Tholpetty, Nilambur), *C. forcipata* (Kerala: Nilambur), *Coryza maculata* (Kerala: Malabar; Tamil Nadu: Nilgiri Hills), *Pseudoclivina costata* (Kerala: Muthanga, Vellarimala, Tholpetty; Karnataka: Gundlupete), *P. memnonia* (Kerala: Muthanga, Tholpetty, Ambalavayal), Dyschirius tamil (Kerala: Tholpetty; Tamil Nadu: Chennai), *Oxylobus asperulus* (Tamil Nadu: Nilgiri Hills), *O. lirifer* (Kerala: Nilambur), *O. lateralis* (Tamil Nadu: Nilgiri Hills), *O. nanus* (Tamil Nadu: Nilgiri Hills), *O. porcatus* (Kerala: Muthanga), *O. quadricollis* (Tamil Nadu: Nilgiris district, Coonoor, Gudalur: Ouchterlony Valley; Nilgiri Hills), and *Scarites dyschromus* (Kerala: Nilambur) (Akhil, 2020). Two species [*Clivina helferi* (Kerala: Peruvannamoozhi) and *Oxylobus follis* (Kerala: Kakkayam) were reported from India (Jithmon, 2020). A new species, *Clivina boreri*, was described from Bihar: Pusa, and *Clivina forcipata* was reported from Tinpahar in the work "Review of *Clivina* subgenus Dacca Putzeys, 1863, with descriptions of two new species (Coleoptera: Carabidae: Clivinini)" (Balkenohl, 2020b). Two new species, *Clivina thenmala* (Kerala: Kollam: Thenmala) and *C. agumbea* (Central India: Maharashtra; Southwest India: Karnataka: Shimoga: Agumbe Ghat, Bhadravati), were described from India, and a single species, *Clivina lata*, was reported from West Bengal: Darjeeling in the work "Revision of the *Clivina castanea* species-group from Asia (Coleoptera: Carabidae: Clivinini)" (Balkenohl, 2021b). A total of 32 species of Scaritinae were reported from various states in north-eastern India in the work "Faunal Diversity of North-East Biogeographic Zone: Insecta: Coleoptera". The species documented include *Clivina costulipennis*, *C. pileolata*, *C. kirschenhoferi*, and *C. semicarinata* from Meghalaya and Assam; *C. maculata* from Nagaland; *Dyschirius constrictus* from Meghalaya; *Haplogaster manipurensis* from Manipur and *H. ovatus* from Meghalaya; *Parathlibops puncticollis* from Meghalaya; and *Pseudoclivina*

assamensis from Assam. Several species of *Scapterus* and *Scarites* were also recorded, including *Scapterus stevensi* (Assam), *Scarites birmanicus* (Manipur), *S. indus*, *S. punctum*, *S. guineensis*, *S. boucardi*, *S. derogatus*, *S. dubious*, *S. emarginatus*, *S. fletcheri*, *S. mandibularis*, *S. praedator*, *S. orthomus*, *S. selene*, and *S. retusus* (all from Assam), *S. rugipennis* and *S. sulcatus* (Meghalaya). Additionally, *Thliboclivina bartolozzii*, *Trilophus ellipticus*, *T. parallelus* (Meghalaya), and *T. interpunctatus* and *T. schawalleri* (Assam) were reported (Chandra et al., 2021).

A total of 11 species of Scaritinae were reported from various localities in Kerala, including *Clivina tranquebarica, C. brevior, C. lobata, and C. westwoodi* from Pudussery, Chulanur Peafowl Sanctuary, and Walayar Reserve Forest; *Distichus planus* from Pudussery; *Dyschirius paucipunctus* and *D. tricuspis* from Pudussery; *Oxylobus asperulus* and *O. porcatus* from Dhoni Forest, Walayar Reserve Forest, and the Malabar Coast; *Pseudoclivina costata* from Chulanur Peafowl Sanctuary; and *Sulciclivina attenuata* from Pudussery (Divya, 2022). A checklist of carabid species in the Chinnar Wildlife Sanctuary of the south Western Ghats was provided, which included seven species of Scaritinae (*Clivina brevior*, *C. lobata*, *Dyschirius paucipunctus*, *Oxylobus asperulus*, *O. porcatus*, *Pseudoclivina costata*, and *P. memnonia*), along with detailed information on these species (Sruthi & Sabu, 2022). A new species, *Parathlibops devagiriensis* was described from Tamil Nadu: Ettimadai in the work "A new apterous species of the genus *Parathlibops* Basilewsky (Coleoptera: Carabidae: Scaritinae) from the Western Ghats, a global hotspot of biodiversity in Southwest India" (Aswathi et al., 2022). A total of nine species of Scaritinae were reported from Kerala, including *Clivina tranquebarica*, *C. brevior*, *C. gamma*, *C. lobata*, and *C. westwoodi* from Palakkad (Pattambi) and Wayanad (Ambalavayal); *Distichus planus* from Ambalavayal and Pattambi; *Dyschirius*

paucipunctus from Ambalavayal; *Leleuporella devagiriensis* from Pattambi; and *Pseudoclivina memnonia* from Ambalavayal (Ashly, 2023). A new species, *Clypeuspinus devagiriensis*, was described from Kozhikode: Mavoor, Palliyol, Kerala in the work "A new species of the genus *Clypeuspinus* Balkenohl, 2021 (Coleoptera: Carabidae: Scaritinae) from India" (Neethu & Sabu, 2023). A detailed Indian Checklist of Scaritinae Bonelli, 1810 (Coleoptera: Carabidae) was published consisting 176 Scaritinae species and their literature references along with distribution (Aswathi et al., 2024). A new report of *Clivina ursulae* from the Indian mainland was provided in the work "New distributional records of Carabidae from the Wetlands of South India" (Neethu et al., 2024). A single species, *Scarites sulcatus*, was reported from Hayuliang: Dalai Bridge, Anjaw District, Arunachal Pradesh, India in the work "New Distribution Records of Terrestrial and Aquatic Beetles from Anjaw District, Arunachal Pradesh, India" (Ghosh et al., 2025).

2.2. Taxonomy of Subfamily Trechinae from India

Bates (1891a, 1891b, 1892a) made several foundational contributions to the taxonomy of the subfamily Trechinae in India during the late 19th century. His work led to the documentation of three species of the genus *Tachys*, *T. bioculatus*, *T. klugii*, and *T. scydmaenoides* from Konbir and Tetara, India; four species of the genus *Bembidion*, *B. pamirense*, *B. punctulipenne*, *B. tibiale*, and *B. pustulatum* from the Pamir region; and the reporting of *Tachyta umbrosa* from India in the journal *Annali del Museo Civico di Storia Naturale di Genova*. These records represent some of the earliest systematic treatments of Trechinae beetles in the Indian subcontinent and remain significant for regional coleopteran taxonomy and biogeographic reference.

After Bates, contributions to the taxonomy of Trechinae from India can be traced back to the works of Andrewes (1920–1936), who described several Trechinae

species in his comprehensive taxonomic studies on Indian Carabidae. These include generic keys such as *Trechus*, *Perileptus*, and *Tachys*. His foundational descriptions remain relevant as taxonomic references even today. From 1920 to 1936, Andrewes made substantial contributions to the taxonomy of the subfamily Trechinae in India by describing a total of 167 species. *Bembidion kara* was documented from multiple localities in India, including West Almora in the Swal River Basin (United Provinces), Namsu (Sikkim), and Gopaldhara (West Bengal) in the work "Notes on Oriental Carabidae – II" (Andrewes, 1921c). Further expanding the knowledge on Indian Carabidae, in his publication *"The Fauna of an Island in the Chilka Lake. Carabidae"* reported three species of Subfamily Trechinae from India [*Pogonus biroi* (recorded from Barkuda Island, Chilka Survey Stations, Puri district of Orissa, Balugaon, Ganges delta, and Sorabkatti), *Tachys ornatus* (noted from Bengal, Ranchi, and Puri in Orissa), and *T. emarginatus]* (Andrewes, 1921d). These early records significantly contributed to the foundational understanding of the distribution and diversity of Trechinae beetles in India. Eleven new species of Trechinae were described from diverse regions of India, thereby enhancing the understanding of the group's taxonomy and distribution (Papers on Oriental Carabidae – VIII) (Andrewes, 1922). Key species include *Bembidion orinum*, *B. loricatum*, *B. regale*, and *B. kempi*, reported from various localities in Himachal Pradesh, Uttarakhand, and Jammu & Kashmir. Several species such as *B. notatum* and *B. xanthochiton* exhibited wide geographic ranges, spanning from the Western Himalayas to Sikkim and West Bengal. *Bembidion compactum* and *B. cameroni* were also recorded from north-eastern states like Assam and Manipur, while *B. leptaleum* and *B. radians* extended into the eastern Himalayan zone. In addition, *Elaphropus comptus* was described from Assam, West Bengal, and Karnataka. This work significantly expanded the known

diversity and biogeographic records of Indian Trechinae. In the same work, Andrewes also reported two additional species from India. *Bembidion lissonotum* was recorded from Himachal Pradesh and Uttarakhand, specifically from the Sunderdhunga Valley and Almora region. *Trechus indicus* was reported from a wide range of localities, including Himachal Pradesh (Simla Hills, Kotgarh) and various regions in Uttarakhand, such as Dehradun, Anarwala, Chakrata Division, Konain, Bodyar, Korawa Khud, Sijla Gad, Kanasar, Khedar Khud, Mussoorie, Dhobi Ghat, Ringal Gad, Siwalik Hills, Mohan Rau, Kumaon, West Almora, and Nainital, as well as Tehri State. Seven species of the genus *Bembidion* were described from various parts of India, enriching the faunal knowledge of Trechinae in the work "Notes on Oriental Carabidae–V (Andrewes, 1923a). *Bembidion eutherum* showed a wide distribution across Assam, Nagaland, Himachal Pradesh, and Uttarakhand. Species such as *B. splendens*, *B. xestum*, and *B. clarum* were mainly reported from the Himalayan region, including Uttarakhand, Himachal Pradesh, and parts of the Northeast and Sikkim. *B. exquisitum* and *B. phaedrum* were found in Himachal Pradesh and Uttarakhand, while *B. braminum* was described from the Palani Hills and Kodaikanal in Tamil Nadu. This study contributed significantly to the taxonomy and biogeographic mapping of Indian Trechinae. Nineteen new species were described from various regions across India, contributing significantly to the faunal documentation of the group in the work "Notes on Oriental Carabidae – VI" (Andrewes, 1924c). Notable species include *Asaphidion championi* from Assam (Darrang) and Uttarakhand, and several species of *Bembidion* such as *B. limatum* (Himachal Pradesh), *B. ladas*, *B. pluto*, *B. satanas*, *B. hasurada*, and *B. ladakense* from Jammu & Kashmir and adjoining Himalayan regions. Some species like *B. luntaka* exhibited a broad Himalayan distribution from Kashmir to Himachal Pradesh

and Uttarakhand. Additional taxa, including *B. exaratum*, *B. gagates*, and *B. aquilum*, were recorded from multiple northern states. Three *Elaphropus* species, *E. babaulti*, *E. blandus*, and *E. micraulax* were also described, with wide geographic ranges spanning the Himalayan and peninsular regions. Furthermore, *Bembidion bracculatum* was newly reported from Jammu & Kashmir and Uttarakhand. These descriptions expanded the known diversity and distribution of Indian Carabidae, particularly in the Himalayan ecosystem.

In the comprehensive work *"*A Revision of Oriental Species of the Genus *Tachys"*, 29 new species were described from diverse regions across India (Andrewes, 1925b). Notable among these are *Asaphidion cuprascens* from Uttarakhand (Haldwani, Kaldbunga), *A. griseum* from Assam (Eastern Duars), *A. obscurum* and *A. ornatum* from various parts of Uttarakhand, and *A. viride* from Sikkim. Several new species of *Elaphropus* were described from the Himalayas and Peninsular India, including *E. buxans* (Tamil Nadu: Palni Hills), *E. opacus* (Uttar Pradesh: Sardah), *E. championi*, *E. charactus*, and *E. rhombophorus* from multiple Himalayan foothill locations. *E. malabaricus* was recorded from Kerala (Malabar, Kannur), and *E. charis*, *E. nannodes*, and *E. nilgiricus* from the Nilgiri Hills and Deccan regions. Among *Tachys* species, Andrewes described *T. brachys*, *T. cardoni*, *T. ochrias*, and *T. vilis* from Tamil Nadu, Uttarakhand, and Jammu & Kashmir. In addition to these new species, he also reported six previously known species from India, including *Lymnastis indicus*, *L. pilosus*, *L. pullulus*, *Tachys euryodes*, *T. impressus*, and *T. sericeus*, mostly from West Bengal (Kolkata) and Uttarakhand. Three new species of the genus *Bembidion* were described from India: *B. charon* (Kumaon: Burphu, Gori River Gorge), *B. persephone* (Kumaon: Shelshel), and *B. eurydice* (Kumaon: Gori River Gorge) (Andrewes, 1926). Additionally, he reported

two species of *Perileptus*, namely *P. ceylanicus* and *P. indicus*, from a wide range of localities across Uttarakhand, Maharashtra, Uttar Pradesh, West Bengal, Sikkim, Assam, Meghalaya, and Manipur. Two new species [*Amerizus bolivari* from Sikkim and *Bembidion trimaculatum* from Punjab: Upper Jhelum and Uttarakhand: Dehradun) were described from India in the work *"*Descriptions of some new species of Carabidae from North India*"* (Andrewes, 1927d). All Carabidae species known from India until 1930 were catalogued, along with their distribution and literature details, including 129 Trechinae species in the "*Catalogue of Indian Insects*" (Andrewes, 1930a). Three new species were described from India: *Bembidion psilodorum* (Kashmir: Lidar Valley), *B. beesoni* (Jammu & Kashmir: Gulmarg), and *Elaphropus salemus* (Tamil Nadu) in the work "Papers on Oriental Carabidae — XXVII" (Andrewes, 1933a). Three new species (*Bembidion eupages*, *B. hutchinsoni*, and *B. ixion*) were described from Jammu & Kashmir, India in the work "Report on Coleoptera of the Family Carabidae" (Andrewes, 1934). Two new species, *Bembidion irregulare* (Kashmir: Gund; Shaksgan Valley) and *B. sillemi* (Jammu & Kashmir: Srinagar, Sind Valley, Kangan, and Gund), were described from India (Netolitzky, 1934). Subsequently, two additional species, *B. discordans* (Jammu & Kashmir: Srinagar) and *B. ajmonis* (Jammu & Kashmir: Razdhainangan), were described (Netolitzky, 1935b). A detailed account of the eight tribes of the subfamily Harpalinae, along with taxonomic keys and species descriptions, including 166 Trechinae species, was provided in the second volume of the "*Fauna of British India including Burma and Ceylon*" (Andrewes, 1935). A single new species, *Trechus perissus*, was described from Sikkim: Dzongri, India in the work "Papers on Oriental Carabidae – XXX" (Andrewes, 1936a).

A total of 16 new species of the subfamily Trechinae have been described from India after Andrewes (1936), contributing significantly to the taxonomic understanding of this group. Asingle species, *Amerizus kashmiricus*, was described from Jammu & Kashmir, India in the work "*Tiruka kashmirica sp. n*. (Bembidionini)" (Jedlička, 1938). One species, *Eocnides assamensis*, was described from Assam, India in the work "Trois tréchites orientaux nouveaux" (Jeannel, 1954). One species, *Trechus balfourbrownei*, was described from Sikkim, India in the work "On *Trechus imaicus* Jeannel (Coleoptera, Trechinae)" (Ueno, 1965). Another species, *Stevensius brunneus*, was described from Sikkim, India in the work "A new humicolous trechine beetle from Hokuriku, central Japan" (Ueno, 1977). One species, *Trechus meurguesianus*, was described from Jammu & Kashmir, India in the work "Description of *Trechus meurguesianus* New Species of Kashmir India and Notes on Some Little-Known Asiatic Species (Coleoptera: Carabidae)" (Deuve, 1980). Two species, *Trechus bhadarwahensis* and *T. calashensis*, were described from Jammu & Kashmir, India in the work "2 New Trechus Spp of the Western Himalayas, India (Coleoptera: Caraboidea, Trechinae)" (Deuve, 1982a). Another species, *Trechus caspiricus*, was described from Jammu & Kashmir, India in the work "Un Trechus nouveau du Cachemire indien (Coleoptera: Caraboidea)" (Deuve, 1982b). Three new species, *Amerizus casalei* (Sikkim), *A. deuvei* (Jammu & Kashmir), and *A. ledouxi* (Uttarakhand), were described from India in the work "Études sur la tribu des Bembidiini s. str. III. Notes sur le sous-genre *Tiruka* Andrewes, et descriptions d'espèces nouvelles (Coleoptera, Carabidae)" (Perrault, 1985). A single new species, *Stevensius brunneoides*, was described from Sikkim, India in the work "Nouveaux Trechinae des Philippines, du Sikkim, du Népal, de la Chine et de l'Équateur (Coleoptera, Trechidae)" (Deuve, 2001).

A total of 20 species of Trechinae beetles from various regions of Uttar Pradesh were documented in the State Fauna Series 22: Fauna of Uttar Pradesh (Kushwaha & Hegde, 2015). Their study included members of the genera *Asaphidion*, *Bembidion*, *Elaphropus*, and *Tachys*, with extensive locality records such as Saharanpur, Barabanki, Lakhimpur Kheri, Shahjahanpur, and the Dudhwa National Park. The species reported include *Asaphidion championi*; *A. indicum Bembidion luniferum; B. xanthacrum; B. niloticum; B. Sobrinum; Elaphropus latissimus; E. babaulti; E. blandus; E. ceylanicus; E. dulcis; E. klugii; E. virgatus; E. peryphinus; E. poecilopterus; E. politus; E. fumicatus;* and *Tachys opalescens* This work significantly expanded the known distribution of Trechinae and related taxa within the state and emphasized the region's carabid diversity. Two species, *Bembidion sobrinum* and *B. niloticum*, were reported from West Bengal: Sundarban; Gosaba: Pakhirala in the work "Diversity of Ground Beetles (Insecta: Coleoptera: Carabidae) from Indian Sundarban with seven new records" (Kushwaha et al., 2017). A single new species, *Himalotrechus humeratus*, was described from Arunachal Pradesh, India in the work "A new genus of Trechini beetles from the Eastern Himalaya (Coleoptera: Carabidae)" (Belousov et al., 2019). A total of 22 species were reported from India, including *Asaphidion championi* (Assam), *Bembidion clarum* (Manipur, Nagaland), *B. compactum* (Manipur), *B. eutherum* (Assam, Nagaland), *B. kara* (Meghalaya), *B. notatum* (Meghalaya), *B. xanthacrum* (Assam), *Elaphropus latissimus* (Meghalaya), *E. comptus* (Assam), *E. ovatus* (Assam), *E. micraulax* (Meghalaya), *E. ocellatus* (Nagaland), *E. poecilopterus* (Meghalaya), *E. politus* (Nagaland), *E. unitarius* (Meghalaya), *E. vagabundus* (Assam), *Perileptus cameroni* (Manipur), *P. ceylanicus* (Meghalaya), *P. imaicus* (Manipur), *Tachys impressipennis* (Assam), *T. cameroni*

(Manipur), and *Tachyta coracinus* (Assam) in the work "Faunal Diversity of North-East Biogeographic Zone: Insecta: Coleoptera" (Chandra et al., 2021).

A total of 12 species, *Bembidion niloticum*, *Elaphropus ceylanicus*, *E. decoratus*, *E. klugii*, *E. micraulax*, *E. nigellus*, *E. nilgiricus*, *E. politus*, *Tachys impressus*, *T. tropicus*, *T. impressipennis*, and *Perileptus ceylanicus* were reported from Walayar Reserve Forest, Chulannur Peafowl Sanctuary, and Malampuzha in Palakkad district of Kerala (Divya, 2022). Three species, *Elaphropus nigellus, E. nilgiricus*, and *E. politus* were reported from Chinnar Wildlife Sanctuary in Kerala (Sruthi, 2022). A total of ten species, *Bembidion niloticum*, *Elaphropus ceylanicus*, *E. decoratus*, *E. klugii*, *E. nigellus*, *E. nilgiricus*, *E. politus*, *Tachys impressipennis*, *T. impressus*, and *T. tropicus* were reported from Ambalavayal and Pattambi agricultural ecosystem of Kerala (Ashly, 2023). A new species, *Pogonus malabarensis*, was described from Chambad Agricultural Field of the north Malabar region in Kerala, India (Shigina & Sabu, 2024a). Two species of the genus *Elaphropus*, *E. fumicatus* and *E. virgatus* were newly reported from the wetlands of Mavoor, Kozhikode, Kerala in the work "New Distributional Records of Carabidae from the Wetlands of South India" (Neethu et al., 2024). Three species, *Asaphidion championi* (Hayuliang: Dalai Bridge), *Bembidion phaedrum* (Walong: near Inspection Bungalow), and *Trechus indicus* (Walong: near Inspection Bungalow) were reported from Anjaw District, Arunachal Pradesh, India in the work "New Distribution Records of Terrestrial and Aquatic Beetles from Anjaw District, Arunachal Pradesh, India" (Ghosh et al., 2025).

2.3. Ecology of Subfamily Scaritinae and Trechinae from India

A comprehensive account of the ecology of Carabidae, which has since served as a foundational reference for carabid ecological studies worldwide, was provided in 1977 (Thiele, 1977). In contrast, ecological studies on carabid beetles in India remain

limited. The general ecological aspects of carabid beetles within the broader context of Indian insect fauna were discussed in the works “Ecology and Biogeography of High-Altitude Insects” and “Ecology and Biogeography of India” (Mani, 1968, 1974).

Forest litter faunal diversity and Carabid beetle systematics were assessed, and reported that Carabids were most abundant in the litter (L) and foliage (F) layers during the pre-summer season in Wayanad region of the Western Ghats (Abhitha, 2010). The occurrence of *Dyschirius hingstoni* (Scaritinae) in the rice agro-ecosystems of Bihar was reported (Kushwaha & Hegde, 2015). The diversity, abundance, and distribution patterns of carabid beetles in Gladiolus and Gerbera crops in Jorhat, Assam were studied (Mili et al., 2018). “*Ecology of Carabidae beetles in the Nilgiri Biosphere Reserve*” was studied and *Clivina castanea* was identified as a dominant species through pitfall trapping, while both *C. brevior* and *C. castanea* were among the dominant species recorded using light trapping method (Akhil, 2020). “*Ecology of Carabidae beetles in the Malabar Wildlife Sanctuary*” was studied and reported two rare species (*Clivina helferi* from Peruvannamoozhi and *Oxylobus follis* from Kakkayam) (Jithmon, 2020). A study on the “*Ecology of carabid beetles in the Palghat Gap in the South Western Ghats*” and from Kerala, India reported that *Elaphropus nilgiricus* and *E. politus* were some of the dominant light-attracted Carabidae in the semideciduous forest of Chulanur Peafowl Sanctuary; *E. politus, E. nilgiricus*, and *E. nigellus* were dominant in the dry-deciduous forest of Walayar Reserve Forest; and *Clivina brevior, Clivina tranquebarica, E. politus, E. nilgiricus*, and *Bembidion niloticum* were among the dominant species in the rice paddy ecosystem of Pudussery paddy field (Divya, 2022). A study on the “*Ecology of Carabidae beetles in Chinnar Wildlife Sanctuary*” revealed that the subfamily Trechinae was one of the dominant groups and *Elaphropus nigellus* was among the

dominant species (Sruthi, 2022). A study on the "*Ecology of carabid communities in the rice agro-ecosystems of Ambalavayal and Pattambi*" reported that *Clivina tranquebarica* and *Paratachys impressus* were the dominant light-trapped species in Ambalavayal, while *Clivina brevior* was among the dominant light-trapped species in Pattambi. In pitfall traps, *Elaphropus politus* and *C. tranquebarica* were dominant in Ambalavayal, whereas *E. politus* was one of the dominant species in Pattambi rice agro-ecosystem (Ashly, 2023).

Chapter 3

MATERIALS AND METHODS

3. MATERIALS AND METHODS

3.1 Study area

3.1.1. Taxonomy- Kerala

For taxonomic research, insect specimens housed in the collections of Entomology Lab of St. Joseph's College (Autonomous), Devagiri, sourced from major research initiatives and student projects conducted across diverse habitat types in Kerala were utilized. Additionally, specimens from the National Insect Collections of the Zoological Survey of India (ZSI), Kozhikode, which provide comprehensive coverage of Kerala's entomofauna, were also examined.

3.1.2. Ecology

Study Area and Habitat Selection

For ecological study, two different habitat types within the North Malabar region of Kerala were selected for representing forest and Agricultural ecosystems.

- Forest Habitat: Semi-Evergreen Forest of Aralam Wildlife Sanctuary (AWS) and Tropical Evergreen Forest of Ranipuram Forest (RF) were selected to represent the Western Ghat's evergreen and semi-evrgreen forest systems.
- Agricultural Habitat: The rice- dominated paddy fields of Chambad, an important agricultural belt in North Malabar, was selected to represent cultivated landscapes and related agroecosystem.

This dual-habitat framework provided a basis for comparative analysis of species assemblages,

and habitat-specific patterns across natural and managed ecosystems.

3.1.2.1. Aralam Wildlife Sanctuary

Aralam Wildlife Sanctuary is a protected area located in the Kannur district of Kerala. It covers an area of 55 square kilometres. The sanctuary is well known for its rich biodiversity and serves as an important corridor for wildlife moving between the northern Western Ghats and the forests of Kerala (Kerala Forest and Wildlife Department, 2021). The topography of the sanctuary consists of a blend of evergreen forests, semi-evergreen forests and deciduous forests (Sreekumar & Balakrishnan, 2001). The altitude ranges from 50 meters to 1,145 meters above sea level (Kerala Forest and Wildlife Department, 2021).

3.1.2.2. Ranipuram Forest

Ranipuarm Forest is an important eco-tourism centre located in the Kasaragod district of Kerala, near the border with Karnataka. This region is part of the Western Ghats, a UNESCO World Heritage Site recognized for its biodiversity and ecological importance (UNESCO World Heritage Sites, 2025). The forest spans an area of about 50 square kilometres, with its topography comprising evergreen forests and deciduous forests. The altitude ranges from 700 meters to 1,100 meters above sea level (Kerala Forest Department, 2021).

3.1.2.3. Chambad Agricultural Field

Notable for practicing organic and sustainable farming methods, which are encouraged by local agricultural bodies and farmer cooperatives. These practices have been adopted to maintain soil health and protect the ecosystem surrounding the paddy and other agricultural crops (Kerala Agricultural University). Altitude ranges from 10 to 150 meters above sea level (Kerala state planning Board, 2021).

3.2. Data collection and Analysis

3.2.1. Collection of specimens

Specimens were collected during 2019-2022 period from Aralam wildlife Sanctuary, Ranipuram Forest and Chambad Agricultural field using pitfall traps and light traps methods for ecological study. Pitfall trapping is a widely recognized collection method for collecting carabid beetles in ecological studies (Lövei & Sunderland, 1996; Kotze et al., 2011). The pitfall trap consists of plastic containers with a width of 8 cm and a depth of 10 cm, buried in the soil up to their rims to align with the soil surface. These containers are half-filled with a preservative liquid, which is a mixture of salt and soap water. In order to facilitate rapid drowning, soap water is added to the liquid to reduce surface tension. To lessen the amount of rain and debris that enters the trap, a lid is placed over the aperture. In order to prevent "digging in" effects, traps were arranged in a row and spaced 20 meters apart (Sabu & Shiju, 2010). Total thirty traps were set in each site during each season (non-rainy and rainy) for two years. In the afternoon, traps were set up, and 24 hours later, they were collected. The remaining trapped beetles were released after the minimum number of representative specimens were chosen and classified. Freshwater washing and 70% ethyl alcohol preservation were performed on specimens intended for laboratory examination.

The most common sampling method is light trapping. There are thousands of nocturnal insect species. The best method for collecting samples of these insects is light trapping (Szentkiralyi, 2002). Since they are nocturnal, carabid beetles spend the night actively searching for food. This suggests a high carabid fauna capture rate with light traps (Abdulla et al., 2008). When there is a high chance of flooding or damp ground, light trapping works better than pitfall trapping (Jocque et al., 2016). The

study makes use of an electronic insect light trap with UV-A lighting technology (SAFS Timer Insect LED Light trap, Model SAFS_Itrap_01B). Preservative liquid is kept in a tray within traps. The distance between each trap and the others was 750 meters which was noticed as wide enough to avoid overlapping attraction zones of the carabid beetles in the study habitats. Total thirty light traps were set up in each site per each season for two years. Light traps were set up in the evening time, and were collected in the morning period. The majority of the captured beetles were released after the minimum number of representative specimens were chosen and classified by genus level. 70% ethyl alcohol was used to preserve specimens intended for laboratory analysis.

The third technique for gathering ground beetles is handpicking. Scaritinae beetles of medium to big sizes were manually collected. The collector's experience determines how well the handpicking method works (Timm et al., 2007). The primary locations for ground beetle collection were grassy areas, logs, and stones.

3.2.2. Taxonomy of Subfamily Scaritinae and Trechinae

Taxonomic keys for the identification of collected specimens up to species level were available (Andrewes, 1929, 1935; Boyd & Erwin, 2016; Deuve, 1990-2001). Also used modified and newly prepared taxonomic keys. Specimens from various international museums, Natural History Museum, Paris, France (MNHN) and Natural History Museum, Berlin, Germany (ZMHB), were analysed for taxonomical studies and Verifications. Leica S8 APO stereo zoom microscope with 80x magnification was used for identification, and Leica M205C stereo zoom microscope with Leica MC 170 HD microscope camera was used to take pictures. Leica Application Suite (LAS) version 4.12 was used to improve the photographs. The

length of the body was measured from the tip of the mandibles to the apex of the pygidium and from the tip of the labrum to the apex of the elytra. Every measurement was given in millimetres. Identified specimens were labelled and deposited in the national repository of ZSIK (Zoological Survey of India, Kozhikode- Western Ghat Regional Centre).

3.2.3 Checklist and Pictorial key

A checklist of the species from the study sites were provided. Taxonomic keys were prepared by modifying existing keys and comparing translated descriptions of literatures collected from various sources. Checklist of Scaritinae and Trechinae beetles was drafted based on Catalogue of Andrewes, Lorenz and Löbl & Löbl (Andrewes, 1930a; Löbl & Löbl, 2017; Lorenz, 2005, 2024) and by verifying the distribution data of each species in different literatures. Pictorial key for the subfamily Scaritinae and Trechinae up to the species level were prepared based on Andrewe's foundational works "*Fauna of British India including Burma and Ceylon, Part I &II*" (Andrewes, 1929, 1935).

3.3. Ecological Analysis

Ecological analysis of identified Scaritinae and Trechinae beetles from the Forest and Agricultural habitats were performed using the data obtained through light trap method. Data was used to derive its relative abundance, rank-abundance curve and to study the attributes of diversity, richness and evenness using PAST (PAST version 3.15) software (Hammer et al., 2001). MS-Excel 2010 was used to create graphs and perform basic statistical data analysis, including calculating the percentage and relative abundance of species using various sampling techniques. Data

obtained from the pitfall trap collections were not used for the diversity analysis and seasonality measurement due to their low abundance.

3.3.1. Diversity Analysis

Alpha diversity indices (diversity, richness, and evenness), Beta diversity indices (Bray Curtis similarity index), and rank abundance plots were taken into consideration in order to comprehend the diversity patterns. The three indices of Simpson's evenness index, Shannon-Weaver diversity index, and Margalef's species richness index (d) were used to estimate alpha diversity.

Margalef's index (d) (Clifford & Stephenson,1975; Magurran, 2004)

was calculated by using the following formula.

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

S = total number of species

N = total number of individuals

The most widely used diversity index is the Shannon-Weaver diversity index (Shannon & Weaver, 1949), which takesinto account both species richness and evenness. It can also provide heterogeneity of information (Rosenstock, 1998; Cheng, 1999), and it can be used to test the differences between two communities using a Shannon *t*-test/ANOVA (Magurran, 2004). It is calculated by using the following formula.

$H' = - \Sigma i\ Pi\ (\log (Pi)$

Where, *Pi is the proportion of individuals found in the* i^{th} *species.*

Simpson's Evenness index ($E_{1/D}$), addresses equitability of the species (Simpson, 1949).

$E_{1/D} = [(1/D)/S]$

Where, *1/D is the reciprocal form of the Simpson index (D) and 'S' is the number of species in the sample.*

$D = \Sigma pi^2$

Where, *Pi = the proportion of individuals in the* i^{th} *species* (Magurran, 2004)

PAST (PAST version 3.15) software was used to create a rank-abundance plot for each approach in order to evaluate patterns in the species makeup of the Scaritinae and Techinae beetle assemblages. For the techniques, a rank-abundance plot was created by plotting the relative abundance of each order against the species' rank. The similarity of Scaritinae and Techinae beetle species composition across environments was measured and compared using the Bray-Curtis similarity coefficient (Bray & Curtis, 1957). This index is calculated as where BCjk is the similarity between the j^{th} and k^{th} habitats and yij represents the abundance for the i^{th} species in the j^{th} habitat. All 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 the three habitats, using R software version 4.3.3 (R Core Team, 2024),) with the packages ggplot2 (Wickham, 2016) and iNEXT (Hsieh et al., 2024).

3.3.2 Statistical analysis

Since the sample size exceeded the minimum requirement for the Central Limit Theorem, data normalization was performed to stabilize variance and improve the normality of the sampling distribution prior to further analysis. The significance levels of the changes were analysed using the t test. The significance level for each analysis was set at $P<0.05$. PAST software version 3.15 (Hammer et al., 2001) was

used for all statistical and diversity analyses. Species were classified as ‘dominant’ if their relative abundance contributed 5% and above. ‘Minor’ species contributed 0.1-4.99% and the species were classified as ‘rare’ if their relative abundance contributed less than 0.1%. Statistical analyses of Two-way Anova was conducted using Minitab Statistical Software version 18 (Minitab LLC, State College, PA, USA) for the comparison of Forest and Paddy field data.

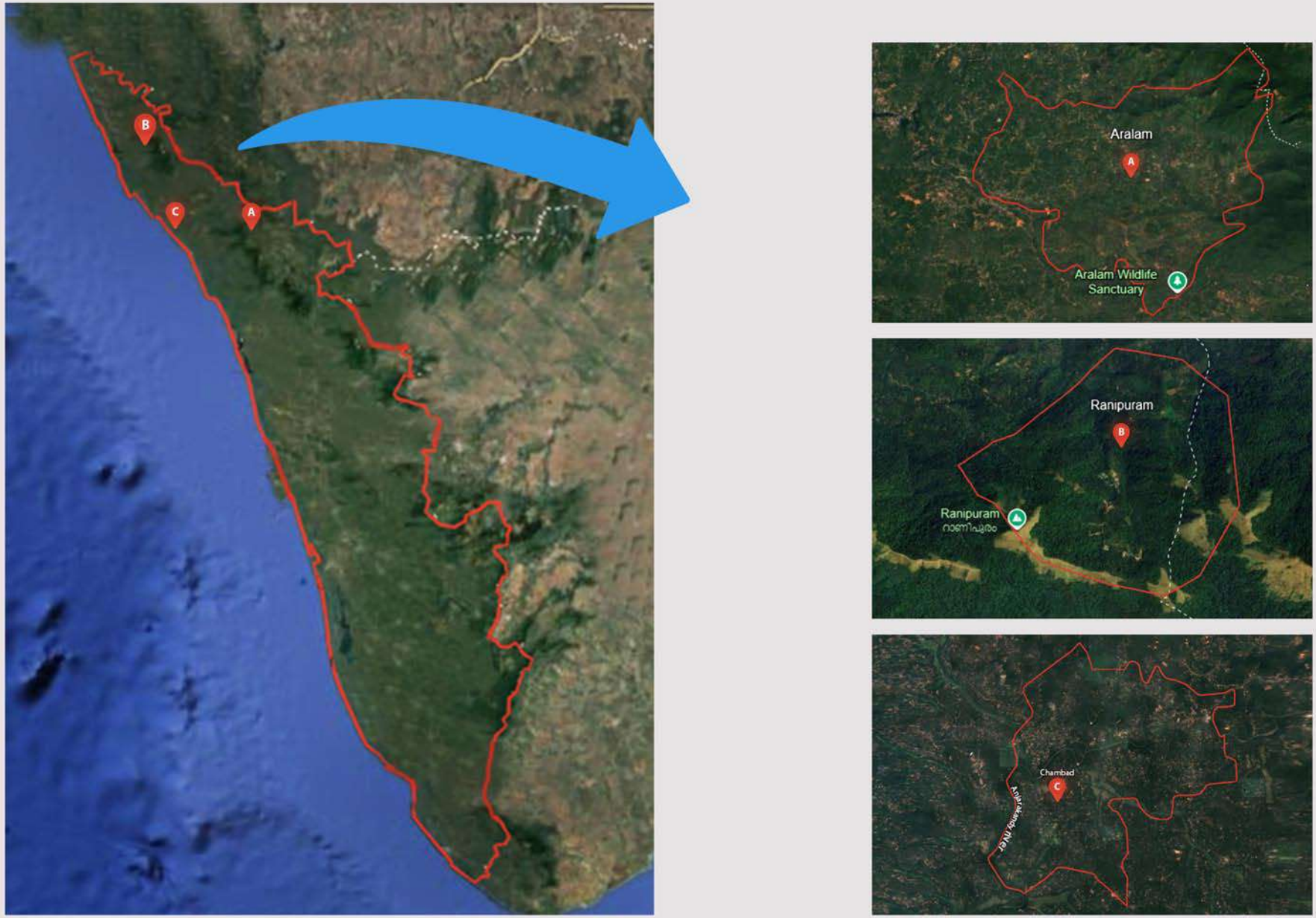


Figure 1: Map showing study area of Ecology work- A) Aralam Wild Life Sanctuary; B) Ranipuram Forest; C) Chambad Agricultural Field.

Figure 2: Study site- A) Forest Habitat; B) Light trap setup; C) Pitfall trap setup.

Figure 3 : Study site- A) Agricutural Habitat ; B) Light trap setup; C) Pitfall trap setup.

Chapter 4

RESULTS

4. RESULTS

4.1. Taxonomy

4.1.1. Scaritinae species recorded from Kerala

Scaritinae belonging to 22 species, 3 tribes and 11 genera were collected from Kerala during 2019-2023 period

Table 1: Scaritinae species collected from Kerala during 2019-2023 period

Tribe	Genus	Species
1. Clivinini Rafinesque, 1815	1. *Clivina* Latreille, 1802	1. *C. arunachalensis* Saha & Biswas, 1985
		2. *C. brevior* Putzeys, 1866
		3. ** *C. boreri* Balkenohl, 2020
		4. *C. forcipata* Putzeys, 1863
		5. *C. lobata* Bonelli, 1813
		6. *C. thenmala* Balkenohl, 2021
		7. *C. tranquebarica* Bonelli, 1813
		8. *** *C. ursulae* Balkenohl, 2020

	2. *Clypeuspinus* Balkenohl, 2021	9. *C. devagiriensis* Neethu & Sabu, 2023
	3. *Coryza* Putzeys, 1867	10. *C. maculata* (Nietner, 1856)
	4. *Leleuporella* Basilewsky, 1956	11. *L. devagiriensis* Abhita & Sabu, 2009
	5. *Orictites* Andrewes, 1931	12. ** *Orictites constulipennis* (Bates 1892)
	6. *Pseudoclivina* Kult, 1947	13. *P. costata* (Andrewes, 1929)
	7. *Trilophidius* Jeannel, 1957	14. *** *T. impunctatus* (Putzeys, 1868)
	8. *Trilophus* Andrewes, 1927	15. *T. interpunctatus* Putzeys, 1866
2. Dyschiriini Kolbe, 1880	9. *Dyschirius* Bonelli, 1810	16. *D. paucipunctus* Andrewes, 1929
3. Scaritini Bonelli, 1810	10. *Distichus* Motschulsky, 1858	17. *D. planus* Chaudoir, 1855
		18. *D. puncticollis* Chaudoir, 1855
	11. *Oxylobus* Chaudoir, 1855	19. *O. asperulus* Chaudoir, 1857
		20. *O. lateralis* Dejean, 1828
		21. * *O. pygmaeaus* Andrewes, 1929
		22. *O. porcatus* Fabricius, 1798
*** First report from India; ** First report from south India; * First report from Kerala		

4.1.2. Trechinae species recorded from Kerala

Trechinae belonging to 27 species, 3 tribes and 7 genera were collected from Kerala during 2019-2023 period.

