TAXONOMY, SPECIES DIVERSITY AND DISTRIBUTION PATTERNS OF ANTS OF NEPAL

A THESIS SUBMITTED TO THE

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DOCTOR OF PHILOSOPHY

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BY

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DECLARATION

Thesis entitled **"Taxonomy, Species Diversity and Distribution Patterns of Ants of Nepal"** which is being submitted to the Central Department of Zoology, Institute of Science and Technology (IOST), Tribhuvan University, Nepal for the award of the degree of Doctor of Philosophy (Ph.D.), is a research work carried out by me under the supervision of Prof. Dr. Prem Bahadur Budha of Central Department of Zoology, Tribhuvan University and co-supervised by Prof. Dr. Himender Bharti of Centre for Restoration of Ecosystem of Punjab, Punjabi University, India and Dr. Leeanne Alonso, Conservation Associate of Re:wild (formerly Global Wildlife Conservation), USA.

This research is original and has not been submitted earlier in part or full in this or any other form to any university or institute, here or elsewhere, for award of any degree.

[Indra Prasad Subedi]
18 October 2022

RECOMMENDATION

This is to recommend that **Indra Prasad Subedi** has carried out research entitled **"Taxonomy, Species Diversity and Distribution Patterns of Ants of Nepal"** for the award of Doctor of Philosophy (Ph.D.) in **Zoology** under our supervision. To our knowledge, this work has not been submitted for any other degree.

He has fulfilled all the requirements laid down by the Institute of Science and Technology (IOST), Tribhuvan University, Kirtipur for the submission of the thesis for the award of Ph.D. degree.

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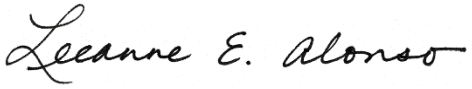

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On the recommendation of supervisor **Prof. Dr. Prem Bahadur Budha / Co-supervisors Prof. Dr. Himender Bharti** and **Dr. Leeanne Alonso,** this Ph.D. thesis submitted by **Indra Prasad Subedi**, entitled **"Taxonomy, Species Diversity and Distribution Patterns of Ants of Nepal"** is forwarded by Central Department Research committee (CDRC) to the Dean, IOST, TU.

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(Indra Prasad Subedi)

October 2022

ABSTRACT

Nepal is known for its high biological diversity, particularly due to its variety of habitat types and high elevation range. Nepal is likely to have a very high diversity of ants (Hymenoptera: Formicidae). However, little is known about the ant fauna of Nepal because only a few studies have been conducted to explore Nepalese myrmecofauna. A comprehensive systematic treatment for Nepalese ants is lacking. This study represents the first detailed study of ants of Nepal, a hyperdiverse but understudied group in the region. The study aimed to contribute to a better understanding of the taxonomy of ants of Nepal, as well as their diversity and distribution patterns. The study was conducted from 2018 to 2022 in Nepal covering tropical, subtropical, and temperate forests. The study was specifically aimed to prepare a generic synopsis of ants of Nepal along with new species descriptions, to produce an up-to-date checklist with taxonomic annotations, and to examine the diversity and distribution patterns of ants in Nepal. The study was conducted systematically applying the Ants of the Leaf Litter (ALL) protocol for sampling ants in Shivapuri-Nagarjun National Park, Ranibari Community Forest, and the Tribhuvan University Campus Forest area. Ant specimens from Tarai, Siwalik, and Hills of eastern, central, and western regions of Nepal, and other parts of the country were also examined. Ant collecting methods included pitfall trapping, baiting, hand collecting, beating of lower vegetation, sweeping, and sifting leaf litter and soil cores. Incidence-based Coverage Estimator (ICE), Chao2, and Jackknife2 estimators were used to estimate species richness at each site. Non-metric Multidimensional Scaling (NMDS) based on the Bray-Curtis similarity index was performed to assess variation in site-wise species composition. A synoptic overview of the taxonomy, distribution, and ecology of 64 ant genera is presented based on the study of newly collected materials and available literature. These genera belong to nine subfamilies as follows: Amblyoponinae (1 genus), Dolichoderinae (6 genera), Dorylinae (5), Ectatomminae (1), Formicinae (15), Leptanillinae (1), Myrmicinae (21), Ponerinae (13) and Pseudomyrmecinae (1). The first comprehensive keys to ant subfamilies and genera of Nepal, based on worker caste, are presented with the aim of facilitating easy identification to subfamily and genus level. Species descriptions of six new species *Aenictus nepalensis* sp. nov., *Temnothorax buddha* sp. nov., *T. kathmanduensis* sp. nov., *T. nepalensis* sp. nov., *T. pathibharensis* sp. nov., and *T. taplejungensis* sp. nov. are provided. Short descriptive notes on worker caste of five

potentially new species including three species of *Aphaenogaster*, and one species each of *Leptogenys* and *Pheidole* are provided. A rare ant species endemic to Nepal, *Emeryopone franzi,* is redescribed based upon recent collections. Species status of *Leptogenys laeviceps* was revived on the basis of this study. An up-to-date checklist of 186 nominal species, including 72 Myrmicine, 59 Formicine, 27 Ponerine, 10 Doryline, 9 Dolichoderine, 6 Pseudomyrmecine, 1 Amblyoponine, 1 Ectatommine, and 1 Leptanilline species was prepared. The genera *Camponotus* and *Myrmica* were the most speciose with 16 species each. Fourteen genera and 69 species were recorded as new faunal records for Nepal. Twenty-two species have types designated from Nepal and, of them, 10 are currently considered as endemic to Nepal. Altogether 48 genera and 158 species were recorded from study sites at SNNP, RCF, TUC and Tarai, Siwaliks and Hills of eastern, central and western regions of Nepal. The ant species richness was decreased with increasing elevation in these study sites. The ants of Nepal are grouped into nine functional groups which are as follows (high to low prevalence order): Opportunists, specialized predators, generalized Myrmicinae, tropical climate specialists, subordinate Camponotini, cold climate specialists, hot climate specialists and dominant Dolichoderinae. The diversity of each functional group coincides with the pattern of species richness across elevation gradients. The majority of the ant species of Nepal (75.4%) have affinities to the Indomalayan ant fauna, followed by Palearctic fauna (18.18%). Altogether 20 cosmopolitan tramp species have been recorded from Nepal, of which 14 species were recorded during this study. Four of these are major pest ant species, *Monomorium pharaonis*, *Paratrechina longicornis*, *Tapinoma melanocephalum*, and *Trichomyrmex destructor*. The results of this study may provide a foundation for future explorations and taxonomic studies on ants.

LIST OF ACRONYMS AND ABBREVIATIONS

ALL	: Ants of the Leaf Litter
BCN	: Bird Conservation Nepal
CDZMTU	: Central Department Zoology Museum of Tribhuvan University
cf.	: Conferret (meaning Compared with)
DNPWC	: Department of National Park and Wildlife Conservation
FAO	: Food and Agriculture Organization
FG	: Functional group
FRTC	: Forest Research and Training Center
GIS	: Geographic Information System
ICE	: Incidence-based Coverage Estimator
ICZN	: International Code of Zoological Nomenclature
KFRI	: Kerala Forest Research Institute, India
m asl	: meter above sea level
MoFE	: Ministry of Forests and Environment
MoFSC	: Ministry of Forests and Soil Conservation
mya	: million years ago
NHMTU	: Natural History Museum Tribhuvan University
NMDS	: Non-metric Multidimensional Scaling
NP	: Nepal
PAST	: Paleontological Statistics
QGIS	: Quantum Geographic Information System
RCF	: Ranibari Community Forest
SNNP	: Shivapuri-Nagarjun National Park
TUC	: Tribhuvan University Campus

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CHAPTER 1

INTRODUCTION

1.1 Background

Ants are the most diverse social insects (Guénard, 2013), which are notable ecologically dominant groups as predators, scavengers, and herbivores, making them economically important among insects (Wilson & Hölldobler, 2005; Parker & Kronauer, 2021). In terrestrial ecosystems, they account for a substantial part of animal biomass (Graham *et al.*, 2009). An estimated 20 quadrillion ants live on Earth, contributing a biomass of 12 megatons of dry carbon (Schultheiss *et al*., 2022). Ant biomass surpasses wild bird and mammal biomass, and accounting for 20% of total human biomass (Schultheiss *et al.*, 2022). It is further estimated that ants and termites together constitute 30% of the animal biomass in the Amazon rainforest (Fittkau & Klinge, 1973; Hölldobler & Wilson, 1990). Because of their ecological dominance and effect on a wide range of other species, ants are often used in environmental monitoring and assessment research (Hölldobler & Wilson, 1990; Andersen & Majer, 2004; Philpott & Armbrecht, 2006; Delabie *et al.*, 2009; Guzmán-Mendoza *et al.*, 2016).

Ants are particularly insightful for conservation and environmental management due to their close relationship with the environment, predictable responsiveness to environmental perturbations, relevance in performing variety of ecological roles, and ease of sampling (Folgarait, 1998; Agosti & Alonso, 2000; Kaspari & Majer, 2000; Delabie *et al.*, 2009; Andersen, 2019). Ants have been widely used as biological indicators for assessing soil quality and function (De Bruyn, 1999; Venuste *et al.*, 2018), land use, conservation and management (Majer, 1983; Andersen & Majer, 2004), forest restoration (Lawes *et al.*, 2017), agroecosystem condition (Peck *et al.*, 1998), biodiversity richness (Alonso, 2000; Majer *et al*., 2007), and habitat disturbance (King *et al*., 1998).

The order Hymenoptera, one of four mega-diverse insect orders, includes ants, bees, chalcids, ichneumons, hornets, sawflies, and wasps. Ants are classified as a single family, the Formicidae, with 16 extant subfamilies, 346 genera, 14,084 species, and 1,711 subspecies (AntWeb, 2022; Bolton, 2022). It is believed that estimated number of species is likely to be closer to 25,000–30,000 in the globe (Ward, 2007). Formicidae is a derived clade within the aculeate superfamily Vespoidea with all of its members

being eusocial (Brothers, 1999; Moreau *et al*., 2006). According to genomic evidence, ants and apoidea (speciform wasps and bees) are sister groups (Johnson *et al.*, 2013). The viewpoint contradicts earlier beliefs that ants are closely linked to ectoparasitoid wasps. The first ants appeared around 100 million years ago (mya) during the Cretaceous period (Wilson & Hölldobler, 2005). Peters *et al.* (2017) claimed that existing Hymenoptera diverged 281 mya by analyzing 3,256 protein-coding genes in 173 insect species. They also hypothesized that the last common ancestor of ants and Apoidea lived between 192 and 136 mya, during the Jurassic or Cretaceous. Ants are social insects with a caste system, and their colony is made up of two female castes (workers and queens) and a male caste. Workers are typically non-reproductive individuals who undertake everyday routines like as nest upkeep, brood care, and foraging. Queens are reproductive individuals who are mostly winged and are responsible for the reproduction of the colony. Males are reproductive individuals who are primarily winged and die soon after mating. Worker-like reproductive ergatoids or intercastes such as ergatogyne, ergatoid males, and erganter males may also be found in the colonies of some ants (Peeters, 1991; Yamauchi *et al*., 1996; Heinze, 1998).

1.2 Nepal and its faunal diversity

Nepal, with a size of 148,516 square kilometers, is one of the countries with high geographic and species diversity. Its geographic position (from 26.4831 to 29.8412°N of latitude and 80.3333 to 88.0944°E of longitude) and topography (elevation range from 60 to 8848 meter above sea level [m asl]) support a high species diversity. Nepal is bordered in the north by China and east, west, and south by India. Nepal is a part of the Himalaya Biodiversity Hotspot, one of 36 biodiversity hotspots on the Earth (Hoffman *et al.*, 2016; Koenig, 2016). The biodiversity hotspots are the most biologically diverse, yet threatened, terrestrial regions on the planet (Hoffman *et al.*, 2016). The country has six biomes, nine ecoregions, 35 forest types, and 118 ecosystems (MoFSC, 2009). FRTC (2021) proposed 69 distinct vegetation types for Nepal, including 54 different kinds of forests and woodlands, six kinds of shrubland and scrub, and nine kinds of grassland and savanna. Some of the vegetation types of Nepal includes *Tectona grandis* Forest, *Eucalyptus* Forest, tropical mixed broadleaf Forest, tropical riverine evergreen Forest, *Shorea robusta* Forest, *Dalbergia sisso-Senegalia catechu* Forest, *Terminalia* Forest, tropical deciduous riverine Forest, *Pinus roxburghii* Forest, subtropical mixed broadleaf Forest, *Castanopsis-Schima* Forest,

Rhododendron scrub, tropical savanna, tropical riverine grassland, tropical hill grasslands, subtropical grasslands, temperate grasslands, upper alpine grasslands (see FRTC, 2021 for details). There are different climatic zones in Nepal, ranging from the Tarai region in the south (<500 m asl) to the High Himalayan region in the north (>5,000 m asl), depending on the season and elevation (CCKP, 2022). While precipitation varies spatially, receiving more than 3000 mm in some central and northerly pockets, typically 1500–2,000 mm in central and southern plains, and less than 1,000 mm in some high-altitude locations, the average temperature in Nepal falls from >24℃ in the south to sub-zero levels in high mountains (CCKP, 2022).

Nepal has high faunal biodiversity with insects accounting for 12,136 species (Thapa, 2015), invertebrates (excluding insects) with 1726 species (Thapa, 2019), 252 species of fishes (Shrestha, 2019), 50 species of amphibians and 130 species of reptiles (Schleich & Kästle, 2002), 886 species of birds (DNPWC & BCN, 2018), and 212 species of mammals (Amin *et al.*, 2018). It is worth mentioning that over 3,883 species have been described from Nepalese specimens (Thapa, 2015).

The earliest records of ants from Nepal were *Aphaenogaster pachei*, and *Myrmica pachei* which were reported in 1906 AD (Forel, 1906). Since then, several researchers, particularly foreigners, have contributed to our understanding of Nepalese ants, primarily by describing species or publishing species records, including Menozzi (1939), Mani and Singh (1962), Wilson and Taylor (1967), Collingwood (1970; 1982), Baroni Urbani (1975, 1977a, 1977b), Bolton (1974, 1977, 1992, 2000b, 2007), De Andrade (1994), Rigato (1994), Schödl (1998), Dubois (1998), Radchenko and Elmes (1998, 1999, 2001, 2009, 2010), Elmes and Radchenko (2009), Ward (2001), Dill (2002), Seifert (2003, 2020), Seifert *et al.* (2017), Wang (2003), LaPolla (2004a), Radchenko (2003), Baroni Urbani and de Andrade (2007), Jaitrong and Ruangsittichai (2018), Hosoishi and Ogata (2016), Williams and LaPolla (2016, 2018), Guénard *et al.* (2018), Eguchi (2008), Branstetter (2009), Wetterer (2008, 2009a, c, 2010c, 2011), and Thapa (2000, 2015). Despite limited research on ants of Nepal, 22 species have been described from Nepalese specimens (Subedi & Budha, 2020b). The ant genera and species reported from Nepal in these publications represent around 13.55% and 0.87% of all known ant genera and species worldwide (Bolton, 2022), respectively. A few additional works have been published, adding to our understanding of ants of Nepal

(Joshi, 1998; Joshi & Manandhar, 2001; Neupane & Subedi, 2018; Adhikari *et al*., 2020a, b; Subedi & Budha, 2020a, b; Subedi, 2021).

1.3 Ant taxonomy

Ant taxonomy has a long history that has been documented in Brown (1955) and Bolton (2003), and its current status has been reviewed in Ward (2007). The modern classification of ants began with the description of 17 ant species under the single genus *Formica* by Linnaeus (1758). These species are now divided into 11 separate genera and four subfamilies (Ward, 2007). With the availability of genetic data and new fossil records, significant progress in ant taxonomy has been made in recent days. The species-level taxonomy of such a complex and hyperdiverse taxa, however, is far from complete. The continued efforts of taxonomists worldwide in species discovery and knowledge exchange may lead to the gap being bridged (Ward, 2007). Taxonomists have typically been preoccupied with the discovery, description, and classification of taxa with little or no attention for their ecological or economic significance. The necessity of taxonomists for investigating ant taxa related to environmental, food security, and public health issues is growing at the present. Ant species also play an indispensable role in invasion biology theory and practice (Le Roux & Wieczorek, 2009; Gotzek *et al.*, 2012).

A good taxonomy focuses on discovering unique features to diagnose taxa, comparing characters that distinguish related taxa, recognizing characters that unify taxa, and describing and arranging those qualities so that other scholars can identify each taxon (Bolton, 2007). The taxonomic study of ants in third-world countries such as Nepal presents a significant challenge because type specimens have rarely been deposited in the country where they were found (Subedi & Budha, 2020a). Ant type specimens are mostly housed at museums abroad, and museums are unwilling to send delicate type specimens to taxonomists in the under-developed and developing countries (Naskrecki, 2004). Developing ant taxonomy in Nepal is a challenging task that necessitates a multi-stage research strategy. The strategy requires involving local ant exploration, preparing an updated species checklist, assigning species codes to all species, compiling overviews of Nepalese ant genera with identification keys, describing unidentified species, and undertaking taxonomic revision of Nepalese species.

Prior to the beginning of this research, there was little information on ant fauna of Nepal, with just a few published papers on occasional collections by foreign scientists.

This study is the first-ever comprehensive assessment of ants of Nepal that includes a generic synopsis, an updated checklist with taxonomic annotations, and new species descriptions. This Ph.D. thesis summarizes the findings of an extensive ant diversity inventory conducted in different locations such as Shivapuri-Nagarjun National Park (SNNP), Ranibari Community Forest (RCF), Tribhuvan University Campus Forest area (TUC), and selected forests of Tarai, Siwaliks and Hills of eastern, central and western regions of Nepal. This faunistic survey also provides important information about the diversity and distribution patterns of ant species in Nepal. The thesis also includes keys to all known subfamilies and genera from Nepal, as well as diagnostic features and images for each newly recorded species. Finally, the study identifies information gaps in the Nepalese ant fauna in order to stimulate further research and conservation.

1.4 Rationale

There are several reasons why ants are important to enhance our understanding of insect life, or of the diversity of species in Nepal. Their generic level taxonomy is arguably the best known among any big group of terrestrial arthropods (Bolton, 1994; Ward, 2007), with worldwide or regional taxonomic keys available (Bolton, 1994; Eguchi *et al.*, 2011, 2014; General & Alpert, 2012). They are one of the most abundant insect groups in many ecosystems, serving a variety of ecological roles and interacting with other organisms. They are notable for their social behavior as well as foraging behaviors (Hölldobler & Wilson, 1990) generating great scientific and popular attention. Because the conservation aims that are presently focused on vertebrates cannot adequately comprehend ants and other invertebrates, a global conservation plan that includes ants is necessary (Jenkins *et al.*, 2013).

A geographically diverse country like Nepal is likely to have high ant diversity. However, Nepalese ants have been little studied so this assertion has been untested until now. Earlier samplings and reporting of ants of Nepal were mostly based on isolated collection events and were not based on comprehensive sampling within taxonomic frameworks. Because information is scarce, it is critical to establish a firm foundation of understanding about the native ant fauna.

This thesis is the first comprehensive work on Nepalese ants that includes an extensive species list, and a generic synopsis. Taxonomic keys to Nepalese ant genera and taxonomic annotations on the species will certainly aid further taxonomic studies and pave the way for more advanced research. This research also provides useful resources

for ecologists, taxonomists, and conservationists who want to use ants as focal taxon for conservation and taxonomic investigations.

1.5 Objectives

The study broadly aimed to contribute to a better understanding of the taxonomy of Nepalese ants, as well as their diversity and distribution patterns. To achieve the overall aim of this thesis, the specific objectives of the study are as follows:

1. to prepare a generic synopsis of ants of Nepal along with new species descriptions.
2. to produce a comprehensive checklist of ants of Nepal with taxonomic annotations.
3. to examine the diversity and distribution patterns of ants in the study area.

1.6 Organization and brief overview of thesis

This thesis includes extensive work on taxonomy, species diversity and distribution patterns of ants of Nepal. The thesis contains six chapters, three of which are based on each specific objective. The following is the overview of thesis chapters:

Chapter 1. Introduction

This chapter gives background information and identifies research gaps. The study's rationale and objectives are presented. This chapter also contains an outline of the thesis chapters.

Chapter 2. Generic synopsis of ants of Nepal along with new species descriptions

This chapter provides the synoptic overview of taxonomy, distribution and ecology of ant genera recorded from Nepal. Each examined genus is illustrated by full-face and profile images. Worker based identification keys to nine subfamilies and 64 genera of ants of Nepal are also included. Species descriptions along with differential diagnosis of six new species, morphological characteristics of five potentially new species, and redescription of *Emeryopone franzi*, a rare endemic ant of Nepal are presented.

Chapter 3. Checklist of ant species of Nepal with taxonomic annotations

The checklists are important tools for species conservation because they provide a solid understanding of the current state of the biota, which can serve as a foundation for conservation actions (Pfeiffer *et al.*, 2011). Checklists need updating over time as new

information is collected. This chapter contains an up-to-date annotated checklist of ants of Nepal with 186 nominal species from 64 genera, and nine subfamilies.

Chapter 4. Diversity and distribution patterns of ants of Nepal

This chapter discusses the diversity and distribution patterns of ants in the SNNP, RCF, TUC, and selected forests in the Tarai, Siwalik, and Hills of eastern, central and western regions of Nepal. This chapter covers elevational distribution patterns, and functional group composition of ants, as well as the distribution of ant genera based on forest types in the study area. Additionally, distribution of ant species by subfamily, biogeographic affinities of ant species of Nepal and a list of tramp/invasive species (a varied group of ant species that have expanded worldwide) are also provided.

Chapter 5. Conclusions and Recommendations

The key findings are synthesized in this chapter. Additionally, it offers suggestions for further research to researchers, academicians, and students.

Chapter 6. Summary

This chapter presents an overall summary of this thesis work.

CHAPTER 2

2. GENERIC SYNOPSIS OF ANTS OF NEPAL ALONG WITH NEW SPECIES DESCRIPTIONS

Abstract

Given the diversity of habitats, Nepal most likely has high diversity of ants, but relatively few investigations of ants have been undertaken in the country. A comprehensive systematic study of ants of Nepal has not been undertaken. This study aimed to provide synoptic overview of the taxonomy, biology and ecology of ant genera of Nepal based upon recent collections and review of literature. It also intends to describe ant species that are new to science. The ants were collected systematically from Shivapuri-Nagarjun National Park, Ranibari Community Forest, Tribhuvan University Campus Forest area, and from other different parts of the country. The collection methods included pitfall trapping, baiting, hand collecting, beating lower vegetation, sweeping, and sifting leaf litter and soil cores. The taxonomy, biology, and ecology of 64 ant genera from nine subfamilies are provided in the form of brief generic synopses. Identification keys for ant subfamilies and genera of Nepal based on the worker caste are provided. Fourteen genera were recorded as new records for Nepal. The genera examined during the study were illustrated by head in full-face and habitus in profile view images. Six species new to science, namely *Aenictus nepalensis* sp. nov., *Temnothorax buddha* sp. nov., *T. kathmanduensis* sp. nov., *T. nepalensis* sp. nov., *T. pathibharensis* sp. nov., and *T. taplejungensis* sp. nov. are described. Five species potentially new to science, including three species of *Aphaenogaster* and one species each of *Leptogenys* and *Pheidole*, are introduced briefly. A rare ant species endemic to Nepal, *Emeryopone franzi* (Baroni Urbani, 1975), which was described based on single specimen, was redescribed based upon collections for this study.

2.1 Introduction

Nepal is expected to have high ant diversity, although Nepalese ants are largely unknown. Most prior studies of Nepalese ants were based on occasional collections rather than systematic sampling within taxonomic frameworks. The most important earlier publication on ants of Nepal was by Collingwood (1970), which included 34 species based on the collections of the "1954 British Museum expedition to east Nepal" and the "1961 H. Janetshek's expedition to Khumbu Himal region". As of now (2022),

22 new species have been described by foreign authors from Nepalese specimens (Forel, 1906; Baroni Urbani, 1975, 1977a, b; Bolton, 1977, 2000a; De Andrade, 1994; Dubois, 1998; Radchenko & Elmes, 1998, 1999, 2009; Schödl, 1998; Radchenko, 2003; Baroni Urbani & de Andrade, 2007; Elmes & Radchenko, 2009; Williams & LaPolla, 2016, 2018). Nepalese species have been included in revisions of many ant genera, including *Acropyga* (LaPolla, 2004a), *Cataulacus* (Bolton, 1974), *Crematogaster* (Hosoishi & Ogata, 2016), *Meranoplus* (Schödl, 1998), *Myrmica* (Radchenko & Elmes, 1998, 2001, 2009), *Cardiocondyla* (Seifert, 2003; Seifert *et al*., 2017), *Lasius* (Seifert, 2020), *Perissomyrmex* (Ogata & Okido, 2007), *Pheidole* (Eguchi, 2008), *Prenolepis* (Williams & LaPolla, 2016), *Pristomyrmex* (Wang, 2003), *Lepisiota* (Wachkoo *et al.*, 2021), *Lophomyrmex* (Rigato, 1994), *Lordomyrma* (Liu *et al.*, 2021), *Recurvidris* (Bolton, 1992), *Tetramorium* (Bolton, 1977), and *Tetraponera* (Ward, 2001). However, no attempts were made to investigate the comprehensive ant biodiversity of Nepal prior to this study.

Globally, the four most diverse ant subfamilies are: Myrmicinae, Formicinae, Ponerinae, and Dolichoderinae. Myrmicinae is the largest subfamily with 147 genera and 7076 species followed by Formicinae (53 genera, 3254 species), Ponerinae (50 genera, 1274 species) and Dolichoderinae (28 genera, 713 species) (Bolton, 2022). Phylogenetic relationships between genera within these four subfamilies, Dolichoderinae (Ward *et al.*, 2010), Ponerinae (Schmidt, 2013; Schmidt & Shattuck, 2014), Myrmicinae (Ward *et al*., 2015), and Formicinae (Blaimer *et al.*, 2015; Ward *et al.*, 2016), have been partially resolved at the molecular level with a number of paraphyletic groups identified and requiring further in-depth work to be fully resolved. Molecular phylogenetic studies have also been published for a few other subfamilies, including Myrmiciinae (Ward & Brady, 2003), Aneuretinae (Ward *et al.*, 2010), Dorylinae (Brady *et al.*, 2014; Borowiec *et al.*, 2019), Agroecomyrmecinae (Ward *et al.*, 2015), Pseudomyrmecinae (Chomicki *et al.*, 2015), Amblyoponinae (Ward & Fisher, 2016), Ectatomminae and Heteroponerinae (Camacho *et al.*, 2022). Recently, Camacho *et al*. (2022) merged Ectatomminae and Heteroponerinae into a single subfamily Ectatomminae, presenting its diagnosis in ten combinational characteristics, and resolving the relationships using Ultra Conserved Element (UCE) phylogenomics.

Formicinae includes well-known economically significant genera such as the carpenter ants *Camponotus*, weaver ants *Oecophylla*, and spiny ants *Polyrhachis*. The stingless

Formicine ants are remarkable in that they manufacture formic acid as a protective venom. The Ponerinae subfamily belongs to the Poneroid clade while other major ant subfamilies belong to the Formicoid clade. Ponerines are unique in that they retain relatively simplified social structure having a wide variety of derived morphological, ecological, and behavioral characters, making them ideal for studying the early evolutionary traits that are important for the success of Myrmicines and Formicines (Hölldobler & Wilson, 1990; Schmidt & Shattuck, 2014). The tribal and generic classifications of Ponerinae have been updated by Schmidt and Shattuck (2014) to incorporate molecular phylogenetic data (Schmidt, 2013) and a re-evaluation of Ponerine morphological diversity. Borowiec's revision of the Dorylinae subfamily laid a basis for future research by radically revising the taxonomy of the genera involved (Borowiec, 2016). The subfamily Pseudomyrmecinae is a unique group of active arboreal ants having large eyes, and slender body (Ward, 2001). Pseudomyrmecinae comprises of *Tetraponera* from the Paleotropics, *Pseudomyrmex* from the Neotropics and Nearctic, and *Myrcidris* from South America (Ward, 1990; Ward & Downie, 2005).

Extensive ant surveys often collect thousands of specimens, with hundreds of species to identify, which is both time-demanding and costly (Pik *et al.*, 1999; Moreno *et al.*, 2008; de Souza *et al.*, 2012). Furthermore, identifying such a varied group up to species level is extremely difficult. Using a higher taxon as a substitute for species might be one strategy to addressing this challenge (Landeiro *et al.*, 2012). Generic level information has been shown to be sufficient to use as an indicator and as a substitute to species specific information to reduce sampling costs and enhance monitoring efficacy (Souza *et al.*, 2016). The genus is a taxonomically stable taxa, and probable misidentifications are less likely than at the species level (Ward, 2007; Guénard *et al.*, 2010). Furthermore, the number of ant genera was found to have a significant positive relationship with the number of species in many studies (Andersen, 1995; Dunn *et al.*, 2009). Because of its strong predictive value, genus may be used as the most effective surrogate of species, potentially saving up to 40% of overall project expenses (Souza *et al.*, 2016). Souza *et al.* (2021) discovered a strong correlation between genera and ant species in terms of richness and composition. They further noted that genera were effective at detecting species distribution patterns over topographic gradients, emphasizing the potentiality of utilizing genera as a substitute for species.

It is imperative that biologists who are interested in studying the ants of Nepal need basic information on important ant genera. The aim of this chapter is to provide a synoptic overview of ant genera known from Nepal. The chapter also includes simplified keys to the ant subfamilies and genera of Nepal. Species descriptions of six new species, and five potentially new species are also provided.

2.2 Materials and methods

2.2.1 Study area

The study area comprised of Shivapuri-Nagarjun National Park (SNNP), Ranibari Community Forest (RCF), Tribhuvan University Campus Forest area (TUC), and Tarai, Siwalik, and Hills of eastern, central, and western regions of Nepal encompassing tropical, subtropical and temperate forests (Figure 1).

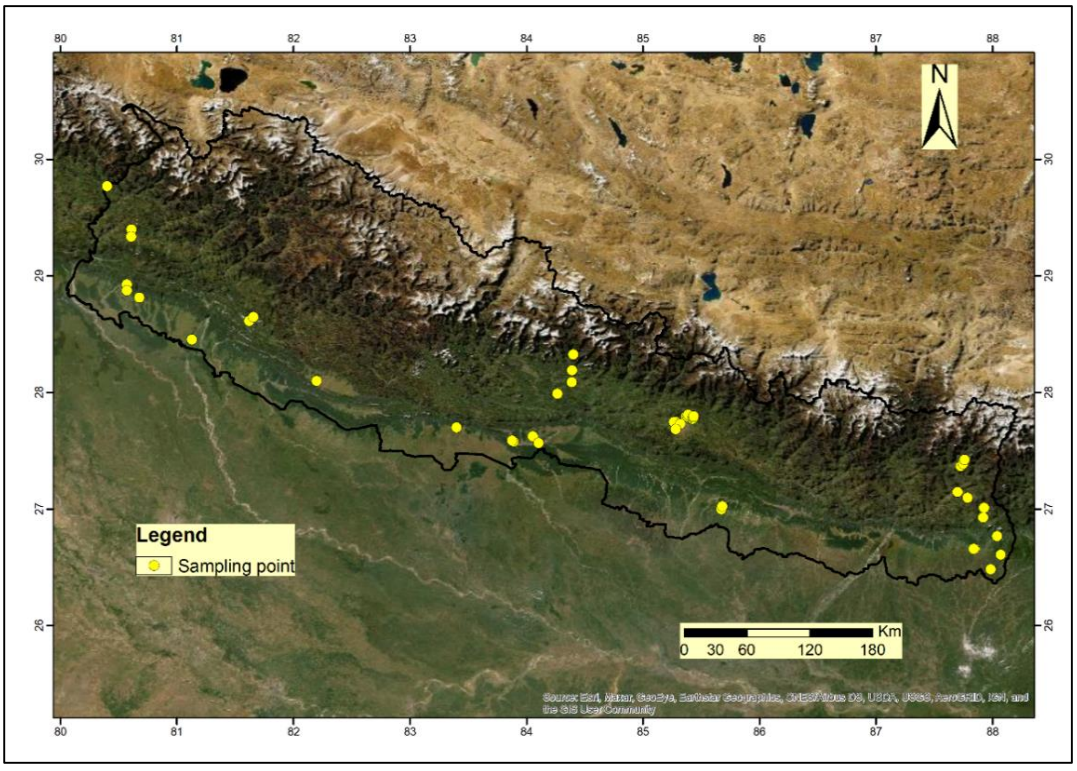

Figure 1: Ant collection sites in different physiographic zones of Nepal

The main study site, SNNP contains two forest islands, Shivapuri and Nagarjun. Shivapuri Forest is located between 27.7500°N and 27.8667°N latitude and 85.2667°E to 85.7500°E longitude, whereas Nagarjun Forest is between 27.7167°N and 27.7667°N latitude and 85.2167°E to 85.3000°E longitude. It claims territory in Kathmandu, Nuwakot, Dhading, and Sindhupalchowk districts covering an area of 159 square km. The Park is bordered by densely populated suburbs. The elevation ranges

from 1350 to 2732 meters above sea level (m asl) within a short distance. Shivapuri-Nagarjun National Park symbolizes Nepal's subtropical and temperate zones. This is Nepal's single protected area that is wholly inside the central Himalayan mid-mountain range (SNNP, 2017). This biodiversity hotspot harbors four forest types: lower mixed hardwood Forest, Chirpine Forest, Upper mixed hardwood Forest, and Oak Forest (SNNP, 2017). The major tree species in the park includes *Schima wallichii, Castanopsis indica, Alnus nepalensis, Pinus roxburghii, Quercus semicarpifolia, Q. lanuginosa,* and *Rhododendron arboreum* (Figure 2).

Figure 2: Sampling sites at Shivapuri-Nagarjun National Park (A, C, D) and Ranibari Community Forest (B)

Ranibari Community Forest is the only community forest in the middle of Kathmandu city, and it represents a natural forest patch in the center of urban area. *Zizyphus incurva*, *Stranvaesia nussia*, *Persea duthiei*, *Engelhardtia spicata*, *Celtis australis*, and *S. wallichii* are the dominant tree species in RCF (Maharjan *et al.*, 2006). The Tribhuvan University Campus Forest area, which is 5 km southwest of Kathmandu, consists of scattered planted forests with significant human disturbance. The forest area of TUC mainly contains *Salix babylonica*, *P. roxburghii, Celtis australis, Grevillea robusta, Cinnamomum camphora, A. nepalensis,* and *Eucalyptus camaldulensis*. The study sites also comprise of selected forests such as Sal (*Shorea robusta*), *Schima-Castanopsis*, broadleaf mixed, Deodar, Uttis (*Alnus*), Riverine, and *Cryptomeria* forests of western, central and eastern regions of Nepal (Figure 2).

2.2.2 Ant sampling

This study is based on specimens obtained from several sample locations in Nepal, mostly from 2018 to 2022. The most extensive sampling was carried out at SNNP using multiple sampling techniques such as pitfall traps, baiting, hand collection, beating low vegetation, and hand sorting of sifted leaf litter and soil cores. The sampling follows a standard protocol for the collection of ground-dwelling ants, the Ants of Leaf Litter (ALL) Protocol, in terms of spatial design and sampling techniques (Agosti & Alonso, 2000). Because there is no one ideal approach for ant sampling, ALL protocol recommends using at least two methods at the same time. It also advises that baiting, pitfall traps, Winkler bags or Burlese funnels, and direct sampling are excellent set of methods for biodiversity monitoring. Surveys were done in the spring and summer months. The sampling transects, each 200 m long, were established within the forest by following foot trails in the Nagarjun, Shivapuri, and Sundarijal sectors of SNNP. However, two parallel transects of 100 m each were laid in some sites depending on the accessibility and availability of space at a specific sample site. Four sites were sampled along the altitudinal gradient in each section of SNNP (Appendix I). Each transect comprises 20 sampling plots, each measuring 10 m × 10 m, and is maintained within a minimal elevational range. Each plot had a bait trap and a pitfall trap set up in addition to hand-collecting for five minutes by two people in the same plot (Figure 3). The similar techniques were used in the Ranibari Community Forest and Tribhuvan University Campus Forest area for collecting samples. Ants were also collected by beating of low vegetation and hand collecting along motorable roads from Nagarjun to Jamacho, foot trails from Panimuhan to Bagdwar, and Sundarijal to Okhreni to increase the inventory of ants.

2.2.2.1 Hand collection: Ants were hand-collected by visual searches on the ground, in rotten logs and stumps, on tree trunks, in dead and live branches, in bamboo, on low vegetation, under moss, and under stones. Further, the soil cores were sifted using a hand sieve pan to collect hypogeic ants that live beneath soil. Hand collection was done along each transect as well as from other areas.

2.2.2.2 Baiting: Cookie baits (5 grams in each bait) were laid on 20 × 20 cm square paper and set out 10 m apart along the transect line (Figure 3, 4C). Twenty baits in each transect were placed and the baits were left out for 45 minutes.

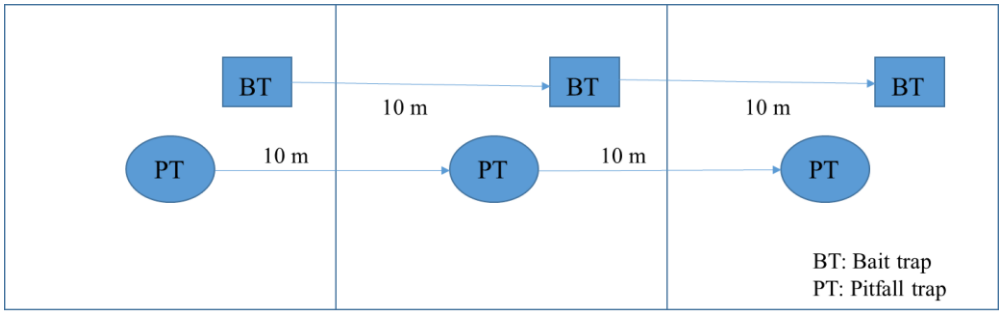

Figure 3: Arrangement of bait and pitfall traps in each sample site at SNNP, RCF and TUC (only a part of transect is shown)

2.2.2.3 Pitfall trapping: Pitfall traps were placed every 10 meters along a 200-meter transect with a random start, and the traps were recovered after 48 hours (Figure 3). Altogether 20 pitfall traps 10 m apart along transect were kept in each site and each sector of SNNP had four such transects. Thus, there were 80 pitfall traps kept in each sector of SNNP. Each trap was constructed by burying a plastic cup (8 cm diameter by 10 cm deep) with its lip level with the ground and filling one-third with soapy water to intercept ants traveling over the cups (Figure 4A).

Figure 4: Field collection A. Pitfall trap B. Beating lower vegetation C. Baiting D. Sifting litter with hand sieve pan

Ant specimens that were collected from entomological survey of a forest health project conducted by the Forest Research and Training Center (FRTC), Ministry of Forests and Environment, Government of Nepal with technical assistance of Kerala Forest Research Institute, India (KFRI) supported by Food and Agriculture Organization (FAO) Nepal in 2020 were also included in the study. These data were collected by sweeping, beating in the low vegetation, and hand collection methods along South to North belt transects in altitudinal gradients from the eastern, central, and western regions. The sites of the collection covered 14 districts in Tarai, Siwalik, and Hills, encompassing selected forests in eastern, central and western regions (Appendix II). In each forest, 100-meter-long parallel transects were set at least 250 meters apart, with each sampling plot measuring 10 × 10 m. Six plots were established in major forest types such as Sal, *Schima-Castanopsis*, and broadleaf mixed forests, and three plots each in small forests such as, Deodar, *Alnus*, Riverine, and *Cryptomeria* forests.

Ant specimens that were opportunistically collected from various locations across the country since 2006, primarily by the author, were among the other specimens examined. However, the specimens/data obtained from opportunistic collections were not used in statistical analysis but were only included in taxonomic investigations.

2.2.3 Sample sorting and preservation

All ant specimens and other invertebrates were separated from debris. After separation, the samples were washed with ethanol. The specimens were sorted according to morphospecies. The ants obtained in the field were preserved in 75% ethanol for screening and sorting before being point mounted or moved to 95% ethanol within a year for long-term preservation to ensure that the specimens were viable for molecular research when needed (Sk. Yamane pers. comm.). The ant specimens were dry preserved on point mounts selecting at least one individual of each morphospecies from each collection site.

2.2.4 Morphological examinations, morphometry and species-level identification

The morphological examinations of specimens were done with stereo zoom microscopes (Coslab MSZ-115, Zeiss Stemi 508, and Bestscope BS-3020B). Morphological terms by Bolton (1994) were followed to explain morphological features of ants. Furthermore, the terms proposed by Harris (1979) were followed to describe surface sculpturing. Images were captured under stereomicroscope by a Samsung SM-M625F digital camera. Fiji, an image processing software based on

ImageJ2, was used to create scale bar in ant images (Schindelin *et al.*, 2012). All morphometric measurements were taken on point-mounted dry specimens with a pin-holding microscope stage, allowing complete rotations around the X, Y, and Z axes. The specimens were morphometrically measured using an ocular micrometer placed in a stereo zoom microscope at a magnification up to ×45 for each character. The subfamilies and genera were identified using available keys including Bolton (1994), Schmidt and Shattuck (2014), and Borowiec (2016). Species-level identification was done using identification keys available for different genera such as, *Aenictus* (Jaitrong & Yamane, 2011), *Cardiocondyla* (Seifert, 2003), *Cerapachys*, *Parasyscia* (Bharti & Akbar, 2013a), *Dolichoderus* (Barabag & Jaitrong, 2022), *Hypoponera* (Bharti *et al.*, 2015), *Lasius* (Bharti & Gul, 2013), *Lepisiota* (Wachkoo *et al.*, 2021), *Leptogenys* (Bharti & Wachkoo, 2013; Arimoto & Yamane, 2018; Xu & He, 2015), *Meranoplus* (Schödl, 1998), *Monomorium* (Heterick, 2001), *Myrmica* (Radchenko & Elmes, 2010), *Nylanderia* (Wachkoo & Bharti, 2015), *Odontoponera* (Yamane, 2009), *Ooceraea* (Bharti *et al.*, 2021), *Polyrhachis* (Karmaly, 2004; Kohout, 2006; Wong & Guénard, 2021), *Prenolepis* (Williams & Lapolla, 2018), *Stictoponera* (Chen *et al.*, 2017), *Strumigenys* (Bharti & Akbar, 2013b), *Temnothorax* (Yusupov *et al.*, 2020a), *Tetramorium* (Bolton, 1977; Bharti & Kumar, 2012), and *Tetraponera* (Ward, 2001). Additional identification methods included species description/redescription, comparing specimens with voucher specimens or high-resolution images provided by AntWeb (https://antweb.org) and AntWiki (https://antwiki.org), if available for the concerned species, and expert suggestions or by the combination of two or more procedures. Unidentified species were given a code number (for example, *Leptogenys* sp. NP-IPS-01). The expression "sp. cf." is used for forms that are similar to a named taxon but whose specific distinctness is unknown. As a result, "*Ectomomyrmex* cf. *astutus*" refers to a species that is either related to or con-specific with "*Ectomomyrmex astutus*".

2.2.5 Arrangement and data sources

The subfamilies, and genera within each subfamily are listed alphabetically. The type species, type locality and synoptic accounts on diagnosis, distribution and ecology are provided for each genus. Head in full-face and habitus in profile view images are provided to illustrate each genus physically examined during the study. The available name of the taxa, authority and synonyms were updated from Bolton (2022). Global

species/subspecies data of ants were adopted from Bolton (2022) and the total species count for Nepal was obtained by counting the species described, species identified from collections based on this study, and the named species documented in available literature. The synoptic overview of each genus was prepared by examining materials obtained during the study and evaluating relevant literature.

2.2.6 Specimen deposition

Specimens were deposited at the Central Department Zoology Museum of Tribhuvan University (CDZMTU) and some of the specimens were deposited at the Natural History Museum, Tribhuvan University (NHMTU) and at the Entomology Lab, Forest Research Training Centre (FRTC), Ministry of Forests and Environment.

2.2.7 Measurements and indices

The measurements are in millimeters (mm) and are given to the nearest two decimal places. The following definitions and abbreviations apply to measurements and indices (Table 1):

Table 1: Morphological measurements and indices

Abbreviation	Measurements and indices	Definitions
HL	Head length	The straight-line length of the head from the anterior clypeal margin to the mid-point of the occipital margin in full-face view (excluding mandibles).
HW	Head width	The maximum width of the head in full-face view (excluding eyes).
SL	Scape length	The maximum straight-line length of the first antennal segment from its apex to the articulation with the condylar bulb.
OL	Ocular length	The maximum length of the eye.
WL	Masosoma or Weber's length	The diagonal length of the mesosoma in profile view, from posteroventral corner of propodeum to the farthest point on anterior face of pronotum (excluding neck).
MH	Mesosoma height	The height of the mesosoma from the lowermost point of mesosoma to the imaginary line connecting the uppermost points of promesonotum and propodeum in profile view.
ML	Mandible length	The straight-line length of mandible at full closure in full-face view, from the mandibular apex to the anterior clypeal mergin.
PrW	Pronotal width	The maximum width of the pronotum in dorsal view.
PeH	Petiole height	The maximum height of the petiole in profile, measured at right angle to petiole length.
PeL	Petiole length	The maximum length of the petiole in dorsal view, from the anterior to posterior margin.
PeW	Petiole width	The maximum width of the petiole in dorsal view.
PPL	Postpetiole length	The maximum length of the postpetiole between anterior and posterior margins in dorsal view.

PPW	Postpetiole width	The maximum width of the postpetiole in dorsal view.
PPH	Postpetiole height	The maximum height of the postpetiole in profile view.
PDH	Propodeal height	The maximum height of the propodeum in profile view.
ESL	Propodeal spine length	The length of the propodeal spine from its tip to the center of the propodeal spiracle in profile view.
FL	Profemur length	The length of the profemur along longitudinal axis in posterior view
LHT	Metatibia length	The length of hind tibia (excluding the proximomedial part of the articulation)
CI	Cephalic index	HW/HL
MI	Mandible index	ML/HL
SI1	Scape index I	SL/HL
SI2	Scape index 2	SL/HW
OI1	Ocular index I	OL/HL
OI2	Ocular index 2	OL/HW
PI	Petiolar index	PeL/PeH
PPI	Postpetiolar index	PPL/PPH
ESLI	Propodeal spine length index	ESL/HW
AI	Mesosomal index	AL/AH

The measurements are shown below in habitus in profile and head in full-face views of a *Temnothorax* species (Figure 5).

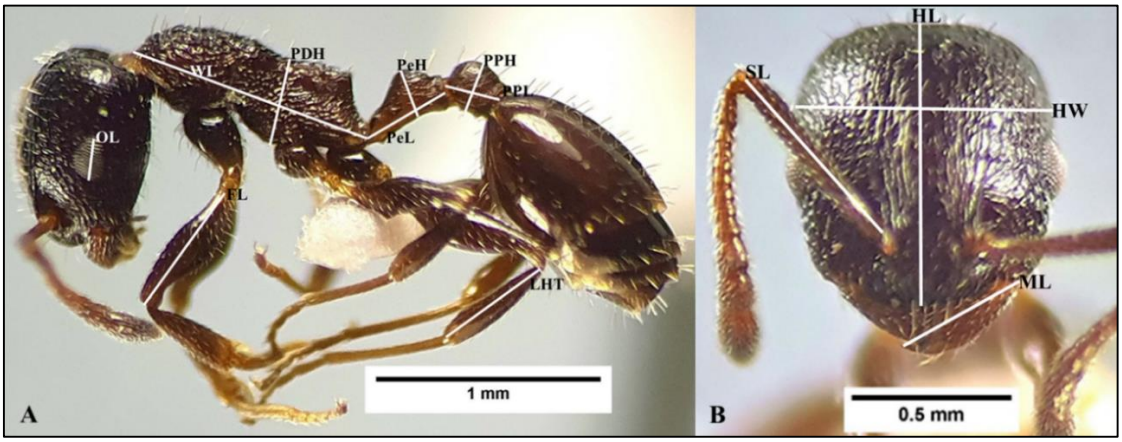

Figure 5: Illustration of some measurements in a *Temnothorax* species A. Habitus in profile view B. Head in full-face view

2.3 Results

Nine subfamilies and 64 genera of ants have so far been known from Nepal. The subfamilies known from Nepal includes Amblyoponinae, Dolichoderinae, Dorylinae, Ectatomminae, Formicinae, Leptanillinae, Myrmicinae, Ponerinae, and Pseudomyrmecinae. During the course of this research, 14 genera were identified as new genus records for Nepal, of which 11 genera have previously been documented in

articles based on this research (Subedi *et al.*, 2020, 2021a, c). The keys to subfamilies and genera of ants of Nepal based upon worker caste were prepared and presented below. Moreover, synoptic overview of known Nepalese ant genera including type species, type locality, distribution, diagnosis and ecology are also provided.

2.3.1 Keys to subfamilies of ants of Nepal

Dichotomous keys to the subfamilies of ants of Nepal are presented below (Table 2). The keys include nine ant subfamilies reported from Nepal.

Table 2: Keys to subfamilies of ants of Nepal

Couplet	Lead	Subfamily
1	Pygidium flattened or impressed, and armed with numerous peg-like spines or a single pair of spines posterolaterally.	Dorylinae (Part)
-	Pygidium rounded or convex, and unarmed (very rarely armed with spines) posterolaterally.	2
2	Single-segmented waist (petiole) between mesosoma and gaster.	3
-	Two-segmented waist (petiole and postpetiole) between mesosoma and gaster.	7
3	Sting absent.	4
-	Sting present (usually prominent and functional).	5
4	Acidopore present, tip of the gaster with a circular or semi-circular opening usually fringed with short hairs. Acidopore when concealed by pygideal projection, antennal sockets lie behind posterior clypeal margin.	Formicinae
-	Acidopore absent, tip of the gaster with a transverse slit-like orifice, never fringed with short hairs. Antennal sockets always bordering the posterior clypeal margin.	Dolichoderinae
5	Petiole attached broadly to the first gastral segment. Petiole without a free posterior face in profile view.	Amblyoponinae
-	Petiole attached narrowly to the first gastral segment. Petiole with a free posterior face in profile view.	6
6	Elongate and roughly parallel frontal lobes mostly covering antennal sockets. Frontal carina not converging posteriorly. Mandibles triangular.	Ectatomminae
-	Rounded or bluntly triangular frontal lobes. Frontal carina, when present, converging posteriorly. Mandible variable in shape from linear to triangular.	Ponerinae
7	Promesonotal suture conspicuous, freely flexible.	8
-	Promesonotal suture vestigial or absent.	9
8	Eyes present and well-developed.	Pseudomyrmecinae
-	Eyes absent.	Leptanillinae
9	Eyes always absent. In full-face view, antennal sockets completely exposed, not covered by frontal lobes. Clypeus narrow. Antennal sockets very close to anterior head margin.	Dorylinae (part)
-	Eyes usually present. In full-face view, antennal sockets partially or completely covered by frontal lobes. Clypeus developed. Antennal sockets usually far from anterior head margin.	Myrmicinae

2.3.2 Keys to Dolichoderinae ant genera of Nepal based on worker caste

Dichotomous keys to genera of the subfamily Dolichoderinae are given below (Table 3). Some of the couplets in this key are modified after General and Alpert (2012).

Table 3: Keys to Dolichoderinae ant genera of Nepal based on worker caste

Couplet	Lead	Genus
1	Anterior part of the gaster overhangs petiole in profile view. Petiolar node absent.	2
-	Gaster does not overhang petiole in profile view. Petiolar node prominent.	3
2	In profile-view, gaster with 4 tergites on the upper surface, with the fifth segment reflexed. Anal pore ventral. Pronotum usually without erect hairs.	*Tapinoma*
-	In profile-view, gaster with five tergites on the upper surface. Anal pore terminal. Pronotum usually with 2–10 erect hairs.	*Technomyrmex*
3	Palps short and hardly visible. In profile-view, propodeal dorsum much shorter than its declivity, mesosoma compact in appearance.	*Chronoxenus*
-	Palps long and prominent. In profile-view, propodeal dorsum and its declivity almost equal in length, mesosoma elongated in appearance.	4
4	Mesosomal integument with thick and distinct sculpture.	*Dolichoderus*
-	Mesosoma with thin and usually smooth or shagreened integument.	5
5	Anteromedial clypeal margin with broad, shallow concavity. Compound eyes placed relatively anterior on the head. Propodeal declivity concave.	*Ochetellus*
-	Anteromedial clypeal margin with pointed or rounded central projection. Compound eyes placed relatively high on the head. Propodeal declivity convex.	*Iridomyrmex*

2.3.3 Keys to Dorylinae ant genera of Nepal based on worker caste

Dichotomous keys to ant genera of the subfamily Dorylinae are modified after Borowiec (2016) and presented below (Table 4). The keys include the genus *Syscia*, recorded in adjacent countries but not from Nepal for comparison.

Table 4: Keys to Dorylinae ant genera of Nepal based on worker caste

Couplet	Lead	Genus
1	Pygidium without many setae, at the maximum having 1–2 pairs of thick setae or cuticular projections. Propodeal lobes short or absent.	2
-	Pygidium having numerous, specific, peg-like/spiniform setae thicker than adjacent hairs; setae above four, or numerous. Propodeal lobes conspicuous, whenever pygidium is small or having little specific setae.	3
2	Antennae 8–10 segmented. Waist with petiole and postpetiole. Pygidium small, in the form of narrow strip, not impressed medially, simple, having no cuticular spines/modified setae.	*Aenictus*
-	Antennae with 8–12 segments. Waist with petiole only. Pygidium big, impressed at apex, having 1–2 cuticular teeth/spines laterally.	*Dorylus*
3	Pronoto-mesopleural suture fully/partly fused in profile, with no bending incision in cuticle near promesonotal dorsolateral border.	*Parasyscia*

-	Pronoto-mesopleural suture a deep incision in profile, characteristically bent beneath mesosomal dorsolateral border.	4
4	Helcium perimeter large compared to petiole, situated above mid-height of petiole. Petiolar rare face and postpetiolar anterior face low, and undifferentiated.	*Cerapachys*
-	Helcium perimeter moderate compared to petiole, situated around midpoint petiole. Petiolar rare face and postpetiolar anterior face distinct.	5
5	Postpetiole narrow dorsally, equal to petiole. First gastral tergite not folding above sternite in profile, sternite visible anteriorly.	*Ooceraea*
-	Postpetiole relatively broad dorsally, larger than petiole. First gastral tergite folding above sternite in profile, sternite at least partly masked anteriorly.	*Syscia*

2.3.4 Keys to Formicinae ant genera of Nepal based on worker caste

Dichotomous keys to ant genera of the subfamily Formicinae are presented below (Table 5). Some of the couplets in this key are modified after Bolton (1994).

Table 5: Keys to Formicinae ant genera of Nepal based on worker caste

Couplet	Lead	Genus
1	Antenna 9–11 segmented.	2
-	Antenna 12 segmented.	4
2	Propodeum armed with spines, teeth, or tubercles. Petiolar node with a pair of teeth or spines or only emarginate.	*Lepisiota*
-	Propodeum and petiole unarmed, lacking spines, teeth or tubercles.	3
3	Eyes very small, with few facets (usually less than 10). Palps very short, not extended along the ventral side of the head. Palp formula 5, 3, or less.	*Acropyga*
-	Eyes large, with 11–100 ommatidia. Palps long and developed. Palp formula 6, 4.	*Plagiolepis*
4	Antennal sockets placed close to the posterior clypeal margin. Metapleural gland orifice distinct and present in the metapleuran above the hind coxa and below the level of propodeal spiracle.	5
-	Antennal sockets placed far behind posterior clypeal margin or metapleural gland orifice not in the position mentioned above or both.	12
5	Maxillary palp short and indistinct having 2–4 segments.	*Pseudolasius*
-	Maxillary palp long and prominent having 6 segments.	6
6	Propodeal spiracle oval, elliptical or an elongate slit. First sternite of gaster with a transverse sulcus just behind helcium.	7
-	Propodeal spiracle circular or subcircular. First sternite of gaster without a transverse sulcus just behind helcium.	8
7	Mandible with 8 or more teeth. The third tooth from the apex always smaller and shorter than the fourth.	*Formica*
-	Mandible with 5–7 teeth. The third tooth larger and longer than the fourth.	*Cataglyphis*
8	Mandibles roughly triangular, with 4–7 teeth. Propodeal spiracle at or near the declivity of the propodeum. Petiole scale in profile usually inclined forwards with a short anterior face and much longer posterior face.	9

-	Mandible at least with 7 teeth, usually having more than 7. Propodeal spiracle situated close to the posterior propodeal margin. Petiole tall and narrow with more or less equal anterior and posterior face.	*Lasius*
9	Mesosoma long and thin, with or without the constriction of mesonotum in profile.	10
-	Mesosoma short and compact, without the constriction of mesonotum in profile.	11
10	Pronotum just slightly convex in profile. Erect setae on the head irregularly scattered.	*Paratrechina*
-	Pronotum distinctly convex in profile. Erect setae on the head form 2 parallel rows.	*Prenolepis*
11	Propodeum having a pair of erect setae.	*Paraparatrechina*
-	Propodeum missing a pair of erect setae.	*Nylanderia*
12	Mandible with 10 or more teeth or denticles. Petiole reduced to an elongate, low node allowing the gaster to be reflexed over the alitrunk.	*Oecophylla*
-	Mandible with less than 10 teeth or denticles. Petiole erect node or scale, gaster incapable of reflexing over the alitrunk.	13
13	Petiolar node and usually the mesosoma armed with spines, teeth, or denticles.	*Polyrhachis*
-	Petiolar node and mesososma lacking spines, or teeth.	14
14	Small species. Antennal insertions at about midlength of frontal carinae and relatively well separated. Clypeus with no conspicuous anterolateral extensions. Mesosoma not evenly convex in profile with propodeum depressed and metanotal groove strongly impressed.	*Colobopsis*
-	Small to medium-sized species. Antennal insertions usually in front of the midlength of the frontal carinae and less well separated. Clypeus typically with conspicuous anterolateral extensions. Mesosoma in profile evenly convex or with propodeum distinctly impressed.	*Camponotus*

2.3.5 Keys to Myrmicinae ant genera of Nepal based on worker caste

Dichotomous keys to Nepalese ant genera of the subfamily Myrmicinae are modified after Bolton (1994), Eguchi *et al.* (2011), and General and Alpert (2012) and presented below (Table 6).

Table 6: Keys to Myrmicinae ant genera of Nepal based on worker caste

Couplet	Lead	Genus
1	Antennal scrobe present below the eye. Petiole sessile having no anterior peduncle.	*Cataulacus*
-	Antennal scrobe either absent or present above the eye or both eyes and scrobes absent. Petiole sessile or with anterior peduncle.	2
3	Postpetiole attached on the dorsal surface of the first gastral segment. Petiole dorsoventrally flattened lacking a node. Gaster roughly heart-shaped in dorsal view and capable of being reflexed over the alitrunk.	*Crematogaster*
-	Postpetiole attached on the anterior surface of the first gastral segment. Petiole not dorsoventrally flattened usually with a node. Gaster not particularly heart-shaped in dorsal view and not capable of being reflexed over the alitrunk.	3

4	Antenna 4–6 segmented. Petiole, postpetiole and first gastral segment having sponge–like tissue.	*Strumigenys*
-	Antenna 7–12 segmented. Petiole, postpetiole and first gastral segment lacking sponge–like tissue.	4
5	Antenna with 2-segmented antennal club.	5
-	Antenna with 3-segmented or sometimes 4– or 5–segmented antennal club or rarely without a club.	7
6	Antenna 12-segmented.	*Cardiocondyla* (part)
-	Antenna 8–11 segmented.	6
7	Antennal scrobe present. Eyes elongate. Monomorphic species.	*Mayriella*
-	Antennal scrobe absent. Eyes small or round. Dimorphic or polymorphic species.	*Carebara*
8	Antenna 7-segmented.	*Myrmicaria*
-	Antenna 9–12 segmented.	8
9	Antenna 9-segmented.	9
-	Antenna 10–12 segmented.	10
10	Antennal scrobes present. Promesonotum sharply marginate laterally. Petiole sessile.	*Meranoplus*
-	Antennal scrobe absent. Promesonotum not sharply marginate. Petiole pedunculate.	*Perissomyrmex*
11	Antenna 10-segmented.	*Tetramorium* (part)
-	Antenna 11–12 segmented.	11
12	Antenna 11-segmented.	12
-	Antenna 12-segmented.	18
13	Frontal lobes absent or reduced; antennal articulations exposed. Anterior clypeal margin denticulate or sharply crenulate.	*Pristomyrmex*
-	Frontal lobes present, antennal articulations fully or mostly covered. Anterior clypeal margin usually unarmed.	13
14	Mandible with 7 teeth with apically 3 larger teeth followed by 4 smaller teeth.	*Tetramorium* (part)
-	Mandible usually having less than 7 teeth. Teeth arrangement unlike above if 7 or more teeth present.	14
15	Mandible with 8 or more teeth, or denticles in the masticatory margin. Antennal scrobe completely absent.	*Lophomyrmex*
-	Mandible with 4–6 teeth in the masticatory margin. Antennal scrobe completely absent or shallowly present.	15
16	Maxillary palp 4 or 5-segmented.	16
-	Maxillary palp 1 to 3-segmented.	17
17	Propodeum bispinose with upwardly and forwardly curve spines.	*Recurvidris*
-	Propodeum nearly unarmed to bispinose with posteriorly or posterodorsally directed spines.	*Cardiocondyla* (part)
18	Pronotal dorsum convex, not marginate laterally. Propodeum unarmed.	*Monomorium* (part)
-	Pronotal dorsum sharply marginate laterally. Propodeum armed with spines.	*Lophomyrmex* (part)
19	Palp formula 6, 4. Posterior tibial spur usually pectinate.	*Myrmica*
-	Palp formula less than 6, 4 (up to 5, 3). Posterior tibial spur usually simple or absent, very rarely pectinate.	19

20	Teeth or denticles lacking in the middle part of the masticatory margin of the mandible.	*Pheidole* (part)
-	Teeth or denticles present in the middle part of the masticatory margin of the mandible.	20
21	Antennal scrobe moderately or strongly developed. Frontal carina distinct.	*Lordomyrma*
-	Antennal scrobe and frontal carina absent, if present weak.	21
22	Antennal club 3-segmented.	22
-	Antennal club 4-segmented or indistinct.	27
23	Mesosoma dorsum lacking standing pilosity. Lateral and median portions of clypeus fused and projecting as a shelf over the mandibles.	*Cardiocondyla* (part)
-	Mesosoma dorsum usually with standing pilosity. Median portions of clypeus more or less produced, but not form a shelf over the mandibles.	23
24	Anterior clypeal margin having single median seta. Propodeal spines lacking.	*Monomorium* (part)
-	Anterior clypeal margin lacking a single median seta, but having a pair of long setae or row of setae. Propodeal spines usually developed, rarely reduced to small denticles.	24
25	Mandible with 5–6 teeth in the masticatory margin.	25
-	Mandible with 7 or more teeth or denticles in the masticatory margin.	26
26	Teeth regularly spaced, lacking a long diastema between third and fourth teeth.	*Temnothorax*
-	Teeth arranged in groups, a long diastema between groups of apical 3 teeth and basal group of two teeth.	*Vombisidris*
27	Promesonotum distinctly higher than anterior border of propodeal dorsum.	*Pheidole* (part)
-	Promesonotum not or slightly higher than anterior border of propodeal dorsum.	*Lordomyrma* (part)
28	Median portion of clypeus narrow and longitudinally bicarinate. Frontal lobes relatively close together so that the posteromedian portion of the clypeus, where it is inserted between frontal lobes, narrower than one of the frontal lobes.	*Stenamma*
-	Median portion of clypeus broad and not longitudinally bicarinate. Frontal lobes relatively far apart so that the posteromedian portion of the clypeus, where it is inserted between frontal lobes, broader than one of the frontal lobes.	28
29	Mandibular masticatory margin bearing 1 or 2 small denticles between pre-apical and third large teeth. Palp formula 3, 2 or less.	*Pheidole* (part)
-	Mandibular masticatory margin lacking small denticles between pre–apical and third large teeth. Palp formula 5, 3 or 4, 3.	*Aphaenogaster*

2.3.6 Keys to Ponerinae ant genera of Nepal based on worker caste

Dichotomous keys to ant genera of the subfamily Ponerinae are modified after Eguchi *et al.* (2014), and Schmidt and Shattuck (2014) and presented below (Table 7). Two genera (*Anochetus*, and *Ponera*) not yet documented in Nepal but often found in neighboring countries are also included in the key for comparison.

Table 7: Keys to Ponerinae ant genera of Nepal based on worker caste

Couplet	Lead	Genus
1	Prominent ocular prominences on the head. Long and straight mandibles, in full-face view inserted medially on anterior margin of the head.	2
-	No prominent ocular prominences on the head. Short to long, usually triangular or rarely straight mandibles, in full-face view inserted at anterolateral corners of head.	3
2	Nuchal carina continuous without median branch extending anteriad. A pair of dark lines (apophyseal lines) absent on the posterior face of the head.	*Anochetus*
-	Nuchal carina medially with a V-shaped anterior extension. A pair of dark converging lines present on the posterior face of the head.	*Odontomachus*
3	Abundant stout traction setae present on dorsal surface of mesotibiae amongst background pilosity.	*Centromyrmex*
-	Traction setae absent on dorsal surface of mesotibiae (sometimes a few stout setae present on dorsal surface of mesotibia near tarsus but never extending along length of tibia).	4
4	A large pectinate spur present on metatibial apex ventrally, but no smaller, simple spur.	5
-	Both large pectinate and smaller, simple spur present on the metatibial apex ventrally.	7
5	Elongate-triangular mandibles, with 5 long attenuated teeth. Apical teeth extremely elongated and sickle-shaped.	*Emeryopone*
-	Triangular to elongate-traingular mandibles, with no long and attenuated teeth. Apical tooth not sickle-shaped.	6
6	Anterior conspicuous round depression and paired postero-ventral teeth present on subpetiolar process.	*Ponera*
-	Anterior conspicuous round depression and paired posteroventral teeth absent on subpetiolar process.	*Hypoponera*
7	Pectinate tarsal claws or the claws armed with one or two preapical teeth.	8
-	Tarsal claws unarmed.	9
8	Ocelli present. Eyes extremely large, placed at the anterior end of head. Long, forceps-like mandible with rows of many teeth and a large triangular flange.	*Harpegnathos*
-	Ocelli absent. Eye size variable however not extremely large, placed at/near midline of head. Triangular or thin and curved mandibles without triangular flange.	*Leptogenys*
9	Slit-like propodeal spiracle.	10
-	Round or ovoid propodeal spiracle.	13
10	Petiolar node with a pair of spines on posterodorsal margin.	*Diacamma*
-	Petiolar node simple, without spines.	11
11	Petiolar posterodorsal margin usually having a row of small teeth or denticles.	*Pseudoneoponera*
-	Petiolar posterodorsal margin lacking a row of small teeth or denticles.	12
12	Mesopleuron without a transverse groove. Metanotal groove absent.	*Bothroponera*
-	Mesopleuron with a transverse groove. Metanotal groove present.	*Ectomomyrmex*

13	Mandibles subtriangular with 6–7 distinct teeth. Eyes extremely small. Clypeus with a blunt anteromedian rectangular projection.	*Buniapone*
-	Mandibles triangular. Eyes small or large. Clypeus without a blunt anteromedial rectangular projection.	14
14	Head and body strongly striate. Petiolar dorsal edge emarginate-denticulate. Anterior margin of clypeus having a series of minute teeth.	*Odontoponera*
-	Head and body weakly striate (light striations may occur on mesosoma). Petiole squamiform. Anterior clypeal margin without teeth, mandible with a basal pit or groove.	*Brachyponera*

2.3.7 Generic synopsis of ant genera of Nepal

2.3.7.1 Subfamily: Amblyoponinae Forel, 1893

The subfamily Amblyoponinae, often known as "Dracula ants", is a primitive ant group with distinctive morphology and behavior. The subfamily has nine extant genera and 143 species, distributed all over the world, with the majority occurring in tropical forested areas (Bolton, 2022). The subfamily is represented by only one species, *Stigmatomma pertinax* in Nepal.

Genus: *Stigmatomma* Roger, 1859

Type species: *Stigmatomma denticulatum* Roger, 1859. Type locality: Zakynthos Island, Griechenland, Greece (Roger, 1859).

Stigmatomma is the most speciose genus in the subfamily Amblyoponinae, with 53 extant species found worldwide (Bolton, 2022). Yoshimura and Fisher (2012) revived the generic status of *Stigmatomma* from its synonymy under *Amblyopone* Erichson, 1842. The genus can be diagnosed by slender elongated jaws with sharp triangular teeth, clypeal margin with row of tiny teeth, eyes moderate to small or vestigial, 11–12 segmented filliform antennae, cubical petiole broadly connected to the gaster, gaster narrow, not broader than mesosoma (Bharti & Rilta, 2015). These ants are hypogeic, nesting and foraging underground in the soil or undercover in leaf litter and rotting logs (Brown, 1960). Workers are mostly solitary hunters and specialized predators of chilopods like geophilomorph centipedes (Brown, 1960; Gotwald & Lévieux, 1972; Masuko, 1993). They occasionally feed upon other arthropods (Gotwald & Lévieux, 1972), and the queens sometimes engage in non-destructive cannibalism by feeding on the hemolymph of their own larvae, earning them the nickname "Dracula ants" (Saux *et al.*, 2004).

2.3.7.2 Subfamily: Dolichoderinae Forel, 1878

Dolichoderinae is the fourth biggest ant subfamily and is distributed worldwide. This study expands Nepal's ant records to six Dolichoderine ant genera represented by nine species, an increase from the prior records of four genera and six species. Two genera and three species were recorded as new to Nepal. An overview of the species diversity of Nepalese Dolichoderine ants in comparison to its global richness is provided below (Table 8).

Table 8: Number of Dolichoderinae ant taxa reported from Nepal compared to its global diversity

SN	Genera	Global diversity* (species/subspecies)	Nepal diversity* (species)	New records for Nepal
1	*Chronoxenus*	6/3	2	1
2	*Dolichoderus*	131/19	2	–
3	*Iridomyrmex*	79/1	1	–
4	*Ochetellus*	7/3	1	1
5	*Tapinoma*	70/22	1	1
6	*Technomyrmex*	94	2	–
	Total	**435**	**9**	**3**

Source: *Global species/subspecies count adopted from Bolton (2022) and species count for Nepal based upon species documented in Subedi *et al.* (2020) and additional species recorded during this study.

Genus: *Chronoxenus* Santschi, 1919 (Figs. 6 A, B)

Type species: *Bothriomyrmex myops* Forel, 1895 (obsolete combination of *Chronoxenus myops*). Type locality: Kolaba, South Konkan, India (Forel, 1895).

Chronoxenus is a widespread genus distributed in the Old World and Australia (Shattuck, 1992a). The diagnostic characters of the genus include palp formula 4, 3 or 2, 2; small compound eyes with 10–40 ommatidia; mandible having 5–6 teeth and 0–5 denticles with distinct basal angle; anterior clypeal margin with almost equal-sized downwardly curved hairs (see Shattuck, 1992a for full description). *Chronoxenus* workers superficially resemble with smaller species of *Tapinoma* and *Technomyrmex* but differ in having a petiole with an erect scale; smaller compound eyes, a distinct basal mandibular angle, and short indistinct palps (Shattuck, 1992a; General & Alpert, 2012). They occur in a variety of habitats, such as grasslands, savannas, and lowland rainforests, and often building nests in soil or rotting logs (Shattuck, 1992a).

Genus: *Dolichoderus* Lund, 1831 (Figs. 6 C, D)

Type species: *Formica attelaboides* Fabricius, 1775 (obsolete combination of *Dolichoderus attelaboides*). Type locality: Brafilia, Brazil (Fabricius, 1775).

Dolichoderus is distributed worldwide except in Saharan and Sub-Saharan Africa and Malagasy regions (Shattuck & Marsden, 2013). These ants can be diagnosed by anterior hypostoma producing anteroventral prolonged projection, the presence of mesopleural process, occassionally as a blunt protuberance, a mesosomal dorsum with spines in certain cases, a robust integumental sculpture, and an anteriorly extended mesosternum (see Shattuck, 1992a for full description). These are generally diurnal ants and are scavengers and also feed on honeydews for which they tend hemipterans. They build their nests in soil under stones or in rotting logs or some build simple cartoon nests, and forage in columns on the ground or on low vegetation (Shattuck & Marsden, 2013).

Genus: *Iridomyrmex* Mayr, 1862 (Figs. 6 E, F)

Type species: *Formica detecta* Smith, 1858 (obsolete combination of *Iridomyrmex detecta*). Type locality: Hunter River, New South Wales, Australia (Smith, 1858).

Iridomyrmex is one of the largest Dolichoderine ant genera distributed predominantly in Australia, with just a few species also found in Asia and Oceania (Heterick & Shattuck, 2011; Bolton, 2022). The workers of the genus can be diagnosed by relatively posterior position of the eyes on the head, 12-segmented antenna with short scape, clypeus with lateral convex areas and anterior central pointed or rounded projection, and small petiole (see Shattuck, 1992a for full description). These ants are very abundant, active, and aggressive in dry environments influencing the distribution and activity of other ants (Lobry de Bruyn, 1999). Their nests are located in soil, under rocks, barks, logs, above ground mounds, cryptic holes, and twigs, with the nest sizes ranging from a few hundreds to 300,000 workers (Shattuck, 2000; Heterick & Shattuck, 2011).

Genus: *Ochetellus* Shattuck, 1992 (Figs. 6 G, H)

Type species: *Hypoclinea glabra* Mayr, 1862 (obsolete combination of *Ochetellus glaber*). Type locality: Sydney, New South Wales, Australia (Mayr, 1862).

Ochetellus is found from Japan, Myanmar and the Philippines to Australia and Fiji, and also known from the Indian subcontinent and as far north as the Korean Peninsula (Shattuck, 1992a, AntWeb, 2022). The *Ochetellus* workers can be diagnosed by the presence of anterior margin of the clypeus with broad, shallow concavity in the middle, a metanotal groove (a conspicuous notch in the rather flat dorsal mesosomal surface), propodeal declivity concave, and petiolar scale upright and not inclined anteriorly (see

Shattuck 1992b for full diagnosis). They appear to be similar with small-sized *Dolichoderus* in mesosoma profile, but may be differentiated by their smaller size and distinctive petiole (Shattuck, 1992a). They inhabit in forested habitats, nesting under stones, rotting wood and in the soil. They are arboreal or epigeic foragers (Shattuck, 1992a). They also forage upon fluids and sweets in homes. A widespread tramp species *Ochetellus glaber* was recorded for the first time from Nepal during this study.

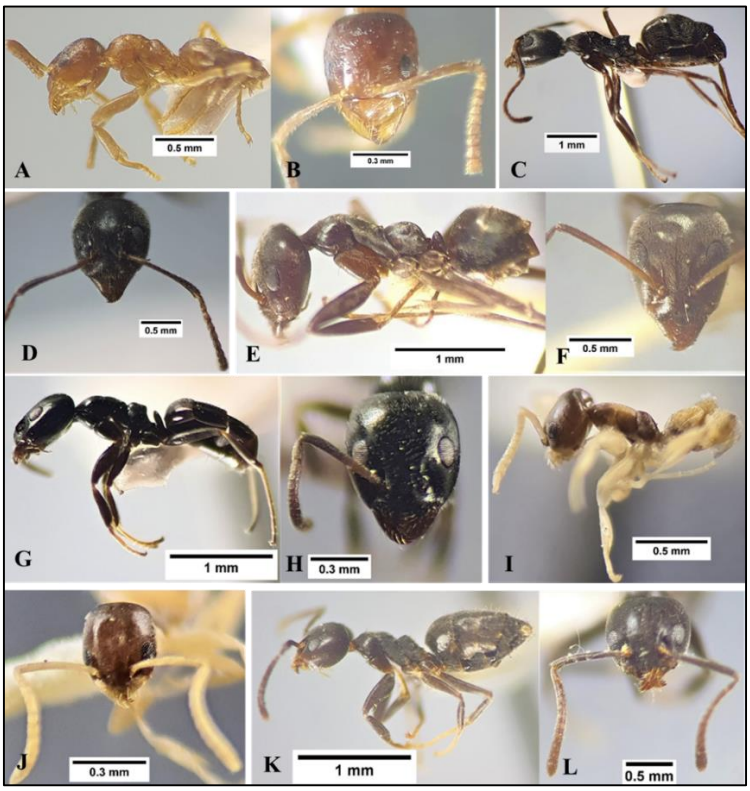

Figure 6: Profile and full-face images of Dolichoderine ant genera of Nepal. **A, B** *Chronoxenus wroughtonii* **C, D** *Dolichoderus affinis* **E**, **F** *Iridomyrmex anceps* **G, H** *Ochetellus glaber* **I, J** *Tapinoma melanocephalum* **K, L** *Technomyrmex elatior*

Genus: *Tapinoma* Foerster, 1850 (Figs. 6 I, J)

Type species: *Tapinoma collina* Foerster, 1850, junior synonym of *Tapinoma erraticum* (Latreille, 1798). Type locality: Germany.

Tapinoma is found all over the world, mostly in the tropics (Bolton, 2022). The genus can be diagnosed by the presence of 3–7 toothed mandible, mandible with an indistinct basal angle, pronotum missing erect hairs, and a propodeum shorter dorsally than its declivity, a petiolar node absent or diminished, and four visible gastral tergites (see Shattuck, 1992a for full description). These ants are mainly arboreal, generalized foragers, while some of them are associated with myrmecophyte plants, while some others are ground or leaf litter nesters especially in tropical and subtropical regions.

They build their nests in open soil, beneath rocks and barks, plant stems, houses, and rotting woods, forming a moderate to large-sized nests with up to hundreds of dealate queens (Shattuck, 1992a). *Tapinoma melanocephalum* is a widespread tramp or eventually a pest pest species.

Genus: *Technomyrmex* Mayr, 1872 (Figs. 6 K, L)

Type species: *Technomyrmex strenua* Mayr, 1872. Type locality: Sarawak, Borneo, Malaysia (Bolton, 2007).

Technomyrmex is a widespread genus found mostly in the Afrotropical, Oriental and Malesian tropics and subtropics (Bolton, 2007, 2022). *Technomyrmex* workers are distinguished by 12–14 toothed mandible, a 12-segmented antenna with no club, an unarmed propodeum, a diminished petiole dorsally obscured by a gastral tergite, and five visible gastral tergites (see Bolton, 2007 for full description). These ants primarily consume honeydew released by hemipterans, but other species are generalist foragers (Bolton, 2007). These are mostly arboreal or subarboreal ants that build nests in soil, twigs, or branches, or constructing cartoon nests under leaves or on tree trunks (Shattuck, 1992a).

2.3.7.3 Subfamily: Dorylinae Leach, 1815

The subfamily Dorylinae is particularly interesting since the majority of the species are nomadic and predatory, conducting massive raids on other ants, wasps, and termites. The subfamily is distributed across the world's tropics and subtropics. This study expands Nepal's ant records to five Doryline ant genera represented by 11 species, an increase from the previous records of three genera and four species. Two genera and six nominal species were recorded as new to Nepal, and a new species is described. An overview of the species diversity of Doryline ants of Nepal in comparison to its global richness is given below (Table 9).

Table 9: Number of Dorylinae ant taxa reported from Nepal compared to its global diversity

SN	Ant genera	Global diversity* (species/subspecies)	Nepal diversity* (species)	New to Nepal
1	*Aenictus*	199/25	6	5 (1 new species)
2	*Cerapachys*	5	1	1
3	*Dorylus*	60/67	2	–
4	*Ooceraea*	17	1	–
5	*Parasyscia*	52	1	1
	Total	**333/92**	**11**	**7**

Source: *Global species/subspecies count adopted from Bolton (2022) and species count for Nepal based upon species documented in Subedi *et al.* (2020) and additional species recorded during this study.

Genus: *Aenictus* Shuckard, 1840 (Figs. 7 A, B)

Type species: *Aenictus ambiguus* Shuckard, 1840. Type locality: Pune, Mumbai [Punah, Bombay], Maharashtra, India (Shuckard, 1840).

Aenictus is a widespread genus throughout the Old World, with the majority of occurrences in the Afrotropics and Southeast Asia (Borowiec, 2016). The workers of Nepalese species of the genus have 10-segmented antennae, a propodeal spiracle positioned high on the propodeum, and a notably binodal waist, with the first segment being the largest gastral segment (see Borowiec, 2016 for full diagnosis). These ants have a nomadic lifestyle, with no permanent nests. Several workers attack a single nest or small area during foraging raids, which can occur both during the day and at night, with several workers coordinating their efforts to carry large prey items back to the nest or shelter (Shattuck, 2008; Eguchi *et al*., 2014). Their colonies can contain up to 80,000 individuals, with some foraging above ground and sheltering in semi-open spaces and others remaining cryptic (Borowiec, 2016). This study yielded six species; four of which are new to Nepal, *Aenictus nepalensis* (*laeviceps* group) is described as new species and *Aenictus* cf. *ceylonicus* (*ceylonicus* group) needs species confirmation.

Genus: *Cerapachys* Smith, 1857 (Figs. 7 C, D)

Type species: *Cerapachys antennatus* Smith, 1857. Type locality: Sarawak, Borneo, Malaysia (Smith, 1857).

Cerapachys is a genus distributed from northwest India and Tibet to southern China, Nepal, Java, Borneo, and the Philippines (Borowiec, 2016; Guénard *et al.*, 2017). These non-army ant dorylines can be diagnosed by a distinct pronotomesopleural suture, a well-developed carina on the pronotal collar, spiracle below the propodeum's mid-height, well-developed pygidium having modified setae, a single pectinate spur on each mid and hind tibia, and a helcium positioned supra axially above mid-height of third abdominal segment (see Borowiec, 2016 for full diagnosis). *Cerapachys* species build their nests in rotting logs and wood fragments, under stones, leaf litter, and soil. Some species appear to be semi-nomadic, with much larger colonies than cryptic congeners, whose colonies may not exceed 100 (Eguchi *et al.*, 2014).

Genus: *Dorylus* Fabricius, 1793 (Figs. 7 E, F)

Type species: *Vespa helvola* Linnaeus, 1764. Type locality: South Africa.

Dorylus is found in Sub-Saharan Africa through North Africa and Asia Minor to Borneo in Southeast Asia, with the Afrotropics hosting the most species (Borowiec, 2016). *Dorylus* workers are distinguished by a well-developed promesonotal suture, a propodeal spiracle positioned high on the propodeum, and the absence of propodeal lobes, a single waist segment, a large pygidium with a flattened surface and armed with two cuticular projections, and simple pretarsal claws (Borowiec, 2016). They have massive colonies and are the primary arthropod predators in tropical forests. They live a nomadic lifestyle and forage in soil, or leaf litter and are noticeable swarm raiders on the forest floor and in lower vegetation (Kronauer *et al.*, 2007; Eguchi *et al.*, 2014; Borowiec, 2016). *Dorylus orientalis* is a well-known agricultural pest species in Nepal, mainly in potato (Joshi, 1998).

Genus: *Ooceraea* Roger, 1862 (Figs. 7 G, H)

Type species: *Ooceraea fragosa* Roger, 1862. Type locality: Sri Lanka (Roger, 1862).

Ooceraea occurs in Australia and Oceania, Oriental, and Palaearctic regions, with one widely introduced tramp species, *O. biroi*, in tropical regions (Borowiec, 2016; Yamada *et al.*, 2018; Zhou *et al.*, 2020; Bharti *et al.*, 2021). Workers are distinguished from other dorylines by developed pronotomesopleural suture, propodeal spiracle positioned low on the sclerite and pygidium armed with modified setae, antennae with 11 or fewer segments, two-segmented waist with strongly tubulated abdominal segment III, and with no constrictions between IV, V, and VI abdominal segments (see Borowiec, 2016 for full diagnosis). They are commonly found in leaf litter and soil core samples, and colonies range in size from a hundred to several hundred individuals (Borowiec, 2016). The most studied Doryline species, *O. biroi*, is a specialist predator on the brood of other ants, though it can attack other soft-bodied insects (Wetterer *et al.*, 2012).

Genus: *Parasyscia* Emery, 1882 (Figs. 7 I, J)

Type species: *Parasyscia piochardi* Emery, 1882. Type locality: Syria (Emery, 1882).

Parasyscia is found throughout the warm temperate and tropical regions of the Old World (Borowiec, 2016) and a few species in the subtropics (Fisher & Bolton, 2016). The workers can be identified by propodeal spiracle positioned low on the sclerite and propodeal lobes present, constriction between abdominal segments III and IV, petiole dorsolaterally not marginate, no constriction between IV, V, and VI abdominal segments, pronotomesopleural suture fused, helcium axial, middle tibiae with a single

pectinate spur, pretarsal claws unarmed, and abdominal segment III anterodorsally often marginate (see Borowiec, 2016 for full diagnosis). The genus includes small, cryptic ants found in rotting logs, under stones (Brown, 1975), arboreal nests (Sarnat & Economo, 2012), and urban environments (Borowiec, 2016). Their colonies appear to have a small number of individuals (Borowiec, 2016).

Figure 7: Profile and full-face images of Doryline ant genera of Nepal. **A, B** *Aenictus hodgsoni* **C, D** *Cerapachys sulcinodis* **E, F** *Dorylus orientalis* **G, H** *Ooceraea biroi* **I, J** *Parasyscia wighti*

2.3.7.4 Subfamily: Ectatomminae Emery, 1895

The subfamily Ectatomminae includes large ants with robust body. The subfamily has 12 extant genera and 302 species distributed all over the world, with the majority occurring in temperate regions (Bolton, 2022). The subfamily is represented by a single species, *Stictoponera bicolor* (Emery, 1889) which was documented as new record for Nepal during this study.

Genus: *Stictoponera* (Emery, 1889) (Figs. 8 A, B)

Type species: *Ponera coxalis* Roger, 1860 (obsolete combination of *Stictoponera coxalis*). Type locality: Sri Lanka [Ceylon] (Roger, 1860).

Stictoponera is a predatory Ectatommine ant genus with 42 species, occurring in the Oriental region (Bolton, 2022; Camacho *et al.*, 2022). Camacho *et al.* (2022) resurrected *Stictoponera* from synonymy under *Gnamptogenys* and placed the species

in *coxalis*, *laevior*, and *taivanensis* groups (Lattke, 2004; Chen *et al.*, 2017). Nepalese *Stictoponera* workers are distinguished by their typically large occipital lobes, large eyes situated posteriorly on the head, densely foveolate to areolate mesosoma dorsum, and distinct color pattern (see Lattke, 2004 for full diagnosis – *Gnamptogenys bicolor*). Members of the genus nest primarily on the ground amid rotting logs or leaf litter, while some are arboreal (Gobin *et al.*, 1997; Lattke, 2004). They form relatively modest colonies of a few hundred workers (Lattke, 1994). They are primarily generalist predators, although some species specialize in millipedes, beetles, and ants.

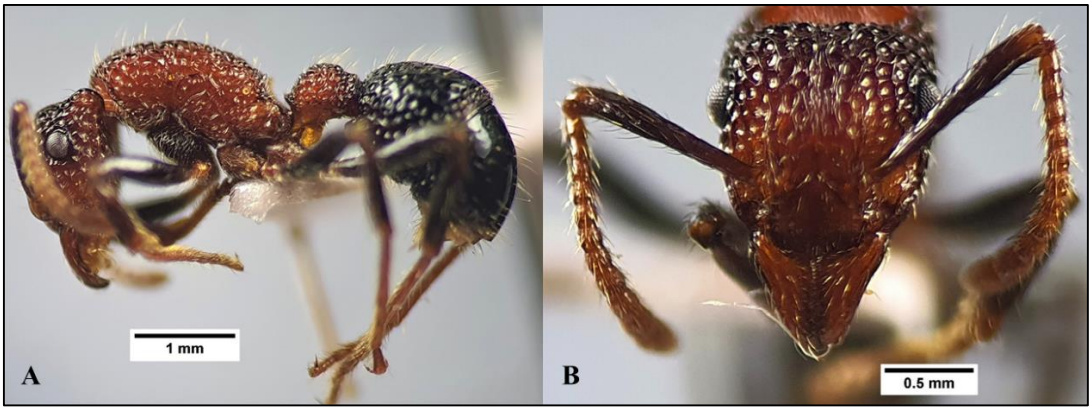

Figure 8: Profile and full-face images of Ectatommine ant genus of Nepal. **A, B** *Stictoponera bicolor*

2.3.7.5 Subfamily: Formicinae Latreille, 1809

Formicinae is the second largest ant subfamily which is distributed worldwide in wide range of terrestrial habitats. This study expands Nepal's ant records to 15 Formicine ant genera and 63 species, with an increase from the earlier records of 11 genera and 36 species. Four genera and 27 species are recognized as new records for Nepal. An overview of diversity of Nepalese Formicine ants compared to its global richness is given (Table 10).

Table 10: Number of Formicinae ant taxa reported from Nepal compared to its global diversity

SN	Ant genera	Global diversity* (species/subspecies)	Nepal diversity* (species/subspecies)	New to Nepal
1	*Acropyga*	42	1	–
2	*Camponotus*	1089/413	16	8
3	*Cataglyphis*	99/18	1	–
4	*Colobopsis*	96/22	3	3
5	*Formica*	176/15	3	–
6	*Lasius*	125/1	4	–
7	*Lepisiota*	99/45	6/1	5
8	*Oecophylla*	2/12	1	–
9	*Nylanderia*	125/25	5	4

10	*Paraparatrechina*	38/4	1	1 (unidentified species)
11	*Paratrechina*	5	1	–
12	*Plagiolepis*	62/13	1	1
13	*Polyrhachis*	706/82	9/2	4/1
14	*Prenolepis*	19	4	–
15	*Pseudolasius*	51/15	1	1
	Total	**2734/665**	**58/3**	**27/1**

Source: *Global species/subspecies count adopted from Bolton (2022) and species count for Nepal based upon species documented in Subedi *et al.* (2020) and additional species recorded during this study.

Genus: *Acropyga* Roger, 1862

Type species: *Acropyga acutiventris* Roger, 1862. Type locality: Sri Lanka (Roger, 1862).

Acropyga is limited to warm temperate and tropical regions across the world (LaPolla, 2004a). These tiny, sturdy, and yellowish hypogeic ants reside in leaf litter, soil and rotting logs. They are well-known for their obligatory trophobiotic association with mealybugs (Williams, 1998; LaPolla, 2004a). These obligate coccidophiles rely exclusively on honeydew generated by mealybugs (Williams, 1998; Schneider & LaPolla, 2011). The following characteristics distinguish *Acropyga* workers from other formicines (LaPolla, 2004a): antenna 7–11 segmented with short scapes, very small eyes placed laterally at lower one fourth of head, palp formula less than 6:4, propodeal spiracles large and rounded, head and gaster covered by thick appressed hairs, and erect hairs scattered entirely.

Genus: *Camponotus* Mayr, 1861 (Figs. 9 A, B)

Type species: *Formica ligniperda* Latreille, 1802 (obsolete combination of *Camponotus ligniperda*). Type locality: Vitrac-sur-Montane, France.

Camponotus (Carpenter ants) is the world's largest ant genus which is widespread in all biogeographical regions (Hölldobler & Wilson, 1990; Bolton, 2022). This hyperdiverse genus is widespread in Nepal with over 16 known species, however, many species are yet to be identified mainly because of lack of generic revision and updated species key for this region. They are medium to large, dimorphic or polymorphic, generalist predators and scavengers, occurring in almost all terrestrial habitats. They can be diagnosed by the position of antennal insertions, which are always set back from the posterior border of the clypeus. However, the usual Formicine character, the presence of a conspicuous ring of hairs around acidopore, is lacking in this genus.

Genus: *Cataglyphis* Foerster, 1850

Type species: *Cataglyphis fairmairei* Foerster, 1850, junior synonym of *Cataglyphis bicolor* (Fabricius, 1793). Type locality: Algeria (Foerster, 1850).

Cataglyphis is commonly distributed in semi deserts and deserts, arid and open habitats (Bolton, 2022). Workers are distinguished from other formicines by their large, triangular, and dentate mandible; palp formula 6:4, initial segment of maxillary palp flat, presence of eyes and ocelli, eyes positioned behind the head mid-length, and slit-like propodeal spiracle (see Agosti, 1990 for full diagnosis). Many species exhibit polymorphism or dimorphism. These active, fast-moving ants build their nests directly on the ground and feed on dead insects (Lenoir *et al.*, 2009). They aid in plant pollination (Herrera *et al.*, 1984) and seed dispersal (Boulay *et al.*, 2007).

Genus: *Colobopsis* Mayr, 1861 (Figs. 9 C, D)

Type species: *Formica truncata* Spinola, 1808 (obsolete combination of *Colobopsis truncata*). Type locality: Italy (Spinola, 1808).

The ants of the genus *Colobopsis* occur throughout the Oriental, Australian and Palearctic regions and in the New World but are absent from the Afrotropics and most of the Neotropics (Ward *et al.*, 2016). The workers may be diagnosed by the following characteristics: Dimorphic, with few or no intermediates between majors and minors. Minor workers: Small size, rounded head, relatively small eyes, well-separated antennal insertions, short frontal carinae, more or less subquadrate clypeus (as long as wide or little wider than long) (see Ward *et al.*, 2016 for full diagnosis). Major workers: Usually phragmotic head that blocks the entrance to the nest in twigs with their head, strongly truncate and marginate to weakly truncate, elongate-rectangular clypeus. These are typically arboreal ants that nest in holes in dead branches or twigs (Wheeler, 1904).

Genus: *Formica* Linnaeus, 1758 (Figs. 9 E, F)

Type species: *Formica rufa* Linnaeus, 1761. Type locality: Sweden.

Formica may be characterized by the presence of three ocelli, 6-jointed maxillary and 4-jointed labial palpi, petiole with a single vertical scale (see Smith, 1858 for description). Slave-making, a stunning form of social parasitism, is exhibited by *Formica sanguinea* (Romiguier *et al.*, 2018) in which it attacks host species' nests to provide a supply of worker for its nest upkeep. *Formica* ants are utilized as classical

model for researching social parasitism, and the taxonomic classification of the genus into four subgenera is largely dependent on host/parasite status (Savolainen & Deslippe, 1996; Romiguier *et al.*, 2018).

Genus: *Lasius* Fabricius, 1804 (Figs. 9 G, H)

Type species: *Formica nigra* Linnaeus, 1758 (obsolete combination of *Lasius niger*). Type locality: Johannishus, Sweden (Seifert, 2020).

Lasius is a diverse and widespread Holarctic ant genus (Janicki *et al.*, 2016; Bolton, 2022). Workers have a small to medium, stout body, a big head in proportion to the alitrunk, a palp formula of 6:4, mandibles with 7–12 teeth, a rounded propodeal spiracle, and a conspicuous, erect and symmetrical petiole in profile (see Wilson, 1955 for full diagnosis). *Lasius* is one of the most important insect genera in the Holarctic in regard to biomass and materials or energy flow (Seifert, 2020). These ants have notable ecological influence and are a well-known model organism for studying social insect biology, honeydew-producing insect symbiosis, and transitory social parasitism, where they rely on the host species only to establish colonies (Boudinot *et al.*, 2022).

Genus: *Lepisiota* Santschi, 1926 (Figs. 9 I, J)

Type species: *Plagiolepis rothneyi* Forel 1894 (obsolete combination of *Lepisiota rothneyi*). Type locality: Barrackpore, West Bengal, India (Forel, 1894).

Lepisiota is another diverse Formicine genera in the Old World (Bolton, 2022). These are generalized foragers, and are especially rich in less forested habitats where they nest in rotting logs, the ground, beneath stones or standing trees (Brown, 2000; Garcia *et al.*, 2013). The genus can be identified by following traits: 11-segmented antenna, well-developed eyes, ocelli typically present, propodeum with a pair of spines, teeth or tubercles, bispinose, bidentate or emarginated petiole, well-developed acidopore (see Bolton, 1994 also).

Genus: *Nylanderia* Emery, 1906 (Figs. 9 M, N)

Type species: *Formica vividula* Nylander, 1846 (obsolete combination of *Nylanderia vividula*). Type locality: Finland (Nylander, 1846).

Nylanderia is the most diverse of all *Prenolepis*-genus-group genera with a nearly cosmopolitan distribution (LaPolla *et al.*, 2010a, 2011). It has the greatest diversity in the tropics, but it is also an important faunal component in temperate regions (Ward,

2000). The workers of *Nylanderia* have the following diagnostic features: six mandibular teeth, well-developed eyes located laterally in midlength of the head, erect macrosetae on the scape, legs, and paired macrosetae on pro-and mesonotum, and no erect setae on propodeum (see LaPolla *et al*., 2010a, 2011 for full diagnosis). They are found in a wide range of habitats, from deserts to rainforests, with high diversity in forests and warm environments (LaPolla *et al.*, 2011). *Nylanderia* is one of the most common genera collected during this study.

Genus: *Oecophylla* Smith, 1860 (Figs. 9 K, L)

Type species: *Formica virescens* Fabricius, 1775 (obsolete combination of *Oecophylla virescens*, junior synonym of *O. smaragdina*). Type locality: Australia (Fabricius, 1775).

The weaver ants, *Oecophylla* are found from Oriental, Indo-Australian and Afrotropical regions (Garcia *et al*., 2013). These ants can be diagnosed by elongate triangular mandible, 12-segmented antenna, well-developed eyes, strongly convex clypeus, elongate mesosoma with constriction, elongate and thin petiole, short and oval gaster. The workers of these arboreal ants weave intricate nests out of the host plant's leaves and larval silk (Cole & Jones, 1948; Holldobler & Wilson, 1977; Devarajan, 2016). These ants are well-known for their eusociality (Schlüns *et al.*, 2009), interaction with plants (Blüthgen & Fiedler, 2002; Lach & Hoffmann, 2011) and usefulness as a biological control agent (Van Mele, 2008; Van Mele *et al.*, 2009; Forbes & Northfield, 2017).

Genus: *Paraparatrechina* Donisthorpe, 1947 (Figs. 9 O, P)

Type species: *Paratrechina pallida* Donisthorpe, 1947 (obsolete combination of *Paraparatrechina pallida*). Type locality: Maffin Bay, New Guinea (Donisthorpe, 1947).

Paraparatrechina is restricted to the Asian, African and Australian paleotropics (LaPolla *et al.*, 2010a). *Paraparatrechina* can be diagnosed by the following characteristic features: small ants (TL 1–2 mm), 5 mandibular teeth, well-developed eyes located laterally in midlength of the head, distinctly paired setae on cephalic dorsum, dense pubescence on the dorsum of head and mesosoma, a unique setal pattern on mesosoma (pronotum bears two pairs of erect setae, mesonotum and propodeum bear one pair each) (see LaPolla *et al.*, 2010a for full diagnosis). They are found in a

wide range of tropical habitats, from rainforest to forest clearings in the sifted litter, rotten logs, and forest canopy (LaPolla *et al.*, 2010b).

Figure 9: Profile and full-face images of Formicine ant genera of Nepal. **A, B** *Camponotus mutilarius* **C, D** *Colobopsis rothneyi* **E**, **F** *Formica candida* **G, H** *Lasius magnus* **I, J** *Lepisiota sericea* **K**, **L** *Oecophylla smaragdina* **M**, **N** *Nylanderia birmana* **O**, **P** *Paraparatrechina* sp. NP-IPS-01.

Genus: *Paratrechina* Motschoulsky, 1863 (Figs. 10 A, B)

Type species: *Paratrechina currens* Motschoulsky, 1863 (obsolete combination of *Paratrechina longicornis*). Type locality: Russia (de Motschoulsky, 1863).

Paratrechina is worldwide in distribution with Afrotropical and Malagasy regions as the center of its diversity (LaPolla *et al.*, 2013). The workers of *Paratrechina* have the following diagnostic features: five mandibular teeth, eyes large and distinctly convex, three small but distinct ocelli, 12-segmented antennae with very long scapes, mesosoma long and slender, legs distinctly long, head with roughly paired erect macrosetae, propodeum without macrosetae and legs, mesosomal dorsum and gaster with abundant erect macrosetae (see LaPolla *et al.*, 2010a, 2013 for full diagnosis). The genus contains a well-known invasive species, *P. longicornis*, which is likely the most widespread ant species in the world and has established itself as an agricultural and household pest (Wetterer, 2008).

Genus: *Plagiolepis* Mayr, 1861 (Figs. 10 E, F)

Type species: *Formica pygmaea* Latreille, 1798 (obsolete combination of *Plagiolepis pygmaea*). Type locality: France (Latreille, 1798).

Plagiolepis is native to the Old World, with mostly occurring in tropical and temperate regions, although some species spread to the New World as a result of human commerce (Wetterer, 2014a; Bolton, 2022). The workers may be identified by the following characters: five mandibular teeth, large clypeus, palp formula 6:4, 11-segmented antenna, well developed eyes, short mesosoma, weak constriction between pronotum and propodeum, unarmed propodeum, petiole reduced, acidopore fringed with hairs (see also Bolton, 1973 for diagnosis). They are tiny ants nesting in soil, rotten logs or trees and have polygynous colonies (Salata *et al.*, 2018). These ants engage in inquiline social parasitism, in which workers are lost and only sexual forms are produced (Degueldre *et al.*, 2021).

Genus: *Polyrhachis* Smith, 1857 (Figs. 10 C, D)

Type species: *Formica bihamata* Fabricius, 1775 (obsolete combination of *Polyrhachis bihamata*). Type locality: Insula St. Iohannis Indiae (Fabricius, 1775).

Polyrhachis is one of the biggest ant genera primarily found in the Old-World tropics (Dorow, 1995). They are distinguished by their capacity to construct nests out of larval silk and spines on the mesosoma and petiole. *Polyrhachis* workers can be diagnosed by stout denticulate mandible, elongate antennae, palp formula 6:4, mesosoma compressed and usually flattened, armed with spines or hooks in pronotum, mesonotum, propodeum or petiole, subglobose abdomen (see also Smith, 1857, 1858 for diagnosis). They

perform critical roles in ecosystem as predators, scavengers and tenders of phloem-sucking insects (Dorow, 1995). Ecologically, they are monogynous to polygynous, monodomous to polydomous and may have small to massive colonies (Dorow, 1995). They construct nests in the ground, rotting logs, tree cavities or in the foliage.

Genus: *Prenolepis* Mayr, 1861 (Figs. 10 G, H)

Type species: *Tapinoma nitens* Mayr, 1853 (obsolete combination of *Prenolepis nitens*). Type locality: Siska, Slovenia (Mayr, 1853b).

Prenolepis is found mainly in southern China and Southeast Asia, with a widespread North American species and a European species (Williams & LaPolla, 2016). *Prenolepis* can be diagnosed by the following characteristics: medium to large ants (TL 2.4–4.9 mm), 5–7 mandibular teeth, medium to large eyes located far posteriorly to the midline of the head, palp formula 6:4, very long antennal sockets, randomly placed erect setae on head dorsum, erect setae on scapes, legs, mesosoma dorsum and propodeum, elongated mesosoma with median constriction (mesonotal constriction) (see Williams & LaPolla, 2016; LaPolla *et al.*, 2010a for full diagnosis). *Prenolepis* primarily occurs in tropical habitats, with one species found in temperate habitats.

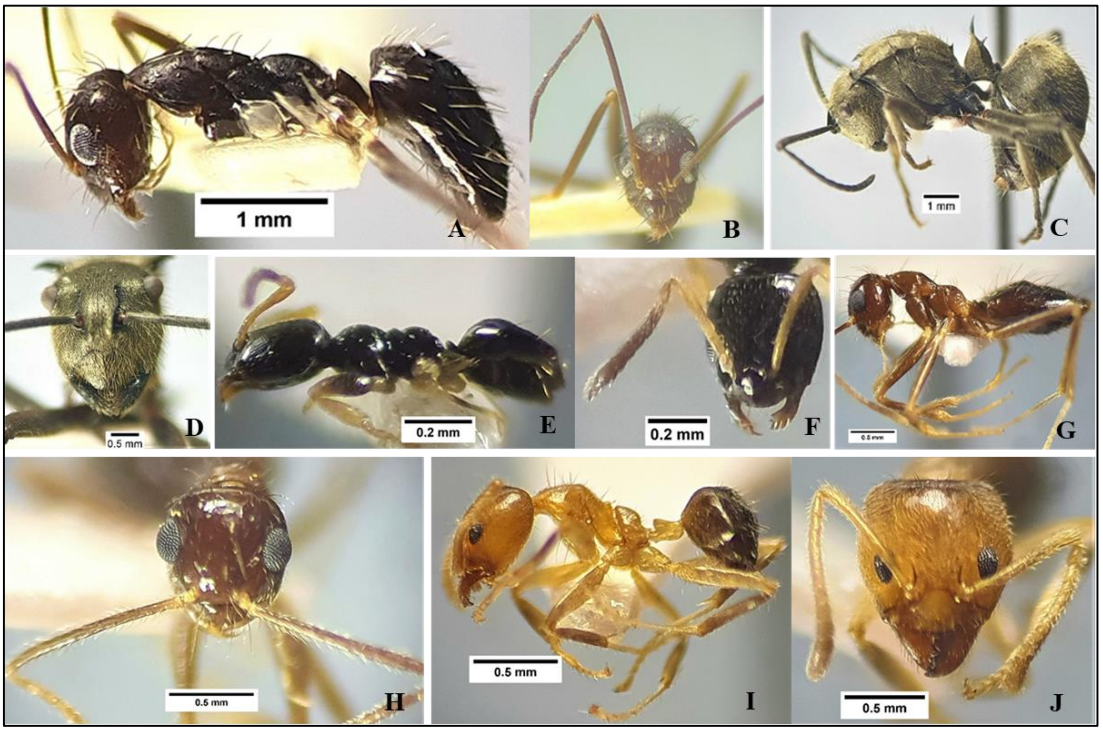

Figure 10: Profile and full-face images of Formicine ant genera of Nepal. **A, B** *Paratrechina longicornis* **C, D** *Polyrhachis tyrannica* **E**, **F** *Plagiolepis jerdonii* **G, H** *Prenolepis naoroji* **I, J** *Pseudolasius familiaris*

Genus: *Pseudolasius* Emery, 1887 (Figs. 10 I, J)

Type species: *Formica familiaris* Smith, 1860 (obsolete combination of *Pseudolasius familiaris*). Type locality: Makassar, Sulawesi, Indonesia (Smith, 1860b).

Pseudolasius occurs throughout the Old-World tropics occurring in southern Asia to northern Australia (LaPolla, 2004b; LaPolla *et al.*, 2010a). *Pseudolasius* can be diagnosed by the following characteristic features: 4–7 mandibular teeth, poorly-developed eyes typically located below midlength of the head, random setae on cephalic dorsum, erect setae on scapes, legs, mesosomal dorsum and propodeum, body covered by dense pubescence, posterior cephalic margin emarginate in major workers (see LaPolla *et al.*, 2010a for full diagnosis). They have polymorphic workers, probably the best known, with completely dimorphic majors and minors in most species (LaPolla, 2004b). They appear to be hypogeic. They have been reported to have trophobiotic relationships with scale insects at plant roots (Malsch *et al.*, 2001).

2.3.7.6 Subfamily: Leptanillinae Emery, 1910

The subfamily Leptanillinae includes small or tiny subterranean ants. The subfamily has seven extant genera and 70 species, distributed in tropical and warm temperate regions of the Old World and Australia (Baroni Urbani, 1977a; Bolton, 2022). The subfamily is known in Nepal by a single species, *Leptanilla buddhista* Baroni Urbani, 1977, which was described based upon the specimens from Nepal.

Genus: *Leptanilla* Emery, 1870

Type species: *Leptanilla revelierii* Emery, 1870. Type locality: Corsica, France (Emery, 1870)

Leptanilla is represented by 49 species and is found throughout the tropics and subtropics of the Old World (Baroni Urbani, 1977a; Bolton, 1990). Workers are distinguished by their small size, pale color, slender body, narrow, blade-like curved mandibles, three teeth in the masticatory margin, 12-segmented antennae, fully-exposed antennal sockets extremely near to the anterior head margin, no eyes, and two-segmented waist (Eguchi *et al.*, 2014). They live in forests, in soil, nesting under stones and wood pieces (Eguchi *et al.*, 2014). The biology of these infrequently encountered hypogeic ants is little understood. These predatory ants are said to be specialized on geophilomorph centipedes (Masuko, 1990; Ogata *et al.*, 1995). The reasons for their

rarity in collection include their tiny size, hypogeic existence, and perhaps small colony (Masuko, 1990; Wong & Guénard, 2016).

2.3.7.7 Subfamily: Myrmicinae Lepeletier de Saint-Fargeau, 1835

The subfamily Myrmicinae is the largest ant subfamily with morphologically very diverse ant species. The subfamily is distributed all over the world in all major habitats. This study expands Nepal's ant records to 21 Myrmicine ant genera represented by 72 species, with an increase from the previous records of 19 genera and 60 species. Two genera and 12 species are recorded as new to Nepal, and at least nine species (five species of *Temnothorax*, one species of *Pheidole* and three species of *Aphaenogaster*) are potentially new to science. An overview of the species diversity of Nepalese Myrmicine ants in comparison to its global richness is given below (Table 11).

Table 11: Number of Myrmicinae ant taxa reported from Nepal compared to its global diversity

SN	Ant genera	Global diversity* (species/subspecies)	Nepal diversity* (species)	New to Nepal
1	*Aphaenogaster*	209/16	8	5 (3 species likely new to science)
2	*Cardiocondyla*	72/2	7	–
3	*Carebara*	224/22	4	1
4	*Cataulacus*	65	1	–
5	*Crematogaster*	518/260	3	–
6	*Lophomyrmex*	13	1	–
7	*Lordomyrma*	35	1	–
8	*Mayriella*	9	1	–
9	*Meranoplus*	88	3	–
10	*Monomorium*	297/22	3	2
11	*Myrmica*	187/1	16	1
12	*Myrmicaria*	39/32	1	1
13	*Perissomyrmex*	6	1	–
14	*Pheidole*	1159/124	6	2 (1 species likely new to science)
15	*Pristomyrmex*	62	1	–
16	*Recurvidris*	12	1	–
17	*Stenamma*	84	1	–
18	*Strumigenys*	858	10	2
19	*Temnothorax*	458/36	6	6 (5 new species)
20	*Tetramorium*	586/9	4	1
21	*Trichomyrmex*	27/3	1	–
	Total	**5008/527**	**80**	**21**

Source: *Global species/subspecies count adopted from Bolton (2022) and species count for Nepal based upon species documented in Subedi *et al.* (2020) and additional species recorded during this study.

Genus: *Aphaenogaster* Mayr, 1853 (Figs. 11 A, B)

Type species: *Aphaenogaster sardous* Mayr, 1853. Type locality: Sardinia, Italy (Mayr, 1853a).

Aphaenogaster is distributed worldwide except southern South America, sub-Saharan Africa and Antarctica (Radchenko & Perkovsky, 2016; Bolton, 2022). These monomorphic ants can be diagnosed by longer than broad head with an elongate neck, 12-segmented antenna with 4-segmented club, medium-sized eye, elongate and depressed mesonotum, propodeal with a pair of spines or small teeth, petiole with anterior peduncle and node. These ants are well-known ecosystem engineers for their bioturbation activities affecting soil and landscape processes (Richards, 2009). This genus was one of the most frequently collected ants during this study and the present collection most likely comprises three species new to science.

Genus: *Cardiocondyla* Emery, 1869 (Figs. 11 C, D)

Type species: *Cardiocondyla elegans* Emery, 1869. Type locality: Capodimonte, Naples, Italy (Emery, 1869).

Cardiocondyla is distributed worldwide, which is native to Afrotropical, Australasia, Indomalaya, Malagasy, Oceania, Palearctic, and introduced to Nearctic and Neotropical regions (Bolton, 2022). The genus comprises of small to minute monomorphic ants. They have a sub-rectangular head with small and narrow frontal lobes, triangular mandible with 5 teeth, 11–12 segmented antenna with 3-segmented club, and large and conspicuous eyes placed well in front of the head midlength. Promesonotal suture absent, metanotal groove absent or distinctly impressed dorsally. Propodeum with a pair of teeth or spines. The petiole has a long peduncle, a distinct node, and a small subpetiolar process. The postpetiole is very broad in dorsal view and dorsoventrally flattened in profile view. The dorsa of the head, mesosoma, waist, and gaster have no standing hairs but do have sparse pubescence. *Cardiocondyla* species recorded from Nepal such as, *mauritanica*, *obscurior*, *minutior*, *emeryi* and *wroughtonii* are cosmopolitan tramp species occurring all over the world (Seifert, 2003). Majority of *Cardiocondyla* species construct nests in soil, or even under stones (Seifert, 2003).

Genus: *Carebara* Westwood, 1840 (Figs. 11 E, F)

Type species: *Carebara lignata* Westwood, 1840. Type locality: Java, Indonesia (Westwood, 1840).

Carebara is found in Afrotropical, Australasia, Indomalaya, Malagasy, Nearctic, Neotropical, Oceania, and Palearctic regions (AntWeb, 2022). The genus includes dimorphic or secondarily monomorphic ants ranging their size from very tiny to very big, subterranean, and litter dwelling (Hölldobler & Wilson, 1990). *Carebara* workers may be diagnosed by the presence of triangular and subtriangular mandible with 4–7 teeth, 8–11 segmented antennae with 2-segmented club, eyes reduced or absent, pedunculate petiole with distinct node (Fischer *et al.*, 2014). Some species are generalized foragers or mass raiders (Berghoff *et al.*, 2003), while others are specialized predators (Fischer *et al.*, 2014). They build their nest in rotting wood or on termite mound (Bolton, 1973).

Genus: *Cataulacus* Smith, 1853 (Figs. 11 G, H)

Type species: *Cataulacus taprobanae* Smith, 1853. Type locality: Sri Lanka [Ceylon] (Smith, 1853).

The genus *Cataulacus* is found in Afrotropical, Indo-Australian and Oriental regions, with the Ethiopian region having the greatest diversity (Bolton, 1974). *Cataulacus* is a genus of arboreal ants that range in size from tiny to large and are usually black, monomorphic and armored. They have a dorsoventrally flattened head, alitrunk, and gaster. Antennae 11-segmented with 3-segmented club. Antennal scrobes run beneath the eyes. Several denticles project laterally from the sides of the head. The anterior clypeal margin is notched. Mandible edentate to weakly denticulate. Large eyes with over 100 ommatidia. Frontal carinae are widely separated. Pronotum marginate with a number of teeth. Propodeal spines are dentiform. Petiolar spines are absent. The first gastral tergite is very large. This genus is diagnosed from other Myrmicine genera by antennal scrobe extending beneath the eye, frontal lobe and frontal carina being exceptionally developed horizontally, and first gastral tergite constituting the whole gastral dorsum (Eguchi *et al.*, 2011). They are typically forest dwellers feeding on vegetation and nest in hollows in the living and dead tree branches (Eguchi *et al.*, 2011).

Genus: *Crematogaster* Lund, 1831 (Figs. 11 I, J)

Type species: *Formica scutellaris* Olivier, 1792. Type locality: Provence, France (Olivier, 1792).

Crematogaster is a huge cosmopolitan genus of small ants with a characteristically heart-shaped gaster that can bend over the mesosoma. The workers of the genus may

be easily diagnosed by the following features: dorsally attached postpetiole to the first gastral segment, lack of dorsal petiolar node allowing the flexing of the gaster forwards (Buren, 1958). The genus has global distribution with several widespread species; however, no species with distinct tramp or invasive nature have been reported. They may be hypogeic, epigeic, or arboreal and often associated with coccids and aphids. Many species nest arboreally in dead parts of standing trees and hollows of tree trunks and branches or build carton nests and some nest in soil or rotting logs on the ground (Creighton, 1950; Longino, 2003; Blaimer, 2012b).

Genus: *Lophomyrmex* Emery, 1892 (Figs. 11 K, L)

Type species: *Oecodoma quadrispinosa* (obsolete combination of *Lophomyrmex quadrispinosus*). Type locality: Malabar, Karnataka/Kerala, India (Jerdon, 1851).

Lophomyrmex is a distinct genus found in Oriental and Indo-Australian regions (Rigato, 1994; Bolton, 2022). The workers of this terrestrial, monomorphic genus may be diagnosed by mandible with an apical tooth, one preapical tooth and series of irregular denticles, medially protruded anterior clypeal margin, 11-segmented antenna with 3-segmented club, long and well-developed propodeal spines (see Rigato, 1994 for full diagnosis). These are commonly ground dwelling and surface scavenging ants in secondary forest (Rigato, 1994). They nest in soil, generally beneath the stones or logs or around tree bases (Eguchi *et al.*, 2011).

Genus: *Lordomyrma* Emery, 1897

Type species: *Lordomyrma furcifera* Emery, 1897. Type locality: Berlinhafen, Papua New Guinea (Emery, 1897).

Lordomyrma is found in Indomalaya, Australasia, Oceania and parts of the Palaearctic regions (Janicki *et al.*, 2016). Its workers may be diagnosed from other myrmicines by the following characteristics: 12-segmented antennae, a simple sting with a straight apex, triangular mandibles having seven or more teeth with size decreasing from apex, well-developed propodeal spines, a bicarinate clypeus and elongate frontal carinae (Sarnat, 2006; Liu *et al.*, 2021). These are small-sized ants having moderate colonies (Lucky & Sarnat, 2008). The majority of the species live in moist forested habitats while some are arboreal nesters and foragers (Sarnat, 2006; Lucky & Sarnat, 2008). A recent taxonomic review of *Lordomyrma* from China has synonymized *L. sinensis* with

L. bhutanensis (Liu *et al.*, 2021), reducing the number of *Lordomyrma* species documented from Nepal to one.

Genus: *Mayriella* Forel, 1902

Type species: *Mayriella abstinens* Forel, 1902. Type locality: Mackay, Queensland, Australia (Forel, 1902a).

Mayriella is an Indo-Australian Myrmicine genus. The workers of the genus may be diagnosed by 10-segmented antenna with 2-segmented club, well-developed antennal scrobe, bidentate anterior clypeal margin with mediolaterally concave clypeus, and elongate compound eyes narrowed anteroventrally (Shattuck & Barnett, 2007). The ants of the genus primarily occur in wet forested areas, foraging in leaf litter and nesting in soil beneath stones or rotting logs or occasionally arboreally (Shattuck & Barnett, 2007). The only Nepalese species of the genus, *Mayriella transfuga* is described from Nepal, which is now known to exist widely in many Asian countries.

Genus: *Meranoplus* Smith, 1853 (Figs. 11 M, N)

Type species: *Cryptocerus bicolor* Guérin-Méneville, 1844 (obsolete combination of *Meranoplus bicolor*). Type locality: Pondichery, India (Guérin-Méneville, 1844).

Meranoplus is a distinct Myrmicine genus that includes stocky, hairy, slow-moving, armored ants distributed across the Old-World Tropics (Andersen, 2006). The genus may be diagnosed by the compact mesosoma extended dorsolaterally and posterolaterally, and by 9-segmented antenna with 3-segmented club, mandible with 4–5 teeth, non-pedunculate petiole (Bolton, 1994, 2003). These ants have a unique protective promesonotal shield extended over the propodeum and well-developed antennal scrobes. These ground-dwelling ants build their nests in soil and forage on the ground. The majority of species are generalist omnivores that graze on grains opportunistically, whereas some are specialist granivores (Andersen *et al.*, 2000; Andersen, 2006).

Genus: *Monomorium* Mayr, 1855 (Figs. 11 O, P)

Type species: *Monomorium monomorium* Bolton, 1987 (replacement name for *Monomorium minutum* Mayr, 1855). Type locality: Lombardy, Italy (Mayr, 1855).

Monomorium is a highly diverse genus occurring worldwide with vast majority of species inhabiting tropical regions of the Old World (Bolton, 1987), and a few endemic

species in North America (DuBois, 1986). The workers may be diagnosed by 10–12 segmented antenna with 3-segmented club, mandibles having 3–4 teeth, anterior clypeal margin with a single median seta, propodeum usually unarmed, petiole pedunculate with distinct node, postpetiole shorter than petiole, first gastral tergite overlapping the sternite (DuBois, 1986; Bolton, 1987; Eguchi *et al.*, 2011). The genus occurs in many terrestrial habitats and microhabitats such as bare lands, grasslands and forests nesting under stones and in soil, while some species are arboreal (Eguchi *et al.*, 2011). The members may be generalist feeders or parasites or granivores. Some species are most successful cosmopolitan tramps, including *M. pharaonis* (Wetterer, 2010b). Two tramp species, *M. pharaonis* and *M. floricola* were recorded during this study.

Figure 11: Profile and full-face images of Myrmicine ant genera of Nepal. **A, B** *Aphaenogaster beesoni* **C, D** *Cardiocondyla kagutsuchi* **E**, **F** *Carebara* sp. NP-IPS-01 **G, H** *Cataulacus granulatus* **I, J** *Crematogaster himalayana* **K**, **L** *Lophomyrmex ambiguus* **M**, **N** *Meranoplus bicolor* **O**, **P** *Monomorium pharaonis*

Genus: *Myrmica* Latreille, 1804 (Figs. 12 A, B)

Type species: *Formica rubra* Linnaeus, 1758, Type locality: Sweden (Linnaeus, 1758).

Myrmica is found in a range of natural and semi-natural habitats throughout Central and Southeast Asia, with the Himalaya having the highest species richness and several endemic species (Bharti, 2008). The workers of *Myrmica* can be diagnosed by the 12-segmented antenna with 3–4 segmented club, palp formula 6, 4, generally pectinate spurs on the posterior tibiae, and presence of propodeal spines. The majority of these ants are found in meadows, forests, and grasslands. They are generalist scavengers, social parasites, and predators which nest in soil, beneath stones, under moss, in rotten logs and even in leaf litter (Radchenko & Elmes, 2010). Depending on the species, colony size ranges from a few tens to several thousands of workers and one to ten or even hundreds of queens (Wardlaw & Elmes, 1996).

Genus: *Myrmicaria* Saunders, 1842 (Figs. 12 C, D)

Type species: *Myrmicaria brunnea* Saunders, 1842. Type locality: Northern India (Saunders, 1842).

Myrmicaria is found across the Afrotropical, Oriental and Indo-Australian regions. The workers of the genus may be diagnosed easily by the presence of 7-segmented antenna, short and high mesosoma, propodeal spines, petiole with long peduncle and developed node, long legs, and hairy body. These ants generally nest in soil (Yahya *et al.*, 2009). They are often considered as mound building ants (Hölldobler & Wilson, 1990); however, it is debatable whether they build true mounds (Kenne & Dejean, 1999; Yahya *et al.*, 2009). The workers forage alone or in small groups. The genus was first recorded from Nepal during current survey.

Genus: *Perissomyrmex* Smith, 1947

Type species: *Perissomyrmex snyderi* Smith, 1947. Type locality: Guatemala (Smith, 1947b).

Perissomyrmex live primarily in high altitude environments in the Oriental and Neotropical regions (Xu & Zhang, 2012; Bolton, 2022). The genus can be diagnosed by elongate roughly rectangular mandibles, clypeus with no central carina, 9-segmented antenna with 3-segmented club, pronotum lacking teeth, usually strongly striate head and mesosoma, propodeal lobe short and obtuse at the apex (see Xu & Zhang, 2012 for full diagnosis). Radchenko (2003) described *P. nepalensis* from Nepalese specimens, which is currently a junior synonym of *P. monticola* (Xu & Zhang, 2012). Their nests were discovered within top soil and rotting wood in a ground (Xu & Zhang, 2012).

Genus: *Pheidole* Westwood, 1839 (Figs. 12 E, F, G, H)

Type species: *Atta providens* Sykes, 1835 (obsolete combination of *Pheidole providens*). Type locality: Poona, India (Sykes, 1835).

Pheidole is a hyperdiverse genus and is one of the most common ant genera in natural forests and may be found all over the world, particularly in the tropics and subtropics (Wilson, 2003). Because of its role in predation, scavenging, seed dispersion, soil-mixing, and as prey item, *Pheidole* is frequently recognized as a keystone taxon, a species that has an excessively high impact on its surroundings (Eguchi, 2008). This dimorphic genus has remarkably distinct major and minor workers. Major workers have massive head with a deep impression in the centre of the occipital margin. Other characteristics include 12-segmented antenna with 3-segmented club; eyes situated in the midlength of the sides of head; massive, strongly curved mandibles; a propodeum with a pair of spines or teeth; and a petiole usually emarginated. Minor workers have a shallow emargination in the head; 12-segmented antenna with 3-segmented club; mandibles usually with 2–3 large teeth; and eyes usually present just in front of head midlength. It was one of the most frequently encountered ants in the present study. It nests in rotten logs, on the ground, beneath rocks, soil, under bark and tree cavities.