Table 2: Trechinae species collected from Kerala during 2019-2023 period

Tribe	Genus	Species
1. Bembidiini Stephens, 1827	1. ****Anomotachys* Jeannel, 1946	1. *****A. acaroides* (Motschulsky, 1860)
	2. *Bembidion* Latreille, 1802	2. ** *B. kara* Andrewes, 1921
		3. *B. niloticum* Dejean, 1831
	3. *Elaphropus* Motschulsky, 1839	4. *E. ceylanicus* (Nietner, 1858)
		5. *E. decoratus* (Andrewes, 1925b)
		6. *** *E. elutus* (Neitner, 1851)
		7. ** *E. fumicatus* (Motschulsky, 1851)
		8. * *E. haliploides* (Bates, 1892)
		9. *E. klugii* (Nietner, 1858)
		10. *E. nigellus* (Andrewes, 1935)

		11. *E. nilgiricus* (Andrewes, 1925)
		12. ** *E. ovatus* (Motschulsky, 1851)
		13. *E. politus* (Motschulsky, 1851)
		14. * *E. poecilopterus* (Andrewes, 1925)
		15. ** *E. unitarius* (Bates, 1892)
	4. ***Lymnastis* Motschulsky, 1862	16. ** *L. pilosus* Bates, 1892
		17. ** *L. pullulus* Motschulsky,1862
	5. *Tachys* Dejean, 1821	18. ** *T. cardoni* Andrewes, 1925
		19. ** *T. euryodes* Bates, 1892
		20. *T. fasciatus* Motschulsky, 1851
		21. *T. impressipennis* Motschulsky, 1859
		22. ** * *T. plagiatus* Putzeys, 1875
		23. ** *T. sericeus* Motschulsky, 1851
		24. *T. tropicus* Nietner, 1858

2. Trechini Bonelli, 1810	6. *Perileptus* Schaum, 1860	25. *P. ceylanicus* Nietner, 1857
		26. ****** *P. indicus* Jeannel, 1923
3. Pogonini Bonelli, 1810	7. *Pogonus* Csiki, 1907	27. ******** *P. malabarensis* Shigina & Sabu, 2024
******** New species; *** First report from India; ** First report from south India; * First report from Kerala		

4.1.3. Taxonomic Keys

4.1.3.1. Key to the species of subfamily Scaritinae recorded from Kerala

Genus *Clivina* Latreille, 1802

(Modified from Andrewes, 1929; Balkenohl, 2001, 2021)

1. Scutellary striole absent……..……***C. arunachalensis***
- Scutellary striole present……..……..**2**
2. Mesotibiae without spur above apex……***C. tranquebarica***
- Mesotibiae with spur above apex…….……..**3**
3. Labrum 7 setose…….**4**
- Labrum 9 setose…….**5**
4. Prothorax convex…….***C. thenmala***
- Prothorax almost parallel……...**6**
5. Head with impressions…….……..**7**
- Head without impressions…….***C. boreri***
6. Neck constriction widely interrupted at middle……***C. lobata***
- Neck constriction deep, uninterrupted at middle…….***C. brevior***
7. Frons with short oval central pore and a small pore at each side anteriorly; pronotum with bulge like vault at base……***C. forcipata***
- Frons with elongated central sulcus and a sulcus like impression at each side anteriorly; pronotum without bulge like vault at base……..…***C. ursulae***

Genus *Clypeuspinus* Balkenohl, 2021

1. Third interval of elytra with two setigerous punctures……..***C. devagiriensis***

Genus *Coryza* Putzeys, 1867

1. Humeral tooth on elytra slight……..***C. maculata***

Genus *Distichus* Motschulsky, 1858

1. Neck coarsely punctate…….……***……D. planus***
- Neck finely punctate…….……***D. puncticollis***

Genus *Dyschirius* Bonelli, 1810

1. Prothorax with median line deep throughout……***D. paucipunctus***

***Genus Leleuporella* Basilewsky, 1956**

1. Reflexed lateral border complete, extending over posterior setiferous punctures……...……***L. devagiriensis***

***Genus Orictites* Andrewes, 1931**

1. Pronotum punctated……...……***O. costulipennis***

***Genus Oxylobus* Chaudoir, 1855**

(Modified from Andrewes, 1929)

1. Prothoarx with a foveole in front angle……..**2**
- Prothorax without a foveole in front angle…….……**3**
2. Clypeal suture deep…….***O. pygmaeus***
- Clypeal suture shallow……..***O. porcatus***
3. Prothorax widest at or before middle……..***O. asperulus***
- Prothorax widest at basal third…….……..***O. lateralis***

Genus *Trilophidius* Jeannel, 1957

1. Elytral intervals impunctate…….***T. impunctatus***

***Genus Trilophus* Andrewes, 1927**

1. No neck constriction……..*T. interpunctatus*

4.1.3.2. Pictorial key (up to the species level) to the subfamily Scaritinae of Kerala

4.1.3.3. Key to the species of subfamily Trechinae recorded from Kerala

***Genus Anomotachys* Jeannel, 1946**

1. Border of elytra setulose and dentate……..*A. acaroides*

***Genus Bembidion* Latreille, 1802**

1. Each elytron with two dorsal pores on interval three…….…….*B. niloticum*
- Each elytron with three dorsal pores on interval three…….....*B. kara*

***Genus Elaphropus* Motschulsky, 1839**

(Modified from Andrewes, 1935)

1. Elytra fully striate……..…….*E. klugii*
- Elytra not fully striate……..……...**2**
2. Each elytron with three impressed dorsal striae…….*E. ceylanicus*
- Each elytron with not more than two dorsal striae……...……..**3**
3. Each elytron with only one dorsal stria……...…….*E. unitarius*
- Each elytron with two dorsal striae……...……**4**
4. Each elytron with only one dorsal pore…….……....*E. haliploides*
- Each elytron with two dorsal pores……...**5**
5. Basal sulcus of prothorax interrupted at middle……...**6**
- Basal sulcus of prothorax uninterrupted at middle……...**7**
6. Frontal furrows deep and converging in front……*E. fumicatus*
- Frontal furrows not converging in front……..……...**8**

7. Prothorax with a small pore at middle……..…….***E. elutus***

- Prothorax without pore at middle…….……**9**

8. Elytral surface black without any spot…….……..***E. nigellus***

- Elytral surface reddish brown, each with two pale transverse spots…….***E. decoratus***

9. Prothorax without transverse basal sulcus……***E. ovatus***

- Prothorax with transverse basal sulcus……..…..**10**

10. Elytral stria two not extending forward beyond the front dorsal pore……***E. poecilopterus***

- Elytral stria two extending forward beyond the front dorsal pore……....**11**

11. Dorsal striae crenulate……..***E. politus***

- Dorsal striae not crenulate……...***E. nilgiricus***

Genus *Lymnastis* Motschulsky, 1862

1. Elytral striae up to four and five visible……..…….***L. pilosus***

- Elytral striae very faint, only one and two visible……..……***L. pullulus***

***Genus Perileptus* Schaum, 1860**

1. Antennal joints shorter and lighter in colour…….***P. ceylanicus***

- Antennal joints longer and darker in colour……...***P. indicus***

Genus *Pogonus* Csiki, 1907

1. Basal area of pronotum depressed with dense coarse punctures and distinct lateral carina…….……..***P. malabarensis***

***Genus Tachys* Dejean, 1821**

(Modified from Andrewes, 1935)

1. Border of elytra dentate……..…….***T. impressipennis***

- Border of elytra not dentate…….…….……..**2**

2. Front dorsal pore adjoining stria three or four…….……..**3**

- Front dorsal pore on interval six…….……...**4**

3. Elytra with dark band across middle…….……***T. fasciatus***

- Elytra with dark band from base to apex…….…….…....***T. plagiatus***

4. Microsculpture of the head between eyes formed by transverse lines…….....***T. tropicus***

- Microsculpture of the head between eyes formed by isodiametric meshes…...**5**

5. Each elytron with four impressed dorsal striae ……**6**

- Each elytron with three impressed dorsal striae……...……...***T. cardoni***

6. Elytra only vaguely clouded……..***T. euryodes***

- Elytra with a dark cloud……..……***T. sericeus***

4.1.3.4. Pictorial key (up to the species level) to the subfamily Trechinae of Kerala

4.1.4. Checklist of subfamily Scaritinae from Kerala

Tribe Clivinini Rafinasque, 1815

Genus *Clivina* Latreille, 1802

Type species: Scarites *arenarius* Fabricius, 1775

Clivina Latreille,1802: 96; Bonelli, 1813: 480 Dejean, 1825: 411; Putzeys,1846: 523, 577; Lacordaire, 1854: 204; Putzyes, 1863: 29; id, 1867: 107; id, 1868: 10; id, 1873: 15; Tschitcherine, 1904: 258; Andrewes, 1924a: 11; id, 1926a: 372; id, 1929: 344, 351; id, 1930a: 110; Bänninger, 1937: 101, 106, 108; Jeannel, 1941: 65, 250, 256; id, 1946: 213, 220, 226, 234; Kult, 1951: 16; Erwin & Sims, 1984: 372, 426; Saha et al., 1992: 6; Kumar, 1997: 992; Balkenhol, 2001: 13; id, 2005: 141; Lorenz, 2005: 37; Bousquet, 2009: 37; Bouchard et al., 2011: 108; Abdel-Dayem, 2012: 198; Bousquet,

2012: 36, 70, 404; Hogan, 2012: 68, 105, 108, 111, 116; Dostal, 2012b: 33; id, 2015: 27; Kushwaha & Hegde, 2015: 399; Kushwaha et.al., 2015: 20; Dostal & Bulirsch, 2016: 65; Bulirsch & Stachowiak, 2017: 135; Balkenohl, 2017b: 197; Balkenohl, 2018: 199; Balkenohl, 2020a: 74; id, 2020b:1; id, 2021: 33; Sruthi & Sabu, 2022: 21631; Aswathi et.al., 2024: 417.

***Clivina arunachalensis* Saha & Biswas, 1985**

Clivina arunachalensis Saha & Biswas, 1985: 118; Aswathi et.al., 2024: 420.

Pseudoclivina arunachelnsis (Saha & Biswas, 1985); Balkenohl, 2001: 18.

Materials Examined. (n=21). Aralam Wildlife Sanctuary, 10ex., Light trap, 17.vi.2019, 10.vii.2020, 29. viii.2021; Ranipuram forest, 6 ex., Light trap, 10. v.2022, 11.vii.2020, 12.vii.2020; Chambad agricultural field, 4 ex., Light trap, 10.iii.2019, 25.ix.2019.

Distribution: India (Kerala: Kuttikkattoor, Poonoor, Thamarassery Tholpetty, Muthanga, Ambalavayal; Jharkhand: Dhanbad: Maithon Dam, Singhbhum; Madhya Pradesh: Ramana; Arunachal Pradesh: Tirap, Namdhapa; Uttarakhand: Dehradun).

***Clivina (Clivina) brevior* Putzeys, 1867**

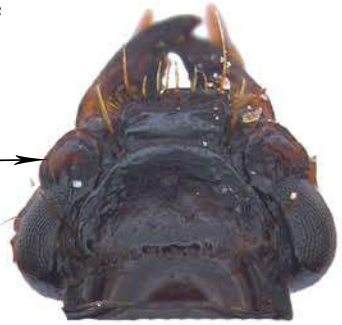
Clivina brevior Putzeys, 1867a: 126; Bates, 1892: 277; Andrewes, 1926a: 375; id, 1929: 355, 378; id, 1930a: 112; Balkenohl, 2001: 14; Lorenz, 2005: 142; Abitha, 2010: 71; 108; Akhil, 2019: 70, 130; Sruthi & Sabu, 2022: 21631; Divya, 2022: 106; Ashly, 2023: 95; Aswathi et.al., 2024: 421.

Materials Examined. (n =3,117). Aralam Wildlife Sanctuary, 35 ex., Light trap, 03.v.2019, 10.iii.2021, 28.vi.2019; Ranipuram Forest, 50 ex., Light trap, 20.iv.2020, 22.iv.2020, 25.iv.2020, 10.v.2022, 11.v.2022, 13.v.2022, 10.vii.2020, 11.vii.2020, 12.vii.2020, 15.xi.2022, 16.xi.2022, 17.xi.2022; Chambad Agricultural field, 2,909 ex., Light trap, 10.iii.2019, 11.iii.2019, 12.iii.2019, 13.iii.2019, 14.iii.2019,

Pictorial key to the Scaritinae beetles of Kerala

Key to the Indian tribes of Subfamily Scaritinae

1. Clypeal wings present.....Clivinini



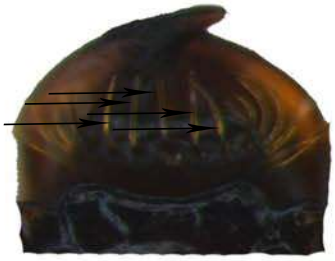
- Clypeal wings absent.....2

2. Pronotum globsoe.....Dyschirini

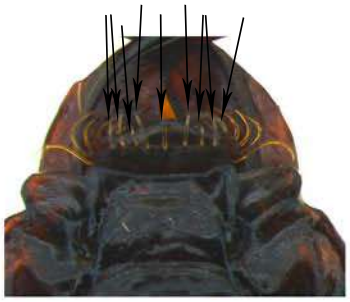
- Pronotum subquadrate or quadrate.....Scaritini

Key to the genus of the tribe Clivini from Kerala

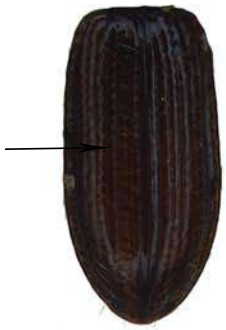
1. Labrum 5 setose.....2



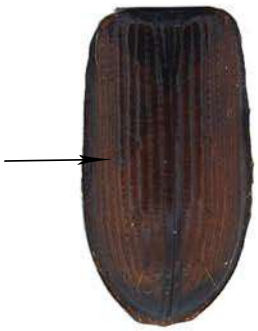
- Labrum 6, 7 or 9 setose.....3



2. Elytra with setigerous pores on interval 5....*Trilophus*

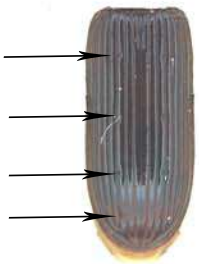


- Elytra without any raws of setiferous pores on interval 5.....*Trilophidius*

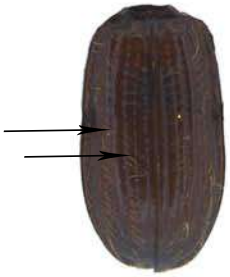


3.Elytra without setigerous punctures on interval 3.....*Pseudoclivina*

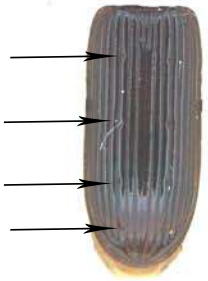
- Elytra with setigerous pores on interval 3.....4



4. Comb like row of 25-30 setate on
interval 3 & 5.....*Leleuporella*



- Interval 3 of elytron with 2 to 4
setigerous pores.....5



5. Clypeus with 4 tubrcle like teeth.....*Coryza*

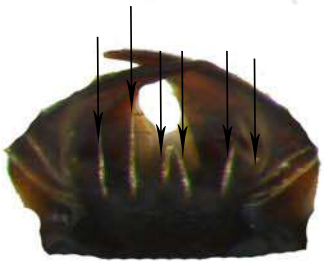
- Clypeus without tooth.....6

6. Head with frons, clypeus and supra-antenal plate
elongate.....*Clypeuspinus*

- Head with frons, clypeus and supra-antennal plate
not elongate.....*Clivina*

Key to the genus of the tribe Dyschirini from Kerala

1.Labrum 6 setose..... .*Dyschirius*



Key to the genus of the tribe Scaritini from Kerala

1.Elytra oval.....*Oxylobus* →

- Elytra parallel.....*Distichus* →

Key to the species of the genus *Clivina* from Kerala

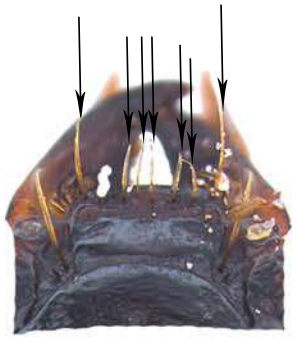
1.Scutellary striole absent.....*C. arunachalensis*

- Scutellary striole present.....2

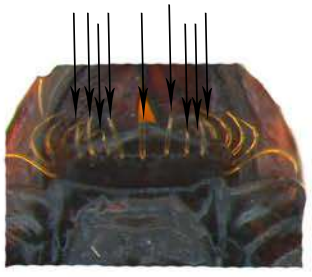
2. Mesotibiae without spur above apex.....*C.tranquebarica*

- Mesotibiae with spur above apex.....3

3. Labrum 7 setose.....4



- Labrum 9 setose.....5



4.Prothoarax convex .....*C. thenmala*

- Prothorax parallel.....6

5.Head with impressions.....7

- Head without impressions.....*C. boreri*

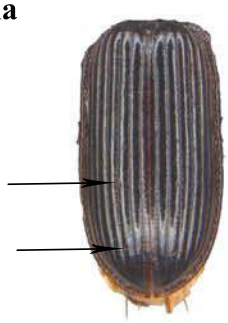
6.Neck constriction interrupted at middle, shallow.....*C. laobata*

- Neck constriction not interrupted at middle, deep.....*C. brevior*

7. Frons with short oval central pore and a small pore at each side anteriorly.....*C. forcipata*

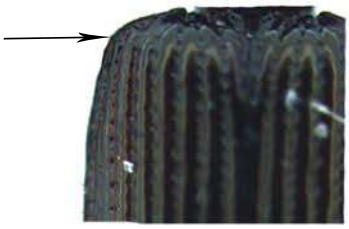
- Frons with elongated central sulcus and a sulcus like impression at each side anteriorly.....*C. ursulae*

Key to the speciec of the genus *Clypeuspinus* from Kerala



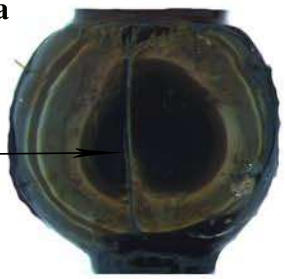
1.Third interval of elytra with two setigerous punctures.....*C. devagiriensis*

Key to the species of the genus *Coryza* from Kerala



1.Humeral tooth present.....*C. maculata*

Key to the species of the genus *Dyschirius* from Kerala



1.Prothorax with medin line deep throughout .....*D. paucipunctus*

1.Neck coarsely punctate.....*D. planus*

- Neck finely punctate.....*D.puncticollis*

Key to the species of the genus *Pseudoclivina* from Kerala

1.Humeral tooth of elytra is at the base of interval 6.....*P. costata*

Key to the species of the genus *Leleuporella* from Kerala

1. Reflexed lateral border complete, extending over posteriorsetiferous punctures.....*L.devagiriensis*

Key to the species of the genus *Trilophus* from Kerala

1.No neck constriction.....*T. interpunctatus*

Key to the species of the genus *Trilophidius* from Kerala

1.Elytral intervals impunctate.....*T. impunctatus*

Key to the species of the genus *Oxylobus* from Kerala

1.Prothorax with a foveole with in the front angle.....2

- Prothrax without foveole with in the front angle.....3

2.Clypeal suture deep.....*O. pygmaeus*

- Clypeal suture shallow..... .....*O. porcatus*

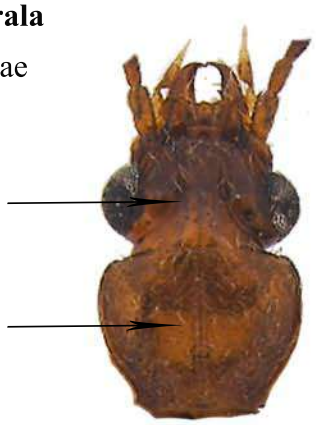
3.Prothorax widest at or before middle.....*O. asperulus*

- Prothorax widest at basal third.....O. *lateralis*

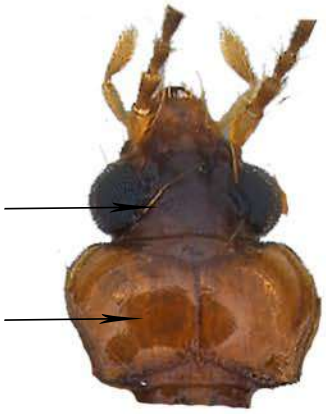
Pictorial key to the Trechinae beetles of Kerala

Key to the Indian tribes of Subfamily Trechinae

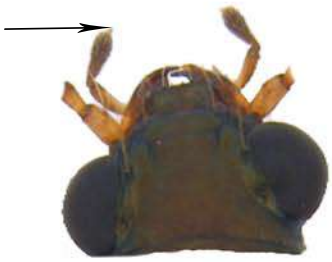
1. Long sensory setae in the head
and pronotum.....Trechini



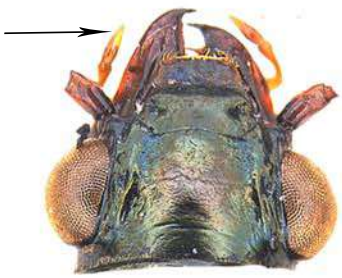
- No sensory setae in head anad pronotum.....2



2. Reduced maxillary palpomere with
subulation at apex.....Bembidiini

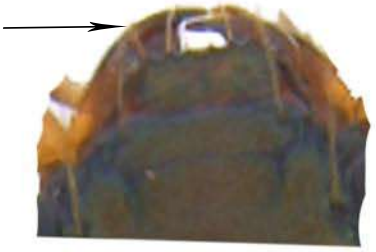


- Well developed fusiform maxillary
palpomere without subulation.....Pogonini

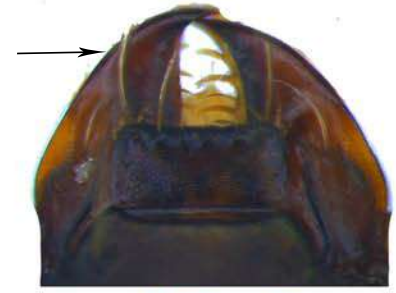


Genus key to the tribe Bembidiini from Kerala

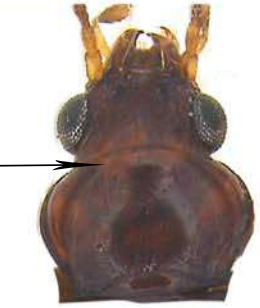
1.Mandibles short .....*Bembidion*



- Mandibles long 2



2.Upper surface glabrous.....3



- Upper surface shortly pubescent.....*Lymnastis*

3.Apical striole on elytra absent.....*Anomotachys*

- Apical striole on elytra present.....4

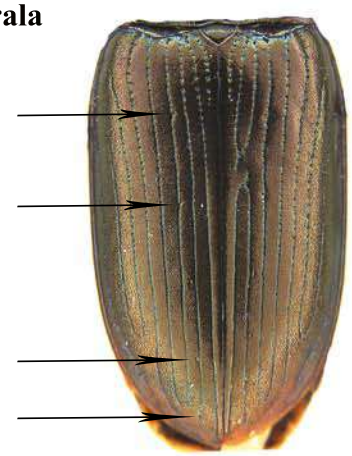
4. Mentum with two circular
pores.....*Tachys*

- Mentum without pores.....*Elaphropus*

Genus key to the tribe Trechini from Kerala

1.Curved frontal furrows
that orbit the eyes.....*Perileptus*

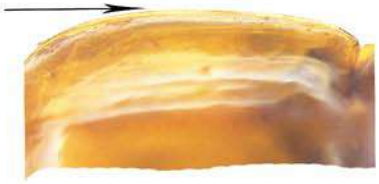
Genus key to the tribe Pogonini from Kerala



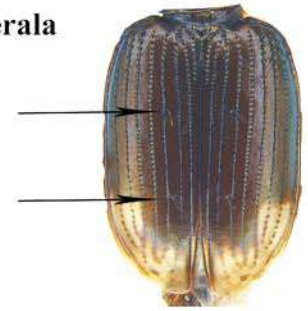
1.Interval three of elytron
with 4 to 5 setiferous pores.....*Pogonus*

Species key to the genus *Anomotachys* from Kerala

1.Border of elytra setulose
and dentate.....*A. acaroides*

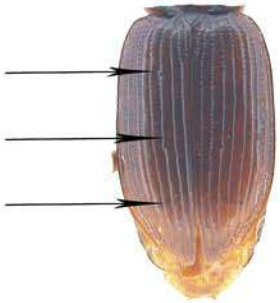


Species key to the genus *Bembidion* from Kerala



1.Elytron with 2 dorsal
pores on interval 3.....*B. niloticum*

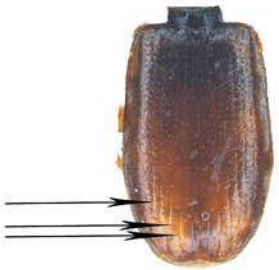
- Elytron with 3 dorsal
pores on inteval 3.....*B. kara*



Species key to the genus *Lymnastis* from Kerala

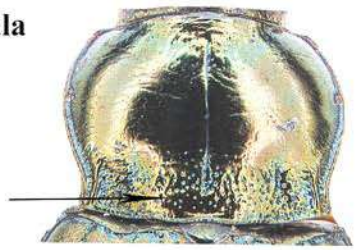
1. Elytral striae upto 4 and
5 visible through out.....*L. pilosus*

- Elytral striae faint, only
visible towards apex.....*L. pullulus*



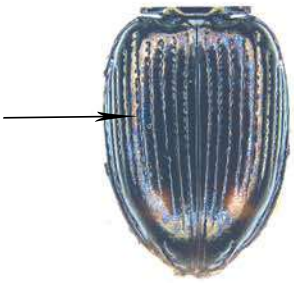
Species key to the genus *Pogonus* from Kerala

1.Basal area of pronotum depressed with
dense coarse punctures.....*P. malabarensis*

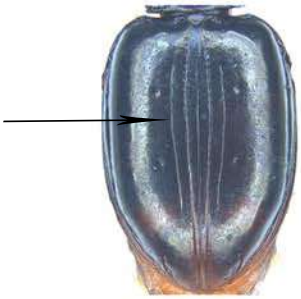


Species key to the genus *Elaphropus* from Kerala

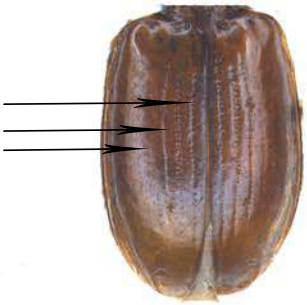
1. Elytra fully striate..... .....*E. klugii*



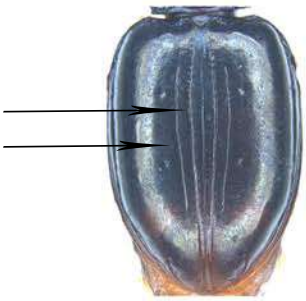
- Elytra not fully striate.....3



2. Elytron with 3 impressed
dorsal striae.....*E. ceylanicus*

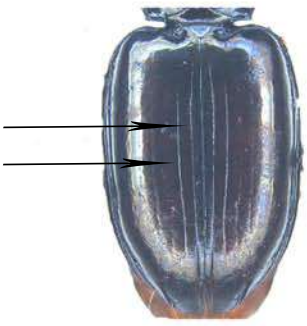


- Elytron with not more than
2 dorsal striae.....4



3. Elytron with only
one dorsal striae.....*E. unitarius*

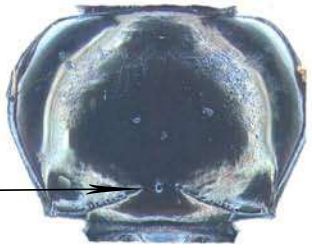
- Elytron with 2 dorsal striae.....5



5.Elytron with only one
dorsal pore.....*E. haliploides*

- Elytron with 2 dorsal pores.....6

6.Basal sulcus of prothorax
interrupted at middle.....7



- Basal sulcus of prothorax
uniterrupted at middle.....8

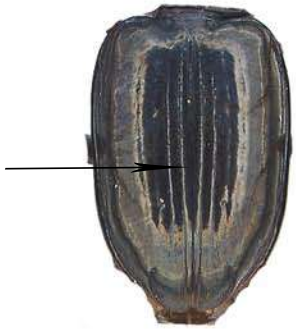
7.Frontal furrow deep and
converging in front.....*E. fumicatus*

- Frontal furrows not converging in front.....10

8. Prothorax with a small pore at middle.....*E. elutus*

- Prothorax without pore at middle.....9

9. Elytral surface black
without any spot.....*E. nigellus*



- Elytra reddish brown, each with elytron with
two transverse pale spots.....*E. decoratus*

10. Prothorax without
transverse basal sulcus.....*E. ovatus*

- Prothorax with transverse basal sulcus.....11

11. Elytral striae 2 not extending forward
beyond the front dorsal pore..... .....*E. poecilopterus*

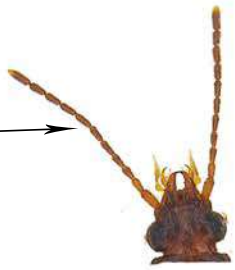
- Elytral striae 2 extending forward
beyond the front dorsal pore.....12

12 Dorsal striae crenulate..... .....*E. politus*

- Dorsal striae not crenulate.....*E. nilgiricus*

Species key to the genus *Perileptus* from Kerala

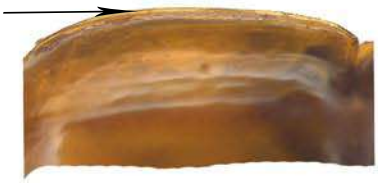
1. Antennae joints shorter and
lighter in colour.....*P. ceylanicus*



- Antennal joints longer and
darker in colour.....*P. indicus*

Species key to the genus *Tachys* from Kerala

1. Border of elytra dentate..... .*T. impresipennis*

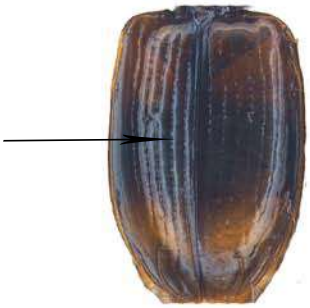


- Border of elytra not dentate.....2

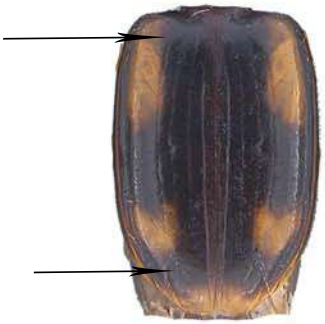
2. Front dorsal pore adjoining striae 3.....3

- Front dorsal pore on interval 6.....4

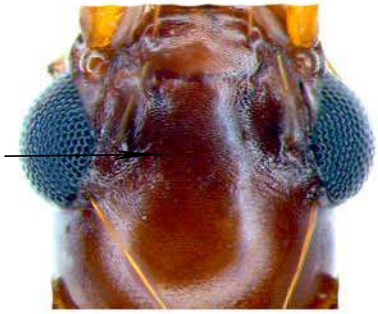
3. Elytra with a dark band across middle.....*T. fasciatus*



- Elytra with dark band from base to apex...*T.. plagiatus*

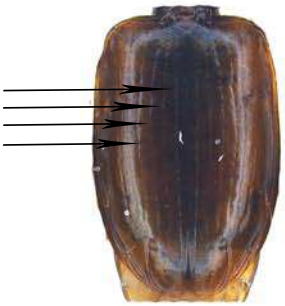


4. Microsculpture of the head between eyes formed by transverse lines.....*T. tropicus*

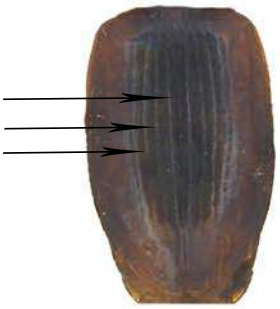


- Microsculpture of the head between eyes formed by isodiametric meshes.....5

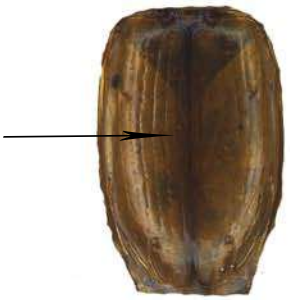
5. Elytron with four impressed dorsal stria.....6



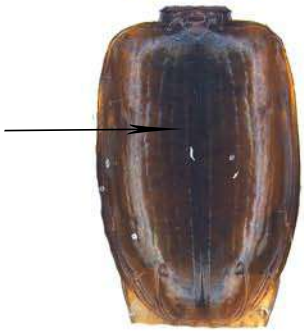
- Elytron with three impressed dorsal striae...*T. cardoni*



6. Elytra only vaguely clouded.....*T. euryodes*



- Elytra with dark cloud.....*T. sericeus*



22.iii.2021, 24.iii.2021, 23.iii.2021, 25.iii.2021, 26.iii.2021, 16.vi.2019, 17.vi.2019, 18.vi.2019, 19.vi.2019, 20.vi.2019, 22.vi.2019, 25.viii.2021, 26.viii.2021, 27.viii.2021, 28.viii.2021, 29.viii.2021, 22.iv.2019, 23.iv.2019, 24.iv.2019, 25.iv.2019, 26.iv.2019, 01.v.2021, 02.v.2021, 03.v.2021, 04.v.2021, 16.iii.2022, 17.iii.2022, 18.iii.2022, 25.vii.2019, 26.vii.2019, 27.vii.2019, 28.vii.2019, 29.vii.2019, 30.vii.2019, 14.ix.2021, 15.ix.2021, 16.ix.2021, 17.ix.2021, 18.ix.2021, 25 ex., Pitfall trap, 22.iv.2019, 23.iv.2019, 03.v.2021, 16.vi.2019, 17.vi.2019, 16.ix.2021, 17.ix.2021, 3 ex., Hand picking, 24.iv.2019, 02.v.2021, 25.viii.2021, 25 ex., pitfall trap, 03.v.2019, 04.v.2019, 06.v.2019, 28.vi.2019, 15.viii.2021; Ponnani, 25 ex., Light trap, 05.vi.2023, 06.vi.2023, 07.vi.2023; Chalakkudi, 20 ex., Light trap, 15.viii.2023, 16.viii.2023; Velloor, 60 ex., Light trap, 25.ix.2023, 26.ix.2023, 27.ix.2023, 28.ix.2023; Vettinad, 15 ex., Light trap, 03.iv.2023, 04.iv.2023, 05.iv.2023.

Distribution: India (Kerala: Naduvannur, Kuttikattoor, Medical College, Thamarassery; Muthanga, Tholpetty, Ambalavayal, Nilambur, Pattambi, Chinnar, Pudussery, Walayar Reserve Forest, Chulanur Peafowl Sanctuary; Tamil Nadu: Path to SSR estate; Maharashtra: Aurangabad: Deohara; Bihar: Pusa); Indonesia; Myanmar; Malaysia.

** ***Clivina boreri*** **Balkenohl, 2020**

Clivina boreri Balkenohl, 2020: 5; Aswathi et.al., 2024: 424.

Materials Examined. (n =17). Chambad Agricultural field, 17ex., Light trap, 27. viii.2021, 29. viii.2021; 14.ix.2021, 15.ix.2021, 17.ix.2021.

Distribution: India (Bihar: Pusa); Nepal.

Clivina forcipata **(Putzeys, 1863)**

Dacca forcipata Putzeys, 1863: 68; id, 1867: 25; Csiki, 1927b: 493.

Clivina forcipata (Putzeys, 1863); Andrewes, 1928a: 150; id, 1929: 355, 380: id, 1930a: 114; Csiki, 1933: 638; Kult, 1951: 25; Balkenohl, 2001: 15; Lorenz 2005: 145; Abitha, 2010: 77; Akhil, 2019: 131; Balkenohl, 2020b:1; id, 2021b: 36; Aswathi et.al., 2024: 424.

Materials Examined. (n =19). Chambad Agricultural field, 19 ex., Light trap, 18.vi.2019, 26. viii.2021, 14. Vii.2022, 18.vii.2022, 27.vii.2019, 16.ix.2021, 17.ix.2021, 10.vi.2022.

Distribution: India (Kerala: Chalakkudi, Thamarassery, Nilambur; Andra Pradesh: Anantapur; Odisha: Ganjam: Barkuda Island: Chilka Lake; Jharkhand: Rajmahal, Tinpahar; West Bengal: Kolkata, Mertlik, Sardah Haldibari Cooch Behar; Bihar: Pusa); Bangladesh; Sri Lanka.

***Clivina lobata* Bonelli, 1813**

Clivina lobata Bonelli, 1813: 481; Dejean, 1825: 414; Putzeys, 1846: 599; id, 1867: 120; Andrewes, 1919a: 209; id, 1921a: 340; id, 1922[Ψ]: 392; id, 1924a: 11; id, 1926a: 375; id, 1929: 355, 375; id, 1930a:114; Saha et al., 1992: 3, 8; Lorenz, 2005: 143; Abitha, 2010: 79; Kushwaha & Hegde, 2015: 399, 419; Kushwaha et al., 2015: 20; Kushwaha et al., 2017: 337; Balkenohl, 2017b: 255; Mili et al., 2018: 118; Sruthi & Sabu, 2022: 21631; Divya, 2022: 107; Ashly, 2023: 98; Aswathi et.al., 2024: 422.

Materials Examined. (n =47). Chambad Agricultural field, 9 ex., Pitfall trap, 18.vi.2019, 20.vi.2019; Vesala Agricultural field, 6 ex., Pitfall trap, 14.ix.2021; Vellimadukunnu, 10 ex., Light trap, 15. v.2023, 16. v.2023, 17. v.2023; Panamaram, 17 ex., Light trap, 24.vii.2023, 25.vii.2023; Chalakkudi, 5 ex., Light trap, 15. viii.2023.

Distribution: India (Kerala: Thamarassery, Thirunelli, Chulanur Peafowl Sanctuary, Chinnar, Koottar, Ambalavayal, Pattambi; Gujarat; Bihar: Pusa; Chhattisgarh: Raipur;

Uttar Pradesh: Prayagraj, Ramnagar; Assam: Jorhat; West Bengal, Sundarban, Gosaba, Pakhirala); China; Japan; Myanmar; Thailand.

***Clivina thenmala* Balkenohl, 2021a**

Clivina thenmala Balkenohl, 2021: 3, 13, 55, 58, 60, 68, 71, 75; Aswathi et.al., 2024: 424.

Materials Examined. (n =8). Aralam Wildlife Sanctuary, 2 ex., Light trap, 16.vii.2021; Chambad Agricultural field, 5 ex., Light trap, 20.vi.2019, 22.vi.2019, 25. viii.2021, 1 ex., pitfall trap, 14.iii.2019.

Distribution: India (Kerala: Thenmala).

***Clivina tranquebarica* Bonelli, 1813**

Clivina tranquebarica Bonelli, 1813: 484; Andrewes, 1926a: 377; id, 1929: 353, 359; id, 1930a: 117; Kult, 1951: 20; Balkenhol, 1994: 26; Lorenz, 2005: 144; Bousquet, 2009: 45; Abitha, 2010: 81; Kushwaha & Hegde, 2015: 399, 419; Balkenohl, 2017b: 257; Akhil, 2019: 131; Balkenohl, 2021a: 36, 38; Divya, 2022: 108; Ashly, 2023: 101; Aswathi et.al., 2024: 419.

Materials Examined. (n =937). Aralam Wildlife Sanctuary, 98 ex., Light trap, 03.v.2019, 04.v.2019, 10.iii.2021, 28.vi.2019, 29.vi.2019, 15.viii.2021, 16.viii.2021, 17.viii.2021, 7 ex., Pitfall trap, 12.iii.2019, 13.iii.2019, 28.vi.2019, 29.vi.2019; Ranipuram Forest, 58 ex., Light trap, 20.iv.2020, 22.iv.2020, 25.iv.2020, 10.v.2022, 11.v.2022, 13.v.2022, 10.vii.2020, 11.vii.2020, 12.vii.2020, 15.xi.2022, 16.xi.2022, 17.xi.2022, 3 ex., Pitfall trap, 20.iv.2020, 22.iv.2020, 5 ex., Hand picking, 22.iv.2020, 25.iv.2020, 10.v.2022; Chambad Agricultural Field, 535 ex., Light trap, 10.iii.2019, 11.iii.2019, 12.iii.2019, 13.iii.2019, 14.iii.2019, 22.iii.2021, 24.iii.2021, 23.iii.2021, 25.iii.2021, 26.iii.2021, 16.vi.2019, 17.vi.2019, 18.vi.2019, 19.vi.2019, 20.vi.2019, 22.vi.2019, 25.viii.2021, 26.viii.2021, 27.viii.2021, 28.viii.2021, 29.viii.2021,

22.iv.2019, 23.iv.2019, 24.iv.2019, 25.iv.2019, 26.iv.2019, 01.v.2021, 02.v.2021, 03.v.2021, 04.v.2021, 16.iii.2022, 17.iii.2022, 18.iii.2022, 25.vii.2019, 26.vii.2019, 27.vii.2019, 28.vii.2019, 29.vii.2019, 30.vii.2019, 14.ix.2021, 15.ix.2021, 16.ix.2021, 17.ix.2021, 18.ix.2021, 7 ex., Pitfall trap, 22.iv.2019, 23.iv.2019, 03.v.2021, 4 ex., Hand picking, 24.iv.2019, 02.v.2021, 25.viii.2021; Vellimadukunnu, 55 ex., Light trap, 15. v.2023, 16. v.2023, 17. v.2023; Panamaram, 24 ex., Light trap, 24.vii.2023, 25.vii.2023, 26.vii.2023; Ponnani, 45 ex., Light trap, 05.vi.2023, 06.vi.2023, 07.vi.2023; Chalakkudi, 36 ex., Light trap, 15.viii. 2023, 16. viii.2023, 17. viii.2023, 18. viii.2023; Velloor, 51 ex., Light trap, 25.ix.2023, 26.ix.2023, 27.ix.2023, 28.ix.2023; Anjal, 9 ex., Light trap, 20.iv.2023, 21.iv.2023.