Genus: *Pristomyrmex* Mayr, 1866

Type species: *Pristomyrmex pungens* Mayr, 1866 (junior synonym of *Pristomyrmex punctatus* (Smith, 1860). Type locality: Malacca, Malaysia (Mayr, 1866a).

Pristomyrmex is found primarily in the Oriental region with some endemic species occurring in Australia and Africa (Wang, 2003). *Pristomyrmex* may be diagnosed by raised transverse ridge or a few tooth-like prominences on the dorsal labrum, anterior clypeal margin with 2–3 pairs of long hairs, 11-segmented antenna with 3-segmented club, and subtriangular mandibles with 3–5 teeth (Wang, 2003). The vast majority of species live in the rainforest, forage as predators or scavengers, and nest in soil, leaf litter, decaying wood, dead standing trees, or surrounding plant roots (Wang, 2003). These ants were usually found on moist, mossy rocks, tree trunks, foraging on leaves, and disturbed habitats (Zettel, 2006).

Genus: *Recurvidris* Bolton, 1992

Type species: *Recurvidris recurvispinosa* (Forel, 1890). Type locality: Pune, Maharashtra, India (Forel, 1890a).

Recurvidris is found in the Oriental and Indo-Australian regions (Bolton, 1992). The workers of the genus may be diagnosed by 11-segmented antenna with 3-segmented club, mandible having 4–5 teeth, propodeal spines bending upwards and forwards from its base, pedunculate petiole with low node, postpetiole reduced, first gastral segment tremendously compressed dorsoventrally (see Bolton, 1992 for full diagnosis). These ants are found primarily in forested habitats, leaf litter on the forest floor, and occasionally in grasslands, nesting in soil and constructing soil mounds around the nest entrance (Eguchi *et al.*, 2011; Jaitrong *et al.*, 2019). The most widespread species of the genus, *Recurvidris recurvispinosa* was previously recorded from Nepal.

Genus: *Stenamma* Westwood, 1839

Type species: *Stenamma westwoodii* Westwood, 1839. Type locality: Isle of Wight, Great Britain (Westwood, 1839).

Stenamma is a genus of cryptic, cold-adapted ants that may be found across most of the northern hemisphere. The workers of the genus may be diagnosed by 12-segmented antenna with 4-segmented club, eyes placed anterior to the mid-length of side of head, clypeus longitudinally bicarinate medially, clypeal posteromedial margin narrow and elongate backwardly between frontal lobes, mid- and hind tibia without spurs (see also Branstetter, 2009). These ants live in mesic forested habitats and are collected by sifting leaf litter from the moist forest floor (Branstetter, 2009, 2013). These ants have small nests with slow-moving workers who freeze while disturbed (Branstetter, 2013). Nests are most commonly found in leaf litter, although they may also be found in huge logs, rotting woods, under bark, beneath stones, in epiphytes, mud banks and in the ground (Branstetter, 2013).

Genus: *Strumigenys* Smith, 1860 (Figs. 12 I, J)

Type species: *Strumigenys mandibularis* Smith, 1860. Type locality: Sao Paulo, Brazil (Smith, 1860a).

Strumigenys is one of the largest genera found worldwide, primarily in the tropics and subtropics (Bolton, 2000b). The majority of the species have a limited range; however, some are widespread including well-known tramp species. These tiny cryptic ants can be diagnosed by elongate trap-jaw like mandibles terminating in an apical fork of two spiniform teeth; 6-segmented antennae with 2-segmented club, funicular segments II and III reduced; eyes small, well-developed spongiform outgrowth on the ventral and

lateral sides of petiole and post petiole (see Bolton, 1999; Eguchi *et al.*, 2011 for full diagnosis). They nest in decaying logs, leaf litter, or soil, with some species nesting in tree cavities. They are specialized predators, mostly hunting springtails or other minute arthropods (Hölldobler & Wilson, 1990) using their mandibles working with a kinetic mode of action (Bolton, 1999).

Genus: *Temnothorax* Mayr, 1861 (Figs. 12 K, L)

Type species: *Myrmica recedens* Nylander, 1856 (obsolete combination of *Temnothorax recedens*). Type locality: Southern France near Beaucaire, France (Nylander, 1856).

Temnothorax is one of the most diverse ant genera found worldwide (Bolton, 2022). The genus occupies a wide array of habitats ranging from dry deserts to tropical rainforests, and at elevations from sea level to 4000 m (Prebus, 2015, 2017; Guénard *et al.*, 2016). These small ants are usually found in leaf litter, beneath stones and arboreal settings, where they build small nests (Beckers *et al.*, 1989; Prebus, 2017). The workers and gyne of *Temnothorax* can be diagnosed by clypeus with weak median emargination and median carina, maxillary stipes lacking transverse crest, 11–12 segmented strongly clavate antennae with distinct 3-segmented club, and frontal carinae, antennal scrobes and median isolated clypeal seta absent (see Bolton, 2003 for full diagnosis). This genus was recorded in Nepal for the first time from this study, and five new species are described based upon recent collections.

Genus: *Tetramorium* Mayr, 1855 (Figs. 12 M, N)

Type species: *Formica caespitum* Linnaeus, 1758 (obsolete combination of *Tetramorium caespitum*). Type locality: Floghult, Bohusalan, Sweden (Linnaeus, 1758).

Tetramorium is one of the most speciose genera, with the majority of species found in the Old-World tropics and only a few in the New World. Workers of the genus can be identified by mandible with 6–7 teeth (2–3 large apical teeth followed by 4 denticles), clypeus laterally produced into a sharp ridge in front of antennal insertions, 10–12 segmented antenna with 3-segmented club, body hairs usually simple, sting with apical or apicodorsal translucent lamelliform appendages (Bolton, 1977). These ants live in open areas, meadows, and woodlands and generally forage on the ground. They construct their nests in the ground, commonly with soil mounds, under stones, and

rotten logs, twigs, wood pieces, and soil (Eguchi *et al.*, 2011). Two extensively dispersed tramp species, *T. bicarinatum* and *T. lanuginosum* have been documented in Nepal.

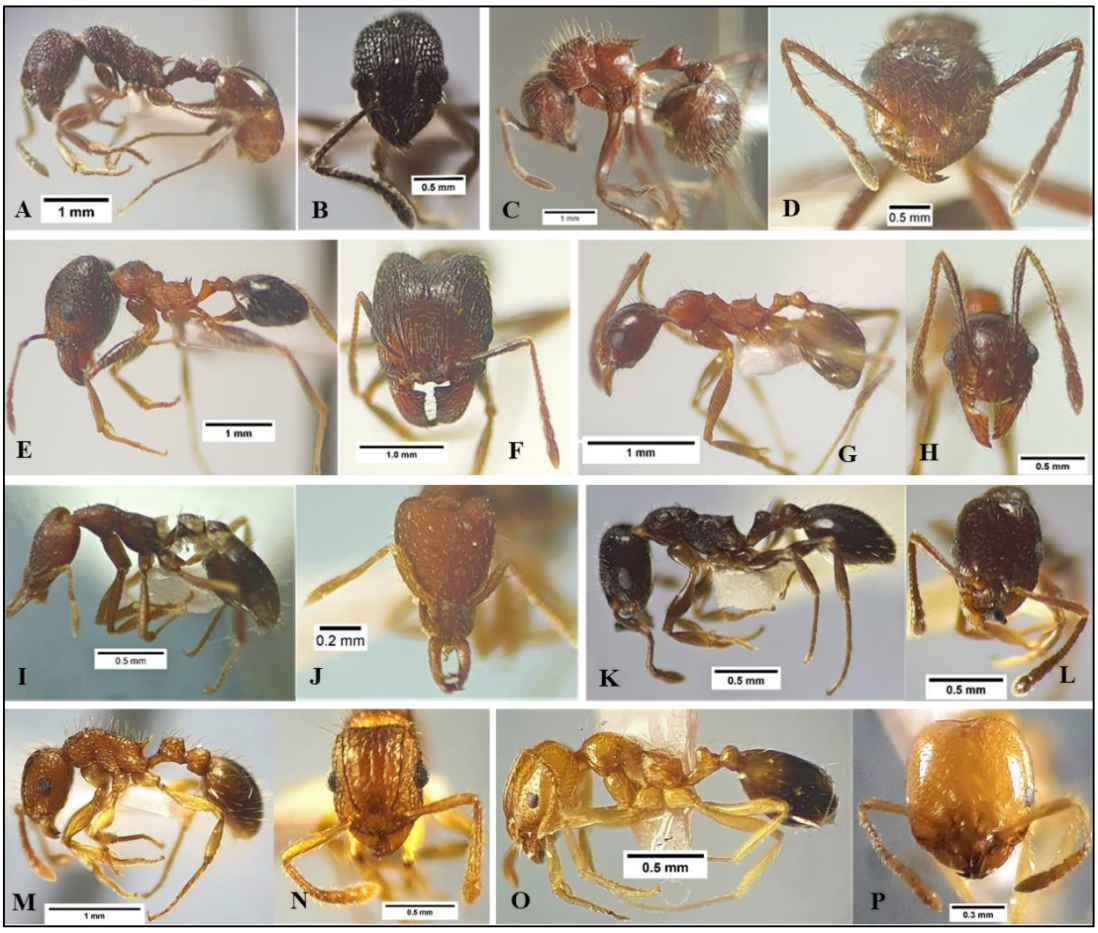

Figure 12: Profile and full-face images of Myrmicine ant genera of Nepal. **A, B** *Myrmica smythiesii* **C, D** *Myrmicaria brunnea* **E**, **F** *Pheidole jucunda* major **G, H** *P. jucunda* minor **I, J** *Strumigenys virgila* **K**, **L** *Temnothorax wroughtonii* **M**, **N** *Tetramorium bicarinatum* **O**, **P** *Trichomyrmex destructor*

Genus: *Trichomyrmex* Mayr, 1865 (Figs. 12 O, P)

Trichomyrmex is recorded from the Palaearctic, Afrotropic, Malagasy, Nearctic, Neotropical, Oriental and Australian regions and is native to Afrotropical, Indomalaya, Malagasy, and Palearctic regions (AntWeb, 2022). The workers are usually polymorphic and they may be diagnosed by 12-segmented antenna, mandible with 3–4 teeth, anterior clypeal margin weakly convex to concave, anterior clypeal margin with a middle single seta, and propodeum unarmed with transverse sculpture dorsally (Sharaf *et al.*, 2016), see also Bolton (1987) for a detailed description of the *Monomorium scabriceps* and *destructor* groups that were resurrected as the genus *Trichomyrmex*. The majority of species nest directly on the ground, beneath stones, or

even in termitaria, while some are granivores, predators, or scavengers (Sharaf *et al.*, 2016). This genus includes a widespread, well-known invasive species, *Trichomyrmex destructor*, which is also documented from Nepal.

2.3.7.8 Subfamily: Ponerinae Lepeletier de Saint-Fargeau, 1835

The subfamily, Ponerinae, is the third-largest subfamily within the family Formicidae and makes up its own clade. The Ponerinae are diverse and widespread across the world, including in Nepal. This study expands Nepal's ant records to 13 Ponerine genera represented by 27 nominal species, an increase from the previous records of eight genera and 10 species. This study yielded four genera and 18 species as new records for Nepal, and one species, *Leptogenys* NP-IPS-01 (*diminuta* group) is likely new to science. An overview of the species diversity of Nepalese Ponerine ants in comparison to its global richness is given below (Table 12).

Table 12: Number of Ponerinae ant taxa reported from Nepal compared to its global diversity

SN	Ant genera	Global diversity* (species/subspecies)	Nepal diversity* (species/subspecies)	New to Nepal
1	*Bothroponera*	43/3	1	1
2	*Brachyponera*	18/5	3	1
3	*Buniapone*	1/1	1	1
4	*Centromyrmex*	15/2	1	1
5	*Diacamma*	44/23	5	3
6	*Ectomomyrmex*	27/4	2	2
7	*Emeryopone*	5	1	–
8	*Harpegnathos*	9/4	1	1
9	*Hypoponera*	154/22	1	1
10	*Leptogenys*	316/14	7	6 (1 species likely new to science)
11	*Odontomachus*	73	1	–
12	*Odontoponera*	2/2	2	1
13	*Pseudoneoponera*	19/10	2	1
	Total	**726/90**	**28**	**19**

Source: *Global species/subspecies count adopted from Bolton (2022) and species count for Nepal based upon species documented in Subedi *et al.* (2020) and additional species recorded during this study.

Genus: *Bothroponera* Mayr, 1862 (Figs. 13 A, B)

Type species: *Ponera pumicosa* Roger, 1860 (Obsolete combination of *Bothroponera pumicosa*). Type locality: Kaffernlande, South Africa (Roger, 1860).

Bothroponera is found in Sub-Saharan Africa through southern Asia to the Philippines (Schmidt & Shattuck, 2014; Guénard *et al.*, 2017; Bolton, 2022). Nepalese *Bothroponera* workers are characterized by a narrow, convex, and medially elevated

clypeus; moderately large frontal lobes; roughly triangular mandibles with six teeth; mesopleuron not divided by a transverse groove; slit-like propodeal spiracle; metanotal groove absent; nodiform petiole lacking posterodorsal spines or teeth or denticles, well-developed subpetiolar process, and weakly sculptured body with dense pubescence (see Schmidt & Shattuck, 2014 for full diagnosis). In Nepal, a single species, *B. tesseronoda* represents the genus. This is possibly the most investigated *Bothroponera* species, which builds underground nests with 50–170 workers (Jessen & Maschwitz, 1986). The species appears to be a generalist predator of arthropods, mostly termites, and sometimes recorded as visitors to extra-floral nectaries (Shivashankar *et al.*, 1995; Agarwal & Rastogi, 2008).

Genus: *Brachyponera* Emery, 1900 (Figs. 13 C, D)

Type species: *Euponera* (*Brachyponera*) *luteipes croceicornis* Emery, 1900 (obsolete combination of *Brachyponera croceicornis*). Type locality: New Guinea, Papua New Guinea (Emery, 1900b).

Brachyponera is a ubiquitous ant genus expanding in Africa, through southern Asia to Australia and differs from other ponerinae in worker-queen reproductive dimorphism (Ito & Ohkawara, 1994; Gotoh & Ito, 2008), and includes certain invasive species occurring in urban and undisturbed forested habitats (Guénard *et al*., 2015; Warren *et al.*, 2015). The Nepalese *Brachyponera* workers may be identified by mandibles with a basal pit, small eyes located close to mandibular insertions, and deep metanotal groove. Propodeum lies lower to thorax and usually strongly narrow dorsally. Propodeal spiracle is small and round. Petiole is squamiform, and prora reduced, not externally visible. Gaster is with a little girdling constriction, and metatibiae bear two spurs (see Schmidt & Shattuck, 2014 for full description). The workers are solitary epigeic generalist predators and scavengers that are small and solitary. Nests are usually built out of decaying wood or soil. *Brachyponera chinensis* employs a sort of foraging strategy, tandem-carrying, in which the workers are directly carried and then released by a successful scout once they have located the food source (Guénard & Silverman, 2011).

Genus: *Buniapone* Schmidt & Shattuck, 2014 (Figs. 13 E, F)

Type species: *Ponera amblyops* Emery, 1887 (obsolete combination of *Buniapone amblyops*). Type locality: Sumatra, Java, Indonesia (Emery, 1887).

Buniapone is a monotypic genus found only in Southern and Southeast Asia, from southern China to the islands of southern Indonesia, and west to India (Schmidt & Shattuck, 2014). It is very distinct morphologically and can be diagnosed by long and narrow-toothed mandibles with six prominent teeth, 12-segmented antennae, antennal scape surpassing cephalic border, blunt medial clypeal projection, merely reduced eyes, no pronotal and mesonotal spines, obsolete metanotal groove, ovoid propodeal spiracles, complex metapleural gland opening, squamiform petiole, and scattered erect hairs and fine dense golden pubescence on the body (see also Schmidt & Shattuck, 2014). Except for the fact that *Buniapone* is hypogeic, little is known about their behavior. Although their prey preferences are not known, they are most likely predators.

Genus: *Centromyrmex* Mayr, 1866 (Figs. 13 G, H)

Type species: *Centromyrmex bohemanni* Mayr, 1866, junior synonym of *Centromyrmex brachycola* (Roger, 1861). Type locality: Rio de Jeneiro, Brazil (Mayr, 1866a).

Centromyrmex is an easily recognizable genus occurring in tropics worldwide, however, the majority are found in Afrotropics (Bolton & Fisher, 2008; Bolton, 2022). The Nepalese *Centromyrmex* workers can be diagnosed by mandibles triangular to elongate triangular, eyes absent, antennal scape strongly dorsoventrally flattened, metapleural gland opening lies beneath propodeal spiracle, propodeum unarmed, helcium relatively high, mesotibiae and meso/metabasitarsi with peg-like setae (see also Bolton & Fisher, 2008; Schmidt & Shattuck, 2014). They are adapted to a hypogeic and subterranean life with the adaptational features as in other fossorial ants such as relatively smooth cuticle, flattened scapes, no eyes, and traction setae in the legs (Bolton & Fisher, 2008; Schmidt & Shattuck, 2014). Workers are specialized predators feeding solely on termites, occurring in and around termitaries, under leaf litter, soil upper layers, or decaying logs (Bolton & Fisher, 2008).

Genus: *Diacamma* Mayr, 1862 (Figs. 13 I, J)

Type species: *Ponera rugosa* Le Guillou, 1842 (obsolete combination of *Diacamma rugosum*). Type locality: Borneo (Le Guillou, 1842).

Diacamma is a well-defined genus occurring from India to Australia (Bolton, 2022). It is well recognized for its unusual reproductive biology. Colonies are typically medium in size, with a few hundred monomorphic workers, and are completely devoid of

queens. Instead, mated workers, often known as "gamergates," carry out reproduction (Peeters & Higashi, 1989). The characteristic deep striate sculpturing covering the head, mesosoma and petiole, deep pits ("gemmal pits") on mesosomal margin, petiole bispinose, prominent arolia, and lateral metapleural gland opening posteriorly by U-shaped cuticular lip are useful to diagnose *Diacamma* workers (see also Schmidt & Shattuck, 2014). Ground-dwelling or arboreal, these large black ants build their nests in soil, rotten logs, or even trees. The workers are generalist predators and forage individually on the ground and on low vegetation (Eguchi *et al.*, 2014).

Figure 13: Profile and full-face images of Ponerine ant genera of Nepal. **A, B** *Bothroponera tesseronoda* **C, D** *Brachyponera chinensis* **E**, **F** *Buniapone amblyops* **G, H** *Centromyrmex feae* **I, J** *Diacamma scalpratum* **K, L** *Ectomomyrmex annamitus*

Genus: *Ectomomyrmex* Mayr, 1867 (Figs. 13 K, L)

Type species: *Ectomomyrmex javanus* Mayr, 1867. Type locality: Java, Indonesia (Mayr, 1867).

Ectomomyrmex is found in Indo-Australia and Australasia, from India to Japan, and from northwest China to north Australia (Brown, 1963). The following characteristics distinguish *Ectomomyrmex* workers: highly sculptured head, mesosoma, and petiole, head generally prismatic posteriorly, mesopleuron separated by a transverse groove, and petiole with a sweeping posterior face (see Schmidt & Shattuck, 2014 for full diagnosis). *Ectomomyrmex* species are typically found in well-developed forests and other forested settings and build their nests in rotting logs and wood fragments, as well as under stones and in the soil (Eguchi *et al.*, 2014). Very little is known about their habits. They appear to be generalist arthropod predators, with feeding patterns that fall somewhere between epigeic and hypogeic (Wilson, 1958). The workers appear to act dead when disturbed (Wilson, 1958).

Genus: *Emeryopone* Forel, 1912 (Figs. 14 A, B)

Type species: *Emeryopone buttelreepeni* Forel, 1912. Type locality: Sumatra, Indonesia (Forel, 1912).

Emeryopone is recorded in Israel, India, Nepal, south China, Indonesia, and Malaysia (Baroni Urbani, 1975; Xu, 1998; Varghese, 2006), however rare collections likely underestimate its true range. The workers can be distinguished from other Ponerinae by prolonged, arched mandibles having five elongated teeth with greatly attenuated apical tooth, medium-sized frontal lobes separated anteriorly by a posterior clypeal extension, tiny eyes, head and body foveolate, with very dense punctures on cephalic dorsum and gradually thinner on mesosoma, petiole, moderate pilosity and varied pubescence (see also Schmidt & Shattuck, 2014). Practically unknown about their habits, although their unique mandibles imply a specific diet. *Emeryopone* is very rare with only four *E. franzi* specimens collected from Nagarjun Forest. It is worth mentioning that this endemic ant of Nepal was documented almost after 48 years of its previous record. They are almost certainly cryptobiotic (living in concealment), based on their morphological traits and collecting data, and the rarity (Baroni Urbani, 1975; Xu, 1998; Varghese, 2006).

Genus: *Harpegnathos* Jerdon, 1851 (Figs. 14 C, D)

Type species: *Harpegnathus saltator* Smith, 1858. Type locality: Tellicherry, India (Jerdon, 1851).

Harpegnathos is restricted to the area bordering India, the Philippines, south China, and Java (Donisthorpe, 1937). Workers have pliers-like mandibles and large anteriorly

positioned eyes, making them one of the most morphologically distinct ponerines. Ocelli, rudimentary metanotal groove, lateral metapleural gland orifice, serrated tarsal claws, conspicuous arolia, an extended nodiform petiole, a short curved anterior face of A3, and a robust girdling constriction between pre and post sclerites of A4 are other diagnostic characters (see also Schmidt & Shattuck, 2014). The morphological features, jumping abilities, foraging patterns, complex nest design, peculiar reproductive habits and unique social system of these ants are all noteworthy (Schmidt & Shattuck, 2014). These large cryptic ants are usually found on the ground and most likely occur in forest edges and sparsely forested areas (Eguchi *et al.*, 2014).

Genus: *Hypoponera* Santschi, 1938 (Figs. 14 E, F)

Type species: *Ponera abeillei* Andre, 1881 (obsolete combination of *Hypoponera abeillei*). Type locality: Corsica, near Ajaccio, France (André, 1881).

Hypoponera is the most cosmopolitan Ponerine genus occurring in all continents except in Antarctica (Schmidt & Shattuck, 2014). Nepalese *Hypoponera* workers may be diagnosed by triangular mandible, 12-segmented antenna with distinct antennal club, very small eyes, promesonotal suture separating pronotum from mesonotum, metanotal groove distinct dorsally, unarmed propodeum narrowed dorsally, petiole squamiform, subpetiolar process a rounded lobe lacking posterior teeth, single spur in hind tibia (see also Schmidt & Shattuck, 2014 for full description). The genus includes small cryptic species inhabiting densely forested habitats and make small colonies in soil, rotten wood and leaf litter (General & Alpert, 2012; Eguchi *et al.*, 2014).

Genus: *Leptogenys* Roger, 1861 (Figs. 14 G, H)

Type species: *Leptogenys falcigera* Roger, 1861. Type locality: Sri Lanka (Roger, 1861).

The most diverse genus of Ponerine ants, *Leptogenys*, is primarily found in tropical and subtropical areas (Bolton, 2022). The pectinate claws and a carinate median clypeal lobe help identify the workers (Bolton, 1975; Rakotonirina & Fisher, 2014). The lack of a basal protarsal comb, which is found in most Ponerini, is another helpful characteristic for separating this genus from other Ponerinae (Lattke, 2011). These ants live like army ants and have ergatoid queens that hunt termites (Schmidt & Shattuck, 2014). The genus has species with large eyes that are epigeic to small eyes that are cryptobiotic, and they nest in a variety of habitats, such as leaf litter, rotting wood, logs,

soil, beneath stones, and even in vegetation (Bolton, 1975; Rakotonirina & Fisher, 2014). One of the *Leptogenys* species (NP-IPS-LEP01) in the *diminuta* species group found in Nepal is most likely a new species.

Genus: *Odontomachus* Latreille, 1804 (Figs. 14 I, J)

Type species: *Formica haematoda* Linnaeus, 1758 (obsolete combination of *Odontomachus hematodus*). Type locality: America Meridionali (Linnaeus, 1758).

Odontomachus is widely distributed across the world's tropics and subtropics, with the highest diversity in the Neotropics and Malesia (Brown, 1976). *Odontomachus* and *Anochetus* workers may be distinguished from any other genera by remarkable trap-like mandibles and associated behaviors (Schmidt, 2013; Larabee *et al.*, 2016). The presence of a medially V-shaped nuchal carina and a pair of dark converging apophyseal lines on the posterior surface of the head distinguish *Odontomachus* from *Anochetus* (Schmidt & Shattuck, 2014). The trap mandibles' rapid closing is among the fastest movements ever recorded in any animal (Larabee & Suarez, 2014). Their nests are generally found in soil or rotting wood, while some species nest in abandoned termite nests or arboreal habitats or rock crevices (General & Alpert, 2012). They are mainly the generalist predators of arthropods, but some species partially specialize in specific prey such as termites. Workers are monomorphic, epigeic foragers, with certain species being partially arboreal (Brown, 1976).

Genus: *Odontoponera* Mayr, 1862 (Figs. 14 K, L)

Type species: *Ponera denticulata* Smith, 1858 (obsolete combination of *Odontoponera denticulata*). Type locality: Singapore (Smith, 1858).

Odontoponera includes moderately large, hard-bodied species found only in Southeast Asian countries, frequently observed from the Philippines, Vietnam, Thailand, southern China, Peninsular Malaysia, and Borneo (Schmidt & Shattuck, 2014). Workers of *Odontoponera* have a denticulate anterior clypeal margin, toothed pronotal borders, prominent striate sculpturing, denticulate-emarginate petiole, and a small, ventrally directed tooth at the apex of the hypopygium, which distinguishes them from other ponerines (see Schmidt & Shattuck, 2014 for detailed characters). Workers of the genus are primarily epigeic foragers and generalist predators or scavengers (Pfeiffer *et al.*, 2006; Zhou *et al.*, 2007) and generally occur in forest edges and disturbed areas (Eguchi *et al.*, 2014).

Figure 14: Profile and full-face images of Ponerine ant genera of Nepal. **A, B** *Emeryopone franzi* **C, D** *Harpegnathos venator* **E**, **F** *Hypoponera confinis* **G, H** *Leptogenys kitteli* **I, J** *Odontomachus monticola* **K, L** *Odontoponera denticulata* **M, N** *Pseudoneoponera bispinosa*

Genus: *Pseudoneoponera* Donisthorpe, 1943 (Figs. 14 M, N)

Type species: *Pseudoneoponera verecundae* Donisthorpe, 1943. Type locality: Waigeu, Camp Nok, New Guinea, Indonesia (Donisthorpe, 1943a).

Pseudoneoponera occurs from India to Australia, where it has the highest diversity of species. The genus is known for its peculiar foamy protective secretions, small colonies, and strange social structures, including the frequent occurrence of gamergates (Schmidt & Shattuck, 2014). Workers can be diagnosed by stout body, coarse body sculpture, shaggy pilosity, obsolete metanotal groove, a nodiform semicircular petiole and often a denticulate posterodorsal edge, usually longitudinally striate tergite A3, and strong gastral constriction between A3 and A4 (see Schmidt & Shattuck, 2014 for full diagnosis). Like most Ponerines, they have tiny colonies of 10 to 20 workers and are

generalist predators and scavengers. They generally occur in wooded habitats. *Pseudoneoponera* workers are closely related with *Bothroponera* and *Ectomomyrmex*, but the latter two genera lack a row of tiny denticles in the posterodorsal border of the petiolar node and longitudinal striations on tergite A3 (Eguchi *et al.*, 2014).

2.3.7.9 Subfamily: Pseudomyrmecinae Smith, 1852

The subfamily Pseudomyrmecinae is a small ant subfamily of distinctive arboreal ants. The subfamily contains three genera and 235 species found from the Old and New World tropics (Ward, 2001; Bolton, 2022). This study expands Nepal's ant records to six Pseudomyrmecine species, an increase from the previous records of four species. This study yielded two species as new records for Nepal.

Genus: *Tetraponera* Smith, 1852 (Figs. 15 A, B)

Type species: *Tetraponera atrata* Smith, 1852 (junior synonym of *Tetraponera nigra* (Jerdon, 1851). Type locality: Maharashtra, India (Smith, 1852).

The ant genus *Tetraponera* has 89 extant species distributed throughout Old-World tropics (Bolton, 2022). *Tetraponera* workers may be diagnosed by short mandible having distinctive masticatory and basal margins; continuous medio-clypeal lobe, roughly convex, and non-truncate, typically with toothed or crenulate anterior edge; antenna 12-segmented; prominent compound eyes with width two-third or more than length; metanotal groove conspicuously impressed; stinging apparatus membranous (see Ward, 1990, 2006 for full diagnosis). These ants are mostly arboreal ants nesting exclusively above-ground in dead twigs, branches, or cavities of plants (Ward, 1990, 1991).

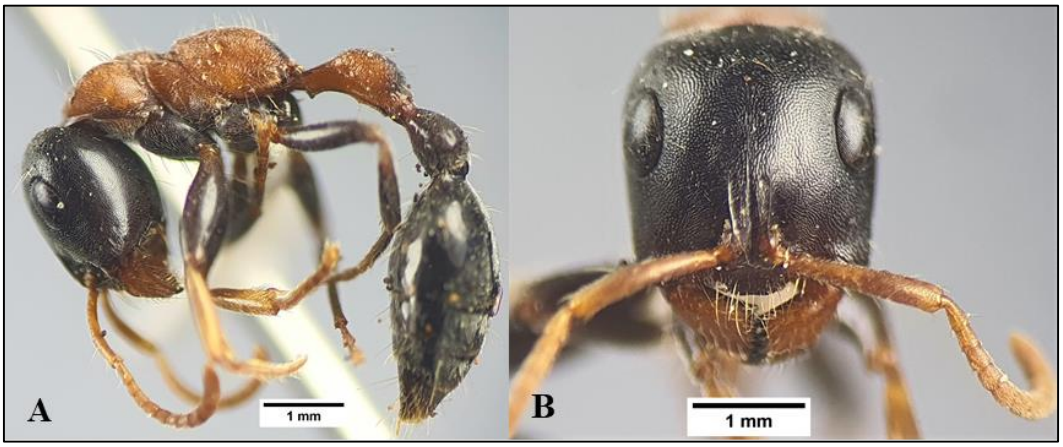

Figure 15: Profile and full-face images of Pseudomyrmecine ant genus of Nepal **A, B** *Tetraponera rufonigra*

2.3.8 New species descriptions

Five species of *Temnothorax*, and one species of *Aenictus* are described as new to science. The newly described ant species will be deemed available upon publication in peer-reviewed journals to comply with the provisions of article 8 of the International Code of Zoological Nomenclature (ICZN, 1999). One species of *Leptogenys*, three species of *Aphaenogaster*, and one species of *Pheidole*, which are potentially new to science are introduced briefly. *Emeryopone franzi*, a rare endemic ant of Nepal, is redescribed based on new specimens collected during this investigation.

***Aenictus nepalensis* sp. nov.** (Figs. 16 A, B, C, D)

Materials examined: Holotype. Worker (CDZMTU HymF111), Nagarjun Forest, Shivapuri-Nagarjun National Park (SNNP), Secondary Mixed Forest, 27.7483°N, 85.2722°E, 1930 m asl, 22–24.x.2019, pitfall collection, I.P. Subedi and R.P. Pokhrel leg.; **Paratype**. 3 workers (CDZMTU HymF112), same data as holotype.

Worker description

Head: Head slightly longer than broad (CI 80.95) in full-face view, with convex lateral margin and somewhat straight posterior margin. Antennae 10-segmented, antennal scape moderately long (SL 0.54), just reaching the posterolateral corner of the head, antennal segments longer than broad, II–VII segments almost equal in length each other. Frontal carina short. Anterior clypeal margin with several denticles. Mandibles sub-triangular. The masticatory margin of mandibles bears a large apical tooth, medium-sized subapical tooth, and 6–7 small denticles.

Mesosoma: Promesonotum convex dorsally in profile, propodeum with slightly convex in dorsal outline in profile view, declivity dorsally margined, propodeum unarmed, propodeal spiracle round.

Petiole and postpetiole: Petiole and postpetiole rounded in outline and almost equal in length, a subpetiolar process very long, thin and pointed, its apex directed downward and backward, elongate gaster, first gastral segment narrows anteriorly, no girdling constriction between gastral segments.

Gaster: Gaster smooth and shiny. Sting exerted.

Sculpture and pilosity: Head entirely smooth and shiny. Mandible not striate, Pronotum smooth and shiny slightly punctate in the anteriormost margin; mesothorax,

metathorax, and propodeum densely punctate; petiole and postpetiole smooth and shiny; entire body yellowish brown; femur shiny, broader distally, sparsely distributed moderately long and short white hairs; pronotal hairs very short, antennae and legs hairy.

Color: The species is unicolorous with yellow shiny body which is unique among all *Aenictus laeviceps* group species.

Measurements and indices: Holotype: HL 0.88, HW 0.75, SL 0.54, AL 1.17, PeL 0.29, PeH 0.38, CI 80.95, SI2 72. Paratypes (n=3): HL 0.79–0.88, HW 0.71–0.75, SL 0.63–0.67, AL 1.25–1.29, PeL 0.25–0.29, PeH 0.38–0.42, CI 80.95–90, SI 83.33–94.12.

Etymology: The species is named after the country name "Nepal" where it is described.

Distribution: Nepal (Nagarjun Forest).

Bionomics: There is no direct biological information available because the type series was collected from a pitfall trap kept in the Nagarjun Forest. The site had secondary mixed forests dominated by Chilaune (*Schima wallichii*) and Katush (*Castanopsis* sp.) and was largely covered by leaf litter.

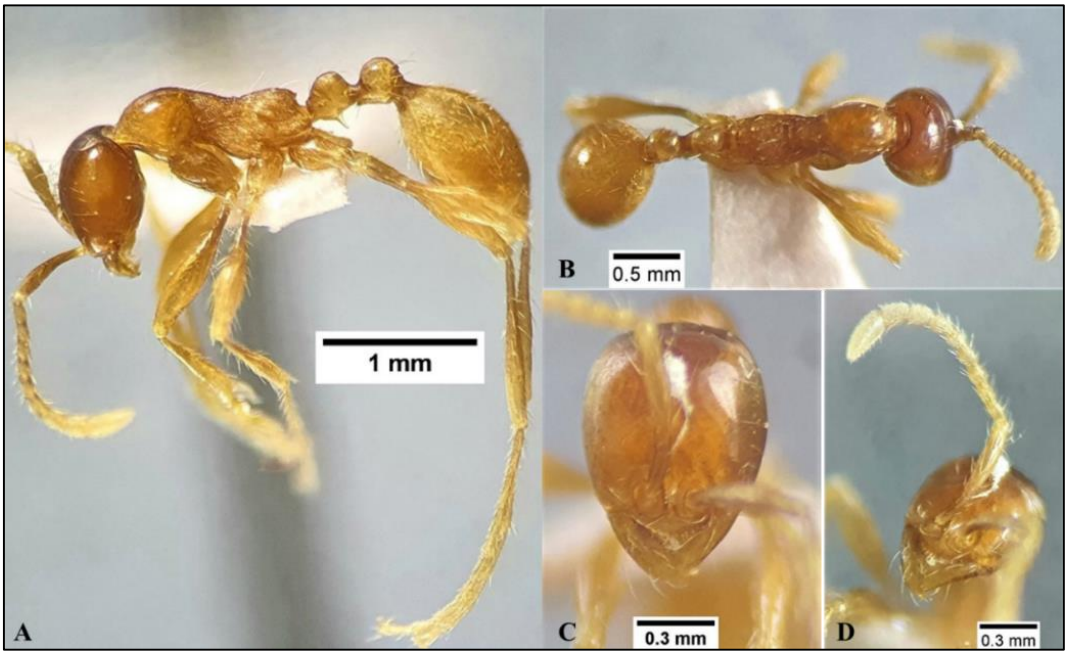

Figure 16: *Aenictus nepalensis* sp. nov. holotype worker, A. Habitus in profile view B. Habitus in dorsal view C. Head in full-face view D. Antenna in close up view

Differential diagnosis: The species is unicolorous with yellow shiny body which is unique among all *Aenictus laeviceps* group species. The new species differs from *A.*

hodgsoni in having punctate propodeum and is dorsally convex. The subpetiolar process is longer, thin and pointed than that in *A. fergusoni* and *A. hodgsoni*. "Typhlatta spots" is not as distinct as in *A. fergusoni* which has yellow "Typlatta spots" with dark reddish-brown head and mesosoma.

***Temnothorax buddha* sp. nov.** (Figs. 17 A, B, C and 18 A, B, C)

Materials examined: Holotype. Worker (CDZMTU HymF121), Jamacho, Nagarjun Forest, Shivapuri-Nagarjun National Park, 27.7452°N, 85.2667°E, 2094 m asl, bait collection, 3.v.2019, I.P. Subedi leg.; **Paratype**. 1 queen (CDZMTU HymF122), same data as a holotype.

Worker description

Head: In full-face view head slightly longer than broad (CI 0.79), with little rounded occipital corners and slightly convex or nearly straight posterior margin; anterior clypeal margin convex; eyes relatively large (OL 0.14); mandibles elongate, masticatory margins with five teeth; antennae 12-segmented; scape almost reaches the posterior margin of head in full-face view (SI1 0.67, SI2 0.84).

Mesosoma: In profile view, mesosoma with convex dorsum; promesonotal suture visible only ventrally, not reaching up to middle, metanotal groove shallow; propodeal spines moderately long (ESL 0.14), straight, slightly widened at the base, their tips are obliquely truncate; propodeal declivity roughly concave.

Petiole and postpetiole: In profile, petiolar node longer than high with somewhat long anterior peduncle; petiolar node with steep and almost straight anterior face and convex, massive with sharpened corners dorsum; Postpetiole shorter than petiole (PeL 0.31, PPL 0.22) with rounded dorsum and almost similar in height with petiole; in dorsal view broader than petiole, more or less equal in length and width itself.

Gaster: Smooth and shiny.

Sculpture and pilosity: Head dorsum with regular longitudinal striations extending to the occiput, frons and genae nearly smooth and shiny, mandibles with faint striations, coarse longitudinal and reticulate rugae in mesosoma, petiole, postpetiole and gaster with almost similar sculptures. Suberect to erect hairs covering entire body, decumbent pubescent hairs on antennae and legs, dense in funicular segments of antennae.

Colour: Body yellowish with little lighter legs and antennae, pilosity white.

Measurements and indices: HL 0.67, HW 0.53, SL 0.44, OL 0.14, FRS 0.13, AL 0.79, AH 0.35, PNW 0.35, HTL 0.42, PeL 0.31, PeW 0.17, PeH 0.21, PPL 0.22, PPW 0.24, PPH 0.21, ESL 0.14, CI 0.79, SI1 0.67, SI2 0.84, OI1 0.21, OI2 0.26, PI 1.47, PPI 1.07, AI 2.28, ESLI 0.26.

Figure 17: *Temnothorax buddha* sp. nov. holotype worker, A. Habitus in profile view B. Head in full-face view C. Habitus in dorsal view

Queen: The queen is mostly similar with workers except some usual modifications. Larger and more robust body with thick hair, mandibles almost triangular, antennal scape almost reaching occipital border, large eyes, three distinct ocelli, gaster smooth and shiny with blackish yellow, body color yellowish with black tinge, legs and antennae faint yellow.

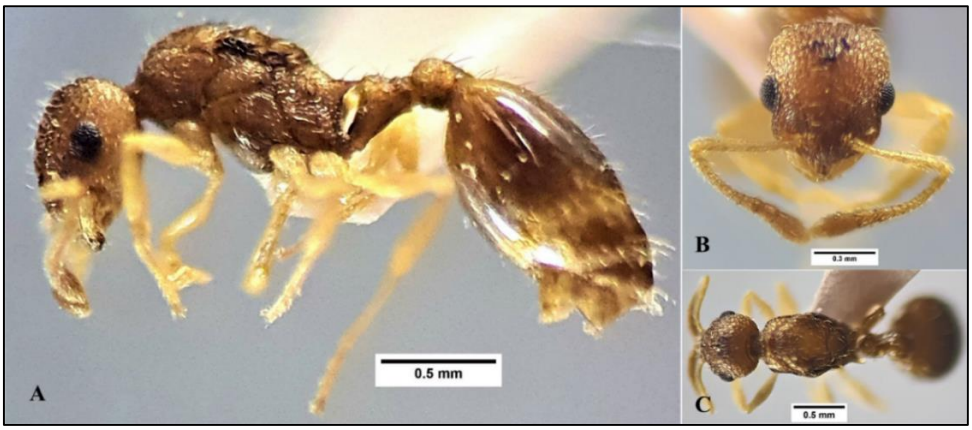

Figure 18: *Temnothorax buddha* sp. nov. paratype queen, A. Habitus in profile view B. Head in full-face view C. Habitus in dorsal view

Measurements and indices: HL 0.69, HW 0.60, SL 0.53, OL 0.17, FRS 0.14, AL 1.03, AH 0.47, PNW 0.50, HTL 0.44, PeL 0.33, PeW 0.19, PeH 0.22, PPL 0.31, PPW 0.22,

PPH 0.22, ESL 0.19, CI 0.87, SI1 0.76, SI2 0.88, OI1 0.24, OI2 0.28, PI 1.50, PPI 1.38, AI 2.18, ESLI 0.33.

Male: unknown

Bionomics: These ants were collected from the cookie baits kept at Nagarjun Forest nearby Jamacho Monastery.

Distribution: It is reported only from Nagarjun Forest, Shivapuri-Nagarjun National Park, Nepal.

Etymology: The species is named after the Lord Buddha who was born in Nepal.

Differential diagnosis: *Temnothorax buddha* sp. nov. is comparable with Himalayan species such as, *T. microreticulatus* Bharti *et al*., 2012; *T. pamiricus* (Ruzsky, 1902); *T. pakistanensis* Rasheed *et al*., 2020 and *T. himachalensis* Bharti *et al*., 2012, which also have a unicolorous yellow body. But *T. buddha* sp. nov. is distinguished from *T. microreticulatus* by a strongly sculptured and longer head (CI 1.26 *vs* max 1.17) and mesosoma, thinner propodeal spines, much rounded petiole node, shorter and broader petiolar peduncle and massive postpetiole. The new species differs from *T. pamiricus* and *T. himachalensis* in much longer propodeal spines, developed strong sculpture, petiole shape. The new species differs from *T. pakistanensis* in shorter head (CI 1.26 *vs* min 1.26 and max 1.32) and scape (SI1 0.65 *vs* min 0.72), absence of deep metanotal groove, longer propodeal spines, shape petiole, and coarser sculpture of body. The new species is also comparable with *T. indra* (Terayama & Onoyama, 1999), however differs from the later in body sculpture, more concave propodeal declivity, shorter petiolar spines and longer antennal scape.

***Temnothorax kathmanduensis* sp. nov.** (Figs. 19 A, B, C and 20 A, B, C)

Materials examined: Holotype. Worker (CDZMTU HymF116), Center for Nepal and Asian Studies premises, Kirtipur, Kathmandu, central Nepal, 27.6814°N, 85.2831°E, 1330 m asl, pitfall collection, 27–29.v.2019, I.P. Subedi leg. **Paratypes**. 6 workers (CDZMTU HymF117), same data as a holotype; 2 workers (CDZMTU HymF118), Sundarijal Forest, SNNP, Kathmandu, 27.7697°N, 85.4250°E, 1577 m asl, hand collection, 10.x.2020, I.P. Subedi leg.; 2 workers (CDZMTU HymF119), coronation garden, TUC, Kirtipur, Kathmandu, 27.6814°N, 85.2831°E, 1330 m asl, 1.v.2016. I.P. Subedi leg.; 1 queen (CDZMTU HymF120), same data as a holotype.

Worker description

Head: Head somewhat longer than broad (CI 0.91), with little rounded occipital corners and slightly emarginate posterior margin; anterior clypeal margin nearly convex; mandibles with five teeth, apical tooth longest, gradually decrease in size from apex to base; antennae 12-segmented; relatively short scape (SL 0.64) not reaching the posterior margin of head in full-face view.

Mesosoma: Promesonotal suture visible; metanotal groove distinct; propodeal spines very short and triangular (dentate), propodeal declivity concave.

Petiole and postpetiole: In profile, petiole with a relatively long peduncle (PeL 0.31); the anterior and posterior faces inclined, both faces tapered to form a node; subpetiolar process reduced to a small denticle. In profile, postpetiole globular and almost similar in height with petiole; in dorsal view broader than petiole, more or less equal in length and width.

Sculpture and pilosity: Mandible with longitudinal striations, cepalic dorsum with fine, irregular striations, clypeus with 5–7 longitudinal rugulae. In profile view, mesosoma rugulose, fairly weak rugulosity in pronotum, petiole with very weak rugae. Mesosoma dorsum strongly rugulose, petiole weakly rugulose, postpetiole thickly granulated. Gaster smooth and shiny. Erect hair sparsely distributed throughout the body, hairs shorter in head, short suberect dense hairs on antennae, short decumbent hairs on legs, few long setae on anterior clypeal margin.

Colour: Body dark brown, more or less uniformly colored, with a little darker head and lighter mandible, antennae and legs.

Measurements and indices, ordered as holotype (paratype, n=6): HL 0.78 (0.78–0.92), HW 0.71 (0.64–0.78), SL 0.64 (0.58–0.75), OL 0.19 (0.18–0.21), FRS 0.28 (0.22–0.28), AL 1.03 (0.97–1.11), AH 0.39 (0.36–0.43), PNW 0.49 (0.46–0.53), HTL 0.64 (0.56–0.64), PeL 0.31 (0.25–0.39), PeW 0.19 (0.17–0.19), PeH 0.22 (0.21–0.25), PPL 0.25 (0.24–0.31), PPW 0.21 (0.22–0.26), CI 0.91 (0.82–0.85), SI1 0.82 (0.67–0.87), SI2 0.90 (0.79–1.17), OI1 0.25 (0.21–0.25), OI2 0.27 (0.26–0.28), PI 1.38 (1.20–1.69), PPI 1.20 (1.12–1.38), AI 2.64 (2.45–3.00).

Queen: Head almost like that in workers, but slightly wider, with three distinct ocelli. Scape not reaching posterior cephalic border as in worker. Eyes as large as in workers. Mesosoma relatively longer and much taller. Propodeal spines absent. Petiole and

postpetiole as long as that of workers, but little wider. Pronotal dorsum with parallelly arranged longitudinal striations with a smooth and shiny surface between fine ridges, fine striations in mesosoma in profile view. Sculpture in petiole and postpetiole similar to that in workers. Body shiny and color almost like that of workers.

Measurements and indices: HL 0.92, HW 0.81, SL 0.61, OL 0.19, FRS 0.25, AL 1.42, AH 0.83, PNW 0.75, HTL 0.58, PeL 0.36, PeW 0.22, PeH 0.28, PPL 0.31, PPW 0.28, PPH 0.28, CI 0.88, SI1 0.67, SI2 0.76, OI1 0.21, OI2 0.24, PI 1.30, PPI 1.10, AI 1.70.

Figure 19: *Temnothorax kathmanduensis* sp. nov. holotype worker, A. Habitus in profile view B. Head in full-face view C. Habitus in dorsal view

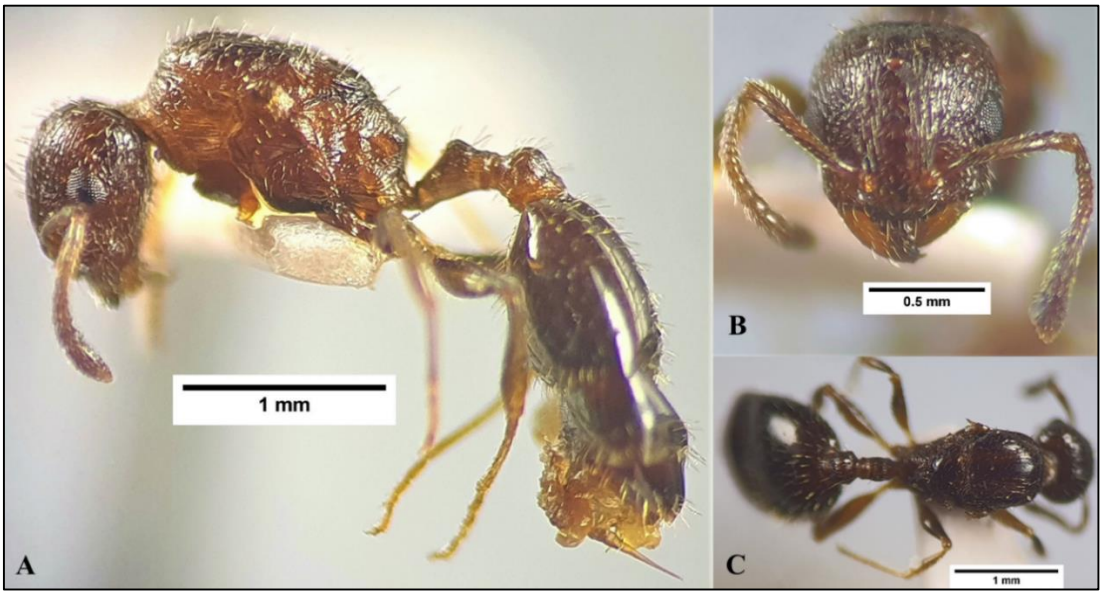

Figure 20: *Temnothorax kathmanduensis* sp. nov. paratype queen, A. Habitus in profile view B. Head in full-face view C. Habitus in dorsal view

Males: unknown

Bionomics: These ants were collected from the planted forest at Tribhuvan University Campus area, Kirtipur in 2016 by hand collection and in 2019 by pitfall trapping along with a queen. They were also hand collected from Sundarijal Forest, SNNP in 2020.

Distribution: Tribhuvan University Campus, Kirtipur, Kathmandu, Nepal. Sundarijal Forest, Shivapuri-Nagarjun National Park, Nepal.

Etymology: The species is named after its type locality Kathmandu, a capital city of Nepal.

Differential diagnosis: The new species is more closely related with *Temnothorax wroughtonii* but the new species can be distinguished from the later by dentate propodeum, distinctly sculptured head and mesosoma. The new species is also comparable with *T. inermis* (Forel, 1902), but differ from the later in having dentate propodeum, differently sculptured head and mesosoma, shallow pronoto-mesonotal suture, and shape of petiolar node.

***Temnothorax nepalensis* sp. nov.** (Figs. 21 A, B, C)

Material examined: Holotype. Worker (CDZMTU HymF123), Ranibari Community Forest, Kathmandu, 27.7294°N, 85.3206°E, 1310 m asl, hand collection, 01.iii.2022, I.P. Subedi leg.

Worker description

Head: Head slightly longer than broad (CI 0.91) in full-face view; broadly rounded occipital corners and roughly straight, posterior head margin; eyes large (OL 0.14), placed roughly at the middle of the head laterally; anterior clypeal margin broadly convex with a small notch at the middle; mandibles subtriangular, armed with 5 teeth in its masticatory margin, apical tooth longest, followed by smaller sub-apical tooth and very small teeth; antennae 12-segmented with distinct 3-segmented club, scape moderately long (SL 0.53), clearly surpasses the posterior head margin.

Mesosoma: Pronotum wide, gently convex anteriorly, humeri in dorsal view distinctly angulate, mesosoma dorsum roughly straight in profile; dorsal outline of mesosoma without any impression, metanotal groove absent; propodeal spines long and sharp (ESL 0.19), directed backward and outward.

Petiole and postpetiole: Petiole with long anterior peduncle (PeL 0.31); in profile petiolar node distinct with inclined and nearly straight anterior slope, peduncle clearly

distinguished from node, posterior face of the petiole nearly rounded; postpetiolar node as high as a petiolar node, with the fairly rounded dorsum.

Gaster: Gaster roughly oval, smooth and shiny.

Sculpture and pilosity: Head dorsum longitudinally striated, clypeus and gena smooth; mandibles with longitudinal striations; mesosoma longitudinally striated; gaster smooth and shiny; suberect to erect hairs scattered over the whole body, hair sparse in mesosoma, petiole and postpetiole and denser in head and gaster; appressed to suberect pubescent hairs on antennae, with denser hairs on funicular segments; few erect and decumbent pubescent hairs on legs.

Colour: Whole body nearly concolorous drak-brown, with head and gaster slightly darker, antennae with darker club, mandible, and legs yellowish contrasting from body color, pilosity white.

Measurements and indices: HL 0.64, HW 0.58, SL 0.53, OL 0.14, FRS 0.14, AL 0.83, AH 0.32, PNW 0.39, HTL 0.47, PeL 0.31, PeW 0.17, PeH 0.14, PPL 0.25, PPW 0.22, ESL 0.19, CI 0.91, SI1 0.83, SI2 0.90, OI1 0.22, OI2 0.24, PI 1.38, PPI 0.63, AI 2.61, ESLI 0.33.

Figure 21: *Temnothorax nepalensis* sp. nov. holotype worker, A. Habitus in profile view B. Head in full-face view C. Habitus in dorsal view

Queens and males: unknown.

Bionomics: Specimen was collected from the Ranibari Community Forest, only natural forest in the centre of Kathmandu city, central Nepal.

Distribution: Ranibari Community Forest, Kathmandu, central Nepal.

Etymology: The species is named after its country of origin.

Differential diagnosis: The new species, *T. nepalensis* differs from all known Himalayan species in having angulate humeri (in dorsal view). This combination of characters is found only in 6 known species of this genus living in the Eastern Palaearctic – *T. koreanus* (Teranishi, 1940) (North and South Korea, China (Hubei) and Japan), *T. alinae* (Radchenko, 1994) (Russia, Primorsky Territory), *T. cuneinodis* Radchenko, 2004 (North Korea), *T. angulohumerus* Zhou *et al.*, 2010 (China, Hunan) and *T. orchidus* Zhou *et al.*, 2010 (China, Yunnan). The *T. nepalensis* differs from *T. koreanus* in 12 segments antennae, spines shape, waist, etc. The new species differs from *T. alinae* and *T. cuneinodis* by a much longer petiole (PI 1.38 *vs* > 1.20 and 1.05 respectively), spines (ESLI 0.33 *vs* >0.25 and 0.23 respectively), scape clearly surpasses the posterior head margin (scape *T. alinae* and *T. cuneinodis* not reach the occipital margin), sculpture of body, as well as more distinctly angulate humeri. *Temnothorax nepalensis* is closest to *T. angulohumerus* and *T. orchidus*, but differs from the first and second species in longer propodeal spines (ESLI 0.33 *vs* max 0.22 and 0.20 respectively) and longer petiole (PI 1.38 *vs* max 1.11 and 1.00 respectively). *T. nepalensis* also differs from *T. angulohumerus* in its short scape (SI1 0.83 *vs* > 0.86, SI2 0.90 vs >0.96), pronotum in profile gently convex (strongly convex and steepy in *angulohumerus*), unicolorous dark brown body (yellowish brown in *angulohumerus*).

***Temnothorax pathibharaensis* sp. nov.** (Figs. 22 A, B, C)

Materials examined: Holotype. Worker (CDZMTU HymF114), Pathibhara, Furrabhu, Taplejung, eastern Nepal, Fir Forest (*Abies* sp.), 27.4215°N, 87.7629°E, 3413 m asl, 9.x.2020, B.R. Shrestha & T. Sherpa leg. **Paratype**. 1 worker (CDZMTU HymF115), same data as a holotype.

Worker description

Head: In full-face view, head slightly longer than broad (CI 0.85); broadly rounded occipital corners and straight, posterior head margin; eyes placed roughly at the middle of the head laterally; eyes bulging, anterior clypeal margin broadly convex; mandibles subtriangular, armed with 5 teeth in its masticatory margin, apical tooth longest; antennae 12-segmented with the distinct 3-segmented club, scape moderately long (SI1 0.84–0.87, SI2 1.02–1.08), just surpasses the posterior head margin.

Mesosoma: Mesosoma dorsum fairly convex anteriorly and roughly straight posteriorly; metanotal groove distinct; propodeal spines moderately long.

Petiole and postpetiole: Petiole longer than high with long anterior peduncle (PeL 0.31, PeH 0.21); in profile petiolar node with inclined and roughly straight anterior face, convex posterior face and very roughly rounded, thicker dorsum; postpetiolar node taller than petiolar node, with the nearly rounded dorsum.

Gaster: Gaster roughly oval, smooth and shiny.

Sculpture and pilosity: Head with dense longitudinal striations; mandibles with faint longitudinal striations; mesosoma with longitudinal rugae; petiole and postpetiole finely rugulose; gaster smooth and shiny; suberect to erect hairs scattered over the whole body, hair sparse in mesosoma and denser in gaster; decumbent to subdecumbent pubescent hairs on antennae; decumbent pubescent hairs on legs.

Colour: Head, lower half mesosoma, petiole, postpetiole and gaster dark brown to blackish in colour, antennae, mandible, the upper half of mesosoma, legs yellowish-brown, pilosity white.

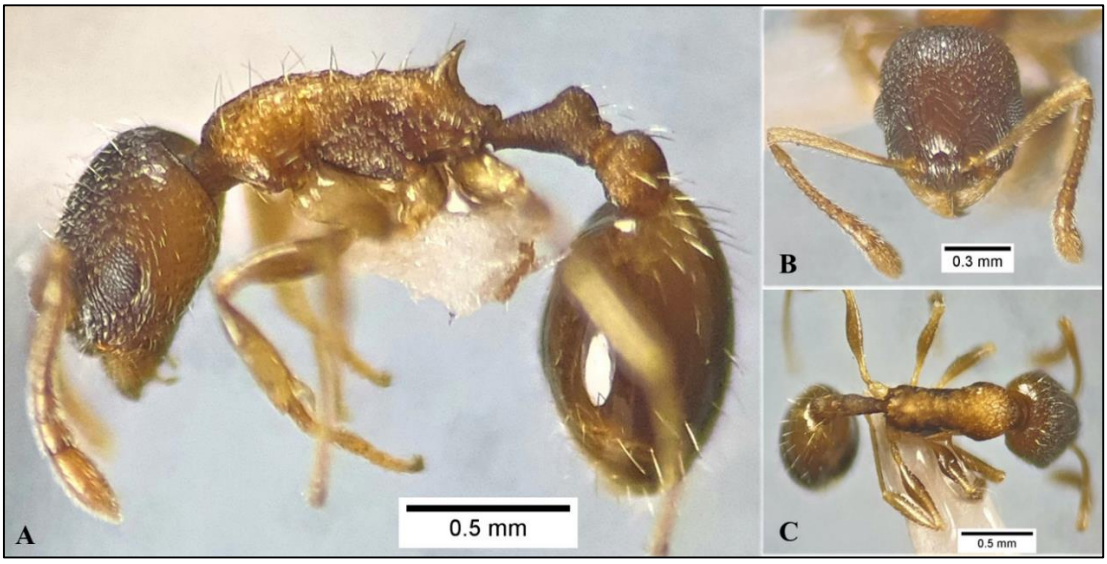

Figure 22: *Temnothorax pathibharensis* sp. nov. holotype worker, A. Habitus in profile view B. Head in full-face view C. Habitus in dorsal view

Measurements and indices, ordered as holotype (paratype): HL 0.74 (0.69), HW 0.63 (0.54), SL 0.64 (0.58), OL 0.18 (0.13), FRS 0.15 (0.14), AL 0.89 (0.81), AH 0.33 (0.28), PNW 0.36 (0.33), HTL 0.49 (0.50), PeL 0.31 (0.28), PeW 0.15 (0.14), PeH 0.21 (0.18), PPL 0.24 (0.19), PPW 0.19 (0.17), ESL 0.13 (0.13), CI 0.85 (0.78), SI1 0.87

(0.84), SI2 1.02 (1.08), OI1 0.25 (0.18), OI2 0.29 (0.23), PI 1.47 (1.54), PPI 1.21 (1.17), AI 2.67 (2.90), ESLI 0.20 (0.23).

Queens and males: unknown.

Bionomics: Specimens were collected from the east Himalayan *Abies* Forest in Nepal.

Distribution: Nepal: Pathibhara, Furrabhu, Taplejung district, eastern Nepal.

Etymology: The species is named after the type locality Pathibhara located in Nepal.

Differential diagnosis: The new species, *Temnothorax pathibharaensis* is closely related to *T. simlensis* (Forel, 1904), *T. rothneyi* (Forel, 1902) and *T. taplejungensis* sp. nov. However, it differs from first two species in a much longer scape, which reaches (or even slightly exceeds) the occipital margin of the head, while in *T. rothneyi* and *T. simlensis* the scape does not reach the occipital margin of the head. In addition, *T. pathibharaensis* sp. nov. is also distinguished by its longer and lower petiole and the shape of the propodeal spines etc. It is different from *taplejungensis* by the presence of long propodeal spines (ESLI 0.20–0.23), longer petiolar peduncle in contrast to short spines and short peduncle in *taplejungensis* (ESLI 0.12).

***Temnothorax taplejungensis* sp. nov.** (Figs. 23 A, B, C)

Material examined: Holotype. Worker (CDZMTU HymF113), Deurali, Fungling, Taplejung, eastern Nepal, 27.3653°N, 87.7277°E, 2653 m asl, 7.x.2020, B.R. Shrestha & T. Sherpa leg.

Worker description

Head: Head slightly longer than broad (CI 0.82) in full-face view; broadly rounded occipital corners, posterior head margin straight; eyes placed laterally roughly at the middle of the head; anterior clypeal margin broadly convex; mandibles subtriangular, armed with 5 teeth in its masticatory margin, apical tooth longest; antennae 12-segmented, scape moderately long (SL 0.47), clearly surpassing the posterior head margin.

Mesosoma: Mesosoma dorsum slightly convex anteriorly and roughly straight posteriorly; metanotal groove distinct but shallow; propodeal spines very short, dentate.

Petiole and postpetiole: Petiole longer than high with short anterior peduncle (PeL 0.19, PeH 0.17); in profile petiolar node with inclined and roughly straight anterior and

posterior faces and nearly rounded, thicker dorsum; postpetiolar node as high as a petiolar node, with the fairly rounded dorsum.

Gaster: Gaster roughly oval, smooth and shiny.

Sculpture and pilosity: Head with dense but fine longitudinal striations, except for the clypeus and gena which are smooth; mandibles with fairly marked longitudinal striations; Mesosoma rugulose, petiole and postpetiole with grainy sculpture; gaster smooth and shiny; suberect to erect hairs scattered over the whole body, hair sparse in mesosoma and denser in gaster; decumbent to suberect pubescent hairs on antennae, with denser hairs on funicular segments; decumbent pubescent hairs on legs.