Distribution: India (Kerala: Nilambur, Chelannur, Kuttikkattoor, Thondayad, Thamarassery Pudussery, Chulanur Peafowl Sanctuary, Walayar Reserve Forest, Ambalavayal, Pattambi, Tholpetty, Lower Kodayar; Tamil Nadu: Kadayam, Srivalliputhur, Tenkasi: SA estate, Courtallam, Nellai Wildlife Sanctuary; Gujarat: Piplod; Bihar: Pusa; Uttar Pradesh: Deoria, Hardoi, Siddharth Nagar, Sitapur, Lalitpur, Mirzapur; South East India; West Bengal: Kalimpong; Uttarakhand: Dehradun, Dobhalwala, Rishikesh); Cambodia; Laos; Indonesia; Malaysia; Myanmar; Sree Lanka; Thailand; Vietnam; Nepal; Yunnan.

*** ***Clivina ursulae*** **Balkenohl, 2020**

Clivina ursulae Balkenohl, 2020: 7.

Materials Examined. (n =105). Chambad Agricultural Field, 95 ex., Light trap, 29.vi.2019, 11.vii.2020, 12.vii.2020, 15. viii.2021, 16. viii.2021, 15.xi.2022, 16.xi.2022, 17.xi.2022, Badiyadukka Agricultural Field,10 ex., Light trap, 12.viii.2019, 14.x.2020, 15. x.2020.

Distribution: Sri Lanka.

Genus *Clypeuspinus* Balkenohl, 2021

Type species: *Psilus validus* Andrewes, 1936.

Clypeuspinus Balkenohl, 2021: 357; Neethu & Sabu, 2023: 589; Aswathi et.al., 2024: 424.

***Clypeuspinus devagiriensis* Neethu & Sabu, 2023**

Clypeuspinus devagiriensis, Neethu & Sabu, 2023: 589; Aswathi et.al., 2024: 425.

Materials Examined. (n =1). Chambad Agricultural Field, 1ex., Light trap, 12.vii.2020.

Distribution: India (Kerala: Mavoor, Palliyol).

Genus *Coryza* Putzeys, 1867

Type species: *Clivina maculata* Nietner, 1856.

Coryza Putzeys, 1867a: 194; Tschitschérine, 1904: 258[ψ]; Andrewes, 1926a: 380; id, 1929: 344, 346; id, 1930a: 130; Jeannel, 1946: 221, 225; Balkenohl, 2001: 11, 17; Lorenz, 2005: 148; Dostal, 2017: 116; Balkenohl, 2017b: 257; Aswathi et.al., 2024: 430.

***Coryza maculata* (Nietner, 1856)**

Clivina maculata Nietner, 1856: 391; id, 1857: 246; Putzeys, 1863:51.

Coryza maculata (Nietner, 1856); Putzeys, 1867: 196; Andrewes, 1926a: 380; id, 1927a: 105; id, 1927b: 265; id, 1929: 348, 349; id, 1930a: 131; Balkenohl, 2001: 17; Lorenz, 2005: 148; Balkenohl, 2017b: 257; Akhil, 2019: 132; Balkenohl, 2021b: 36; Aswathi et.al., 2024: 430.

Materials Examined. (n =2). Chambad Agricultural Field, 2ex., Light trap, 16. viii.2021.

Distribution: India (Kerala: Malabar; Tamil Nadu: Nilgiri Hills, Srivalliputhur; Karnataka: North Kanara; Maharashtra: Nagpur; Bihar: Pusa; Nagaland: Naga Hills;

West Bengal: Eastern Duars; Uttarkhand: West Almora, Garhwal, Haldwani, Dehradun); Myanmar; Sree Lanka; Nepal.

Genus *Leleuporella* Basilewsky, 1956

Type species: *Leleuporella caeca* Basilewsky, 1956a.

Leleuporella Basilewsky, 1956a: 424; Balkenohl, 1997: 605; id, 1999:436, 440, 496, 498; id, 2001: 28, 31, 34, 36, 58; Lorenz, 2005: 148; Abitha & Sabu, 2009: 59; Bousquet, 2012: 36; Fedorenko, 2012: 127; Grebennikov et. al., 2017: 2; Bulirsch & Magrini, 2019a: 299; Aswathi et.al., 2024: 425.

***Leleuporella devagiriensis* Abitha & Sabu, 2009**

Leleuporella devagiriensis Abitha & Sabu, 2009: 59; Bulirsch & Magrini, 2019a: 299, 302; Ashly, 2023: 104; Aswathi et.al., 2024: 425.

Materials Examined. (n =35). Chambad Agricultural Field, 35ex., Light trap, 14.ix.2021, 15.ix.2021, 16.ix.2021, 17.ix.2021, 18.ix.2021.

Distribution: India (Kerala: Kunnamangalam, Pattambi).

Genus *Orictites* Andrewes, 1931

Type species: *Orictites minotaur* Andrewes, 1931.

Orictites Andrewes, 1931: 433, 438; Csiki, 1933: 638; Balkenohl, 1996: 24; Lorenz, 1998: 135; Baehr, 1999: 115; Balkenohl, 2001: 9, 17; Lorenz, 2005: 146; Balkenohl, 2017a: 4; id, 2017d: 1; id, 2020a: 74; Aswathi et.al., 2024: 425.

****Orictites costulipennis* (Bates, 1892)**

Clivina costulipennis Bates, 1892: 281; Andrewes, 1926a: 373; id, 1929: 354, 366; id, 1930a: 113; Saha & Halder, 2000: 2, Balkenohl, 2001: 14.

Oricites costulipennis (Bates, 1892); Balkenohl, 2017a: 1; id, 2017d: 6, 12, 21; Aswathi et.al., 2024: 425.

Materials Examined. (n =3). Chambad Agricultural Field, 3ex., Light trap, 15.ix.2021.

Distribution: India (Meghalaya: Shillong, Cherrapunji); Indonesia; Malaysia; Myanmar; Thailand.

Genus *Pseudoclivina* Kult, 1947

Type species: *Clivina grandis* Dejean, 1826.

Pseudoclivina Kult, 1947: 30, 32; id, 1951: 18; Balkenohl, 2001: 18; Lorenz, 2005: 145; Dostal, 2012a: 25, 32; id, 2017: 118; Balkenohl, 2017b: 258; Aswathi et.al., 2024: 430.

***Pseudoclivina costata* (Andrewes, 1929)**

Clivina costata Andrewes, 1929: 354, 364; id, 1930a: 113.

Pseudoclivina costata (Andrewes, 1929); Kult, 1951:18; Balkenohl, 2001:18; Lorenz, 2005: 145; Dostal, 2012a: 31; Akhil, 2019: 133; Sruthi & Sabu, 2022: 21631; Divya, 2022: 109; Aswathi et.al., 2024: 431.

Materials Examined. (n =3). Kakkayam Forest, 3 ex., Light trap, 05.iii.2021.

Distribution: India (Kerala: Muthanga, Vellarimala, Tholpetty, Chinnar: Alampetty, Chulanur Peafowl Sanctuary; Karnataka: Gundlupete; Tamil Nadu: Nilgiri Hills, Kadayam, Srivalliputhur).

Genus *Trilophidius* Jeannel, 1957

Type species: *Trilophus congoanus* Burgeon, 1935

Trilophidius Jeannel, 1957: 142; Balkenohl, 1999: 430, 436, 440, 463, 495, 505; id, 2001: 1, 3, 11, 28, 32, 34, 37, 49; Lorenz, 2005: 148; Grebennikov et. al., 2017: 2; Balkenohl, 2017b: 260; id, 2017c: 51, 55; Balkenohl, 2018: 197; Aswathi et.al., 2024: 427.

******Trilophidius impunctatus* (Putzeys, 1868)**

Dyschirius impunctatus Putzeys, 1868: 22

Trilophidius impunctatus (Putzeys, 1868): 22; Balkenohl, 1999: 441, 444; Lorez, 2005:148.

Materials Examined. (n =2). Chambad Agricultural Field, 2ex., Light trap, 26.iii.2021.

Distribution: Sri Lanka; Myanmar; Thailand; Vietnam; Indonesia.

Genus *Trilophus* Andrewes, 1927

Type species: *Dyschirius interpunctatus* Putzeys, 1867

Trilophus Andrewes, 1927b: 263; id, 1929: 344, 381; id, 1930a: 356; Ciski, 1933: 639; Burgeon, 1935: 153; Jeannel, 1957: 140; Saha et. al., 1992: 6; Balkenohl, 1994: 26; id, 1999: 429; id, 2001: 5,17, 34, 36, 50, 58; Lorenz, 2005: 148; Grebennikov et. al., 2017: 2; Balkenohl, 2017b: 260; Balkenohl, 2020a: 74; Aswathi et.al., 2024: 427.

***Trilophus interpunctatus* (Putzeys, 1867)**

Dyschirius interpunctatus Putzeys, 1867: 97; id, 1878: 174.

Oxydrepanus interpunctatus (Putzeys, 1867); Andrewes, 1926a: 378.

Trilophus inetrpunctatus (Putzeys, 1867): Andrewes, 1927b: 265; id, 1929: 383; id, 1930a: 356; Jeannel, 1957: 140; Balkenohl, 1999: 441, 444, 461; id, 2001: 52, 56; Lorenz, 2005: 148; Abitha, 2010: 89, 109; Balkenohl, 2017b: 260; Aswathi et.al., 2024: 428.

Materials Examined. (n =8). Ranipuram Forest, 1 ex., Light trap, 22.vi.2019; Chambad Agricultural Field, Light trap, 7ex., 22.iii.2021, 24.iii.2021, 23.iii.2021, 25.iii.2021, 26.iii.2021; 27. viii.2021, 28. viii.2021, 29. viii.2021.

Distribution: India (Kerala: Thamarassery; Bihar: Purnia, Kierpur; West Bengal: Kolkata; Punjab: Firozpur; Uttarakhand: Kumaon: West Almora); Bangladesh; Indonesia; Nepal; Pakisthan.

Genus *Dyschirius* Bonelli, 1810

Type species: *Scarites thoracicus* Rossi, 1790.

Stephens, 1827: 37, 40; Putzeys, 1846: 524; Lacordaire, 1854: 202; Putzeys,1867: 32; Andrewes, 1919a: 99; Müller, 1922: 33; Andrewes, 1926a: 377; id, 1929: 390; id, 1930a: 159; Jeannel, 1941: 250, 260, 275; id, 1946: 213, 215, 218; Saha et. al., 1992: 9; Fedorenko, 1996: 5, 9, 11, 13, 18, 20, 22, 25, 27, 32, 37, 40, 50, 54, 56, 58, 62, 71; Lorenz, 2005: 151; Bulirsch, 2009: 559; Bosquet, 2012: 431; Hogan, 2012: 106, 111, 116, 231; Kushwaha & Hegde, 2015: 399, 419; Fedorenko, 2016: 439; Bulirsch & Stachowiak, 2017: 137; Balkenohl, 2017b: 263; Bulirsch, 2018: 229; Aswathi et.al., 2024: 427,433.

***Dyschirius paucipunctus* Andrewes, 1929**

Dyschirius paucipunctus (Andrewes, 1929); Lorenz, 2005: 154; Sruthi & Sabu, 2022: 21631; Divya, 2022: 110.; Ashly, 2023: 105; Aswathi et.al., 2024: 434.

Materials Examined. (n =70). Aralam Wildlife Sanctuary, 52 ex., Light trap, 03. v.2019, 04. v.2019, 05. v.2019, 06v.2019, 10.iii.2021, 11.03.2021, 14.iii.2021, 15. viii.2021, Ranipuram Forest, 1 ex., Light trap, 15.xi.2022; Chambad Agricultural field, 17 ex., Light trap, 14.iii.2019, 22.iii.2021, 24.iii.2021, 19.vi.2019, 20.vi.2019, 22.vi.2019, 28. viii.2021, 29. viii.2021.

Distribution: India (Kerala: Chinnar: Kootar, Pudussery, Ambalavayal; Maharashtra: Pune; Karnataka: Belgaum); Sree Lanka.

Genus *Distichus* Motschulsky, 1858

Type Species: *Scarites planus* Bonelli, 1813.

Motschulsky, 1858: 96; Chaudoir, 1880: 44; Ganglbauer, 1891: 129; Bedel, 1895: 38; Péringuey, 1896a: 379 ♆; Reitter, 1899 ♆: 8; Tchitcherine, 1904: 258, 265; Jacobson, 1906 ♆: 269; Barthe, 1911♆: 184; Porta, 1923: 80; Andrewes, 1923b: 225; id, 1924a:9; Csiki, 1927a: 473; Bänninger, 1931: 201; id, 1933: 92; Schatzmayr, 1936: 27; Bänninger, 1937: 85, 124; id, 1938: 75, 88; Jeannel, 1941: 237, 252; id, 1946: 237; Reichardt, 1977: 388; Erwin & Sims, 1984: 370; Dostal, 1996: 7; id, 1999: 100; Lorenz, 2005: 137; Abitha, 2009: 92, 103; Hogan, 2012: 28; Balkenohl, 2017b: 275; Kushwaha & Hegde, 2017: 12; Aswathi et.al., 2024: 448.

***Distichus planus* (Bonelli, 1813)**

Scarites planus Bonelli, 1813: 470; Dejean, 1825: 395; id, 1830: 198; Bonelli, 1829 ♆: 233, 279; id, 1930 ♆: 301; Jeannel, 1941: 253; Kushwaha & Hegde, 2015: 399, 417; Aswathi et.al., 2024: 450.

Taneolobus planus (Bonelli, 1813); Chaudoir, 1855: 46.

Distichus planus (Bonelli, 1813); Chaudoir, 1880: 42, 53; Tchitchérine, 1904: 265; Andrewes, 1919a: 99; id, 1919b: 470id, 1921b: 146; Lorenz, 2005:137; Balkenohl, 2017b: 275; Abdel-Dayem et. al.,2017: 9; Ghahari et.al., 2009: 445; Divya, 2022: 112; Ashly, 2023: 106; Aswathi et.al., 2024: 450.

Materials Examined. (n =7). Chambad Agricultural field, 3ex., Light trap, 10.iii.2019, 11.iii.2019, 29.vii.2019, 2 ex., Pitfall trap, 29.vii.2019, Vellimadukunnu Agricutural field, 2ex., Light trap, 10.ii.2021.

Distribution: India (Kerala: Ambalavayal, Pattambi, Pudussery; Tamil Nadu: Tiruchirapalli: Kallikudi; Uttar Pradesh: Ajnari, Chitrakoot, Jalaun, Orai, Pahar); France; Portugal; Spain; Italy; Malta; Greece; Morocco; Tunisia; Egypt; Israel; Jordan; Syria; Turkey; Cyprus; Iraq; Saudi Arabia; Yemen; Iran; Georgia; Azerbaijan; Kazakhstan; Uzbekistan; Turkmenistan; Tadzhikistan; Pakistan; Russia.

***Distichus puncticollis* (Chaudoir, 1855)**

Taeniolobus puncticollis Chaudoir, 1855: 47.

Distichus puncticollis (Chaudoir, 1885); Chaudoir, 1880: 55; Bates, 1891: 325; Andrewes, 1919a: 162; id, 1921b: 146, 168; id, 1924a: 9; Lorenz, 2005:137; Balkenohl, 2017b: 275; Kushwaha & Hegde, 2017: 12; Balkenohl, 2021b: 35; Aswathi et.al., 2024: 451.

Scarites puncticollis (Chaudoir, 1855); Andrewes, 1929: 234, 287; id, 1930a: 302; Kushwaha & Hegde, 2015: 399, 418.

Materials Examined. (n =3). Chambad Agricultural field, 3ex., Light trap, 29.vii.2019, 22.iii.2021.

Distribution: India (Kerala: Walayar; Tamil Nadu: Kodaikanal, Tiruchirappalli: Kallikudi; Puducherry; Karnataka: Madapur; Maharashtra; Rajasthan: Tetara; Gujarat: Ghogha; Madhya Pradesh: Indore: Mhow; Odisha: Ganjam: Surada; West Bengal: Kolkata, Birbhum, Berhampur, Narayanganj; Bihar: Tinpahar, Pusa: Chapra; Uttar Pradesh: Fyzabad: Guptar Ghat, Barabanki, Hardoi: Sandi Bird Sanctuary, Lakhimpur Kheri, Dudhwa National Park, Salukapur; Uttarakhand: Almora); Bangladesh; Sree Lanka; Nepal.

Genus *Oxylobus* Chaudoir, 1855

Type Species: *Scarites porcatus* Fabricius, 1798.

Oxylobus Chaudoir, 1855: 5; id, 1879: 127, 129; Andrewes, 1924a: 8; id, 1929: 17, 22, 36, 210, 292; id, 1930a: 252; Bänninger, 1937: 85, 89, 92; Saha, 1986: 67; Lorenz, 2005: 141; Abitha, 2009: 95; Bousquet, 2012: 35; Hogan, 2012: 11, 41, 85, 119, 125, 225; Kushwaha & Hegde, 2015: 399, 417; Kushwaha et. al., 2015: 20; Balkenohl, 2017b: 274; Aswathi et.al., 2024: 415, 440.

***Oxylobus asperulus* Chaudoir, 1857**

Oxylobus asperulus Chaudoir, 1857: 58; id, 1879: 133; Andrewes, 1922a: 245; id, 1924b: 129; id, 1929: 296, 311; id, 1930a: 252; Lorenz, 2005: 141; Akhil, 2020: 135; Balkenohl, 2021b: 35, 38; Divya, 2022: 112; Aswathi et.al., 2024: 441.

Materials Examined. (n =3). Malabar Wildlife Sanctuary, 2ex., Hand picking, 09.iii.2022, 15.iii.2021.

Distribution: India (Kerala: Dhoni Forest, Walayar Reserve Forest, South Malabar, Silent Valley; Tamil Nadu: Palani Hills; Nilgiri Hills, Kalakad Mundanthurai Tiger Reserve, Kodaikanal, Neutral Saddle, Kookal, Madurai, Shembaganur, Pillur, Shevaroy Hills, Trichinopoly, Combatore, Chinnampathiponnuthu, Varapalayam, Ponnuthamman Temple, Periyanaickenpalayam, Erode, Kandamatheswaran Koil Saraham, Gettavadi kuttai; Karnataka: Hulikal, Nandidrug; Andra Pradesh: Horseley Konda); Sree Lanka.

***Oxylobus lateralis* Dejean, 1825**

Oxylobus lateralis Dejean, 1825: 400; Chaudoir, 1855: 8; id,1879: 131; Andrewes, 1929: 297, 316; id, 1930a: 253; Lorenz, 2005: 141; Hogan, 2012: 105, 108, 111, 116, 249; Akhil, 2020: 136; Aswathi et.al., 2024: 443.

Materials Examined. (n =2). Peruvannamuzhi, 2ex., Hand picking, 03.iii.2019.

Distribution: India (Tamil Nadu: Palani Hills, Chengalpattu, Coimbatore, Chinnamalai, Bommanampalayam, Ettimadai, Nilgiri Hills, Kallar, Ooty, Cuddalore, Konankuppam, Madurai, Tiruchirappalli, Manaparai, Elamanam village, Ponniyar dam, Sumbadapatti, Sirugamani, Salem: Varagampadi, Dindigul, Kodaikkanal, Madurai, Alagar Hills, Puducherry; Karnataka: Bengaluru; Andra Pradesh: Nagalapuram Hill; Maharashtra: Pune; Madhya Pradesh: Seoni, Pyorthadi); Sree Lanka.

***Oxylobus porcatus* (Fabricius, 1798)**

Scarites porcatus Fabricius, 1798: 43; Motchulsky, 1855: 40.

Oxylobus porcatus (Fabricius, 1798): Andrewes, 1921b: 157; id, 1924a: 8; id, 1929: 295, 305; id, 1930a: 254; Lorenz, 2005: 141; Chandra, 2008: 159, 162; Chandra et. al., 2010: 53; Hogan, 2012: 105, 108, 111, 116, 249; Kushwaha & Hegde, 2015: 399, 417; Balkenohl, 2017b: 274; Akhil, 2020: 137; Sruthi & Sabu, 2022: 21632; Divya, 2022: 113; Aswathi et.al., 2024: 444.

Materials Examined. (n =11). Aralam Wildlife Sanctuary, 3ex., Hand picking, 28.vi.2019, 15. viii.2021; Peruvannamuzhi, 4 ex., Hand picking, 03.iii.2019; Malabar Wildlife Sanctuary, 2ex., Hand picking, 09.iii.2022, 15.iii.2021; Periya Resrve Forest, 2 ex., Hand picking, 02.ii.20201.

Distribution: India (Kerala: Malabar Coast, Walayar Reserve Forest, Chinnar, Alampetty, Muthanga; Tamil Nadu: Coimbatore, Pattisalai, Periyanaickenpalayam, Mettupalayam, Shembaganur, Shevaroy Hills, Thengumarahada, Madurai, Palani Hills, Nilgiri Hills, Kallar, Pillur, Ooty, Kanyakumari, Vattaparai, Megamalai, Upper Manalar, Megamalai Wildlife Sanctuary, Ramanadhi Dam, Kadayam Range, Kalakad Mundanthurai Tiger Reserve, Nilgiris, Ambedkar nagar, Kagguchi panchayat; Karnataka: Belgaum, Kanara; Andhra Pradesh: Visakhapatnam, Chittoor, Horseley Konda; Jharkhand: Singhbhum, Baddia, Chakardharpur, Konbir; Rajasthan; Tetara, Odisha: Barkul, Barkuda, Ganjam, Lake Chilka; Chhattisgarh: Chitrakot; Madhya Pradesh: Seoni, Barelipar, Jabalpur, Satna, Motinala, Majhgaon; Jharkhand: Giridih, inpahar; Bihar: Patna; Uttar Pradesh; West Bengal: Sahibganj, Rajmahal; Uttarakhand); Sree Lanka; Pakistan.

***Oxylobus pygmaeaus* Andrewes, 1929**

Oxylobus pygmeaus Andrewes, 1929: 295, 307; id, 1930a: 255; Lorenz, 2005: 141; Aswathi et.al., 2024: 445.

Materials Examined. (n =2). Malabar Wildlife Sanctuary, 2ex., Hand picking, 09.iii.2022, 15.iii.2021.

Distribution: India (Tamil Nadu: Tirunelveli, Shengaltheri; Karnataka: South Mysore).

4.1.5. Checklist of subfamily Trechinae from Kerala

** * **Genus *Anomotachys* Jeannel, 1946**

Type species: *Anomotachys acaroides* (Motschulsky, 1860) ψ

Anomotachys Jeannel, 1946: 1; Lorenz, 2005:207.

** * ***Anomotachys acaroides*** **(Motschulsky, 1860)** ψ

Tachys acaroides Motschulsky, 1859: 39; Putzeys, 1875: 740; Andrewes, 1925b: 469; id, 1928: 19; id, 1935: 289; Lorenz, 2005:207.

Anomotachys acaroides (Motschulsky, 1860): Jeannel, 1946:1; Lorenz, 2005: 207.

Materials Examined. (n =45). Aralam Wildlife Sanctuary, 1ex., Light trap, 28.vi.2019; Ranipuram Forest, 16 ex., Light trap, 22.iv.2020, 25.iv.2020, 11.vii.2020, 12.vii.2020, 10. v.2022, 11. v.2022, 13. v.2022; Chambad Agricultural field, 28 ex., Light trap, 25.iii.2021, 27. viii.2021, 28. viii.2021, 29. viii.2021,14.ix.2021, 15.ix.2021, 16.ix.2021.

Distribution: Sri Lanka; Indonesia.

Genus *Bembidion* Latreile, 1802

Type species: *Carabus quadriguttatus* Fabricius, 1775

Bembidion Latreille, 1802: 82; Muller, 1918: 26; Andrewes, 1924a: 16; Andrewes, 1930a:10; id, 1930b: 38; Jedlicka, 1933: 21; Andrewes, 1935: 17; Lindroth, 1976:

161-1980; id, 1985: 1-226; Netolitzky, 1942: 28-124; Muller, 1986: 31-40; Toledano & Sciaky, 1998: 97; Toledano, 2000: 5-70; Marggi et al., 2003: 819; Lorenz, 2005: 217; Toledano & Rébl, 2006: 7; Liebherr, 2008: 31 Ψ; Toledano, 2009: 579; Guéorguie, 2011: 513 ΨMaddison & Cooper 2014: 741; Larochelle & Larivière, 2015: 1; Kushwaha & Hegde, 2015: 397; Raupach et. al., 2016: 121; Ghannem & Boumaiza, 2017a: 21; Lobl & Lobl, 2017 b: 297; Schmidt & Michalik, 2017: 101; Neri & Toledano; 2017: 59; id, 2018: 301; Chandra et al., 2021: 384; Divya, 2022: 114; Ashly, 2023: 109.

****Bembidion kara* Andrewes, 1921**

Bembidion kara Andrewes, 1921c: 250; id, 1923a: 101; Andrewes, 1930a: 40; Jedlička, 1932: 47; id, 1933:2, 8; Andrewes, 1935: 114; Lorenz, 2005: 227; Lobl & Lobl, 2017: 338.

Materials Examined. (n =1). Malabar Wildlife Sanctuary, 1 ex., Light trap, 09.iii.2022.

Distribution: India (Meghalaya: Garo hills, Someswari river; Naga hills; West Bengal: Namsoo, Gopaldhara, Eastern Duars; Himachal Pradesh: Simla, Jubbul, Chepal, Patharnala; Uttarakhand: Almora, Swal River basin, Khairna, Dehradun, Riversong, Ranikhet, Haldwani, Siwaliks); China: Xizang; Yunnan; Nepal.

***Bembidion niloticum* Dejean, 1831**

Bembidion niloticum Dejean, 1831:73; Bates, 1873: 301; id, 1886: 156; Bates, 1889: 269; Andrewes, 1919a: 472; id, 1919b: 100; id, 1921c: 249; id, 1924b: 18; id: 1930a: 42; id, 1935: 199; Lorenz, 2005: 221; Kushwaha & Hegde, 2015: 406; Kuswaha et.al., 2017: 335; Lobl & Lobl, 2017: 319; Divya 2022: 115; Ashly, 2023: 109.

Materials Examined. (n =56). Ranipuram Forest, 36 ex., Light trap, 22.iv.2020, 25.iv.2020, 10. v.2022, 11. v.2022, 13. v.2022, 11.vii.2020, 12.vii.2020, 15.xi.2022,

16.xi.2022; Chambad Agricultural field, 20 ex., Light trap, 10.iii.2019, 11.iii.2019, 12.iii.2019, 13.iii.2019, 22.iii.2021, 23.iii.2021, 24.iii.2021, 18.vi.2019, 19.vi.2019, 20.vi.2019, 22.vi.2019, 25. viii.2021, 26. viii.2021, 27.viii.2021, 28.viii.2021.

Distribution: India (Kerala: Pudussery, Ambalavayal, Pattambi; Haryana; Uttar Pradesh: Barabanki, Sultanpur; Siddharth Nagar; Bhais ka nala; West Bengal: Dhappa; Nagaland; Uttarakhand: Upper Jhelum, Almora, Ranikhet, Mussoorie, Lyallpur); Cambodia; Laos; Myanmar; Philippines; Sri Lanka; Vietnam; China; Iran; Iraq; Israel; Japan; Jordan; Kyrgystan; Kazakstan; Nepal; Oman; Pakistan; Russia; Saudi Arabia; Syria; Taiwan ; Turkey; Turkmenistan; United Arab Emirates; Uzbekistan; Australia.

Genus: *Elaphropus* Motschulsky, 1839

Type species: *Elaphropus caraboides* Motschulsky, 1839

Elaphropus Motschulsky 1839: 73; Erwin 1974: 125; id. 1975: 1; Kopecký 2003: 63; Lorenz 2005: 207; Boyd & Erwin 2016: 87; Lobl & Lobl 2017: 342; Chandra et.al., 2021: 384; Divya, 2022: 115; Sruthi & Sabu, 2022: 21631; Ashly, 2023: 110.

***Elaphropus ceylanicus* (Nietner, 1858)**

Tachys ceylanicus Nietner, 1858: 423; Andrewes 1925b: 436; id. 1929: 307; id. 1930a: 326; id. 1935: 257; Kushwaha & Hegde 2015: 410; Divya 2022: 116; 110.

Elaphropus ceylanicus (Nietner, 1858): Lorenz, 2005: 208.

Materials Examined. (n =144). Aralam Wildlife Sanctuary, 16 ex., Light trap, 20.iv.2020, 15.viii.2021; 16. viii. 2021, 17.viii.2021; Ranipuram Forest, 10 ex., Light trap, 25.iv.2020, 10.vii.2020, 11.vii.2020, 12.vii.2020, 15.xi.2022, 16.xi.2022, 17.xi.2022; Chambad Agricultural field, 116 ex., 10.iii.2019, 11.iii.2019, 12.iii.2019, 13.iii.2019, 14.iii.2019, 22.iv.2019, 23.iv.2019, 24.iv.2019, 25.iv.2019, 26.iv.2019, 22.iii.2021, 24.iii.2021, 23.iii.2021, 25.iii.2021, 26.iii.2021, 16.vi.2019, 17.vi.2019,

18.vi.2019, 19.vi.2019, 20.vi.2019, 22.vi.2019, 25.viii.2021, 26.viii.2021, 27.viii.2021, 28.viii.2021, 29.viii.2021, 2 ex., pitfall trap, 19.vi.2019.

Distribution: India (Kerala: Pudussery, Ambalavayal, Pattambi; Uttar Pradesh: Lakhimpur Kheri, Salukapur, Dudhwa National Park; West Bengal: Kolkata; Gopaldhara, Gielle Khola, Tista Valley, Eastern Duars; Uttarakhand: Almora, Dehradun; Andra Pradesh: Teppukadu; Karnataka); Indonesia; Malaysia; Myanmar; New Guinea; Philippines; Sri Lanka; Vietnam; China.

***Elaphropus decoratus* (Andrewes, 1925)**

Bembidoin ornatum Nietner, 1858: 426.

Tachys ornatus (Nietner 1858)

Tachys decoratus Andrewes, 1925b: 424; id, 1930a: 328; id, 1935: 278.

Elaphropus decoratus (Andrewes, 1925b): Lorenz, 2005: 209; Divya, 2022: 116; Ashly, 2023: 111.

Materials Examined. (n =363). Aralam Wildlife Sanctuary, 20 ex., Light trap, 03.v.2019, 04.v.2019, 10.iii.2021, 11.iii.2019, 28.vi.2019,30.vi.2019, 15.viii.2021, 16.viii.2021; Ranipuram Forest, 20 ex., Light trap, 22.iv.2020, 25.iv.2020, 10.v.2022, 11.v.2022, 13.v.2022, 15.xi.2022; Chambad Agricultural field, 323 ex., Light trap, 10.iii.2019, 11.iii.2019, 12.iii.2019, 13.iii.2019, 14.iii.2019, 22.iii.2021, 24.iii.2021, 23.iii.2021, 25.iii.2021, 26.iii.2021, 16.vi.2019, 17.vi.2019, 18.vi.2019, 19.vi.2019, 20.vi.2019, 22.vi.2019, 25.viii.2021, 26.viii.2021, 27.viii.2021, 28.viii.2021, 29.viii.2021, 22.iv.2019, 23.iv.2019, 24.iv.2019, 25.iv.2019, 26.iv.2019, 01.v.2021, 02.v.2021, 03.v.2021, 04.v.2021, 16.iii.2022, 17.iii.2022, 18.iii.2022, 25.vii.2019, 26.vii.2019, 27.vii.2019, 28.vii.2019, 29.vii.2019, 30.vii.2019, 14.ix.2021, 15.ix.2021, 16.ix.2021, 17.ix.2021, 18.ix.2021.

Distribution: India- Kerala [Pudussery, Ambalavayal, Pattambi); Sri Lanka (Nalanda, Colombo, Kandy).

******Elaphropus elutus* (Neitner, 1851)**

Tachys elutus Andrewes, 1935: 278.

Elaphropus elutus (Neitner, 1851): Lorenz, 2005: 209

Materials Examined. (n =4). Aralam Wildlife Sanctuary, 1 ex., Light trap, 15. viii.2021; Chambad Agricultural field, 3 ex., Light trap, 27. viii.2021, 28. viii.2021.

Distribution: Myanmar (Tavoy district).

*****Elaphropus fumicatus* (Motschulsky, 1851)**

Tachys fumigatus Motchulsky 1851: 509; Andrewes 1925b: 466; id. 1928b: 5; Andrewes 1930a: 330; id. 1933a: 3; Alluad 1933: 17- 20; Andrewes 1935: 287; Lorenz, 2005: 211; Neethu et.al., 2023: 3.

Elaphropus fumigatus (Motschulsky, 1851): Lorenz 2005: 211; Kushwaha & Hegde 2015: 408; Marggi et al., 2017: 349.

Materials Examined. (n =1849). Aralam Wildlife Sanctuary, 41 ex., Light trap, 03.v.2019, 05.v.2019, 05.v.2019, 06.v.2019, 10.iii.2021, 11.iii.2021, 12.iii.2021, 13.iii.2021, 15.viii.2021, 16.viii.2021, 17.viii.2021, 12 ex., pitfall trap, 05.v.2019, 05.v.2019, 06.v.2019, 10.iii.2021, 11.iii.2021, 12.iii.2021, 13.iii.2021; Ranipuram Forest, 143 ex., Light trap, 20.iv.2020, 22.iv.2020, 25.iv.2020, 10.v.2022, 11.v.2022, 13.v.2022, 14.v.2022, 15.v.2022,16.v.2022, 10.vii.2020, 11.vii.2020, 16.xi.2022, 17.xi.2022, 9 ex., pitfall trap, 22.iv.2020, 25.iv.2020, 10.vii.2020, 11.vii.2020, 16.xi.2022; Chambad Agricultural field, 1641 ex., Light trap, 10.iii.2019, 11.iii.2019, 12.iii.2019, 13.iii.2019, 14.iii.2019, 22.iii.2021, 24.iii.2021, 23.iii.2021, 25.iii.2021, 26.iii.2021, 16.vi.2019, 17.vi.2019, 18.vi.2019, 19.vi.2019, 20.vi.2019, 22.vi.2019, 25.viii.2021, 26.viii.2021, 27.viii.2021, 28.viii.2021, 29.viii.2021, 22.iv.2019,

23.iv.2019, 24.iv.2019, 25.iv.2019, 26.iv.2019, 01.v.2021, 02.v.2021, 03.v.2021, 04.v.2021, 16.iii.2022, 17.iii.2022, 18.iii.2022, 25.vii.2019, 26.vii.2019, 27.vii.2019, 28.vii.2019, 29.vii.2019, 30.vii.2019, 14.ix.2021, 15.ix.2021, 16.ix.2021, 17.ix.2021, 18.ix.2021, 3 ex., pitfall trap, 25.vii.2019.

Distribution: India (Uttar Pradesh: Lucknow, Kuckrail Forest Area, Hardoi, Neer, Bhais Ka nala, Shahjahanpur, Khannaut River bank, Mathura, Kishori Kunj, Barabanki, Banki, Sitapur, Tendua Jheel, Sultanpur); Philippines; New Guinea; South East Asia; Fujian; Guangdong; Hong Kong; Iran; Israel; Japan; South Korea; Taiwan; Madagaskar; Australia.

***Elaphropus haliploides* (Bates, 1892)**

Tachys haliploides Bates 1892: 289; Andrewes 1919b: 472; id. 1925b: 478; id. 1928b: 4; id. 1930a: 331; id. 1935: 293: Lorenz, 2005: 207.

Elaphropus haliploides (Bates, 1892): Lorenz, 2005: 207.

Materials Examined. (n =1). Aralam Wildlife Sanctuary, 1 ex., Light trap, 17. viii.2021.

Distribution: ORR- India (Bihar; Uttarakhand); Cambodia; Indonesia; Myanmar; Philippines; New Guinea; Vietnam Japan.

***Elaphropus klugii* (Nietner, 1858)**

Tachys klugi Nietner 1858: 423; Bates 1886: 155; id. 1892: 291; Andrewes, 1925b: 414; id. 1930a: 332; id. 1935: 252.

Elaphropus klugii (Nietner, 1858): Lorenz 2005: 209; Kushwaha & Hegde 2015: 408; Marggi et.al., 2017: 350; Löbl and Löbl, 2017: 350; Divya 2022: 116; Ashly, 2023: 112.

Materials Examined. (n =156). Aralam Wildlife Sanctuary, 41 ex., Light trap, 03.v.2019, 03.v.2019, 04.v.2019, 05.v.2019, 28.vi.2019, 29.vi.2019, 30vi.2019,

10.iii.2021, 11.iii.2021, 12.iii.2021, 15.viii.2021, 16.viii.2021, 17.viii.2021, 3 ex., pitfall trap, 04.v.2019; Ranipuram Forest, 39 ex., Light trap, 20.iv.2020, 22.iv.2020, 25.iv.2020, 10.v.2022, 11.v.2022, 12.v.2022, 10.vii.2020, 11.vii.2020, 12.vii.2020, 13vii.2020, 16.xi.2022, 17.xi.2022, 5 ex., pitfall trap, 12.vii.2020, 13vii.2020; Chambad Agricultural field, 53 ex., Light trap, 10.iii.2019, 11.iii.2019, 12.iii.2019, 24.iii.2021, 23.iii.2021, 25.iii.2021, 17.vi.2019, 18.vi.2019, 19.vi.2019, 20.vi.2019, 22.vi.2019, 26.viii.2021, 27.viii.2021, 28.viii.2021, 29.viii.2021, 2 ex., pitfall trap, 25.iii.2021; Chalakkudi, 13 ex., Light trap, 16.viii.2023.

Distribution: India (Kerala: Pudussery, Pattambi, Uttar Pradesh: Mathura, Kishori Kunj, Jalaun, Orai; Himachal Pradesh; Sikkim); Indonesia; Malaysia; Myanmar; New Guinea; Philippines; Sri Lanka; South East Asia; Thailand; China; Guizhou Hong Kong; Japan; Nepal; Taiwan.

***Elaphropus nigellus* (Andrewes, 1935)**

Tachys nigellus Andrewes 1935: 277.

Elaphropus nigellus (Andrewes 1935): 277; Lorenz 2005: 210; Sruthi & Sabu, 2022: 21632, Divya, 2022: 117; Ashly, 2023: 113.

Materials Examined. (n =56). Aralam Wildlife Sanctuary, 22 ex., Light trap, 03.v.2019, 03.v.2019, 04.v.2019, 05.v.2019, 10.iii.2021, 11.iii.2021, 12.iii.2021, 29.vi.2019; Ranipuram Forest, 18 ex., Light trap, 25.iv.2020, 10.v.2022, 11.v.2022, 12.v.2022, 10.vii.2020, 11.vii.2020, 12.vii.2020, 17.xi.2022; Chambad Agricultural field, 16 ex., Light trap, 24.iii.2021, 18.vi.2019, 19.vi.2019, 20.vi.2019, 26.viii.2021, 27.viii.2021, 28.viii.2021.

Distribution: India (Kerala: Nilambur, Ambalavayal, Pattambi, Chulanur, Pudussery, Walayar, Chinnar; Tamil Nadu: Nilgiri hills).

***Elaphropus nilgiricus* (Andrewes, 1925)**

Tachys nilgiricus Andrewes, 1925b: 446; id. 1930a: 334; id. 1935: 265.

Elaphropus nilgiricus (Andrewes, 1925b): Lorenz 2005: 210; Sruthi & Sabu, 2022: 21632, Divya, 2022: 118; Ashly, 2023: 114.

Materials Examined. (n =206). Aralam Wildlife Sanctuary, 95 ex., Light trap, 03.v.2019, 03.v.2019, 04.v.2019, 05.v.2019, 28.vi.2019, 29.vi.2019, 30vi.2019, 10.iii.2021, 11.iii.2021, 12.iii.2021, 29.vi.2019; Ranipuram Forest, 101 ex., Light trap, 20.iv.2020, 22.iv.2020, 25.iv.2020, 10.v.2022, 11.v.2022, 12.v.2022, 11.vii.2020, 12.vii.2020, 17.xi.2022, 18.ix.2022,19.ix.2022; Chambad Agricultural field, 2 ex., Light trap, 24.iii.2021; Vettinad, 8 ex., Light trap, 03.iv.2023, 04.iv.2023.