Colour: Head and gaster dark brown to black in colour, pro-, meso- and metanotum, antennae, mandible, legs, petiole and postpetiole yellowish-brown, dark patch in the lower posterior half of mesosoma, pilosity white.

Measurements and indices: HL 0.57, HW 0.47, SL 0.47, OL 0.13, FRS 0.15, AL 0.67, AH 0.25, PNW 0.28, HTL 0.40, PeL 0.19, PeW 0.15, PeH 0.17, PPL 0.17, PPW 0.17, ESL 0.06, CI 0.82, SI1 0.83, SI2 1.0, OI1 0.22, OI2 0.26, PI 1.17, PPI 1.09, AI 2.67, ESLI 0.12.

Queens and males: unknown.

Figure 23: *Temnothorax taplejungensis* sp. nov. holotype worker, A. Habitus in profile view B. Head in full-face view C. Habitus in dorsal view

Bionomics: Specimen was collected from the east Himalayan Oak-Laurel Forest in eastern Nepal.

Distribution: Nepal: Deurali, Fungling, Taplejung district, eastern Nepal.

Etymology: The species is named after the type locality Taplejung district of Nepal.

Differential diagnosis: The new species, *Temnothorax taplejungensis* is closely related to *T. simlensis* and *T. pathibharaensis* sp. nov. However, it is different from *simlensis* by the presence of dense longitudinal rugae in the head, longer scapes surpassing the posterior margin of the head (*T. simlensis* lack dense longitudinal rugae on the head, shorter scapes barely reaching posterior head margin) and different from *pathibharaensis* by the presence of short, triangular propodeal spines (ESLI 0.12) and short petiolar peduncle in contrast to longer spines and peduncle in *pathibharaensis* (ESLI 0.20–0.23).

Keys to *Temnothorax* of Nepal based on worker caste

1. Humeri strongly developed and angulate in dorsal view. ……... ……..……..… ***Temnothorax nepalensis* sp. nov.**
- Humeri rounded, not projecting to any marked extent. ……...……..… 2
2. Propodeum without denticles or with very short blunt denticles, color uniformly brown to dark brown. ……..……... 3
- Propodeum with spines of variable length, color from uniformly yellow or bicolor with brown head and gaster ……..……..…. 4
3. Part of the head, as well as areas on the mesosoma largely smooth and shiny. ..... ***T. wroughtonii***
- Entire surface of head and mesosoma strongly rugulose. ……..… ……..…… ***T. kathmanduensis* sp. nov.**
4. Body uniformly yellow, scape short (SI1 0.65), propodeal spines straight and thin, weakly widened at base, directed upwards ……***T. buddha* sp. nov.**
- Body bicolor, at least head and gaster distinctly darker than mesosoma, scape long (SI1 0.83–0.87), propodeal spines curved and widened at base. . …….. 5
5. Petiolar peduncle and propodeal spines long (PeL 0.28–0.31, ESLI 0.20–0.23) ……..…..…… ***T. pathibharaensis* sp. nov.**
- Petiolar peduncle and propodeal spines short, triangular (PeL 0.19, ESLI 0.12). ……..…….. ***T. taplejungensis* sp. nov.**

***Aphaenogaster* NP-IPS-APH01** (Figs. 24 A, B, C)

Materials examined: Nagarjun Forest, SNNP, 27.7444–27.7452°N, 85.2667–85.2942°E, 1400–2094 m asl, hand/bait/pitfall collections, 1–6.v.2019, 22–24.x.2019, I.P. Subedi *et al*. leg. (CDZMTU HymF124); Shivapuri Forest, SNNP, 27.7911°N–27.8064°N, 85.3900°E–85.3711°E, 1650–2458 m asl, hand/bait/pitfall collections, 2–6.xi.2018, 3.xi.2021, 11.xii.2021, I.P. Subedi *et al*. leg. (CDZMTU HymF125); Sundarijal Forest, SNNP, 27.7928°N, 85.4356°E, 2175 m asl, pitfall collection, 16–18.xii.2020, I.P. Subedi *et al*. leg.

Worker description: Head longer than broad, roughly rounded occipital margins. Frontal carina short, just reaching anterior level of eye. Anterior clypeal margin convex. Eyes large positioned at the middle of the head. Mandibles elongated, roughly triangular and longitudinally striated. Scape long surpassing occipital margin by one-third of its length. Antennal club distinct. Mesosoma long and slender, mesonotum noticeably above the level of pronotum in profile, metanotal groove deep. Propodeum unarmed, lacking spines, teeth or tubercles. Petiolar peduncle long, node distinct, round. Postpetiole massive slightly longer than high, with sloping anterior and posterior surfaces. Gaster smooth and shiny.

Head dorsum weakly sculptured. Mesosoma mostly transversely striated, striations deep, pronotal dorsum smooth and shiny. Petiole and postpetiole smooth and shiny. Many long, erect, white hairs on head, pronotum, postpetiole and gaster, hair sparse on mesonotum, propodeum and petiole. Short erect hairs on trochanter, femur; short decumbent hairs on tibia. Color dark brown to black with lighter legs and antennae.

***Aphaenogaster* NP-IPS-APH02** (Figs. 25 A, B, C)

Materials examined: Nagarjun Forest, SNNP, hand/pitfall collections, 27.7458°N, 85.2856°E, 1666 m asl, 1–6.v.2019, 22–24.x.2019, I.P. Subedi *et al*. leg. (CDZMTU HymF126); Shivapuri Forest, SNNP, 27.7875°N, 85.3939°E, 1902 m asl, pitfall collection, 2–6.xi.2018, I.P. Subedi *et al*. leg. (CDZMTU HymF127); Sundarijal Forest, SNNP, hand/pitfall collection, 27.7697°N–27.7753°N, 85.4328°E–85.4250°E, 2175 m asl, 10.x.2020, 16–18.xii.2020, I.P. Subedi *et al*. leg.

Worker description: Head elongated, clearly longer than its width, posterior head margin rounded. Eyes present just beneath the middle of the head. Antennal club distinctly light in colour from other antennal segments. Antennal scape surpasses

posterior head margin by over one-third of its length. Mandible roughly triangular, longitudinally striated, eight teeth on masticatory margin. Anterior clypeal margin shallowly concave. Mesosoma long, metanotal groove distinct. Propodeum unarmed. Petiolar peduncle long, node distinct, postpetiole large. Gaster smooth and shiny.

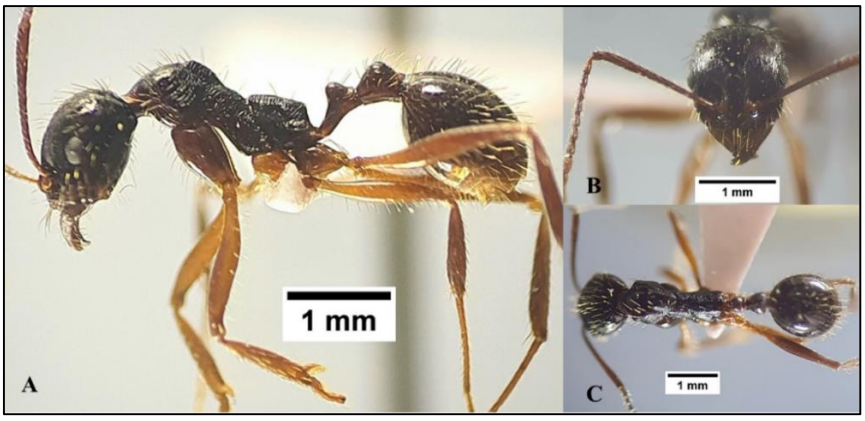

Figure 24: *Aphaenogaster* NP-IPS-APH01 A. Habitus in profile view B. Head in full-face view C. Habitus in dorsal view

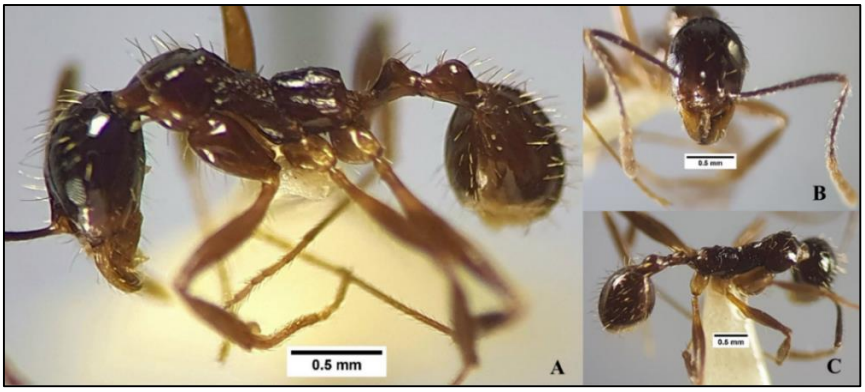

Figure 25: *Aphaenogaster* NP-IPS-APH02 A. Habitus in profile view B. Head in full-face view C. Habitus in dorsal view

Figure 26: *Aphaenogaster* NP-IPS-APH03 A. Habitus in profile view B. Head in full-face view C. Habitus in dorsal view

Body dark brown, almost uniformly colored with lighter mandibles, legs and antennal club. Head dorsum looks smooth, with superficial sculpturing under high power. Pronotum smooth and shiny, mesonotum and propodeum lightly sculptured. Petiole and postpetiole smooth and shiny. Many erect hairs on head, pronotum, petiole, postpetiole and gaster. Erect hairs very sparse on mesonotum and propodeum.

***Aphaenogaster* NP-IPS-APH03** (Figs. 26 A, B, C)

Materials examined: Shivapuri Forest, SNNP, 27.7911°N–27.8064°N, 85.3900°E–85.3711°E, 1650–2458 m asl, bait/pitfall collections, 2–6.xi.2018, I.P. Subedi *et al*. leg. (CDZMTU HymF128).

Worker description: Head longer than broad, occipital corners roughly rounded. Anterior clypeal margin roughly straight, very shallowly depressed at the middle. Eyes placed nearly at the middle of the head. Mandibles massive, roughly triangular and longitudinally striated, masticatory margin with 12 teeth. Scape long surpassing occipital margin nearly by half of its length. Antennal club distinct, lightly colored than the rest of the flagellar segments.

Mesosoma long and slender, metanotal groove present. Propodeal spines short. Petiolar peduncle very long, node distinct, nearly round. Postpetiole massive longer than high. Gaster smooth and shiny. Head and mesosoma heavily sculptured, sculpture not deep. Petiole and postpetiole smooth and shiny. Short, erect, white hairs on head and gaster, erect hair sparse on pronotum, mesomotum amd postpetiole, erect hairs lacking on propodeum and petiole. Head and mesosoma black in color, petiole, postpetiole and gaster dark brown, mandibles, legs and antennal lighter.

***Pheidole* NP-IPS-PHE01** (Figs. 27 A, B, C and 28 A, B, C)

Materials examined: Nagarjun Forest, SNNP, 27.7444°N, 85.2942°E, 1400 m asl, bait collection, 22.x.2019, I.P. Subedi leg. (CDZMTU HymF129).

Worker description: Minor: Head almost equal in length and width, mandible elongate, triangular, smooth and shiny. Clypeus short and smooth, anterior clypeal margin roughly convex. Posterior head margin straight with curving occipital margins. Eyes small. Antenna 12-segmented with 3-segmented club; antennal scape long surpasses posterior head margin by half of its length. Pronotum in profile convex, metanotal groove distinct, pronoto-mesonotal groove shallow, meso-metapleural suture distinct. Propodeal dorsum straight and declivity sloping in profile view, spines very

short. Petiolar peduncle long, node distinct, postpetiole short. Gaster smooth and shiny. Body with several erect hairs.

Major: Head almost equal in length and width, head with several longitudinal ridges. Mandible massive, roughly triangular, smooth and shiny. Clypeus short and smooth, anterior clypeal margin notched at the middle. Posterior head margin depressed at the middle. Eyes small. Antenna 12-segmented with 3-segmented club; antennal scape very short not reaching up to posterior head margin. Pronotum in profile raised high in the middle, metanotal groove distinct, pronoto-mesonotal groove shallow, meso-metapleural suture distinct. Propodeal dorsum straight and declivity sloping in profile view, spines moderately long. Petiolar peduncle long, node distinct, postpetiole short. Gaster smooth and shiny. Body with several erect hairs.

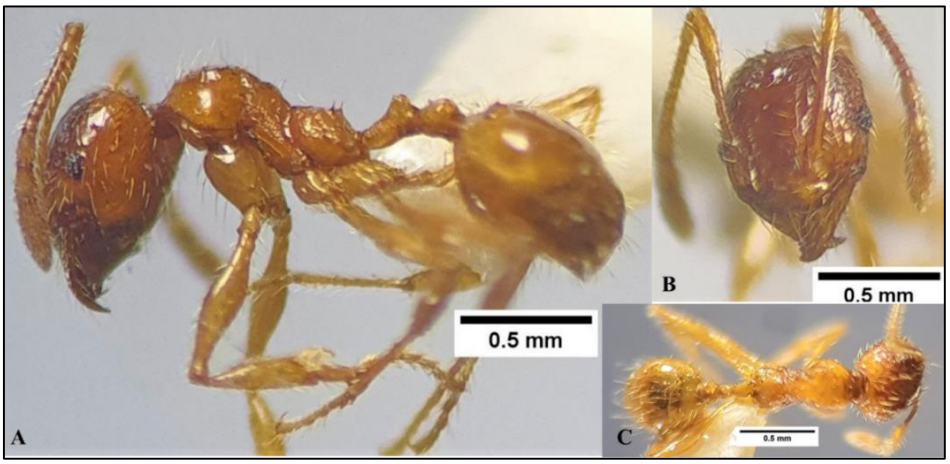

Figure 27: *Pheidole* NP-IPS-PHE01 minor A. Habitus in profile view B. Head in full-face view C. Habitus in dorsal view

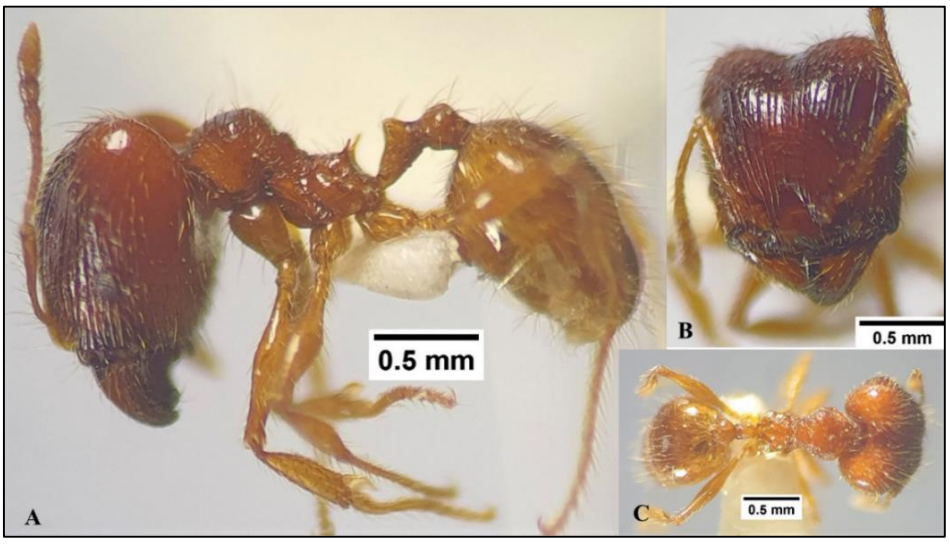

Figure 28: *Pheidole* NP-IPS-PHE01 major A. Habitus in profile view B. Head in full-face view C. Habitus in dorsal view

***Leptogenys* NP-IPS-LEP01** (Figs. 29 A, B, C)

Material examined: RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m asl, pitfall collection, I.P. Subedi leg. (CDZMTU HymF130).

Worker description: Head longer than wide, posterior head margins rounded. Eyes large. Antennae 12-segmented, scape surpasses the posterior margin by one-fifth of its length. Hairs dense on antennal scape. Head dorsum smooth and shiny, with few striations on the antreriorly. Clypeus ridged at the middle; anterior clypeal margin triangular. Longitudinal carina starting from antennal sockets extends up to the posterior margin of eyes. Mandibles elongated, longitudinal striated.

Pronotum forming a narrow neck anteriorly. Pronoto-mesonotal and meso-metapleural sutures distinct. Metanotal groove impressed. Mesosoma regularly rugose not striated. Pronotum, and petiole smooth. Propodeal declivity transversely striated. Petiole narrower towards the node. Gaster smooth and shiny. White erect hairs scattered through the body. Body dark brown in color with partly black gaster.

Figure 29: *Leptogenys* NP-IPS-LEP01 A. Habitus in profile view B. Habitus in dorsal view C. Head in full-face view D. Antenna in close up view

2.3.9 Redescription of *Emeryopone franzi* Baroni Urbani, 1975 (Figs. 14 A. B)

A Ponerine ant species, *Emeryopone franzi* was described from Nepal as *Belonopelta franzi* by Baroni Urbani (1975) based on a single worker collected from Pokhara, Kaski in 1971. Four specimens of the species were collected by pitfall trapping and hand collecting from Nagarjun Forest 48 years after its previous collection. Based on these recently collected materials, this endemic species of Nepal has been redescribed as follows:

Materials examined: 2 workers, Nagarjun Forest, SNNP, 27.7444°N, 85.2942°E, 1400 m asl, pitfall collection, 22–24.x.2019, I.P. Subedi, K. Chaudhary and A. Pandey leg. (CDZMTU HymF131); 1 worker, ibid, 1-3.v.2019, I.P. Subedi and R.P. Pokhrel leg.; 1 worker, Nagarjun Forest, 27.7487°N, 85.2736°E, 1912 m asl, hand collection, 1.v.2019, I.P. Subedi leg.

Measurements and indices (n=4): TL 4.88–5.88, WL 1.50–1.56, HL 1.00–1.06, HW 0.78–0.88, SL 0.78–0.81, PeL 0.39–0.42, PeH 0.56–0.63, PeW 0.44–0.50, PrW 0.59–0.63, ML 0.56–0.75, CI 78.13–87.50, MI 56.25–75.00, SI 89.29–104.00, PTI 116.67–145.45

Head: Head longer than broad (HL 1.00–1.06 mm, HW 0.78–0.88), with slightly convex lateral occipital margins and very weakly concave posterior margin. Clypeus broadly convex, having a median longitudinal lumpy pointed protrusion. Mandibles elongate-triangular, roughly as long as head, with a strongly curved outer margin and a masticatory margin containing 5 powerful teeth including a very long apical tooth, a medium subapical tooth and three relatively shorter teeth. Eyes very small (EL 0.5–0.6 mm), located laterally towards the anterior corner of head, near to mandibular base. Frontal lobes medium-sized, separated anteriorly by posterior clypeal extension. Frontal carina short and slightly visible, distinct median longitudinal furrow present. Antenna 12-segmented, with long scape (SL 0.78–0.81) just surpassing the posterior cephalic border, 3-segmented antennal club.

Mesosoma: Pronotum rounded anteriorly and convex laterally. Mesosoma forms a continuous weakly convex curve in profile. Promesonotal suture distinct. Metanotal groove obsolete, meso-metanotal suture well-marked on the pleura. Propodeum dorsum very weakly convex, nearly straight. Propodeal declivity obliquely truncate, shorter than dorsum. Propodeal spiracle round.

Petiole and Postpetiole: Petiolar node thick, roughly triangular in profile view, slightly convex anteriorly and nearly straight posteriorly, wider than long (PeW 0.44–0.50, PeL 0.39–0.42), with the well-developed subpetiolar process without window.

Gaster: Gaster elongate, having moderate girdling constriction between first and second gastral segments. Second gastral tergite moderately arched, making the gaster mildly curved downward. Sting long and strong. Medium tibiae with a single simple spur, hind tibiae with pectinate spur.

Sculpture and pilosity: Head and body foveolate, with very dense punctures on cephalic dorsum and gradually fewer punctures on mesosoma, petiole, and third abdominal segment. Distance between punctures shorter than puncture diameter. Pronotal dorsum and petiolar node finely and densely punctate. Lateral sides of mesosoma with sparse large punctures and feeble striation. Fourth abdominal segment, antennae, and legs with very thin and sub-lucid knurls. Mandibles smooth and shiny. Integument with abundant appressed pubescence all over the body. Dorsal part of head, antennae and legs without long hairs. Dorsa of vertex, mesosoma, and abdomen with suberect long hairs. Long bristles present on the anterior clypeal margin. A few short erect hairs on the mandible.

Color: Ferruginous or dark reddish-brown body with lighter legs, antennae and mandibles.

Remarks: The holotype of *Emeryopone franzi* has more strongly convex head margins in comparison to recently collected Nepalese specimens of *Emeryopone*. These specimens differ from holotype in having shiny, sparse and smaller foveae in the head and a little shorter petiole. These differences would fall within the range of intraspecific variations and thus determined as *E. franzi*. *Emeryopone franzi* is most closely related to *E. buttelreepeni* but differs from the latter by relatively larger size, longer antennal scape surpassing the posterior margin of the head, and subpetiolar process without anterior fenestra.

2.4 Discussion

The study used multiple collection methods including pitfall trapping, hand collecting, baiting, beating lower vegetation, sweeping, sifting leaf litter and soil cores, while adhering to the ALL Protocol (Agosti & Alonso, 2000). Pitfall trapping is the most commonly used ant sampling method (Schlick-Steiner *et al.*, 2006; Dunn *et al.*, 2007) and is an adequate method for providing reliable estimates of species composition (Andersen, 1991), however, this is highly debatable in particular within habitats in which leaf litter is present. The hand-collecting method may be the best choice for analyzing ant diversity because more pitfall traps are required to obtain the same amount of information, increasing the time-cost of sampling and sample processing (Abril & Gómez, 2013). This might be the case in areas with a low diversity of species and area with low habitat complexity, but in tropical and subtropical areas, hand collecting might serve as complementary method only. Leaf litter, sweeping, beating,

and general collecting procedures were described as the effective ways for obtaining the highest number of species from lowland and mid-elevation forests on Doudou mountains, Southwestern Gabon (Fisher, 2004). However, it is quite natural that some of the species may be overlooked that could have been collected through other methods. Thus, the study employed multiple methods to assure that the majority of ant species be collected.

The keys to subfamilies and genera of Nepal presented in this thesis are based on the worker caste (rather than queens or males) because the workers are most usually encountered caste during ant collection. The keys are relatively easy to follow, but a stereomicroscope is required to see the characters used in the keys. Additional identification materials and information should be checked for further confirmation, such as global identification keys (Bolton, 1994; Schmidt & Shattuck, 2014; Borowiec, 2016), regional keys if available for the specific group, original descriptions, and comparisons with type images.

A brief synoptic review of each of the 64 ant genera recorded in Nepal is provided. Generic synopses have been published for the ants of different countries or regions including the United States (Smith, 1943, 1947a), West Africa (Bolton, 1973), Vietnam (Eguchi *et al.*, 2011, 2014), and the Philippines (General & Alpert, 2012). Because the genus is a stable taxon and relatively easy to identify, generic level information may be highly valuable (Ward, 2007; Guénard *et al.*, 2010). Thus, using genus instead of species may aid in resolving the exceedingly difficult challenge of identifying ant specimens to the species level (Landeiro *et al.*, 2012). This would be adequate for many aspects of ecological research, such as determining distribution patterns across topographic gradients (Souza *et al.*, 2021). This synoptic review of ant genera should thus be a valuable resource for researchers interested in studying ants of Nepal.

This study documented six ant species that are new to science, and 69 species not previously recorded in Nepal. Many additional ant species are likely to be discovered and described in Nepal because Nepal has high habitat diversity, and relatively few taxonomic investigations have been undertaken in the country. Furthermore, due to the lack of regional keys or taxonomic revisions for some hyperdiverse genera, such as *Camponotus*, *Crematogaster*, and *Pheidole*, some of the ant specimens in this study have yet to be identified upto species level. Additionally, some specimens may belong to species that are not yet described.

This study describes a new ant species in the *Aenictus laeviceps* group, *A. nepalensis* sp. nov. from Nepal based on worker caste. In addition, the first records of *A. aitkenii* Forel, 1901, *A. binghamii* Forel, 1900, *A. fergusoni* Forel, 1901 and *A. hodgsoni* Forel, 1901 for Nepal are reported. Only a single *Aenictus* species, *A. sagei* Forel, 1901 was previously known from Nepal (Jaitrong & Ruangsittichai, 2018). The *Aenictus laeviceps* group was established by Wilson (1964) along with other four informal "groups" within the genus *Aenictus*. Jaitrong and Yamane (2011) revised the *A. laeviceps* group, listing 13 species from the eastern part of the Oriental region, as well as Indo-Australian and Australasian regions, seven of which were new descriptions. Jaitrong and Schultz (2016) described a new species of the *laeviceps* group, *A. shilintongae* from China. *A. laeviceps* group is similar in appearance to the *A. currax* and *A. leptotyphlatta* groups. The *Aenictus laeviceps* group is distinguished from the latter two by the following characteristics (Jaitrong & Yamane, 2011): roundly convex anterior clypeal margin bearing 5-12 denticles; occipital margin of the head rounded in full-face view; typhlatta spot usually located anterior to occipital corner in profile; and well-developed subpetiolar process with downwardly and backwardly directed apex. Several additional species of *Aenictus* are likely to be discovered or described from Nepal considering its high habitat diversity and location in the Central Himalaya.

Five new *Temnothorax* species are described based on this study. The workers and queen of *Temnothorax* can be diagnosed by the following characters (Bolton, 2003): clypeus with weak median emargination and median carina; maxillary stipes lacking transverse crest; 11–12 segmented strongly clavate antennae with distinct 3-segmented club; frontal carinae, antennal scrobes and median isolated clypeal seta absent. Seventeen species and one subspecies of *Temnothorax* are known from the Himalayan region (Bharti *et al.*, 2012, 2016b; Rasheed *et al*., 2020; Yusupov *et al.*, 2020a, b).

2.5 Conclusions

This study produced a generic synopsis of 64 ant genera from nine subfamilies in Nepal. Identification keys for ant subfamilies and genera of Nepal based on the worker caste were developed. During this research, 14 new ant generic records were documented, 11 of which have been published in papers based on this study. The images of head in full-face and habitus in profile-view aid in validating the records. Six species, *Temnothorax kathmanduensis* sp. nov., *T. taplejungensis* sp. nov., *T. pathibharensis* sp. nov., *T. buddha* sp. nov., *T. nepalensis* sp. nov., and *Aenictus nepalensis* sp. nov. are described

as new to science. Other potentially new species include three *Aphaenogaster* species and one each of *Leptogenys* and *Pheidole*. *Emeryopone franzi* is redescribed based on new specimen collections. The study provides major contributions by adding numerous taxa to the list of Nepalese myrmecofauna. The considerable increase in generic and species richness ascribed to this study is attributable, in part, to the diverse sampling methods used. Given the significance of ants in the ecosystem, this work sought to fill in research gaps in ant exploration in Nepal. By doing so, it will aid researchers who are interested in advancing their study of ant biodiversity and, eventually, in understanding Nepal's biodiversity more broadly and in conservation efforts.

CHAPTER 3

3. CHECKLIST OF ANT SPECIES OF NEPAL WITH TAXONOMIC ANNOTATIONS

Abstract

As a first step in understanding species richness and distribution patterns, as well as for the progress of taxonomy and systematics, a trustworthy and comprehensive species checklist is essential. The checklist of ant species of Nepal was prepared by identifying ant specimens collected from sampling across Nepal, as well as by compiling previously published data on ant species in Nepal. The checklist of ants of Nepal includes nine subfamilies, 64 genera, and 186 nominal species. Myrmicinae is the most diverse of the nine subfamilies, with 21 genera and 72 species, followed by Formicinae (14 genera and 59 species), Ponerinae (13 genera and 27 species), Dorylinae (5 genera and 10 species), Dolichoderinae (6 genera and 9 species), Pseudomyrmecinae (1 genus and 6 species), and Amblyoponinae, Ectatomminae and Leptanillinae, with 1 genus and 1 species each. Ten species are endemic to Nepal, while 22 have a type locality in Nepal. Sixty-nine species are new species records for Nepal obtained during this study accounting for more than one-third of all known species. The checklist also includes the type locality of each species, distribution data in Nepal and their worldwide distribution, and taxonomic annotations for all newly recorded species.

3.1 Introduction

A species checklist documents the taxonomic knowledge of a set of organisms in a certain location and during a specific period of time (Alonso & Agosti, 2000). A checklist supplements species distribution databases and aids in finding information gaps and range expansions (Gasper *et al.*, 2016). A checklist provides an essential baseline for macro-ecological investigations, species distribution modeling, and conservation strategies (Gasper *et al.*, 2016). Understanding the existing state of biota provides a foundation for conservation actions, making checklists important tools for species conservation (Pfeiffer *et al.*, 2011). Thus, a reliable and comprehensive species checklist is required as a first step to understanding species diversity and patterns of distribution. A species checklist is also important as the basis for the advancement of taxonomy and systematics.

Ant species checklists for different South Asian and South East Asian countries have previously been published, including for India (Bharti *et al.*, 2016a), China (Guénard & Dunn, 2012), Bhutan (Dendup *et al.*, 2021), Pakistan (Rasheed *et al.*, 2019), Sri Lanka (Dias *et al.*, 2020), Thailand (Khachonpisitsak *et al.*, 2020), Laos (Jaitrong *et al.*, 2016), Vietnam (Eguchi *et al.*, 2011, 2014). Checklists are also prepared and published for specific geographical territories/provinces within the wider political boundary of a country such as for, Yunnan Province (China) (Liu *et al.*, 2015), Hengduan mountains (China) (Liu *et al.*, 2020) and isolated Islands within Borneo (Brunei, Malaysia and Indonesia) (Pfeiffer *et al.*, 2011). Global ant diversity data are also accessible online, in websites including AntWeb https://www.antweb.org/, AntWiki https://www.antwiki.org/, and antmaps https://antmaps.org/ However, there is a discrepancy in concerning the reported number, identity and locations of ant species in Nepal. The number and identity of stated Nepalese ant taxa vary in the different online databases: 41 genera and 91 species/subspecies are listed in AntWiki (2022), 46 genera and 101 species/subspecies are listed in AntWeb (2022) and 54 genera, and 157 species are listed in antmaps.org (2022). The data in these databases need updating and verification for certain entries. The ant species checklist presented here will contribute to clarifying the species numbers and list on these websites.

The Nepalese myrmecofauna is most likely far more diverse than we currently know, and we should predict a significantly greater number of ant species as more data is collected in new locations. Beginning in 1906 with the discovery of two species, taxonomic research on ants in Nepal has resulted in the description of 23 species to date, 22 of which are still valid species (Subedi & Budha, 2020b; Williams, 2022). *Perissomyrmex nepalensis* described from Nepal is now a junior synonym of *P. monticola* (Xu & Zhang, 2012). Specimens of species listed prior to the commencement of this study were not accessible to examine since their depositions are in foreign museums. However, the images of the type materials of species described from Nepal available on Antweb (2022) were examined.

The ant fauna of Nepal is highly diverse but still poorly known. This study makes a significant contribution to our knowledge of Nepalese ants, focusing on the ant diversity of several specific study areas as well as summarizing ant species data for the entire country. This approach has resulted in a comprehensive summary of ant diversity as well as the identification of information gaps. This study also contributes to a better

understanding of ant diversity patterns across the country, as well as identification of priority conservation areas for ants and other insects. This work provides the most comprehensive faunal inventory of ants yet documented from Nepal. Sixty-nine species (over one-third of all recognized species) are new species records for Nepal, six species are described as new to science, and another five species are likely new to science are briefly introduced. The high increase in species richness due to this study is attributable, in part, to the diverse set of sampling methods used, since many past studies relied mainly on manual collecting.

As part of this broader study of ants of Nepal, a checklist of ant species was compiled, with taxonomic annotations. This checklist will serve as an essential baseline for the study of myrmecofauna of Nepal, sparking additional studies on ant diversity in Nepal.

3.2 Materials and methods

The checklist of ant species of Nepal was prepared on the basis of the identification of ant specimens collected for a broader study of ants of Nepal from various locations across Nepal (The second chapter of this thesis contains detail information about the study area, data collection techniques and identification) and also by compiling previously published data on ant species in Nepal. Global distribution records of ant species are presented at the country level except for large Islands such as Borneo, Sumatra, and New Guinea. Unless otherwise specified, the distribution records are derived from data accessible from the Global Ant Bioinformatics project (Janicki *et al.*, 2016; Guénard *et al.*, 2017). Presenting location data by geopolitical entities is appropriate, owing to the fact that data records in most publications and from specimen labels at the museum are organized by geopolitical regions such as a country, island, state, and province (Guénard *et al.*, 2010).

Subfamilies, genera in each subfamily, and species in each genus are ordered alphabetically. The type locality for each species is also given. Based on data availability, the species checklist gives the distribution of the species within Nepal, including district, precise place, latitude, longitude, altitude, as well as the collectors' names and location of the depositories of any ant specimens. Only valid species are included in the list, whereas morphospecies and undescribed species are excluded. Species validity, spellings, and authorships follow Bolton (2022). Material/s examined are mentioned for newly recorded species for the country (indicated by * in the list below `), and newly recorded distribution data for the country for every species

collected or examined during this investigation. Short taxonomic notes are provided for all newly recorded species and when relevant, there are also notes for other species. A checklist of ant species of Nepal with biogeographic elements, available provincial distribution, and functional groups classification of each species is provided in Appendix (Appendix III). Ant species described from Nepalese specimens, new country records based upon this study, tramp species, and the species endemic to Nepal are also indicated in the list (Appendix III). The main list of ant species excludes any ant species that are not supported by specimen or literature records, have unverified references, or both, and are labeled as dubious/unverified records.

The depositories referenced in this checklist are abbreviated as follows:

ANIC "Australian National Insect Collection, Canberra, Australia".

AMNH "American Museum of Natural History, New York City, USA".

CASC "California Academy of Sciences, San Francisco, California".

CDZMTU "Central Department Zoology Museum of Tribhuvan University, Nepal".

ELMES "Collection of GW Elmes, UK".

JTLC "John T. Longino personal collection, University of Utah, Utah, USA".

KGAC "Kiko Gómez Abal collection, Barcelona. Spain".

MARTENS "University of Mainz, Germany (Private Collection of Martens)".

MCZC "Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA".

MHNG "Muséum d'Histoire Naturelle, Geneva, Switzerland".

MSNG "Museo Civico di Storia Naturale "Giacomo Doria", Genoa, Italy".

NHMB "Naturhistorisches Museum, Basel, Switzerland".

NHMUK "The Natural History Museum, London, United Kingdom".

NHMW "The Natural History Museum Vienna, Austria".

PSWC "Philip S. Ward collection, California, USA".

SCHULZ "Ted Schulz private collection, Washington DC, USA".

SIZK "Schmalhausen Institute of Zoology of the Ukrainian National Academy of Sciences, Kiev".

UCDC "Bohart Museum of Entomology, University of California, Davis".

USNM "United States National Museum of Natural History, Washington DC".

3.3 Results

3.3.1 Species and generic diversity

The checklist of ant species of Nepal (below) contains nine subfamilies, 64 genera and 186 nominal species. The subfamilies recorded from Nepal are Amblyoponinae, Dolichoderinae, Dorylinae, Ectatomminae, Formicinae, Leptanillinae, Myrmicinae, Ponerinae and Pseudomyrmecinae. During the study, seven subfamilies, 55 genera, and 129 nominal species were examined. The species and generic richness of each subfamily are summarized in Table 13.

Table 13: Nominal species of ants of Nepal per genus and subfamily

Subfamily	Genus	Number of species
Amblyoponinae (1 genus, 1 species)	*Stigmatomma*	1
Dolichoderinae (6 genera, 9 species)	*Chronoxenus*	2
	Dolichoderus	2
	Iridomyrmex	1
	Ochetellus	1
	Tapinoma	1
	Technomyrmex	2
Dorylinae (5 genera, 10 species)	*Aenictus*	5
	Cerapachys	1
	Dorylus	2
	Ooceraea	1
	Parasyscia	1
Ectatomminae (1 genus, 1 species)	*Stictoponera*	1
Formicinae (15 genera, 59 species)	*Acropyga*	1
	Camponotus	16
	Cataglyphis	1
	Colobopsis	3
	Formica	3
	Lasius	4
	Lepisiota	7
	Oecophylla	1
	Nylanderia	5
	Paraparatrechina	0
	Paratrechina	1
	Plagiolepis	1
	Polyrhachis	11
	Prenolepis	4
	Pseudolasius	1
Leptanillinae (1 genus, 1 species)	*Leptanilla*	1
Myrmicinae (21 genera, 72 species)	*Aphaenogaster*	5
	Cardiocondyla	7

	Carebara	4
	Cataulacus	1
	Crematogaster	3
	Lophomyrmex	1
	Lordomyrma	1
	Mayriella	1
	Meranoplus	3
	Monomorium	3
	Myrmica	16
	Myrmicaria	1
	Perissomyrmex	1
	Pheidole	6
	Pristomyrmex	1
	Recurvidris	1
	Stenamma	1
	Strumigenys	10
	Temnothorax	1
	Tetramorium	4
	Trichomyrmex	1
Ponerinae (13 genera, 27 species)	*Bothroponera*	1
	Brachyponera	3
	Buniapone	1
	Centromyrmex	1
	Diacamma	5
	Ectomomyrmex	2
	Emeryopone	1
	Harpegnathos	1
	Hypoponera	1
	Leptogenys	6
	Odontomachus	1
	Odontoponera	2
	Pseudoneoponera	2
Pseudomyrmecinae (1 genus, 6 species)	*Tetraponera*	6
9 subfamilies	**64 genera**	**186**

Of the nine subfamilies, Myrmicinae is the most diverse with 21 genera and 72 nominal species which is followed by Formicinae (15 genera and 59 species), Ponerinae (13 genera and 27 species), Dorylinae (5 genera and 10 species), Dolichoderinae (6 genera and 9 species), Pseudomyrmecinae (1 genus and 6 species), Amblyoponinae, Ectatomminae and Leptanillinae (1 genus and 1 species) (Table 13). The most speciose Nepalese ant genera are *Camponotus* and *Myrmica* with 16 species each. The other more diverse genera include *Polyrhachis* (11 species), *Strumigenys* (10), *Lepisiota* (7), *Cardiocondyla* (7), *Aphaenogaster* (6), *Pheidole* (6), *Tetraponera* (6), *Leptogenys* (6),

Aenictus (5), *Nylanderia* (5), and *Diacamma* (5). Three genera are represented by four species each, six genera by three species each, seven genera by two species each, and the other thirty-three genera are each represented by a single species. This study reported 14 genera and 69 species as new records for Nepal, of which 11 genera and 36 species have already been documented in publications based on this study (Subedi *et al.*, 2020, 2021 a, b, c, 2022 a, b, c; Subedi, 2021). Taxonomic notes on all newly recorded species are provided in the annotated species checklist below. The checklist contains 10 species endemic to Nepal. Among the ant species in the checklist, 22 have a type locality from Nepal.

3.3.2 Checklist of ant species of Nepal, with taxonomic annotations

Family: Formicidae Latreille, 1809 (Type genus: *Formica* Linnaeus, 1758)

3.3.2.1 *Subfamily: Amblyoponinae* (1 genus and 1 species)

***Stigmatomma pertinax* (Baroni Urbani, 1978)**

Type locality: Chim Khona near Ghum, Darjeeling, India (Baroni Urbani, 1978).

Distribution: Nepal, India (Baroni Urbani, 1978).

Nepal: Maiwakhola, Sanghu, Taplejung, Oak forest litter, K.H. Hyatt leg., 26.x.1961, F.A. Esteves det., 19.vi.2017, NHMUK (AntWeb, 2022).

3.3.2.2 *Subfamily: Dolichoderinae* (6 genera and 9 species)

***Chronoxenus dalyi* (Forel, 1895)**

Type locality: Conoor, Tamilnadu, India (Forel, 1895).

Distribution: Afganistan, Bangladesh, China, India, Malaysia, Nepal, Singapore (Forel, 1895; Guénard *et al.*, 2017).

Nepal: Tate, Solukhumbu, 2900 m, H. Janetschek leg., iv–vi.1961 (Collingwood, 1970).

Notes: This species was documented as *Bothriomyrmex dalyi* in Collingwood (1970). Heterick and Shattuck (2011) transferred *B. dalyi* into the genus *Chronoxenus*.

****Chronoxenus wroughtonii* (Forel, 1895)** (Figs. 6 A, B)

Type locality: Pune, Maharashtra, India (Forel, 1895).

Distribution: Nepal (new record), Afghanistan, China, India, Malaysia, Philippines, Singapore, Sri Lanka, Taiwan (Guénard *et al.*, 2017).

Material examined: Shivapuri Forest, SNNP, 27.7919°N, 85.3848°E, 2165 m, pitfall collection, 3-5.xi.2018, I.P. Subedi and K. Chaudhary leg. (CDZMTU HymF132).

Notes: These ants are very small, brownish yellow, and covered with light pubescence, which is particularly abundant on the gaster. The clypeus is large and subtriangular, with a roughly arched anterior margin. Antennae are thick and the scape surpasses the posterior head margin. Mesosoma is short and wide, with distinct sutures. The legs are stout, and the gaster is broadly oval.

***Dolichoderus affinis* Emery, 1889** (Figs. 6 C, D)

Type locality: Tenasserim, Thagata, Kawkareet, Myanmar (Emery, 1889).

Distribution: China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Philippines, Thailand, Vietnam, (Shattuck, 1994; Dill, 2002; Guénard *et al*., 2017).

Nepal: Locality unknown, NHMUK (Dill, 2002).

Materials examined: RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, 22.x.2021, I.P. Subedi leg.; TUC, Kirtipur, Kathmandu, 27.6814°N, 85.2831°E, 1330 m, 29.v.2019, I.P. Subedi leg.

Notes: This species may be diagnosed by its noticeably sharp-edged propodeal posterodorsal margin and distinctly concave propodeal declivity.

***Dolichoderus taprobanae* (Smith, 1858)**

Type locality: Ceylon, Sri Lanka (Smith, 1858).

Distribution: Bangladesh, Borneo, China, India, Laos, Myanmar, Nepal, Sri Lanka, Vietnam (Guénard *et al.*, 2017; AntWeb, 2022).

Nepal: 16 km NE Tumlingtar, Sankhuwasabha, 27.4167°N, 87.3167°E, 740 m, C. Carpenter leg., 8.v.1991, PSWC (Subedi *et al.*, 2020; AntWeb, 2022).

Materials examined: Sauraha, Chitwan, hand collection, 10.iii.2013, I.P. Subedi leg.

***Iridomyrmex anceps* (Roger, 1863)** (Figs. 6 E, F)

Type locality: Malacca, Malaysia (Roger, 1863).

Distribution: Tramp species found in Australian mainland, as well as throughout the Pacific (reported from many south and southeast Asian nations such as China, India, Nepal, Malaysia, Thailand, Sri Lanka, Vietnam, Laos), and several Pacific islands (Heterick & Shattuck, 2011).

Nepal: Gorkha, viii.1996, A.R. Sthapit leg. (Joshi & Manandhar, 2001; Thapa, 2015)

Materials examined: Tanahun, Sal Forest, 27.5922°N, 84.1605°E, 418 m, 30.ix.2020, P.B. Budha and P. Shrestha leg.; Salleri Chyandada, Panchthar, Pine Forest, 27.1845°N, 87.7559°E, 1422 m, 15.x.2020, B.R. Shrestha and T. Sherpa leg.

***Ochetellus glaber* (Mayr, 1862)** (Figs. 6 G, H)

Type locality: New South Wales, Australia (Mayr, 1862).

Distribution: Tramp species found in Asutralasian (Australia, New Zealand), Indo-Australian (Borneo, Philippines), Nearctic (USA), Oriental (India, Sri Lanka, Nepal) and Palaearctic (China, Japan, Korea) regions (Guénard *et al.*, 2017; Subedi *et al.*, 2021c).

Materials examined: TUC, Kirtipur, Kathmandu, 27.6814°N, 85.2831°E, 1330 m, 29.v.2019, I.P. Subedi leg. (CDZMTU HymF133); Salleri Chyandada, Panchthar, Pine Forest, 27.1837°N, 87.7538°E, 1455 m, 15.x.2020, B.R. Shrestha and T. Sherpa leg.

Notes: *Ochetellus glaber* is a ubiquitous tramp species, however, a recent comparative analysis of morphometrics and images revealed that it is a species complex native to many regions (Hoffmann *et al.*, 2011). Images of the species from different regions exhibit variations in scape length, body sculpturing, pilosity and coloration (AntWeb, 2022). This species is documented in Subedi *et al.* (2021c) as a new record for Nepal. Nepalese specimens are small, with antennal scape just reaching the occipital margin, not strongly sculptured, and are blackish in color with lighter legs and gaster.

***Tapinoma melanocephalum* (Fabricius, 1793)** (Figs. 6 I, J)

Type locality: Cajennae, French Guinea (Fabricius, 1793).

Distribution: Spread over the Old and New Worlds, in both the northern and southern hemispheres, encompassing over 154 geographical areas (Wetterer, 2009b).

Materials examined: Budhitola, Kailali, Sal Forest, 28.9252°N, 80.5701°E, 937 m, 15.x.2020 (CDZMTU HymF134); Godawari, Kailali, Riverine Forest, 28.8721°N, 80.5711°E, 245 m, 17.x.2020; Binayi Triveni, Ghumti, Nawalpur, Sal Forest, 27.5758°N, 83.8925°E, 183 m, 3.x.2020; Madhyabindu, Chaliskilo, Nawalpur, Sal Forest, 27.6226°N, 84.0597°E, 196 m, 4.x.2020; Tanahun, Sal Forest, 27.5922°N, 84.1605°E, 418 m, 30.ix.2020; Ratanpur, Bhanu, Tanahun, Champ plantation,

28.0851°N, 84.3895°E, 813 m, 29.ix.2020; Beshishahar, Naruwal, *Schima-Castanopsis* Forest, 28.1880°N, 84.3930°E, 930 m, 1.x.2020, P.B. Budha and P. Shrestha leg.

Notes: The ghost ant *T. melanocephalum* is one of the most widely distributed indoor and outdoor pest species. Wetterer (2009b) mapped the worldwide spread of this species. This species may be diagnosed by distinctly bicolored body with variable tone, spatulate maxillary palps with widened and flattened 3rd and 4th segments, and 5th segment inserted into the ventral face of 4th segment (Guerrero, 2018). Recent analysis of worker samples of Ghost ants from all around the globe indicated that there are two species, with over 90% of the samples being identified as *T. melanocephalum* (Seifert, 2022). This species is documented in Subedi *et al.* (2021c) as a new record for Nepal.

***Technomyrmex elatior* Forel, 1902** (Figs. 6 K, L)

Type locality: Assam, India (Forel, 1902c).

Distribution: Brunei, China, Combodia, India, Indonesia, Italy, Malaysia, Nepal, Philippines, Singapore, Sri Lanka, Vietnam (Guénard *et al.*, 2017)

Nepal: Pokhara, Kaski, roadside edge, bipinnate legume, 28.2167°N, 83.9667°E, 760 m, P.S. Ward leg., 10.xii.1988, Bolton det., 31.xii.2006, PSWC (AntWeb, 2022).

Materials examined: RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, pitfall collection, 15.x.2019, I.P. Subedi and R.P. Pokhrel leg.; Banbehada, Kailali, Sal Forest, 28.8180°N, 80.6789°E, 204 m, 18.x.2020, P.B. Budha and P. Shrestha leg.

***Technomyrmex obscurior* Wheeler, 1928**

Type locality: Yi Leang, Yunnan, China (Wheeler, 1928).

Distribution: China, Myanmar, Nepal (Guénard *et al.*, 2017).

Nepal: 4 km SSW Pokhara, *Schima-Castanopsis* Forest, under stone, 28.2000°N, 83.9667°E, 900 m, P.S. Ward leg., 10.xii.1988, Bolton det., 31.xii.2006, PSWC (AntWeb, 2022).

Materials examined: Nagarjun Forest, SNNP, 27.7444°N, 85.2942°E, 1400 m, pitfall and bait collection, 22–24.x.2019, I.P. Subedi leg.; Tanahun, Sal Forest, 27.5922°N, 84.1605°E, 418 m, 30.ix.2020, P.B. Budha and P. Shrestha leg.; Rhoga, Dama, Ilam, Sal Forest, 26.7650°N, 88.0401°E, 302 m, 15.x.2020, B.R. Shrestha and T. Sherpa leg.; Baikunda, Panchthar, Sal Forest, 27.1435°N, 87.6981°E, 613 m, B.R. Shrestha and T. Sherpa leg.

3.3.2.3 *Subfamily: Dorylinae* (5 genera and 10 species)

***Aenictus aitkenii* Forel, 1901** (Figs. 30 A, B)

Type locality: Kanara, Karnataka, India (Forel, 1901).

Distribution: Nepal (new record), India, Sri Lanka (Shattuck, 2008).

Materials examined: Sundarijal Forest, SNNP, 27.7732°N, 85.4271°E, hand collection and litter sifting, 10.x.2020, I.P. Subedi leg. (CDZMTU HymF135).

Notes: These ants have entirely sculptured head, largely striated mesososma, dentate propodeum, densely punctate, broad and bulbous petiole and postpetiole, well-developed subpetiolar process, and smooth and shiny gaster. Scape clearly surpasses the posterior head margin. Body is black with dark reddish-brown antennae, head, legs, petiole and postpetiole.

***Aenictus binghamii* Forel, 1900** (Figs. 30 C, D)

Type locality: Burma, Myanmar and Assam, India (Forel, 1900b).

Distribution: Nepal (new record), Laos, Myanmar, Thailand, Vietnam (Jaitrong & Yamane, 2011)

Materials examined: Shivapuri Forest, SNNP, 27.7911°N, 85.3711°E, 1650 m, hand collection, 4.xi.2018, I.P. Subedi leg., (CDZMTU HymF136).

Notes: The workers have entirely shiny head and sculptured mesosoma, opaque pronotum entirely with fine and dense reticulation and microreticulate femora of all legs. The identification is based upon the key and species description in Jaitrong and Yamane (2011).

***Aenictus fergusoni* Forel, 1901** (Figs. 30 E, F)

Type locality: Kerala (Travancore), India (Forel, 1901).

Distribution: Nepal (new record), Bangladesh, China, India, Myanmar, Nicobar Island, Sri Lanka, Thailand, Vietnam (Guénard *et al.*, 2017).

Materials examined: TUC, Kirtipur, Kathmandu, 27.6814°N, 85.2831°E, 1330 m, *Salix* Forest, hand collection, 5.i.2016, I.P. Subedi leg. (CDZMTU HymF137); Champa Devi trail, 27.6319°N, 85.2697°E, 1850 m, pitfall collection, ix.2018, R.P. Pokhrel leg.

Notes: *Aenictus fergusoni* was diagnosed by entirely punctate propodeum, slightly convex propodeum in profile and a distinct transverse carina in propodeal declivity.

***Aenictus hodgsoni* Forel, 1901** (Figs. 7 A, B)

Type locality: Moulmain, Myanmar (Forel, 1901).

Distribution: Nepal (new record), Cambodia, China, Hong Kong, Indonesia, Laos, Myanmar, Thailand, Vietnam (Jaitrong & Yamane, 2011).

Materials examined: Nagarjun Forest, SNNP, 27.7444°N, 85.2942°E, 1400 m, pitfall collection, 22–24.x.2019, I.P. Subedi and R.P. Pokhrel leg. (CDZMTU HymF138); Nagarjun Forest, SNNP, 27.7458°N, 85.2856°E, 1665 m, hand collection, 22.x.2019, I.P. Subedi leg.

Notes: The workers were diagnosed by partly smooth and shiny propodeum, dorsally nearly straight propodeum in profile, and lack of transverse carina in propodeal declivity. The specimens were collected by pitfall trap and hand collection of foragers from *Schima wallichii*, *Castanopsis* and *Pinus* forests partly covered by leaf litter. This record represents an extension of the known range of the species from South East Asia.

***Aenictus sagei* Forel, 1901**

Type locality: Dharmsala, Himanchal Pradesh, India (Forel, 1901).

Distribution: India, Nepal, Afghanistan (Jaitrong & Ruangsittichai, 2018).

Nepal: Locality unknown (Jaitrong & Ruangsittichai, 2018)

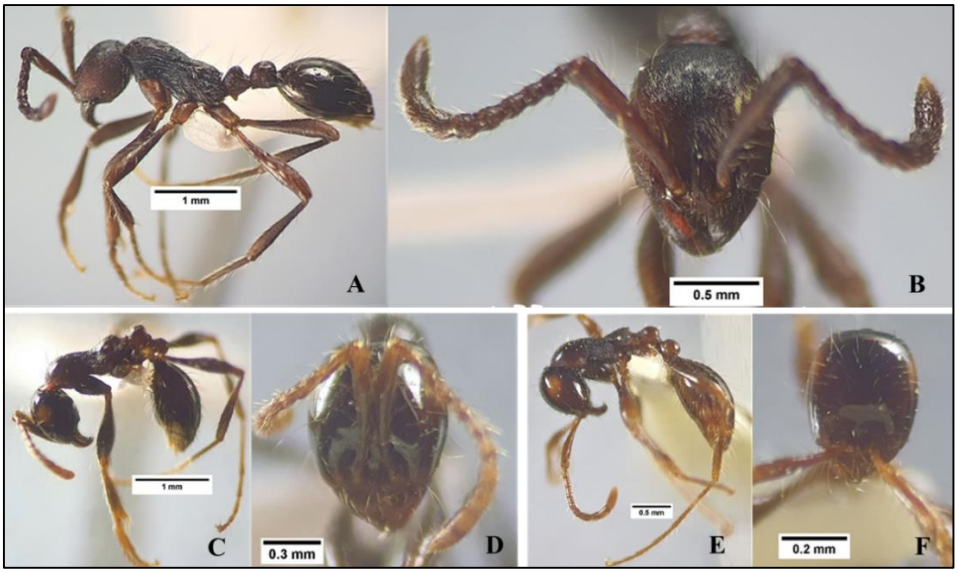

Figure 30: Profile and full-face images of *Aenictus* **A, B** *A. aitkenii* **C, D** *A. binghamii* **E**, **F** *A. fergusoni*

***Cerapachys sulcinodis* Emery, 1889** (Figs. 7 C, D)

Type locality: Tenasserim, Mt. Mooleyit, Myanmar (Emery, 1889).

Distribution: Borneo, China, India, Indonesia, Laos, Malaya peninsula, Myanmar, Nepal, Philippines, SE Asia, Thailand, Vietnam (Bingham, 1903; Brown, 1975; Guénard & Dunn, 2012; Bharti & Akbar, 2013a; Subedi *et al*., 2021a).

Nepal: Nagarjun Forest, SNNP (Subedi *et al*., 2021a).

Material examined: Nagarjun Forest, SNNP, 27.7487°N, 85.2736°E, 1912 m, pitfall collection, 13–15.iv.2019, I.P. Subedi leg. (CDZMTU HymF139).

Notes: The worker is small, black with brown legs and antennae, rectangular head, sparsely punctured cephalic dorsum, large eyes, striated mandibles, 12-segmented clavate antennae with short scape, compact mesosoma, petiole longer than broad with dorsum rounding into sides, smooth median area on the dorsal surface of petiolar node, postpetiole slightly wider behind, elongated gaster, sparsely scattered white erect hairs. This species is documented in Subedi *et al*. (2021a) as a new record for Nepal.

***Dorylus labiatus* Shuckard, 1840**

Type locality: Assam, Maharastra, India (Shuckard, 1840).

Distribution: Bangladesh, China, India, Nepal, Pakistan, Sri Lanka (Guénard *et al.*, 2017).

Nepal: Khumaltar, Lalitpur, on Cauliflower, i.1962, D.R. Sharma leg. (Joshi & Manandhar, 2001; Thapa, 2000).

***Dorylus orientalis* Westwood, 1835** (Figs. 7 E, F)

Type locality: India (Westwood, 1835).

Distribution: Bangladesh, Borneo, China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Pakistan, Sri Lanka, Thailand, Vietnam (Guénard *et al.*, 2017).

Nepal: Kathmandu, iv–vi.1961, viii.1970, N. Kumar leg.; near Banepa, Kavrepalanchok, 1420 m, Namdu, Dolakha, 1400 m, Sikris, 2250 m (Collingwood, 1970; Joshi & Manandhar, 2001; Thapa, 2015).

Materials examined: TUC, Kathmandu, *Salix* Forest, pitfall trap, 27.6814°N, 85.2831°E, 1330 m, I.P. Subedi leg.

***Ooceraea biroi* (Forel, 1907)** (Figs. 7 G, H)

Type locality: Singapore (Forel, 1907).

Distribution: Recorded from over 24 countries and Island groups (Wetterer *et al.*, 2012).

Nepal: Amlekhganj, Bara, E.I. Coher leg. (Wilson & Taylor, 1967).

Material examined: Lahachok, Pokhara, 28.5167°N, 83.8667°E, S. Adhikari leg.

Notes: This pantropical tramp species was first documented in Wilson and Taylor (1967) as *Syscia sylvestrii* from Nepal.

***Parasyscia wighti* (Bharti & Akbar, 2013)** (Figs. 7 I, J)

Type locality: Silent Valley National Park, Kerala, India (Bharti & Akbar, 2013a)

Distribution: Nepal, India (Bharti & Akbar, 2013a).

Nepal: RCF, Kathmandu (Subedi *et al.*, 2021a).

Materials examined: RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, pitfall trap, 13–15.x.2019, I.P. Subedi leg. (CDZMTU HymF140).

Notes: The workers are very small, reddish brown, head longer than broad, large crowded punctures on cephalic dorsum, reduced eyes, subtriangular mandibles, 12-segmented clavate antennae with short scape, compact mesosoma rectangular in dorsal view, propodeal declivity with margined upper side, broader than long petiole, hook like subpetiolar processes, subtrapezoidal postpetiole slightly wider behind, elongated gaster, decumbent or subdecumbent hairs mostly prominent in postpetiole and gaster. This species is documented in Subedi *et al.* (2021a) as a new record for Nepal. This record represents a major extension of the known record from Kerala, India.

3.3.2.4 *Subfamily: Ectatomminae* (1 genus and 1 species)

***Stictoponera bicolor* (Emery, 1889)** (Figs. 8 A, B)

Type localities: Bhamo, Teinzo, Shwegoo and Tenasserim, Myanmar (Emery, 1889).

Distribution: Cambodia, India, Indonesia, Malaysia, Laos, Myanmar, Thailand, Vietnam, China, Nepal (Lattke, 2004; Guénard *et al.*, 2017; Subedi *et al.*, 2021c).

Materials examined: Binayi Triveni, Nawalpur, Sal Forest, 27.5758°N, 83.8925°E, 144–183 m, 3.x.2020, P.B. Budha and P. Shrestha leg. (CDZMTU HymF141).

Notes: The species identification was determined as *Stictoponera bicolor* by its bicolored body, typically large occipital lobes, and large eyes posteriorly set on the head. This species is documented in Subedi *et al.* (2021c) as *Gnamptogenys bicolor* (obsolete combination of *Stictoponera bicolor*), as a new record for Nepal.

3.3.2.5 *Subfamily: Formicinae* (15 genera and 59 species)

***Acropyga yaeyamensis* Terayama & Hashimoto, 1996**

Type locality: Iriomote-jima, Urauchi, Okinawa, Japan (Terayama & Hashimoto, 1996).

Distribution: China, Nepal, Japan (LaPolla, 2004a).

Nepal: Godawari, Lalitpur, C. Baroni Urbani leg., MCZC, NHMB (LaPolla, 2004a).

***Camponotus angusticollis* (Jerdon, 1851)**

Type locality: Karnataka/Kerala, Malabar, India (Jerdon, 1851).

Distribution: Bangladesh, Borneo, India, Indonesia, Malaysia, Nepal, Sri Lanka (Guénard *et al.*, 2017)

Nepal: Jarsa, Dolakha, 2000 m, iv–vi.1961, H. Janetschek leg. (Collingwood, 1970).

***Camponotus compressus* (Fabricius, 1787)**

Type locality: Tamil Nadu, India (Fabricius, 1787).

Distribution: Bangladesh, Borneo, Canary Islands, China, India, Indonesia, Liechtenstein, Maldives, Malaysia, Nepal, Pakistan, Philippines, Sri Lanka, United Arab Emirates (Guénard *et al.*, 2017).

Nepal: Chyaubas, Kavrepalanchok, 2000 m; Sikris, Dolakha, 2300 m, J. Quinland leg.; Phewa Lake, Pokhara, Kaski, 830 m, J. Quinland leg. (Collingwood, 1970); 36 km N Tumlingtar, 27.5500°N, 87.2333°E, 790 m, 1.iv.1991, C. Carpenter leg., UCDC (AntWeb, 2022).

Materials examined: Pokhara, Kaski, 28.2141°N, 83.9728°E, hand collection, 5.xi.2021, N. Subedi leg.; Jamune, Tanahun, 27.9875°N, 84.1831°E, 530 m, I.P. Subedi leg., 28.xii.2006; Nagarjun Forest, SNNP, 1750 m, hand collection, 1.v.2019, I.P. Subedi leg.

***Camponotus dolendus* Forel, 1892**

Type locality: Dharmashala, India (Forel, 1892a)

Distribution: China, India, Laos, Nepal (Guénard *et al.*, 2017).

Nepal: Namdu, Dolakha, 1450 m; Cha Khola, Kavrepalanchok, 900–1000 m, Hoxe valley; Phewa Lake near Pokhara, Kaski, 830 m. J. Quinland (Collingwood, 1970;

Thapa, 2015), 12 km ENE Tumlingtar, 27.3333°N, 87.3167°E, 1150 m, 9.v.1991, C. Carpenter leg., UCDC (AntWeb, 2022).

Material examined: RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, hand collection, 1.iii.2019, A. Subedi leg.

***Camponotus himalayanus* Forel, 1893**

Type locality: India (Forel, 1893).

Distribution: India, Nepal (Collingwood, 1970).

Nepal: Thansindu, Solukhumbu, 3500 m, iv–vi.1961, H. Janetschek leg. (Collingwood, 1970).

****Camponotus irritans* (Smith, 1857)** (Figs. 31 A, B)

Type locality: Malacca, Borneo, Sarawak, Malaysia (Smith, 1857).

Distribution: Nepal (new record), Borneo, China, India, Malaysia, Nicobar Island, Sri Lanka, Vietnam (Guénard *et al.*, 2017).