Distribution: India (Kerala: Chulanur, Pudussery, Walayar, Chinnar; Ambalavayal, Pattambi; Tamil Nadu: Nilgiri Hills; Theppukad; Karnataka: Mysore); Sri Lanka.

****Elaphropus ovatus* (Motschulsky, 1851)**

Tachys ovatus Andrewes 1919a: 198; id. 1925b: 463; id. 1928b: 5; Allauaud 1930: 14; Andrewes 1930a: 336; id. 1935: 284; Lorenz 2005: 208.

Elaphropus ovatus Chandra et.al., 2021: 384.

Materials Examined. (n =134). Aralam Wildlife Sanctuary, 1 ex., pitfall trap, 28.vi.2019; Ranipuram Forest, 34 ex., Light trap, 20.iv.2020, 22.iv.2020, 25.iv.2020, 10.v.2022, 11.v.2022, 12.v.2022, 10.vii.2020, 11.vii.2020, 12.vii.2020, 17.xi.2022; Chambad Agricultural field, 97 ex., Light trap, 10.iii.2019, 11.iii.2019, 12.iii.2019, 24.iii.2021, 23.iii.2021, 25.iii.2021, 19.vi.2019, 20.vi.2019, 26.viii.2021, 27.viii.2021, 2 ex., pitfall trap, 20.vi.2019 .

Distribution: ORR- India (Assam: Dupuis, Patkai Hills); Indonesia; Malaysia; Myanmar; Philippines; Singapore; Sri Lanka; China; Japan; Taiwan.

***Elaphropus politus* (Motschulsky, 1851)**

Tachys politus Motchulsky, 1851: 509; Putzeys 1875: 743; Bouchard 1903: 170; Andrewes 1919a: 199; id. 1921b: 146; id. 1925: 448b; id. 1930a: 338; id. 1935: 269.

Elaphropus politus (Motschulsky, 1851): Lorenz, 2005: 210, Kushwaha & Hegde, 2015: 395; Sruthi & Sabu, 2022: 21632; Divya 2022: 119; Ashly, 2023: 115.

Materials Examined. (n =1,287). Aralam Wildlife Sanctuary, 142 ex., Light trap, 03.v.2019, 03.v.2019, 04.v.2019, 05.v.2019, 10.iii.2021, 11.iii.2021, 12.iii.2021, 29.vi.2019, 30.vi.2019, 15.viii.2021, 16.viii.2021, 17.viii.2021, 18.viii.2021, 10 ex., pitfall trap, 10.iii.2021, 11.iii.2021, 12.iii.2021, 18.viii.2021; Ranipuram Forest, 274 ex., Light trap, 20.iv.2020, 22.iv.2020, 25.iv.2020, 10.v.2022, 11.v.2022, 12.v.2022, 11.vii.2020, 12.vii.2020, 17.xi.2022, 18.ix.2022,19.ix.2022, 17 ex., pitfall trap, 20.iv.2020, 22.iv.2020, 11.vii.2020, 12.vii.2020, 17.xi.2022; Chambad Agricultural field, 691 ex., Light trap, 10.iii.2019, 11.iii.2019, 12.iii.2019, 13.iii.2019, 14.iii.2019, 22.iii.2021, 24.iii.2021, 23.iii.2021, 25.iii.2021, 26.iii.2021, 22.iv.2019, 23.iv.2019, 24.iv.2019, 25.iv.2019, 26.iv.2019, 01.v.2021, 02.v.2021, 03.v.2021, 04.v.2021, 16.iii.2022, 17.iii.2022, 18.iii.2022, 16.vi.2019, 17.vi.2019, 18.vi.2019, 19.vi.2019, 20.vi.2019, 22.vi.2019, 25.viii.2021, 26.viii.2021, 27.viii.2021, 28.viii.2021, 29.viii.2021, 14.ix.2021, 15.ix.2021, 16.ix.2021, 17.ix.2021, 18.ix.2021, 22 ex., pitfall trap, 12.iii.2019, 13.iii.2019, 22.iii.2021, 24.iii.2021, 16.vi.2019, 15.ix.2021, 16.ix.2021, 17.ix.2021; Ponnani, 52 ex., Light trap, 05.vi.2023, 06.vi.2023, 07.vi.2023; Velloor, 33 ex., Light trap, 26.ix.2023, 27.ix.2023, 28.ix.2023; Vettinad, 46 ex., Light trap, 03.iv.2023, 04.iv.2023, 05.iv.2023.

Distribution: India (Kerala: Chulanur, Pudussery, Walayar, Chinnar, Ambalavayal, Pattambi; Uttar Pradesh: Auraiya, Fatehpur, Muradganj, Mathura, Kishori Kunj,

Jhansi, Ambabai, Shahjahanpur, Jailwara Sugarcane Research Institute rest house campus; Kerala: [Alampetty, Chinnar, Kootar); South East Asia.

***Elaphropus poecilopterus* (Bates, 1873)**

Tachys poecilopterus Bates 1873: 331; id. 1892: 295; Andrewes 1925b: 441; id. 1926a: 67; id. 1930a: 337; id. 1935: 254.

Elaphropus poecilopterus (Bates, 1873): Saha & Halder 2000: 1- 40; Lorenz 2005: 210; Kushwaha & Hegde 2015: 409; Chandra et.al., 2021: 384.

Materials Examined. (n =1375) Aralam Wildlife Sanctuary, 791 ex., Light trap, 03.v.2019, 03.v.2019, 04.v.2019, 05.v.2019, 06.v.2019, 07.v.2019, 10.iii.2021, 11.iii.2021, 12.iii.2021, 13.iii.2021, 14.iii.2021, 29.vi.2019, 30.vi.2019,01.vii.2019, 02.vii.2019, 03vii.2019, 15.viii.2021, 16.viii.2021, 17.viii.2021, 18.viii.2021; Ranipuram Forest, 34 ex., Light trap, 22.iv.2020, 25.iv.2020, 10.v.2022, 11.v.2022, 11.vii.2020, 12.vii.2020, 17.xi.2022, 18.ix.2022, 19.ix.2022; Chambad Agricultural field, 478 ex., Light trap, 10.iii.2019, 11.iii.2019, 12.iii.2019, 13.iii.2019, 14.iii.2019, 22.iii.2021, 24.iii.2021, 23.iii.2021, 25.iii.2021, 26.iii.2021, 22.iv.2019, 23.iv.2019, 24.iv.2019, 25.iv.2019, 26.iv.2019, 01.v.2021, 02.v.2021, 03.v.2021, 04.v.2021, 16.iii.2022, 17.iii.2022, 18.iii.2022, 16.vi.2019, 17.vi.2019, 18.vi.2019, 19.vi.2019, 20.vi.2019, 22.vi.2019, 25.viii.2021, 26.viii.2021, 27.viii.2021, 28.viii.2021, 29.viii.2021, 14.ix.2021, 15.ix.2021, 16.ix.2021, 17.ix.2021, 18.ix.2021; Ponnani, 72 ex., Light trap, 05.vi.2023, 06.vi.2023, 07.vi.2023.

Distribution: India (Uttar Pradesh: Sitapur, Lyallpur, Barabanki, Sultanpur, Sunderbans; Punjab; Assam; West Bengal Garo Hills, Gopaldhara, Tarkhola, Tista Valley, Eastern Duars, Sardah, Kolkata; Himachal Pradesh; Uttarakhand: Almora, Ranikhet, Haldwani, Kheri, Dehradun; Sikkim; Karnataka: Mysore, Bangalore);

Cambodia; Indonesia; Laos; Malaysia; Myanmar; Singapore; Thailand; Vietnam; Cambodia; China; Taiwan.

****Elaphropus unitarius* (Bates, 1892)**

Tachys uniatrius Bates, 1892: 296; Andrewes, 1925b: 425; id, 1935: 281.

Elaphropus unitarius (Bates, 1892): Lorenz, 2005: 210

Materials Examined. (n =1). Chambad Agricultural field, 1 ex., Light trap, 26. viii.2021.

Distribution: India (Assam: Garo hills); Myanmar (Keran Hills; Tavoy; Maungmagan; Tenasserim).

****Genus *Lymnastis* Motschulsky, 1862**

Type species: Lymnaeum indicum Motschulsky, 1851

Lymnastis Motschulsky, 1862: 27; 1875: 436; Reitter, 1884: 124; Andrewes, 1925b: 493; id, 1930a: 205; id, 1935: 302; Lorenz, 2005: 211; Lobl & Lobl, 2017: 343.

****Lymnastis pilosus* Bates, 1892**

Lymnastis pilosus Bates, 1892: 296; Andrewes, 1925b: 495; id, 1930a: 205; id, 1935: 305; Lorenz, 2005: 211; Lobl & Lobl, 2017: 343.

Materials Examined. (n =5). Chambad Agricultural field, 5 ex., Light trap, 26. viii.2021, 27. viii.2021.

Distribution: India (West Bengal: Kolkata; Uttarakhand: Haldwani); Vietnam; Indonesia; Malaysia; Myanmar; Philippines; New Guinea; Singapore; Hong Kong; Taiwan; AUR- Australia.

****Lymnastis pullulus* Motschulsky, 1862**

Lymnastis pullulus Motschulsky, 1862: 31; Andrewes, 1925b: 498; id, 1930a: 206; id, 1935: 306; Lorenz, 2005: 211.

Materials Examined. (n =29). Chambad Agricultural field, 29 ex., Light trap, 18.vi.2019, 19.vi.2019, 20.vi.2019, 26. viii.2021, 27. viii.2021, 28. viii.2021.

Distribution: India (West Bengal: Kolkata).

Genus: *Tachys* Dejean, 1821

Type species*: Tachys scutellaris*

Tachys Dejean, 1821: 16; Stephens, 1828: 2; Dejean, 1831: 33; Motschulsky, 1862: 27; Putzeys, 1875: 737; Bates, 1882: 138; Reitter, 1884: 116; Netolitzkey, 1914: 173; Andrewes, 1924a: 18; id, 1925b: 327; id, 1930a: 325; id, 1935: 206; Lorenz, 2005: 211; Boyd & Erwin, 2016: 87; Marggi et.al., 2017: 345.

***Tachys cardoni* Andrewes, 1925**

Tachys cardoni Andrewes, 1925b: 343; id, 1930a: 325; id, 1935: 225; Lorenz, 2005: 212.

Materials Examined. (n =30). Aralam Wildlife Sanctuary, 4 ex., Light trap, 17. viii.2021, 18. viii.2021; Ranipuram Forest, 3 ex., Light trap, 18.ix.2022; Chambad Agricultural field, 23 ex., Light trap, 10.iii.2019, 11.iii.2019, 12.iii.2019, 13.iii.2019, 22.iii.2021, 24.iii.2021, 16.vi.2019, 17.vi.2019, 18.vi.2019, 28. viii.2021, 29. viii.2021.

Distribution: India (Jharkhand: Chota Nagpur, Barwa; Bihar; Uttarakhand)

***Tachys euryodes* Bates, 1892**

Tachys euryodes Bates, 1892: 289; Andrewes, 1925b: 343, 360; id, 1929: 16; id, 1930a: 328; id, 1935: 22; Lorenz, 2005: 212; Lobl & Lobl, 2017: 345.

Materials Examined. (n =10). Aralam Wildlife Sanctuary, 4 ex., Light trap, 10.iii.2021, 17. viii.2021; Chambad Agricultural field, 6 ex., Light trap, 22.iii.2021, 14.ix.2021, 15.ix.2021, 16.ix.2021.

Distribution: India (West Bengal: Kolkata, Sardah; Uttarakhand: Haldwani); Indonesia; Malaysia; Myanmar; Singapore; Sri Lanka; Thailand; Japan.

***Tachys fasciatus* Motschulsky, 1851**

Tachys fasciatus Motschulsky, 1851: 506; Andrewes, 1928a: 3; id, 1929: 306; id, 1935: 217; Lorenz, 2005: 212.

Materials Examined. (n =265). Aralam Wildlife Sanctuary, 11 ex., Light trap, 03.v.2019, 04.v.2019, 05.v.2019, 07.v.2019, Ranipuram Forest, 51 ex., Light trap, 22.iv.2020, 25.iv.2020, 10.v.2022, 11.v.2022, 12.vii.2020, 17.xi.2022, 18.ix.2022, 2 ex., pitfall trap, 22.iv.2020; Chambad Agricultural field, 197 ex., Light trap, 11.iii.2019, 12.iii.2019, 14.iii.2019, 22.iii.2021, 24.iii.2021, 26.iii.2021, 22.iv.2019, 23.iv.2019, 24.iv.2019, 25.iv.2019, 26.iv.2019, 01.v.2021, 02.v.2021, 03.v.2021, 04.v.2021, 16.vi.2019, 17.vi.2019, 18.vi.2019, 19.vi.2019, 20.vi.2019, 22.vi.2019, 25.vii.2019, 26.vii.2019, 27.vii.2019, 28.vii.2019, 29.vii.2019, 30.vii.2019, 25.viii.2021, 26.viii.2021, 27.viii.2021, 28.viii.2021, 29.viii.2021, 14.ix.2021, 15.ix.2021, 16.ix.2021, 17.ix.2021, 18.ix.2021, 4 ex., pitfall trap, 22.iv.2019, 26.vii.2019, 27.vii.2019 .

Distribution: Trought out India, Sri Lanka and Myanmar; South East Asia; Japan; Australia; Egypt; South Africa.

***Tachys impressipennis* Motschulsky, 1859**

Tachys impressipennis Motchulsky, 1859: 39; Andrewes, 1925b: 346; id, 1930a; 331; id, 1935: 215; Lorenz, 2005: 212; Lobl & Lobl, 2017: 344; Divya 2022: 122; Ashly, 2023: 116.

Materials Examined. (n =110). Aralam Wildlife Sanctuary, 11 ex., Light trap, 16. viii.2021, 17. viii.2021, 18. viii.2021; Ranipuram Forest, 23 ex., Light trap, 25.iv.2020, 11.vii.2020, 11.vii.2020, 12.vii.2020, 17.xi.2022; Chambad Agricultural

field, 76 ex., Light trap, 10.iii.2019, 11.iii.2019, 12.iii.2019, 13.iii.2019, 22.iii.2021, 24.iii.2021, 25. viii.2021, 26.viii.2021, 27.viii.2021, 28.viii.2021, 30.viii.2021, 14.ix.2021, 15.ix.2021, 17.ix.2021.

Distribution: India (Pudussery, Chulanur, Walayar, Ambalavayal); Throughout South East Asia; Japan; Yemen; Australia.

******Tachys plagiatus* Putzeys, 1875**

Tachys plagiatus Putzeys, 1875: 745; Andrewes 1925b: 371; Jedlička, 1965: 170; Lorenz, 2005: 212; Shigina & Sabu 2024b: 589.

Materials Examined. (n =37). Aralam Wildlife Sanctuary, 3 ex., Light trap, 13.iii.2021, Ranipuram Forest, 10 ex., Light trap, 12.vii.2020, 17.xi.2022, 18.ix.2022; Chambad Agricultural field, 24 ex., Light trap, 10.iii.2019, 11.iii.2019, 25. viii.2021, 26. viii.2021, 27. viii.2021.

Distribution: Australia, Indonesia, Melanesia (Papua New Guinea), Philippines, Taiwan.

****Tachys sericeus* (Motschulsky, 1851)**

Tachys sericeus Motschulsky, 1851: 507; Andrewes, 1925b: 343, 362; id, 1928a: 3; id, 1930a: 340; id, 1935: 223; Lorenz, 2005: 213.

Materials Examined. (n =11). Aralam Wildlife Sanctuary, 2 ex., Light trap, 15. viii.2021; Ranipuram Forest, 7 ex., Light trap, 20.iv.2020, 22.iv.2020, 12.vii.2020, 15.xi.2022; Chambad Agricultural field, 2 ex., Light trap, 22.iv.2019.

Distribution: India (West Bengal; Bihar); Indonesia; Malaysia; Myanmar; New Guinea.

***Tachys tropicus* Nietner, 1858**

Tachys tropicus Nietner, 1858: 421; Putzeys, 1875: 746; Andrewes, 1925b: 343; id, 1930a: 12; 1d, 1935: 227; Lorenz, 2005: 213; Divya, 2022: 121; Ashly, 2023: 120; Shigina & Sabu 2024b: 589.

Materials Examined. (n =140). Aralam Wildlife Sanctuary, 28 ex., Light trap, 03.v.2019, 05.v.2019, 10.iii.2021, 11.iii.2021, 12.iii.2021, 15.viii.2021; Ranipuram Forest, 33 ex., Light trap, 20.iv.2020, 22.iv.2020, 25.iv.2020, 10.v.2022, 11.v.2022, 13.v.2022, 10.vii.2020, 11.vii.2020, 12.vii.2020, 15.xi.2022, 16.xi.2022; Chambad Agricultural field, 79 ex., Light trap, 10.iii.2019, 11.iii.2019, 12.iii.2019, 13.iii.2019, 14.iii.2019, 22.iii.2021, 24.iii.2021, 23.iii.2021, 25.iii.2021, 26.iii.2021, 19.vi.2019, 20.vi.2019, 22.vi.2019, 25.viii.2021, 26.viii.2021, 27.viii.2021, 28.viii.2021, 29.viii.2021.

Distribution: India (Kerala: Pudussery, Walayar, Chulanur, Ambalavayal, Pattambi); Sri Lanka.

Genus: *Perileptus* Schaum, 1860

Type species*: Carabus areolatus* Creutzer, 1799 Ψ

Perileptus Schaum, 1860: 663; Putzeys, 1870a: 9; idb: 362; Ganglbauer, 1892: 185; Bedel, 1896: 82; Jacobson, 1906: 296; Jeannel, 1922: 90; id, 1923: 396; Andrewes, 1930a: 267; id, 1935: 48; Tosava, 1935: 3; Ueno, 1953: 38; Lorenz, 2005: 167; Lobl & Lobl, 2017: 358: Divya, 2022: 123.

***Perileptus ceylanicus* Nietner, 1857**

Perileptus ceylanicus (Nietner, 1857): 136; Andrewes, 1930a: 268; id, 1935: 51; Lorenz, 2005: 168; Divya, 2022: 123.

Materials Examined. (n =69). Chambad Agricultural field, 69 ex., Light trap, 11.iii.2019, 12.iii.2019, 13.iii.2019, 26.vii.2019, 27.vii.2019, 28.vii.2019, 29.vii.2019,

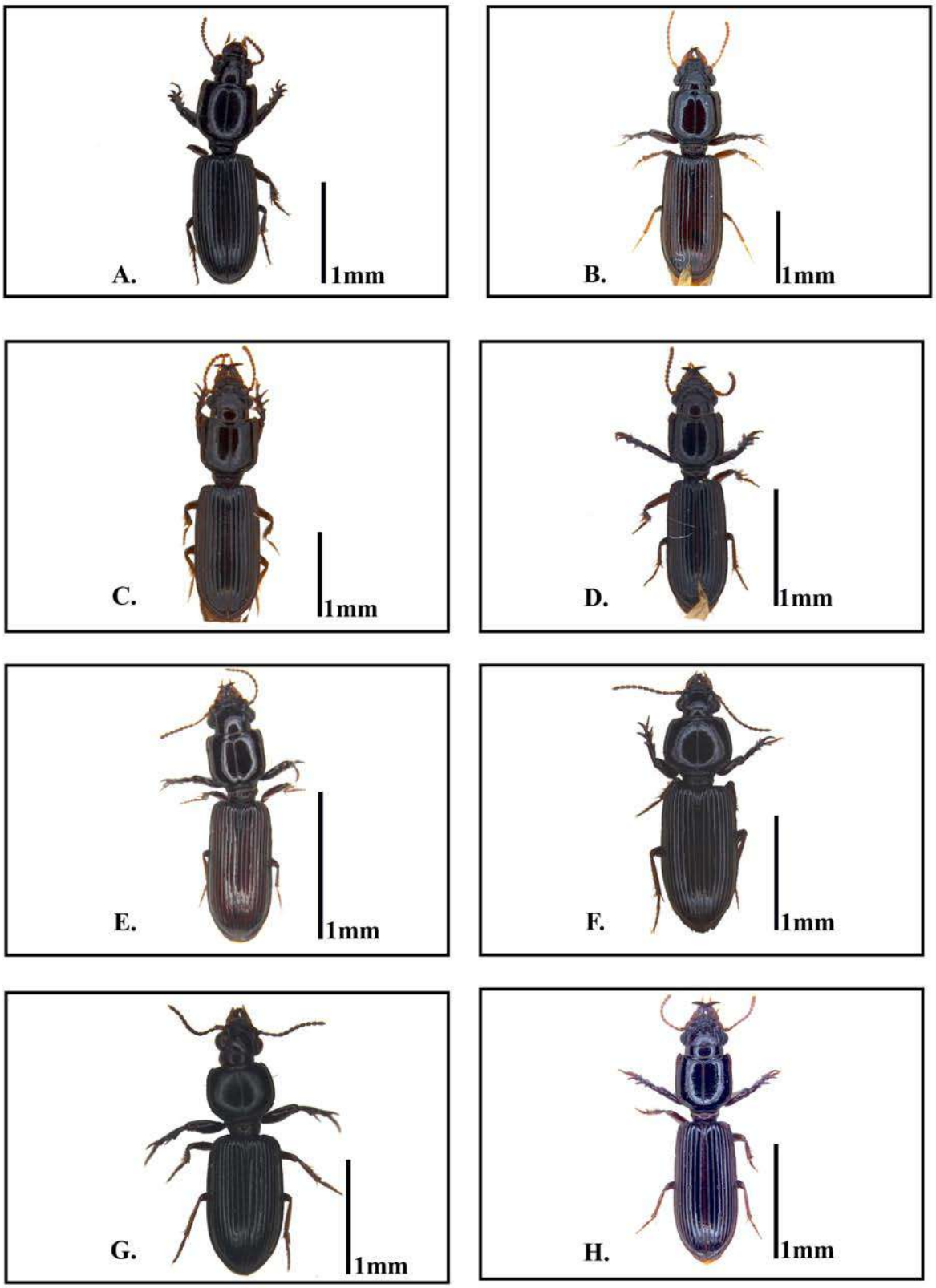


Plate 1: Dorsal habitus of A) *Clivina arunachalensis* Saha & Biswas, 1985 **B)** *Clivina brevior* Putzeys, 1866 **C)** *Clivina boreri* Balkenohl, 2020 **D)** *Clivina forcipata* Putzeys, 1863 **E)** *C. lobata* Bonelli, 1813 **F)** *Clivina thenmala* Balkenohl, 2021 **G)** *Clivina tranquebarica* Bonelli, 1813 **H)** *Clivina ursulae* Balkenohl, 2020.

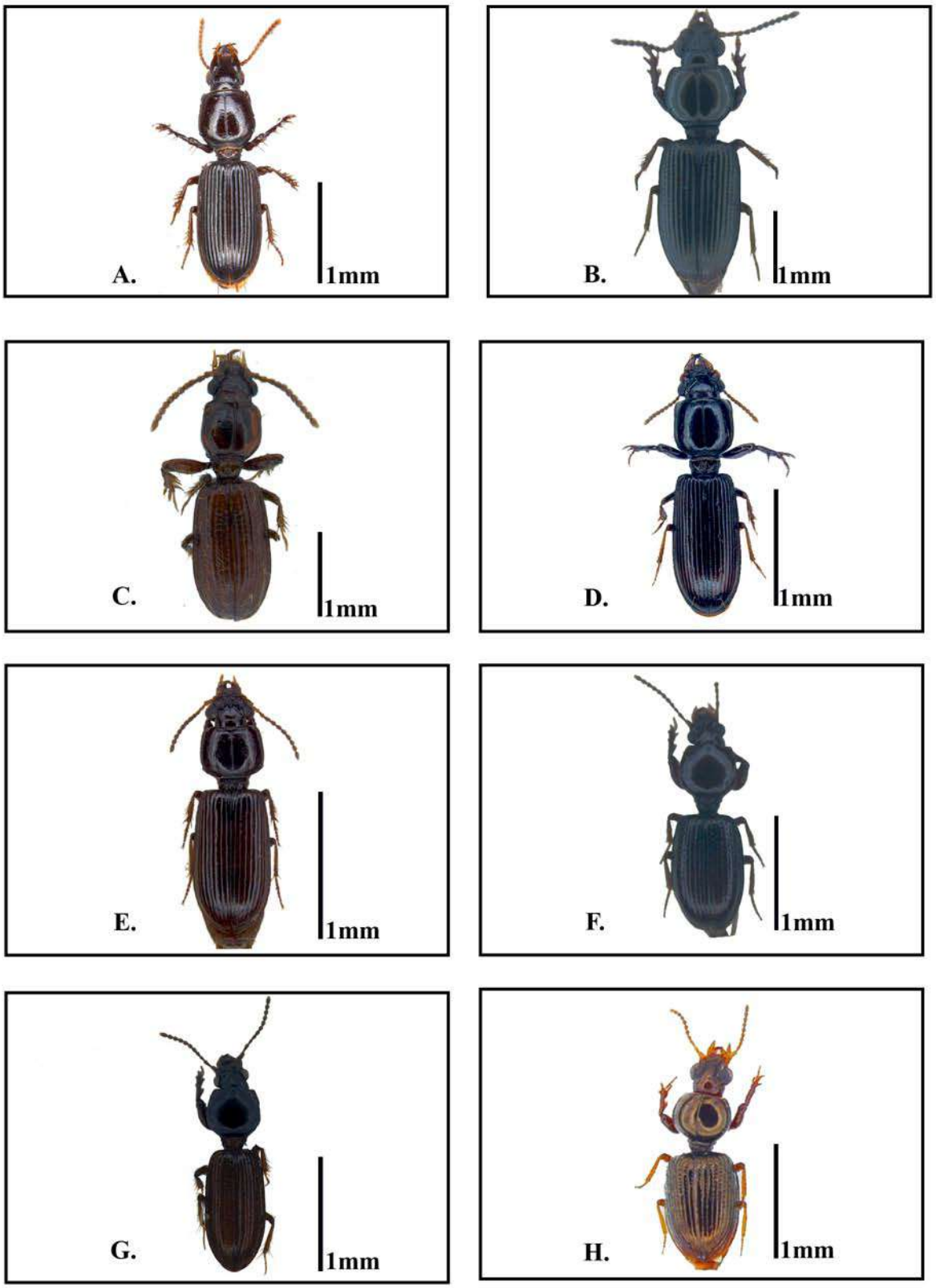


Plate 2: Dorsal habitus of A) *Clypeuspinus devagiriensis* Neethu & Sabu, 2023 **B)** *Coryza maculata* (Nietner, 1856) **C)** *Leleuporella devagiriensis* Abhita & Sabu, 2009 **D)** *Orictites constulipennis* **E)** *Pseudoclivina costata* (Andrewes, 1929) **F)** *Trilophidius impunctatus* (Putzeys, 1868) **G)** *Trilophus interpunctatus* Putzeys, 1866 **H)** *Dyschirius paucipunctus* Andrewes, 1929.

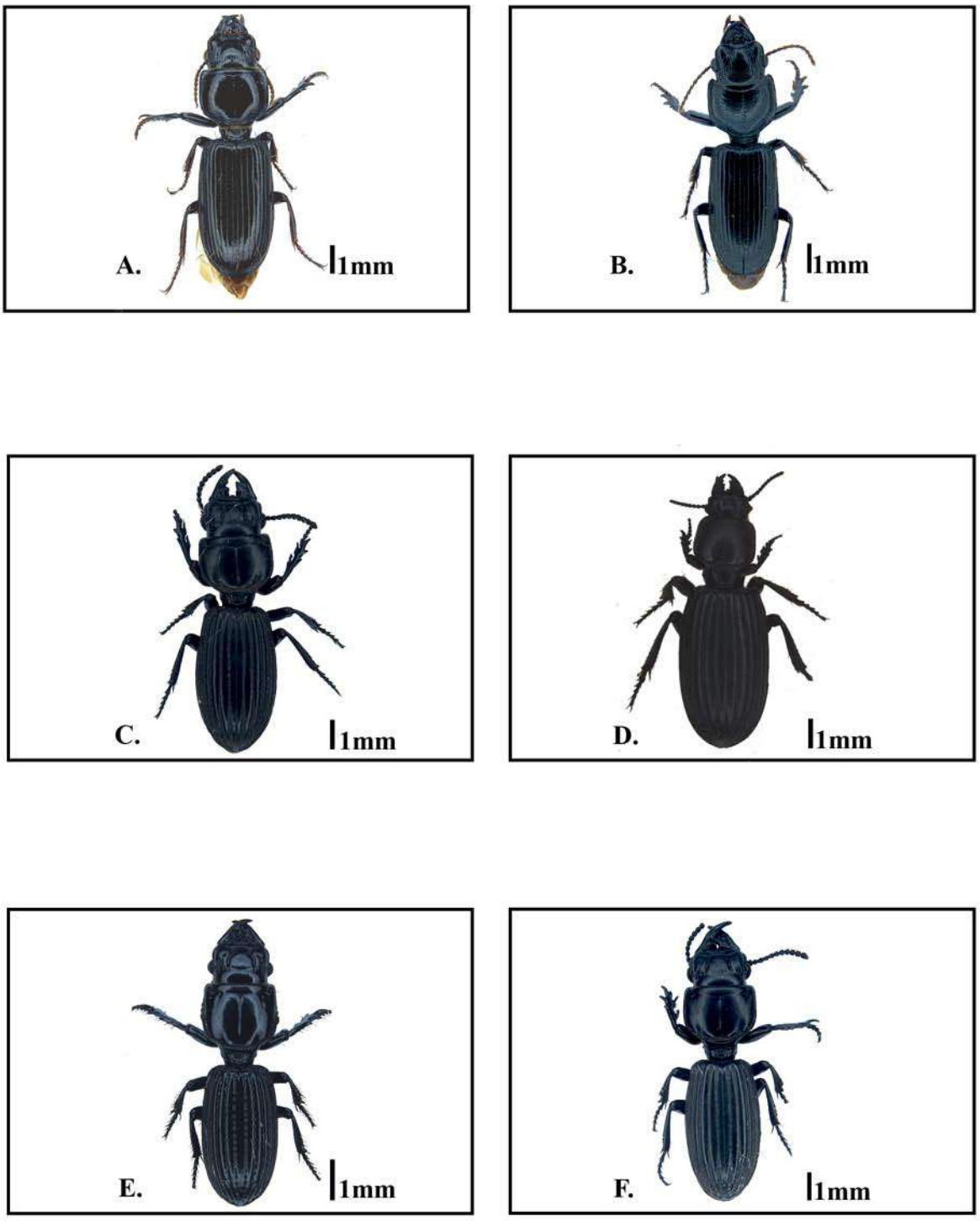


Plate 3: Dorsal habitus of A) *Distichus planus* Chaudoir, 1855 **B)** *Distichus puncticollis* Chaudoir, 1855 **C)** *Oxylobus asperulus* Chaudoir, 1857 **D)** *Oxylobus lateralis* Dejean, 1828 **E)** *Oxylobus pygmaeaus* Andrewes, 1929 **F)** *Oxylobus porcatus* Fabricius, 1798.

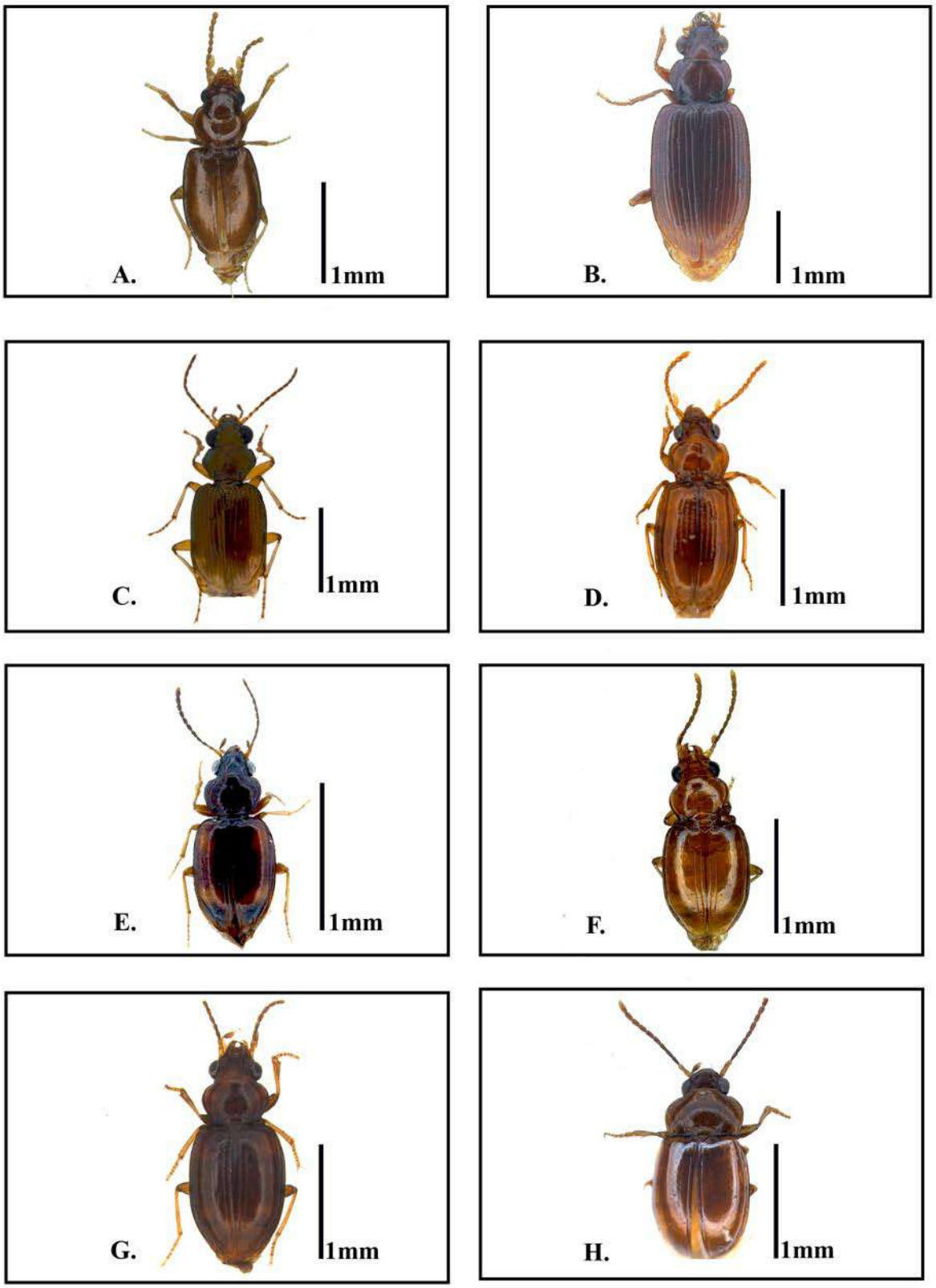


Plate 4: Dorsal habitus of A) *Anomotachys acaroides* (Motschulsky, 1860) **B)** *Bembidion kara A*ndrewes, 1921 **C)** *Bemdiodion niloticum* Dejean, 1831 **D)** *Elaphropus ceylanicus* (Nietner, 1858) **E)** *Elaphropus decoratus* (Andrewes, 1925) **F)** *Elaphropus elutus* (Neitner, 1851) **G)** *Elaphropus fumicatus* (Motschulsky, 1851) **H)** *Elaphropus haliploides* (Bates, 1892).

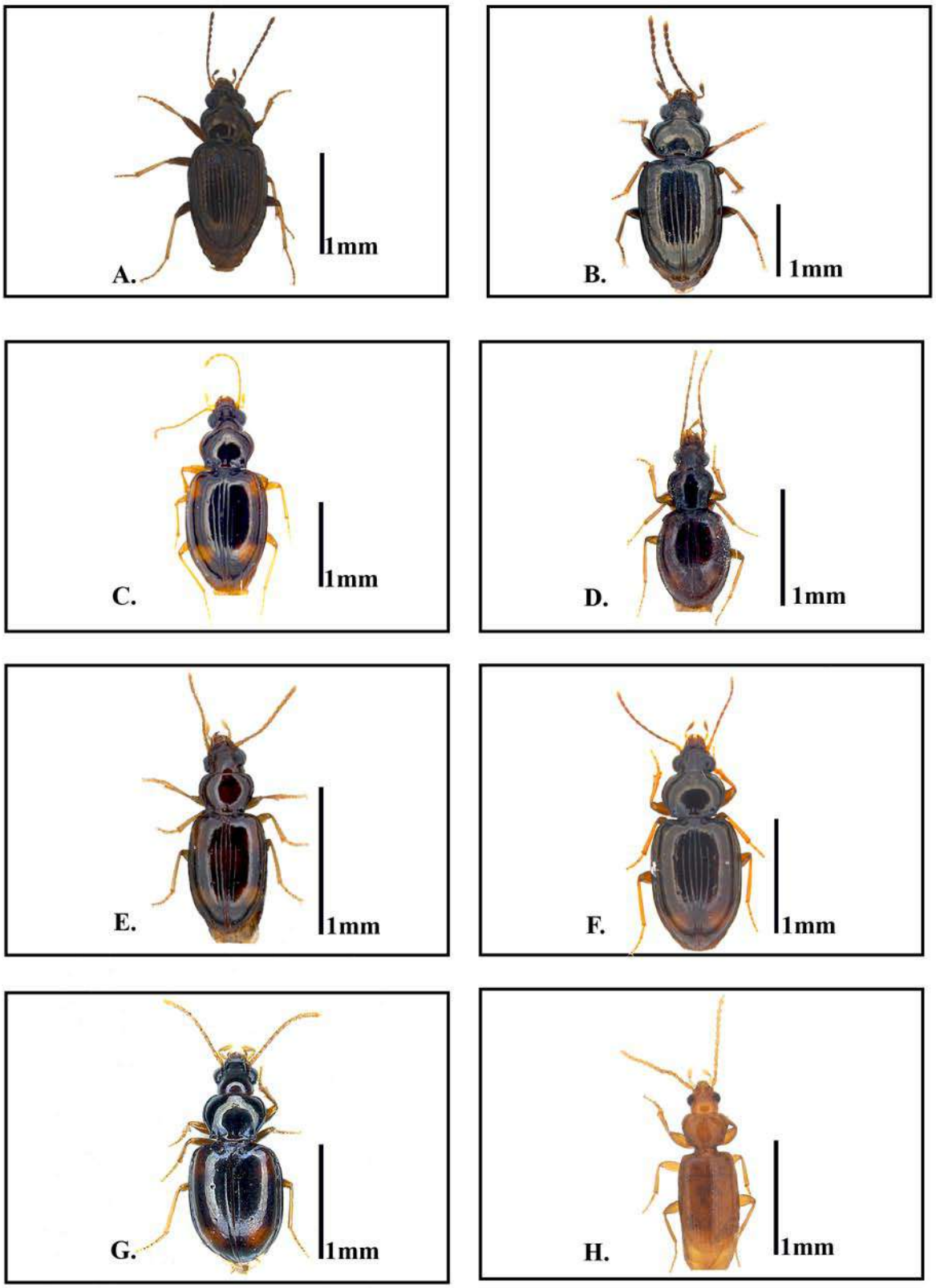


Plate 5: Dorsal habitus of A) *Elaphropus klugi i* (Nietner, 1858) **B)** *Elaphropus nigellus* (Andrewes, 1935) **C)** *Elaphropus nilgiricus* (Andrewes, 1925) **D)** *Elaphropus ovatus* (Motschulsky, 1851) **E)** *Elaphropus poecilopterus (*Andrewes, 1925) **F)** *Elaphropus politus* (Motschulsky, 1851) **G)** *Elaphropus unitarius* (Bates, 1892) **H)** *Lymnastis pilosus* Bates, 1892

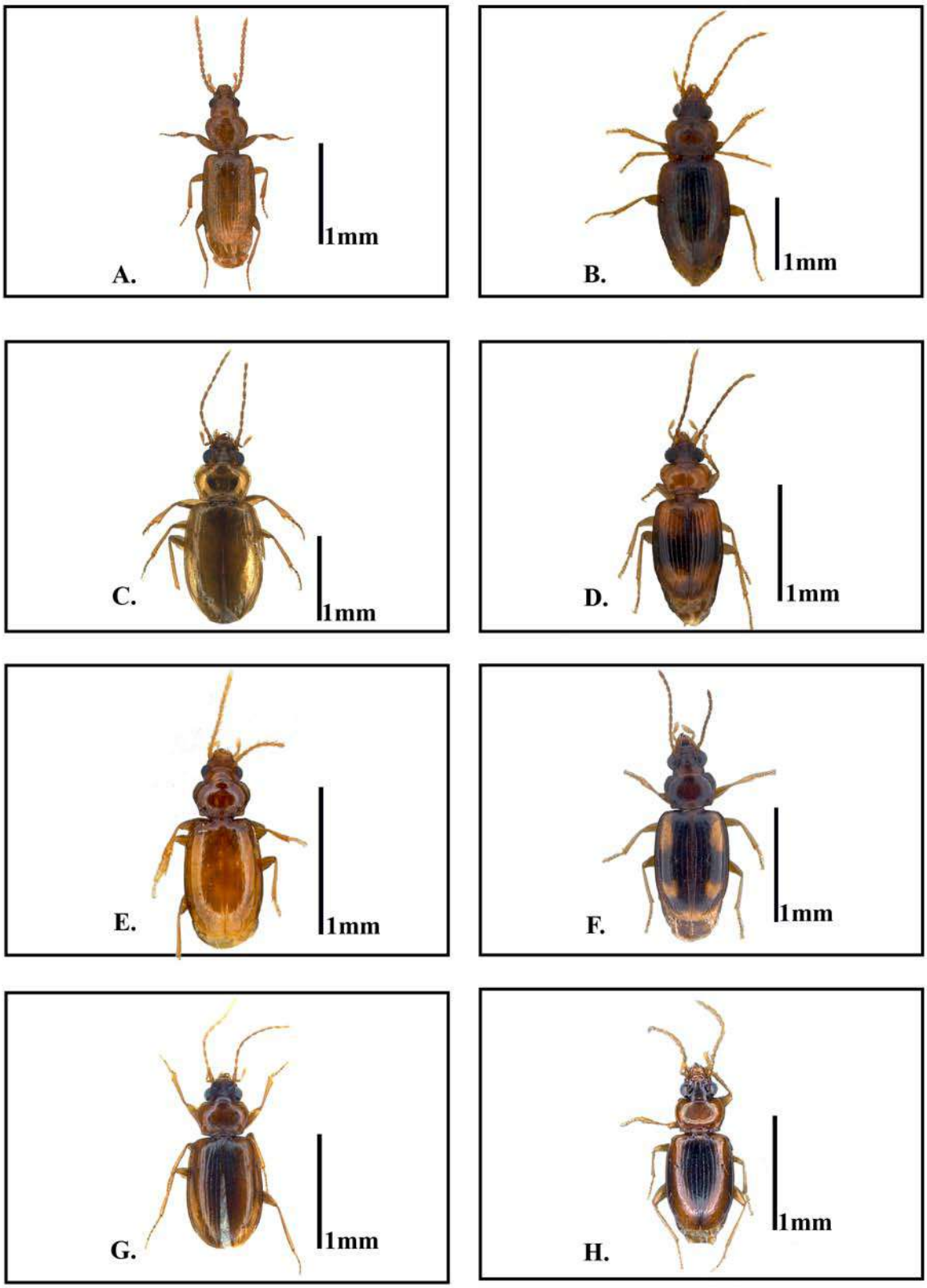
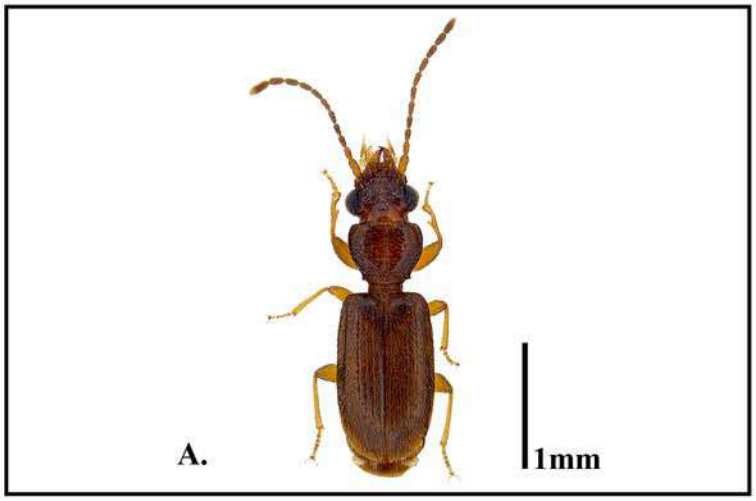
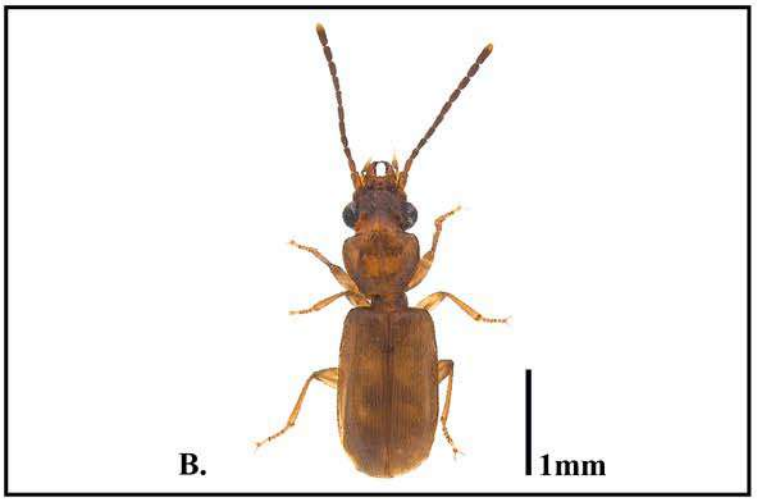


Plate 6: Dorsal habitus of A) *Lymnastis pullulus* Motschulsky,1862 **B)** *Tachys cardoni* Andrewes, 1925 **C)** *Tachys euryodes* Bates, 1892 **D)** *Tachys fasciatus* Motschulsky, 1851 **E)** *Tachys impressipennis* Motschulsky, 1859 **F)** *Tachys plagiatus* Putzeys, 1875 **G)** *Tachys sericeus* Motschulsky, 1851 **H)** *Tachys tropicus* Nietner, 1858.