Materials examined: RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, hand collection, 19.x.2019, I.P. Subedi leg. (CDZMTU HymF142); Nagarjun Forest, SNNP, 1400–1700 m, hand collection, 30.x.2021, I.P. Subedi leg.; Salmodevi forest, Kathmandu, 10.i.2019, I.P. Subedi leg.; TUC, Kirtipur, Kathmandu, 27.6814°N, 85.2837°E, 1330 m, hand collection, 29.v.2019; Nagarjun Forest, SNNP, 27.7444°N, 85.2948°E, 1400 m, pitfall and hand collection, 22.x.2019, I.P. Subedi leg.; Nagarjun Forest, SNNP, 27.7487°N, 85.2736°E, 1912 m, pitfall collection, 22–24.x.2019; Shivapuri Forest, SNNP, 1800 m, 4.xi.2021; Shivapuri Forest, SNNP, 27.7875°N, 85.3939°E, 1902 m, pitfall collection, 3–5.xi.2018; Raniban, Kathmandu, 10.ii.2017, hand collection, I.P. Subedi leg.

Notes: This is an elongate and slender ant with oval head, elongate, compressed mesosoma with faintly broader pronotum, abdomen ovate and entire body with erect pale hairs. Head and gaster dark brown and antennae, mesosoma and legs are generally reddish brown in color. The species identification is based upon species description in Smith (1857) and examination of type images available at Antweb.

***Camponotus lamarckii* Forel, 1892**

Type locality: India (Forel, 1892a).

Distribution: India, Nepal (Collingwood, 1970).

Nepal: Pokhara, Kaski, 1000 m., J. Quinland leg. (Collingwood, 1970).

Materials examined: Gangolia, Rupandehi, 27.5861°N, 83.4935°E, 9.iii.2013, I.P. Subedi leg.; Lamjung, *Alnus nepalensis* forest, 28.2804°N, 84.3557°E, 825 m, 2.x.2020, P.B. Budha and P. Shrestha leg.; Sundarijal Forest, SNNP, 27.7854°N, 85.4208°E, 10.x.2020, I.P. Subedi leg.

***Camponotus lasiselene* Wang & Wu, 1994**

Type locality: Menglun of Jinhung Co., Yunnan province, China (Wang & Wu, 1994).

Distribution: Nepal, China, Thailand, Vietnam (Wang & Wu, 1994; Subedi *et al*., 2021b; Jaitrong & Jeenthong, 2022).

Materials examined: RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, pitfall collection, 13–15.x.2019, I.P. Subedi *et al.* leg. (CDZMTU HymF143); idem, hand collection, 14.iv.2021, I.P. Subedi, I. Pandit and A. Subedi leg.

Notes: The species has opaque black body with profuse white short hairs, brownish red mandibles, acutely margined pronotum, and plier-shaped propodeal spines. It can be distinguished from its closest relative *C. selene* by the density of erect body hairs. This species is documented in Subedi *et al.* (2021b) as new record for Nepal.

***Camponotus mutilarius* Emery 1893** (Figs. 9 A, B)

Type locality: Carin Cheba, Myanmar (Emery, 1893b).

Distribution: Nepal, India, Myanmar, Thailand, Vietnam (Wachkoo, 2015; Subedi *et al.*, 2021b).

Nepal: Pokhara, kaski, 28.1667°N, 83.9667°E, 760 m, 10.xii.1988, P.S. Ward leg, UCDC (AntWeb, 2022).

Materials examined: Kalika Bhagwati Temple, Baglung, 28.2555°N, 83.6136°E, hand collection, 7.iii.2013, I.P. Subedi leg. (CDZMTU HymF144); Bet, Darchula, Sal Forest, 29.7693°N, 80.4036°E, 734–819 m, 8.x.2020, P.B. Budha and P. Shrestha leg.; Ngyadi, Lamjung, *Bombax ceiba*, 28.3231°N, 84.4014°E, 962 m, 1.x.2020, P.B. Budha and P. Shrestha leg.

Notes: This species has reddish mesosoma, petiole and conspicuous red blotches on either side of abdominal segment III. The color pattern appears to be consistent in

Nepalese specimens. The species is easily distinguishable from its closely related species *C. wasmanni* which is uniformly black in color. This species is documented in Subedi *et al*. (2021b) as a new record for Nepal.

***Camponotus nicobarensis* Mayr, 1865** (Figs. 31 C, D)

Type locality: Nicobar Island, India (Mayr, 1865).

Distribution: Nepal (new record), Bangladesh, China, India, Laos, Thailand, Vietnam (Guénard *et al.*, 2017).

Materials examined: RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, hand collection, 15.x.2019, 12.x.2021, I.P. Subedi leg. (CDZMTU HymF145); Nagarjun Forest, SNNP, 27.7444°N, 85.2942°E, 1400 m, 22–24.x.2019; Nagarjun Forest, SNNP, 1600–1750 m, hand collection, 3.v.2019, I.P. Subedi leg.; Chipledhunga, Pokhara, Kaski, 28.2238°N, 83.9869°E, hand collection, 19.vi.2006, I.P. Subedi leg.

Notes: This is relatively larger species, generally rust red in color, often fading to brown. The mandibles are red brown, whereas head, thorax and abdomen fairly pale. The head is finely wrinkled, clypeus protruded anteriorly. Mesosoma is convex in profile with stripes, abdomen with wrinkled striations, legs wrinkled like leather and body is with many long erect hairs. The identification is based upon species description in Mayr (1865) and examination of type images available at Antweb.

***Camponotus nirvanae* Forel, 1893** (Figs. 31 E, F)

Type locality: Kanara, Karnataka, India (Forel, 1893).

Distribution: Nepal (new record), India (Bharti *et al.*, 2016a).

Specimens examined: RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, hand collection, 15.x.2019, I.P. Subedi leg. (CDZMTU HymF146); Shivapuri Forest, SNNP, 27.7911°N, 85.3711°E, 1650 m, hand collection, 14.iv.2021, I.P. Subedi leg.

Notes: Head longer than broad and anteriorly subtruncate. Clypeus rectangularly rounded, and narrower posteriorly. Antennal scape just reaches posterior head margin. Antennal carina distinct and divergent. Head and mesosoma with fine and dense striations. Gaster smooth and shiny. The species is determined using the Bingham (1903) description, image comparison, and advice from experts.

***Camponotus opaciventris* Mayr, 1879** (Figs. 31 G, H)

Type locality: Calcutta, India (Mayr, 1879).

Distribution: Nepal, Afghanistan, India, Sri Lanka (Wachkoo & Akbar, 2016; Subedi *et al.*, 2021b).

Materials examined: Maize Research Farm, Rampur, Chitwan, 27.6539°N, 84.3567°E, 175 m, hand collection, 9.iii.2013, I.P. Subedi leg. (CDZMTU HymF147); Chhilikot Hill, Dang, 28.1489°N, 82.4010°E, 800 m, pitfall trap, 23.x.2019, K. Chaudhary leg.

Notes: The species has robust body with coarse sculpturing in the head and mesosoma, as well as short, sparse, and lighter gastral pubescence. The species is distinguishable from its closely related species *C. sericeus* which has gaster coated with thick, appressed, golden mossy pubescence. This species is documented in Subedi *et al.* (2021b) as a new record for Nepal.

***Camponotus rufoglaucus* (Jerdon, 1851)**

Type locality: Karnataka, India (Jerdon, 1851).

Distribution: Bangladesh, Borneo, Cambodia, China, India, Indonesia, Laos, Malaysia, Nepal, Sri Lanka, Thailand, Vietnam (Guénard *et al.*, 2017).

Nepal: Pokhara, Kaski, 1000 m, J. Quinland leg. (Collingwood, 1970).

Materials examined: RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, pitfall/hand collection, 15.x.2019, I.P. Subedi leg.; Tanahun, Sal Forest, 27.5922°N, 84.1605°E, 418 m, 30.ix.2020, P.B. Budha and P. Shrestha leg.; Shivapuri Forest, SNNP, 27.7911°N–27.7875°N, 85.3711°E–85.3939°E, 1650–1902 m, pitfall collection, 2.xi.2018, I.P. Subedi leg.; Sundarijal Forest, SNNP, 27.7697°N–27.7836°N, 85.4250°E–85.4356°E, 1577–2033 m, pitfall collection, 16–18.xii.2020, I.P. Subedi and R.P. Pokhrel leg.; Dumkibas, Nawalpur, *Dalbergia sisso-Acacia catechu* Forest, 27.5842°N, 83.8781°E, 124 m, 3.x.2020, P.B. Budha and P. Shrestha leg.; Tikapur Park, Kailali, Riverine Forest, 28.4831°N, 81.1263°E, 143 m, 19.x.2020, P.B. Budha and P. Shrestha leg.

****Camponotus selene* (Emery, 1889)** (Figs. 31 I, J)

Type locality: Tenasserim, Myanmar (Emery, 1889).

Distribution: Nepal, India, China, Myanmar (Emery, 1889; Guénard & Dunn, 2012; Bharti *et al.*, 2016a; Subedi *et al.*, 2021b).

Materials examined: TUC, Kirtipur, Kathmandu, 27.6825°N, 85.2842°E, 1320 m, pitfall trap, 9–11.v.2019, I.P. Subedi and S. Adhikari leg. (CDZMTU HymF148);

Sundarijal Forest, SNNP, 27.7714°N, 85.4264°E, 1600 m, hand collection, 10.x.2020, I.P. Subedi leg.

Notes: The species has opaque black body with few hairs, acutely margined pronotum, and plier-shaped propodeal spines. It can be distinguished from its closest relative *C. lasiselene* by its sparsely distributed body hair. This species is documented in Subedi *et al.* (2021b) as new record for Nepal.

***Camponotus sericeus* (Fabricius, 1798)** (Figs. 31 K, L)

Type locality: Senegal (Fabricius, 1798).

Distribution: Very common ant in Afrotropical region, and also recorded from several countries in Malagasy, Oriental and Palearctic regions (Guénard *et al.*, 2017).

Materials examined: Sagarnath, Sarlahi, 26.9943°N, 85.6725°E, 115 m, *Eucalyptus camaldulensis* plantation, 21.x.2020, B.R. Shrestha and T. Sherpa leg. (CDZMTU HymF149); Ratanpur, Tanahun, 28.0878°N, 84.3928°E, 859 m, Champ (*Magnolia champaca*) plantation, 29.xi.2020, P.B. Budha and P. Shrestha leg.

Notes: The species has robust body with coarse sculpturing in the head and mesosoma. It has a gaster covered in dense, appressed, golden mossy pubescence, which makes cuticular sculpture invisible without removing hair. This feature is significant in distinguishing this species from the closely related *C. opaciventris.* This species is documented in Subedi *et al.* (2021b) as a new record for Nepal.

***Camponotus singularis* (Smith, 1858)**

Type locality: Java, Indonesia (Smith, 1858).

Distribution: Borneo, China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Thailand, Vietnam (Guénard *et al.*, 2017).

Nepal: Phewa Lake, Pokhara, Kaski, 830 m, J. Quinland leg. (Collingwood, 1970).

***Camponotus wroughtonii* Forel, 1893**

Type locality: Himalaya, India (Forel, 1893).

Distribution: India, Nepal (Forel, 1893; Collingwood, 1970).

Nepal: Likhu Khola, Ramechhap, 1690 m; Yaral, Solukhumbu, 3900 m; Pangboche, 4000 m; Thangpoche, 3500 m.; Cha Khola, Kavrepalanchok, 900–1000 m, Hoxe, 1200 m, H. Janetschek leg., iv–vi.1961 (Collingwood, 1970; Subedi *et al.*, 2020); 16 km SW

Jomsom, Mustang, 28.6833°N, 83.6167°E, 2550 m, P.S. Ward leg., UCDC (AntWeb, 2022).

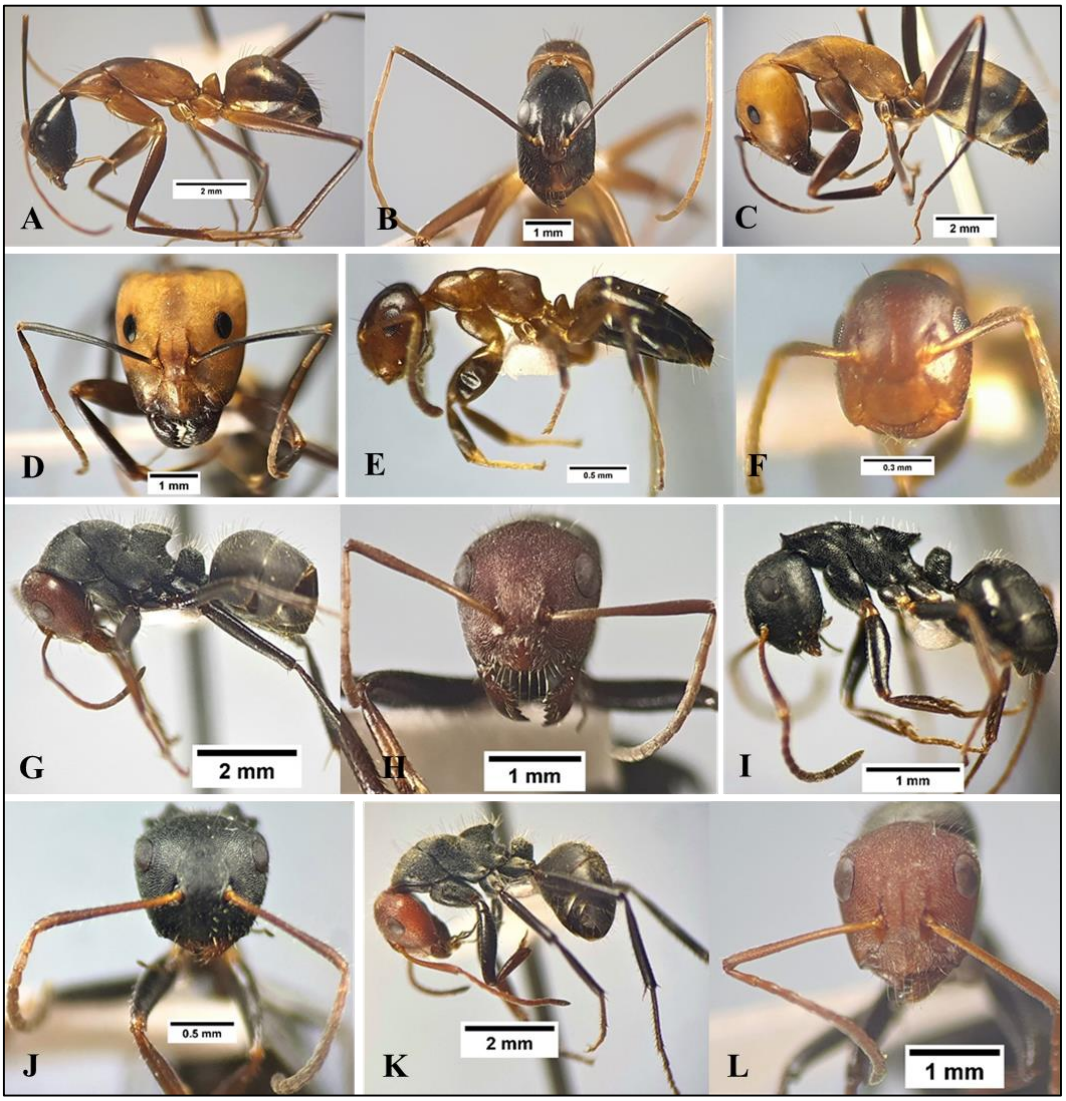

Figure 31: Profile and full-face images of *Camponotus* **A, B** *C. irritans* **C, D** *C. nicobarensis* **E, F** *C. nirvanae* **G, H** *C. opaciventris* **I, J** *C. selene* **K, L** *C. sericeus*

***Cataglyphis emeryi* (Karavaiev, 1910)**

Type locality: Kazakhstan (Karavaiev, 1911).

Distribution: Afghanistan, Iran, Kazakhstan, Nepal, Turkmenistan, Uzbekistan (Guénard *et al.*, 2017).

Nepal: Locality unknown (Subedi *et al.*, 2020).

Notes: The occurrence of this species in Nepal needs further verification.

****Colobopsis longi* (Forel, 1902)** (Figs. 32 A, B)

Type locality: Garo Hills, Assam, India (Forel, 1902c).

Distribution: Nepal (new record), India (Forel, 1902c).

Materials examined: RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, pitfall/hand collection, 15.x.2019, I.P. Subedi leg. (CDZMTU HymF150); Shivapuri Forest, SNNP, 27.7911°N–27.7875°N, 85.3711°E–85.3939°E, 1650–1902 m, pitfall collection, 2.xi.2018, I.P. Subedi leg.

Notes: The head is hardly retracted infront, eyes moderately large, and antennal scape long. The pro-mesonotal suture forms a small notch in mesosoma profile. A meso-metanotal notch is very deep. The first and second gastral segments are with yellowish white spots on each side. The mesosoma is finely reticulated while the gaster is shiny having faint wrinkles across. This is the first record for Nepal.

***Colobopsis rothneyi* (Forel, 1893)** (Figs. 9 C, D)

Type locality: Barrackpore, West Bengal, India (Forel, 1893).

Material examined: TUC, Kirtipur, Kathmandu, 27.6833°N, 85.2823°E, 29.vii.2019, I.P. Subedi leg. (CDZMTU HymF151).

Notes: Body is yellowish in color with head darker at the apex, and gaster dark brown. Head is much longer than wide. Scape is short not reaching the posterior head margin. Eyes are moderately large located towards upper half of the head. Mesosoma is short, and propodeal dorsum convex in profile view. The species identification based on Forel (1893) and (Forel, 1913). The species is closely related with *Colobopsis truncata* but the head is significantly longer, abdomen lacks yellow spots, pronotum narrower than in *truncate* (Forel, 1913).

***Colobopsis vitrea* (Smith, 1860)** (Figs. 32 C, D)

Type locality: Batjan Island (Bachian), Indonesia (Smith, 1860b).

Distribution: Australia, Borneo, China, India, Indonesia, Malaysia, Nepal, New Guinea, Philippines, Thailand (Guénard *et al.*, 2017; Subedi *et al.*, 2021c).

Materials examined: Harku Danda, Ilam, Sal Forest, 26.7641°N, 88.0413°E, 338 m, 15.x.2020, B.R. Shrestha and T. Sherpa leg. (CDZMTU HymF152).

Notes: This species is black, smooth and shining. Head is slightly broader than mesosoma. Eyes are located high laterally on the head. Antennal scape surpasses the head margin. Mesososma is narrow and compressed, and gaster is subglobose. The

species identification is based on worker description in Smith (1860b). This species is documented in Subedi *et al.* (2021c) as a new record for Nepal.

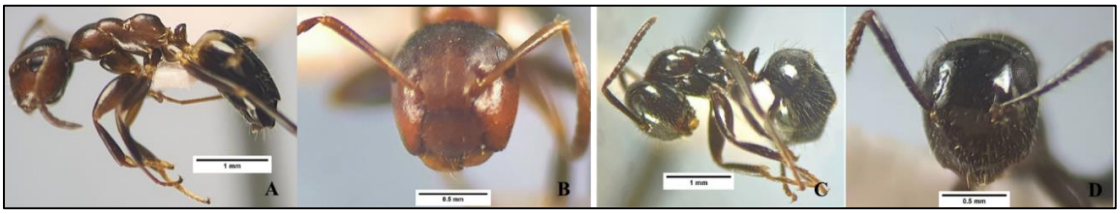

Figure 32: Profile and full-face images of *Colobopsis* **A, B** *C. longi* **C, D** *C. vitrea*

***Formica candida* Smith, 1878** (Figs. 9 E, F)

Type locality: Road across the Pamir from Sarikol to Panja, Kyrgyzstan (Smith, 1878).

Distribution: Widespread in the Palearctic region, and also found in India and Nepal in the Oriental (Guénard *et al.*, 2017; AntWeb, 2022).

Nepal: Ghyaru, Manang, 28.6500°N, 84.0500°E, 3700 m, 7.iv.2008, M Granados leg., KGAC (AntWeb, 2022).

Materials examined: Muktinath, Mustang, 28.8146°N, 83.8738°E, hand collection, 6.iii.2013, I.P. Subedi leg.

***Formica fusca* Linnaeus, 1758**

Type locality: Sweden, Europe (Linnaeus, 1758).

Distribution: Widespread in the Palearctic region, and also found in India, Nepal and Pakistan in the Oriental, and Canada and the United States in the Nearctic (Guénard *et al.*, 2017; AntWeb, 2022).

Nepal: Gurja Khani, Myagdi, rotten barley husks, 2830 m, 1965, K.M. Hyatt, leg. (Collingwood, 1970).

***Formica picea* Nylander, 1846**

Type locality: Finland (Nylander, 1846).

Distribution: Widespread in the Palearctic region, and also recorded from Nepal and Pakistan in the Oriental (Guénard *et al.*, 2017; AntWeb, 2022).

Nepal: Mustang, 4800 m (Mani & Singh, 1962).

***Lasius alienoflavus* Bingham, 1903**

Type locality: Himalayas, North India (Bingham, 1903).

Distribution: Bhutan, India, Nepal, Pakistan (Collingwood, 1982)

Nepal: Talphi, Jumla, 25.ix.1972, H. Franz leg., NHMB (Collingwood, 1982).

***Lasius crinitus* (Smith, 1858)**

Type locality: Northern India (Smith, 1858).

Distribution: Bhutan, India, Nepal (Collingwood, 1982).

Nepal: Junbesi, Solukhumbu, 2700 m, iv–vi.1961, H. Janetschek leg. (Collingwood, 1970); Arun river valley, Duna, 25.v.1973, NHMB; Bdota, 3000 m, 14.iv.1973, Lay leg., NHMB (Collingwood, 1982).

***Lasius magnus* Seifert, 1992** (Figs. 9 G, H)

Type locality: Gogona, Bhutan (Seifert, 1992).

Distribution: Nepal, Bhutan, India (Seifert, 2020).

Nepal: Induwa Kola valley, 27.0000°N, 87.0000°E, 2000 m, 18.iv.1984; Simigau, Dugong Kharka, 27.8700°N, 86.2400°E, 2100 m, 16.v.2000 (Seifert, 2020).

Materials examined: Nagarjun Forest, SNNP, hand collection, 1400–1700 m, 30.x.2021, I.P. Subedi leg.; Nagarjun Forest, SNNP, 27.7487°N, 85.2736°E, 1912 m, pitfall collection, 3–5.v.2019, 22–24.x.2019, I.P. Subedi *et al*. leg.

***Lasius niger* (Linnaeus, 1758)**

Type locality: Johannishus, Sweden (Linnaeus, 1758).

Distribution: Nearctic (Canada, USA), Oriental (India, Maldives, Nepal, Pakistan) and Palaearctic (around 50 different countries) regions (Guénard *et al.*, 2017).

Nepal: Bakhri Kharka, Myagdi, 1830 m, J. Quinland leg. (Collingwood, 1970); Arun River Valley, Duna, 2400 m, 1.vi.1973, Lay leg. (Collingwood, 1982).

***Lepisiota lunaris* (Emery, 1893)**

Type locality: Colombo, Sri Lanka (Emery, 1893a)

Distribution: India, Nepal, Pakistan, Sri Lanka (Emery, 1893a; Collingwood, 1970; Bharti *et al.*, 2016a; Rasheed *et al.*, 2019).

Nepal: Jiri Khola Valley, Dolakha, 1900 m; Solukhumbu, Ringmo-Junbesi, 2800 m; Ghai, 2700 m; Tate, 2900 m; Nare Ghat, 2700 m; Likhu Khola, Ramechhap, 1690 m, iv–vi.1961, H. Janetschek leg. (Collingwood, 1970).

Materials examined: Shivapuri Forest, SNNP, 27.7875°N, 85.3939°E, 1902 m, pitfall collection, 3–5.xi.2018; Sundarijal Forest, SNNP, 27.7697°N–27.7753°N, 85.4250°E–85.4328°E, 1577–1808 m, pitfall and hand collections, I.P. Subedi leg.

Notes: This species is documented as *Acantholepis lunaris* in Collingwood (1970).

***Lepisiota mayri* Wachkoo *et al.*, 2021** (Figs. 33 A, B)

Type locality: Andretta, Himanchal Pradesh, India (Wachkoo *et al.*, 2021).

Distribution: Nepal (New record), India (Wachkoo *et al.*, 2021).

Materials examined: TUC, Kirtipur, Kathmandu, 27.6815°N, 85.2818°E, pitfall collection, 27–29.v.2019, I.P. Subedi and S. Adhikari leg. (CDZMTU HymF153), Okhreni, SNNP, 27.7908°N, 85.4208°E, 1878 m, hand collection, 10.x.2020, I.P. Subedi and U. Dyola leg.

Notes: These ants are black in color and medium-sized. They have three small ocelli, and very long antennal scape that surpasses posterior cephalic margin by one-third of its length. Propodeum having posteriorly diverged thick, blunt spines. Petiole is upright, laterally angulate, and dorsally emarginate, with narrow, upwardly pointing spines. Head and mesosoma are with fine microreticulate sculpture. Abundant erect setae present in the body.

***Lepisiota modesta* (Forel, 1894)** (Figs. 33 C, D)

Type locality: Musooorie, Uttarakhand, India (Wachkoo *et al.*, 2021).

Distribution: Nepal (new record), India (Wachkoo *et al.*, 2021).

Materials examined: Shivapuri Forest, SNNP, 27.7954°N, 85.3686°E, 1874 m, beating vegetation, 11.xii.2021, I.P Subedi leg. (CDZMTU HymF154); Sundarijal Forest, SNNP, 27.7753°N, 85.4356°E, 1808 m, pitfall collection, 16–18.xii.2020, I.P. Subedi, U. Dyola, R.P. Pokhrel leg.; Nagarjun Forest, SNNP, 27.7487°N, 85.2736°E, 1912 m, pitfall collection, 22–24.x.2019, I.P. Subedi *et al*. leg.

Notes: These ants are black in color and medium-sized. They have three small ocelli, and very long antennal scape that surpasses posterior cephalic margin by one-third of its length. Propodeal spines reduced to tubercles. Petiole is upright, laterally angulate, and dorsally emarginate, with narrow, upwardly pointing spines. Body is smooth and shiny, having sparse erect setae.

***Lepisiota opaca* (Forel, 1892)** (Figs. 33 E, F)

Type locality: Kanara, Karnataka, India (Forel, 1892b).

Distribution: Nepal (New record), China, India, Sri Lanka (Guénard & Dunn, 2012; Dias *et al.*, 2020; Wachkoo *et al.*, 2021).

Material examined: Tanahun, Sal Forest, 27.5922°N, 84.1605°E, 418 m, 30.ix.2020, P.B. Budha and P. Shrestha leg.; TUC, Kirtipur, Kathmandu, 27.6814°N, 85.2831°E, 1330 m, pitfall collection, 27–29.v.2019, I.P. Subedi and S. Adhikari leg. (CDZMTU HymF155).

Notes: These ants are bicolored, with reddish-yellow body and purplish-black head and gaster. They have three small ocelli, and very long antennal scape that surpasses posterior cephalic margin by one-third of its length. Propodeal spines are diverged, upwardly directed and sharp. Petiole is upright, laterally angulate, and dorsally emarginate, with upwardly pointing straight spines. Body is shiny and abundantly covered with erect setae.

***Lepisiota rothneyi* (Forel, 1894)** (Figs. 33 G, H)

Type locality: Barrackpore [Barrakpore], West Bengal, India (Forel, 1894).

Distribution: Nepal (new record), China, India, Myanmar, Vietnam (Guénard *et al.*, 2017).

Materials examined: Ratanpur, Bhanu, Tanahun, Champ plantation, 28.0851°N, 84.3895°E, 813 m, 29.ix.2020, P.B. Budha and P. Shrestha leg. (CDZMTU HymF156); Amaltari, Nawalpur, Mixed Broadleaves Riverine Forest, 27.5606°N, 84.1053°E, 119 m, 4.x.2020, P.B. Budha and P. Shrestha leg.

Notes: These ants are uniformly dark-brown to black in color. Their antennal scape surpasses posterior cephalic margin by one-third of its length or less. Propodeal spine indistinct. Petiole is short and lacks teeth or spines. Pronotum is without erect hairs. The body is shiny and pubescence is sparse.

***Lepisiota rothneyi watsonii* (Forel, 1894)**

Type locality: Myanmar [Birmania] (Forel, 1894).

Distribution: China, Myanmar, Nepal (Forel, 1894; Collingwood, 1970; Guénard & Dunn, 2012).

Nepal: Dolakha: Jiri Khola Valley, 1900 m; Solukhumbu: Ringmo-Junbesi, 2800 m, H. Janetschek leg., iv–vi.1961 (Collingwood, 1970).

Notes: This species was documented as *Plagiolepis watsonii* in Collingwood (1970).

***Lepisiota sericea* (Forel, 1892)** (Figs. 9 I, J)

Type locality: Musooorie, Uttarakhand, India (Wachkoo *et al.*, 2021).

Distribution: Nepal (new record), Afghanistan, India, Iran, Pakistan, Turkmenistan (Guénard *et al.*, 2017).

Material examined: TUC, Kirtipur, Kathmandu, 27.6814°N, 85.2831°E, 1330 m, pitfall collection, 27–29.v.2019, I.P. Subedi and S. Adhikari leg. (CDZMTU HymF157); RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, pitfall and hand collection, 15.x.2019, I.P. Subedi leg.

Notes: These ants are black-brown in color. They have very long antennal scape that surpasses posterior cephalic margin by more than half of its length. Propodeum having posteriorly diverged paired teeth. Petiole is upright, dorsally round, narrow and lacks teeth or spines. Head, pronotum and gaster are sparsely covered by erect setae.

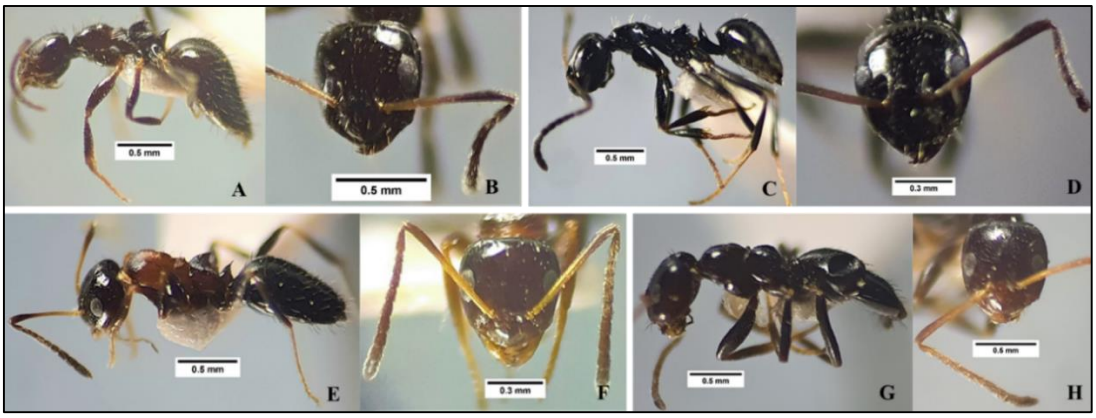

Figure 33: Profile and full-face images of *Lepisiota* **A, B** *L. mayri* **C, D** *L. modesta* **E, F** *L. opaca* **G, H** *L. rothneyi*

***Oecophylla smaragdina* (Fabricius, 1775)** (Figs. 9 K, L)

Type locality: India

Distribution: Australia, Bangladesh, Bhutan, Brunei, Myanmar, Cambodia, China, India, Indonesia, Laos, Malaysia, Nepal, Palau, Papua New Guinea, Philippines, Singapore, Solomon Islands, Sri Lanka, Thailand, Timor Leste, Vietnam (Wetterer, 2017).

Nepal: Namche Bazar, Solukhumbu, 3800 m, 16.v.1958, A.P. Kapoor leg. (Kapoor, 1961); Charnawati/Zharange Khola to Kiratechap, Kavrepalanchok/Sindhupalanchok, 1800–1160 m, Bhotekoshi, 1150 m; Tamba Kosi, 1150–1450 m, Dhunibesi, Dhading, vi.1961 & 65, K.C. Sharma, H. Janetschek *et al*. leg. (Collingwood, 1970; Joshi & Manandhar, 2001; Thapa, 2015); Turture to Phalenksangu, Marsyangdi Valley, 716 m, 2.xi.1982, J. Balderson leg., ANIC (AntWeb, 2022).

Materials examined: Shivapuri Forest, SNNP, 27.7911°N, 85.3711°E, 1650 m, hand collection, 2.xi.2018, I.P. Subedi leg. (CDZMTU HymF158); Banbehada, Kailali, Sal Forest, 28.8180°N, 80.6789°E, 204 m, 18.x.2020, P.B. Budha and P. Shrestha leg.; Tanahun, Sal Forest, 27.5922°N, 84.1605°E, 418 m, 30.ix.2020, P.B. Budha and P. Shrestha leg.; Binayi-Triveni, Ghumti, Nawalpur, Sal Forest, 27.5758°N, 83.8925°E, 144 m, 3.x.2020; Binayi-Triveni, Nawalpur, Sal Forest, 27.5754°N, 83.8907°E, 156 m, 3.x.2020, P.B. Budha and P. Shrestha leg.; Rhoga, Dama, Ilam, Sal Forest, 26.7650°N 26.7623°N, 88.0401°E–88.0388°E, 276–302 m, 15.x.2020, B.R. Shrestha and T. Sherpa leg.; Godawari, Kailali, Riverine forest, 28.8712°N, 80.5698°E, 244 m, 17.x.2020, P.B. Budha and P. Shrestha leg.; Singribeta, Bhadrapur, Jhapa, Sal Forest, 26.6033°N, 88.0726°E, 94 m, 18.x.2020, B.R. Shrestha and T. Sherpa leg.; Ratanpur, Bhanu, Tanahun, Champ plantation, 28.0851°N, 84.3895°E, 813 m, 29.ix.2020, P.B. Budha and P. Shrestha leg.; Budhitola, Kailali, Sal Forest, 28.9246°N, 80.5691°E, 952 m, 15.x.2020, P.B. Budha and P. Shrestha leg.; Charpala Community Forest, Tamnagar, Rupandehi, 27.6953°N, 83.4031°E, 132 m, 21.x.2020, P.B. Budha and P. Shrestha leg.; Beshishahar, Lamjung, *Schima-Castanopsis* Forest, 28.1882°N, 84.3948°E, 956 m, 2.x.2020, P.B. Budha and P. Shrestha leg.; Haldibari, Jhapa, Mixed broadleaf Forest, 26.4788°N, 87.9848°E, 95 m, 17.x.2020, B.R. Shrestha and T. Sherpa leg.

Notes: Weaver ants, *Oecophylla smaragdina*, are economically important, often used in biological control, and are one of the most frequently observed ants during this study.

***Nylanderia birmana* (Forel, 1902)** (Figs. 9 M, N)

Type locality: Mawlamyine, Myanmar [Moulmain, Birmanie] (Forel, 1902c).

Distribution: Nepal (new record), India, Myanmar (Wachkoo & Bharti, 2015).

Materials examined: RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, pitfall and hand collection, 15.x.2019, I.P. Subedi leg. (CDZMTU HymF159); TUC, Kirtipur, Kathmandu, 27.6814°N, 85.2831°E, 1330 m, hand collection, 29.v.2019; Nagarjun

Forest, SNNP, 1400–1700 m, hand collection, 30.x.2021, I.P. Subedi leg.; Nagarjun Forest, SNNP, 27.7487°N, 85.2736°E, 1912 m, pitfall collection, 22–24.x.2019; Shivapuri Forest, SNNP, 1800 m, 4.xi.2021; Shivapuri Forest, SNNP, 27.7875°N, 85.3939°E, 1902 m, pitfall collection, 3–5.xi.2018; Sundarijal Forest, SNNP, 27.7697°N–27.7753°N, 85.4250°E–85.4328°E, 1577–1808 m, hand collection, I.P. Subedi leg.

Notes: These ants are unicolorous, with dark brown to black body. The propodeal dorsum is rounded, and is roughly equal in length with its declivity. In profile view, the propodeum seems on the same plane as the rest of the body. The presence of a dense network of microreticulate sculpture on the head and mesosoma differentiates these ants from other closely related species (Wachkoo & Bharti, 2015).

***Nylanderia bourbonica* (Forel, 1886)**

Type locality: Reunion, Malagasy (Forel, 1886a).

Distribution: India, Chagos, Easter Island, Hawaii, Mauritius, Nepal, Reunion Island, and Seychelles Islands (Wachkoo & Bharti, 2015; Subedi *et al.*, 2020).

Nepal: Nagarjun Forest, SNNP, 1660 m, I.P. Subedi leg., CDZMTU

Materials examined: Nagarjun Forest, SNNP, 27.7458°N, 85.2856°E, 1660 m, pitfall and hand collections, I.P. Subedi leg. (CDZMTU HymF160); Sundarijal Forest, SNNP, 27.7753°N–27.7836°N, 85.4328°E–85.4356°E, 1800–2200 m, hand collection, I.P. Subedi leg.

Notes: The species has entirely single-colored dark-brown to black body with the dorsum of head and mesosoma smooth or covered with fine punctulae. This species can be diagnosed from closely related species *N. birmana* which has microreticulate sculpture on the dorsum of head and mesosoma (Wachkoo & Bharti, 2015). This tramp species is documented in Subedi *et al.* (2020) as the first record for Nepal.

***Nylanderia indica* (Forel, 1894)**

Type locality: Poona, India (Forel, 1894).

Distribution: India, Nepal, Sri Lanka (Forel, 1894; Collingwood, 1970).

Nepal: Thaksindhu, Solukhumbu, 3500 m; Ringmo-Junbesi, 2800 m, Tate, 2900 m; Likhu khola, Ramechhap, 1690 m, H. Janetschek leg., iv–vi.1961 (Collingwood, 1970).

Materials examined: Nagarjun Forest, SNNP, 27.4444°N, 85.2842°E, 1400 m, pitfall collection, 1–3.v.2019, I.P. Subedi leg.; Nagarjun Forest, SNNP, 27.7458°N, 85.2856°E, 1660 m, pitfall collection, 22–24.x.2019, I.P. Subedi leg.; Sundarijal Forest, SNNP, 27.7697°N, 85.4250°E, 1577 m, pitfall collection, 16–18.xii.2020, I.P. Subedi leg.

***Nylanderia smythiesii* (Forel, 1894)** (Figs. 34 A, B)

Type locality: Dehradun, India (Forel, 1894).

Distribution: Nepal (new record), India (Wachkoo & Bharti, 2015).

Materials examined: Nagarjun Forest, SNNP, 27.7444°N, 85.2942°E, 1400 m, 22.x.2019, I.P. Subedi leg. (CDZMTU HymF161); Binayi-Triveni, Nawalpur, Sal Forest, 27.5754°N, 83.8907°E, 156 m, 3.x.2020, P.B. Budha and P. Shrestha leg.; Budhitola, Kailali, Sal Forest, 28.9246°N, 80.5691°E, 952 m, 15.x.2020, P.B. Budha and P. Shrestha leg.; Banbehada, Kailali, Sal Forest, 28.8096°N, 80.6758°E, 204 m, 17.x.2020, P.B. Budha and P. Shrestha leg.; Bet, Darchula, Sal Forest, 29.7672°N, 80.4010°E, 800 m, 8.x.2020, P.B. Budha and P. Shrestha leg.

Notes: These are bicolored ants with variable coloration in different brown shades. The propodeal dorsum is rounded, and is roughly equal in length with its declivity. In profile view, propodeum seems on the same plane as the rest of the body. Gaster is smooth and shiny lacking pubescence beneath erect macrosetae. These ants may be distinguished from other related species by bicolorous body, oval head and smooth and shiny gaster having no pubescence (Wachkoo & Bharti, 2015).

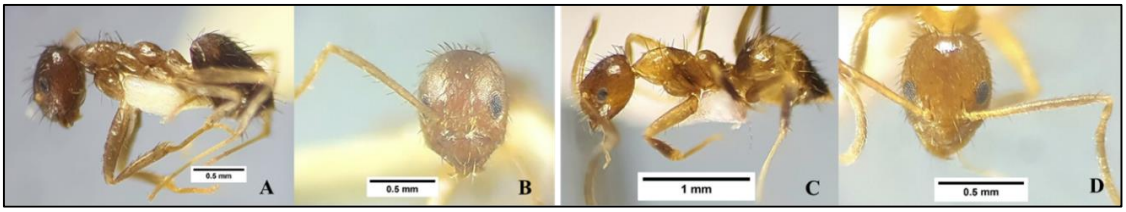

Figure 34: Profile and full-face images of *Nylanderia* **A, B** *N. smythiesii* **C, D** *N. taylori*

***Nylanderia taylori* (Forel, 1894)** (Figs. 34 C, D)

Type locality: Orissa, India (Forel, 1894).

Distribution: Nepal (new record), Bangladesh, China, India, Indonesia, Vietnam (Janicki *et al.*, 2016; Guénard *et al.*, 2017)

Materials examined: Haldibari, Jhapa, Mixed broad leaf forest, 26.4797°N, 87.9862°E, 104 m, 17.x.2020, B.R. Shrestha and T. Sherpa leg. (CDZMTU HymF162).

Notes: These ants are light yellow brown with a thin layer of pubescence. Head is oval and eyes are large. The propodeal dorsum is angular or dorsally rounded, and is shorter than its declivity. In profile view, the propodeum seems to be lower than the rest of the body. This is the first record for Nepal.

***Paratrechina longicornis* (Latreille, 1802)** (Figs. 10 A, B)

Type locality: Senegal (Latreille, 1802).

Distribution: Worldwide distribution over the Old and New Worlds in the northern as well as southern hemispheres (Wetterer, 2008).

Nepal: Ratnanagar, Chitwan, 27.6149°N, 84.4436°E, 200 m, 3.iv.2008, M. Granados leg., KGAC (AntWeb, 2022); Amlekhganj, Bara, E.I. Coher leg., MCZ (Wetterer, 2008).

Materials examined: Tanahun, Sal Forest, 27.5922°N, 84.1605°E, 418 m, 30.ix.2020, P.B. Budha and P. Shrestha leg.; RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, hand collection, 1.iii.2022, I.P. Subedi leg.; Nagarjun Forest, SNNP, 27.7444°N–27.7448°N, 85.2942°E–85.2856°E, 1400–1700 m, hand collection, 1–3.v.2019, 30.x.2021, I.P. Subedi leg.; Shivapuri Forest, SNNP, 27.7911°N, 85.3711°E, 1650 m, pitfall and hand collection, 4.xi.2018, I.P. Subedi leg.

****Plagiolepis jerdonii* Forel, 1894** (Figs. 10 E, F)

Type locality: Pune [Poona], Maharashtra, India (Forel, 1894).

Distribution: Nepal (new record), China, India, Sri Lanka (Bharti *et al.*, 2016a; Dias *et al.*, 2020; Liu *et al.*, 2020).

Materials examined: Budhanilkantha, Kathmandu, 27.7742°N, 85.3598°E, 21.iii.2021, I.P. Subedi leg. (CDZMTU HymF163); Binayi-Triveni, Nawalpur, Sal Forest, 27.5754°N, 83.8907°E, 156 m, 3.x.2020, P.B. Budha and P. Shrestha leg.

Notes: These are very small ants with roughly square head which is slightly narrower in front than behind. Antennal scape just surpassing the posterior cephalic margin and funicular segments slender. Thorax is shorter and robust. The metanotum is rapidly enlarged forward and backward.

***Polyrhachis dives* Smith, 1857**

Type locality: Singapore (Smith, 1857).

Distribution: Australia, Borneo, China, Cambodia, Guam, India, Indonesia, Japan, Krakatau Islands, Laos, Malaysia, Myanmar, Nepal, New Guinea, Philippines, Singapore, Sri Lanka, Thailand, Vietnam (Guénard *et al.*, 2017; Subedi *et al*., 2020).

Nepal: Arun valley, 15.vi.1954, L. Swan leg., CASC (AntWeb, 2022).

****Polyrhachis hippomanes* Smith, 1861** (Figs. 35 A, B)

Type locality: Tondano, Sulawesi, Indonesia (Smith, 1861).

Distribution: Nepal (new record), Bhutan, China, India, Indonesia, Thailand (Smith, 1861; Bharti *et al.*, 2016a; Khachonpisitsak *et al.*, 2020; Liu *et al.*, 2020; Dendup *et al.*, 2021).

Materials examined: RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, hand collection, 1.iii.2022, I.P. Subedi leg. (CDZMTU HymF164); Nagarjun Forest, SNNP, 27.7444°N–27.7448°N, 85.2942°E–85.2856°E, 1400–1700 m, hand collection, 1–3.v.2019, 30.x.2021, I.P. Subedi leg.

Notes: These are black ants with unclearly tinged with blue. The antennae, legs and gaster are pale. Pronotum anteriorly rounded and unarmed, propodeum and petiole with long widely diverge spines, and the legs are long. The identification is based upon worker description in Smith (1861).

***Polyrhachis illaudata* Walker, 1859**

Type locality: Sri Lanka (Walker, 1859).

Distribution: Bangladesh, Borneo, China, India, Indonesia, Krakatau Islands, Laos, Myanmar, Malaysia, Nepal, Philippines, Sri Lanka, Thailand (Collingwood, 1970; Guénard *et al.*, 2017).

Nepal: Phewa Lake, Pokhara, Kaski, 830 m, J. Quinland leg. (Collingwood, 1970).

Notes: This was recorded as *Polyrhachis mayri* in Collingwood (1970).

***Polyrhachis lacteipennis* Smith, 1858**

Type locality: Northern India (Smith, 1858).

Distribution: Afghanistan, India, Iran, Israel, Myanmar, Nepal, Oman, Saudi Arabia, Sri Lanka, Turkmenistan, UAE (Collingwood, 1970; Guénard *et al.*, 2017).

Nepal: Pokhara, Kaski, 1000 m, leg. J. Quinland (Collingwood, 1970); 16 km NE Baglung, 28.3500°N, 83.7333°E, 1620 m, 28.xi.1988, P.S. Ward leg., PSWC (AntWeb, 2022); Basundhara, Kathmandu, 27.7400°N, 85.3336°E, 1320 m, 20.x.2020, I.P. Subedi leg. (Subedi *et al.*, 2020).

Materials examined: RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, pitfall/hand collection, 15.x.2019, I.P. Subedi leg.; Nagarjun Forest, SNNP, 27.7444°N–27.7452°N, 85.2667°E–85.2942°E, 1400–2094 m, hand/pitfall collection, 1–3.v.2019, 30.x.2021, I.P. Subedi leg.; TUC, Kirtipur, Kathmandu, 27.6801°N, 85.2887°E, 1300 m, *Salix* forest, pitfall trap, 11.v.2019, I.P. Subedi & S. Adhikari leg.; Shivapuri Forest, SNNP, 27.7911°N, 85.3711°E, 1650 m, 4.xi.2018, pitfall and hand collection, I.P. Subedi leg.; Sundarijal Forest, SNNP, 27.7697°N–27.7928°N, 85.4250°E–85.4356°E, 1577–2175 m, pitfall and hand collection, I.P. Subedi *et al.* leg.; Tikapur Park, Kailali, Riverine Forest, 28.4831°N, 81.1263°E, 143 m, 19.x.2020, P.B. Budha and P. Shrestha leg.; Baikunda, Panchthar, Sal Forest, 27.1444°N, 87.7020°E, 745 m, 12.x.2020, B.R. Shrestha and T. Sherpa leg.; Ratanpur, Bhanu, Tanahun, Champ plantation, 28.0851°N, 84.3895°E, 813 m, 29.ix.2020, P.B. Budha and P. Shrestha leg.; Madhyabindu, Chaliskilo, Nawalpur, Sal Forest, 27.6226°N, 84.0597°E, 196 m, 4.x.2020; Banbehada, Kailali, Sal Forest, 28.8096°N, 80.6758°E, 204 m, 17.x.2020, P.B. Budha and P. Shrestha leg.

Notes: This was documented as *Polyrhachis simplex* in Collingwood (1970). This species was one of the most commonly encountered species in the field.

***Polyrhachis laevissima* Smith, 1858** (Figs. 35 C, D)

Type locality: Myanmar [Burmah] (Smith, 1858).

Distribution: Nepal (new record), Bangladesh, Borneo, Cambodia, India, Indonesia, Laos, Malaysia, Myanmar, Thailand (Guénard *et al.*, 2017).

Materials examined: Singribeta, Bhadrapur, Jhapa, Sal Forest, 26.6033°N, 88.0726°E, 94 m, 18.x.2020, P.B. Budha leg. (CDZMTU HymF165).

Notes: These ants are black, smooth and shining with distinct light red legs. Mesosoma broad anteriorly and narrowed posteriorly. It is strongly convex in profile with rounded

anterior margin. The petiole bears reduced obtuse teeth. This species is documented in Subedi *et al*. (2021c) as a new record for Nepal.

***Polyrhachis punctillata* Roger, 1863** (Figs. 35 E, F)

Type locality: Sri Lanka [Ceilon] (Roger, 1863).

Distribution: China, Hongkong, India, Myanmar, Nepal, Sri Lanka (Roger, 1863; Bingham, 1903; Subedi *et al*., 2021c; Wong & Guénard, 2021)

Materials examined: Ratanpur, Bhanu, Tanahun, Champ plantation, 28.0851°N, 84.3895°E, 813 m, 29.ix.2020, P.B. Budha and P. Shrestha leg. (CDZMTU HymF166).

Notes: These are blackish ants with pale to silvery yellow pubescence. The mesosoma dorsum in these ants is laterally marginated. Pronotum, propodeum, and petiole bear short teeth. This species is documented in Subedi *et al*. (2021c) as a new record for Nepal.

***Polyrhachis rastellata* (Latreille, 1802)** (Figs. 35 G, H)

Type locality: Indonesia [Indes Orientales] (Latreille, 1802).

Distribution: Borneo, China, India, Indonesia, Malaysia, Nepal, New Guinea, Philippines, Sri Lanka, Thailand (Guénard *et al.*, 2017; Subedi *et al.*, 2020).

Materials examined: Nagarjun Forest, SNNP, 1650 m, hand collection, 3.v.2019, I.P. Subedi leg.; Hemja, Kaski, 28.2795°N, 83.9311°E, 26.x.2007, I.P. Subedi leg. (CDZMTU HymF167).

***Polyrhachis saevissima argentea* Mayr, 1862** (Figs. 35 I, J)

Type locality: Luzon Island, Philippines (Mayr, 1862).

Distribution: Nepal (new record), Borneo, India, Indonesia, Malaysia, Philippines, Solomon Islands, Sri Lanka (Guénard *et al.*, 2017).

Materials examined: Nagarjun Forest, SNNP, 27.7444°N, 85.2942°E, 1400 m, hand collection, 3.v.2019, I.P. Subedi leg. (CDZMTU HymF168).

Notes: These ants are black covered with white pubescence and legs are red with dark markings. Pronotum with forwardly and outwardly directed two straight spines. Propodeum with two long, straight backwardly and upwardly pointing spines. Petiole with two long spines curving outwards and behind with two very small teeth in between. The identification is based upon worker description in Mayr (1862).

***Polyrhachis thompsoni* Bingham, 1903**

Type locality: Tenasserim, Ataran valley, Myanmar (Bingham, 1903).

Distribution: China, India, Myanmar, Nepal (Bingham, 1903; Bharti *et al.*, 2016a; Liu *et al.*, 2020; Subedi *et al.*, 2020).

Nepal: 14.5 km W. Hetauda, Makawanpur, 400 m, 23.xi.1961, E.S. Ross and D.Q. Cavagnaro leg., CAS (AntWeb, 2022).

Materials examined: Sundarijal Forest, SNNP, hand collection, 27.7753°N, 85.4356°E, 1808 m, 16.xii.2020, I.P. Subedi leg.

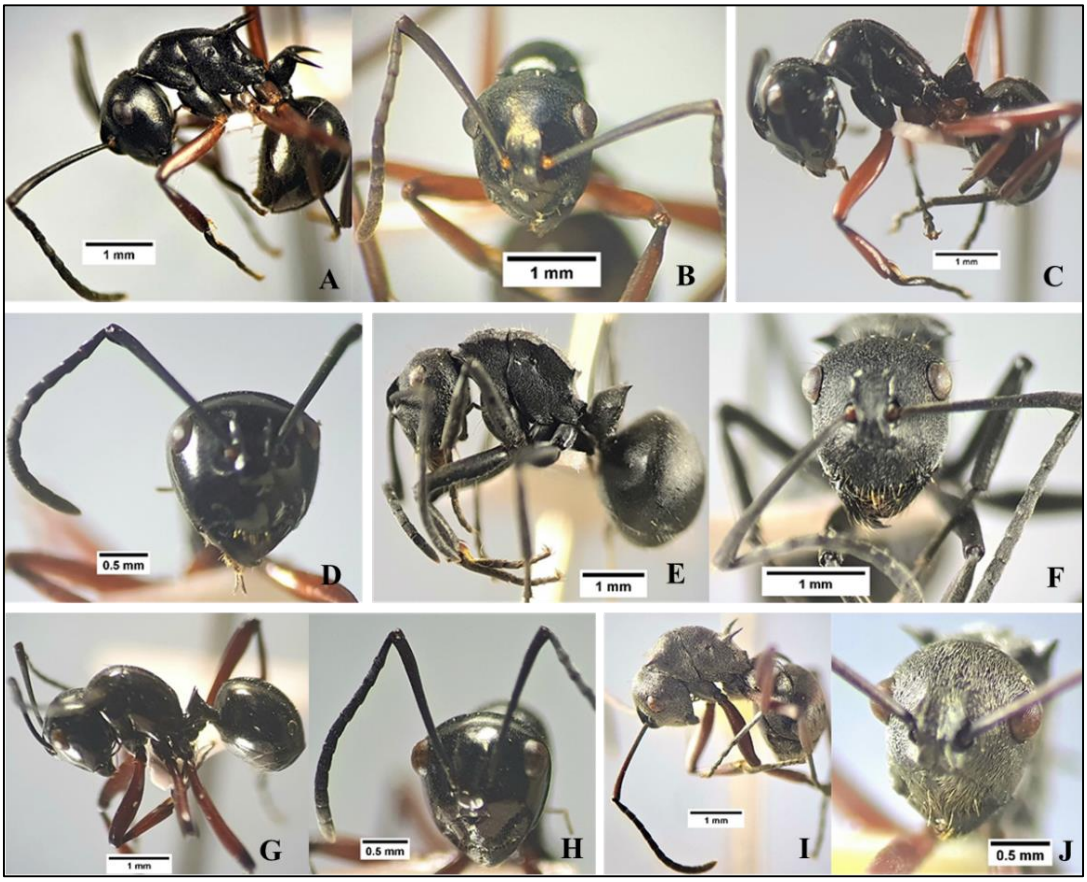

Figure 35: Profile and full-face images of *Polyrhachis* **A, B** *P. hippomanes* **C, D** *P. laevissima* **E, F** *P. punctillata* **G, H** *P. rastellata* **I, J** *P. saevissima argentea*

***Polyrhachis tibialis parsis* Emery, 1900**

Type locality: India (Emery, 1900a).

Distribution: India, Nepal, Sri Lanka (Emery, 1900a; Thapa, 2015; Dias *et al.*, 2020).

Nepal: Kathmandu (Joshi & Manandhar, 2001; Thapa, 2015).

Materials examined: Nagarjun Forest, SNNP, 1400 m, hand collection, 1.v.2019; Jamune, Tanahun, 27.9875°N, 84.1831°E, 530 m, hand collection, 23.x.2007, I.P. Subedi leg.; Raniban, Kathmandu, 10.ii.2017, I.P. Subedi leg.; Salmodevi Forest, Kathmandu, 10.i.2019, I.P. Subedi leg.

***Polyrhachis tyrannica* Smith, 1858** (Figs. 10 C, D)

Type locality: China (Smith, 1858).

Distribution: Borneo, China, India, Indonesia, Macau, Malaysia, Nepal (Subedi *et al*., 2020; Wong & Guénard, 2021).

Nepal: Jamune, Tanahun, 27.9875°N, 84.1831°E, 530 m (Subedi *et al.*, 2020).

Materials examined: Jamune, Tanahun, 27.9875°N, 84.1831°E, 530 m, hand collection, 28.xii.2006, I.P. Subedi leg.; Pokhara, Kaski, 28.xi.2006, I.P. Subedi leg. (CDZMTU HymF169).

Notes: These are blackish ants densely covered with appressed golden pubescence almost all over the body. Head, mesosoma, petiole, gaster and legs also bear numerous erect hairs. The mesosoma dorsum is with strong lateral margin. Pronotum is with slightly curving spines. Propodeum is with short upturned acute teeth. Legs are red in color. This species is documented in Subedi *et al.* (2020) as the first record for Nepal.

***Prenolepis darlena* Williams and LaPolla, 2016**

Type locality: Baglung, Nepal (Williams & LaPolla, 2016).

Distribution: Nepal, Thailand (Williams & LaPolla, 2016).

Nepal: 16 km ENE Baglung, 28.3000°N, 83.7667°E, 1100 m, *Schima-Castanopsis* Forest, 27.xi.1988, P.S. Ward leg. (Williams & LaPolla, 2016).

***Prenolepis naoroji* Forel, 1902** (Figs. 10 G, H)

Type locality: Assam, India (Forel, 1902c)

Distribution: China, India, Indonesia, Malaysia, Nepal, Philippines, Sri Lanka, Thailand, Vietnam (Williams & LaPolla, 2016; Subedi *et al.*, 2020).

Nepal: Jiri Khola, Dolakha; Cha Khola Hokse valley, Kavrepalanchok, 1000 m; Pokhara, Kaski, 830 m, Bakhri Kharka, 1800 m, J. Quinland leg. (Collingwood, 1970).

Materials examined: Nagarjun Forest, SNNP, beating, 30.x.2021, I.P. Subedi leg.; TUC, Kirtipur, Kathmandu, 27.6814°N, 85.2831°E, 1330 m, hand collection, 5.xi.2021, I.P. Subedi leg.

***Prenolepis nepalensis* Williams and LaPolla, 2018**

Type locality: Pokhara, Kaski, Nepal (Williams & Lapolla, 2018).

Distribution: Endemic to Nepal.

Nepal: 4 km SSW Pokhara, Kaski, 28.2000°N, 83.9667°E, 900 m, *Schima-Castanopsis* Forest, low vegetation, 10.xii.1988, P.S. Ward leg. (Williams & Lapolla, 2018).

***Prenolepis rinpoche* Williams, 2022**

Type locality: Mustang district, Gandaki Province, Nepal (Williams, 2022).

Distribution: Endemic to Nepal.

Nepal: 20 km SSW Jomsom, Mustang, 28.6167°N, 83.6333°E, 2300 m, 4.xii.1988, P.S. Ward leg., MCZ (Williams, 2022).

****Pseudolasius familiaris* (Smith, 1860)**

Type locality: Makassar, South Sulawesi, Indonesia (Smith, 1860b).

Distribution: Nepal (new record), China, India, Indonesia, Malaysia, Myanmar (Wachkoo & Bharti, 2014; Guénard *et al.*, 2017).

Materials examined: Rhoga, Dama, Ilam, Sal Forest, 26.7623°N, 88.0388°E, 276 m, 16.x.2020, B.R. Shrestha and T. Sherpa leg. (CDZMTU HymF170).

Notes: These tiny ants are yellowish-brown in color with dark gaster. Erect hairs present throughout the body. The head and gaster are with appressed pubescence. Antenna 12-segmented with the antennal segments longer than wide. The antennal scape surpasses the posterior cephalic border. Mandible armed with 8 teeth.

3.3.2.6 *Subfamily: Leptanillinae* (1 genus and 1 species)

***Leptanilla buddhista* Baroni Urbani, 1977**

Type locality: Bakhri Kharka, Gorkha, Nepal (Baroni Urbani, 1977a)

Distribution: Endemic to Nepal

Nepal: Gorkha, 28.3833°N, 84.7500°E, 1676 m, 24.iv.1954, K.H. Hyatt leg.; Godawari, Lalitpur, 1450 m, 24.v.1976, C. Baroni Urbani leg., NHMB (Baroni Urbani, 1977a).

3.3.2.7 *Subfamily: Myrmicinae* (21 genera and 72 species)

***Aphaenogaster beesoni* Donisthorpe, 1933** (Figs. 11 A, B)

Type locality: Kotkhal, Simla, India (Donisthorpe, 1933b).

Distribution: India, Nepal, Pakistan (Donisthorpe, 1933b; Rasheed *et al.*, 2019; Subedi *et al.*, 2021c).

Materials examined: Suidob Shikar, Dadeldhura, 29.3962°N, 80.6147°E, 2218 m, 12.x.2020, P.B. Budha and P. Shrestha leg. (CDZMTU HymF171).

Notes: This ant is a high-altitude species recorded from *Quercus* Forest from western Nepal. It has hairy body covered by scattered yellow bristles. Head dorsum, mandible, clypeus, mesosoma and the junction of gaster with postpetiole longitudinally striate, whereas petiole, postpetiole and gaster smooth and shiny. This species is closely resembled with *A. smythiesii* which is shinier with posterior part of head pronotum largely smooth and differently punctuated (Donisthorpe, 1933b). This species is documented in Subedi *et al.* (2021c) as a new record for Nepal.

***Aphaenogaster cristata* (Forel, 1902)** (Figs. 36 A, B)

Type locality: Dharmasala, Himanchal Pradesh, India (Forel, 1902b).

Distribution: Nepal (new record), India, Vietnam (Guénard *et al.*, 2017).

Materials examined: Sundarijal Forest, SNNP, 27.7697°N, 85.4250°E, 1577 m, under bark, hand collection, 19.xii.2020, I.P. Subedi leg. (CDZMTU HymF172).

Notes: These ants are dark-brown in color with yellowish mandibles, antennae, and legs. The whole body is smooth and shiny with a feebly reticulate head, mesonotum and metanotum. Few striations are present around the eyes. Pilosity scattered with erect hairs scarce on mesonotum, metanotum and petiole. Propodeal spines are short and stout.

Figure 36: Profile and full-face images of *Aphaenogaster cristata*

***Aphaenogaster pachei* (Forel, 1906)**

Type locality: Tseram, Taplejung, Nepal (Forel, 1906).

Distribution: Nepal, India (Forel, 1906; Bharti *et al.*, 2016a).

Nepal: Tseram, Taplejung, NE Nepal, 28.0000°N, 84.0000°E, 3600 m, Pache leg., MHNG (Forel, 1906); Thorung Pedi, Manang, 28.7750°N, 83.9667°E, 4400 m (AntWeb, 2022); Pangboche, Solukhumbu, 3950 m, Yaral and Taboche (Mingbo Valley), 3900–4800 m; Likhu-Khola, Ramechhap, 1690 m, iv–vi.1961, H. Janetschek leg. (Collingwood, 1970).