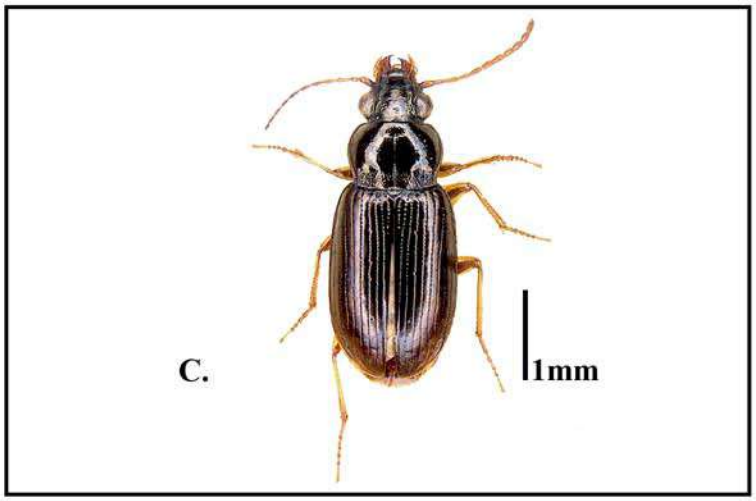


Plate 7: Dorsal habitus of A) *Perileptus ceylanicus* Nietner, 1857 **B)** *Perileptus indicus* Jeannel, 1923 **C)** *Pogonus malabarensis* Shigina & Sabu, 2024.

30.vii.2019, 22.iii.2021, 24.iii.2021, 23.iii.2021, 22.vi.2019, 25. viii.2021, 26. viii.2021, 27. viii.2021, 28. viii.2021, 29. viii.2021, 15.ix.2021, 16.ix.2021, 17.ix.2021, 18.ix.2021.

Distribution: India (Kerala: Pudussery, Walayar Reserve Forest; Maharashtra: Mumbai, Pune; Assam; Meghalaya: Garo hills, Someswari river, Manipur: Shugnu; Uttarakhand: Dehradun, Raipur forest, Asan river, Nim Nadi, Mothrawala, Rispana river, Phandowala, Suswa river, West almora, Haldwani, Tanakpur, Ranikhet, Sarju valley, Bodyar and River song; Sikkim: Gielle Khola, Tista valley, Eastern Duars); Myanmar; Sri Lanka.

****Perileptus indicus* Jeannel, 1923**

Jeannel, 1923: 397, 405; id: 425; Andrewes, 1930a: 268; id, 1935: 53; Lorenz, 2005: 168; Lobl & Lobl, 2017: 358.

Materials Examined. (n =7). Chambad Agricultural field, 7 ex., Light trap, 11.iii.2019, 27. viii.2021, 28. viii.2021, 29. viii.2021.

Distribution: India: (Himachal Pradesh: Khotkai; Uttarakhand: West almora, Upper Gumti valley, Dwarahat, Garhwal, Suini Gad, Chakrata, Sainja Gad, Binal Gad; Sikkim: Rongni valley; West Bengal: Gopaldhara; Eastern Duars; Manipur: Shugnu); China: Yunnan.

Genus: *Pogonus* Dejan, 1821

Type species: *Carabus littoralis* Duftschmid, 1812

Pogonus Dejan, 1821: 9; Lacordaire, 1854: 368; Reitter, 1908: 3; Andrewes, 1930a: 284; id, 1935: 308; Lorenz, 2005: 237; Lobl & Lobl; 2107: 355.

*** **Pogonus malabarensis* Shigina & Sabu, 2023a**

Pogonus malabarensis Shigina & Sabu, 2024a: 889.

Materials Examined. (n =3). Chambad Agricultural field, 3 ex., Light trap, 20. viii.2019.

4.2. Ecology

4.2.1. Semi-Evergreen Forest (AWS)

Twenty-three species of Scaritinae and Trechinae beetles belonging to five genera namely, *Anomotachys* Jeannel, 1946, *Clivina* Latreille, 1802*, Dyschirius* Bonelli, 1810*, Elaphropus* Motschulsky, 183 and *Tachys* Dejean, 1821 and three tribes namely, Bembidiini Stephens, 1827, Clivinini Rafinesque, 1815 and Dyschirini Kolbe, 1880 were recorded from the Semi-evergreen forest in the light trap method. List of species and their abundance are given in Table 4.

Among the 23 species, four species [*Clivina tranquebarica* Bonelli, 1813*, Elaphropus nilgiricus* (Andrewes, 1925)*, E. politus* (Motschulsky, 1851) and *E. poecilopterus* (Andrewes, 1925)] were major, 16 species (*Clivina arunachalensis* Saha & Biswas, 1985, *C. brevior* Putzeys, 1866*, C. thenmala* Balkenohl, 2021*, Dyschirius paucipunctus* Andrewes, 1929*, Elaphropus ceylanicus* (Nietner, 1858)*, E. decoratus* (Andrewes, 1925) *E. fumicatus* (Motschulsky, 1851)*, E. klugii* (Nietner, 1858)*, E. nigellus* (Andrewes, 1935, *Tachys cardoni* Andrewes, 1925*, T. euryodes* Bates, 1892*, T. fasciatus* Motschulsky, 1851*, T. impressipennis* Motschulsky, 1851*, T. plagiatus* Putzeys, 1875*, T. sericeus* Motschulsky, 1851 and *T. tropicus* Nietner, 1858) were minor and three species [*Anomotachys acaroides* (Motschulsky, 1860), *Elapropus elutus* (Neitner, 1851) and *E. haliploides* (Bates, 1892)] were rare species in the Semi-evergreen forest.

Elaphropus poecilopterus (6.59 ±6.07; 55.28%) dominated the assemblage followed by *E. politus* (1.19±1.25; 9.92%) (Table 4). Rank abundance plot of light trap-based species is represented in Figure 4. It showed that one species *Elaphropus*

poecilopterus has a very high relative abundance (55.28%). This indicates strong dominance by a single species in the community. The sharp decline from the first to the second-ranked species (*Elaphropus politus,* 9.92%) shows that species abundances are highly uneven. A few species dominate, while the majority are much less abundant. Most species (after rank 5 or 6) have low and similar abundances (<5%). The steep slope and unequal species contributions suggest low species evenness. The community is dominated by a few taxa, with many species present in small numbers. The Shannon-Weaver diversity (H') of AWS was 1.77, Margalef richness index value (d) was 3.02, and Simpson's evenness index value ($E_{1/D}$) was 0.13 (Table 3). This result indicates that lowest in diversity and evenness and highest dominance may have been disturbed or a few species dominate.

Five species (*Clivina tranquebarica*, *Elaphropus fumicatus*, *E. klugii*, *E. ovatus* and *E. politus*) belonging to two genera (*Clivina* and *Elaphropus*) of the tribes Clivinini and Bembidiini were recorded from AWS in the pitfall trap collections. List of species and their abundance are given in Table 7. Among the five species, four species (*Clivina tranquebarica, Elaphropus fumicatus*, *E. klugii* and *E. politus*) were major and one species (*Elaphropus ovatus*) was minor. *Elaphropus fumicatus* (0.10±0.42; 36.36%) dominated the assemblage followed by *E. politus* (0.08 ± 0.38; 30.30%) (Table 7). Rank Abundance Plot of each species represented in Figure 5. It showed that *Elaphropus fumicatus* (36.36%) and *E. politus* (30.30%) are the most dominant species. These two species together make up 66% of the total relative abundance indicating moderate dominance by a few taxa. There is a sharp drop in abundance from the second to third species (*Clivina tranquebarica*, 21.21%). The remaining species (*Elaphropus klugii* and *E. ovatus*) are progressively less abundant (9.09% and 3.03%).

Seasonality

The overall abundance estimated through light trap collections exhibited no variation with seasons (*p value* > 0.05; Table 6). Among the 23 light attracted species, 13 species (*Clivina arunachalensis, C. brevior, C. tranquebarica, Dyschirius paucipunctus, Elaphropus ceylanicus E. fumicatus, E. nigellus, E. nilgiricus, E. poecilopterus, E. politus, Tachys fasciatus, T. impressipennis* and *T. tropicus*) exhibited seasonal occurrence (*p value* < 0.05); two species (*Elaphropus decoratus* and *E. klugii*) were classified as aseasonal (*p value* > 0.05). Eight species (*Anomotachys acaroides, Clivina thenmala, Elaphropus elutus, E. haliploides, Tachys cardoni, T. euryodes, T. sericeus* and *T. plagiatus*) having mean abundance values below 0.1, were excluded from seasonality analysis due to their low representation. Among the 15 species considered for the estimation of seasonality, twelve species (*Clivina brevior*, *C. tranquebarica*, *Dyschirius paucipunctus, Elaphropus ceylanicus, E. decoratus, E. fumicatus, E. klugii, E. nigellus*, *E. nilgiricus, E. poecilopterus, E. politus* and *Tachys tropicus*) were recorded in both non-rainy and rainy seasons. One species, *Tachys fasciatus* was present only in non-rainy season; two species (*Clivina arunachalensis* and *Tachys impressipennis)* were present only in rainy season (Table 5).

4.2.2. Tropical Evergreen Forest (RF)

Twenty-two species of Scaritinae and Trechinae beetles belonging to seven genera namely, *Anomotachys, Bembidion, Clivina, Dyschirius, Elaphropus, Tachys* and *Trilophus* and three tribes namely, Bembidiini, Clivinini and Dyschirini were recorded from the Tropical evergreen forest in the light trap method. List of species and their abundance are given in Table 8.

Among the 22 species, six species (*Clivina brevior*, *C. tranquebarica, Elaphropus fumicatus, E. nilgiricus, E. politus* and *Tachys fasciatus)* were major and 16 species (*Anomotachys acaroides, Bembidion niloticum, Dyschirius paucipunctus, Elaphropus ceylanicus, E. decoratus, E. klugii, E. nigellus, E. ovatus, E. poecilopterus, Tachys cardoni, T. euryodes T. impressipennis, T. plagiatus, T. sericeus*, *T. tropicus* and *Trilophus interpunctatus*) were minor species in the Tropical evergreen forest.

Elaphropus politus (2.28 ± 1.85; 28.31%) dominated the assemblage followed by *E. fumicatus* (1.19 ± 1.81; 14.77%) (Table 8). Rank abundance plot of light trap-based species is represented in Figure 6. It showed that the first few species (*Elaphropus politus*, *E. fumicatus*, and *E. nilgiricus*) show very high relative abundance, especially *E. politus* which dominates the community with 28.31% relative abundance. The remaining species have relatively low and similar abundances. This shows the presence of many minor species that are represented by only a small number of individuals. The Shannon-Weaver diversity (H') of RF was 2.46, Margalef richness index value (d) was 3.05, and Simpson's evenness ($E_{1/D}$) was 0.35 (Table 3). Shannon-Weaver diversity value of 2.46 suggests a fairly diverse community, with both a good number of species and a reasonable distribution of individuals among them. Margalef richness index value above 2.5 generally suggests high richness. So, RF has a relatively rich species composition, indicating a well-represented taxa pool. Simpson's evenness value of 0.35 implies relatively low evenness, suggesting that a few species dominate, while others are less represented.

Five species (*Clivina tranquebarica*, *Elaphropus fumicatus*, *E. klugii*, *E. politus* and *Tachys fasciatus*) belonging to three genera (*Clivina, Elaphropus* and

Tachys) of the two tribes (Bembidiini and Clivinini) were recorded from RF in the pitfall trap collections. List of species and their abundance are given in Table 11.

All the five species (*Clivina tranquebarica*, *Elaphropus fumicatus*, *E. klugii*, *E. politus* and *Tachys fasciatus*) were major species. *Elaphropus politus* (0.28 ± 0.52; 47.22%) dominated the assemblage followed by *E. fumicatus* (0.15 ± 0.35; 25%) (Table 11). Rank Abundance Plot of each species represented in Figure 7. It showed the dominance of one Species *Elaphropus politus* with a relative abundance of 47.22%. This indicates very low evenness, as nearly half the individuals belong to a single species. The second most abundant species (*Elaphropus fumicatus*) has about 25%, significantly lower than the first. This steep drop further emphasizes species dominance and uneven distribution. The remaining species (*Elaphropus klugii*, *Clivina tranquebarica* and *Tachys fasciatus*) show a decreasing but relatively smooth decline in abundance. This suggests the presence of some diversity, but few species contribute significantly to the population. The plot indicates a species-poor or unevenly structured community, where a small number of species dominate. Even though there is some diversity, the ecological balance is skewed towards dominance.

Seasonality

The overall abundance estimated through light trap collections exhibited statistically significant seasonal variations (Table 10). Among the 22 light attracted species, seven species (*Anomotachys acaroides, Elaphropus decoratus, E. fumicatus, E. nilgiricus, Tachys fasciatus, T. impressipennis* and *T. plagiatus*) exhibited seasonal patterns, 10 species (*Bembidion niloticum, Clivina brevior, C. tranquebarica, Elaphropus ceylanicus, E. klugii, E. nigellus, E. ovatus, E. poecilopterus, E. politus* and *Tachys tropicus*) were classified as aseasonal, and five species were excluded from the seasonality analysis due to their low abundance. Among the 17 species

considered for the estimation of seasonality, 16 species (*Anomotachys acaroides*, *Bembidion niloticum*, *Clivina brevior*, *C. tranquebarica*, *Elaphropus ceylanicus*, *E. decoratus, E. fumicatus*, *E. klugii, E. nigellus, E. nilgiricus, E. ovatus, E. poecilopterus*, *E. politus*, *Tachys fasciatus*, *T. impressipennis* and *T. tropicus*) were recorded in both non-rainy and rainy seasons; one species (*Tachys plagiatus)* was present only in rainy season (Table 9).

4.2.3 Chambad Agricultural Filed (CAF)

Forty-one species of Scaritinae and Trechinae beetles belonging to 16 genera namely, *Anomotachys, Bembidion, Clivina, Clypeuspinus, Coryza, Distichus, Dyschirius, Elaphropus, Leleuporella, Lymnastis, Orictites, Perileptus, Pogonus, Tachys, Trilophidius* and *Trilophus* and six tribes namely, Bembidiini, Clivinini, Dyschirini, Pogonini, Scaritini and Trechini were recorded from Agricultural Field with in the light trap collections. List of species and their abundance are given in Table 12. Among the 41 species, five species (*Clivina brevior, C. tranquebarica, Elaphropus fumicatus, E. poecilopterus* and *E. politus*) were major; 19 species (*Anomotachys acaroides, Bembidion niloticum, Clivina boreri, C. forcipata, C. ursulae, Dyschirius paucipunctus, Elaphropus ceylanicus, E. decoratus, E. klugii, E. nigellus, E. ovatus, Leleuporella devagiriensis, Lymnastis pullulus, Perileptus ceylanicus, Tachys cardoni, T. fasciatus, T. impressipennis, T. plagiatus* and *T. tropicus*) were minor and remaining 17 species (*Clivina arunachalensis, C. thenmala, Clypeuspinus devagiriensis, Coryza maculata, Distichus planus, D. puncticollis, Elaphropus elutus, E. nilgiricus, E. unitarius, Lymnastis pilosus, Orictites costulipennis, Perileptus indicus, Pogonus malabarensis, Tachys euryodes, T. sericeus, Trilophidius impuncatuts* and *Trilophus interpunctatus*) were rare species in Chambad Agricultural Field.

Clivina brevior (23.99±23.31; 37.80%) dominated the assemblage followed by *Elaphropus fumicatus* (13.68 ±15.03; 21.54%) (Table 12). Rank abundance plot of light trap-based species is represented in Figure 8. It showed that *Clivina brevior* is clearly the most dominant species, with the highest relative abundance (37.80%). It stands out far above all others, indicating a highly uneven community. There are 41 species represented in the plot, suggesting a moderately high species richness. The steep slope at the beginning (from *Clivina brevior* to the next few species) and the long tail of species with very low abundances indicate low evenness. A few species dominate the community, while many are rare or occur in low numbers. A significant portion of species have very low relative abundance, indicating the presence of many rare species, which could be due to seasonal effects, microhabitat specialization. The Shannon-Weaver diversity (H') of CAF was 2.08, Margalef richness index value (d) was 4.47, and Simpson's evenness ($E_{1/D}$) was 0.12 (Table 3). The Shannon-Weaver diversity (H') value 2.08 indicates moderate species diversity. There is a reasonable number of species, the distribution is not highly even, with some species likely being more dominant than others. Margalef richness index value of 4.47 suggests high species richness, implying that a diverse range of species is present at the site. Simpson's evenness ($E_{1/D}$) value 0.12 indicates very low evenness in the community. A few species dominate the community, while most others are minor and rare species.

Ten species (*Clivina brevior, C. thenmala, C. tranquebarica, Elaphropus ceylanicus, E. politus, E. fumicatus, E. klugii, E. ovatus, Distichus planus* and *Tachys fasciatus*) belonging to four genera (*Clivina, Distichus, Elaphropus* and *Tachys*) of the three tribes (Bembidiini, Clivinini and Scaritini) were recorded from CAF with in the pitfall trap collections. List of species and their abundance are given in Table 15.

Among the ten species, three species (*Clivina brevior, C. tranquebarica* and *Elaphropus politus*) were major species and remaining seven species (*Clivina thenmala, Elaphropus ceylanicus*, *E. fumicatus, E. klugii, E. ovatus, Distichus planus* and *Tachys fasciatus*) were minor species. *Clivina brevior* (0.21±0.61; 36.76%) dominated the assemblage followed by *Elaphropus politus* (0.18±0.65; 32.35%) (Table 15). Rank Abundance Plot of each species represented in Figure 9. It showed that *Clivina brevior* and *Elaphropus politus* are the two most dominant species, with relative abundances of 36.76% and 32.35%, respectively. Together, these two species accounts for more than 65% of the total abundance, indicating a strong dominance pattern. The steep slope from the first to third species (*Clivina brevior*, *Elaphropus politus*, *Clivina tranquebarica*) and the flat tail at the bottom suggest very low evenness. A few species dominate the community, while the rest occur in much smaller numbers.

Seasonality

The overall abundance estimated through light trap collections exhibited significant variation with seasons (Table 14). Among the forty-one light attracted species, 15 species (*Anomotachys acaroides, Clivina boreri, C. brevior, C. forcipata, C. ursulae, Elaphropus fumicatus, E. decoratus, E. nigellus, E. poecilopterus, Leleuporella devagiriensis, Lymnastis pullulus, Perileptus ceylanicus, Tachys fasciatus, T. impressipennis* and *T. tropicus*) were seasonal species, ten species (*Bembidion niloticum, Clivina tranquebarica, Dyschirius paucipunctus, Elaphropus ceylanicus, E. klugii, E. ovatus, E. politus, Perileptus indicus, Tachys cardoni* and *T. plagiatus*) were aseasonal and 16 species were not considered for the estimation of seasonality. Among the 25 species considered for the estimation of seasonality, 20 species (*Anomotachys acaroides, Bembidion niloticum, Clivina brevior, C.*

tranquebarica, Dyschirius paucipunctus, Elaphropus ceylanicus, E. decoratus, E. fumicatus, E. klugii, E. nigellus, E. ovatus, E. poecilopterus, E. politus, Perileptus ceylanicus, P. indicus, Tachys cardoni, T. fasciatus, T. impressipennis, T. plagiatus and *T. tropicus*) were present in both non-rainy and rainy seasons and five species (*Clivina boreri, C. forcipata, C. ursulae, Leleuporella devagiriensis* and *Lymnastis pullulus*) were present only in rainy season (Table 13).

4.2.4 Comparative analysis of Scaritinae and Trechinae assemblages in AWS, RF and CAF of north Malabar region.

In total 42 species belonging to 15 genera and six tribes were collected using light trap method from the three habitats. Over all abundance showed that Subfamily Trechinae [18 species, 86.29% (AWS); 17 species, 88.67% (RF); 25 species, 51% (CAF); was most abundant than Subfamily Scaritinae [5 species, 13.71% (AWS); 5 species, 11.33% (RF); 16 species, 49% (CAF)] in all the three habitats (Tables 4, 8, 12).

Totally ten species belonging to three genera and two tribes were collected using pitfall trap method from the three habitats. Over all abundance showed that Subfamily Trechinae [4 species, 78.79% (AWS); 4 species, 91.67% (RF); 6 species, 51.15% (CAF)] was most abundant than Subfamily Scaritinae [1 species, 21.21% (AWS); 1 species, 8.33% (RF); 4 species, 48.85% (CAF)] in the Semi-evergreen forest, Tropical evergreen forest and Agricultural field (Tables 7, 11, 15).

Among the 42 species collected with light trap, 15 species (*Clivina boreri, C. forcipata, C. ursulae, Clypiuspinus devagiriensis, Coryza maculata, Distichus planus, D. puncticollis, Elaphropus uniatrius, Leleuporella devagiriensis, Lymnastis pilosus, L. pullulus, Orictites costulipennis, Perileptus indicus, Pogonus malabarensis* and

Trilophus impunctatus were specific to CAF and one species (*Elaphropus haliploides*) was specific to AWS.

Shannon-Weaver diversity (H') value 1.77 of AWS indicating the lowest diversity, indicating fewer species or uneven distribution. Shannon-Weaver diversity (H') value 2.46 of RF indicating the highest species diversity, suggesting a more complex and balanced community. Shannon-Weaver diversity (H') value 2.08 of CAF indicating moderate species diversity. The community is not dominated by a single species. Species are fairly well distributed, but not even. Margalef richness index (d) value 3.02 of AWS has indicating the moderate species richness. The community has a reasonable number of species relative to the number of individuals sampled. Margalef richness index (d) value 3.05 of RF has indicating moderate richness. Margalef richness index (d) value 4.70 of CAF shows the highest species richness, suggesting the presence of a larger number of different species. Simpson's evenness ($E_{1/D}$) value 0.13 of AWS has indicating low evenness. Simpson's evenness ($E_{1/D}$) value 0.35 of RF has the moderately highest evenness, suggesting a more uniform species distribution. Simpson's evenness ($E_{1/D}$) value 0.12 of CAF shows very low evenness, indicating dominance by a few species despite high richness. While, comparing the three sites, it shows that RF is the most balanced ecosystem, with relatively high diversity, moderate richness, and good evenness. CAF is species-rich but uneven, likely dominated by a few species. AWS is less diverse with uneven distribution (Table 3).

4.2.5 Comparative analysis of Scaritinae and Trechinae assemblages in selected Forest and Agricultural Ecosystems of north Malabar region.

Twenty-six species of Scaritinae and Trechinae beetles belonging to four genera namely *Clivina*, *Dyschirius*, *Elaphropus* and *Tachys* were recorded from the

selected forest ecosystems. The Shannon-Weaver diversity (H') of forest ecosystem was 2.28, Margalef richness index value (d) was 3.21, and Simpson's evenness ($E_{1/D}$) was 0.22 (Table 16). Shannon-Weaver diversity (H') value of 2.28 indicates moderate to high diversity. This suggests that the forest ecosystem supports a reasonably varied community of species, with a fair balance in their population sizes. Margalef richness index value (d) value of 3.21 indicates a moderate level of species richness. This suggests the forest hosts a relatively good number of species. Simpson's evenness ($E_{1/D}$) value of 0.22 indicating low evenness. The species are not evenly distributed. A few species are highly dominant, while many others are present in low numbers. Overall interpretation shows a reasonable number of species present and overall a healthy diversity with few species dominating in the community.

Forty-one species of Scaritinae and Trechinae beetles belonging to six genera namely *Anomotachys, Clivina, Dyschirius*, *Elaphropus, Perileptus* and *Tachys* were recorded from the selected Agricultural ecosystem. The Shannon-Weaver diversity (H') of Agricultural ecosystem was 2.08, Margalef richness index value (d) was 4.47, and Simpson's evenness ($E_{1/D}$) was 0.12 (Table 16). Shannon-Weaver diversity (H') value of 2.08 indicating a moderate diversity, while not extremely high, it indicates a reasonably diverse community of species is present within the agricultural landscape. Margalef richness index value (d) of 4.47 indicates a rich species pool, suggesting that a greater number of species were recorded in the agricultural ecosystem compared to the forest ecosystem. Simpson's evenness ($E_{1/D}$) value of 0.12 indicates very low evenness. The community is highly uneven. Few species are overwhelmingly dominant. Most other species occur in very small numbers.

The overall abundance estimated in Forest and Agricultural Ecosystem shows significant variations with seasons (Table 17). The Shannon-Weaver diversity (H') of

forest ecosystem during non-rainy season was 2.16, Margalef richness index value (d) was 3.21, and Simpson's evenness ($E_{1/D}$) was 0.20 (Table 18). Shannon-Weaver diversity value of 2.16 suggests moderate to high diversity. Thus, the forest shows a healthy diversity during the non-rainy season. Margalef richness index value of 3.21 indicates moderate species richness. It shows that the forest supports a fairly wide variety of species, though not extremely high. Simpson's evenness value of 0.20 indicates low evenness, meaning a single species or few species dominates the community during non-rainy season. The Shannon-Weaver diversity (H') of forest ecosystem during rainy season was 2.18, Margalef richness index value (d) was 4.65, and Simpson's evenness ($E_{1/D}$) was 0.11 (Table 18). Shannon-Weaver diversity value 2.18 suggests moderate to high species diversity. It is slightly higher than the non-rainy season value (2.16), indicating a slight increase in diversity during the rainy season. This may be due an increase in species activity and abundance. Margalef richness index value 4.65 indicates higher species richness compared to the non-rainy season (d = 3.21). This suggests that more species were present or detected during the rainy season, possibly due to favourable moisture and temperature conditions. Simpson's evenness value 0.11 reflects lower evenness compared to the non-rainy season (0.20). While diversity and richness increased, the distribution of individuals among species became slightly more uneven, suggesting that a few species may have become more dominant during rainy season.

Based on Brey Curtis similarity coefficient, the highest similarity between the Scaritinae and Trechinae assemblages from light trap collections was in Semi-evergreen forest and Tropical evergreen forest followed by Semi-evergreen forest and Agricultural habitat and least similarity was between Tropical evergreen forest and Agricultural habitat (Table 19, Figure 7). While in pitfall trap collections, highest

similarity was between the Semi-evergreen forest and Tropical evergreen forest and least similarity was between Semi-evergreen forest and Agricultural habitat (Table 20, Figure 10,11).

Among the three habitats, Agricultural ecosystem shows the highest species richness, with its curve climbing the most steeply and approaching a higher asymptote. Semi-evergreen forest and Tropical evergreen forest show comparatively lower richness, with curves stabilizing earlier, suggesting that most species present were captured within the current sampling effort. The extrapolation segments (dashed lines) extend the trend beyond the observed sample size, and their shallow slopes indicate that only a small number of additional species are expected with further sampling. This pattern suggests that the sampling was generally sufficient and that the observed diversity patterns reliably represent true community structure (Figure 14).

While using pitfall trap method, rarefaction curve shows that Semi-evergreen forest and Tropical evergreen forest have lower, saturated diversity suggesting more homogeneous or less diverse communities. The rarefaction and extrapolation curves indicate that sampling was adequate in Agricultural habitat, Semi-evergreen forest and Tropical evergreen forest, as their species diversity curves level off and show narrow confidence intervals, suggesting that additional sampling is not needed (Figure 15).

Table 3: Diversity, richness, evenness of Scaritinae and Trechinae beetles collected with light trap from AWS, RF and CAF.

Study site	**Shannon-Weaver diversity index (H')**	**Margalef 's richness index (d)**	**Simpson's evenness index ($E_{1/D}$)**
Aralam Wildlife Sanctuary	1.77	3.02	0.13
Ranipuram Forest	2.46	3.05	0.35
Chambad Agricultural Field	2.08	4.47	0.12

Table 4: Abundance (Mean ± SD; percentage) of Scaritinae and Trechinae beetles collected with light trap from AWS.

Sl No	Species	Mean ± SD	%
1.	*Elaphropus poecilopterus*	6.59 ±6.07	55.28
2.	*Elaphropus politus*	1.19 ±1.25	9.92
3.	*Clivina tranquebarica*	0.82 ±0.87	6.85
4.	*Elaphropus nilgiricus*	0.79 ±1.31	6.64
5.	*Dyschirius paucipunctus*	0.43 ±0.67	3.63
6.	*Elaphropus klugii*	0.34 ±0.48	2.87
7.	*Elaphropus fumicatus*	0.34 ±0.49	2.87
8.	*Clivina brevior*	0.29 ±0.46	2.45
9.	*Tachys tropicus*	0.23 ±0.42	1.96
10.	*Elaphropus nigellus*	0.18 ±0.39	1.54
11.	*Elaphropus decoratus*	0.17 ±0.37	1.4
12.	*Elaphropus ceylanicus*	0.13 ±0.34	1.12
13.	*Tachys impressipennis*	0.09 ±0.29	0.77
14.	*Tachys fasciatus*	0.09 ±0.29	0.77
15.	*Clivina arunachalensis*	0.08 ±0.28	0.70
16.	*Tachys cardoni*	0.03 ±0.18	0.28
17.	*Tachys euryodes*	0.03 ±0.22	0.28
18.	*Tachys plagiatus*	0.03 ±0.16	0.21
19.	*Tachys sericeus*	0.02 ±0.13	0.14
20.	*Clivina thenmala*	0.02 ±0.13	0.14
21.	*Elaphropus elutus*	0.01 ±0.09	0.07

22.	*Elaphropus haliploides*	0.01 ±0.09	0.07
23.	*Anomotachys acaroides*	0.01 ±0.09	0.07

Table 5: Seasonal abundance (Mean ± SD) of Scaritinae and Trechinae beetle assemblage associated with AWS collected with Light trap ('S' denotes Seasonal; 'AS' denotes Aseasonal; 'NA' denotes Not applicable).

Sl No	**Species**	**Non-rainy season (Mean ± SD)**	**Rainy season (Mean ± SD)**	**Seasonality**	**t-test (*P value*)**
1.	*Anomotachys acaroides*	0.00 ± 0.00	0.02 ± 0.13	NA	>0.05
2.	*Clivina arunachalensis*	0.00 ± 0.00	0.17 ± 0.38	S	<0.05
3.	*Clivina brevior*	0.08 ± 0.28	0.50 ± 0.50	S	<0.05
4.	*Clivina thenmala*	0.00 ± 0.00	0.03 ± 0.18	NA	>0.05
5.	*Clivina tranquebarica*	0.10 ± 0.30	1.53 ± 0.62	S	<0.05
6.	*Dyschirius paucipunctus*	0.83 ± 0.74	0.03 ± 0.18	S	<0.05
7.	*Elaphropus ceylanicus*	0.07 ± 0.25	0.20 ± 0.40	S	<0.05
8.	*Elaphropus decoratus*	0.15 ± 0.36	0.18 ± 0.39	AS	>0.05
9.	*Elaphropus elutus*	0.00 ± 0.00	0.02 ± 0.13	NA	>0.05
10.	*Elaphropus fumicatus*	0.55 ± 0.53	0.13 ± 0.34	S	<0.05
11.	*Elaphropus haliploides*	0.00 ± 0.00	0.02 ± 0.13	NA	>0.05
12.	*Elaphropus klugii*	0.27 ± 0.45	0.42 ± 0.50	AS	>0.05
13.	*Elaphropus nigellus*	0.33 ± 0.48	0.03 ± 0.18	S	<0.05
14.	*Elaphropus nilgiricus*	1.57 ± 1.49	0.02 ± 0.13	S	<0.05
15.	*Elaphropus poecilopterus*	7.92 ± 7.49	5.27 ± 3.82	S	<0.05
16.	*Elaphropus politus*	0.59 ± 0.50	1.78 ± 1.47	S	<0.05

17.	*Tachys cardoni*	0.00 ± 0.00	0.07 ± 0.25	NA	>0.05
18.	*Tachys euryodes*	0.03 ± 0.18	0.03 ± 0.26	NA	>0.05
19.	*Tachys fasciatus*	0.18 ± 0.39	0.00 ± 0.00	S	<0.05
20.	*Tachys impressipennis*	0.00 ± 0.00	0.18 ± 0.39	S	<0.05
21.	*Tachys plagiatus*	0.05 ± 0.22	0.00 ± 0.00	NA	>0.05
22.	*Tachys sericeus*	0.00 ± 0.00	0.03 ± 0.18	NA	>0.05
23.	*Tachys tropicus*	0.33 ± 0.48	0.13 ± 0.34	S	<0.05

Table 6: Statistical analysis of the seasonal variation in the abundance of Scaritinae and Trechinae beetles collected from AWS. ('-' denotes no significant variation; 'S' denotes significant variation; collection methodology- light trap).

	t- test	
	t	*P*
Species abundance	1.90	>0.05 (-)

Table 7: Abundance (Mean ± SD; percentage) of Scaritinae and Trechinae beetles collected with pitfall trap from AWS.

Sl No	**Species**	**Mean ± SD**	**%**
1.	*Elaphropus fumicatus*	0.10 ± 0.42	36.36
2.	*Elaphropus politus*	0.08 ± 0.38	30.30
3.	*Clivina tranquebarica*	0.06 ± 0.27	21.21
4.	*Elaphropus klugii*	0.03 ± 0.20	9.09
5.	*Elaphropus ovatus*	0.01 ± 0.09	3.03

Table 8: Abundance (Mean ± SD; percentage) of Scaritinae and Trechinae beetles collected with light trap from RF.

Sl No	Species	Mean ± SD	%
1.	*Elaphropus politus*	2.28 ± 1.85	28.31
2.	*Elaphropus fumicatus*	1.19 ± 1.81	14.77
3.	*Elaphropus nilgiricus*	0.84 ± 0.77	10.43
4.	*Clivina tranquebarica*	0.48 ± 0.50	5.99
5.	*Tachys fasciatus*	0.43 ± 0.50	5.27
6.	*Clivina brevior*	0.42 ± 0.50	5.17
7.	*Elaphropus klugii*	0.33 ± 0.47	4.03
8.	*Bembidion niloticum*	0.30 ± 0.46	3.72
9.	*Elaphropus poecilopterus*	0.28 ± 0.45	3.51
10.	*Elaphropus ovatus*	0.28 ± 0.45	3.51
11.	*Tachys tropicus*	0.28 ± 0.45	3.41
12.	*Tachys impressipennis*	0.19 ± 0.40	2.38
13.	*Elaphropus decoratus*	0.17 ± 0.37	2.07
14.	*Elaphropus nigellus*	0.15 ± 0.36	1.86
15.	*Anomotachys acaroides*	0.13 ± 0.34	1.65
16.	*Tachys plagiatus*	0.08 ± 0.28	1.03
17.	*Elaphropus ceylanicus*	0.08 ± 0.28	1.03
18.	*Tachys sericeus*	0.06 ± 0.24	0.72
19.	*Clivina arunachalensis*	0.05 ± 0.22	0.62
20.	*Tachys cardoni*	0.03 ± 0.16	0.31
21.	*Trilophus interpunctatus*	0.01 ± 0.09	0.10
22.	*Dyschirius paucipunctus*	0.01 ± 0.09	0.10

Table 9: Seasonal abundance (Mean ± SD) of Scaritinae and Trechinae beetle assemblage associated with RF collected with Light trap ('S' denotes Seasonal; 'AS' denotes Aseasonal; 'NA' denotes Not applicable).