Materials examined: Sagarmatha National Park, Phurte, 27.8167°N, 86.6833°E, 3452 m, 6.v.2002, S. Bevaqua leg.

***Aphaenogaster prudens* (Forel, 1902)**

Type locality: North West Himalaya, India (Forel, 1902b).

Distribution: India, Nepal (Forel, 1902b; Collingwood, 1970).

Nepal: Tate, Solukhumbu, 2900 m; Sikris, 2333 m, K.M. Hyatt leg. (Collingwood, 1970).

***Aphaenogaster smythiesii* (Forel, 1902)**

Type locality: Himalaya, India (Forel, 1902b).

Distribution: Afghanistan, China, India, Nepal, Pakistan, Republic of Korea (Guénard *et al.*, 2017).

Nepal: Sikris-Jarsa, Dolakha, 1950–2300 m; Bakhri Kharka, 1833 m, v.1954, J. Quinland leg. (Collingwood, 1970).

Materials examined: Shivapuri Forest, SNNP, 27.7911°N, 85.3711°E, 1650 m, 4.xi.2018, pitfall and hand collection, I.P. Subedi leg.; helipad, Shivapuri Forest, SNNP, 27.7873°N, 85.3755°E, 1855 m, pitfall and hand collection, 4–6.xi.2018, 3–4.xi.2021, I.P. Subedi leg.; Nagarjun Forest, SNNP, 27.7444°N–27.7452°N, 85.2942°E–85.2667°E, 1400–2087 m, pitfall and bait collection, 22–24.x.2019, I.P. Subedi *et al*. leg.; Sundarijal Forest, SNNP, 27.7697°N–27.7928°N, 85.4250°E–85.4356°E, 1577–2175 m, pitfall and hand collection, I.P. Subedi, I. Pandit, and T. Adhikari leg.

***Cardiocondyla emeryi* Forel, 1881**

Type locality: Virgin Island, St. Thomas, USA (Forel, 1881).

Distribution: Worldwide tramp species distributed in Africa, Asia, Europe, Oceania, West Indies, South, Central and North America (Wetterer, 2012).

Nepal: Kathmandu, vi.1988 (Seifert, 2003).

***Cardiocondyla itsukii* Seifert, Okita and Heinze, 2017**

Type locality: Shizuoka Prefecture, Iwata-shi, Japan (Seifert *et al.*, 2017).

Distribution: Bhutan, China, India, Indonesia, Japan, Nepal, Philippines, Sri Lanka, Thailand, USA (Seifert *et al.*, 2017).

Nepal: Pokhara, Kaski, 27 km NW, 28.3020°N, 83.7810°E, 20.xi.1995, Pokhara vicinity, 28.2000°N, 83.9800°E, 20.xi.1995 (Seifert *et al.*, 2017).

Material examined: RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, hand collection, 1.iii.2022, I.P. Subedi leg.

***Cardiocondyla kagutsuchi* Terayama, 1999** (Figs. 11 C, D)

Type locality: Ishigaki-jima, Omoto-dake, Okinawa prefecture, Japan (Terayama, 1999).

Distribution: Bhutan, China, Fiji, India, Indonesia, Japan, Korea, Malaysia, Mariana Islands, Nepal, Papua New Guinea, Philippines, Polyneisa, Singapore, Sri Lanka, Taiwan, Thailand (Seifert, 2003; Sarnat & Economo, 2012; Seifert *et al.*, 2017).

Nepal: Pokhara, Kaski, 27 km NW, 28.3020°N, 83.7810°E, xi.1995; Pokhara vicinity, xi.1995 (Seifert, 2003).

Materials examined: Nagarjun Forest, SNNP, hand collection, 1900 m, 22.x.2019, I.P. Subedi leg.

***Cardiocondyla mauritanica* Forel, 1890**

Type locality: Gabes, Tunisia (Forel, 1890b).

Distribution: Worldwide tramp species spread broadly in Southern Europe, North Africa, Middle East, South Asia, and North America (Wetterer, 2014c).

Nepal: Thak, Jomosom, Mustang, 1.iii.1974 (Seifert, 2003).

***Cardiocondyla minutior* Forel, 1899**

Type locality: Oahu Island, Honolulu, Hawaii, USA (Forel, 1899).

Ditribution: Worldwide tramp species distributed in both the Old and the New Worlds (Wetterer, 2014b).

Nepal: Kathmandu, 27.viii.1983, M.G. Allen leg.; Kathmandu, vi.1988; Sange, Tanahun, 28.0200°N, 84.3600°E, xi.1961 (Seifert, 2003).

***Cardiocondyla obscurior* Wheeler, 1929**

Type locality: Eisei, Taiwan [Formosa] (Wheeler, 1929).

Distribution: Barbados, Brazil, Caribbean, Germany, India, Israel, Japan, Kenya, Nepal, Polynesia, Spain, Taiwan, USA (Seifert, 2003; Wetterer *et al.*, 2016).

Nepal: Pokhara, Kaski, 1988 (Seifert, 2003).

***Cardiocondyla wroughtonii* (Forel, 1890)**

Type locality: Pune [Poona], Maharastra, India (Forel, 1890a).

Distribution: Australia, Brunei, China, India, Indonesia, Japan, Malaysia, Nepal, Papua New Guinea, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Tanzania, USA (Seifert, 2003; Guénard & Dunn, 2012; Subedi *et al.*, 2020).

Nepal: Locality unknown (Subedi *et al.*, 2020).

Materials examined: Tanahun, Sal Forest, 27.5922°N, 84.1605°E, 418 m, 30.ix.2020, P.B. Budha and P. Shrestha leg.; Ratanpur, Bhanu, Tanahun, Champ plantation, 28.0851°N, 84.3895°E, 813 m, 29.ix.2020, P.B. Budha and P. Shrestha leg.

****Carebara affinis* (Jerdon, 1851)**

Type locality: Malabar, Karnataka/Kerala, India (Jerdon, 1851).

Distribution: Australia, Bangladesh, Borneo, China, India, Indonesia, Laos, Malaysia, Myanmar, Nicobar Island, Philippines, Sri Lanka, Thailand (Guénard *et al.*, 2017).

Materials examined: Chisapani, Surkhet, Sal Forest, 28.6108°N, 81.6193°E, 802 m, 20.x.2020, P.B. Budha and P. Shrestha leg. (CDZMTU HymF173).

Notes: Head almost smooth with few striae in minor and striated in major. Head of the major is lacking deep median longitudinal groove and ocelli. Body sculpture weak,

relatively small-sized and reddish-brown in coloration. This species is documented in Subedi *et al*. (2021c) as a new record for Nepal.

***Carebara bengalensis* (Forel, 1902)**

Type locality: Barrackpore, West Bengal, India (Forel, 1902b).

Distribution: Bangladesh, China, India, Nepal (Guénard *et al.*, 2017)

Nepal: Bhaktapur (Thapa, 2015 as *Oligomyrmex bengalensis*).

***Carebara diversa* (Jerdon, 1851)**

Type locality: Wayanad, Kerala, India (Jerdon, 1851).

Distribution: Bangladesh, Borneo, China, Cambodia, Guinea, India, Indonesia, Japan, Laos, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand, Vietnam (Guénard *et al.*, 2017).

Nepal: Lumle, Kaski (Thapa, 2015 as *Pheidologeton diversus*).

***Carebara lignata* Westwood, 1840**

Type locality: Java, Indonesia (Westwood, 1840).

Distribution: Bangladesh, Cambodia, China, India, Indonesia, Malaysia, Myanmar, Nepal, Singapore, Vietnam (Guénard *et al.*, 2017)

Nepal: Hetauda, Makawanpur, 330 m, W. Peters leg. (Collingwood, 1970).

***Cataulacus granulatus* (Latreille, 1802)** (Figs. 11 G, H)

Type locality: Grand Indes (Latreille, 1802).

Distribution: Borneo, Cambodia, China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Singapore, Sri Lanka, Thailand, Vietnam (Guénard *et al.*, 2017).

Nepal: Locality unknown (Subedi *et al*., 2020).

Material examined: Pokhara, Kaski, 28.2138°N, 83.9717°E, hand collection, 18.vii.2006, I.P. Subedi leg.

***Crematogaster binghamii* Forel, 1904**

Type locality: Sikkim, India (Forel, 1904).

Distribution: Bangladesh, China, India, Nepal, Thailand, Vietnam (Hosoishi & Ogata, 2016; Liu *et al.*, 2020).

Nepal: Zharangje Khola, Kavrepalanchok, 1800 m. (Collingwood, 1970); Kathmandu, 1350 m, 23.ix.1983, M.G. Allen leg. (Hosoishi & Ogata, 2016).

Materials examined: Rhoga, Dama, Ilam, Sal Forest, 26.7650°N, 88.0401°E, 302 m, 15.x.2020, B.R. Shrestha and T. Sherpa leg.

***Crematogaster flava* Forel, 1886**

Type locality: Sivasagar, Assam, India (Forel, 1886b)

Distribution: Bangladesh, India, Myanmar, Nepal (Guénard *et al.*, 2017).

Nepal: Locality unknown (Subedi *et al*., 2020).

Materials examined: TUC, Kirtipur, Kathmandu, 27.6814°N, 85.2831°E, 1330 m, hand collection, 5.xi.2021, I.P. Subedi leg.; Salleri Chyandada, Panchthar, Pine forest, 27.1831°N, 87.7528°E, 1436 m, 11.x.2020, B.R. Shrestha and T.Sherpa leg.

***Crematogaster himalayana* Forel, 1902** (Figs. 11 I, J)

Type locality: Himanchal Pradesh, India (Forel, 1902b)

Distribution: India, Pakistan, Nepal (Forel, 1902b; Rasheed *et al.*, 2019; Subedi *et al.*, 2020)

Materials examined: TUC, Kirtipur, Kathmandu, 27.6814°N, 85.2831°E, 1330 m, pitfall/hand collection, 29.v.2019, 5.xi.2021, I.P. Subedi leg.; RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, pitfall/hand collection, 15.x.2019, I.P. Subedi leg.; Baikunda, Panchthar, Sal Forest, 27.1444°N, 87.7020°E, 745 m, 12.x.2020, B.R. Shrestha and T. Sherpa leg.; Shivapuri Forest, SNNP, 27.7911°N, 85.3711°E, 1650 m, 4.xi.2018, pitfall and hand collection, I.P. Subedi leg.; Nagarjun Forest, SNNP, 27.7444°N–27.7452°N, 85.2942°E–85.2667°E, 1400–2087 m, pitfall and bait collection, 22–24.x.2019, I.P. Subedi *et al*. leg.; Sundarijal Forest, SNNP, 27.7697°N–27.7928°N, 85.4250°E–85.4356°E, 1577–2175 m, pitfall and hand collection, I.P. Subedi, I. Pandit, and T. Adhikari leg.

***Lophomyrmex ambiguus* Rigato, 1994** (Figs. 11 K, L)

Type locality: Kuamun district, Kathgodam, Uttar Pradesh, India (Rigato, 1994).

Distribution: Bangladesh, India, Nepal (Rigato, 1994; Hannan, 2007).

Nepal: 16 km ENE Baglung, 1100 m, P.S. Ward leg. (Rigato, 1994).

Materials examined: Budhitola, Kailali, Sal Forest, 28.9246°N, 80.5691°E, 952 m, 15.x.2020, P.B. Budha and P. Shrestha leg. (CDZMTU HymF174); Baikunda, Panchthar, Sal Forest, 27.1444°N, 87.7020°E, 745 m, 12.x.2020, B.R. Shrestha and T. Sherpa leg.; Shailya Shikhar, Darchula, Pine Forest, 29.7006°N, 80.5456°E, 1415 m, 9.x.2020, P.B. Budha and P. Shrestha leg.; Tanahun, Acacia Forest, 27.8798°N, 84.3399°E, 276 m, P.B. Budha and P. Shrestha leg.

***Lordomyrma bhutanensis* (Baroni Urbani, 1977)**

Type locality: Dechhi Paka, 5 km West of Pelela, Bhutan (Baroni Urbani, 1977b).

Distribution: Bhutan, China, Nepal (Liu *et al.*, 2021).

Nepal: Locality unknown, MCZC (Branstetter, 2009; Liu *et al*., 2021).

***Mayriella transfuga* Baroni Urbani, 1977**

Type locality: Narayangarh, Chitwan, Nepal (Baroni Urbani, 1977b).

Distribution: Bhutan, China, Hong Kong, India, Indonesia, Laos, Malaysia, Nepal, Philippines, Singapore, Thailand (Shattuck & Barnett, 2007; Jaitrong *et al.*, 2016).

Nepal: 6 km NW Narayangarh, Chitwan, 27.7500°N, 84.0833°E, 250 m, 30.vi.1976, Baroni Urbani leg., NHMB, BMNH (Baroni Urbani, 1977b; Shattuck & Barnett, 2007).

***Meranoplus bicolor* Guerin-Meneville, 1844** (Figs. 11 M, N)

Type locality: Pondichery, Tamil Nadu, India (Guérin-Méneville, 1844).

Distribution: Bhutan, China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Pakistan, Singapore, Sri Lanka, Taiwan, Thailand, Vietnam (Schödl, 1998; Jaitrong *et al.*, 2016).

Nepal: Kathmandu, 1350 m 23.ix.1983, Allen leg., BMNH, Hetauda, Makawanpur, 9.x.1972, Franz leg., NHMB; 9 mls. W Hetauda, 400 m, 23.xi.1961, Ross and Cavagnaro leg., CASC; Amlekhganj, Bara, 7–10.x.1972, Franz leg.; Ghorepani, Kaski, NHMB (Schödl, 1998); Kavrepalanchok, 1750 m, iv–vi.1961, H. Janetschek leg. (Collingwood, 1970).

Materials examined: Banbehada, Kailali, Sal Forest, 28.8096°N, 80.6758°E, 204 m, 17.x.2020, P.B. Budha and P. Shrestha leg.; Godawari, Kailali, Riverine Forest, 28.8712°N, 80.5698°E, 244 m, 17.x.2020, P.B. Budha and P. Shrestha leg.; Singribeta, Bhadrapur, Jhapa, Sal Forest, 26.6033°N, 88.0726°E, 94 m, 18.x.2020, B.R. Shrestha

and T. Sherpa leg.; Rampur, Chitwan, 27.6079°N, 84.5686°E, 9.iii.2013, I.P. Subedi leg.; Shivapuri Forest, SNNP, 27.7873°N, 85.3755°E, 1855 m, under soil, 4.xi.2021, I.P. Subedi leg.; Dumkibas, Nawalpur, *Dalbergia sisso-Acacia catechu* Forest, 27.5842°N, 83.8781°E, 124 m, 3.x.2020, P.B. Budha and P. Shrestha leg.; Amaltari, Nawalpur, Mixed broadleaf Forest, 27.5623°N, 84.1053°E, 120 m, 4.x.2020, P.B. Budha and P. Shrestha leg.

***Meranoplus nepalensis* Schödl, 1998**

Type locality: Gokarna Forest Reserve, Kathmandu, Nepal (Schödl, 1998).

Distribution: Endemic to Nepal

Nepal: Gokarnaban, Gokarna Forest Reserve, Kathmandu, 1350 m, 12.vi.1976, Wittmer and Baroni Urbani leg., NHMB; Godawari, Lalitpur, 1450 m, Wittmer and Baroni Urbani leg., NHMB; Kathmandu, H. Franz leg., NHMB; Tumlingtar, Sankhuwasabha, 27.2873°N, 87.2165°E, 950 m, 26.iv.1984, Lobi and Smetana leg., CASC, NHMW (Schödl, 1998).

Materials examined: RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, pitfall/hand collection, 15.x.2019, I.P. Subedi leg.; Coronation Garden, TU, hand collection, 29.v.2019, I.P. Subedi leg.

***Meranoplus rothneyi* Forel, 1902**

Type locality: Cochin, Kerala, India (Forel, 1902b).

Distribution: Bhutan, India, Nepal, Sri Lanka (Schödl, 1998; Dias *et al.*, 2020).

Nepal: NE Kuwapani, Sankhuwasabha, 2250 m, 24.iv.1984, Lobi & Smetana leg.; Arun Valley, 3500 m, 13.vi.1954, Swan leg. (Schödl, 1998).

****Monomorium floricola* (Jerdon, 1851)** (Figs. 37 A, B)

Type locality: Tellicherry, Kerala, India (Jerdon, 1851).

Distribution: Nepal (new record). This is one of the most widely distributed tramp species occurring both in the tropics and subtropics of the New and the Old Worlds, and often in the temperate areas (Wetterer, 2010a).

Materials examined: Pokhara, Kaski, 28.2138°N, 83.9717°E, hand collection, 18.vii.2006, I.P. Subedi leg. (CDZMTU HymF175); Tanahun, Sal Forest, 27.5922°N, 84.1605°E, 418 m, 30.ix.2020, P.B. Budha and P. Shrestha leg.

Notes: These are very small slender ants that may be identified by their minute size and distinctly bicolor body. Their head and gaster are uniformly dark brown to chocolate colored with a pale mesosoma, petiole and postpetiole. These uniquely bicolored ants may be distinguished from *M. monomorium* which is uniformly-colored and *M. pharaonis*, which has a darker gaster and a lighter head and mesosoma.

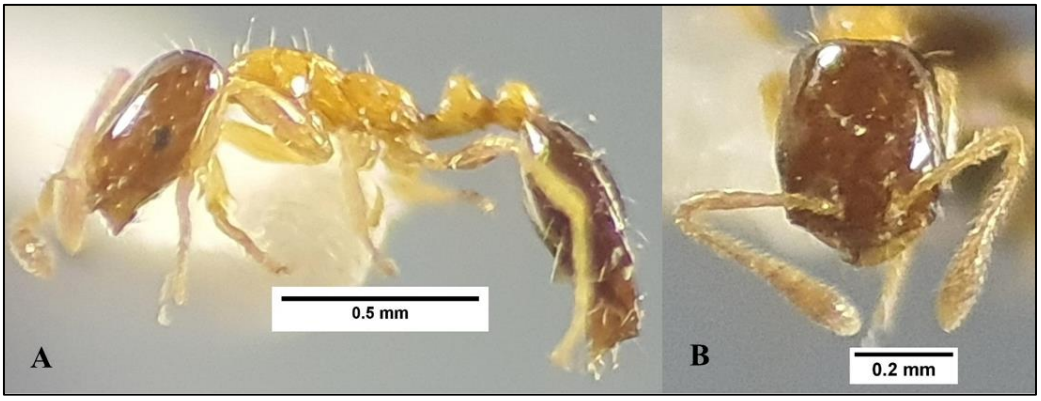

Figure 37: Habitus in profile and Head in full-face view images of *Monomorium floricola*.

***Monomorium pharaonis* (Linnaeus, 1758)** (Figs. 11 O, P)

Type locality: Egypt [Aegypto] (Linnaeus, 1758)

Distribution: Most widely distributed ant in Asia, Africa, Australia, Europe, Oceania, the West Indies, North, Central, and South America (Wetterer, 2010b).

Nepal: Jamune, Tanahun, 27.9875°N, 84.1831°E, 530 m, 28.xii.2006, I.P. Subedi leg., CDZMTU (Subedi *et al*., 2020).

Materials examined: Jamune, Tanahun, 27.9875°N, 84.1831°E, 530 m, 28.xii.2006, I.P. Subedi leg. (CDZMTU HymF176); Godawari, Kailali, Riverine forest, 28.8712°N, 80.5698°E, 244 m, 17.x.2020, P.B. Budha and P. Shrestha leg.; TUC, Kirtipur, Kathmandu, 27.6814°N, 85.2831°E, 1330 m, pitfall collection, 27–29.v.2020; Shivapuri Forest, SNNP, 27.7911°N, 85.3711°E, 1650 m, 4.xi.2018, pitfall and hand collection, I.P. Subedi leg.

Notes: This is one of the most widely distributed pest ants. These ants are of varying color from uniformly yellowish to yellowish body with posteriorly dark-brown gaster. The head, mesosoma, petiole and postpetiole are not shiny unlike entirely smooth and shiny *Trichomyrmex destructor* (Wetterer, 2010b). This species is documented in Subedi *et al*. (2020) as a new record for Nepal.

***Monomorium sahlbergi* Emery, 1898**

Type locality: Jericho, Israel (Emery, 1898).

Distribution: India, Nepal, New Zealand, Oman, Panama, Sri Lanka, Thailand, USA, Yemen (Guénard *et al.*, 2017).

Nepal: 14.5 km W. Hetauda, Makawanpur, 400 m, 23.xi.1961, Ross and Cavagnaro leg., CASC (Subedi *et al.*, 2020).

Materials examined: Sagarnath, Sarlahi, 26.9943°N, 85.6725°E, 115 m, *Eucalyptus camaldulensis* plantation, 21.x.2020, B.R. Shrestha and T. Sherpa leg.; Dumkibas, Nawalpur, 27.5858°N, 83.8802°E, 130 m, 3.x.2020, P.B. Budha and P. Shrestha leg.

***Myrmica aimonissabaudiae* Menozzi, 1939**

Type locality: Sind Valley, Gund, Pakistan (Menozzi, 1939).

Distribution: Afghanistan, Bhutan, Pakistan, India, Nepal, Bhutan (Radchenko & Elmes, 2010; Bharti *et al.*, 2016c).

Nepal: Lumleek, Mustang, 1989; Ghasa-Tukhe, Larjung, 16 km SW Jomsom, 28.6833°N, 83.6167°E, 2550 m, 1.xii.1988, P.S. Ward leg. (Radchenko & Elmes, 2001)

Materials examined: Langtang village, 3000–3500 m, 8.x.2004, T. Matsumara leg.

Notes: This is one of the most common Himalayan species, found in both natural and disturbed habitats. It is most abundant in semi-natural habitats, nesting in open grasslands with or without shrubs, and in deciduous and coniferous forests, and nesting both in ground and in rotting wood (Radchenko & Elmes, 2001; Bharti *et al.*, 2016c).

***Myrmica alperti* Elmes and Radchenko, 2009**

Type locality: Thodung, Solukhumbu, Nepal (Elmes & Radchenko, 2009).

Distribution: China, Nepal (Elmes & Radchenko, 2009; Mo *et al.*, 2015).

Nepal: Thodung, Solukhumbu, 27.6000°N, 86.3500°E, 3200 m, 2–9.iv.1973, Coniferenwald, Martens leg., NHMB; Jiri-Thodung, 28.v.1976, Wittmer and Baroni Urbani leg.; Shiralaybis, Jiri ghat, 2200 m, 8.vi.1973, Martens leg, NHMB, SIZK, ELMES (Elmes & Radchenko, 2009).

***Myrmica bactriana* Ruzsky, 1915**

Type locality: Vicinity of Darindo, Dza-chju river valley, Tibet, China (Ruzsky, 1915).

Distribution: China, Nepal (Radchenko & Elmes, 2010).

Nepal: Ringmo-Junbesi, Solukhumbu, 2800 m; Yaral (Pangboche), 3900 m; Tate, 2900 m; Hoxe (=Hokse), Sindhupalchok, 1000–2000 m (Collingwood, 1970; Thapa, 2015).

***Myrmica boltoni* Radchenko and Elmes, 1998**

Type locality: Dhorpatan, Baglung, Nepal (Radchenko & Elmes, 1998).

Distribution: Endemic to Nepal

Nepal: Dhorpatan, Baglung, 3000 m, 20.v.1973; Martens leg.; Ghorepani, w. Pokhara, ix–x.1971, Franz leg.; 18 km NNE Baglung, 28.4000°N, 83.7000°E, 2540 m, 29.xi.1988, P.S. Ward leg., PSWC; Induwa Kola Valley, Sankhuwasabha, 2000 m, 16.iv.1984, Lobl and Smetana leg.; Marsyangdi, Manang, 28.0833°N, 84.4667°E, 2550 m, 14–17.iv.1980; Lethe, Mustang, 2450–2600 m, 30.iv.1980, Martens and Ausobsky leg.; Chuing Khola, Meme Kharka, Gorkha, 28.3333°N, 84.8333°E, 3300–3400 m, Martens and Schwaller leg.; BMNH, SIZK, ELMES, WARD, MARTENS, SCHULZ (Radchenko & Elmes, 1998), 2 miles SE Sikha, 28.4466°N, 83.6718°E, 2286 m, 21.v.1954, J. Quinland, NHMUK (AntWeb, 2022).

***Myrmica brancuccii* Radchenko, Elmes and Collingwood, 2009**

Type locality: Utrot, Nepal (Radchenko & Elmes, 1999).

Distribution: Nepal, Pakistan (Radchenko & Elmes, 1999).

Nepal: Utrot, 13.v.1983, Brancucci leg., BMNH; Lumle, Kaski, vi.1988, Collingwood leg., BMNH, NHMB, CAC, SIZK (Radchenko & Elmes, 1999).

***Myrmica hecate* Weber, 1947**

Type locality: Botanical Garden, Darjiling, India (Weber, 1947).

Distribution: India, Nepal

Nepal: Lumle, Kaski, 1988, Collingwood leg.; Kathmandu, 28.v.1976, Wittmer & Baroni Urbani leg.; Daman, Makwanpur, 2400 m, 4.vi.1976, Wittmer & Baroni Urbani leg. (Radchenko & Elmes, 2001).

***Myrmica indica* Weber, 1950**

Type locality: Tonglu, Darjiling, E. Himalayas, India (Weber, 1950).

Distribution: India, Nepal, Bhutan (Radchenko & Elmes, 2010).

Nepal: Phulchoki, Lalitpur, 2600 m, 11–14.vi.1976, Wittmer and Baroni Urbani leg.; Chordung, Jiri, Dolakha, 2900 m, 1.iv.1973, Martens leg.; Simbua Khola, near Lassetham, Taplejung, 3000–3150 m, 15.v.1988; Dorhar Kharka, 2700 m, 10.iv.1988, Martens and Schawaller leg.; Tare-Pati, Gosaikunda, Rasuwa, 9.x.1971, Franz leg.; Maghang Kharka, Makalu Barun National Park (MBNP), 27.5936°N, 87.1225°E, 2548 m, 5.xi.2005, Emmett and Subedi leg., Maghang Kharka, MBNP, 27.5692°N, 87.1250°E, 2634 m, 5.xi.2005, Alpert, Alonso & Subedi leg., NHMB, SIZK, ELMES (Elmes & Radchenko, 2009; Bharti *et al.*, 2016c); Maiwakhola, Sanghu, Taplejung, 26.x.1961, Ward leg., BMNH; near Pahakhola, Sankhuwasabha, 27.5833°N, 87.3333°E, 2700 m, 31.v.1988, Martens & Schwaller leg., PSAS (AntWeb, 2022).

Materials examined: Shivapuri Forest, SNNP, 27.8064°N, 85.3900°E, 2458 m, pitfall collection, 4.xi.2018; Near Bagdwar, SNNP, 2400 m, under bark, hand collection, 5.xii.2020, I.P. Subedi leg.

***Myrmica kozlovi* Ruzsky, 1915**

Type locality: Dza-chju river tributary, Kam basin-Yangtze River, Tibet, China (Ruzsky, 1915).

Distribution: China, India, Nepal (Radchenko & Elmes, 2001).

Nepal: Mingbo, Mandsua, Solukhumbu, 4000 m; v.1954, Sikha, Taplejung, 2660 m; J. Quinland leg. (Collingwood, 1970); Phedikhola, Sindhupalanchok, 1500 m; near Banepa, Kavrepalanchok, 1420 m; Resangu, 1900 m (Thapa, 2015).

Notes: This species was discovered at the highest elevations yet documented for any *Myrmica* species (4800 m) and is likely the only *Myrmica* species to have crossed the Himalayan barrier to dwell on both the western and eastern sides (Radchenko & Elmes, 2010).

***Myrmica martensi* Radchenko and Elmes, 1998**

Type locality: Gosainkunda, Sing Gyang, Rasuwa, Nepal (Radchenko & Elmes, 1998).

Distribution: Endemic to Nepal

Nepal: Gosainkunda, Sing Gyang, Rasuwa, 27.6000°N, 86.3500°E, 3200 m, 26.iv.1973, J. Martens leg., NHMB (Radchenko & Elmes, 1998).

***Myrmica pachei* Forel, 1906**

Type locality: Tseram, NE Nepal, Nepal (Forel, 1906).

Distribution: Bhutan, India, Nepal (Radchenko & Elmes, 2010).

Nepal: Tseram, Taplejung, NE Nepal, tree trunk, 3600 m (Forel, 1906); upper Simbu Khola valley, near Tseram, Taplejung, 3250–3350 m, 10–15.v.1998, Martens and Schwaller leg.; Dhara and Alm Lasea, 3000–3300 m, 1.ix.1983, Martens and Schwaller leg., MSNG, MHNG (Radchenko & Elmes, 2001).

***Myrmica rhytida* Radchenko and Elmes, 1999** (Figs. 38 A, B)

Type locality: Kashmir, India (Radchenko & Elmes, 1999).

Distribution: Nepal (new record), India (Radchenko & Elmes, 1999).

Materials examined: Shivapuri Peak, SNNP, 27.8201°N, 85.3853°E, 2732 m, hand collection, 5.xii.2020, I. P. Subedi leg. (CDZMTU HymF101).

Notes: Cephalic dorsum, mesosoma, node of petiole, and postpetiole are coarsely rugose. Mesosomal dorsum has distinct impression. The metanotal groove is deep and broad. The petiolar peduncle is distinct. This species is documented in Subedi *et al.* (2022c) as new record for Nepal.

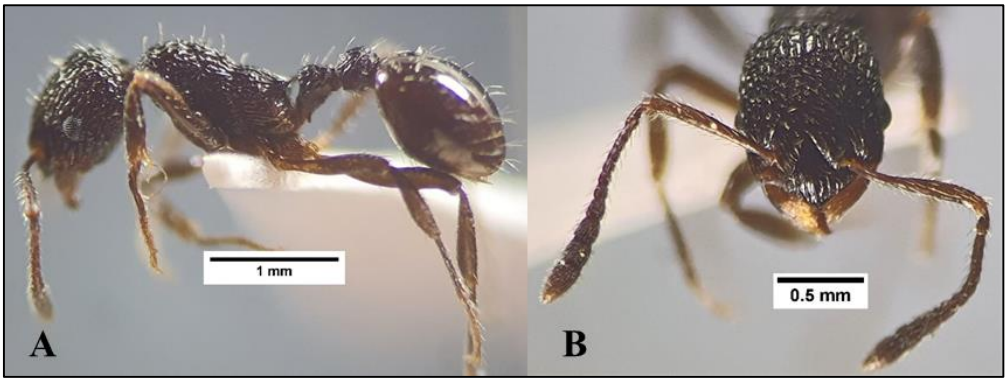

Figure 38: Habitus in profile and Head in full-face view images of *Myrmica rhytida*.

***Myrmica ritae* Emery, 1889**

Type locality: Mt. Mooleyit, Tenasserim, Myanmar (Emery, 1889).

Distribution: China, Myanmar, Thailand, Nepal (Emery, 1889; Collingwood, 1970; Guénard & Dunn, 2012; Khachonpisitsak *et al.*, 2020).

Nepal: Ulleri, Kaski, 2000 m, v.1954, J. Quinland leg. (Collingwood, 1970).

***Myrmica rugosa* Mayr, 1865**

Type locality: Himalaya (Mayr, 1865). No date or collector mentioned in original description which states "Himalaya" (most likely India or Nepal).

Distribution: Bhutan, India, Nepal (Radchenko & Elmes, 2001).

Nepal: Thakkhola, Alt-Marsa, Mustang, 3100–3200 m, 6–7.vii.1973, Martens leg. (Radchenko & Elmes, 2001).

Materials examined: Sundarijal Forest, SNNP, 2100 m, 19.xii.2020; Jamacho, Nagarjun Forest, SNNP, 27.7452°N, 85.2667°E, 2094 m, hand collection, 3.v.2019, I.P. Subedi leg.; Panimuhan, Shivapuri Forest, SNNP, 27.7911°N, 85.3711°E, 1650 m, sifted litter, 4.xi.2021, I.P. Subedi leg.

***Myrmica rupestris* Forel, 1902**

Type locality: Ekra Peak, NW Himalaya, India (Forel, 1902b).

Distribution: Afghanistan, Bhutan, China, India, Nepal (Radchenko & Elmes, 2010; Guénard & Dunn, 2012).

Nepal: Sikris, Dolakha, 2330 m, vi.1954, K.M. Hyatt leg.; Ulleri, Kaski, v.1954, J. Quinlan leg., 2650 m; Gurjakhani, Myagdi, 2833 m, vii.1954, K.M. Hyatt leg. (Collingwood, 1970); Thodung via Those, 3100 m, 29–31.v.1976, Wittmer and Baroni Urbani leg.; Phulchoki, Lalitpur, 2600 m, 11–14.vi.1976; Daman, Makwanpur, 2400 m, 4.vi.1976, Wittmer and Baroni Urbani leg.; Omje Kharka, NW Yamputh, Taplejung, 2300–2500 m, 1.vi.1988, Martens and Schawaller leg., PSWC (Radchenko & Elmes, 2002); 16 km SW Jomsom, Mustang, 28.6833°N, 83.6167°E, 2550 m, 3.xii.1988, P.S. Ward leg., PSWC; Timang, 28.3222°N, 84.3683°E, 2400 m, 7.iv.2008; Thanchok, 28.5333°N, 84.2833°E, 2500 m, 7.iv.2008, M. Granados leg., KGAC (AntWeb, 2022).

Materials examined: Nagarjun Forest, SNNP, 27.7444°N, 85.2915°E, 1400 m, bait collection, 1.v.2019; Nagarjun Forest, SNNP, hand collection, 5.ix.2019, I.P. Subedi leg.; Sagarmatha N.P., Namche bazar, Kunde, 1.vi.2002, S. Bevaqua and R. Boesi leg.

Notes: Collingwood (1970) listed this species as *Myrmica everesti*, which is a junior synonym of currently valid species, *Myrmica rupestris*.

***Myrmica smythiesii* Forel, 1902** (Figs. 12 A, B)

Type locality: Himalaya, India (Forel, 1902b)

Distribution: India, Nepal (Radchenko & Elmes, 2001).

Nepal: Gompa, Tarahot, 3400 m, 5.IV.1973, Martens leg. (Radchenko & Elmes, 2001).

Materials examined: Jamacho, Nagarjun Forest, SNNP, 27.7452°N, 85.2667°E, 2094 m, hand collection, 22.x.2019, I.P. Subedi leg.; Langtang, Ghodatabala, 2100 m, iv.2013, Y. Aryal leg.; KCA, iv.2013, Y. Aryal leg.

***Myrmica weberi* Elmes and Radchenko, 2009**

Type locality: Maghang Kharka, Makalu Barun Conservation Area, Sankhuwasabha, Nepal (Elmes & Radchenko, 2009).

Distribution: Bhutan, India, Nepal (Elmes & Radchenko, 2009).

Nepal: Maghang Kharka, MBNP, Sankhuwasabha, 27.6050°N, 87.1250°E, 2634 m, 7.xi.2005, Alpert, Alonso and Subedi leg., NHMB; Maghang Kharka, MBNP, Sankhuwasabha, 27.5936°N, 87.1225°E, 2548 m, 5.xi.2005, Emmett and Subedi leg., SIZK, NHMB, ELMES; Chauki, Sankhuwasabha, 27.1833°N, 87.4500°E, 2000–3000 m, 22–24.vi.2001, NHMB (Elmes & Radchenko, 2009).

Materials examined: Chatedunga, Taplejung, 27.3906°N–27.3916°N, 87.7481°E–87.7503°E, 2673–2693 m, 8.x.2020, B.R. Shrestha and T. Sherpa leg.

****Myrmicaria brunnea* Saunders, 1842** (Figs. 12 C, D)

Type locality: Northern India (Saunders, 1842).

Distribution: Nepal (new record), China, India, Indonesia, Malaysia, Myanmar, Pakistan, Philippines, Singapore, Thailand, Vietnam (Guénard *et al.*, 2017).

Materials examined: Gaidakot, Nawalpur, vi.2009, I.P. Subedi leg. (CDZMTU HymF102); Chaliskilo, Nawalpur, Sal Forest, 27.6218°N, 84.0565°E, 198 m, hand collection, 4.x.2020, P.B. Budha leg. (CDZMTU HymF103); Dumkibas, Nawalpur, *Dalbergia-Acacia* Forest, 27.5842°N, 83.8781°E, 124 m, 3.x.2020, P.B. Budha leg.

Notes: This is a chestnut brown colored ant with shining body. The body is mostly covered with many long hairs. It has short, roughly rounded, 7-segmented antenna with no distinct club. The eyes are prominent. The mesosoma is short and propodeal spines are long and triangular. The metanotal groove is deep. Peduncle of petiole is very long. The legs are long and the gaster is subglobose. This species is documented in Subedi *et al.* (2022c) as new record for Nepal.

***Perissomyrmex monticola* De Andrade, 1993**

Type locality: Nobding, Bhutan (De Andrade, 1993).

Distribution: Bhutan, India, Nepal (Xu & Zhang, 2012).

Nepal: Chauki, 27.1833–27.2000°N, 87.4500–87.4667°E, 2600–3000 m, 22.vi.2001, NHMB (Radchenko, 2003).

Notes: Radchenko (2003) described *P. nepalensis* as a new species based upon the Nepalese specimens, however Xu and Zhang (2012) synonymized this species with *P. monticola*, described by De Andrade in 1993, based upon morphological similarities in clypeus, propodeum, petiole, and postpetiole.

***Pheidole indica* Mayr, 1879**

Type locality: Calcutta, West Bengal, India (Mayr, 1879).

Distribution: Widespread species found in Afrotropical, Malagasy, Nearctic, Neotropical, Oriental, and Palaearctic regions (Guénard *et al.*, 2017).

Nepal: Tamakoshi, 1150 m; Zarange Khola, 1800 m; Rishengu; Jiri Khola valley, Dolakha, 1900 m, Jiri, 1950 m, Sikris, 2000 m; Likhu Khola, Ramechhap, 1690 m; Kathmandu, iv–vi.1961, H. Janetschek leg. (Collingwood, 1970; Thapa, 2015).

Notes: Collingwood (1970) treated *Pheidole indica* and *P. himalayana* as different species records from Nepal, however, *P. himalayana* is now a junior synonym of *P. indica*.

***Pheidole jucunda* Forel, 1885** (Figs. 12 E, F, G, H)

Type locality: India (Forel, 1885).

Distribution: China, India, Nepal, Sri Lanka (Forel, 1885; Guénard & Dunn, 2012; Dias *et al.*, 2020; Subedi *et al.*, 2020).

Nepal: Sangu, Taplejung, 27.3571°N, 87.6723°E, 1890 m, 16.i.1962, R.L. Coe leg., NHMUK (AntWeb, 2022).

Materials examined: Sundarijal Forest, SNNP, 27.7836°N, 85.4356°E, 2025 m, bait collection, 19.xii.2020, I.P. Subedi leg.; Nagarjun Forest, SNNP, 27.7452°N–27.7487°N, 85.2667°E–85.2736°E, 1900–2094 m, pitfall collection, I.P. Subedi, R.P. Pokhrel and K. Chaudhary leg.; Shivapuri Forest, SNNP, 27.7875°N, 85.3939°E, 1902 m, hand collection, 1.xi.2018, I.P. Subedi leg.

****Pheidole nodus* Smith, 1874** (Figs. 39 A, B)

Type locality: Hyogo, Japan (Smith, 1874).

Distribution: Widely distributed in Manchurian and Oriental regions.

Specimens examined: Gaidakot, Nawalpur district, hand collection, vi.2009, I.P. Subedi leg. (CDZMTU HymF102); Madhyabindu, Chaliskilo, Nawalpur district, Sal Forest, 27.6218°N, 84.0565°E, 198 m, hand collection, 4.x.2020, P.B. Budha leg. (CDZMTU HymF103).

Notes: Major workers bears deep and broad posterior cephalic concavity. Cephalic dorsum is with long, thick erect and short, thin background hairs. The posterior part and dorsolateral lobes of vertex are rugoso-reticulate. Subpetiolar process is frequently wanting and postpetiole is large. This species is documented in Subedi *et al.* (2022c) as a new record for Nepal.

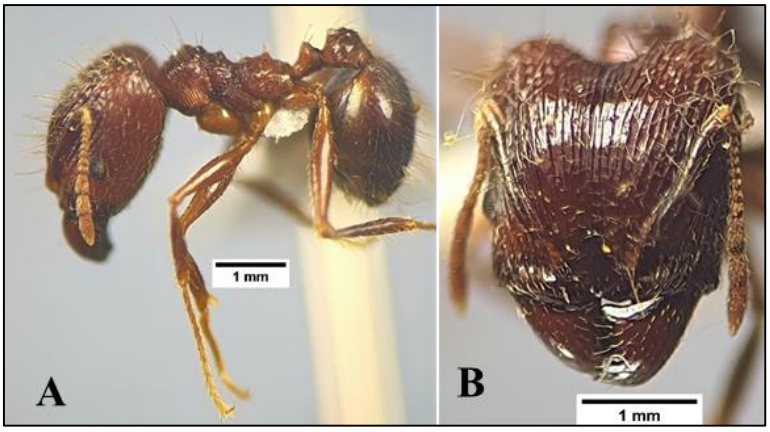

Figure 39: Habitus in profile (A) and Head in full-face view (B) images of *Pheidole nodus* major

***Pheidole parva* Mayr, 1865**

Type locality: Sri Lanka [Ceylon] (Mayr, 1865).

Distribution: Borneo, China, India, Indonesia, Japan, Malaysia, Mauritius, Myanmar, Oman, Philippines, Saudi Arabia, Seychelles, Sri Lanka, Taiwan, Thailand, Vietnam, UAE (Guénard *et al.*, 2017).

Nepal: Locality unknown (Eguchi, 2008).

***Pheidole sagei* Forel, 1902**

Type locality: India (Forel, 1902b).

Distribution: China, India, Nepal, Pakistan (Forel, 1902b; Collingwood, 1970; Guénard & Dunn, 2012; Rasheed *et al.*, 2019).

Nepal: Jiri, Dolakha, 1900 m; Taboche, Solukhumbu, 4550 m, H. Janetschek leg., iv–vi.1961; Cha Khola, Kavrepalanchok, 900–1000 m (Collingwood, 1970; Thapa, 2015).

Materials examined: RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, pitfall and hand collection, 15.x.2019, I.P. Subedi *et al*. leg.

***Pheidole smythiesii* Forel, 1902**

Type locality: India (Forel, 1902b).

Distribution: China, India, Nepal, Thailand, Vietnam (Eguchi, 2008; Liu *et al.*, 2015; Bharti *et al.*, 2016a; Khachonpisitsak *et al.*, 2020; Subedi *et al*., 2020)

Nepal: Pokhara, Kaski, 1000 m, iv.1954, J. Quinland leg. (Collingwood, 1970).

Materials examined: RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, pitfall and hand collection, 15.x.2019, I.P. Subedi leg.; Nagarjun Forest, SNNP, pitfall collection, 27.7444°N–27.7458°N, 85.2942°E–85.2856°E, 1400–1666 m, I.P. Subedi, R.P. Pokhrel and K. Chaudhary leg.

Notes: Collingwood (1970) documented this species as *Ceratopheidole bhavanae*.

***Pristomyrmex sulcatus* Emery, 1895**

Type locality: Carin Cheba, Myanmar [Burma] (Emery, 1895).

Distribution: China, Malaysia, Myanmar, Nepal, Thailand (Wang, 2003).

Nepal: Khandbari, Arun River at Num, Sankhuwasabha, 1500–1600 m, A. and Z. Smetana leg. (Wang, 2003).

Notes: Collingwood (1970) mentioned that few specimens of *Pristomyrmex* from the Janetschek collection are most likely undescribed species.

***Recurvidris recurvispinosa* (Forel, 1890)**

Type locality: Poona, Maharastra, India (Forel, 1890a).

Distribution: China, Hong Kong, India, Japan, Laos, Myanmar, Nepal, Sri Lanka, Taiwan, Thailand (Bolton, 1992; Jaitrong & Wiwatwitaya, 2015; Jaitrong *et al.*, 2016; Dias *et al.*, 2020).

Nepal: Kathmandu, M.G. Allen leg. (Bolton, 1992).

***Stenamma gurkhale* DuBois, 1998**

Type locality: Phulchoki, Lalitpur, Nepal (Dubois, 1998 described as *S. gurkhalis*).

Distribution: Endemic to Nepal

Nepal: Phulchoki, Lalitpur, 27.5833°N, 85.4000°E, 2743 m, 30.v.1983, M. Brendell leg., NHMUK, MCZ (Dubois, 1998; AntWeb, 2022).

***Strumigenys buddhista* De Andrade, 2007**

Type locality: Pokhara, Kaski, Nepal (De Andrade, 2007).

Distribution: Endemic to Nepal

Nepal: Pokhara, Kaski, 28.2185°N, 83.9876°E, 820 m, 15–18.vi.1976, Wittmer and Baroni Urbani leg., NHMB (De Andrade, 2007).

***Strumigenys caniophanoides* De Andrade, 2007**

Type locality: Phuntsholing, Bhutan (Baroni Urbani & de Andrade, 2007).

Distribution: Bhutan, Nepal (Baroni Urbani & de Andrade, 2007).

Nepal: Arun Valley, Sankhuwasabha, 1100 m, 21.iv.1984, Lobi and Smetana leg., MHNG (Baroni Urbani & de Andrade, 2007).

***Strumigenys exilirhina* Bolton, 2000**

Type locality: Sanghu, Taplejung, Nepal (Bolton, 2000b).

Distribution: Bhutan, China, Hong Kong, India, Japan, Nepal, Thailand, Vietnam (Bharti & Akbar, 2013b; Tang *et al.*, 2019; AntWeb, 2022).

Nepal: Sanghu, Taplejung, 3.x.1961, K.H. Hyatt leg., BMNH, MCZ, MHNG, OMNH; Kathmandu, 27.7500°N, 85.1666°E, 23.v.1983, E.M. Brendell leg., PSWC (Bolton, 2000b; AntWeb, 2022).

****Strumigenys godeffroyi* Mayr, 1866** (Figs. 40 A, B)

Type locality: Samoa, Upolu Island (Mayr, 1866b).

Distribution: A widely distributed tramp species occurring in Australia, India, Pakistan, Philippines, Myanmar, Vietnam, and in many pacific and Indian Ocean islands (Guénard *et al.*, 2017).

Materials examined: Nagarjun Forest, SNNP, 27.7458°N, 85.2856°E, 1666 m, pitfall collection, 21.x.2019, I.P. Subedi leg. (CDZMTU HymF105).

Notes: It has a partly or entirely reticulo-punctate mesosoma dorsum. Dorsum of petiole has fine and dense reticulopunctation, but the disc of pospetiole is mostly or completely

smooth. Body has spatulate, flagellate, stiff and simple hairs. This species is documented in Subedi *et al.* (2022c) as a new record for Nepal.

Figure 40: Habitus in profile (A) and Head in full-face view (B) images of *Strumigenys godeffroyi*

***Strumigenys hemisobek* Bolton, 2000**

Type locality: Maiwa Khola, Sanghu, Taplejung, Nepal (Bolton, 2000b)

Distribution: India, Nepal (Bolton, 2000b; Bharti & Akbar, 2013b).

Nepal: Maiwa Khola, Sanghu, Taplejung, 1981 m, 2.x.1961, K.H. Hyatt leg., NHMUK (Bolton, 2000b; AntWeb, 2022).

***Strumigenys hindu* De Andrade, 2007**

Type locality: Pokhara, Kaski, Nepal (Baroni Urbani & de Andrade, 2007).

Distribution: Endemic to Nepal.

Nepal: Pokhara, Kaski, 28.2185°N, 83.9877°E, 820 m, 15–18.vi.1976, Wittmer and Baroni Urbani leg., NHMB (Baroni Urbani & de Andrade, 2007).

***Strumigenys membranifera* Emery, 1869**

Type locality: Portici, Nepoli, Italy (Emery, 1869).

Distribution: Widespread pantropical tramp species recorded from different countries and areas of Europe, America, Africa, Middle East, Asia and Pacific (Wetterer, 2011).

Nepal: Locality unknown (Bolton, 2000b; Wetterer, 2011).

***Strumigenys nepalensis* De Andrade, 1994**

Type locality: Narayangarh, Chitwan, Nepal (De Andrade, 1994).

Distribution: China, Hong Kong, India, Malaysia, Mauritius, Nepal, Singapore, Thailand, Vietnam (Tang *et al.*, 2019).

Nepal: 6 km NW Narayangarh, Chitwan, 250 m, NHMB Nepal Expedition, 21.v.1976, NHMB; 5 km E Manhari, 350 m, NHMB Nepal Expedition, 1976 (De Andrade, 1994).

Materials examined: RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, pitfall and hand collections, 15.x.2019, I.P. Subedi leg.

***Strumigenys podarge* Bolton, 2000**

Type locality: Godawari, Lalitpur, Nepal (Bolton, 2000b).

Distribution: India, Nepal (Bolton, 2000b; Bharti & Akbar, 2013b).

Nepal: Godawari, Lalitpur, 27.5986°N, 85.3872°E, 1700 m, 24.v.1983, M. Brendell leg., MCZ (Bolton, 2000b; AntWeb, 2022).

****Strumigenys virgila* Bolton, 2000** (Figs. 12 I, J)

Type locality: Siwalik Hills, Himanchal Pradesh, India (Bolton, 2000b).

Distribution: Nepal (new record), Bhutan, India (Bharti & Akbar, 2013b).

Materials examined: RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, pitfall collection, 19.x.2019, I.P. Subedi leg. (CDZMTU HymF106).

Notes: It has lamellate propodeal declivity and mostly complex posterior margin. The mandibular apex is with an intercalary tooth between apico-dorsal and apico-ventral teeth and 1 to 2 denticles amid inter-calary and apico-ventral teeth. It is diagnosed from closely related species by intercalary dentition, big lateral spongiform petiolar lobe and by body hairs' distribution and arrangement (Bolton, 2000b). This species is documented in Subedi *et al.* (2022c) as new record for Nepal.

****Temnothorax wroughtonii* (Forel, 1904)** (Figs. 12 K, L)

Type locality: Lidder Valley, Jammu and Kashmir, India (Forel, 1904).

Distribution: Nepal (new record), India (Forel, 1904).

Material examined: Suidob Shikhar, Dadeldhura, *Quercus* Forest, 29.3953°N, 80.6093°E, 2210 m, 11.x.2020, P.B. Budha and P. Shrestha leg. (CDZMTU HymF107).

Notes: It has largely smooth and shiny head, but has few striations on fron and between the eyes and frontal margins. Antenna is 12-segmented with a distinct club. The metanotal groove is distinct. Mesosoma is nearly smooth. Propodeal spines are very short, blunt denticles. Petiolar peduncle is long. Petiolar node is rounded in lateral-view.

Erect or suberect hairs present throughout the body. Gaster is ovate, smooth and shiny. This species is documented in Subedi *et al*. (2022c) as a new record for Nepal.

Tetramorium bicarinatum **(Nylander, 1846)** (Figs. 12 M, N)

Type locality: California, USA (Nylander, 1846).

Distribution: Exceedingly widespread tramp ants found in different countries and neighboring islands of Asia, Africa, Australia, Oceania, Europe, West Indies, North, Central and South America (Wetterer, 2009c).

Nepal: Kathmandu, 1982, M. G. Allen leg., NHMUK (Wetterer, 2009c).

Materials examined: TUC, Kirtipur, Kathmandu, 27.6814°N, 85.2831°E, 1330 m, pitfall collection, 27–29.v.2020; Rajako Chautara, Kaski, 28.1194°N, 84.1029°E, 20.x.2021, N. Subedi leg.

Tetramorium difficile **Bolton, 1977**

Type locality: Tamur River, Dobhan, Dhankuta, Nepal (Bolton, 1977).

Distribution: Bhutan, China, India, Nepal, Vietnam (Bolton, 1977; Liu *et al.*, 2015).

Nepal: Tamur River, Dobhan, Dhankuta, forest litter, 26.9111°N, 87.1617°E, 1.ii.1962, K. Hyatt leg., NHMUK, MCZ (Bolton, 1977; AntWeb, 2022).

Tetramorium lanuginosum **Mayr, 1870**

Type locality: Jakarta, Java, Indonesia (Mayr, 1870).

Distribution: Widspread tramp species in tropics and subtropics of Asia, Australia, and Oceania, and also from Madagascar, Galapagos and East Carribean (Wetterer, 2010c).

Nepal: Amlekhganj, Bara, E.I. Coher leg., MCZ (Wetterer, 2010c).

Materials examined: Rhoga, Dama, Ilam, Sal Forest, 26.7650°N, 88.0401°E, 302 m, 15.x.2020, B.R. Shrestha and T. Sherpa leg.

****Tetramorium obesum*** **Andre, 1887** (Figs. 41 A, B)

Type locality: Gingee, Tamil Nadu, India (André, 1887).

Distribution: Nepal (new record), Bangladesh, India, Myanmar, Vietnam (Guénard *et al.*, 2017).

Material examined: Chaumala, Kailali, Sal Forest, 28.8096°N, 80.6783°E, 207 m, 17.x.2020, P.B. Budha and P. Shrestha leg. (CDZMTU HymF177).

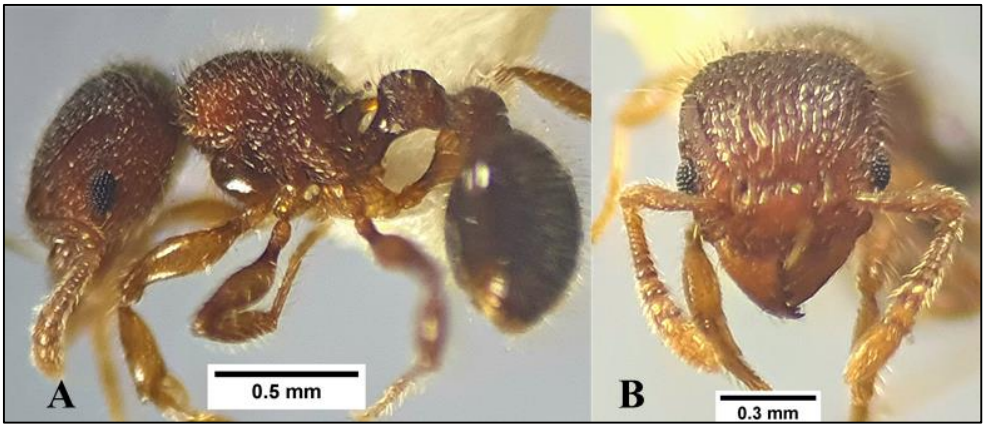

Figure 41: Habitus in profile (A) and Head in full-face view (B) images of *Tetramorium obesum*

Notes: These ants may be recognized by the presence of 12-segmented antenna, long propodeal spines, pedunculate petiole, petiolar node as long as broad, smooth mandible with scattered punctures and trifid hairs on the basal half of first gastral tergite. This species may be distinguished from closely related *T. lanuginosum* which has longitudinally striate mandible, and has simple and bifid hairs on the first gastral tergite (Bharti & Kumar, 2012).

***Trichomyrmex destructor* (Jerdon, 1851)** (Figs. 12 O, P)

Type locality: India (Jerdon, 1851).

Distribution: Widespread invasive species dispersed in Asia and neighboring islands, North Africa, sub-Saharan Africa, Middle East, Australia and Pacific Ocean islands, Europe, West Indies, South, Central and North America (Wetterer, 2009a).

Nepal: Taplejung, 1962, R.L. Coe leg., NHMUK (Wetterer, 2009a); Ratnanagar, Chitwan, 27.6149°N, 84.4436°E, 200 m, 3.vi.2008, M. Granados leg., KGAC (AntWeb, 2022).

Materials examined: Banbehada, Kailali, Sal Forest, 28.8180°N, 80.6789°E, 204 m, 18.x.2020, P.B. Budha and P. Shrestha leg.; Godawari, Kailali, Riverine Forest, 28.8712°N, 80.5698°E, 244 m, 17.x.2020, P.B. Budha and P. Shrestha leg.; Shivapuri Forest, SNNP, 27.7875°N, 85.3939°E, 1902 m, pitfall collection, 2–6.xi.2018, I.P. Subedi *et al*. leg.

3.3.2.8 *Subfamily: Ponerinae* (13 genera and 26 species)

***Bothroponera tesseronoda* (Emery, 1877)** (Figs. 13 A, B)

Type locality: Kolkata, West Bengal, India (Emery, 1877).

Distribution: Nepal (new record), India, Myanmar (Guénard *et al.*, 2017).

Materials examined: Nagarjun Forest, SNNP, 27.7444–27.7452°N, 85.2667–85.2942°E, 1400–2094 m, bait, pitfall and hand collection, 1–3.v.2019, 30.x.2021, I.P. Subedi *et al*. leg.; Shivapuri Forest, SNNP, 27.7911°N, 85.3711°E, 1650 m, pitfall collection, 2–4.xi.2018, I.P. Subedi, R.P. Pokhrel and K. Chaudhary leg. (CDZMTU HymF178).

Notes: The workers have a narrow, convex, and medially elevated clypeus; moderately large frontal lobes; roughly triangular mandibles; mesopleuron not divided by a transverse groove; slit-like propodeal spiracle; no metanotal groove; nodiform petiole lacking posterodorsal spines or teeth or denticles, well-developed subpetiolar process, and weakly sculptured body with dense pubescence.

***Brachyponera chinensis* (Emery, 1895)** (Figs. 13 C, D)

Type locality: Sanghai, China (Emery, 1895).

Distribution: China, India, Japan, Taiwan, Germany, Vietnam, Philippines, Papua New Guinea, New Zealand, Indonesia, North Korea, Malaysia, Thailand, South Korea, Nepal, Russia, USA (Guénard *et al*., 2018).

Nepal: MBNP, Shankhuwasabha, 2400 m, 2005, Alpert *et al*. leg., MCZ (Nelder *et al.*, 2006; Guénard *et al.*, 2018); Nagarjun Forest, SNNP, 1400–1900 m, I.P. Subedi leg., CDZMTU (Subedi *et al*., 2020).

Materials examined: RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, pitfall and hand collections, 15.x.2019, I.P. Subedi leg.; Budhitola, Kailali, Sal Forest, 28.9246°N, 80.5691°E, 952 m, 15.x.2020, P.B. Budha and P. Shrestha leg.; Nagarjun Forest, SNNP, 27.7444°N–27.7452°N, 85.2667°E–85.2942°E, 1400–2094 m, bait, pitfall and hand collections, 1–3.v.2019, 30.x.2021, I.P. Subedi leg.; Shivapuri Forest, SNNP, 27.7911°N–27.8064°N, 85.3900°E–85.3711°E, 1650–2458 m, bait pitfall and hand collections, 2–6.xi.2018, 3.xi.2021, 11.xii.2021, I.P. Subedi et al. leg.; Sundarijal Forest, SNNP, 27.76972°N–27.79278°N, 85.42500°E–85.43556°E, 1577–2175 m, bait, pitfall and hand collections, 10.x.2020, 16–18.xii.2020, I.P. Subedi *et al*. leg.; TUC, Kirtipur, Kathmandu, 27.6801°N, 85.2887°E, 1300 m, *Salix* forest, pitfall trap, 11.v.2019, I.P. Subedi and S. Adhikari leg.

Notes: The Nepalese specimens determined as *B. chinensis* have relatively thin petiole, very finely sculptured dorsal and lateral faces of pronotum and propodeum, and almost

entirely smooth propodeal declivity. The correct status of the Nepalese population should be determined with DNA information. This was one of the most frequently observed species during this study.

***Brachyponera luteipes* (Mayr, 1862)** (Figs. 42 A, B)

Type locality: Nicobar Island, India (Mayr, 1862).

Distribution: Nepal (new record), Borneo, China, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Sri Lanka, Thailand, Vietnam (Guénard *et al*., 2017).

Materials examined: Nagarjun Forest, SNNP, 27.7452°N, 85.2667°E, 2094 m, bait and pitfall collections, 1–3.v.2019, I.P. Subedi leg. (CDZMTU HymF179).

Notes: These are small black ants with brown antennae, mandibles, legs and tip of the gaster. The body contains few erect hairs and is covered with short thick pubescence. The queen has fairly large compound eyes, and three small ocelli. Mesosoma is large, with the metanotum much lower than the pro and mesonotum.

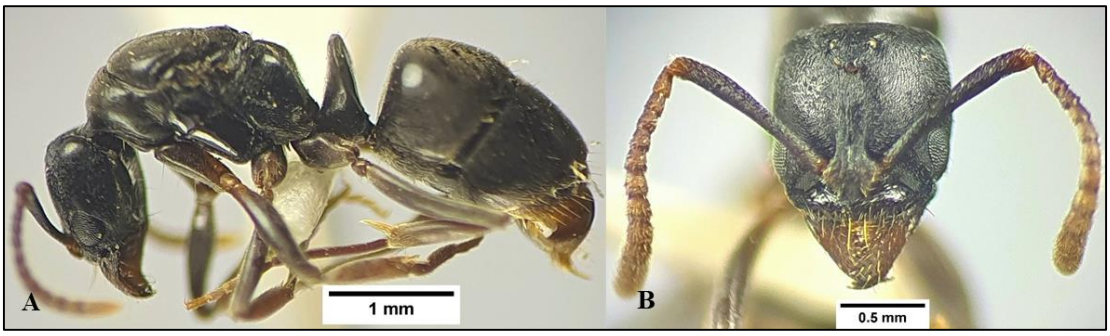

Figure 42: Habitus in profile (A) and Head in full-face view (B) images of queen of *Brachyponera luteipes*

***Brachyponera nigrita* (Emery, 1895)**

Type locality: Carin Cheba, Myanmar [Birmania] (Emery, 1895).

Distribution: India, Indonesia, Myanmar, Nepal, Philippines, Thailand, Vietnam (Guénard *et al.*, 2017).

Nepal: Jiri, Dolakha, 1900 m; Kavrepalanchok, 1750 m, iv–vi.1961, H. Janetschek leg. (Collingwood, 1970).

Materials examined: Nagarjun Forest, SNNP, 27.7444°N–27.7458°N, 85.2942°E–85.2856°E, 1400–1666 m, 22.x.2019, I.P. Subedi leg.

***Buniapone amblyops* (Emery, 1887)** (Figs. 13 E, F)

Type locality: Ajer Mantcior, Sumatra, Indonesia (Emery, 1887).

Distribution: Bangladesh, China, India, Indonesia, Myanmar, Nepal, Singapore, Thailand, Vietnam (Guénard *et al.*, 2017; Subedi, 2021).

Nepal: Pokhara, Kaski, 840 m, I.P. Subedi leg. (Subedi, 2021).