Sl No	Species	Non-rainy (Mean ± SD)	Rainy (Mean ± SD)	Seasonality	t-test (*P value*)
1.	*Anomotachys acaroides*	0.20 ± 0.40	0.07 ± 0.25	S	<0.05
2.	*Bembidion niloticum*	0.33 ± 0.48	0.27 ± 0.45	AS	>0.05
3.	*Clivina arunachalensis*	0.07 ± 0.25	0.03 ± 0.18	NA	>0.05
4.	*Clivina brevior*	0.38 ± 0.49	0.45 ± 0.50	AS	>0.05
5.	*Clivina tranquebarica*	0.50 ± 0.50	0.47 ± 0.50	AS	>0.05
6.	*Dyschirius paucipunctus*	0.00 ± 0.00	0.02 ± 0.13	NA	>0.05
7.	*Elaphropus ceylanicus*	0.05 ± 0.22	0.12 ± 0.32	AS	>0.05
8.	*Elaphropus decoratus*	0.30 ± 0.46	0.03 ± 0.18	S	<0.05
9.	*Elaphropus fumicatus*	2.30 ± 2.00	0.08 ± 0.28	S	<0.05
10.	*Elaphropus klugii*	0.37 ± 0.49	0.28 ± 0.45	AS	>0.05
11.	*Elaphropus nigellus*	0.20 ± 0.40	0.10 ± 0.30	AS	>0.05
12.	*Elaphropus nilgiricus*	1.33 ± 0.68	0.35 ± 0.48	S	<0.05
13.	*Elaphropus ovatus*	0.32 ± 0.47	0.25 ± 0.44	AS	>0.05
14.	*Elaphropus poecilopterus*	0.32 ± 0.47	0.25 ± 0.44	AS	>0.05
15.	*Elaphropus politus*	2.33 ± 2.00	2.23 ± 1.71	AS	>0.05
16.	*Tachys cardoni*	0.00 ± 0.00	0.05 ± 0.22	NA	>0.05
17.	*Tachys fasciatus*	0.67 ± 0.48	0.18 ± 0.39	S	<0.05
18.	*Tachys impressipennis*	0.03 ± 0.18	0.35 ± 0.48	S	<0.05

19.	*Tachys plagiatus*	0.00 ± 0.00	0.17 ± 0.38	S	<0.05
20.	*Tachys sericeus*	0.07 ± 0.25	0.05 ± 0.22	NA	>0.05
21.	*Tachys tropicus*	0.27 ± 0.45	0.28 ± 0.45	AS	>0.05
22.	*Trilophus interpunctatus*	0.00 ± 0.00	0.02 ± 0.13	NA	>0.05

Table 10: Statistical analysis of the seasonal variation in the abundance of Scaritinae and Trechinae beetles collected from RF ('-' denotes no significant variation; 'S' denotes significant variation; collection methodology- light trap).

	t- test	
	t	*P*
Species abundance	5.59	<0.05 (S)

Table 11: Abundance (Mean ± SD; percentage) of Scaritinae and Trechinae beetles collected with pitfall trap from RF.

Sl No	**Species**	**Mean ± SD**	**%**
1.	*Elaphropus politus*	0.28 ± 0.52	47.22
2.	*Elaphropus fumicatus*	0.15 ± 0.35	25
3.	*Elaphropus klugii*	0.08 ± 0.24	13.90
4.	*Clivina tranquebarica*	0.05 ± 0.16	8.33
5.	*Tachys fasciatus*	0.03 ± 0.13	5.55

Table 12: Abundance (Mean ± SD; percentage) of Scaritinae and Trechinae beetles collected with light trap from CAF.

Sl No	Species	Mean ± SD	%
1.	*Clivina brevior*	23.99 ± 23.31	37.80
2.	*Elaphropus fumicatus*	13.68 ± 15.03	21.54
3.	*Elaphropus politus*	5.76 ± 4.44	9.07
4.	*Clivina tranquebarica*	4.46 ± 3.23	7.02
5.	*Elaphropus poecilopterus*	3.98 ± 3.45	6.28
6.	*Elaphropus decoratus*	2.69 ± 2.11	4.24
7.	*Tachys fasciatus*	1.64 ± 1.58	2.59
8.	*Elaphropus ceylanicus*	0.97 ± 0.67	1.52
9.	*Elaphropus ovatus*	0.81 ± 0.80	1.27
10.	*Clivina ursulae*	0.79 ± 1.03	1.25
11.	*Tachys tropicus*	0.66 ± 0.49	1.04
12.	*Tachys impressipennis*	0.63 ± 0.48	1.00
13.	*Perileptus ceylanicus*	0.58 ± 0.54	0.91
14.	*Elaphropus klugii*	0.44 ± 0.50	0.70
15.	*Leleuporella devagiriensis*	0.29 ± 0.46	0.46
16.	*Lymnastis pullulus*	0.24 ± 0.43	0.38
17.	*Anomotachys acaroides*	0.23 ± 0.42	0.37
18.	*Tachys plagiatus*	0.20 ± 0.40	0.32
19.	*Tachys cardoni*	0.19 ± 0.40	0.30
20.	*Bembidion niloticum*	0.17 ± 0.37	0.26
21.	*Clivina forcipata*	0.16 ± 0.37	0.25

22.	*Clivina boreri*	0.14 ± 0.35	0.22
23.	*Dyschirius paucipunctus*	0.14 ± 0.35	0.22
24.	*Elaphropus nigellus*	0.13 ± 0.34	0.21
25.	*Trilophus interpunctatus*	0.06 ± 0.30	0.09
26.	*Perileptus indicus*	0.06 ± 0.24	0.09
27.	*Tachys euryodes*	0.05 ± 0.22	0.08
28.	*Clivina arunachalensis*	0.04 ± 0.20	0.07
29.	*Lymnastis pilosus*	0.04 ± 0.20	0.07
30.	*Clivina thenmala*	0.04 ± 0.20	0.07
31.	*Elaphropus elutus*	0.03 ± 0.16	0.04
32.	*Pogonus malabarensis*	0.03 ± 0.16	0.04
33.	*Orictites costulipennis*	0.03 ± 0.16	0.04
34.	*Distichus planus*	0.03 ± 0.16	0.04
35.	*Distchus puncticollis*	0.03 ± 0.16	0.04
36.	*Coryza maculata*	0.02 ± 0.13	0.03
37.	*Tachys sericeus*	0.02 ± 0.13	0.03
38.	*Elaphropus nilgiricus*	0.02 ± 0.13	0.03
39.	*Trilophus impuncatuts*	0.02 ± 0.13	0.03
40.	*Clypeuspinus devagiriensis*	0.01 ± 0.09	0.01
41.	*Elaphropus unitarius*	0.01 ± 0.09	0.01

Table 13: Seasonal abundance (Mean ± SD) of Scaritinae and Trechinae beetle assemblage associated with CAF collected with Light trap ('S' denotes Seasonal; 'AS' denotes Aseasonal; 'NA' denotes Not applicable).

Sl No	**Species**	**Non-rainy**	**Rainy**	**Seasonality**	**t-test**
		(Mean SD)	**(Mean ± SD)**		**(*P value*)**
1.	*Anomotachys acaroides*	0.02 ± 0.13	0.45 ± 0.50	S	<0.05
2.	*Bembidion niloticum*	0.17 ± 0.38	0.17 ± 0.38	AS	>0.05
3.	*Clivina arunachalensis*	0.03 ± 0.18	0.05 ± 0.22	NA	>0.05
4.	*Clivina boreri*	0.00 ± 0.00	0.28 ± 0.45	S	<0.05
5.	*Clivina brevior*	9.75 ± 5.91	38.23 ± 25.46	S	<0.05
6.	*Clivina forcipata*	0.00 ± 0.00	0.32 ± 0.47	S	<0.05
7.	*Clivina thenmala*	0.00 ± 0.00	0.08 ± 0.28	NA	>0.05
8.	*Clivina tranquebarica*	4.02 ± 2.49	4.90 ± 3.80	AS	>0.05
9.	*Clivina ursulae*	0.00 ± 0.00	1.58 ± 0.93	S	<0.05
10.	*Clypeuspinus devagiriensis*	0.00 ± 0.00	0.02 ± 0.13	NA	>0.05
11.	*Coryza maculata*	0.00 ± 0.00	0.03 ± 0.18	NA	>0.05
12.	*Distchus puncticollis*	0.02 ± 0.13	0.03 ± 0.18	NA	>0.05
13.	*Distichus planus*	0.03 ± 0.18	0.02 ± 0.13	NA	>0.05
14.	*Dyschirius paucipunctus*	0.12 ± 0.32	0.17 ± 0.38	AS	>0.05
15.	*Elaphropu fumicatus*	21.08 ± 18.25	6.27 ± 3.29	S	<0.05
16.	*Elaphropus ceylanicus*	0.85 ± 0.63	1.08 ± 0.70	AS	>0.05
17.	*Elaphropus decoratus*	2.15 ± 1.69	3.23 ± 2.36	S	<0.05
18.	*Elaphropus elutus*	0.00 ± 0.00	0.05 ± 0.22	NA	>0.05

19.	*Elaphropus klugii*	0.47 ± 0.50	0.42 ± 0.50	AS	>0.05
20.	*Elaphropus nigellus*	0.02 ± 0.13	0.25 ± 0.44	S	<0.05
21.	*Elaphropus nilgiricus*	0.03 ± 0.18	0.00 ± 0.00	NA	>0.05
22.	*Elaphropus ovatus*	0.45 ± 0.50	1.17 ± 0.89	AS	>0.05
23.	*Elaphropus poecilopterus*	5.13 ± 3.95	2.83 ± 2.38	S	<0.05
24.	*Elaphropus politus*	5.43 ± 3.63	6.08 ± 5.14	AS	>0.05
25.	*Elaphropus unitarius*	0.00 ± 0.00	0.02 ± 0.13	NA	>0.05
26.	*Leleuporella devagiriensis*	0.00 ± 0.00	0.58 ± 0.50	S	<0.05
27.	*Lymnastis pilosus*	0.00 ± 0.00	0.08 ± 0.28	NA	>0.05
28.	*Lymnastis pullulus*	0.00 ± 0.00	0.48 ± 0.50	S	<0.05
29.	*Orictites costulipennis*	0.00 ± 0.00	0.05 ± 0.22	NA	>0.05
30.	*Perileptus ceylanicus*	0.20 ± 0.40	0.95 ± 0.39	S	<0.05
31.	*Perileptus indicus*	0.02 ± 0.13	0.10 ± 0.30	AS	>0.05
32.	*Pogonus malabarensis*	0.00 ± 0.00	0.05 ± 0.22	NA	>0.05
33.	*Tachys cardoni*	0.25 ± 0.44	0.13 ± 0.34	AS	>0.05
34.	*Tachys euryodes*	0.02 ± 0.13	0.08 ± 0.28	NA	>0.05
35.	*Tachys fasciatus*	1.03 ± 0.84	2.25 ± 1.88	S	<0.05
36.	*Tachys impressipennis*	0.50 ± 0.50	0.77 ± 0.43	S	<0.05
37.	*Tachys plagiatus*	0.22 ± 0.42	0.18 ± 0.39	AS	>0.05
38.	*Tachys sericeus*	0.03 ± 0.18	0.00 ± 0.00	NA	>0.05
39.	*Tachys tropicus*	0.80 ± 0.44	0.52 ± 0.50	S	<0.05
40.	*Trilophus impunctatus*	0.03 ± 0.18	0.00 ± 0.00	NA	>0.05
41.	*Trilophus interpunctatus*	0.07 ± 0.36	0.05 ± 0.22	NA	>0.05

Table 14: Statistical analysis of the seasonal variation in the abundance of Scaritinae and Trechinae beetles collected from CAF ('-' denotes no significant variation; 'S' denotes significant variation; collection methodology- light trap).

	t- test	
	t	*P*
Species abundance	4.84	<0.05 (S)

Table 15: Abundance (Mean ± SD; percentage) of Scaritinae and Trechinae beetles collected with pitfall trap from CAF.

Sl No	**Species**	**Mean ± SD**	**%**
1.	*Clivina brevior*	0.21 ± 0.61	36.76
2.	*Elaphropus politus*	0.18 ± 0.65	32.35
3.	*Clivina tranquebarica*	0.06 ± 0.27	10.29
4.	*Elaphropus fumicatus*	0.03 ± 0.20	4.41
5.	*Distichus planus*	0.02 ± 0.18	2.94
6.	*Elaphropus ceylanicus*	0.02 ± 0.13	2.94
7.	*Elaphropus klugii*	0.02 ± 0.13	2.94
8.	*Elapphropus ovatus*	0.02 ± 0.13	2.94
9.	*Tachys fasciatus*	0.02 ± 0.13	2.94
10.	*Clivina thenmala*	0.01 ± 0.09	1.47

Table 16: Diversity, richness, evenness of Scaritinae and Trechinae beetles collected with light trap method from Forest and Agricultural Ecosystem.

Season	**Collection Methodology**	**Shannon-Weaver diversity index (H')**	**Margalef 's richness index (d)**	**Simpson's evenness index ($E_{1/D}$)**
Forest	Light trap	2.28	3.21	0.22
Agricultural Field		2.08	4.47	0.12

Table 17: Statistical analysis of the variation in the overall abundance of Scaritinae and Trechinae beetles collected from the Forest and Agricultural Ecosystems during non-rainy and rainy seasons with light trap method.

	Collection Methodology	**Two way- Annova**		
Forest	Light trap	**F**	**DF**	***P***
Agricultural Field		146.16	1	<0.05 (S)
Non-rainy		4.35	1	<0.05 (S)
Rainy				

Table 18: Diversity, richness, evenness of Scaritinae and Trechinae beetles collected with light trap method during non-rainy and rainy seasons.

Season	**Collection Methodology**	**Shannon-Weaver diversity index (H')**	**Margalef 's richness index (d)**	**Simpson's evenness index ($E_{1/D}$)**
Non-rainy	Light trap	2.16	3.21	0.20
Rainy		2.18	4.65	0.11

Table 19: Bray Curtis similarity coefficient values of Scaritinae and Trechinae beetle assemblage associated with AWS, RF and CAF in north Malabar region during 2019–2022 period (AWS- Aralam Wildlife Sanctuary; RF- Ranipuram Forest; CAF- Chambad Agricultural Field; collection methodology- light trap).

Habitat	**AWS**	**RF**	**CAF**
AWS			
RF	0.99		
CAF	0.88	0.87	

Table 20: Bray Curtis similarity coefficient values of Scaritinae and Trechinae beetles' assemblage associated with AWS, RF, CAF in north Malabar region (AWS- Aralam Wildlife Sanctuary; RF- Ranipuram Forest; CAF- Chambad Agricultural Field; collection methodology- pitfall trap).

Habitat	**AWS**	**RF**	**CAF**
AWS			
RF	0.99		
CAF	0.86	0.92	

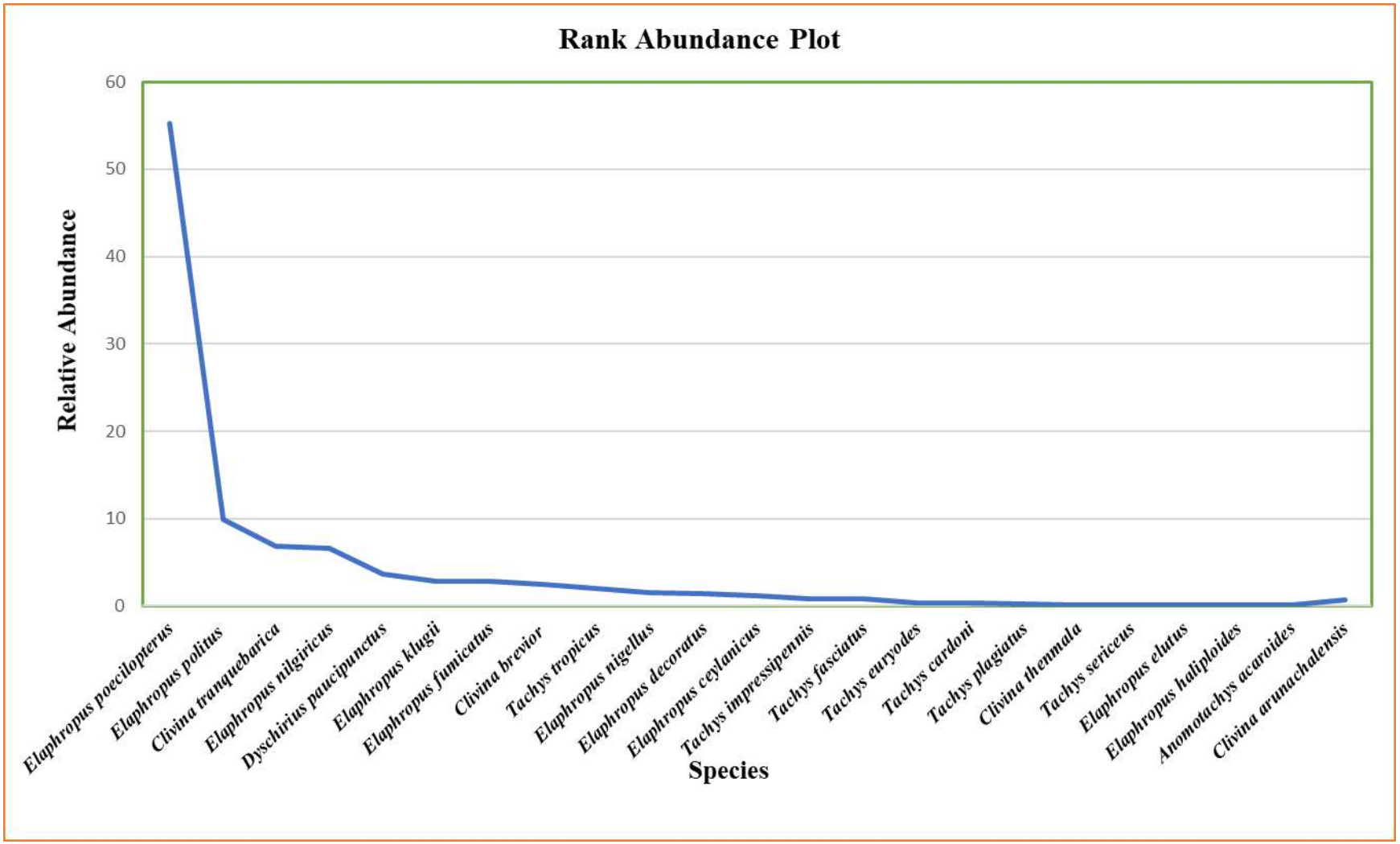


Figure 4: Rank-Abundance Plot for the Scaritinae and Trechinae beetles collected with light trap from AWS

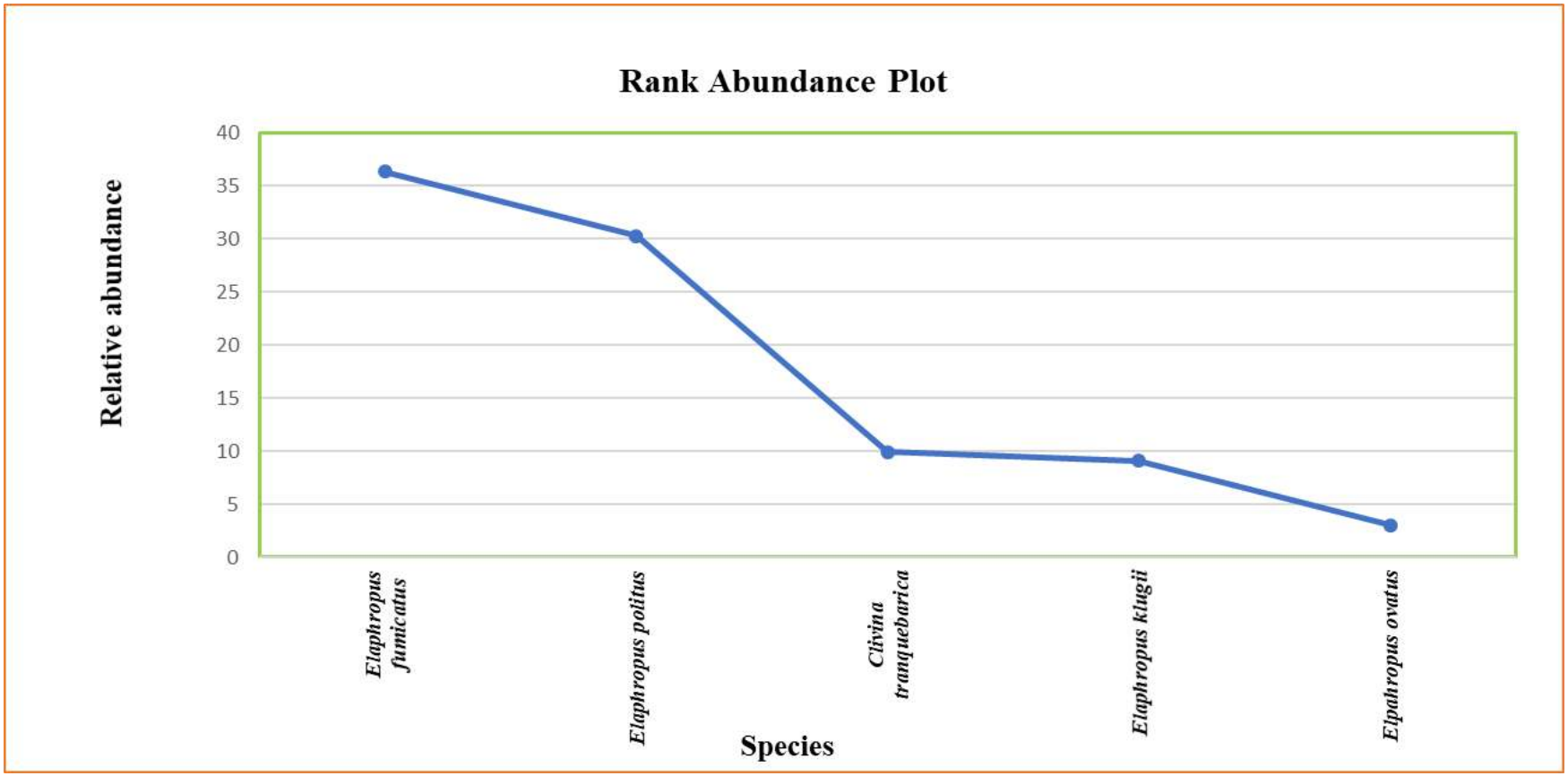


Figure 5: Rank-Abundance Plot for the Scaritinae and Trechinae collected with pitfall trap from AWS

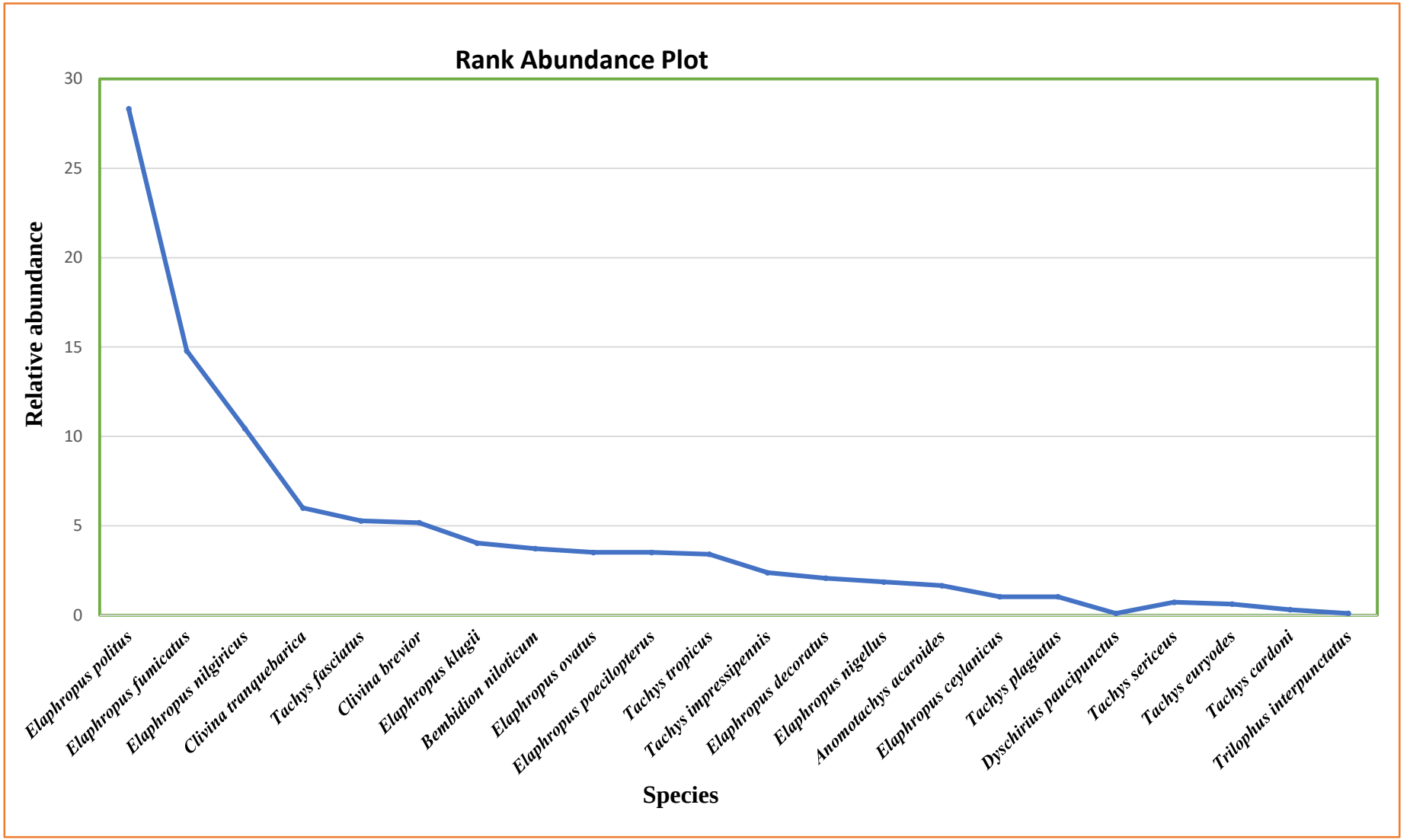


Figure 6: Rank-Abundance Plot for the Scaritinae and Trechinae collected with light trap from RF

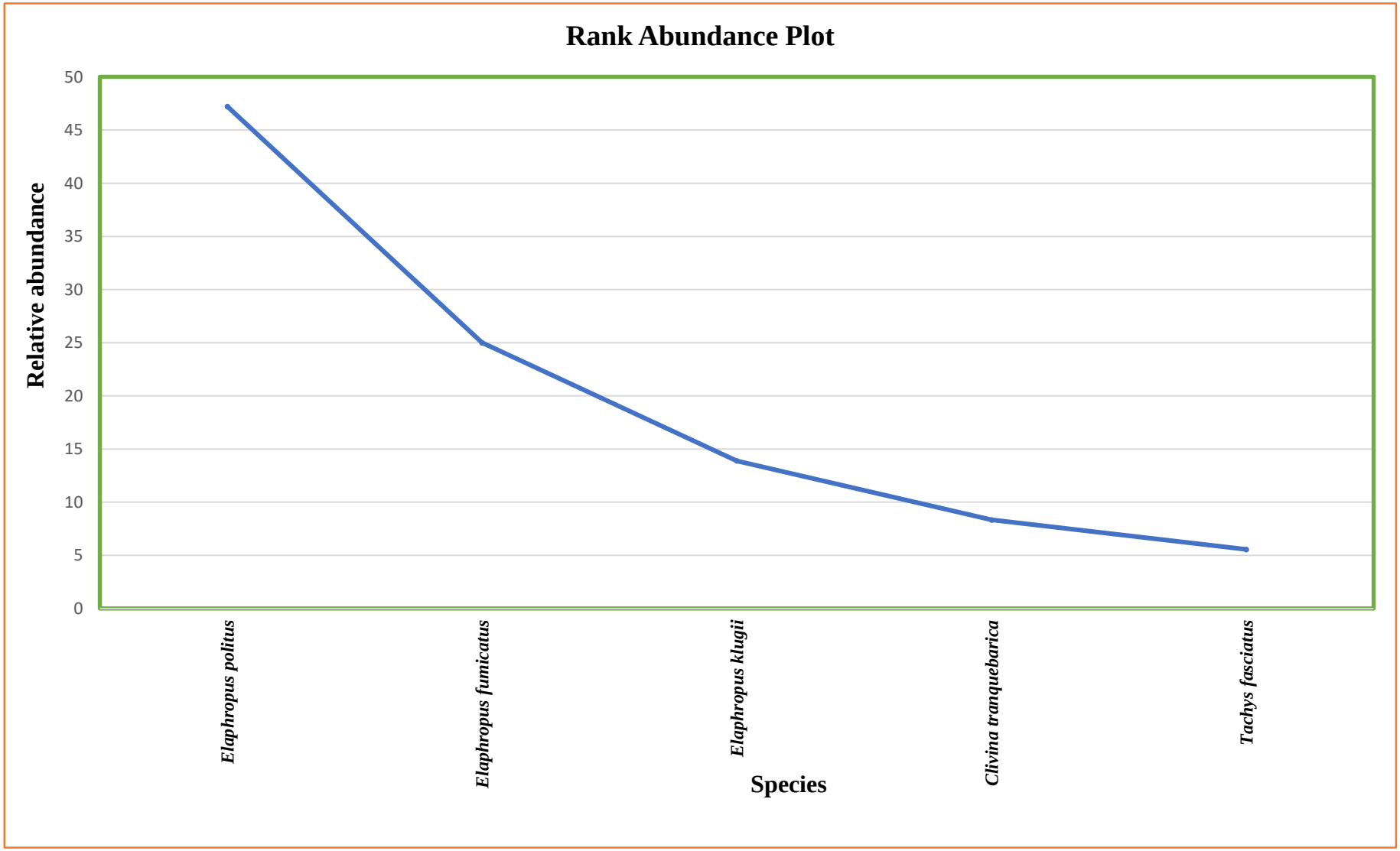


Figure 7: Rank-Abundance Plot for the Scaritinae and Trechinae collected with pitfall trap from RF

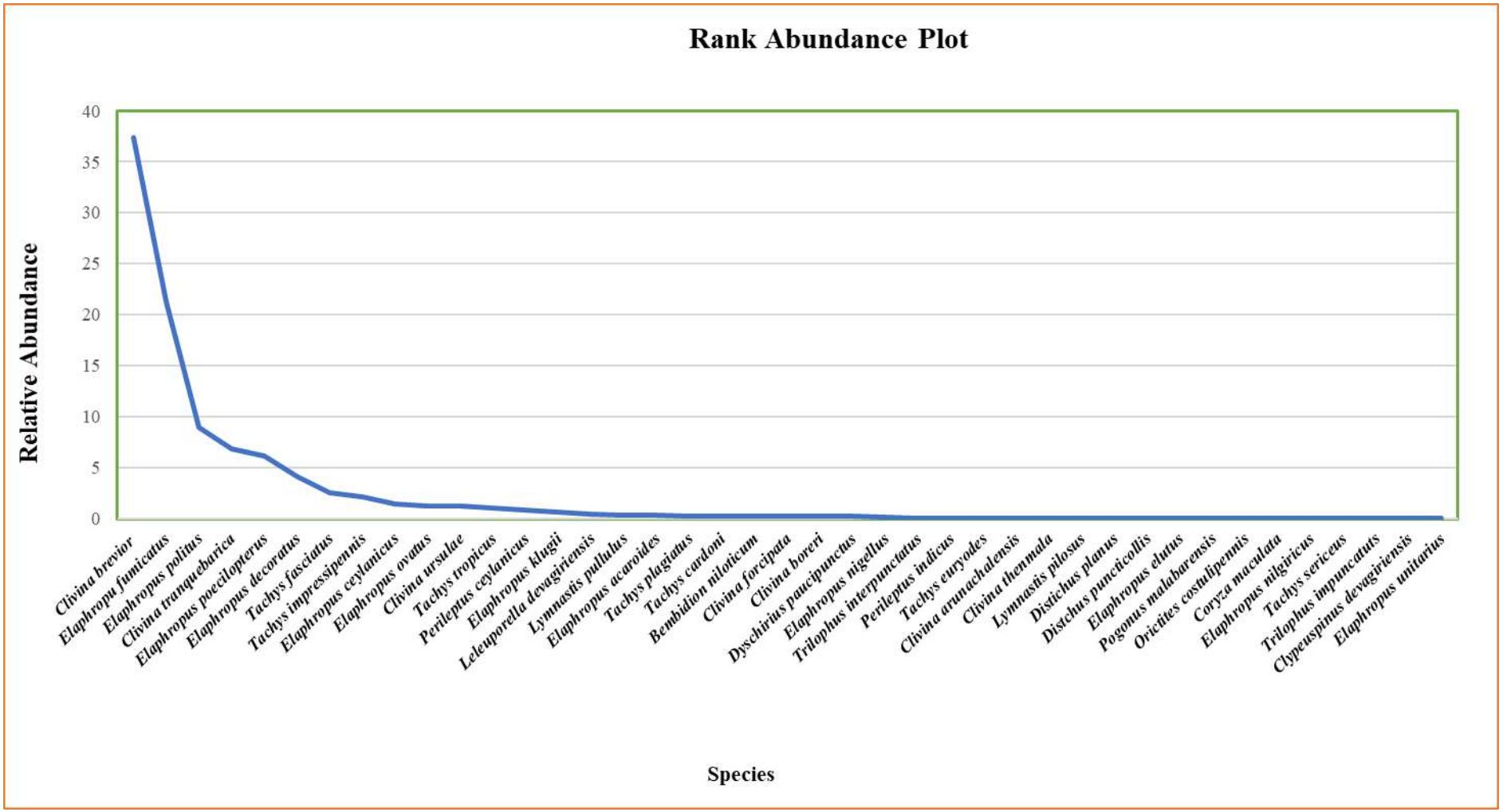


Figure 8: Rank-Abundance Plot for the Scaritinae and Trechinae collected with light trap from CAF

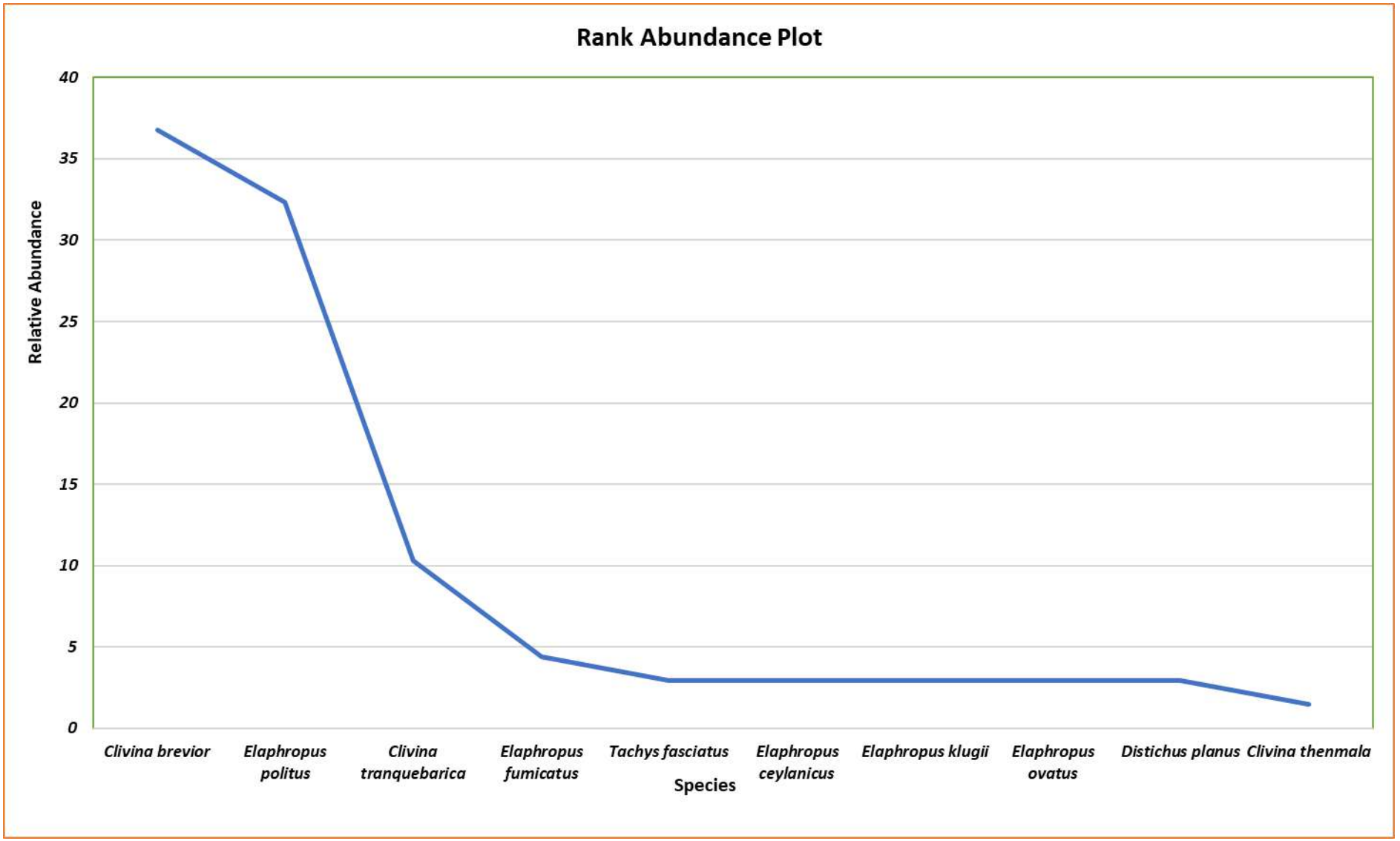


Figure 9: Rank-Abundance Plot for the Scaritinae and Trechinae collected with pitfall trap from CAF

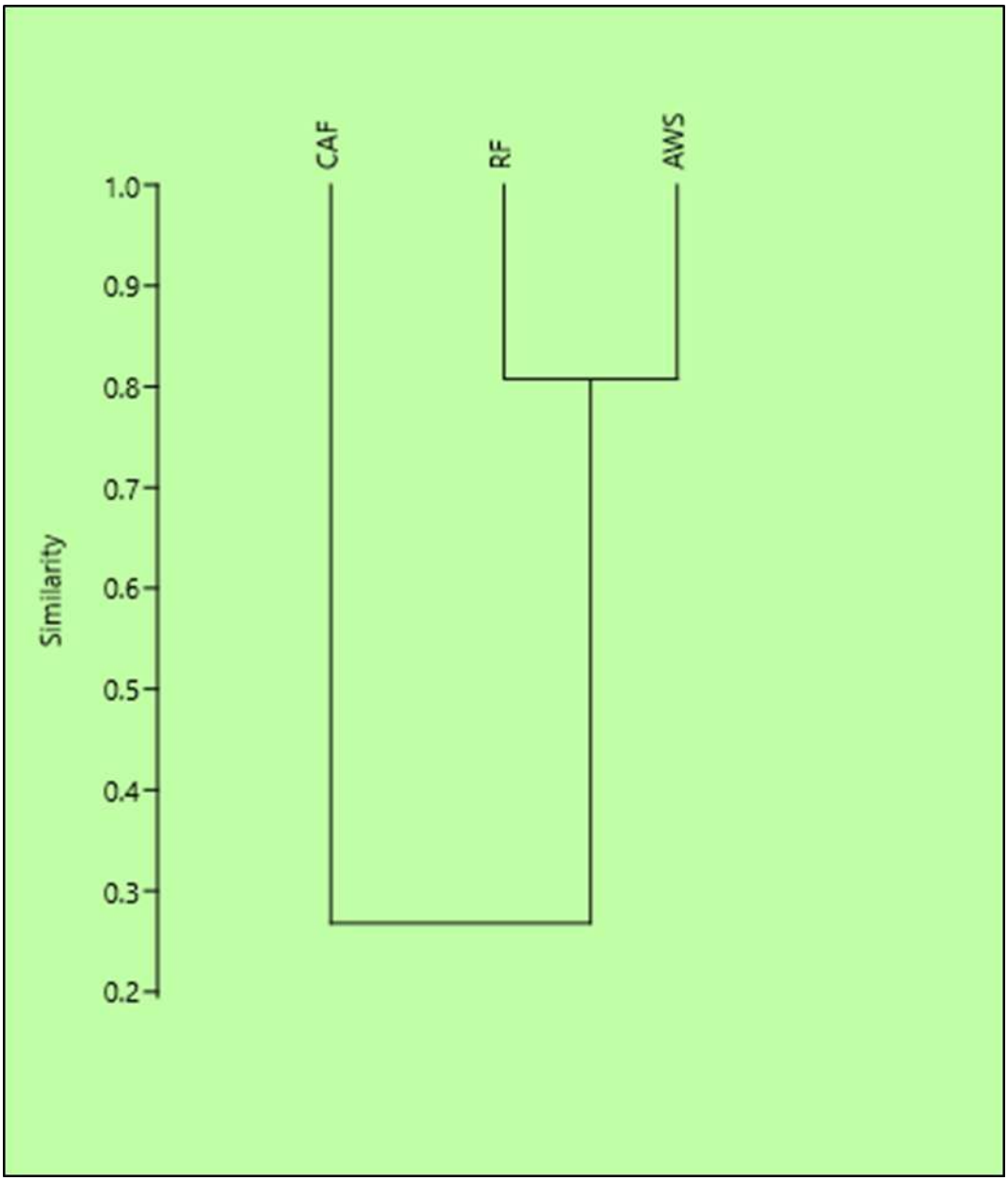


Figure 10: Dendrogram based on hierarchical clustering (paired group) of Scaritinae and Trechinae in Aralam Wildlife Sanctuary (AWS); Ranipuram Forest (RF); Chambad Agricultural Field (CAF) in north Malabar region (Method: light trap).

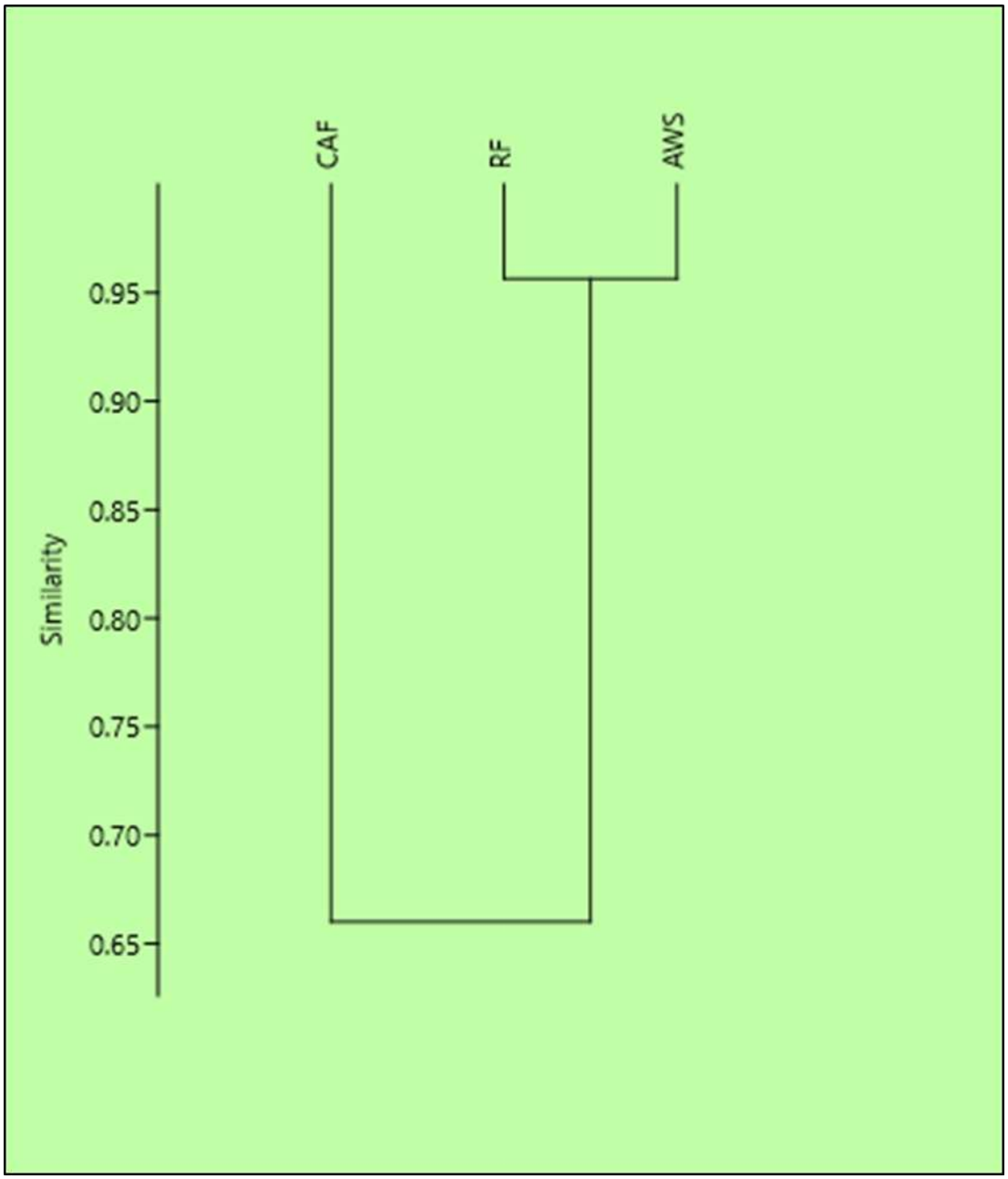


Figure 11: Dendrogram based on hierarchical clustering (paired group) of Scaritinae and Trechinae in Aralam Wildlife Sanctuary (AWS); Ranipuram Forest (RF); Chambad Agricultural Field (CAF) in north Malabar region (Method: pitfall trap).

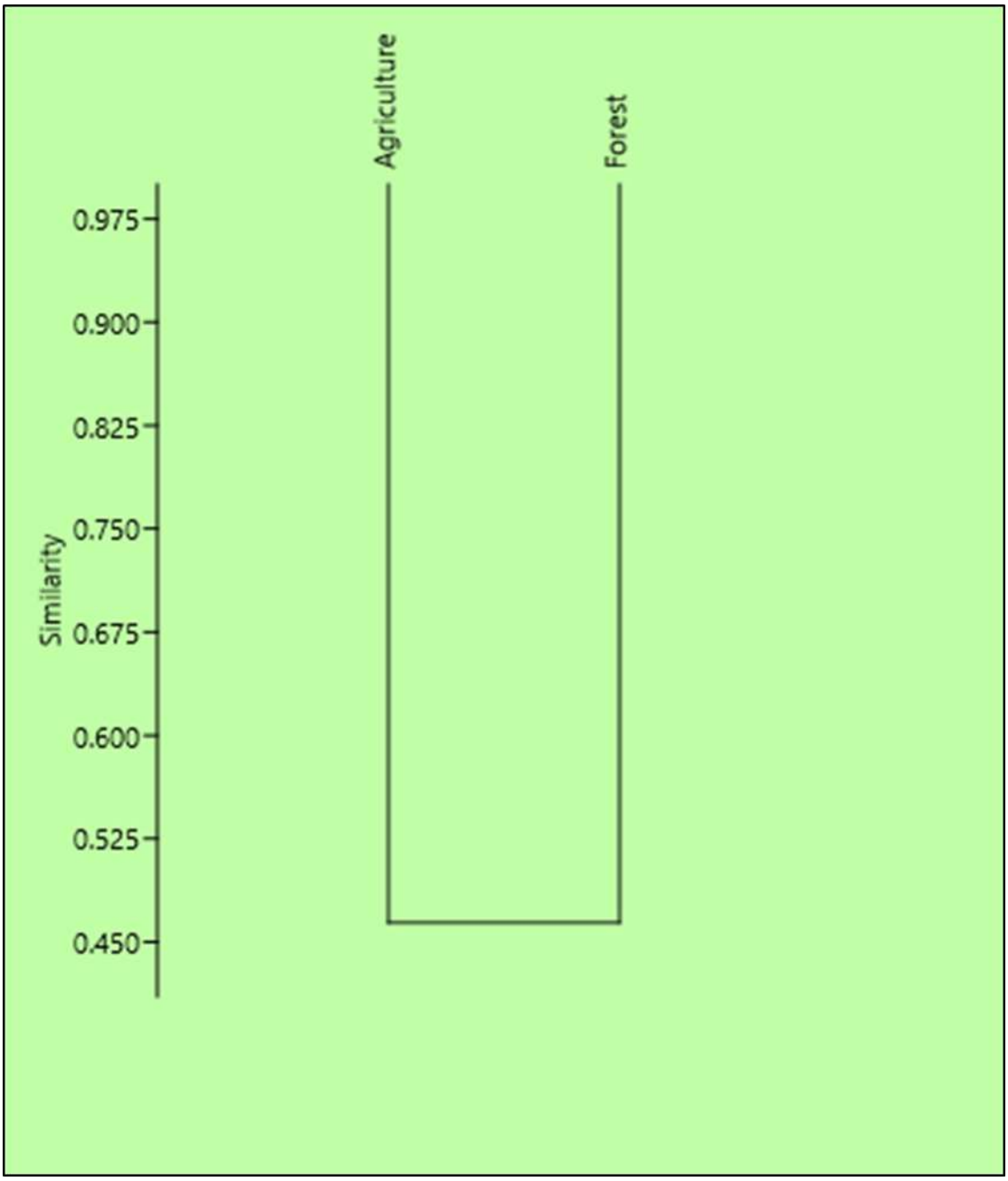


Figure 12: Dendrogram based on hierarchical clustering (paired group) of Scaritinae and Trechinae in Forest Ecosystem; Agricultural Ecosystem in north Malabar region (Method: light trap).

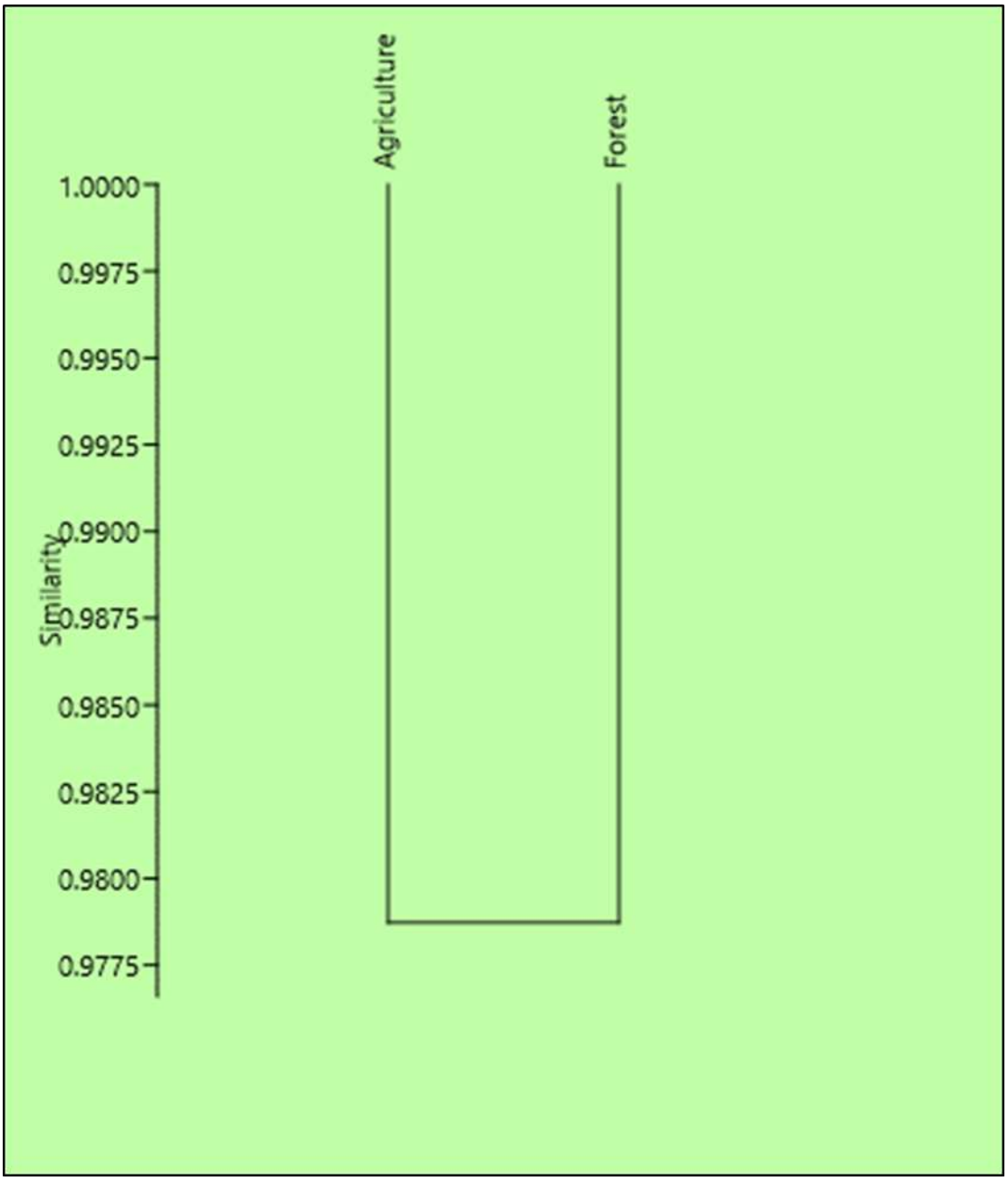


Figure 13: Dendrogram based on hierarchical clustering (paired group) of Scaritinae and Trechinae in Forest Ecosystem; Agricultural Ecosystem in north Malabar region (Method: pitfall trap)

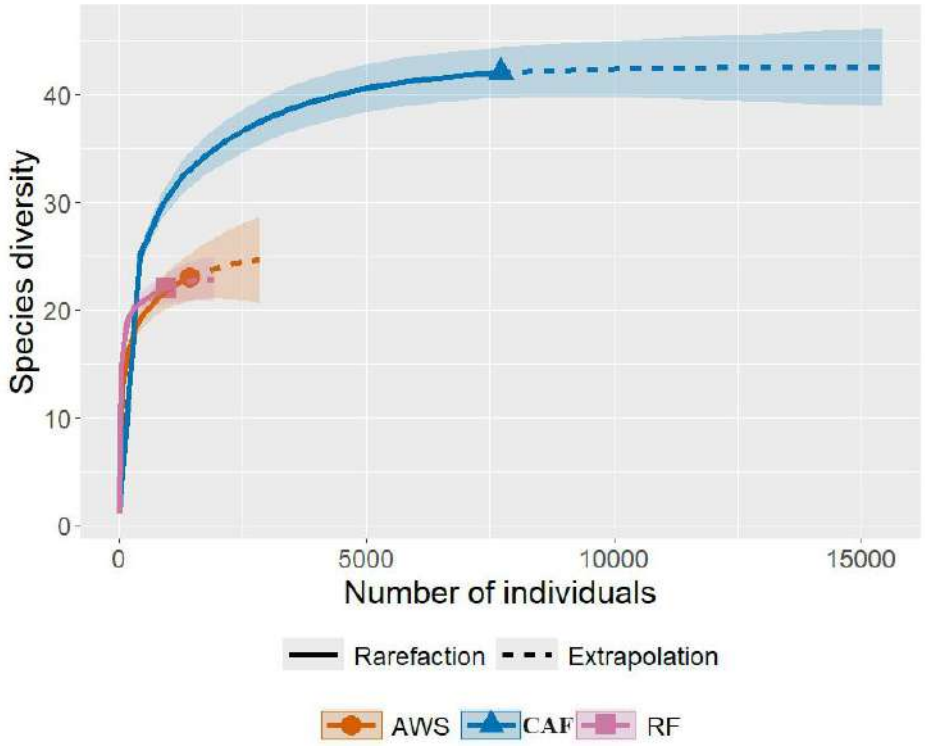


Figure 14: Rarefaction and Extrapolation Curves Showing Species Diversity of Scaritinae and Trechinae Beetles in AWS, CAF, and RF based on the number of individuals Collected (Light trap method).

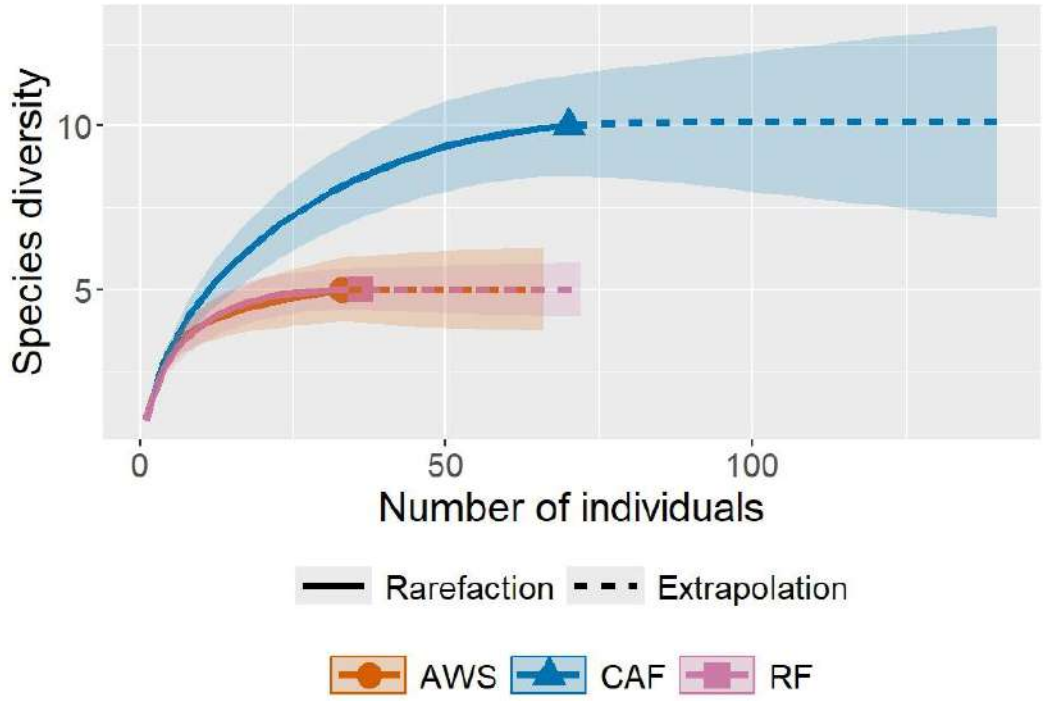


Figure 15: Rarefaction and Extrapolation Curves Showing Species Diversity of Scaritinae and Trechinae Beetles in AWS, CAF, and RF based on the number of individuals Collected (Pitfall trap method).

Chapter 5

DISCUSSION

5. DISCUSSION

5.1. Taxonomy

5.1.1. Taxonomy of Subfamily Scaritinae Bonelli, 1810

The present study provides the first comprehensive taxonomic account of the subfamily Scaritinae from Kerala including the checklist of the species with images and pictorial key for species-level identification. A total of 22 species belonging to three tribes were documented, representing a significant addition to the known Scaritinae fauna of the state (Table 1). These findings augment the previously recorded 42 species from Kerala (Andrewes, 1924a, 1929, 1930; Bänninger, 1938; Saha, 1986; Rajagopal & Kumar, 1992; Balkenohl, 1999, 2001, 2021; Abhitha & Sabu, 2009; Abhitha, 2010; Akhil, 2020; Jithmon, 2020; Divya, 2022; Sruthi & Sabu, 2022; Ashly, 2023; Neethu & Sabu, 2023; Neethu et al., 2024).

Out of the 22 species recorded, five species (*Clivina boreri*, *C. ursulae*, *Orictites constulipennis*, *Trilophidius impunctatus*, and *Oxylobus pygmaeus*) represents the new records for Kerala, thus expanding the known distributional range of these species to the southwestern region of India. Notably, *Clivina ursulae* is reported for the first time from India, with its earlier occurrence restricted to the type locality in southern Sri Lanka (Balkenohl, 2020). The present record from the paddy fields of north Malabar region (Kannur and Kozhikode district) (Neethu et al., 2023) establishes a novel extension beyond the Sri Lankan biogeographic boundary, indicating potential dispersal across coastal habitats of the Indian subcontinent. Two species (*Clivina boreri* and *Orictites constulipennis*) were first-time records for south India. Their earlier distributions were limited to northern and eastern India: *C. boreri* from Bihar (Balkenohl, 2020) and *O. constulipennis* from Meghalaya (Andrewes, 1929, 1930; Aswathi et al., 2024). Their occurrence in Kerala demonstrates a considerable

southward range extension, emphasizing the underestimated diversity of Scaritinae in peninsular India. All these two species (*Clivina boreri* and *Orictites constulipennis*) were recorded from the paddy fields of north Malabar region during the study. One species (*Oxylobus pygmaeaus*) was first report from Kerala and was collected by hand picking method from forests. *Oxylobus pygmaeaus* was previously reported only from Palani and Tirunelveli in Tamil Nadu and South Mysore in Karnataka (Andrewes, 1929). This species is endemic to south India.

Among the 22 species (reported from the study), five species (*Clivina thenmala; Clypeuspinus devagiriensis; Leleuporella devagiriensis; Oxylobus asperulus* and *O. pygmaeaus*) were reported only from south India till now (Aswathi et al., 2024). Of these five species, three species (*Clivina thenmala; Clypeuspinus devagiriensis* and *Leleuporella devagiriensis*) have been reported only from Kerala so far (Aswathi et al., 2024).

Among the 22 Scaritinae species recorded from Kerala, 16 species (*Clivina arunachalensis, C. brevior, C. forcipata, C. lobata, C. thenmala, C. tranquebarica, C. devagiriensis, C. maculata, Leleuporella devagiriensis, Pseudoclivina costata, Trilophus interpunctatus, Dyschirius paucipunctus Distichus planus, D. puncticollis, Oxylobus asperulus* and *O. porcatus)* were previously documented from the state and were also encountered during the present study. *Clivina arunachalensis* was earlier reported from the north Malabar region, specifically Kozhikode and Wayanad districts (Abhitha, 2010; Akhil, 2020). The present investigation further confirms its occurrence in the forest and agricultural habitats of Kannur and Kasaragod districts, thereby extending its known distribution within the north Malabar region of Kerala. *Clivina brevior* was previously reported from the north Malabar region, particularly from Kozhikode and Wayanad districts (Abhitha, 2010; Akhil, 2020; Ashly, 2023; Aswathi

et al., 2023), from central Kerala including Malappuram and Palakkad districts (Akhil, 2020; Divya, 2022), and from southern Kerala, represented by Idukki district (Sruthi & Sabu, 2022). The present study further documents the occurrence of this species from forest habitats and paddy fields of the north Malabar region, as well as from agricultural landscapes of central Kerala (Malappuram and Thrissur districts) and southern Kerala (Kottayam and Thiruvananthapuram districts). *Clivina brevior* is recognized as a widely distributed species occurring across various zoogeographical regions (Andrewes, 1929; Lorenz, 2024). Members of this species exhibit distinct morphological adaptations such as fossorial (digging) forelegs, which facilitate burrowing and enable them to avoid adverse surface conditions, thus allowing persistence in both natural and anthropogenically modified habitats (Hogan, 2012). *Clivina forcipata* has been previously reported from the north Malabar region, particularly from Kozhikode district (Abhitha, 2010), as well as from central Kerala, including Malappuram and Thrissur districts (Andrewes, 1930; Akhil, 2020). The findings of the present study extend its known distribution by documenting the species from agricultural fields within the north Malabar region of Kerala. Similarly, *Clivina lobata* has been recorded earlier from Kozhikode and Wayanad districts of north Malabar (Abhitha, 2010; Ashly, 2023), from Palakkad district in central Kerala (Divya, 2022), and from Idukki district in southern Kerala (Sruthi & Sabu, 2022). The present study further expands this distribution by recording the species from agricultural landscapes in Kannur, Kozhikode, and Wayanad districts of north Malabar, as well as from Thrissur district in central Kerala. This pattern supports earlier observations that *C. lobata* is a widely distributed and common species in the state (Abhitha, 2010; Akhil, 2020; Divya, 2022; Ashly, 2023). In contrast, *Clivina thenmala*, previously reported exclusively from the southern district of Kollam (Balkenohl, 2021), is newly recorded

in this study from both forest habitats and paddy fields of Kannur district in the north Malabar region, thereby considerably extending its known range within Kerala. *Clivina tranquebarica* has previously been reported from the north Malabar region, particularly from Kozhikode and Wayanad districts (Abhitha, 2010; Akhil, 2020; Ashly, 2023), as well as from central Kerala (Palakkad district) (Divya, 2022). The present study substantially expands this distribution by documenting the species from both forest habitats and agricultural fields across the north Malabar region (Kasaragod, Kannur, Kozhikode, and Wayanad districts), central Kerala (Malappuram and Thrissur districts), and southern Kerala (Kollam and Kottayam districts). *Clypeuspinus devagiriensis*, earlier known only from the wetlands of Kozhikode district (Neethu & Sabu, 2023), is additionally recorded here from the paddy fields of Kannur district in the north Malabar region. The combined records clearly indicate this species' strong affinity for moist environments, particularly wetlands and irrigated agricultural fields.

Coryza maculata was previously known from the Malabar region of Kerala (Andrewes, 1929). The present study extends this record by documenting the species from the paddy fields of Kannur district in the north Malabar region. Species of the genus *Coryza* are readily distinguished by the presence of four acute teeth on the clypeus, a highly specialized and diagnostic feature within the tribe Clivinini. *Coryza maculata* is considered rare in southern India, with most earlier records restricted to central, northern, and north-eastern India, including Maharashtra (Nagpur), Bihar (Pusa), West Bengal (Eastern Duars), and Uttarakhand (West Almora, Garhwal, Haldwani, and Dehradun) (Andrewes, 1929; Balkenohl, 2017b; Aswathi et al., 2023). The present record from Kerala therefore represents a significant southern range extension and contributes valuable insights into the species' taxonomic distributional relevance within the Indian Scaritinae fauna. *Leleuporella devagiriensis* was formerly

reported from Kozhikode and Wayanad districts of the north Malabar region (Abhitha & Sabu, 2009; Ashly, 2023). The present study further confirms its occurrence within this region by documenting additional material from Kannur district. *Pseudoclivina costata* has been recorded earlier from Wayanad in the north Malabar region (Akhil, 2020), from Palakkad district in central Kerala (Divya, 2022), and from Idukki district in southern Kerala (Sruthi & Sabu, 2022). The present study expands its known distribution by recording the species from forest habitat in Kozhikode district of the north Malabar region. *Trilophus interpunctatus*, previously reported only from Kozhikode district (Abhitha, 2010), is here recorded from forest habitat of Kasaragod district and paddy field of Kannur district, thereby broadening its known range within north Malabar. *Dyschirius paucipunctus* was earlier known from Wayanad district in the north Malabar region (Ashly, 2023), from central Kerala (Palakkad district) (Divya, 2022), and from southern Kerala (Idukki district) (Sruthi & Sabu, 2022). The present study adds new records from forest and paddy field habitats in Kasaragod and Kannur districts, indicating a wider ecological tolerance than previously documented. Similarly, *Distichus planus*, earlier reported from Wayanad district (Ashly, 2023) and from Palakkad district in central Kerala (Divya, 2022; Ashly, 2023), is newly recorded here from paddy fields in Kannur district of the north Malabar region. *Distichus puncticollis*, known earlier from Palakkad district (Andrewes, 1929), is also documented in this study from paddy fields in Kannur district, thus adding a new locality for the species in Kerala.

Among the genus *Oxylobus*, *O. asperulus* has been previously reported from Palakkad district in central Kerala (Andrewes, 1929; Divya, 2022), while *O. porcatus* was known from forests in Wayanad (Akhil, 2020), Palakkad (Divya, 2022), and Idukki (Sruthi & Sabu, 2022) district. The present study further records *O. asperulus* from the

forest habitat in Kozhikode district and *O. porcatus* from forest habitats in Kasaragod Kannur, Kozhikode and Wayanad districts of the north Malabar region. All known localities of these two species correspond exclusively to undisturbed forest ecosystems, suggesting a strong ecological preference for stable, shaded, and moist environments. Their brachypterous condition (absence of wings) likely restricts dispersal, contributing to their confinement within forested landscapes. Both species are distributed across India and are commonly encountered within forest habitats (Andrewes, 1929).

A total of 25 species previously recorded from Kerala; *Clivina extensicollis* Putzeys, 1846; *Clivina helferi* Putzeys, 1867; *Clivina westwoodi* Putzeys, 1867; *Sulciclivina attenuata* (Herbst, 1806); *Trilophus hirsutus* Balkenohl, 1999; *Trilophus lompei* Balkenohl, 1999; *Pseudoclivina memnonia* (Dejean, 1863); *Sparostes striatulus* Putzeys, 1867; *Dyschirius tricuspis* Andrewes, 1929; *Dyschirius tamil* Andrewes, 1929; *Oxylobus alternans* Andrewes, 1929; *Oxylobus dekkanus* Andrewes, 1929; *Oxylobus dispar* Andrewes, 1929; *Oxylobus follis* Andrewes, 1929; *Oxylobus lirifer* Andrewes, 1929; *Oxylobus montanus* Andrewes, 1929; *Oxylobus quadricollis* Chaudoir, 1855; *Oxylobus silenticus* Saha, 1986; *Parathlibops glaber* (Andrewes, 1929); *Distichus laticeps* (Andrewes, 1929); *Distichus maharatta* Bänninger, 1938; *Distichus picicornis* (Dejean, 1831); *Scarites ceylonicus* Chaudoir, 1880; *Scarites dyschromus* Chaudoir, 1855; and *Scarites praedator* Chaudoir, 1880 were not encountered during the present study.

Clivina extensicollis, previously reported from Kozhikode district in the north Malabar region (Abhitha, 2010), is one of the larger *Clivina species*, distinguished by its elongated prothorax and cylindrical body form (Andrewes, 1929). Because of the present study relied primarily on light-trap sampling, which is more effective for smaller, phototactic *Clivina* species, larger and less light-responsive taxa such as *C.*

extensicollis were likely underrepresented in the collections. *Clivina helferi*, earlier reported from Kozhikode district (Jithmon, 2020), was known from a single specimen, indicating extreme rarity and low detection probability in southern India. Its main distribution lies in northern, eastern, and north-eastern India, including Bihar, Odisha, West Bengal, and Uttarakhand (Andrewes, 1929, 1930; Kushwaha et al., 2017). The scarcity of specimens from Kerala suggests that the species occurs only as a marginal population at the southern limit of its distribution. *Clivina westwoodi* was recorded earlier from Palakkad district in central Kerala (Divya, 2022; Ashly, 2023), each study reporting only a single specimen. Such limited records imply that this species may represent a habitat-specialist with a very narrow ecological niche, possibly restricted to microhabitats that remain inadequately sampled by standard collection methods. *Sulciclivina attenuata*, previously reported from Palakkad district (Divya, 2022), can be reliably distinguished from other *Clivina* species by the absence of a mesotibial spur and by its six-setose labrum traits that are rarely observed within the group (Andrewes, 1929). Its known distribution is concentrated in northern, central, and north-eastern India (Andrewes, 1929; Balkenohl, 2017b, 2022). Thus, the Kerala record represents a significant southern extension, highlighting its taxonomic importance.

Among the genus *Trilophus*, *T. hirsutus* was earlier reported from Palakkad district (Balkenohl, 1999), and *T. lompei* from Kozhikode (Abhitha, 2010) and from Kottayam and north-western Pathanamthitta (Balkenohl, 1999, 2001). None of these species were encountered during the present survey. *Sparostes striatulus*, reported historically from Wayanad district (Andrewes, 1930), has not been documented in Kerala in recent decades. Given its minute size and potentially cryptic habits, it may easily escape detection during routine sampling, suggesting that the species is either

extremely rare or under-collected. Targeted microhabitat-level sampling would be essential to verify its continued presence.

Dyschirius tricuspis, previously recorded from Palakkad district (Divya, 2022), and *D. tamil*, known from Wayanad district (Akhil, 2020), were each represented by only a single specimen in earlier studies. Their rarity in southern India aligns with their primary distribution in the Indian Palearctic region, particularly Uttarakhand (Andrewes, 1929, 1930). Their absence in the present study likely reflects both low abundance and the limitations of conventional sampling.

Several large, entirely wingless Scaritinae species; *Oxylobus alternans*, *O. dispar*, *O. follis*, *O. quadricollis*, *Parathlibops glaber*, *Distichus laticeps*, and *Scarites praedator* were previously recorded from forested localities in central and southern Kerala, including Wallardie, Travancore, Peermade, Thenmala, Parli, and Nilambur (Andrewes, 1929). Because these species range from 15–25 mm in body length and lack flight ability, they are not attracted to light traps. Although pitfall trapping could have targeted such taxa, its effectiveness was significantly reduced due to frequent trap disturbance and destruction by large animals in forested areas. This likely accounts for their absence in the present collections.

Oxylobus dekkanus, earlier reported from Thiruvananthapuram district (Rajagopal & Kumar, 1992), is a large (22 mm), wingless species distributed mainly in South India, including Tamil Nadu, Karnataka, and Andhra Pradesh (Aswathi et al., 2023). Its strong association with the Western Ghats and limited distributional data beyond this region may further explain its absence in the present survey. *Oxylobus lirifer* and *Scarites dyschromus*, reported from Malappuram district (Akhil, 2020), are similarly large (16 mm and 25 mm respectively) and flightless (Andrewes, 1929). The ineffective pitfall trapping in forested areas likely contributed to their non-detection.

Scarites dyschromus is more widely distributed in northern India (Andrewes, 1929; Kushwaha & Hegde, 2015), suggesting that the Kerala population may be small or localized. *Oxylobus silenticus*, known exclusively from Silent Valley in Palakkad district (Saha, 1986), is an endemic and extremely rare species represented by a single specimen. Its strict association with undisturbed rainforest habitat and highly localized range makes the likelihood of detecting this species extremely low. *Oxylobus montanus*, *Distichus picicornis*, and *Scarites ceylonicus* were historically recorded from Kozhikode district (Abhitha, 2010). Beyond Kerala, *O. montanus* is known from the Anamalai Hills in Tamil Nadu (Andrewes, 1929), *D. picicornis* from central and northern India, and *S. ceylonicus* from Maharashtra (Andrewes, 1929). All three species are relatively large and wingless, and their restricted distribution in southern India, combined with limited access to dense forest habitats, likely explains their absence in recent surveys.

Finally, *Distichus maharatta*, reported from the Malabar region in an early study (Bänninger, 1938), is known from only a single specimen from Kerala. Its broader distribution is concentrated in central India, including Maharashtra and Madhya Pradesh (Andrewes, 1929; Bänninger, 1938; Chandra et al., 2010). The rarity of this species in southern India likely accounts for its non-detection during the present study.

Overall, the taxonomic synthesis presented here reveals a remarkably diverse Scaritinae assemblage in Kerala, comprising both widespread oriental elements and locally endemic taxa. The discovery of new state and national records highlights the underexplored nature of Scaritinae diversity in southern India and the need for integrative taxonomic approaches combining morphology, molecular data, and biogeography to refine species boundaries and evolutionary relationships.

5.1.2. Taxonomy of Subfamily Trechinae Bonelli, 1810

The present study offered the first comprehensive account of the composition of Trechinae beetles in Kerala, recording a total of 27 species belonging to three tribes (Table 1). This finding significantly expanded the previously known diversity, which comprised only 16 species from the state (Andrewes, 1921a, b; 1924a; 1925b; 1935; Divya, 2022; Sruthi, 2022; Ashly, 2023). The results indicated that 16 species, namely *Anomotachys acaroides, Bembidion kara, Elaphropus elutus, E. fumicatus, E. haliploides, E. ovatus, E. unitarius, Lymnastis pilosus, L. pullulus, Tachys cardoni, T. euryodes, T. fasciatus, T. plagiatus, T. sericeus, Perileptus indicus*, and *Pogonus malabarensis*, were newly reported from Kerala, thereby expanding the regional faunal checklist.

Among the 27 species recorded, *Pogonus malabarensis* was a newly discovered species from paddy field of north Malabar region (Shigina & Sabu, 2024a). The genus *Pogonus* was mainly found within salt-marsh systems, different *Pogonus* species or ecotypes prefer microhabitats that differ in hydrology (e.g., tidal channels, seasonal ponds), some species show wing-polymorphism and local adaptations tied to these microhabitats (Belleghem et al., 2021). Three species (*Anomotachys acaroides, Elaphropus elutus* and *Tachys plagiatus*) were recorded from India for the first time from the North Malabar region of Kerala during the study. *Anomotachys acaroides* earlier known from Sri Lanka and Indonesia (Andrewes, 1935 Lorenz, 2024); *Elaphropus elutus* earlier known from Myanmar (Andrewes, 1935) and *Tachys plagiatus* had a broader distribution across Japan, Taiwan, Thailand, Vietnam, Indonesia, the Philippines, New Guinea, and Australia (Lorenz, 2024) in Indopacific region.

Ten species (*Bembidion kara, Elaphropus fumicatus, E. ovatus, E. unitarius, Lymnastis pilosus, L. pullulus, Tachys cardoni, T. euryodes, T. sericeus* and *Perileptus indicus*) were first reports from south India during the study. *Bembidion kara,* earlier restricted to north and north-eastern India (Andrewes, 1935; Kuswaha & Hegde, 2021), was recorded from the north Malabar region, representing either a relict population isolated from northern counterparts or a recent range expansion facilitated by dispersal along riparian corridors. *Elaphropus fumicatus*, previously confined to the Gangetic plains and northern India (Andrewes, 1935), was recorded from the north Malabar region, indicating a more continuous distribution. The occurrence of *E. ovatus* and *E. unitarius* in Kerala extended their ranges from north-eastern India (Andrewes, 1935) and emphasize the underexplored diversity of *Elaphropus* in South India. Members of *Elaphropus* are typically associated with moist, shaded riparian zones and exhibit sensitivity to microhabitat alteration (Bousquet, 2012). The detection of *Elaphropus* species in north Malabar region mostly from the paddy fields supports the above observation of (Bousquet, 2012). *Lymnastis pilosus* and *L. pullulus,* previously known only from eastern India (West Bengal: Kolkata) (Andrewes, 1935). Traditionally, *Lymnastis* species from eastern India were considered habitat-restricted to urban or riparian zones, which implicitly shaped their taxonomic diagnosis as habitat-specialists (Andrewes, 1925b; Hůrka, 1996). Records of *Lymnastis pilosus* and *L. pullulus,* in the present study from the north Malabar region of Kerala, indicating that their distribution is broader than previously reported, extending beyond the urban and riparian habitats of eastern India to include to the agricultural fields of southern India. The capacity of *Lymnastis* species to occupy agricultural habitats reinforced the idea that their wider Indian distribution had likely been underestimated due to their small size.

Tachys cardoni (Jharkhand: Chota Nagpur, Barwa; Bihar; Uttarakhand)., *Tachys euryodes* (Uttarakhand: Haldwani; West Bengal: Kolkata, Sardah) and *Tachys sericeus* (Bihar; West Bengal) previously known from northern and eastern India (Andrewes, 1935) and *Perileptus indicus* previously reported from north India, east India and north-eastern India (Uttar Pradesh; West Bengal; Meghalaya: Garohills; Manipur: Shugnu; Uttarakhand: Eastern Duars, Haldwani, Dehradun, Chakrata, Almora, Sarju valley, Tanakpur, Ranikhet; Sikkim: Gielle Khola, Tista valley) (Andrewes, 1935) are newly recorded from the forests and agriculture fields of the north Malabar region of Kerala, indicating that the genus *Tachys* and *Perileptus* are more widely distributed across India than previously documented.

Two species, *Elaphropus haliploides* and *E. poecilopterus* were first time reports from Kerala during the study. Their absence in prior studies could be attributed to the historical concentration of Trechinae surveys in northern and northeastern India (Andrewes, 1935; Jeannel, 1954; Ueno, 1965; Deuve, 1980, 1982; Perrault, 1985; Deuve, 2001; Belousov et al., 2019). Furthermore, the detection of *Elaphropus nigellus* and *E. nilgiricus* reaffirmed their endemic status to southern India (Andrewes 1925b, 1935; Divya, 2022; Sruthi & Sabu, 2022; Ashly, 2023).

Of the 27 species documented, ten species (*Bembidion niloticum, Elaphropus ceylanicus, E. decoratus, E. klugii, E. nigellus, E. nilgiricus, E. politus, Perileptus ceylanicus*, *Tachys impressipennis*, and *T. tropicus*) had been consistently reported in earlier studies from Kerala (Andrewes, 1935; Divya, 2022; Ashly, 2023).

Six species (*Bembidion xanthacrum*, *Elaphropus babaulti*, *E. blandus*, *E. malabaricus*, *E. micraulax* and *Paratachys impressus*) documented in previous records from Kerala (Andrewes, 1924a, 1925b, 1935; Divya, 2022; Ashly, 2023) were not encountered during the present study. This absence may be attributed to temporal and

seasonal variations in sampling, which might not have aligned with the peak activity periods of these species (Magura et al., 2001). Alternatively, their disappearance could reflect broader ecological shifts, including habitat loss driven by progressive modernization since the early 20th century and recurrent flooding events in Kerala, which may have significantly disrupted local faunal assemblages.

5.2 Ecology

5.2.1 Forest Ecosystem

This study provides the first documented data on the diversity, composition, and seasonal patterns of Scaritinae and Trechinae beetles in the semi- evergreen forest of Aralam Wildlife Sanctuary (AWS) and the Tropical Evergreen Forest of Ranipuram Forest (RF) within the north Malabar region of Kannur and Kasaragod district in Kerala. By combining data from both light trap and pitfall trap collections, we provide insights into the structure and dynamics of Scaritinae and Trechinae communities in these forest types.

The results show marked differences in community structure between the two forests. In AWS, the light-trap assemblage was heavily dominated by a single species (*Elaphropus poecilopterus*), which accounted for approximately 55.28% of total individuals, followed by *E. politus*. After rank five or six, the remaining species had very low abundances (< 5%), producing a steeply declining rank abundance curve and indicating strong dominance by a few taxa. In contrast, in RF, the most abundant species (*Elaphropus politus*) constituted 28.31% of the catch, with *E. fumicatus* being the second (14.77%), and a more gradual decline in relative abundance across species. These patterns indicate that the RF supports a more balanced, species-rich assemblage compared to AWS, where the community is skewed towards a single dominant species. The low evenness and high dominance in AWS suggest that only a few species are

thriving, while many others persist in low numbers. A study comparing carabid communities in temperate and boreal forests reported similar results as ours, with a few dominant species and the majority being rare (Belaoussoff et al., 2003; Peterson et al., 2021). This kind of pattern often implies that certain species have competitive or environmental advantages, suppressing others which can signal ecological disturbance, habitat degradation, or strong interspecific competition (Magurran, 1988; Hurlbert, 1971).