Materials examined: Pokhara, Kaski, 28.2136°N, 83.9722°E, 840 m, hand collection, 18.vii.2006, I.P. Subedi leg. (CDZMTU HymF180).

Notes: It has elongated mandible with six prominent teeth. Long erect hairs are sparsely distributed in the body. It has exceptionally dense appressed golden pubescence in cephalic dorsum, pronotum, and mesonotum. This species is documented as new record for Nepal along with its description and overview of its ecology in Subedi (2021).

***Centromyrmex feae* Emery, 1889** (Figs. 13 G, H)

Type locality: Bhamo, Shwegu, Myanmar [Birmania] (Emery, 1889).

Distribution: Nepal (new record), Cambodia, China, India, Indonesia, Malaysia, Myanmar, Singapore, Thailand, Vietnam (Guénard *et al.*, 2017).

Material examined: Lahachok, Kaski, 28.5167°N, 83.8667°E, S. Adhikari leg. (CDZMTU HymF181).

Notes: These ants are reddish-brown, shiny, and hairy. Head is subquadrate, with dotted pits, and sparse hairs. Mandible elongate roughly triangular, smooth, and very finely punctate. Head dorsum has a broad and deep frontal groove. Pronotal dorsum marginated anteriorly. Propodeum is unarmed and dorsally narrow. This is the single species of *feae* group known from Oriental and Malesian regions, likely representing more than one species (Bolton & Fisher, 2008). This is a new record for Nepal, as determined by examination of the material deposited at CDZMTU.

***Diacamma indicum* Santschi, 1920** (Figs. 43 A, B)

Type locality: South Andman Island, India (Santschi, 1920).

Distribution: Nepal (new record), India, Sri Lanka (Bharti *et al.*, 2016a; Dias *et al.*, 2020).

Materials examined: Pokhara, Kaski, 28.2136°N, 83.9722°E, 840 m, I.P. Subedi leg. (CDZMTU HymF182).

Notes: These are moderately large black ants with antennae, mandible, tibiae and sting dark reddish brown. Head elongated with large protruding eyes. Head, mesososma, petiole and first gastral tergite striated. Petiole is not compressed having moderately long teeth.

***Diacamma rugosum* (Le Guillou, 1842)**

Type locality: Borneo (Le Guillou, 1842).

Distribution: Cambodia, China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, New Guinea, Singapore, Vietnam (Guénard *et al.*, 2017).

Specimens examined: Ishworpur, Sagarnath, Sarlahi, *Eucalyptus* plantation, 26.9942°N, 85.6710°E, 109 m, 21.x.2020, B.R. Shrestha and T. Sherpa leg.; Bhandara, Chitwan, 27.6062°N, 84.6315°E, 10.iii.2013, hand collection, I.P. Subedi leg.

****Diacamma scalpratum* (Smith, 1858)** (Figs. 13 I, J)

Type locality: Northern India (Smith, 1858).

Distribution: Bangladesh, India, Myanmar, Nepal, Pakistan (Guénard *et al.*, 2017; Subedi *et al*., 2021c).

Materials examined: Haldibari, Jhapa, Mixed broadleaf Forest, 26.4775°N, 87.9864°E, 98 m, 17.x.2020, B.R. Shrestha and T. Sherpa leg. (CDZMTU HymF183).

Notes: These are very large black ants with antennae, mandible and tibiae dark reddish brown. Head elongated with small eyes and weaker striations. Mesososma and petiole strongly striated. Gastral tergites unstriated and shiny. Petiole strongly compressed, without dorsal striations, having long teeth. This species is documented in Subedi *et al.* (2021c) as a new record for Nepal.

****Diacamma sikkimense* Forel, 1903** (Figs. 43 C, D)

Type locality: Sikkim, India (Forel, 1903).

Distribution: Nepal (new record), India (Zettel *et al.*, 2016).

Materials examined: Binayi-Triveni, Ghumti, Nawalpur, Sal Forest, 27.5748°N, 83.8896°E, 144 m, 3.x.2020, P.B. Budha and P. Shrestha leg. (CDZMTU HymF184).

Notes: The body of these black ants is slender. They have strong microscultpure, abundant erect setae and thick white pilosity. The coarse striations occur from the genae to the first gastral tergite. They have moderately long head with relatively small

protruding eyes. Mandibles are finely striated. Petiolar spines are relatively short and distant. The subpetiolar process is slightly concave between the short teeth.

Figure 43: Habitus in profile and Head in full-face view images of **A, B** *Diacamma indicum* **C, D** *D. sikkimense*

***Diacamma vagans* (Smith, 1860)**

Type locality: Bacan Island, Indonesia (Smith, 1860b).

Distribution: Indonesia (Laciny *et al.*, 2015).

Nepal: Locality unknown

Notes: The existence of *D. vagans* in Nepal has to be further validated despite being cited in the literature since there are no specimen records and no information on the precise location where it was collected.

****Ectomomyrmex annamitus* (André, 1892)** (Figs. 13 K, L)

Type locality: Annam, Vietnam (André, 1892).

Distribution: Nepal (new record), China, India, Myanmar, Philippines, Thailand, Vietnam (Guénard *et al.*, 2017).

Material examined: Pokhara, Kaski, 28.2144°N, 83.9701°E 19.x.2021, N. Subedi leg. (CDZMTU HymF185).

Notes: It is black ant with reddish brown mandibles, antennae, legs and tip of the gaster. Antennae 12-segmented, mandible elongate triangular with seven teeth, scape short

hardly reaching posterior head margin and anterior clypeal margin pointed at the middle. Promesonotal suture well-marked, metanotum clearly and obliquely truncated behind. Petiole is moderately thick, anteriorly concave and posteriorly convex.

***Ectomomyrmex striolatus* (Donisthorpe, 1933)** (Figs. 44 A, B)

Type locality: Dehradun, Uttarakhand, India (Donisthorpe, 1933a).

Distribution: Nepal (new record), India (Bharti *et al.*, 2016a).

Materials examined: Nagarjun Forest, SNNP, 27.7444°N–27.7458°N, 85.2856°E–85.2942°E, 1400–1666 m, 22.x.2019, I.P. Subedi leg. (CDZMTU HymF186).

Notes: It is black ant with brownish mandibles, antennae, legs and apical gastral segments. Pilosity and pubescence are moderate. Antennae 12-segmented, mandible elongate triangular with nine teeth, scape short hardly reaching posterior head margin and anterior clypeal margin concave. Head strongly rugo-vermiculate, mesosoma mostly longitudinally rugo-vermiculate, propodeal declivity and petiole transversely striate, mandibles faintly longitudinally striate with scattered punctures.

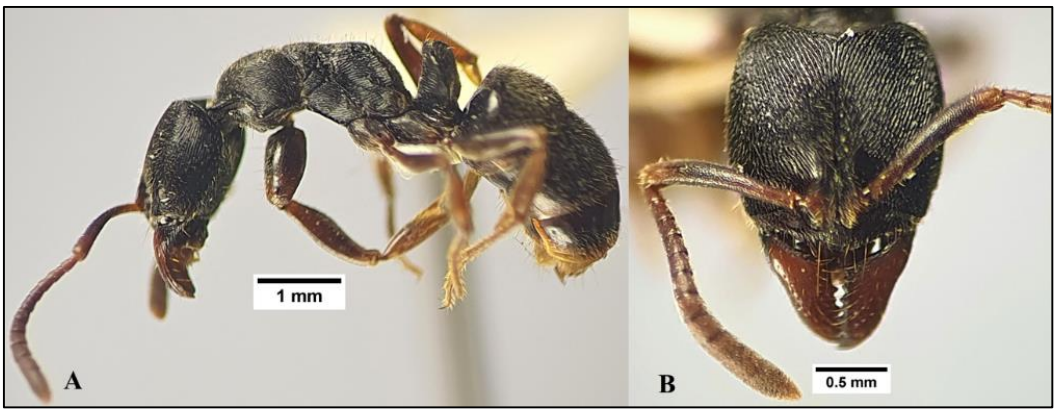

Figure 44: Habitus in profile (A) and Head in full-face view (B) images of *Ectomomyrmex striolatus*

***Emeryopone franzi* (Baroni Urbani, 1975)** (Figs. 14 A, B)

Type locality: Pokhara, Kaski, Nepal (Baroni Urbani, 1975).

Distribution: Endemic to Nepal.

Nepal: Pokhara to Ghorepani, Kaski, 28.2185°N, 83.9877°E, ix–x.1971, H. Franz leg., NHMB (Baroni Urbani, 1975).

***Harpegnathos venator* (Smith, 1858)** (Figs. 14 C, D)

Type locality: Chennai, Tamilnadu, India (Smith, 1858).

Distribution: Bangladesh, China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Singapore, Vietnam (Guénard *et al*., 2017).

Materials examined: Jamune, Tanahun, 27.9875°N, 84.1831°E, 530 m, 28.xii.2006, I.P. Subedi leg. (CDZMTU HymF187).

Notes: This is a large, distinct ant with head, mesosoma and gaster black in color, and mandibles, legs and tip of the gaster yellowish-brown. Ocelli present in triangle almost at the middle of the head. Head rectangular with extremely large eyes at the anterior corner and mandibles extremely elongated. Antennal joints are shorter and gaster is granulated with it base coarsely punctured. This species is recorded as a new record for Nepal in Subedi *et al*. (2020).

***Hypoponera confinis* (Roger, 1860)** (Figs. 14 E, F)

Type locality: Sri Lanka [Ceylon] (Roger, 1860).

Distribution: Nepal (new record), China, India, Indonesia, Malaysia, Myanmar, New Guinea, Singapore, Vietnam (Guénard *et al*., 2017).

Materials examined: Helipad, Shivapuri Forest, SNNP, leaf litter sifting, 27.7873°N, 85.3755°E, 1855 m, I.P Subedi leg. (CDZMTU HymF188).

Notes: This is small, subterranean ant which is yellowish to light brownish-yellow in color. Eyes are vestigial represented by small black spots. Antennal scape just fails to reach the posterior head margin and funiculus not incrassate. Pronoto-mesonotal and mesonotal-metapleural sutures distinct and metanotal groove conspicuous. Petiole dorsum roughly convergent anteriorly and posteriorly and subpetiolar process roughly rounded.

***Leptogenys birmana* Forel, 1900** (Figs. 45 A, B)

Type locality: Myanmar [Burma] (Forel, 1900a).

Distribution: China, India, Myanmar, Nepal, Thailand, Vietnam (Xu & He, 2015; Guénard *et al.*, 2017; Khachonpisitsak *et al*., 2020; Subedi *et al.*, 2022b).

Materials examined: Nagarjun Forest, SNNP, 27.7444°N, 85.2942°E, 1400 m, 1.v.2019, bait collection, I.P. Subedi, A. Pandey and T.R. Adhikari leg. (CDZMTU HymF189).

Notes: The workers have sub-quadrate head and its posterior margin is feebly concave. Head dorsum is longitudinally striate in anterior half and the striations reach posterior

eye margin. Antennal scape short, 4–6 antennal segments nearly as long as wide. Clypeus is convex and unarmed anteriorly. Subpetiolar process is broad and triangular. The first gastral segment is smooth and shiny. They have reddish brown body. This species is documented in Subedi *et al.* (2022b) as a first record of Nepal.

***Leptogenys chinensis* (Mayr, 1870)** (Figs. 45 C, D)

Type locality: China (Mayr, 1870).

Distribution: China, India, Nepal, Philippines, Sri Lanka, Vietnam (Xu & He, 2015; Guénard *et al.*, 2017; Subedi *et al.*, 2022b).

Material examined: RCF, Kathmandu, 27.7308°N, 85.3210°E, 1300 m, hand collection, 15.x.2019, I.P. Subedi leg. (CDZMTU HymF190).

Notes: These ants are relatively small ants. Cephalic dorsum is smooth and shiny without punctures. Propodeal declivity is transversely striate. Node of the petiole is longer than broad in dorsal view. The dorsum of petiole dorsum is sloping anteriorly in profile. This species is documented in Subedi *et al.* (2022b) as a first record of Nepal.

***Leptogenys dentilobis* Forel, 1900** (Figs. 45 E, F)

Type locality: Coonoor, Tamilnadu, India (Forel, 1900a).

Distribution: India, Nepal (Xu & He, 2015; Subedi *et al.*, 2022b).

Materials examined: TUC, Kirtipur, Kathmandu, *Salix* Forest, 27.6801°N, 85.2887°E, 1300 m, pitfall trap, 11.v.2019, I.P. Subedi and S. Adhikari leg.; RCF, Kathmandu, 27.7308°N, 85.3210°E, 1300 m, pitfall trap, 15.x.2019, I.P. Subedi *et al*. leg. (CDZMTU HymF191).

Notes: The species has quadrate head and its posterior margin is straight in full-face view. Head dorsum is sparsely punctate. Anterior clypeal margin toothed. Median carina is very strong. It has smooth and shiny first gastral segment. Subedi *et al.* (2022b) documented this species as a first record of Nepal.

***Leptogenys diminuta* (Smith, 1857)**

Distribution: Australia, Brunei, China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, New Guinea, Philippines, Singapore, Solomons, Sri Lanka, Vietnam, Thailand, (Eguchi & Yamane, 2003; Xu & He, 2015; Guénard *et al.*, 2017; Subedi *et al.*, 2022b).

Type locality: Sarawak, Borneo, Malaysia (Smith, 1857).

Materials examined: Jamune, Tanahun, 27.9875°N, 84.1831°E, 530 m, 28.xii.2006, hand collection, I.P. Subedi leg.; Nagarjun Forest, SNNP, 27.7483°N, 85.2722°E, 1900 m, 3.v.2019, pitfall and hand collection, I.P. Subedi and T.R. Adhikari leg.; Madhyabindu, Nawalpur, Sal Forest, 27.6218°N, 84.0565°E, 198 m, 4.x.2020, hand collection, P.B. Budha and P. Shrestha leg.

***Leptogenys kitteli* (Mayr, 1870)** (Figs. 14 G, H)

Type locality: Sikkim, India (Mayr, 1870).

Distribution: China, India, Indonesia, Malaysia, Myanmar, Nepal, New Guinea, Thailand, Vietnam (Xu & He, 2015; Subedi *et al.*, 2022b).

Materials examined: Nagarjun Forest, SNNP, 27.7444°N, 85.2942°E, 1400 m, 1.v.2019, pitfall collection, I.P. Subedi, A. Pandey and T.R. Adhikari leg. (CDZMTU HymF192); Kalika Bhagwati temple, Baglung, 28.2555°N, 83.6136°E, hand collection, 7.iii.2013, I.P. Subedi leg.; Pokhara, Kaski, 28.2136°N, 83.9722°E, 840 m, 8.iii.2013, hand collection, I.P. Subedi leg.; Bhandara, Chitwan, 27.6062°N, 84.6315°E, hand collection, 10.iii.2013, I.P. Subedi leg.

Notes: It has elongated head which is posteriorly narrow. Head is entirely striated with longitudinally. Eyes are present near middle of head. Clypeus is lacking longitudinal central carina. Pronotum is much wider than mesothorax and propodeum. Entire mesosoma regularly striated. Petiole nodiform which is not compressed longitudinally. Gaster is smooth and shiny. Subedi *et al*. (2022b) documented this species as a first record of Nepal.

Figure 45: Habitus in profile and head in full-face images of *Leptogenys*: **A, B** *L. birmana* **C, D** *L. chinensis* **E, F** *L. dentilobis* **G, H** *L. laeviceps*

***Leptogenys laeviceps* (Smith, 1857)** (Figs. 45 G, H)

Type locality: Sarawak, Borneo, Malaysia (Smith, 1857).

Distribution: India, Indonesia, Myanmar, Malaysia, Nepal, New Guinea, Sri Lanka (Smith, 1857; Guénard *et al.*, 2017; Subedi *et al.*, 2022b).

Materials examined: Jamacho, Shivapuri Forest, SNNP, 27.7456°N, 85.2672°E, 2087 m, 3.v.2019, hand collection, I.P. Subedi, A. Pandey and K. Chaudhary leg. (CDZMTU HymF193); Sundarijal Forest, SNNP, 27.7908°N, 85.4208°E, 1850 m, hand collection, 10.x.2020, I.P. Subedi leg.; RCF, Kathmandu, 27.7308°N, 85.3210°E, 1300 m, hand collection, 15.x.2019, I.P. Subedi leg.; RCF, 27.7294°N, 85.3206°E, 1310 m, 14.iv.2021, I.P. Subedi and I. Pandit leg.; TU Campus, Kirtipur, 27.6801°N, 85.2887°E, 1300 m, pitfall and hand collection, 11.v.2019, I.P. Subedi & S. Adhikari leg.; Hemja, Kaski, 28.2832°N, 83.9330°E, 26.x.2007, hand collection, I.P. Subedi leg.; Butwal, Rupandehi, 9.iii.2013, hand collection, I.P. Subedi leg.

Notes: The workers have fewer striae on the gena and frons. Vertex is smooth and shiny lacking striations, unlike the completely striated cephalic dorsum of *L. diminuta*. Pronotum is almost smooth, unlike striated pronotum in *diminuta*. In addition, *diminuta* larger in size. Subedi *et al.* (2022b) documented this species as a first record of Nepal and resurrected species status of *L. laeviceps.*

***Odontomachus monticola* Emery, 1892** (Figs. 14 I, J)

Type locality: Carin Checu, Myanmar (Emery, 1892).

Distribution: Bangladesh, Borneo, China, India, Laos, Myanmar, Nepal, Philippines, Thailand, Vietnam (Guénard *et al.*, 2017)

Nepal: 4 km SSW Pokhara, Kaski, 28.2000°N, 83.9667°E, 900 m., P.S. Ward leg. (AntWeb, 2022); Basundhara, Kathmandu, 27.7400°N, 85.3336°E, 1320 m, 25.vi.2020, I.P. Subedi leg. (Subedi *et al.*, 2020).

Materials examined: RCF, Kathmandu, 27.7294°N, 85.3206°E, 1310 m, pitfall and hand collection, 15.x.2019, I.P. Subedi leg.; Nagarjun Forest, SNNP, 27.7444°N, 85.2942°E, 1400 m, 1.v.2019, I.P. Subedi leg.; Sundarijal Forest, SNNP, 27.7697°N, 85.4250°E, 1577 m, hand collection, 10.x.2020, I.P. Subedi leg.; Shivapuri Forest, SNNP, 27.7875°N–27.7911°N, 85.3711°E–85.3939°E, 1650–1902 m, bait, pitfall and hand collections, 2–6.xi.2018, 3.xi.2021, 11.xii.2021, I.P. Subedi *et al*. leg.;

***Odontoponera denticulata* (Smith, 1858)** (Figs. 14 K, L)

Type locality: Singapore (Donisthorpe, 1943b).

Distribution: Borneo, China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Philippines, Singapore, Thailand, Vietnam (Guénard *et al.*, 2017; Subedi *et al.*, 2020).

Nepal: Jamune, Tanahun, 530 m, I.P. Subedi leg. (Subedi *et al.*, 2020).

Materials examined: Jamune, Tanahun, 27.9875°N, 84.1831°E, 530 m, I.P. Subedi leg., 28.xii.2006 (CDZMTU HymF194); Bet, Darchula, Sal Forest, 29.7672°N, 80.4010°E, 800 m, 8.x.2020, P.B. Budha and P. Shrestha leg.; Pokhara, Kaski, 28.2141°N, 83.9728°E, I.P. Subedi leg.

Notes: Smith (1858) designated Cape of Good Hope, South Africa as the type locality, however Donisthorpe (1943b) regarded it a mistake and named Singapore as the actual type locality. Anterior clypeal margin is denticulate and mandible is strong in the workers. Eyes are large and circular. Antennal scape slightly surpasses the posterior head margin. Head and mesosoma are with deep transverse rugae. Petiole is narrow with a wide and shallow apical incision. Subedi *et al.* (2022b) documented this species as the first record of Nepal.

***Odontoponera transversa* (Smith, 1857)**

Type locality: Singapore (Smith, 1857).

Distribution: Borneo, China, Indonesia, Malaysia, Myanmar, Nepal, Philippines, Singapore, Thailand, Vietnam (AntWeb, 2022).

Nepal: Pokhara, Kaski, 28.2100°N, 83.9500°E; 800 m, D. Little leg., 1.vi.2001, AMNH (AntWeb, 2022).

Notes: SEM images (ANTWEB1008558) were examined (AntWeb, 2022). This species has been mainly found in the Sundaland region, old records have confused the two species, all treated as *O. transversa* (Yamane, 2009). All records before 2009 have been omitted.

***Pseudoneoponera rufipes* (Jerdon, 1851)**

Type locality: Malabar, Kerala, Karnataka, India (Jerdon, 1851).

Distribution: Borneo, China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Pakistan, Singapore, Thailand, Vietnam (Guénard *et al.*, 2017).

Nepal: Namdu, Dolakha, 1450 m, Jarsa, 2000 m; iv–vi.1961, H. Janetschek leg.; Kavrepalanchok, 1750 m (Collingwood, 1970; Thapa, 2015).

Materials examined: Pokhara, Kaski, 28.2141°N, 83.9728°E, hand collection, 25.xii.2006, I.P. Subedi leg.

Notes: This species was documented as *Bothroponera rufipes* in Collingwood (1970), current valid name for it is *Pseudoneoponera rufipes* (Jerdon, 1851).

***Pseudoneoponera bispinosa* (Smith, 1858)** (Figs. 14 M, N)

Type locality: India

Distribution: China, India, Myanmar, Nepal (Bingham, 1903; Guénard & Dunn, 2012; Subedi *et al*., 2020)

Materials examined: Jamune, Tanahun, 27.9875°N, 84.1831°E, 530 m, I.P. Subedi leg., 28.xii.2006 (CDZMTU HymF195); Banbehada, Kailali, Sal Forest, 28.8180°N, 80.6790°E, 204 m, 18.x.2020, P.B. Budha and P. Shrestha leg.

Notes: Smith (1858) mentioned "Hab. Australia?" in his description of this species, but the type locality is now considered India (Forel, 1900a; Bingham, 1903). This species resembles *Pseudoneoponera rupifes* except in having two subtriangular, flat blunt propodeal spines directed backward and upward. Both the species release thick white frothy secretion of formic acid when disturbed. Subedi *et al*. (2020) documented this species as the first record for Nepal.

3.3.2.9 *Subfamily: Pseudomyrmecinae* (1 genus and 6 species)

***Tetraponera allaborans* (Walker, 1859)**

Type locality: Sri Lanka (Walker, 1859).

Distribution: Common in many countries/Islands of Australasia, Indo-Australia, Oriental and Palearctic regions (Ward, 2001; Guénard *et al.*, 2017).

Nepal: Namdu, Dolakha, 1450 m, iv–vi.1961, H. Janetschek leg. (Collingwood, 1970); 18 km N Baglung, 28.4333°N, 83.6000°E, 1020 m, 6.xii.1988, P.S. Ward leg.; Gokarnaban, Kathmandu, 27.7167°N, 85.4000°E, Wittmer and Baroni Urbani leg., 12.vi.1976, PSWC (AntWeb, 2022); Godawari, Lalitpur, 1450 m, Wittmer and Baroni Urbani leg.; Bajra Barahi, Wittmer and Baroni Urbani leg.; Pokhara, Kaski, 820 m, Wittmer and Baroni Urbani leg.; Iwa Khola and Sablako Pass, near Taplejung, 940–1200 m, Martens and Schawaller leg. (Ward, 2001).

Materials examined: TUC, Kirtipur, Kathmandu, 27.6814°N, 85.2831°E, 1330 m, 29.v.2019, I.P. Subedi leg.; Nagarjun Forest, SNNP, 27.7444°N, 85.2942°E, 1400 m, 1.v.2019, I.P. Subedi leg.

***Tetraponera aitkenii* (Forel, 1902)** (Figs. 46 A, B)

Type locality: Kanara, India (Ward, 2001).

Distribution: Nepal (new record), India, Malaysia, Thailand (Ward, 2001; Khachonpisitsak *et al.*, 2020).

Materials examined: Haldibari, Jhapa, 26.4775°N, 87.9864°E, 98 m, 17.x.2020, B.R. Shrestha and T. Sherpa leg. (CDZMTU HymF196).

Notes: These ants are small-sized, black to brownish black with light colored appendages. The body has long erect hairs which are dense on the head and mesosoma, and the gaster is moderately pubescent. The eyes are moderate in size having eye length shorter than scape length. The scapes are long. Pronotal lateral margin is sharp-edged. Petiole is thin and without posteroventral teeth. The integument is mostly smooth and shiny. This species is documented in Subedi *et al.* (2022a) as new record for Nepal.

***Tetraponera binghami* (Forel, 1902)**

Type locality: Ye valley, Myanmar [Birmanie] (Forel, 1902b).

Distribution: Bhutan, China, India, Malaysia, Myanmar, Nepal, Thailand, Vietnam (Ward, 2001).

Nepal: Amlekhgunj, Bara, 27.2833°N, 84.9833°E, 520 m, 1.xi.1957, E.I. Coher leg., PSWC (Ward, 2001).

***Tetraponera difficilis* (Emery, 1900)** (Figs. 46 C, D)

Type locality: Benculen, Sumatra, Indonesia (Emery, 1900a).

Distribution: Nepal, Brunei, Indonesia, Malaysia, Philippines, Singapore, Thailand (Ward, 2001; Guénard *et al.*, 2017).

Material examined: TUC, Kirtipur, Kathmandu, 27.6814°N, 85.2831°E, 1330 m, 11.iv.2009, I.P. Subedi leg. (CDZMTU HymF197).

Notes: These ants are black to brownish-black in color with lighter appendages. The eyes are medium-sized, clypeus is short, and scape is noticeably longer than eye. Body hair sparse. Mesonotal impression opens anterior with a posterior pit-like depression.

The propodeum has equal height and width, with a dorsal face progressively rounds posteriorly. The petiolar peduncle is short. The integument is glossy and puncticulate. This species is documented in Subedi *et al*. (2022a) as a new record for Nepal.

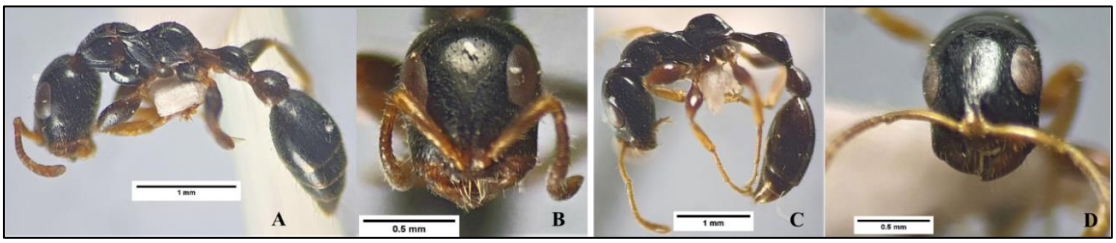

Figure 46: Profile and full-face images of *Tetraponera* **A, B** *T. aitkenii* **C, D** *T. difficilis*

***Tetraponera nigra* (Jerdon, 1851)**

Type locality: Karnataka, Kerala, Southern India (Jerdon, 1851).

Distribution: India, Indonesia, Malaysia, Myanmar, Nepal, Pakistan, Sri Lanka, Thailand (Ward, 2001).

Nepal: Amlekhgunj, Bara, 520 m, E.I. Coher leg. (Ward, 2001).

***Tetraponera rufonigra* (Jerdon, 1851)** (Figs. 15 A, B)

Type locality: Southern India (Jerdon, 1851).

Distribution: Bangladesh, Bhutan, Cambodia, China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Pakistan, Seychelles, Singapore, Sri lanka, Thailand, Vietnam (Ward, 2001; Guénard *et al.*, 2017).

Nepal: Cha Khola valley, Kavrepalanchok, 1000 m; Pokhara, Kaski, 1000 m; J. Quinland leg. (Collingwood, 1970); Jyamira, 27.9350°N, 84.8590°E, 30.vi.2016, Chumlingtar, 27.8590°N, 84.6430°E, 4.vi.2016, J.K. Wetterer leg., UCDC; Sunkoshi river, near Khurko, 27.3333°N, 86.0000°E, 3.vi.2001, E.L. Morrison leg., PSWC; 12 km ENE Tumlingtar, 27.3333°N, 87.3167°E, 1150 m, 9.v.1991, C. Carpenter leg., PSWC; Chitwan National Park, 27.5833°N, 84.3333°E, 600 m, 10.ii.1995, A. Hacklander leg., PSWC; Arun valley, 27.4333°N, 87.1333°E, 610 m, 16.vi.1954, L. Swan leg., CASC (AntWeb, 2022).

Materials examined: Jamune, Tanahun, 27.9875°N, 84.1831°E, 530 m, 28.xii.2006, I.P. Subedi leg.; Nagarjun Forest, SNNP, 27.7444°N, 85.2942°E, 1400 m, 1.v.2019, I.P. Subedi leg.; RCF, Kathmandu, 27.7308°N, 85.3210°E, 1300 m, hand collection, 15.x.2019, I.P. Subedi leg.; TUC, Kirtipur, Kathmandu, 27.6814°N, 85.2831°E, 1330

m, 11.iv.2009, I.P. Subedi leg.; Bhandara, Chitwan, 27.6062°N, 84.6315°E, 10.iii.2013, hand collection, I.P. Subedi leg.; Budhitola, Kailali, Sal Forest, 28.9236°N, 80.5703°E, 983 m, 15.x.2020, P.B. Budha and P. Shrestha leg.; Baikunda, Panchthar, Sal Forest, 27.1444°N, 87.7020°E, 745 m, 12.x.2020, B.R. Shrestha and T. Sherpa leg.

3.3.3 Ant species records from Nepal

Above 14,000 ant specimens were examined during this study. The examined materials include 129 nominal species from 55 genera. Of which, 69 species/subspecies are new to Nepal, and 36 of them have been documented in different scientific papers based on this research (Subedi *et al.*, 2020, 2021a, b, c, 2022a, b, c; Subedi, 2021). The new records include 27 species from Formicinae, 19 from Ponerinae, 11 from Myrmicinae, six from Dorylinae, three from Dolichoderinae, two from Pseudomyrmecinae, and one from Ectatomminae. Several species in the current collections have yet to be identified, including many potentially undescribed species (Appendix IV, V). Twenty-three species have been described since 1906 from specimens from Nepal. Of them, 22 species are currently valid and 10 of them are endemic to Nepal. The species recorded as new to Nepal based on this study from 2018 to 2022, species described from Nepalese specimens and endemic species are indicated in the species checklist of Nepal (Appendix III). Ant species records each year and cumulative species records in Nepal to date (2022) are given below in Figure 47. The figure clearly shows that a significant number of ant species have been added in recent years in Nepal, notably since the beginning of this research.

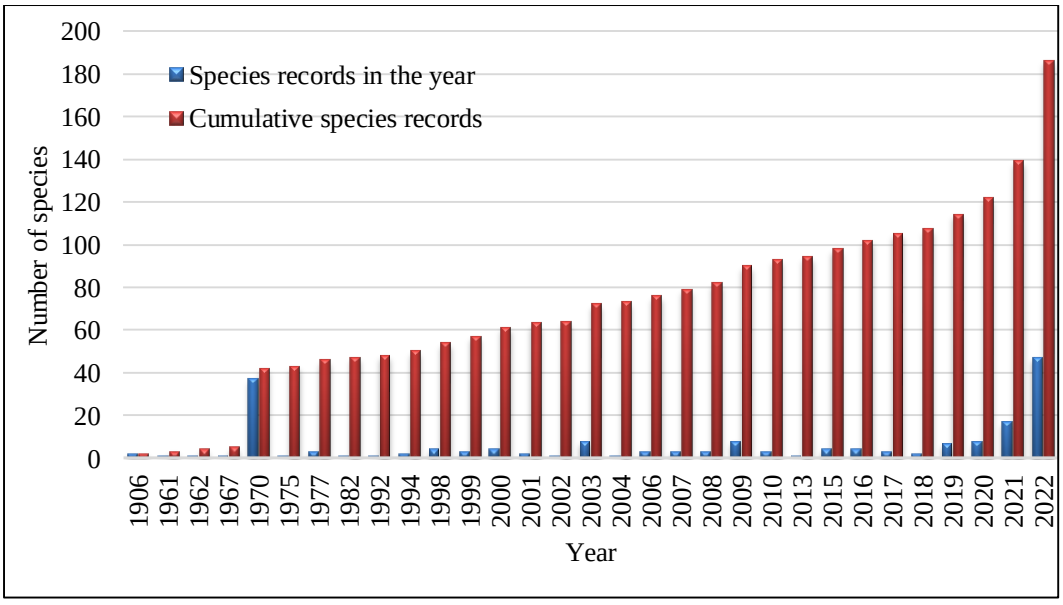

Figure 47: Ant species records per year and cumulative records in Nepal (Nominal species only)

3.3.4 Dubious and unverified records

Ant species documented in online resources such as antmaps.org (2022), AntWeb (2022) and/or AntWiki (2022) that are not validated by specimen or literature records and/or have unverified references are excluded from the main species list and are designated as dubious/unverified records. Altogether 20 (14 species from Formicinae, five from Myrmicinae and one from Ponerinae) such dubious/unverified records are mentioned below, along with reasons for their exclusion (Table 14).

Table 14: Dubious or unverified records of ants of Nepal

SN	Species	References	Explanation
Formicinae			
1	*Camponotus aethiops cachmiriensis* Emery, 1925	antmaps.org (2022)	Reference not verified
2	*C. buddha* Forel, 1892	antmaps.org (2022)	Reference not verified
3	*C. siemsseni* Forel, 1901	antmaps.org (2022)	Reference not verified
4	*C. socrates* Forel, 1904	antmaps.org (2022)	Reference not verified
5	*C. sylvaticus basalis* Smith, 1878	antmaps.org (2022)	Reference not verified
6	*C. s. paradichrous* Emery, 1925	AntWeb (2022)	Missing specimens or literature records
7	*Cataglyphis cugiai* Menozzi, 1939	antmaps.org (2022)	Reference not verified
8	*Formica sanguinea* Latreille, 1798	antmaps.org (2022)	Reference not verified
9	*F. sentschuensis* Ruzsky, 1915	AntWeb (2022)	Missing specimens or literature records
10	*F. truncorum* Fabricius, 1804	antmaps.org (2022)	Reference not verified
11	*Lepisiota wroughtonii* (Forel, 1902)	AntWiki (2022)	Missing literature
12	*Plagiolepis balestrierii* Menozzi, 1939	AntWeb (2022)	Missing specimens or literature records
13	*P. moelleri* Bingham, 1903	AntWeb (2022)	Missing specimens or literature records
14	*P. pontii* Menozzi, 1939	AntWeb (2022)	Missing specimens or literature records
Myrmicinae			
15	*Monomorium automum* Forel, 1902	antmaps.org (2022)	Reference not verified
16	*M. luisae* Forel, 1904	antmaps.org (2022)	Reference not verified
17	*M. orientale* Mayr, 1879	antmaps.org (2022)	Reference not verified
18	*M. sagei* Forel, 1902	antmaps.org (2022)	Reference not verified
19	*Myrmica urbanii* Radchenko & Elmes, 1998	AntWiki (2022)	Reference not verified
Ponerinae			
20	*Diacamma rugosum sculptum* (Jerdon, 1851)	AntWiki (2022), AntWeb (2022)	Missing specimens or literature records

3.4 Discussion

This study prepared the first annotated checklist of Nepalese ants based upon most recent specimen collections and information in existing literature. The checklist

contains nine subfamilies, 64 genera and 186 species/subspecies of ants (Table 13, Appendix III). The ant species richness in Nepal represents nearly 1.35% of the currently known global ant diversity of 14,084 species (Bolton, 2022), and 5.5% of the species richness of the valid 3413 species/subspecies of the Indomalaya bioregion (AntWeb, 2022) as of 13 October 2022. The previous ant species checklist from Nepal prior to this study contained only 34 species (Collingwood, 1970), whereas the latest published checklist based upon this study includes 128 species (Subedi *et al.*, 2020). The checklist of Nepalese ant species here includes records dating back over 117 years. It is evident that not all data are equally reliable, yet older data are useful in taxonomy. Taxonomic literatures are regularly revised, resulting in new knowledge. The list followed the most recent updates in taxonomic status (Bolton, 2022). The most dubious reports were omitted from the list if they are not substantiated by specimen records or if the relevant literature does not confirm the existence of the specific species. Sixty-nine species are documented as new records for the country in course of this study, of which 36 species have already been published in papers based on this study (Subedi *et al.*, 2020, 2021a, b, c, 2022a, b, c; Subedi, 2021). Twenty-two valid species have their type locality from Nepal, whereas 10 species are endemic to Nepal. Six species are described as new to science, however these species are not included in this list, since these species will be considered available only after their publication in peer-reviewed journals (ICZN, 1999). Five other species are presently being described, for which only a short introduction is provided in this thesis. Twenty species were excluded from Nepalese ant list available in different webpages, such as antweb.org, antmaps.org and antwiki.org. The Nepalese ant fauna seems proportionately high in comparison to that of India (Bharti *et al.*, 2016a) and China (Guénard & Dunn, 2012; Liu *et al.*, 2020) given to its small size comparing to its adjacent countries. However, the ant species list of Nepal is far from complete owing to its high geographic and species diversity.

The most diverse subfamily of ants of Nepal is Myrmicinae with 21 genera and 72 nominal species, followed by Formicinae (15 genera and 61 species), Ponerinae (13 genera and 27 species), Dolichoderinae (6 genera and 9 species), Dorylinae (5 genera and 10 species), Pseudomyrmecinae (1 genus and 6 species), Amblyoponinae (1 genus and 1 species), Ectatomminae (1 genus and 1 species), and Leptanillinae (1 genus and 1 species) (Table 13). The most speciose genera are *Camponotus* and *Myrmica* with 16 species each. Three predominant subfamilies in Nepal, Myrmicinae, Formicinae and Ponerinae, and the most speciose genus *Camponotus*, corroborate with their

predominance worldwide (AntWeb, 2022; Bolton, 2022), and in adjacent countries India (Bharti *et al.*, 2016a) and China (Guénard & Dunn, 2012). *Myrmica* is one of the major genera in the Himalayan region (Radchenko & Elmes, 2010), which supports the findings of *Myrmica* as the one of the most speciose genera in Nepal. The dominant ant genera such as *Crematogaster* and *Pheidole*, which are amongst the three largest genera in the world (AntWeb, 2022; Bolton, 2022), are underrepresented in Nepal in terms of nominal species. This is mainly because some specimens are yet to be identified to species level and perhaps also because these are very large genera with many undescribed species and few keys to species level available for Asia.

Previous publications (Tiwari *et al.*, 1999; Dill, 2002; Seifert, 2003; Branstetter, 2009; Latibari *et al.*, 2017; Jaitrong & Ruangsittichai, 2018; Williams & Lapolla, 2018) published 12 species (*Aenictus sagei*, *Cardiocondyla wroughtonii*, *Cataglyphis emeryi*, *Crematogaster flava*, *C. himalayana*, *Diacamma rugosum*, *D. vagans*, *Dolichoderus affinis*, *Lordomyrma bhutanensis*, *L. sinensis*, *Prenolepis fustinoda*, and *Strumigenys membranifera*) without any specific locality data. This study reported locality data based on present collections for five of them (*C. wroughtonii*, *C. flava*, *C. himalayana*, *D. rugosum*, and *D. affinis*). The occurrence of *C. emeryi* and *D. vagans* in Nepal needs further verification given to their disjunct distribution (Janicki *et al.*, 2016; Guénard *et al.*, 2017). Liu *et al*. (2021) proposed *Lordomyrma sinensis* as a junior synonym of *L. bhutanensis* based on phenotypic similarities between paratypes of *sinensis* and holotype of *bhutanensis*. Xu and He (2015) treated *Leptogenys diminuta sarasinorum* as a junior synonym of *L. diminuta*. Boer *et al.* (2020) presented *Monomorium dichroum* as a junior synonym of *M. sahlbergi* based on morphometric and molecular studies. Considering new synonimies, these three species, *Lordomyrma sinensis*, *Leptogenys diminuta sarasinorum* and *Monomorium dichroum* have been excluded from species list of ants of Nepal. Three *Prenolepis* species, namely *shanialena*, *fisheri*, and *fustinoda* are also excluded from species list of Nepal. Williams (2022) described *P. rinpoche* based on the specimens from Nepal which were previously assigned as *P. shanialena*. *Prenolepis fustinoda* was mistakenly assigned to Nepal due to similarities with *P. darlena* (Williams & LaPolla, 2018; Williams, 2022). A specimen (CASENT0281462) recognized as *P. fisheri* was actually a type material for *P. nepalensis* (Williams, 2022).

It is anticipated that future collecting efforts will enrich Nepalese myrmecofauna, with a special emphasis on under sampled areas. A complete inventory and species list of ants is almost impractical due to their enormous species diversity. The number of species records increases when surveys are conducted in new locations and by employing multiple sampling techniques.

3.5 Conclusions

This updated checklist of ants of Nepal provides the most comprehensive ant inventory yet documented from Nepal, with 186 nominal species from 64 genera and nine subfamilies. The present study recorded 69 ant species as new records for Nepal. Myrmicinae is the largest subfamily, with 21 genera and 72 species, while most speciose genera are *Camponotus* and *Myrmica* each with 16 species. The Nepalese myrmecofauna is most likely substantially more diverse than we presently know. This work adds significantly to our understanding of Nepalese ants by focusing on the ant diversity of several specific study locations (such as SNNP, RCF, TUC, and Tarai, Siwaliks and Hills of eastern, central and western regions of Nepal) as well as synthesizing ant species data for the whole country. This approach resulted in a complete overview of ant diversity as well as the identification of information gaps. This checklist will serve as an important benchmark for the study of Nepalese myrmecofauna, promoting more research on ant diversity in Nepal.

CHAPTER 4

4. DIVERSITY AND DISTRIBUTION PATTERNS OF ANTS IN NEPAL

Abstract

Little information is available on the diversity and distribution patterns of ants of Nepal. Ant inventories were carried out in different parts of Nepal covering tropical, subtropical, and temperate forests. Pitfall traps, baiting, hand collection, beating low vegetation, sweeping, leaf litter and soil core sifting were used to sample ants. Species richness was estimated using the Incidence-based Coverage Estimator (ICE), Chao2, and Jackknife2 estimators. Non-metric Multidimensional Scaling was performed to visualize relationships between study sites based on the Bray-Curtis similarity index for presence/absence data of ant species. The survey recorded 48 genera and 158 species including 112 nominal species from study sites. The low-elevation sites had the highest ant species richness that declined with increasing elevation. Of nine ant functional groups recorded, opportunists, subordinate Camponotini, and generalized Myrmicinae were the most common. The diversity of each functional group coincides with the pattern of species richness across elevation. The majority of Nepalese species are associated with Indomalayan and Palearctic components. In the study sites, fourteen tramp ant species were found, including four major pest species. The findings emphasize the necessity of undertaking a more systematic ant inventory in specific habitats and areas, as well as conducting extensive studies to protect Nepalese forests against invasive ant incursions.

4.1 Introduction

4.1.1 Background

Ants are diversified, ecologically dominant, and geographically widespread insects that inhabit all major terrestrial environments (Ward, 2007; Guénard, 2013; Economo *et al.*, 2018). Ants offer a number of ecological services and disservices that aid in the maintenance and functioning of diverse ecosystems (Del Toro *et al.*, 2012). The direct and indirect services provided by ants can be categorized into provisioning, regulating, cultural, and supporting ecological services (Del Toro *et al.*, 2012). Different ant species are utilized as food or medication in different parts of the world (Raksakantong *et al.*, 2010; Rastogi, 2011; Reddy *et al.*, 2011; Van Huis, 2021). Ants provide a variety

of regulatory services, including seed dispersal (Warren & Giladi, 2014; Anjos *et al.*, 2020), pollination (Del-Claro *et al.*, 2019; Delnevo *et al.*, 2020; Sousa-Lopes *et al.*, 2020), animal community regulation (Parr, 2008; Kaspari *et al*., 2011), predation and biological control (Philpott & Armbrecht, 2006; Offenberg *et al.*, 2013; Wetterer, 2017; Thurman *et al.*, 2019; Ohyama *et al.*, 2020; Eisawi *et al.*, 2022). Ants' values have been mentioned in religious writings, classical and current literature (Sleigh, 2004). The major supporting services of ants include carbon and other nutrient cycling, soil movement, decomposition (Del Toro *et al.*, 2015; Frouz *et al.*, 2016; Swanson *et al.*, 2019; Milligan *et al*., 2021), ecosystem engineering (Folgarait, 1998; Frouz & Jilková, 2008; Kovář *et al.*, 2013), and biological indicators (Ellison, 2012; Ribas *et al.*, 2012). Furthermore, several ant species have mutualistic relationships with other insects or plants (Bazile *et al.*, 2012; Tegelaar *et al.*, 2012; Depa *et al.*, 2020; Calixto *et al.*, 2021) or a remarkable ant-termite interaction has a significant impact on their habitat (Tuma *et al.*, 2020). Evidence suggests that ants have a great potential for use in crop-protection. Ants sometimes may be more effective than pesticides for agriculture pest control since they may kill pests, minimize plant damage, and increase agricultural yields (Anjos *et al.*, 2022). Weaver ants are the most studied example of ant usage in crop protection, although numerous other species are also beneficial (Rico-Gray & Oliveira, 2008; Van Mele, 2008; Offenberg, 2015). Through a meta-analysis of ants' participation in plant biotic defense, Rosumek *et al.* (2009) revealed that ant removal reduced plant fitness metrics by 23.7–51.8%, with a more noticeable impact in tropical than temperate regions. While ants are vital to terrestrial ecosystems, our understanding of them still has significant ecological and spatial gaps (Schultheiss *et al*., 2022).

4.1.2 Forest ant diversity and invasive species

Forests are one of the important habitats for ants and their management is important for preserving biodiversity (Lindenmayer *et al*., 2000, 2006; Junninen *et al*., 2007). Although planted forests also contribute to conserve biodiversity, old-growth forests have a higher richness (Hartley, 2002; Ohsawa, 2005). The leaf-litter ants are most densly populated in forests, with their strong concentration in tropical and subtropical regions (Schultheiss *et al.*, 2022). A complete inventory of forest taxa is practically impossible, due to which bioindicators have been utilized in monitoring. Because of their omnipresence and numerical abundance in both intact and disturbed habitats (Majer, 1983; Hoffmann *et al.*, 2000), ease of sampling (Agosti & Alonso, 2000), and

sensitivity and rapid responding abilities to environmental variables, ants may be an ideal taxon for monitoring ecosystem conditions (Majer, 1983; Alonso, 2000). In ecosystem management and biodiversity restoration, ants are frequently used as an indicator taxon (Underwood & Fisher, 2006). They are frequently used to forecast the impacts of humans on forests (Ribas & Schoereder, 2007).

A few introduced ants are greatly detrimental invaders, and five of them, including the "yellow crazy ant *Anoplolepis gracilipes,* argentine ant *Linepithema humile,* big-headed ant *Pheidole megacephala,* little fire ant *Wasmannia auropunctata,* and red imported fire ant *Solenopsis invicta*" are among the world's 100 worst invasive alien species (Lowe *et al.*, 2000). Invasion research related to ants is being hampered by incomplete taxonomy (Hoffmann *et al.*, 2011). However, correct species-level identification of these invaders is extremely difficult since pest screening and monitoring personnel are not generally the expert taxonomists. Knowledge about ants is valuable to both citizens and scientists because accurate identification is crucial for acquiring anticipated management. The information on presence or absence of invasive or native weedy ants in forests is important for monitoring (Underwood & Fisher, 2006). Invasive ants have an impact on native ant and non-ant species, either directly or indirectly and if they are introduced into natural ecosystems, eradication will be exceedingly difficult (Holway *et al.,* 2002). As a result, it is very important to take the appropriate preventative steps in a timely manner to avoid possible ant invasions.

4.1.3 Altitudinal diversity patterns and functional groups of ants

Species richness along altitudinal gradients may decrease or increase with elevation, peak at mid- or low elevation, or exhibit no obvious trend (Szewczyk & McCain, 2016). For most invertebrates, including ants, a mid-elevation peak in species richness and decreasing richness with increasing elevation are the most common patterns (Rahbek, 2005; Szewczyk & McCain, 2016; Subedi & Budha, 2020a). Previous studies on ants have also shown either a mid-elevation peak (Fisher, 1999; Sabu *et al.*, 2008; Bharti *et al.*, 2013; Kwon *et al.*, 2014; Longino *et al.*, 2019; Plowman *et al.*, 2020) or decreasing species richness with increasing elevation pattern (Brühl *et al.*, 1999; Burwell & Nakamura, 2011; Fontanilla *et al.*, 2019; Marathe *et al.*, 2020) as common patterns. Temperature is thought to be a major determinant of ant species richness along an elevational gradient (Sanders *et al.*, 2007; Malsch *et al.*, 2008; Marathe *et al.*, 2020). Other variables influencing ant species richness include nutrient types and number

(Peters *et al.*, 2014), area and geometric constraints (Sanders, 2002), precipitation (Malsch *et al.*, 2008), and seasonal moisture stability (Nowrouzi *et al.*, 2016). Szewczyk and McCain (2016) found that diversity patterns are influenced by the intricate interaction of numerous elements such as temperature and precipitation with geometric restrictions in their comprehensive analysis of global datasets. A combination of geographic and environmental variables influences the pattern of species richness along the elevation gradient (Marathe *et al.*, 2020). The pattern of species richness across elevation matches to the abundance and diversity of each functional group, indicating that the mechanisms regulating these two are most likely identical (Marathe *et al.*, 2021).

The functional group concept is critical for determining the overall pattern of species composition in the study sites. Ants are classified in the functional group system based on the similarity of their reaction patterns to stress, disturbance, and competition (Andersen, 1997, 2000). Ants specialized for competition are grouped as “dominant Dolichoderinae” and “subordinate Camponotini”, while those adapted to environmental stress as “tropical”, “cold climate”, or “hot climate specialists”, disturbance adaptable species are classified as “opportunists” functional groups. “Specialized predators" and “cryptic species” are two types of highly specialized ants. The functional group method is commonly used to investigate the impact of environmental change on ant assemblages (King *et al.*, 1998). When there is a considerable alteration in vegetation structure, the functional group scheme can be a valuable predictive tool for analyzing ant community responses to disturbance, particularly in mesic habitats (Hoffmann & Andersen, 2003). Functional group composition and biogeography may aid in better understanding the reasons that contribute to the spread of tramp species – widespread species that have been established beyond native range (McGlynn, 1999). Most tramp ants are Myrmicines, related to the functional groups, cryptic, opportunists and generalized Myrmicines (McGlynn, 1999).

4.1.4 Biogeography of ants

Diversification of modern ants is believed to have begun in the age of angiosperms (Moreau *et al.*, 2006), with the bulk of species originating in the Neotropics (Moreau & Bell, 2013). From the New World, some ants were introduced into the Old World, such as *Pheidole* (Moreau, 2008). Some of the most diverse genera, such as *Crematogaster* and *Polyrhachis*, evolved in Southeast Asia (Blaimer, 2012a; Mezger

& Moreau, 2016). Bolton (1995) published a taxonomic and zoogeographical census of ant taxa. Moreau and Bell (2013) presented information on biogeographic range evolution of ant subfamilies in different biogeographical realms such as Palearctic, Nearctic, Neotropics, Australasia, Indomalaya and Afrotropics. Nepal has a complicated biogeography and is located at the juncture of the Palearctic and Indomalayan realms (Udvardy, 1975; Olson *et al.*, 2001). The ant fauna of Nepal has not yet been assessed based upon their biogeographical affinities, which might be particularly important because of its location in the Central Himalayas. Following their formation, the Himalayas and this region were most likely occupied by different components bringing varied adaptations (Bharti, 2008).

Since ants are ecologically vital, a greater understanding of ant diversity patterns might help us better understand biogeography and community dynamics, eventually contributing to biodiversity conservation. This chapter summarizes ant species richness in the study area. Ant diversity and distribution patterns by elevation, as well as forest types, and functional group composition of ant species in the study area are discussed. The faunal composition of ants of Nepal by their biogeographic affinities, and tramp/invasive ants recorded from Nepal are also provided.

4.2 Materials and methods

4.2.1 Ant collection, specimen processing and identification

Ant sampling was done in 12 sites in Shivapuri-Nagarjun National Park (SNNP), and one each in Ranibari Community Forest (RCF), and Tribhuvan University Campus (TUC) by using pitfall traps, bait traps and hand collecting techniques following the ALL protocol (Chapter 2 of this thesis provides information on sampling in detail) (Figure 48). The coordinates, elevations and number of plots in each study site are given in Appendix I. Altogether 280 pitfall traps and 280 bait traps were placed within the forests.

Additional materials were collected by hand collecting, beating and sifting soil cores and leaf-litter methods along the motorway from Fulbari gate to Jamacho in the Nagarjun Forest, Panimuhan to Bagdwar foot trail in the Shivapuri Forest, Shivapuri peak and Sundarijal to Okhreni foot trail in the Sundarijal Forest of SNNP. The samples from selected forests of Tarai, Siwalik and Hills of eastern, central and western regions were collected by beating low vegetation, sweeping, and hand collection methods

(Chapter 2 of this thesis provides information on sampling in detail) (Figure 48). The coordinates, elevations and number of plots in each study site are given in Appendix II.

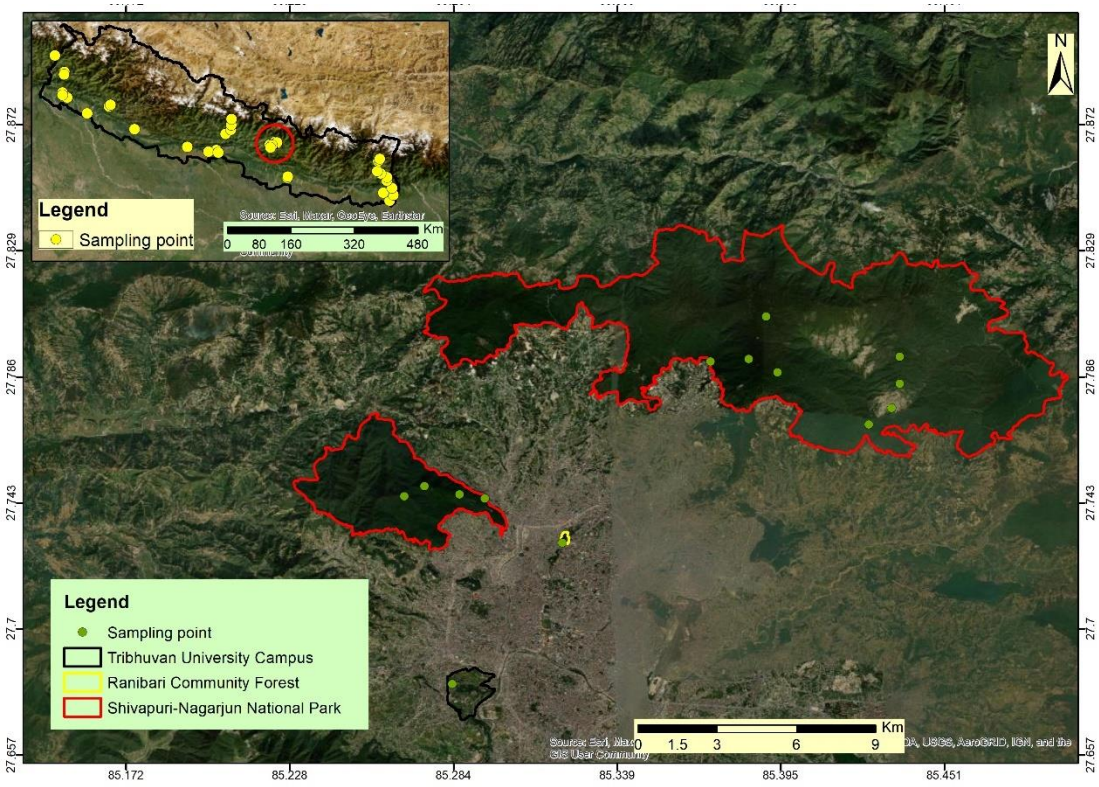

Figure 48: Sampling sites in Nepal (Highlights: Shivapuri-Nagarjun National Park, Ranibari Community Forest and Tribhuvan University Campus)

4.2.2 Data analysis

Incidence-based species accumulation curves, incorporating all sampling methods, were used to examine the adequacy of sampling in different study locations based on the addition of species as a function of sampling effort. Because the number of individuals is not a reliable parameter in ant research, incidence-based (absence/presence data) curves were plotted. The individual-based curves were not selected because data might be skewed, if the ants were collected close to the nest or from the ant trail because of their sociality results in extreme spatial clumping of individuals (Longino *et al.*, 2002). EstimateS 9.1.0 was used to assess and compare the diversity and to estimate species richness (Colwell, 2013) considering the presence/absence data from sampling plots. Incidence-based Coverage Estimator (ICE), Chao2 and Jackknife2 estimators were used to estimate species richness as per the recommendation by Hortal *et al.* (2006). The values obtained with 100 permutations were used to generate accumulation curves for sampled and estimated richness. The species accumulation curves were plotted for sampled and estimated (ICE, Chao2, and

Jackknife2 estimators) species richness for each study location separately. The species richness and elevation were regressed using linear regression model to assess the species distribution patterns along elevation in the study sites. Non-metric Multidimensional Scaling (NMDS) was used to assess variation in sitewise species composition of ant fauna based on the Bray-Curtis similarity index for presence/absence data. Jaccard's similarity or distance index have been calculated to check the similarities or dissimilarities in the species composition in the study sites. The data sets obtained from different sampling protocols were analyzed separately, whereas the data obtained from opportunistic collections were not used for analysis. The analysis was performed using the PAST software package (Hammer *et al.*, 2001).

4.2.3 Faunal composition and distribution maps

All available locality data for species from literature and the present collection were considered for preparing distribution maps for different subfamilies of ants in Nepal. Subfamily-wise species distribution maps of ants in Nepal were prepared by using QGIS 3.16.8 (QGIS Development Team, 2020). The available literatures (King *et al.*, 1998; Andersen, 2000; Brown, 2000; Bharti *et al.*, 2013; Luke *et al.*, 2014) were used to classify ants of Nepal into functional groups. The functional group composition of ant fauna in the study sites at SNNP, RCF, TUC and that of the selected forests of eastern, central and western Nepal were analyzed separately. The biogeographical affinities of all nominal ant species of Nepal are provided (Appendix III) following Bolton (2022).

4.3 Results

4.3.1 Species richness

Over 14,000 specimens were examined during the study, which includes seven subfamilies, 48 genera and 158 species/morphospecies collected from study sites at RCF, SNNP, TUC, and Tarai, Siwaliks and Hills of eastern, central and western Nepal. Of these species, 112 are valid species, at least 11 are new species, and the majority of the remaining species have been identified to the subgenus or species-group level (Appendix IV and V). Myrmicinae, with 14 genera and 64 species, is the most diverse subfamily in the study sites, followed by Formicinae (12 genera and 51 species), Ponerinae (10, 20), Dolichoderinae (6, 9), Dorylinae (4, 9), Pseudomyrmecinae (1, 4), and Ectatomminae (1, 1). The most speciose genus is *Camponotus* (16 species), followed by *Aphaenogaster* (9), *Polyrhachis* (9), *Pheidole* (8), *Crematogaster* (7),

Leptogenys (7), *Myrmica* (7), *Temnothorax* (7), *Tetramorium* (7), *Aenictus* (6), *Lepisiota* (6), *Prenolepis* (5), and *Nylanderia* (5). Twenty ant genera represented by a single species each in the study sites.

The species accumulation curves for sampled species richness by pitfall trapping, bait trapping and hand collection samples in Nagarjun, Shivapuri, Sundarijal, RCF and TUC are approaching towards asymptote indicating that the majority of the species in the study sites have been collected (Figure 49). The figure also shows the estimated species richness curves by ICE, Chao2, and Jackknife2. However, additional sampling efforts will be required for a complete inventory.

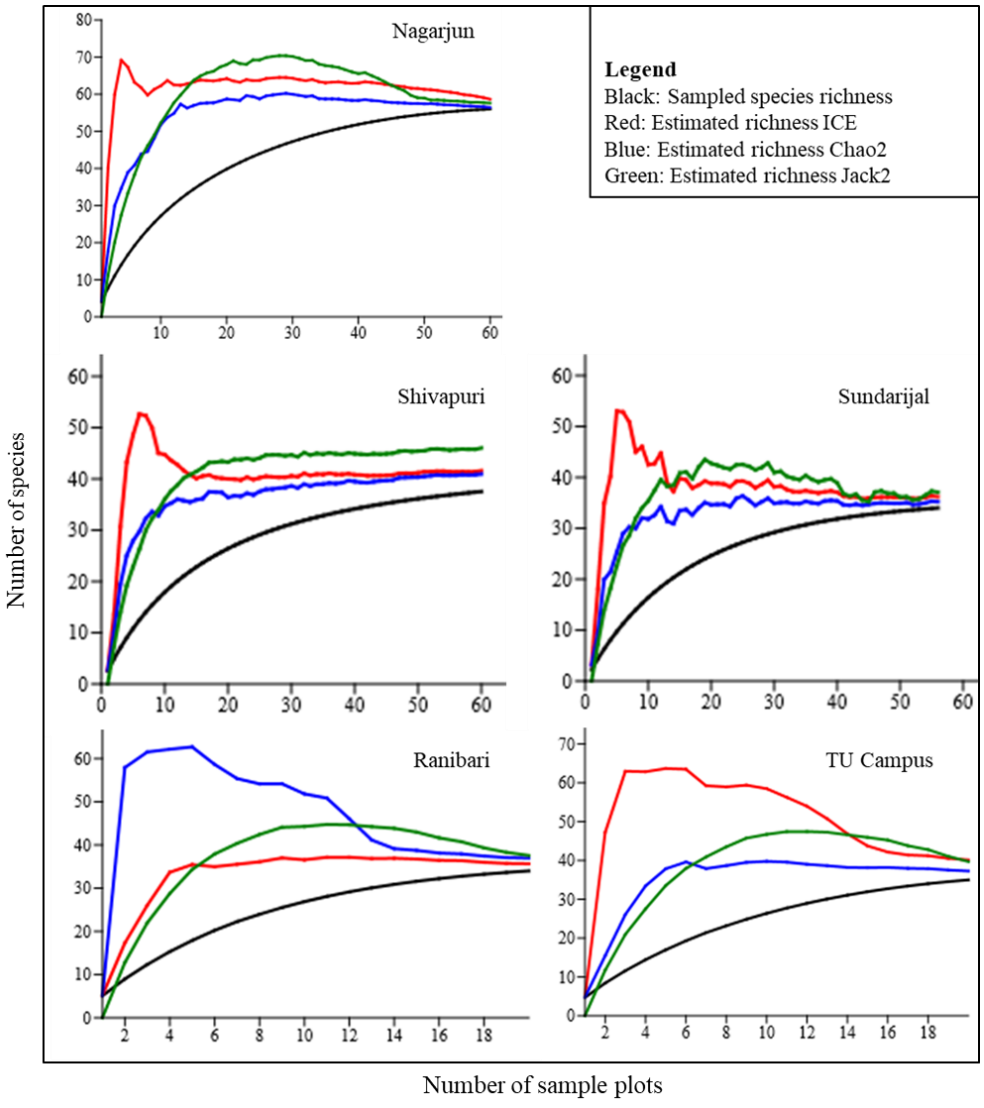

Figure 49: Species accumulation curves of sampled and estimated species richness by ICE, Chao2 and Jackknife2 estimators for study sites at Nagarjun, Shivapuri, Sundarijal, RCF and TUC.