More specifically, the very low evenness in AWS suggests that the ecological conditions like resource availability may favour *Elaphropus poecilopterus* strongly over other species. The findings mirror patterns observed in other Carabid studies. For example, Li et al., (2017) found that in a forest reserve, some habitats supported higher diversity and evenness compared to disturbed or altered habitats; dominance was much lower in more "balanced" habitats. Therefore, from a conservation and ecological perspective, RF appears to be more effective at maintaining a richer and more balanced Carabid community than AWS, which seems dominated by opportunistic species.

The pitfall-trap data also reflect differences between forests. In AWS, out of the five species recorded, four species were major and one species was minor, the dominant species together making up 66.66% of pitfall captures. In RF, five species were detected, and all the species were major, with *Elaphropus politus* dominating (47.22%) followed by *Elaphropus fumicatus* (25%). The steep drop after the dominant species indicates low evenness in both forests under pitfall sampling, even though diversity by light trap was higher in RF. This pattern suggests that ground-dwelling Carabids as captured by pitfall traps are also skewed towards a few species in both forest types, with dominance more pronounced in AWS. It may indicate that ground-associated species are less diverse or more specialized than those attracted to light. Alternatively,

the sampling design may preferentially capture more active or abundant species. Pitfall traps primarily capture ground-active beetles, whereas light traps collect nocturnally active or flying individuals, using both methods together provides a more complete and representative assessment of the overall Carabid community structure (Divya, 2022; Ashly, 2023). The contrast between methods underscores the need for multi-method sampling when assessing beetle diversity (Thiele 1977; Akhil 2020; Divya 2022; Ashly, 2023).

5.2.1.1. Seasonality of light-attracted species

Seasonality analyses revealed clear patterns, that differed substantially between the two forests. This suggest that seasonality influences the activity (or detectability) of at least a subset of species in both forests, but the strength of seasonality is greater in RF (significant overall variation), while in AWS, overall abundance remains relatively stable across seasons despite species-specific changes. The presence of a few species only in certain seasons (rainy or non-rainy) may reflect life cycle timing (e.g., breeding, emergence), climatic preferences, or differences in resource availability (e.g., prey, humidity) between seasons (Yu e al., 2006). The higher seasonal variation in RF could be due to more pronounced seasonal climatic fluctuations (e.g., rainfall) affecting beetle activity, or differences in phenology among species. In AWS, the stability may arise because the dominant species (*Elaphropus poecilopterus*) is present and active across seasons, masking seasonal fluctuations of rarer species.

5.2.2 Agricultural Ecosystem

The Chambad Agricultural ecosystem (CAF) demonstrated the highest species richness (41 species) among the three habitats but also exhibited the lowest evenness and strongest dominance patterns. The striking contrast between richness and evenness highlights the structurally disturbed nature of agricultural landscapes (K˛edzior & Kosewska, 2022).

5.2.2.1. Dominance and Community Structure

Clivina brevior and *Elaphropus fumicatus* overwhelmingly dominated the light-trap assemblage. The steep rank abundance curve and presence of numerous rare species (17 species classified as rare) indicate a highly uneven assemblage. The lowest Simpson's evenness value recorded among all studied habitats, indicating extreme dominance driven by a few opportunistic species. This dominance may reflect the frequent disturbance from agricultural activities, simplified vegetation structure, artificial lighting patterns or habitat homogenization. Previous studies confirm that agricultural landscapes tend to support dominance by generalist or disturbance-tolerant Carabid species (Kromp, 1999).

5.2.2.2. Diversity and Richness

The highest Margalef richness value among all sites, indicates that agricultural mosaics can support high species richness due to edge effects, mixed microhabitats, and periodic disturbances that allow coexistence of both colonizers and transients (McLeish et al., 2021). However, diversity (H′) value is only moderate due to high dominance. This reflects community's characteristic of disturbed habitats, where species richness is high but structural balance is lacking (K˛edzior & Kosewska, 2022).

5.2.2.3. Ground-Dwelling Assemblage (Pitfall Trap)

Pitfall samples showed similar dominance patterns: *Clivina brevior* and *Elaphropus politus* together contributed nearly 69% of individuals. The small number of species (10) in pitfall traps indicates that ground-active beetles are less diverse than flying beetles in agricultural fields, likely due to tilling, pesticide exposure, and microhabitat disruption (Divya, 2022, Ashly, 2023).

5.2.2.4. Seasonal Variation

Seasonality was pronounced in CAF. The strong seasonal turnover reflects agricultural cycles, vegetation phenology, irrigation, and soil moisture fluctuations factors known to influence Carabid phenology (Thiele, 1977). Overall, CAF represents a disturbance-dominated ecosystem with high richness, very low evenness, strong dominance and strong seasonal turnover. This pattern aligns with ecological predictions that disturbed habitats favour generalist species that proliferate rapidly, while sensitive species decline (Niemelä, 2001).

5.2.3. Comparative analysis of Scaritinae and Trechinae assemblages in the AWS, RF and CAF.

Across all three habitats, Subfamily Trechinae was consistently dominant in both light-trap and pitfall captures. In light-trap collections, Trechinae contributed 86.29% (AWS), 88.67% (RF), and 51% (CAF) of individuals, while pitfall samples similarly showed high proportions (AWS: 78.79%; RF: 91.67%; CAF: 51.15%). This dominance pattern aligns with previous research suggesting that Trechinae beetles prefer shaded, moist, and structurally complex habitats typical of forest ecosystems (Lövei & Sunderland, 1996; Rainio & Niemelä, 2003). *Elaphropus politus* was the common dominant light attracted species in all the three habitats. Their smaller size (Andrewes, 1935) may provide advantages such as reduced predation risk, lower food requirements compared to larger counterparts and a potential r-selection life history strategy (Divya, 2022). Trechinae species have several adaptations to survive in moist habitats, which include air pocket on the ventral side of the elytra (for swimming) and adhesive laminae on tarsi (give adhesion on moist surfaces) (May & Kermode 1972). All the Trechinae species are moisture loving, preferring to live in riparian and marsh habitats, and most of them are predators (Ortuno & Arillo, 2010). Species inhabiting

deep litter layers or cave-like microhabitats often shows reduced or absent eyes, relying instead on tactile and chemical cues for navigation (Thiele, 1977). Their highly sensitive antennae enhance the detection of prey, mates, and environmental changes, while flexible metabolic adjustments enable survival in nutrient-poor microhabitats (May & Kermode, 1972). Dominance patterns within ground beetle assemblages are often influenced by species-specific traits that confer advantages under particular environmental conditions. Smaller-bodied carabids with fossorial habits, frequent flight activity, and a tendency to aggregate may achieve higher local representation in disturbed or moisture-rich agricultural soils, as these traits enhance dispersal, refuge-seeking, and resource exploitation (Esau, 1968; Thiele, 1977; Hogan, 2012; Akhil, 2020; Divya, 2022). For understanding the proper reasons for their dominance requires a species-specific analysis of their life biology, feeding habits, and prey resource availability.

In contrast, Subfamily Scaritinae represented a minor proportion in the two forests but showed high abundance in the Agricultural field. *Clivina brevior* and *C. tranquebarica* emerged as the dominant species in agricultural fields, reflected in its high representation in both light and pitfall trap samples (Divya, 2022; Ashly, 2023). Their burrowing habitat (Hogan, 2012), moist preference and frequently engaging flight capacity making it more likely to be attracted to light traps (Thiele, 1977).

The presence of 15 species exclusive to CAF and only one species exclusive to AWS further highlights the distinctive species pool in agricultural habitats, likely influenced by environmental heterogeneity, crop cycles, and increased light availability (K˛edzior & Kosewska, 2022).

Diversity values show substantial variation among the three sites. The Tropical evergreen forest (RF) supports a more complex and stable community, consistent with

studies indicating that evergreen forests with multi-layered vegetation and stable microclimates promote higher Carabid diversity (Magura et al., 2003; Rainio & Niemelä, 2003). The semi-evergreen forest (AWS), which experiences greater seasonal variation and potentially more disturbance, exhibited reduced diversity, likely due to dominance by fewer well-adapted species. CAF despite being a disturbed ecosystem, displayed moderate diversity. Agricultural habitats often promote high species turnover and attract species with wide ecological tolerances, contributing to intermediate diversity levels (Niemelä, 1997). However, diversity in CAF is strongly influenced by uneven abundance distribution, as reflected by its low evenness index (K˛edzior & Kosewska, 2022).

The agricultural field (CAF) supported the highest richness, which may be attributed to habitat heterogeneity created by crop cycles, edge effects, and open vegetation conditions. Disturbed ecosystems often harbour a mixture of generalist, open-habitat, and synanthropic species, thereby inflating richness values (Magurran, 2004). However, richness alone does not indicate ecological stability; this is evident from the sharp contrast between the high richness but low evenness in CAF. RF exhibited the most uniform species distribution, indicating reduced dominance effects and greater niche partitioning. High evenness generally signals ecological stability and balanced interspecific interactions (Wilsey & Stirling, 2007). The AWS showed low evenness, suggesting dominance by a few species adapted to semi-evergreen conditions such as seasonal canopy opening, fluctuations in humidity, and patchy litter distribution. CAF is species-rich, and the lowest evenness, indicating strong dominance by a few species' likely disturbance-tolerant and widely distributed generalist beetles. This pattern is characteristic of intensively managed agricultural systems, where dominance by opportunistic species compresses evenness (Niemelä, 1997).

The comparative results clearly indicate that habitat structure, canopy cover, and disturbance intensity are the primary determinants of Carabid assemblages across the study area. The tropical evergreen forest (RF) supports a more stable and evenly structured community, while the agricultural field (CAF) exhibits high richness but reduced ecological balance. The semi-evergreen forest (AWS) occupies an intermediate position but shows weaker community structure due to uneven species dominance. These findings align with global studies emphasizing that Carabid beetles are strong indicators of habitat quality, forest integrity, and disturbance gradients (Rainio & Niemelä, 2003; Lövei & Sunderland, 1996).

5.2.4. Comparative analysis of Scaritinae and Trechinae assemblages in the selected Forest and Agricultural Ecosystems of north Malabar region.

Seasonal variation strongly influenced the Carabidae community structure across the three habitats; semi-evergreen forest (AWS), Tropical evergreen forest (RF), and Agricultural field (CAF). Although each habitat differed in vegetation structure, resource availability, and microclimatic conditions, the combined seasonal patterns demonstrated clear ecological responses in species richness, diversity, and evenness. The forest ecosystems showed stable diversity across seasons (non-rainy and rainy), indicating that overall species diversity remained moderate to high throughout the year. This resilience suggests that forest Carabid communities are buffered against seasonal fluctuations due to stable canopy cover, moisture retention, and resource heterogeneity (Thiele, 1977; Rainio & Niemelä, 2003). In contrast, the agricultural landscape exhibited stronger seasonal shifts. Agriculture dominated habitats often experience rapid changes in vegetation cover, microclimate, and prey availability, which influence Carabid activity patterns more sharply than in forests (Lövei & Sunderland, 1996). Rainy season supports more species (higher Margalef richness), likely due to optimal

environmental conditions. Evenness declines in the rainy season, implying increased dominance of a few highly adapted species. These findings are consistent with ecological theory stating that tropical forest Carabid communities respond strongly to seasonal moisture fluctuations, which influence reproduction, movement, and habitat selection (Lövei & Sunderland, 1996). The increase in richness but decline in evenness in the rainy season likely reflects asynchronous population growth among species, where some species benefit more than others from the seasonal conditions.

High similarity was observed between the Scaritinae and Trechinae assemblages in Semi-evergreen forest and Tropical evergreen forest followed by Semi-evergreen forest and Agricultural Habitat and least similarity was between Tropical evergreen forest and Agricultural Habitat in light trap collections. Also, highest similarity of Scaritinae and Trechinae assemblages was observed between Semi-evergreen forest and Tropical evergreen forest and least similarity was between Semi-evergreen forest and Agricultural Habitat by pitfall trap method. Highest similarity between the Scaritinae and Trechinae assemblages in Semi-evergreen forest and Tropical evergreen forest is due to natural habitat conditions that exist in the forest ecosystem than open areas in the agro-ecosystem (Divya, 2022).

Chapter 6

CONCLUSION

6. CONCLUSIONS

6.1. Taxonomy

6.1.1. Taxonomy of Subfamily Scaritinae

- A total of 22 species of Scaritinae beetles belonging to three tribes and 11 genera are recorded from Kerala. This study provided the checklist and pictorial key for the identification of Scaritinae beetles, along with a modified taxonomic key for the species found in Kerala.
- Two species (*Clivina ursulae* and *Trilophidius impunctatus*) are newly reported from India.
- Two species (*Clivina boreri* and *Orictites constulipennis*) are first time report from South India.
- One species (*Oxylobus pygmaeaus*) is newly reported from Kerala.
- All the 22 identified species from the subfamily Scaritinae are deposited in the National Insect Collection of the Zoological Survey of India, Kozhikode (ZSIK).

6.1.2. Taxonomy of Subfamily Trechinae

- First time Taxonomic data on the group which remains unexplored or little explored in Kerala and South India**.**
- 27 Trechinae beetle species recorded from Kerala, spanning three tribes and seven genera.
- Study provides a checklist, pictorial key, and revised taxonomic key for Kerala species.
- One new species: *Pogonus malabarensis* Shigina & Sabu, 2024a (from Kerala).
- Three species newly reported in India: *Anomotachys acaroides, Elaphropus elutus* and *Tachys plagiatus*.

- Ten species newly reported from south India: *Bembidion kara, Elaphropus fumicatus, E. ovatus, E. unitarius, Lymnastis pilosus, L. pullulus, Tachys cardoni, T. euryodes, T. sericeus* and *Perileptus indicus*.
- Two species newly reported from Kerala: *Elaphropus haliploides* and *E. poecilopterus*.
- All the 27 identified species from the subfamily Trechinae are deposited in the National Insect Collection of the Zoological Survey of India, Kozhikode (ZSIK).

6.2. Ecology

- Twenty-three species of Scaritinae and Trechinae beetles are documented from Aralam Wildlife Sanctuary (Semi-evergreen forest) in the North Malabar region of Kerala.
- Twenty-two species of Scaritinae and Trechinae beetles are documented from Ranipuram Forest (Tropical- evergreen forest) in the North Malabar region of Kerala.
- Forty-one species of Scaritinae and Trechinae beetles are documented from Chambad Agricultural field in the North Malabar region of Kerala.
- *Elaphropus poecilopterus, E. politus, Clivina tranquebarica* and *Elaphropus nilgiricus* are the dominant species in the AWS using light trap method.
- *Elaphropus fumicatus, E. politus, Clivina tranquebarica* and *Elaphropus Klugii* are the dominant species in the AWS using pitfall trap method.
- *Elaphropus politus, E. fumicatus E. nilgiricus, Clivina tranquebarica, Tachys fasciatus* and *Clivina brevior* are the dominant species in the RF using light trap method.
- *Elaphropus politus, E. fumicatus, E. klugii, Clivina tranquebarica, Tachys fasciatus* are the dominant species in the RF using pitfall trap method.

- *Clivina brevior, Elaphropus fumicatus, E. politus, Clivina tranquebarica* and *Elaphropus poecilopterus* are the dominant species in CAF using light trap method.
- Clivina brevior, Elaphropus politus and *Clivina tranquebarica* are the dominant species in CAF using pitfall trap method.
- Forest ecosystem supports a reasonably varied community of species, with a fair balance in their population sizes. Among the three habitats, RF indicating the highest species diversity, suggesting a more complex and balanced community.
- The study found that overall species diversity and richness is greater in the rainy season. This may be due to favourable moisture and temperature conditions.
- The study indicates overall abundance shows significant variations with in the Forest and Agricultural Ecosystem and also shows significant variations with seasons (Non-rainy and Rainy).
- The highest similarity between the Scaritinae and Trechinae beetles' assemblages from light trap collections is in Semi-evergreen forest and Tropical- evergreen forest followed by Semi-evergreen forest and Agricultural Habitat and least similarity is between Tropical- evergreen forest and Agricultural Habitat. While in pitfall trap collections, highest similarity is between the Semi-evergreen forest and Tropical- evergreen forest and least similarity is between Semi-evergreen forest and Agricultural Habitat.

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Chapter 7

RECOMMENDATIONS

7. RECOMMENDATIONS

- The present study indicating the presence of rich fauna of Scaritinae and Trechinae beetles in Kerala, 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.
- Detailed studies on the biology of prominent Scaritinae and Trechinae beetle's species

  (reproduction, larval development, feeding behaviour, longevity) in the Forest and Agricultural Fields are needed.
- Evaluating how habitat alterations, natural disasters, land-use changes, pesticide use, fragmentation, and climate change affect Scaritinae and Trechinae communities is crucial for developing effective conservation strategies, especially for sensitive or endemic species. Scaritinae and Trechinae beetles play a dual role in agro-ecosystems, as effective predators of insect pests and weed seeds, but with the possibility of also feeding on rice and seeds of other valuable crops. Therefore, detailed studies are needed to distinguish which species function primarily as predators and which act as seed eaters, so that their ecological roles are properly understood.

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Chapter 8

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8. REFRENCES

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LIST OF FIGURES

LIST OF TABLES

LIST OF PLATES

Plate 6. Dorsal habitus of A) *Lymnastis pullulus* Motschulsky,1862; B) *Tachys cardoni* Andrewes, 1925; C) *Tachys euryodes* Bates, 1892; D) *Tachys fasciatus* Motschulsky, 1851; E) *Tachys impressipennis* Motschulsky, 1859; F) *Tachys plagiatus* Putzeys, 1875; G) *Tachys sericeus* Motschulsky, 1851; H) *Tachys tropicus* Nietner, 1858.

Plate 7. Dorsal habitus of A) *Perileptus ceylanicus* Nietner, 1857; B) *Perileptus indicus*nJeannel, 1923; C) *Pogonus malabarensis* Shigina & Sabu, 2024.

LIST OF ABBREVIATIONS

AWS: Semi-Evergreen Forest (Aralam Wildlife Sanctuary)

RF: Tropical Evergreen Forest (Ranipuram Forest)

CAF: Chambad Agricultural Field

ψ: Un available References

Indian Journal of Entomology 86(3): 889-891 (2024) DoI. No.: 10.55446/IJE.2023.1279

A NEW SPECIES OF THE GENUS *POGONUS* DEJEAN (COLEOPTERA: CARABIDAE: TRECHINAE) FROM THE NORTH MALABAR REGION IN SOUTH INDIA

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ABSTRACT

Tribe Pogonini of the carabid subfamily Trechinae is represented by a single genus *Pogonus* Dejean, 1821 with a single species *Pogonus biroi* Csiki, 1907 in the Oriental region. A new species, *Pogonus malabrensis* sp.nov., is described from the north Malabar region in south India with a key to the Oriental species of the genus.

Key words: Pogonini, Bembidiini, Trechini, *Pogonus biroi*, *Pogonus malabarensis* sp.nov., ground beetles, light trap, oriental region, Chambad, Sri Lanka

Subfamily Trechinae (Carabidae) is represented by five tribes with 328 genera and 5317 species at the global level (Lorenz, 2022). Among the five tribes of Trechinae, Pogonini Laportae, 1834 is represented in all zoogeographical regions of the world, but is most diverse in the Palaearctic region (Bosquet, 1997). Tribe Pogonini represented by 12 genera with 85 species (Anichtchenko, 2020; Lorenz, 2022). Trechinae in India falls under three tribes (Bembidiini Stephens, 1827, Trechini Bonelli, 1810 and Pogonini Laporte, 1834). They are small to medium-sized ground beetles with a size range of 1.5 to 7 mm (Andrewes, 1935). Among the three Indian tribes, Pogonini is represented by a single genus *Pogonus* Dejean, 1821 in Oriental region with a single species (*Pogonus biroi* Csiki, 1907) distributed in India and Sri Lanka (Andrewes, 1935). In the present work, one new species *Pogonus malabarensis* sp. nov., is described from south India with a key to the Oriental species of the genus. Out of the 51 known speicies of genus *Pogonus*, 30 species are described with female specimens alone by earlier workers, and colour of the body, punctures on pronotum, pores on elytral interval three, isodiametric meshes on the body etc. are used as the diagnostic characters for the 30 species described with female specimens (Chaudoir, 1842, 1871; Dejean, 1821, 1828; Andrewes, 1935; Habu, 1954, Baehr, 1984). Images of genitalia of the species of the genus are not available for this group for comparison.

MATERIALS AND METHODS

Specimens were collected with light traps placed on the hedgerows of a rice paddy field at Chambad (11°52'23.5"N 75°30'24.5"E) from Kannur district in the north Malabar region of south Kerala during monsoon season (June to August). Identification was done using keys in Andrewes (1935) and by comparing with the holotype image of *Pogonus biroi* Csiki, 1907 in Natural history museum in Budapest, Hungary (HNHM) (Europeana Foundation, 2009) and also the images from Muséum National d'Histoire Naturelle, Paris, France (MNHN). Images were taken using Leica M205C Stereo zoom microscope fitted with Leica MC 170 HD digital camera. Measurements are taken with Leica LAS V4.5 software. Verified specimens are deposited in the National Insect Collections of Zoological Survey of India Western Ghats Regional Centre, Kozhikode (ZSIK). Abbreviations used- TLA: body length from apex of mandibles to pygidium; TLB: body length from apex of labrum to apex of elytra; PL: length of pronotum along median line; PW: maximum width of pronotum; EL: maximum length of closed elytra; EW: maximum width of elytra; ZSIK: Zoological Survey of India, The Western Ghats Regional Centre, Kozhikode

RESULTS AND DISCUSSION

A. Images of genitalia of the species of the genus

Key to the species of genus *Pogonus* Dejean (1821) in Oriental region

1. Surface of head and disc of pronotum without punctures and wrinkles; hind angles of pronotum obtuse, basal area of pronotum depressed with fine punctures without lateral carina; obsolete isodiametric meshes on head and pronotum; elytral surface including apex uniformly brown ....*Pogonus biroi* Csiki, 1907

- Surface of head and disc of pronotum with punctures and transverse wrinkles; hind angles of pronotum acute, basal area of pronotum depressed with dense coarse punctures and distinct lateral carina; distinctly visible isodiametric meshes on head and pronotum; elytral surface brown with yellow translucent markings at the apex of elytral border.....*Pogonus malabarensis* **sp. nov.**

B. *Pogonus malabarensis* sp. nov. (Fig. 1A-E)

Type: Holotype (female), Paratypes 2 ex. (2 females). Labelled 'India: Kerala: Chambad, paddy field (11°52'23.5"N75°30'24.5"E), 'Light trap', 20.viii.2019, Coll. Shigina K'. Types deposited in the Western Ghats Regional Centre, Kozhikode (ZSIK).

Description: Length. Holotype (Female): 6.7 mm Colour: Head, pronotum, prosternum, proepisternum, metasternum, metepisternum and abdominal ventrites greenish brown colour; mandibles, antennal segments five to 11, legs and proepisternal margin dark brown; maxillary palpi, first antennal segment reddish brown with dark patch, segments two to four yellowish brown; eyes pale grey; mentum dark brown (Fig. 1A). Head: Shiny with fairly deep, nearly parallel frontal furrows extending and diverging beyond clypeus. Antennae not extending beyond base of elytra. Surface of head with punctures and transverse wrinkles. Neck constriction indistinct. Labrum truncate and six setose, rounded anteriorly with few setae. Clypeus rectangular with two setae and the clypeal suture faint. Ligula wide, truncate at apex, two setae at middle arising from one pore, paraglossae small, free at apex and extending beyond ligula. Mentum with bifid median tooth with two setae. Submentum slightly emarginate in the middle of apex and strongly emarginated at middle of base with a pair of setae on each side. Antennae filiform, joint one stout, two shorter than three, pubescent from apex of scape and densely pubescent from joint four. Palpi pubescent, penultimate segment long, slender, in the shape of an inverted cone, apical segment fusiform. Mandibles short but stout, apex pointed. Eyes prominent, not enclosed by genae. Gula large and wide. Isodiametric meshes of microsculpture distinct. Pronotum: Prothorax convex, subquadrate, bisetose, strongly rounded anteriorly and more sinuate posteriorly close to the hind angles. Pronotum convex with wavy transverse wrinkles and coarse punctures at the disc. Hind angles acute with well-developed carina at each side. Median line of pronotum deep and well impressed. Basal area of pronotum evidently depressed with dense coarse punctures and front transverse impression with few coarse punctures. Isodiametric microsculptures distinct throughout (Fig. 1B).

Elytra: Shiny, nearly parallel sides, wider than prothorax, basal border entire, emarginated at middle. Well-developed scutellar striole. Stria with deep punctures and is completely absent towards apex. All Stria free at base, rounded with small prominence at the tip. Elytral interval three with five pores; first three pores on stria three, fourth and fifth pore on interval three; elytral striae six and seven fused at apex. Isodiametric microsculptures distinct throughout the elytra (Fig. 1C).

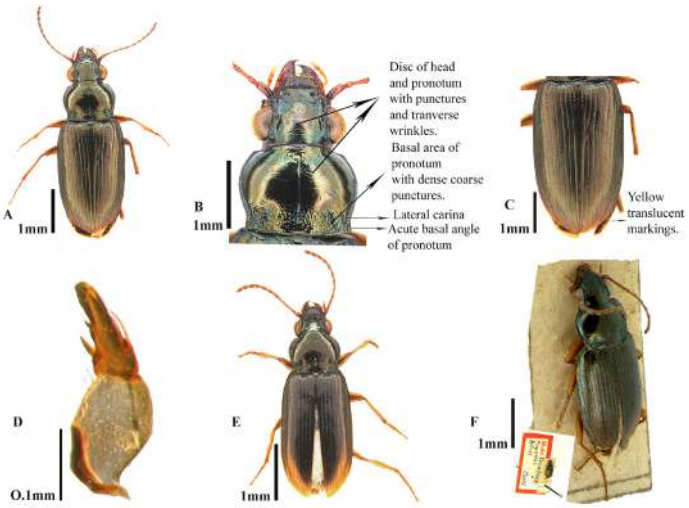

Fig. 1. A–E: *Pogonus malabarensis* sp.nov., A: Dorsal habitus; B: Head and pronotum; C: Elytra; D: Female genitalia; E: Dorsal habitus of paratype with variation; and F: Dorsal habitus of *Pogonus biroi* holotype.

Hind wings: Well developed. Legs: Densely pubescent from middle of tibia, protibia truncate at apex, claws simple. Venter: Venter region densely punctate and consist of distinct network of isodiametric meshes including metacoxa. Posterior border of abdominal segments yellowish brown. Metepisternum wide and bordered. Three to five abdominal ventrites with paired setiferous pores at middle and sixth abdominal ventrite with four setiferous pores. Female genitalia: Gonocoxite one with two setae at apex; gonocoxite two narrow and elongate, slightly curved, with two ventrolateral ensiform setae near base and one nematiform setae in the middle (Fig. 1D).

Measurements: Holotype, TLA = 6.7 mm, TLB = 6.3 mm, PL = 1.3 mm, PW = 1.9 mm, EL = 3.8 mm, EW = 2.40 mm; Paratype (n=2), TLA = 6.1–6.7 mm, TLB = 5.8–6.3 mm, PL =1.1–1.3 mm, PW = 1.8–1.9 mm, EL = 3.5–3.8 mm, EW = 2.3–2.5 mm.

Distribution: INDIA: Kerala: Kannur: Chambad.

Etymology: Named after the geographical collection region.

Diagnosis: *Pogonus malabarensis* **sp.nov.**, is morphologically similar to *P. biroi* (Fig. 1F) but strongly differs from *P. biroi* by, basal angle of pronotum acute in contrast to the obtuse basal angle of pronotum in *P. biroi*; surface of head and disc of pronotum, excluding basal area with fine punctures and transverse wrinkles in contrast to the impunctate head and disc of pronotum (other than basal area) and without transverse wrinkles in *P. biroi*; basal area of pronotum with dense coarse punctures with distinct lateral carina on each side in contrast to the fine punctures on basal area of pronotum and without lateral carina in *P. biroi* and absence of yellow translucent markings at the apical border of elytra in *P. biroi*.

Remarks: One paratype (Fig. 1E) is with yellow translucent markings covering the entire apical half of elytra which we consider as a variation of other types of *Pogonus malabarensis* **sp.nov.**, with the apex of elytral border with yellow translucent markings.

ACKNOWLEDGEMENTS

Financial assistance provided by the Council for Scientific and Industrial Research (CSIR, Govt. of India 08/453(0013)/2019-EMR-I dated 09/04/2019) to first author and DST-SERB Carabidae taxonomy project to the second author are gratefully acknowledged. Thierre Dueve and Azadeh Taghavian (Muséum National d'Historie Naturelle, Paris) are acknowledged for providing images; Paul Aston for literature support; and Aswathi S B, Nijisha K, Neethu V P and Anagha Sudhakar V S (St. Joseph's College (Autonomous), Devagiri for logistical support.

FINANCIAL SUPPORT

Financial assistance was provided by the Council for Scientific and Industrial Research (CSIR, Govt. of India 08/453(0013)/2019-EMR-I dated 09/04/2019) to the first author and DST-SERB Carabidae taxonomy project to the second author.

AUTHOR CONTRIBUTION STATEMENT

Shigina K and Sabu K Thomas analyzed the specimens, verified the review and drafted the manuscript.

CONFLICT OF INTEREST

No conflict of interest.

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(Manuscript Received: May, 2023; Revised: August, 2023;
Accepted: August, 2023; Online Published: September, 2023)
Online First in www.entosocindia.org and indianentomology.org Ref. No. e23279

Indian Journal of Entomology 86(2): 589-591 (2024) DoI. No.: 10.55446/IJE.2024.1713

NEW RECORDS OF THE GENUS *TACHYS* CASEY (COLEOPTERA: CARABIDAE: TRECHINAE) FROM INDIA

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ABSTRACT

New records two Carabidae species [*Tachys plagiatus* Putzeys, 1875 and *Tachys tropicus* Nietner, 1858 (Coleoptera: Carabidae: Trechinae)] from India with detailed descriptions and notes on their geographical distribution are provided.

Key words: Carabidae, Bembidiini, new records *Tachys plagiatus*, *Tachys tropicus*, *Paratachys*, *Polyderis*, *Merotachys*, south India, Aralam Wildlife sanctuary, light trap, north Malabar

Subfamily Trechinae Bonelli, 1810 is composed of small ground beetles (1.5 to 5 mm) and they live in riparian zones, associated with edges of water bodies or swamps (May and Kermode, 2012). Their small size makes it hard to spot and sort specimens in the collections often leading to a higher chance of missing them. The subfamily Trechinae is less explored in India after Andrewes (1935) and with only 18 species within the genera, *Elaphropus* Motschulsky, 1857 and *Tachys* Casey 1918 were reported from south India (Andrewes, 1935). *Tachys*, a genus within the tribe Bembidiini, stands out as one of the smaller genera in its subfamily, boasting a size range of 1.5 to 3.5 mm and a global presence with 273 species (Lorenz, 2022). Within the genus *Tachys* there are four distinct subgenera- *Tachys* Dejean, 1821 (43 species); *Polyderis* Motschulsky, 1862 (38 species); *Merotachys* Basilewsky, 1965 (one species); and *Paratachys* Casey, 1918 (153 species) (Lorenz, 2022). Among these, subgenera *Paratachys* and *Polyderis* are treated as distinct genus by Erwin. Genus *Tachys* is represented in India by 10 species belonging to the subgenera *Paratachys* and *Polyderis*, with eight species (seven species of subgenus *Paratachys* and one species of subgenus *Polyderis*) found in the northern region and two species (*Tachys (polyderis) impressipennis* Motschulsky, 1859 and *Tachys (polyderis) brachys* Andrewes, 1925) of subgenus *Polyderis* distributed throughout the country (Andrewes, 1935). The subgenus *Polyderis* with these two species is the only representatives of the genus in south India. *Tachys (paratachys) plagiatus* known with three subspecies- *T. plagiatus plagiatus* Putzeys, 1875 from Australian (Australia, Papua New Guinea), Oriental (Indonesia, Philippines) and Palearctic realms (Taiwan); *T. plagiatus sexmaculatus* Andrewes, 1925 from Oriental (Thailand, Vietnam) and Palearctic (Taiwan) realms and *T. plagiatus shimosae* Tanaka, 1956 from Palearctic (Japan) realm. *Tachys* (*paratachys) tropicus* Nietner, 1858 reported from only Sri Lanka. First reports of two species *Tachys (paratachys) plagiatus* Putzeys, 1875 and *T. (paratachys) tropicus* Nietner, 1858 from India with revised descriptions and distribution patterns is presented.

MATERIALS AND METHODS

The collections of beetles were done using light trap method from Aralam Wildlife Sanctuary (11.9220° N, 75.7904° E) from Kannur district in the north Malabar region of Kerala during 2019–2020 period. The classification pattern provided by Lorenz (2022) was followed in the present study. Species-level identification was done with the aid of taxonomic keys in Andrewes (1935) and verified by comparing with the syntype images of *Tachys plagiatus* deposited in Victoria Museum and *T. tropicus* deposited in the Museum für Naturkunde, Berlin. Images were taken using Leica M205C Stereo zoom microscope fitted with Leica MC 170 HD digital camera. Measurements are taken with Leica LAS V4.5 software. Verified specimens are deposited in the National Insect Collections of Zoological Survey of India Western Ghats Regional Centre, Kozhikode (ZSIK).

Abbreviations used: TLA: body length from apex of mandibles to pygidium; TLB: body length from apex of labrum to apex of elytra; PL: length of pronotum

ORIENTAL INSECTS
2024, VOL. 58, NO. 3, 415–473
https://doi.org/10.1080/00305316.2024.2320644

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Checklist of Indian Scaritinae Bonelli, 1810 (Coleoptera: Carabidae)

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ABSTRACT

A checklist with distribution patterns and literature details of the 176 Scaritinae species under 23 genera reported from the Indian mainland are provided. Out of these species, 72 species are endemic to India and 104 species have a wider range of distribution. Among the 72 endemic Indian species, 59 species are from the Indian ORR region; eight species are from the Indian PAR region, three species in both the Indian ORR and PAR regions, and the localities of two species are unknown. Among the 72 Indian endemic species, eight species are endemic to the Himalayan Hotspots of Biodiversity, five species are endemic to the Indo-Burma Hotspot of Biodiversity and seven species are endemic to the Western Ghats Hotspot of Biodiversity.

ARTICLE HISTORY
Received 15 September 2023
Accepted 15 February 2024

KEYWORDS
Ground beetle; hotspot of biodiversity; Himalaya; Indo-Burma; The Western Ghats

Introduction

Scaritinae Bonelli, 1810 is a speciose subfamily of family Carabidae with 2407 species worldwide classified under 5 tribes, 13 subtribes, 146 genera, and 46 subgenera (Lorenz 2021). Andrewes (1930) classified the 136 known Indian species under 12 genera (*Gnaphon* Andrewes 1920, *Haplogaster*; Chaudoir 1879, *Scarites*; Fabricius 1775, *Oxylobus*; Chaudoir 1855, *Scapterus*; Dejean 1826, *Oxygnathus*; Dejean 1826, *Sparostes*; Putzeys 1867, *Coryza*; Putzeys 1867, *Clivina*; Latreille 1802, *Trilophus*; Andrewes 1927b, *Dyschirius*; Bonelli 1810, and *Zelma*; Andrewes 1920). Our review revealed that 176 Scaritinae species falling under four tribes, Clivinini, Dyschiriini, Salcediini and Scaritini are reported in India till today and with 40 species added to the lists after 1930 by Andrewes (1932, 1933, 1936a), Bänninger (1931, 1935), Kult (1951), Jedlička (1964), Casale (1980), Saha and Biswas (1985), Saha (1986), Fedorenko (1997a, 2016), Abhitha and Sabu (2009), Bulirsch (2009), Dostal

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Published online 14 Mar 2024

Indian Journal of Entomology Online published Ref. No. e25619 DoI. No.: 10.55446/IJE.2025.2619

NEW DISTRIBUTIONAL RECORDS OF CARABIDAE FROM THE WETLANDS OF SOUTH INDIA

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ABSTRACT

***Clivina ursulae* Balkenohl, 2020 (subfamily Scaritinae) hitherto known only from Sri Lanka is recorded for the first time from India. This study also reports *Elaphropus fumicatus* (Motschulsky, 1851), *Elaphropus virgatus* (Andrewes, 1925) (subfamily Trechinae), *Lebidia bioculata himalayica* Andrewes, 1924, and *Pentagonica erichsoni* Schmidt-Göbel, 1846 (subfamily Lebiinae) for the first time from South India, earlier which have been reported from northern, north eastern and eastern regions of India.**

Key words: Ground beetles, Indian mainland, Kerala, light trap, Mavoor, new record, subfamily, subspecies, Tamil Nadu, taxonomy

Carabidae consist of about 40,968 species worldwide, with approximately 1,967 species reported from India (Lorenz, 2024; Anichtchenko, 2024). The current study adds one more species to the Indian carabid fauna by documenting *Clivina ursulae* Balkenohl, 2020, which was previously known only from Sri Lanka. Additionally, the study also reports *Elaphropus virgatus* (Andrewes, 1925), *E. fumicatus* (Motschulsky, 1851), *Pentagonica erichsoni* Schmidt-Göbel, 1846 and the subspecies *Lebidia bioculata himalayica* Andrewes, 1924, for the first time from South India. *Elaphropus virgatus* is exclusively found on the Indian mainland and was previously recorded only from the northern (Uttar Pradesh) and eastern (Bihar and West Bengal) regions of India (Andrewes, 1930; Kushwaha and Hegde, 2013). In contrast, *Elaphropus fumicatus* exhibits a broad range of distribution and displays a high degree of variability (Andrewes, 1935). In India, it was previously reported only from the northern region (Uttar Pradesh) (Kushwaha and Hegde, 2013). *Pentagonica erichsoni* shows distribution in Oriental, Palaearctic and Australian regions. In India this species has been previously reported only from northeastern (Manipur) and eastern (West Bengal) regions (Raj and Thomas, 2019). *Lebidia bioculata himalayica*, a subspecies of *L. bioculata*, is the only subspecies among the four recognized subspecies that has been reported in India, specifically in the northern state of Uttarakhand and eastern state of West Bengal (Andrewes, 1930; Löbl and Löbl, 2017).

MATERIALS AND METHODS

Specimens were collected using light trap (SAFS UV LED Light trap, India) from the Wetlands of Mavoor (11°16'31.7"N 75°54'54.1"E, 11°15'37.5"N 75°56'20.8"E, 11°15'59.4"N 75°56'47.7"E), Kozhikode district, Chambad (11°52'23.5"N 75°30'24.5"E), Kannur district, Kerala and Marchinaickenpalayam (10°37'14.2"N 76°51'15.9"E), Coimbatore district, Tamil Nadu during 2021-2022. Classification scheme provided in Lorenz (2024) was followed. Identifications were done with the taxonomic keys and descriptions provided in Andrewes (1924, 1935), Baehr (2011), Balkenohl (2020) and also by comparing with the type and the verified specimens deposited in National Forest Insect Collection (NFIC), Forest Research Institute (FRI), Dehradun and images of verified specimens from Natural History Museum Data Portal, London. Identified specimens are deposited in the National Insect Collections of Zoological Survey of India, Western Ghats Regional Centre, Kozhikode (ZSIK). Images and measurements were taken using a Leica M205C stereomicroscope fitted with Leica MC170HD digital camera and Leica Application Suite (LAS) software version 4.12. All measurements are reported in millimetre. Abbreviations of measurements used: TLB: Total body length from labrum to the apex of elytra, PL: Length of pronotum along median line, PW: Maximum width of pronotum, EL: Maximum length of closed elytra, EW: Maximum width of elytra. Symbols used: # New record from Indian mainland, *New record from south India.

CERTIFICATE

This is to certify that ~~Prof./Dr./Mr.~~/Ms..... Shigina K Research Scholar, St Joseph's College (Autonomous), Devagiri, Kozhikode *has participated / ~~delivered an invited lecture/chaired a session~~/presented a paper titled* Scarutinae and Trechinae Beetles Rice ecosystem in North Malabar *in the Three-day International Seminar on* **Faunal Diversity** ***Climate | Global Warming | Human Interference*** *organized by Department of Zoology, Sir Syed College Taliparamba in association with IQAC, Sir Syed College, Taliparamba; Zoological Survey of India, WGRC, Kozhikode & Department of Zoology Mananthavady Campus, Kannur University from 10th - 12th March, 2022*

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Dr. Abdul Rasheed V. T.	Dr. Zeena K. V.	Prof. Dileep C. D.
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