According to nonparametric estimators, ICE, Jackknife2, and Chao2, this study acquired 82–92% of the potential species from the Shivapuri sector of SNNP, 94–98%

from the Nagarjun sector of SNNP, 89–94% from the Sundarijal sector of SNNP, 89–94% from RCF, and 87–94% from TUC (Table 15). These results clearly show that a significant proportion of ant species were sampled in this study.

Table 15: Sampled and estimated (ICE, Jackknife2, and Chao2 estimators) species richness in study sites at Nagarjun, Shivapuri, Sundarijal, RCF and TUC

Study sites	Sampled richness	Estimated richness	Estimated proportion of potential species sampled (%)
Shivapuri	38	41–46	82–92
Nagarjun	56	57–59	94–98
Sundarijal	34	36–38	89–94
RCF	34	36–38	89–94
TUC	36	38–41	87–94

The species accumulation curves for sampled species richness by beating, sweeping and hand collection samples from selected forests of Tarai, Siwaliks, and Hills of eastern, central and western regions of Nepal are also showing a trend of plateauing for western and central regions, but are not completely leveled off showing that a significant proportion of species have been collected (Figure 50). The data indicated that approximately 61–74% of potential species from the eastern, 78–90% from the central and 69–82% from the western regions, were collected during the study.

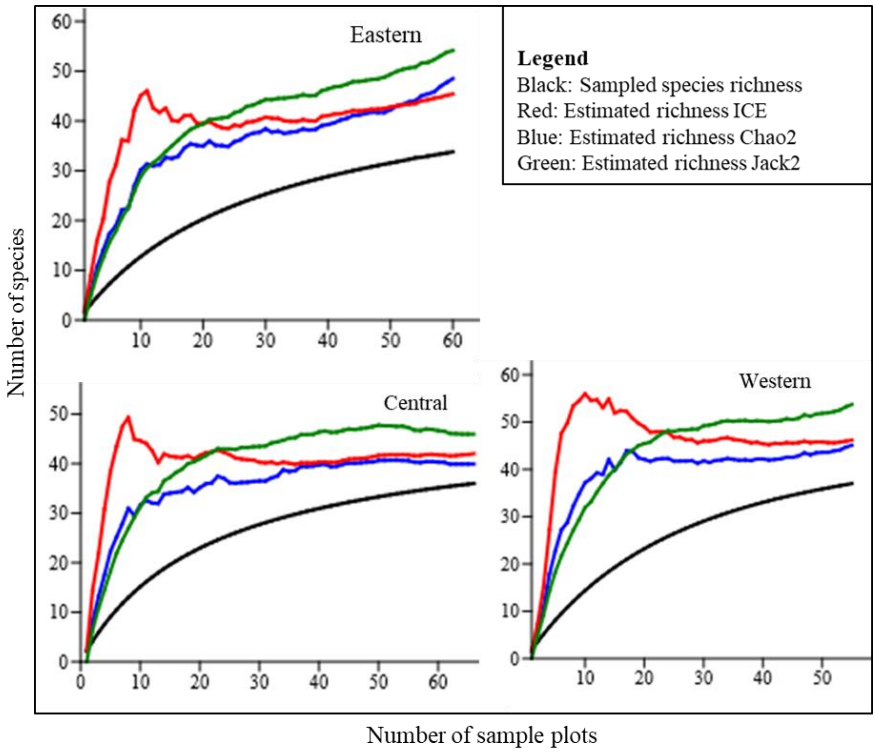

Figure 50: Species accumulation curves of sampled and estimated species richness by ICE, Chao2 and Jackknife2 estimators for study sites at eastern, central and western regions.

4.3.2 Altitudinal diversity and functional group composition

Altitudinal ranges for all 48 genera based upon the present collection from SNNP, RCF, TUC and selected forests of eastern, central and western Nepal are provided (Table 16). *Cerapachys*, *Pseudolasius*, *Stictoponera*, *Parasyscia* and *Paraparatrechina* were recorded from a narrow elevational range (within 300 m). *Camponotus*, *Crematogaster*, *Lepisiota*, *Leptogenys*, *Lophomyrmex*, *Meranoplus*, *Myrmicaria*, *Nylanderia*, *Polyrhachis*, *Prenolepis*, *Technomyrmex* and *Tetramorium* were recorded from a wide range of elevation (over 1900 m). *Diacamma*, *Stictoponera*, *Pseudolasius* and *Pseudoneoponera* were amongst the genera recorded from lower altitudes (up to 800 m) only, while *Temnothorax*, *Myrmica*, *Lasius*, *Hypoponera*, *Emeryopone* and *Chronoxenus* were amongst the genera recorded from higher elevations (above 1300 m) only.

Table 16: Ant genera with their species richness and elevational ranges in study sites

SN	Ant genera	Number of species	Elevation lowest (m)	Elevation highest (m)
1	*Aenictus*	6	1300	1900
2	*Aphaenogaster*	9	1310	2458
3	*Bothroponera*	1	1400	2094
4	*Brachyponera*	3	284	2732
5	*Camponotus*	16	87	2175
6	*Cardiocondyla*	4	128	1416
7	*Carebara*	3	802	2033
8	*Cerapachys*	1	1912	1912
9	*Chronoxenus*	1	2165	2165
10	*Colobopsis*	3	338	1912
11	*Crematogaster*	7	93	2208
12	*Diacamma*	2	98	800
13	*Dolichoderus*	2	800	1575
14	*Dorylus*	1	1310	1310
15	*Ectomomyrmex*	2	265	1902
16	*Emeryopone*	1	1400	1912
17	*Stictoponera*	1	144	183
18	*Hypoponera*	1	1900	1900
19	*Iridomyrmex*	2	418	1455
20	*Lasius*	2	1650	2210
21	*Lepisiota*	6	144	2208
22	*Leptogenys*	7	198	2094
23	*Lophomyrmex*	2	93	2218
24	*Meranoplus*	2	94	1902
25	*Monomorium*	3	115	1902
26	*Myrmica*	7	1400	2693
27	*Myrmicaria*	1	95	2664

28	*Nylanderia*	5	87	2460
29	*Ochetellus*	1	1310	1455
30	*Odontomachus*	1	1400	1650
31	*Odontoponera*	1	734	1416
32	*Oecophylla*	1	87	1650
33	*Paraparatrechina*	1	1310	1600
34	*Parasyscia*	1	1310	1310
35	*Paratrechina*	1	175	1912
36	*Pheidole*	8	95	2460
37	*Plagiolepis*	1	119	859
38	*Polyrhachis*	9	94	2460
39	*Prenolepis*	6	119	2460
40	*Pseudolasius*	1	276	276
41	*Pseudoneoponera*	1	204	800
42	*Strumigenys*	3	1310	1666
43	*Tapinoma*	1	183	1310
44	*Technomyrmex*	2	93	2094
45	*Temnothorax*	7	1310	3413
46	*Tetramorium*	7	128	2165
47	*Tetraponera*	4	98	1666
48	*Trichomyrmex*	1	204	1902

Note: Number of species include valid species, newly described species and morphospecies

Ant species richness is decreased with increasing elevation in study sites at SNNP, RCF and TUC (R^2 = 0.86042, t = -8.6007, p = 0.001; Figure 51).

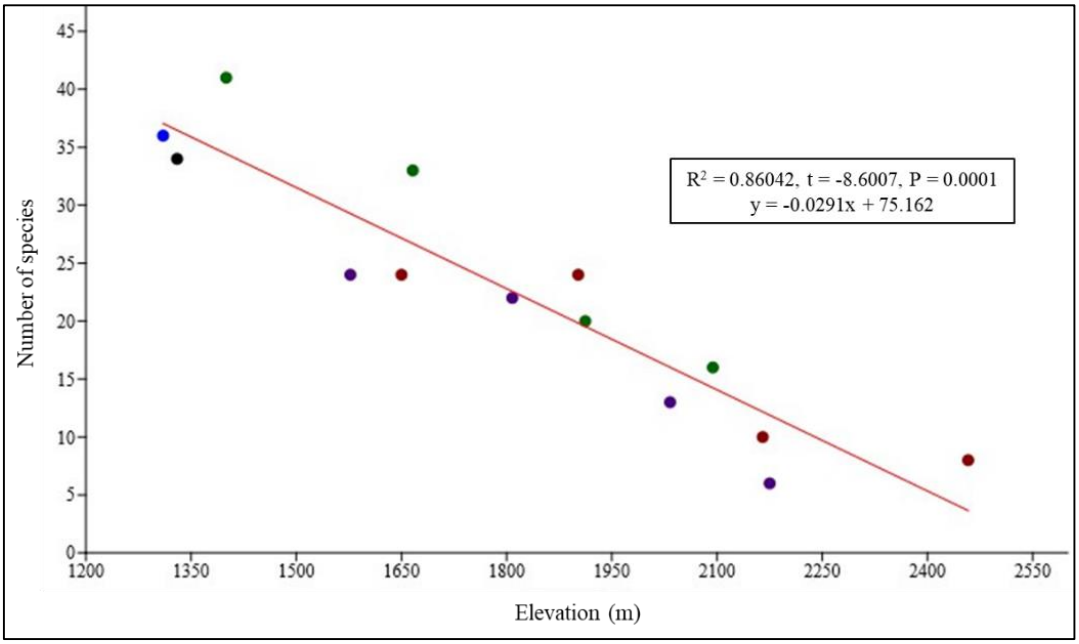

Figure 51: Ant species richness along elevation gradient in SNNP, RCF and TUC. [SNNP: Shivapuri-Nagarjun National Park (Nagarjun sites 1–4: green dots, Shivapuri sites 1–4: red dots, Sundarijal sites 1–4: purple dots), RCF: Ranibari Community Forest (black dot), and TUC: Tribhuvan University Campus (blue dot)]

The species richness is also declined with increasing elevation in selected forests of Tarai, Siwaliks, and Hills of eastern, central and western regions of Nepal (R^2 = 0.26074, t = -3.8488, p = 0.0003; Figure 52).

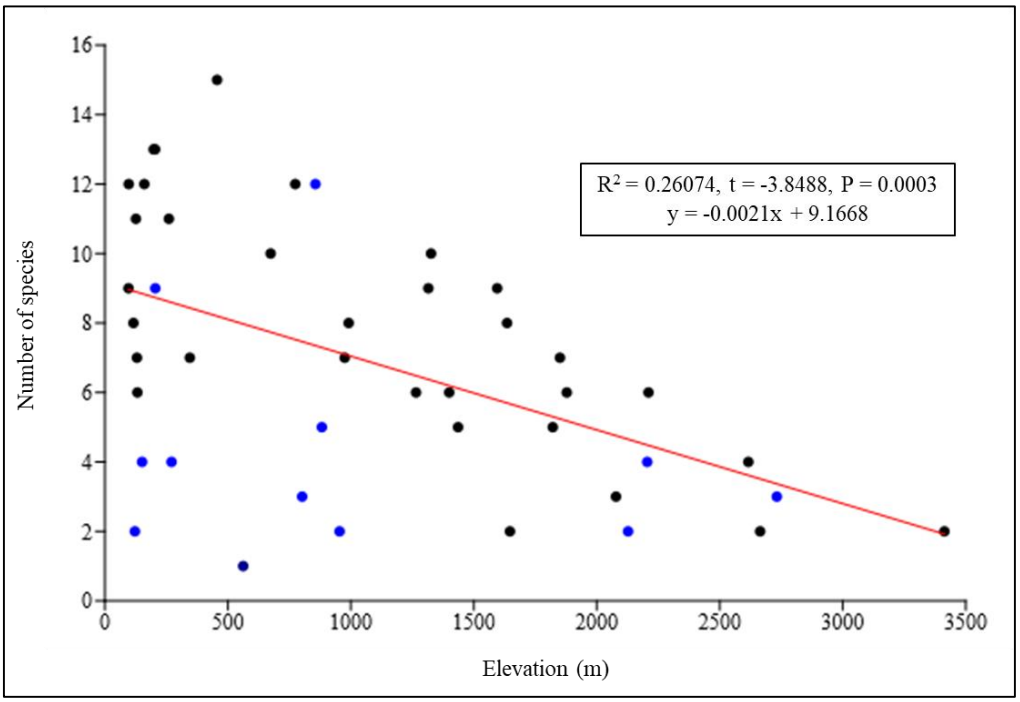

Figure 52: Ant species richness along elevation in selected forests of Tarai, Siwaliks and Hills of eastern, central and western regions of Nepal

All of the ant genera collected from the study sites fall into nine functional groups (Table 17). Opportunists are found in varied habitats and represented by *Aphaenogaster*, *Cardiocondyla*, *Diacamma*, *Lepisiota*, *Monomorium*, *Myrmica*, *Nylanderia*, *Ochetellus*, *Paratrechina*, *Technomyrmex*, and *Tetramorium*. Subordinate Camponotini were collected from all the sites and represented by hyperdiverse genera such as *Camponotus*, and *Polyrhachis*. Generalized Myrmicinae was also one of the most frequently encountered groups and represented diverse genera like *Pheidole*, and *Crematogaster*. Climate specialists included *Aenictus*, *Dolichoderus*, *Dorylus*, *Lasius*, *Lophomyrmex*, *Meranoplus*, *Myrmicaria*, *Oecophylla*, *Prenolepis*, *Pseudolasius*, *Stictoponera*, *Temnothorax*, and *Tetraponera*. Cryptic ants are very small sized ants mainly collected in leaf litter and soil cores which are represented by four genera namely, *Hypoponera*, *Carebara*, *Emeryopone*, and *Strumigenys*. Some of the specialized predator genera recorded in the study are *Brachyponera*, *Cerapachys*, *Ectomomyrmex*, *Leptogenys*, and *Odontoponera* which are generally large-sized. The details of functional group classification of all nominal ant species of Nepal are provided in Appendix III.

Table 17: Functional group classification of ant genera recorded in the study sites

SN	Functional groups	Ant genera
1	Cold Climate Specialists	*Chronoxenus, Lasius, Prenolepis, Temnothorax*
2	Cryptic Species	*Cardiocondyla, Emeryopone, Hypoponera, Plagiolepis, Strumigenys*
3	Dominant Dolichoderinae	*Iridomyrmex*
4	Generalized Myrmicinae	*Crematogaster, Myrmicaria, Pheidole*
5	Hot Climate Specialists	*Meranoplus*
6	Opportunists	*Aphaenogaster, Cardiocondyla, Diacamma, Lepisiota, Monomorium, Myrmica, Nylanderia, Ochetellus, Paraparatrechina, Paratrechina, Tapinoma, Technomyrmex, Trichomyrmex, Tetramorium*
7	Specialized Predators	*Bothroponera, Brachyponera, Cerapachys, Ectomomyrmex, Leptogenys, Odontomachus, Odontoponera, Parasyscia, Pseudoneoponera*
8	Subordinate Camponotini	*Camponotus, Colobopsis, Polyrhachis*
9	Tropical Climate Specialists	*Aenictus, Dolichoderus, Dorylus, Lophomyrmex, Oecophylla, Pseudolasius, Stictoponera, Tetraponera*

Opportunists account for the highest proportion (nearly one-third of all collected species) of ant fauna in this study, followed by subordinate Camponotini, generalized Myrmicinae, tropical climate specialists, specialized predators, cold climate specialists, cryptic species, hot climate specialists and dominant Dolichoderinae (Figure 53).

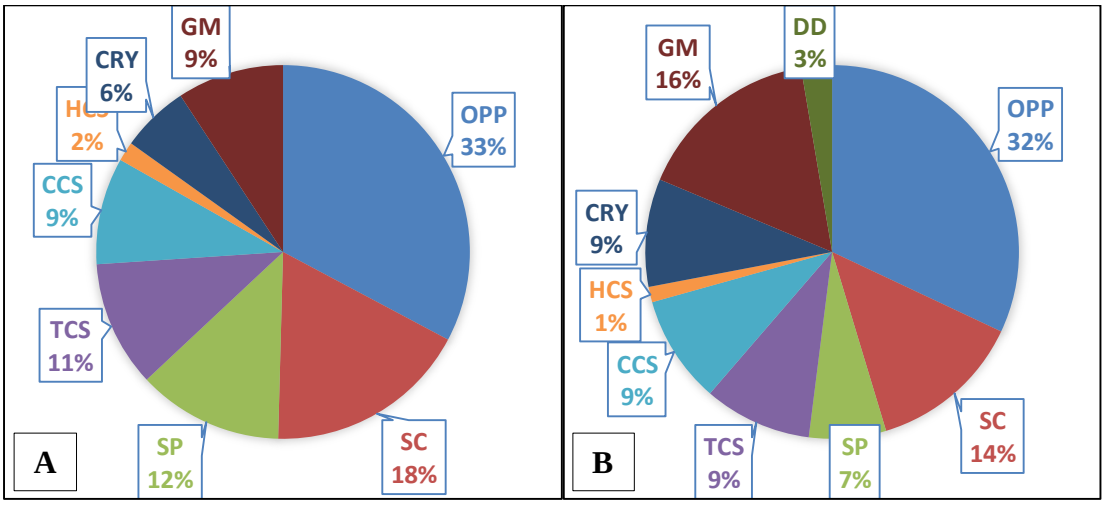

Figure 53: Functional group composition of all nine functional groups recorded in study sites, **A**. SNNP, RCF and TUC combined, **B**. Tarai, Siwalik and Hills of eastern, western and central regions combined. Functional groups: CCS: Cold Climate Specialists, CRY: Cryptic Species, DD: Dominant Dolichoderinae, GM: Generalized Myrmicinae, HCS: Hot Climate Specialists, OPP: Opportunists, SC: Subordinate Camponotini, SP: Specialized Predators, TCS: Tropical Climate Specialists.

Functional group diversity and diversity of each functional group decreased with increasing elevation. The pattern of species richness across elevation corresponds to the

abundance and diversity of each functional group. Ant species from eight functional groups were recorded from lowest elevation sites, such as RCF and TUC, followed by six to seven from sites below 2000 m, such as Nagarjun sites 1, 2 and 3, Sundarijal sites 1 and 2, and Shivapuri sites 1 and 2, whereas only three to five from sites above 2000 m, such as Sundarijal sites 3 and 4, Shivapuri sites 3 and 4, and Nagarjun site 4 (Figure 54). Opportunists, specialized predators and cold climate specialists were recorded from all sites, whereas subordinate Camponotini and generalized Myrmicinae were recorded from all sites except the highest elevation site (Figure 54). Opportunists were the most dominant functional group in all sites followed by subordinate Camponotini. With the exception of climate specialists, there are no discernible patterns of an increase or decrease in the relative proportion of any particular functional groups with the change in elevation (Figure 54). Hot and tropical climate specialists were not recorded from elevations above 2000 m, whereas higher proportion of cold climate specialists were recorded from these sites (Figure 54).

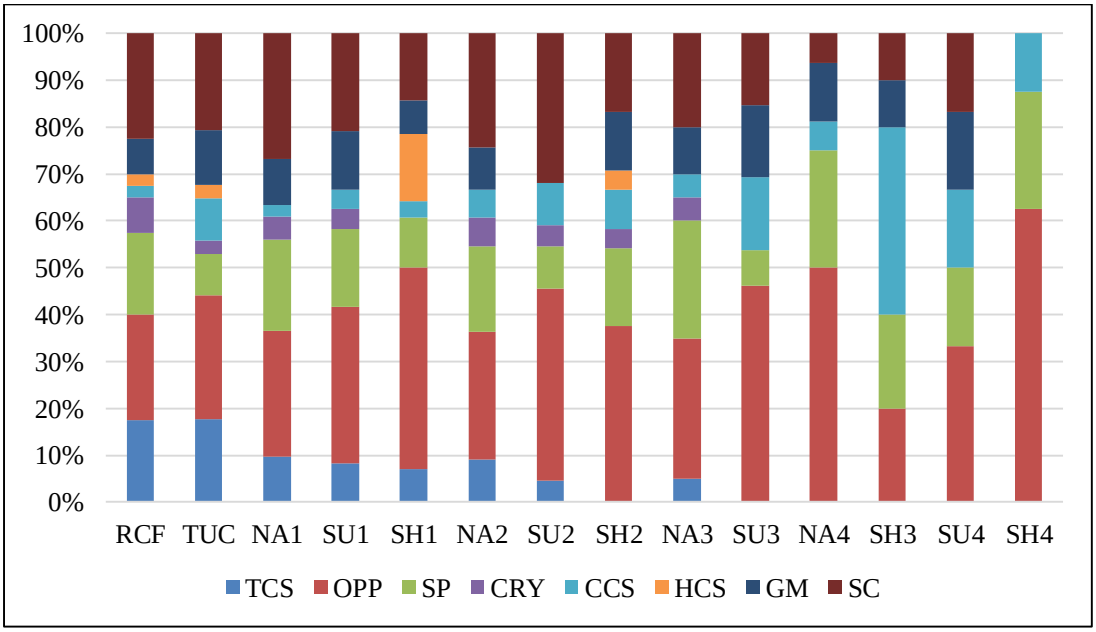

Figure 54: Relative proportion of functional group across elevation in RCF, TUC and SNNP (from left to right: site elevations are in increasing order ranging from 1310 m to 2458 m). Functional groups: CCS: Cold Climate Specialists, CRY: Cryptic Species, DD: Dominant Dolichoderinae, GM: Generalized Myrmicinae, HCS: Hot Climate Specialists, OPP: Opportunists, SC: Subordinate Camponotini, SP: Specialized Predators, TCS: Tropical Climate Specialists. Study sites: RCF: Ranibari Community Forest, TUC: Tribhuvan University Campus, Shivapuri-Nagarjun National Park (SNNP) sites: NA1: Nagarjun Site 1, NA2: Nagarjun Site 2, NA3: Nagarjun Site 3, NA4: Nagarjun Site 4, SU1: Sundarijal Site 1, SU2: Sundarijal Site 2, SU3: Sundarijal Site 3, SU4: Sundarijal Site 4, SH1: Shivapuri Site 1, SH2: Shivapuri Site 2, SH3: Shivapuri Site 3, SH4: Shivapuri Site 4.

The similarity or dissimilairity in the species composition between different study sites was evaluated using Jaccard's similarity or distance index in presence/absence data of ant species in specific study sites (Table 18). Nagarjun Forest site 1 and site 2 have the most similar species composition (Jaccard's similarity index = 0.64), followed by Sundarijal site 1 and site 2 (Jaccard's similarity index = 0.48), and Nagarjun site 4 with Shivapuri site 2 and Sundarijal site 3 (Jaccard's similarity index = 0.38) (Table 18). The species composition of Shivapuri site 4 was the most distinct from that of Ranibari Community Forest and Tribhuvan University Campus (Jaccard's distance index = 0.98) (Table 18).

Table 18: Jaccard's similarity or distance index for sitewise species composition

	TUC	**RCF**	**NA1**	**NA2**	**NA3**	**NA4**	**SH1**	**SH2**	**SH3**	**SH4**	**SU1**	**SU2**	**SU3**	**SU4**
TUC	**1**	.75	.81	.80	.90	.89	.86	.86	.93	.98	.79	.81	.91	.92
RCF	.25	**1**	.80	.79	.88	.89	.78	.80	.93	.98	.80	.86	.91	.92
NA1	.19	.20	**1**	.36	.70	.81	.80	.77	.91	.91	.75	.79	.90	.91
NA2	.20	.21	.64	**1**	.68	.78	.76	.70	.89	.89	.70	.78	.88	.89
NA3	.10	.12	.30	.33	**1**	.67	.78	.67	.75	.92	.78	.76	.78	.82
NA4	.11	.11	.19	.23	.33	**1**	.67	.62	.75	.86	.75	.73	.62	.71
SH1	.14	.22	.20	.24	.22	.33	**1**	.55	.86	.86	.77	.79	.72	.80
SH2	.14	.20	.23	.30	.33	.38	.45	**1**	.68	.81	.67	.69	.63	.80
SH3	.07	.07	.09	.11	.25	.25	.14	.32	**1**	.79	.86	.81	.72	.77
SH4	.02	.02	.09	.11	.08	.14	.14	.19	.21	**1**	.90	.89	.83	.73
SU1	.21	.20	.25	.30	.22	.25	.23	.33	.14	.10	**1**	.52	.72	.85
SU2	.19	.14	.21	.22	.24	.27	.21	.31	.19	.11	.48	**1**	.65	.88
SU3	.09	.09	.10	.12	.22	.38	.28	.37	.28	.17	.28	.35	**1**	.64
SU4	.08	.08	.09	.11	.18	.29	.20	.20	.23	.27	.15	.12	.36	**1**

Note: Black colored numbers represent similarity index, red colored numbers indicate distance index.

The distribution and relationship of study sites based upon the species composition indicated that TUC and RCF are isolated from Shivapuri site 3 and 4 and other sites at SNNP (Figure 55). Shivapuri site 1, 2 and Nagarjun site 4 are closely associated in terms of their species composition, whereas Nagarjun site 1 and 2, and Sundarijal 1 and 2 share similar species compostion with each other (Figure 55).

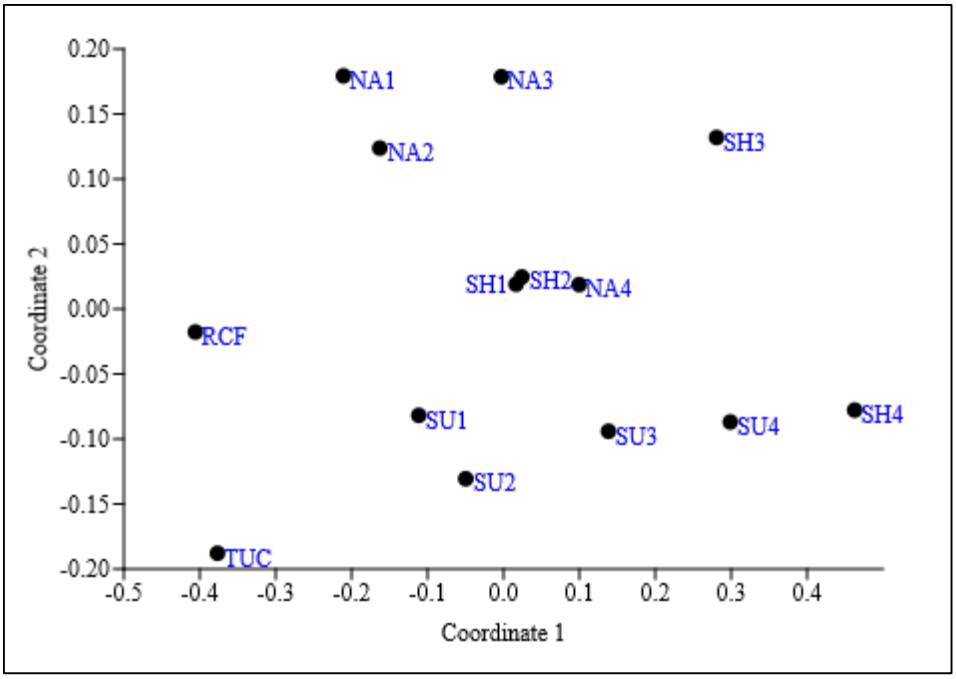

Figure 55: Non-metric Multidimensional Scaling (NMDS) employing Bray-Curtis similarity index for presence/absence data of sitewise species composition (Stress = 0.1805). (Legend study sites: RCF: Ranibari Community Forest, TUC: Tribhuvan University Campus, NA1: Nagarjun Site 1, NA2: Nagarjun Site 2, NA3: Nagarjun Site 3, NA4: Nagarjun Site 4, SU1: Sundarijal Site 1, SU2: Sundarijal Site 2, SU3: Sundarijal Site 3, SU4: Sundarijal Site 4, SH1: Shivapuri Site 1, SH2: Shivapuri Site 2, SH3: Shivapuri Site 3, SH4: Shivapuri Site 4)

4.3.3 Distribution of ant species in Nepal

The species distribution by ant subfamilies in Nepal based upon the species collected during this study and species listed in available literature has been illustrated in the map of Nepal (Figures 56 and 57). The figures clearly indicate that Myrmicinae and Formicinae are most widely distributed ant subfamilies in Nepal. The subfamilies Dolichoderinae, Ponerinae and Pseudomyrmecinae were also recorded from throughout the country. The subfamily Dorylinae seems to have recorded from a few locations only. The subfamilies Amblyoponinae, Leptanillinae, and Ectatomminae, each represented by a single species in Nepal, have a very restricted distribution as per the available data (Figure 56).

The ant fauna of Nepal have affinities largely with Indomalayan and Palearctic elements, while only a few species have affinities with the Australasian, Afrotropic, Neotropic, Oceanian, Malagasy, and Nearctic elements. The most abundant faunal elements for Nepalese myrmecofauna are from the Indomalaya biogeographic realm (75.4%, 141 species) followed by the Palearctic (18.18%, 34 species), Australasia

(1.6%, 3 species), Afrotropic, Neotropic, Oceania (1.07%, 2 species), and Malagasy and Nearctic (0.53%, 1 species). Only 10 species are recorded as endemic to Nepal, with seven being Indomalayan and three being Palearctic fauna.

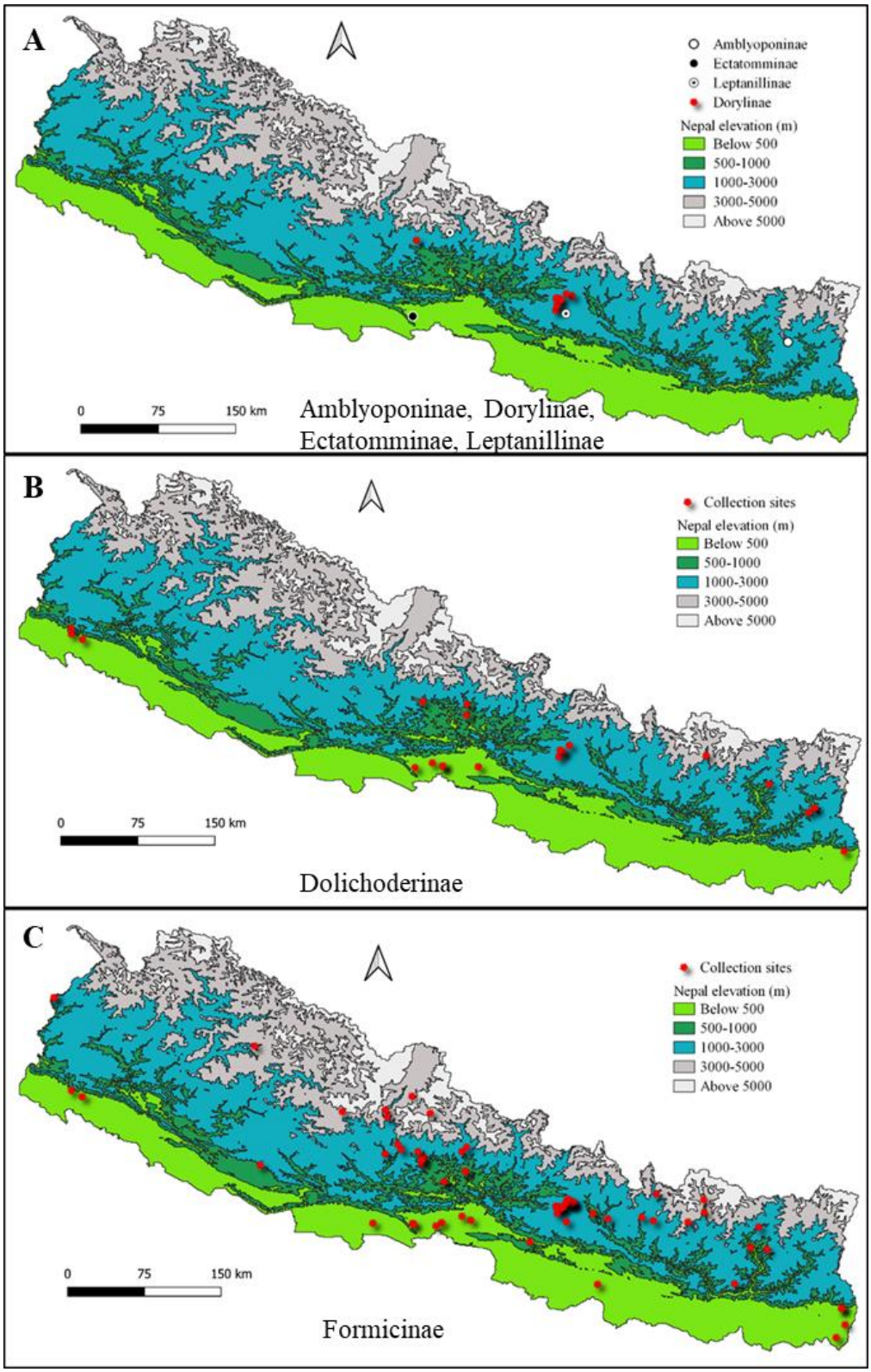

Figure 56: Distribution of subfamilies (A) Amblyoponinae, Dorylinae, Ectatomminae, Leptanillinae, (B) Dolichoderinae, and (C) Formicinae in Nepal

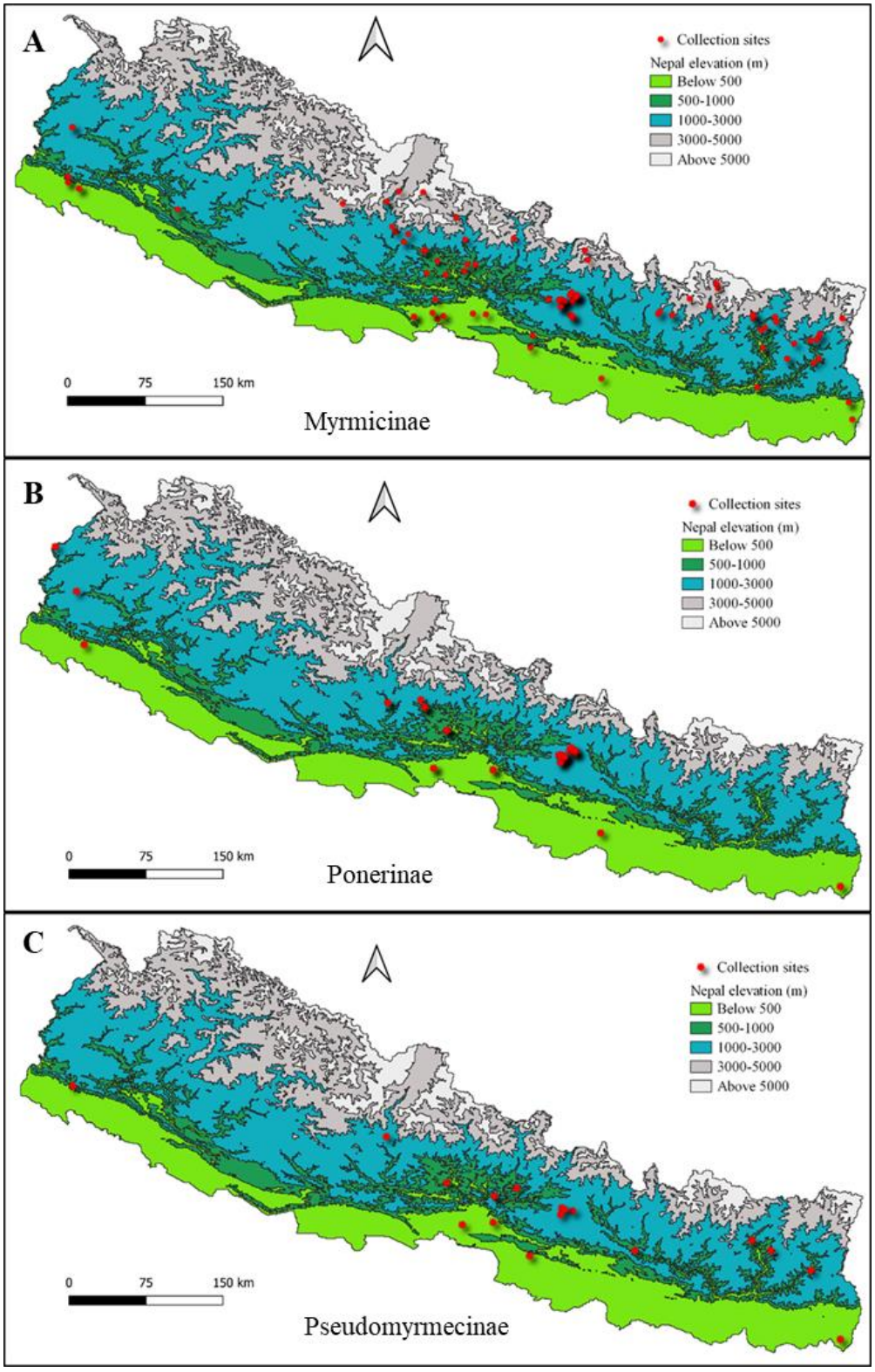

Figure 57: Distribution of subfamilies (A) Myrmicinae, (B) Ponerinae and (C) Pseudomyrmecinae in Nepal

4.3.4 Forest ants and tramp/invasive species

Ant are collected from different types of forests which are categorized into three types: Tropical, Subtropical and Temperate forests. The study recorded 41 genera from

subtropical, 31 from tropical and 19 temperate forests (Table 19). Twelve ant genera namely, *Brachyponera, Camponotus, Crematogaster, Lepisiota, Leptogenys, Lophomyrmex, Monomorium, Nylanderia, Pheidole, Polyrhachis, Prenolepis,* and *Tetramorium* were recorded from all three types of forests. *Aenictus, Bothroponera, Cerapachys, Dolichoderus, Dorylus, Emeryopone, Hypoponera, Ochetellus, Odontomachus, Parasyscia, Paraparatrechina* and *Strumigenys* were recorded from subtropical forests only. *Myrmicaria, Plagiolepis, Pseudolasius, Pseudoneoponera,* and *Stictoponera* were recorded only from tropical forests while *Chronoxenus* was recorded from temperate forests only.

Table 19: Ant genera by forest types

SN	Forest types	Ant genera
1	Tropical forest	*Brachyponera, Camponotus, Cardiocondyla, Carebara, Crematogaster, Colobopsis, Diacamma, Ectomomyrmex, Iridomyrmex, Lepisiota, Leptogenys, Lophomyrmex, Meranoplus, Monomorium, Myrmicaria, Nylanderia, Odontoponera, Oecophylla, Paratrechina, Plagiolepis, Pheidole, Polyrhachis, Prenolepis, Pseudolasius, Pseudoneoponera, Stictoponera, Tapinoma, Technomyrmex, Tetramorium, Tetraponera, Trichomyrmex.*
2	Subtropical forest	*Aenictus, Aphaenogaster, Bothroponera, Brachyponera, Camponotus, Cardiocondyla, Carebara, Cerapachys, Colobopsis, Crematogaster, Dolichoderus, Dorylus, Ectomomyrmex, Emeryopone, Hypoponera, Iridomyrmex, Lasius, Lepisiota, Leptogenys, Lophomyrmex, Meranoplus, Monomorium, Myrmica, Nylanderia, Ochetellus, Odontomachus, Odontoponera, Oecophylla, Parasyscia, Paraparatrechina, Paratrechina, Pheidole, Polyrhachis, Prenolepis, Strumigenys, Tapinoma, Technomyrmex, Temnothorax, Tetramorium, Tetraponera, Trichomyrmex.*
3	Temperate forest	*Aphaenogaster, Brachyponera, Bothroponera, Camponotus, Chronoxenus, Crematogaster, Lasius, Lepisiota, Leptogenys, Lophomyrmex, Monomorium, Myrmica, Myrmicaria, Nylanderia, Pheidole, Polyrhachis, Prenolepis, Temnothorax, Tetramorium.*

Twenty tramp/invasive ants are recorded from Nepal, encompassing all previously reported species as well as those obtained during this study (Table 20). The majority of these species were collected in Nepal before to 2000, however they were only formally published later (Table 20). Amongst 20 tramp species, seven are exotic species for Nepal (Table 20). During this research, fourteen tramp species were collected, six of which were recorded as new to Nepal (Table 20). Of them, five species, *Monomorium pharaonis, Nylanderia bourbonica, Ochetellus glaber, Strumigenys godeffroyi* and *Tapinoma melanocephalum* have been formally documented as new record in the papers based on this research (Subedi *et al.*, 2020, 2021c, 2022c). All tramp species, except *Monomorium floricola,* were collected from natural habitats. Amongst all

recorded tramp species, four species, *Monomorium, pharaonis*, *Trichomyrmex destructor*, *Paratrechina longicornis* and *Tapinoma melanocephalum* are considered as major pests. The impact of these pest species in the natural habitats, however, has yet to be quantified in Nepal.

Table 20: Tramp ant species with their status and earliest records in Nepal

SN	Tramp ant species	Status	Earliest record in Nepal
1	*Brachyponera chinensis*	Native	2006 (Nelder *et al*., 2006)
2	*Cardiocondyla emeryi*	Exotic	1988 (Seifert, 2003)
3	*Cardiocondyla kagutsuchi*	Native	1995 (Seifert, 2003)
4	*Cardiocondyla mauritanica*	Exotic	1974 (Seifert, 2003)
5	*Cardiocondyla minutior*	Native	1961 (Seifert, 2003)
6	*Cardiocondyla obscurior*	Native	1988 (Seifert, 2003)
7	*Cardiocondyla wroughtonii*	Native	≤2003 (Seifert, 2003)
8	*Iridomyrmex anceps*	Native	1996 (Thapa, 2015)
9	**Monomorium floricola*	Native	2006 (I.P. Subedi leg.)
10	**Monomorium pharaonis*	Exotic	2006 (Subedi *et al*., 2020)
11	**Nylanderia bourbonica*	Native	2019 (Subedi *et al*., 2020)
12	**Ochetellus glaber*	Native	2019 (Subedi *et al*., 2021c)
13	*Ooceraea biroi*	Native	1956 (Wilson & Taylor, 1967)
14	*Paratrechina longicornis*	Exotic	1956 (Wetterer, 2008)
15	**Strumigenys godeffroyi*	Native	2019 (Subedi *et al*., 2022c)
16	*Strumigenys membranifera*	Exotic	≤2000 (Bolton, 2000b)
17	**Tapinoma melanocephalum*	Native	2020 (Subedi *et al*., 2021c)
18	*Tetramorium bicarinatum*	Exotic	1982 (Wetterer, 2009c)
19	*Tetramorium lanuginosum*	Native	1956 (Wetterer, 2010c)
20	*Trichomyrmex destructor*	Exotic	1962 (Wetterer, 2009a)

*New record for Nepal identified during this study

4.4 Discussion

This is the most extensive research on Nepalese ants to date (2022), covering an altitudinal range of 87 m to above 3000 m, encompassing Tarai, Siwaliks, and hills. The species accumulation curves of sampled richness from different sites reveal that a substantial proportion of ant species were obtained during the surveys as the curves approach asymptote (Table 15, Figure 50). However, the curves are not totally leveled

off, indicating that further sampling may be required for the inventory of complete richness. The study recorded Myrmicinae as the most diverse ant subfamily in Nepal, followed by Formicinae, Ponerinae, Dolichoderinae, Dorylinae, Pseudomyrmecinae, and Ectatomminae. Despite the fact that accurate comparisons with other studies are challenging because of the differences in sampling techniques, temporal and geographical range covered, and recognized taxonomic level, the results are comparable with ant inventories in nearby regions, notably in the major subfamilies, and common genera reported. China's South (Fellowes, 2006), Southwest (Fontanilla *et al.*, 2019), and Yunnan Province (Liu *et al.*, 2015), and India's Northwest Siwalik (Bharti *et al.*, 2017) are examples of such investigations. Myrmicinae, Formicinae and Ponerinae are the globally top three most diverse subfamilies in generic and species richness (AntWeb, 2022; Bolton, 2022), and in neighboring countries, India (Bharti *et al.*, 2016a) and China (Guénard & Dunn, 2012). The most speciose ant genera in Nepal are *Camponotus* and *Myrmica* with 16 species each and some unidentified species. *Camponotus* is the most speciose genus in the world (Bolton, 2022), whereas *Myrmica* is one of the most diverse throughout Central and Southeast Asia, including the Himalaya (Radchenko *et al.*, 2007; Bharti & Sharma, 2013).

Ant species richness has been decreased with increasing elevation in study sites (Figures 51, 52). Decreasing pattern has been found to be the most common species richness elevation pattern of ant diversity (Sanders & Rahbek, 2012; Szewczyk & McCain, 2016; Subedi & Budha, 2020a). The results of this study corroborate with several studies across the world reporting decreasing pattern, such as Mount Kinabalu, Malaysia (Brühl *et al*., 1999), subtropical Queensland, Australia (Burwell & Nakamura, 2011), Southwest China (Fontanilla *et al*., 2019), Eastern Himalaya (Marathe *et al*., 2020), and Mount Talang, Indonesia (Herwina *et al*., 2020). However, as the majority of these investigations were conducted within an elevational range within the tropics or within a temperate environment, rather than between tropical and temperate elevations, a precise comparison of these studies with the current study appears to be difficult. The majority of studies indicate that there are much more species in tropical lowlands than in temperate regions, yet within a site, higher species richness can be found at the low elevation range.

The subfamily-wise distribution of ants in Nepal indicated that the Myrmicinae and Formicinae are most widely distributed (Figures 56, 57). However, the actual

distribution patterns of ant subfamily in Nepal cannot be precisely depicted based upon this data since several parts in Nepal are underexplored. Given Nepal's geological and climatic diversity, the ant species richness must be substantially more than the existing data suggests. The study gaps indicate the need for more structured sampling and identification of ants in Nepal, with a focus on specific regions and habitats.

Opportunists, subordinate Camponotini and generalized Myrmicines were most prevalent functional groups in the study areas, whereas dominant Dolichoderinae were rare or missing. King *et al.* (1998) found a similar functional group composition in Australian humid tropics, with most commonly occurring opportunists and generalized Myrmicines, and uncommon or missing dominant Dolichoderinae. Similarly, Marathe *et al.* (2021) identified opportunists and generalized Myrmicines as the most prevalent functional groups in the Eastern Himalaya. Majority of functional groups in this study had low diversity at high altitudes. Marathe *et al.* (2021) reported the similar decline in the species richness of each functional group at higher elevations. Bernadou *et al.* (2013) reported that physical and land-cover variables both affect functional group composition and species richness across altitudinal gradients.

The Nepalese ants comprises mainly Indomalayan fauna, followed by the Palearctic elements. Because Nepal is located at the junction of the Palearctic and Indomalaya, it appears natural for them to be the dominating biogeographic components. The endemism seems relatively low owing to high geographical and biological diversity in the country. With increased investigation and identification of ants of Nepal, the number of endemic species may rise in the future.

Subtropical forests were most diverse in the study sites, followed by tropical and temperate forests (Table 19). Due to the presence of both tropical and temperate genera, the subtropical forest may have been observed as the most diversified. Furthermore, it is also partially attributed to a difference in sampling effort.

Fourteen tramp species were recorded during this study, of them four species, *Monomorium pharaonis*, *Trichomyrmex destructor*, *Paratrechina longicornis* and *Tapinoma melanocephalum* are established pests worldwide. Twelve cosmopolitan ant species, including these four species, have been reported to cause substantial agricultural, ecological, and/or household problems (Wetterer, 2015). *Paratrechina longicornis* is the most extensively distributed ant species, having data from both the Old and New Worlds (Wetterer, 2008). Given the importance of biodiversity

conservation, invasive ant eradication initiatives have been launched around the world with the goal of eradicating *Anoplolepis gracilipes, Linepithema humile, Pheidole megacephala, Wasmannia auropunctata, Solenopsis invicta, S. geminata, T. melanocephalum, Lepisiota frauenfeldi, Myrmecia brevinoda, Monomorium indicum, P. longicornis* (Hoffmann *et al.*, 2016). Two of these globally problematic ants, *P. longicornis* and *T. melanocephalum* were also recorded in Nepal, and many more might be identified as additional studies are conducted in the urban and semiurban areas. Invasive species expansion was recognized as one of the primary causes of deforestation and forest degradation in Nepal by MoFE (2018). The invasion now has a strong impact in the lowlands and a relatively low impact in the highlands, but risks are growing as global temperatures increase (Bharti *et al.*, 2013; MoFE, 2018). Thus, planning ahead is critical since control measures will only be successful if applied on time.

4.5 Conclusions

This is the most comprehensive study of Nepalese ant biodiversity ever conducted. Altogether 48 genera and 158 species including 112 nominal species were identified from study sites. The largest subfamily was Myrmicinae and most speciose genus was *Camponotus*. The species richness declined with increasing elevation in the study sites. The study identified nine functional groups, the most prominent of which are opportunists, subordinate Camponotini, and generalized Myrmicinae. The abundance and diversity of each functional group correlate to the pattern of species richness across elevation. In Nepal, the most diverse and widely distributed ant subfamilies are Myrmicinae and Formicinae. The majority of ant species in Nepal are from the Indomalayan and Palearctic elements. Fourteen tramp species have been identified in the study. The findings highlight the significance of conducting more organized ant inventories in specific habitats and regions, as well as the importance of conducting comprehensive research to safeguard forests of Nepal from invasive ant invasions.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The taxonomic status of ants of Nepal has been updated based on systematic collections from 2018 to 2022, including examination of past opportunistic collections since 2006 in different parts of the country as well as distributional records from published literature. In Nepal, there are currently nine subfamilies, 64 genera and 186 named species of ants, along with new records of 14 genera and 69 species. Comprehensive taxonomic keys based upon morphological characteristics of the worker caste have been presented for ant subfamilies and genera of Nepal. Six new species, *Temnothorax kathmanduensis* sp. nov., *T. taplejungensis* sp. nov., *T. pathibharensis* sp. nov., *T. buddha* sp. nov., *T. nepalensis* sp. nov., and *Aenictus nepalensis* sp. nov. are described. Five species have been identified as potentially new to science and are under formal species description process. Myrmicinae has been identified as the most diverse subfamily, with *Camponotus* (Formicinae) and *Myrmica* (Myrmicinae) being the most speciose genera. The abundance and diversity of functional groups, as well as species richness, were found to be declined with increasing elevation. Opportunists account for the highest proportion of the nine functional groups recorded. Faunal composition by biogeographic regions shows the predominance of Indomalayan fauna followed by Palearctic, with other faunal components trailing far behind. The reports of tramp/invasive species in Nepalese forests indicate that incursion has already begun, indicating the need for quantification of effects, if any, and a subsequent forest conservation plan.

Because the work adds significantly to our knowledge of ants of Nepal, this study is an important benchmark in the investigation of Nepalese ants. It is anticipated that ant diversity in Nepal is much higher than we currently know. More systematic inventories in understudied areas will certainly significantly increase Nepal's known ant diversity. The findings of this study and information gaps identified as a result of this study should serve as a motivator for anyone interested in studying ants of Nepal.

5.2 Recommendations

Based upon the findings of this study, the following recommendations are made for future research:

1. Taxonomic collections need to be focused on nest sampling of ants for effective taxonomic work since the members of all the castes may be captured.
2. Taxonomic revisions of ant genera using more robust tools, such as DNA-based approaches, morphometry, scanning electron microscopy (SEM) and X-ray micro computed tomography (μCT), have been suggested as potential area of advanced taxonomic research.
3. Studies on tramp or invasive species need to be conducted in urban and semi-urban areas.
4. This study is primarily focused on forest areas. More studies should be conducted in grasslands, agricultural fields, and human settlements to add additional species that may specialize in these habitat types.

CHAPTER 6

SUMMARY

Nepal is in the central part of the exceptionally biodiverse regions in the world, the Himalaya Biodiversity Hotspot, one of the 36 Biodiversity Hotspots in the World. However, the diversity and distribution of the ant fauna of Nepal is little known. Considering the importance of exploration of Nepalese ant fauna, a study was conducted from 2018 to 2022 to better understand their taxonomy, diversity and distribution patterns. The study covering tropical, subtropical, and temperate regions has the following specific objectives: 1. to prepare a generic synopsis of ants of Nepal along with new species descriptions, 2. to produce an up-to-date checklist of Nepalese ant species with taxonomic annotations, and 3. to examine the diversity and distribution patterns of ants in the study area of Shivapuri-Nagarjun National Park (SNNP), Ranibari Community Forest (RCF), Tribhuvan University Campus (TUC) forest area, and selected forests of Tarai, Siwalik, and Hills of eastern, central, and western regions of Nepal. Ants were sampled using multiple collecting methods including pitfall trapping, baiting, hand collecting, beating lower vegetation, and sifting leaf litter and soil cores along altitudinal gradients. In addition, the study consulted taxonomic records from published literature and examined previously collected ant specimens from opportunistic collections from different parts of the country since 2006 (collected mainly by the author). Ant specimens obtained from extensive entomological surveys of the Forest health project of Forest Research and Training Center, Department of Forests, Nepal funded by FAO Nepal 2020 were also examined during the study. In the FAO survey, ants were sampled in selected forests by using sweeping, beating low vegetation and hand collections along South to North belt transects across the altitudinal gradients covering Tarai, Siwaliks and Hills of eastern, central and western regions of Nepal.

The results of the study are summarized in three chapters (Chapter 2–4) each addressing one of the study objectives. Chapter 2 provides a synoptic overview of taxonomy, biology and ecology of ant genera recorded from Nepal. Each examined genus is illustrated by full-face and profile images. A list of species/subspecies in each genus is also presented along with new records for the country. Subfamily-level and genus-level keys based on morphological traits of worker castes are provided for all ant subfamilies and genera of Nepal. Species descriptions along with differential diagnosis of six ant

species new to science, namely *Temnothorax kathmanduensis* sp. nov., *T. taplejungensis* sp. nov., *T. pathibharensis* sp. nov., *T. buddha* sp. nov., *T. nepalensis* sp. nov., and *Aenictus nepalensis* sp. nov. are provided. Three species of *Aphaenogaster*, one species each of *Leptogenys* and *Pheidole*, which are potentially new to science are introduced briefly. *Emeryopone franzi*, a rare ant, endemic to Nepal, is re-described based on new materials obtained during this investigation. The findings provide an introductory insight into the knowledge of ant genera, and it can be viewed as a significant step towards the exploration of new ant species from Nepal.

Chapter 3 presents an up-to-date annotated checklist list of ant species of Nepal with 186 nominal species/subspecies from 64 genera and nine subfamilies. The type locality of the species, global distribution and records within the country, specimen collection data and taxonomic annotations are provided. Resurrection of species status of *Leptogenys leaviceps* was done. Myrmicinae, Formicinae, and Ponerinae are recorded as the most diverse subfamilies respectively in generic and species richness. *Camponotus* and *Myrmica* are most speciose ant genera in Nepal. The checklist included 69 species as new records for Nepal, 22 species have types designated from Nepal, and 10 species are endemic to Nepal. The number of nominal species recorded annually and the cumulative records from Nepal, since the first ant species recorded from Nepal in 1906, are also provided. It demonstrates a notable increase in the number of species in the last four years for this study, with several new ant species records for Nepal and at least six descriptions of ant species new to science. Twenty species/subspecies listed in different webpages such as antweb.org, antwiki.org, antmaps.org which are not substantiated by specimen records and/or unverified literatures excluded from Nepal ant checklist.

Chapter 4 elaborates the diversity and distribution pattern of ants. This chapter discusses species richness in the study area, functional group composition, and biogeographic affinities of ant species of Nepal. Furthermore, the distribution of ant genera based on forest types, and elevation gradients are discussed. A list of tramp/invasive ant species occurring in Nepal is presented. The species richness is drecreasing with elevation in the study area. The ant functional groups labeled as opportunists, specialized predators and generalized myrmicines (Andersen, 1997, 2000) were recorded as the prevalent functional groups. More than two-third of the Nepalese ant species comprise Indomalayan elements followed by Palearctic. Twenty

cosmopolitan ant species are found to occur in Nepal, including four major pest species, *Monomorium pharaonis*, *Paratrechina longicornis*, *Tapinoma melanocephalum* and *Trichomyrmex destructor*.

One of the conclusions of this study is that our understanding of the ant fauna of Nepal is still incomplete, with several species yet to be discovered or taxonomically resolved, and many parts of the country still under sampled. However, this study provides a comprehensive examination of the fundamental taxonomic diversity and distribution of ants in Nepal, providing a sound foundation for future explorations and taxonomic works on Nepalese ants. The data on diversity and distribution patterns presented here provide introductory concepts for future exploration emphasizing the need of undertaking more systematic inventory in specific habitats and regions, as well as conducting extensive studies to protect forests against invasive ant incursions.

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APPENDICES

Appendix I: Site coordinates, elevation and number of plots in sites at SNNP, RCF and TUC

SN	Study sites	Latitude (°N)	Longitude (°E)	Elevation (m)	Number of plots
1	SNNP Nagarjun 1	27.7444	85.2942	1400	20
2	SNNP Nagarjun 2	27.7458	85.2856	1666	20
3	SNNP Nagarjun 3	27.7487	85.2736	1912	20
4	SNNP Nagarjun 4	27.7452	85.2667	2094	20
5	SNNP Shivapuri 1	27.7911	85.3711	1650	20
6	SNNP Shivapuri 2	27.7875	85.3939	1902	20
7	SNNP Shivapuri 3	27.7919	85.3842	2165	20
8	SNNP Shivapuri 4	27.8064	85.3900	2458	20
9	SNNP Sundarijal 1	27.7697	85.4250	1577	20
10	SNNP Sundarijal 2	27.7753	85.4328	1808	20
11	SNNP Sundarijal 3	27.7836	85.4356	2033	20
12	SNNP Sundarijal 4	27.7928	85.4356	2175	20
13	RCF	27.7294	85.3206	1310	20
14	TUC	27.6814	85.2831	1330	20

SNNP: Shivapuri-Nagarjun National Park, RCF: Ranibari Community Forest, TUC: Tribhuvan University Campus

Appendix II: Site coordinates, average elevation and number of plots in selected forests in Tarai, Siwaliks and Hills of eastern, central and western regions of Nepal

SN	Study sites	Latitude (°N)	Longitude (°E)	Average elevation (m)	Number of plots
1	Chaumala, Kailali	28.8096	80.6783	205	3
2	Banbehada, Kailali	28.8114	80.6777	204	6
3	Tikapur Park, Kailali	28.4844	81.1274	151	3
4	Budhitola, Kailali	28.9236	80.5703	991	6
5	Godawari, Kailali	28.8696	80.5757	260	6
6	Chisapani, Surkhet	28.6108	81.6193	802	3
7	Baibang, Dang	28.0953	82.1994	562	3
8	Bet, Darchula	29.7672	80.4010	774	6
9	Shailya Shikhar, Darchula	29.6981	82.5436	1400	6
10	Suidob Shikhar, Dadeldhura	29.3953	80.6093	2210	6
11	Ugratara, Dadeldhura	29.3344	80.6058	1647	6
12	Sagarnath, Sarlahi	26.9943	85.6725	130	6
13	Ishworpur, Sarlahi	26.9931	85.6883	122	3
14	Tamnagar, Rupandehi	27.6961	83.4002	132	6
15	Ghumti, Nawalpur	27.5772	83.8900	160	6
16	Chaliskilo, Nawalpur	27.6220	84.0556	198	9

17	Dumkibas, Nawalpur	27.5842	83.8781	126	6
18	Amaltari, Nawalpur	27.5646	84.1044	116	6
19	Damauli, Tanahun	27.9880	84.2664	456	6
20	Ratanpur, Tanahun	28.0851	84.3895	856	3
21	Baidi, Tanahun	27.8798	84.3399	271	3
22	Naruwal, Lamjung	28.1870	84.3923	975	6
23	Ngyadi, Lamjung	28.3231	84.4014	954	3
24	Khudi, Lamjung	28.2804	84.3557	882	3
25	Jalthal, Jhapa	26.4797	87.9862	97	6
26	Bhadrapur, Jhapa	26.6033	88.0726	96	6
27	Shivasatakshi, Jhapa	26.6537	87.8445	130	6
28	Rhoga, Ilam	26.7650	88.0401	345	6
29	Chureghanti, Ilam	26.9282	87.9276	1265	6
30	Sandakpur, Ilam	27.0080	87.9292	2127	3
31	Kanxi Baazar, Panchthar	27.0929	87.7867	2205	3
32	Baikunda, Panchthar	27.1442	87.7020	674	6
33	Salleri Chyandada, Panchthar	27.1831	87.7528	1436	6
34	Deurali, Taplejung	27.3653	87.7277	2616	6
35	Chatedunga, Taplejung	27.3916	87.7503	2664	6
36	Pathibara, Taplejung	27.4215	87.7630	3413	6
37	Shivapuri, Kathmandu	27.7954	85.3685	1850	6
38	Shivapuri, Kathmandu	27.8008	85.3685	2078	6
39	Nagarjun Helipad, Kathmandu	27.7444	85.2839	1595	6
40	Nangedada, Kathmandu	27.7481	85.2764	1821	6
41	Ranibari, Kathmandu	27.7308	85.3208	1326	6
42	Kirtipur, Kathmandu	27.6808	85.2856	1315	6
43	Sundarijal, Kathmandu	27.7714	85.4264	1635	6
44	Okhreni, Kathmandu	27.7908	85.4208	1878	6
45	Shivapuri Peak	27.8202	85.3853	2732	3

Appendix III: Ant species recorded from Nepal, biogeographic elements, functional groups and provincial distribution.

SN	Species	Bioregions	FG	Province
1	*Acropyga yaeyamensis* Terayama & Hashimoto, 1996	PAL	TCS	3
2	**Aenictus aitkenii* Forel, 1901	INM	TCS	3
3	**Aenictus binghamii* Forel, 1900	INM	TCS	3
4	**Aenictus fergusoni* Forel, 1901	INM	TCS	3
5	**Aenictus hodgsoni* Forel, 1901	INM	TCS	3
6	*Aenictus sagei* Forel, 1901	INM	TCS	
7	**Aphaenogaster beesoni* Donisthorpe, 1933	PAL	OPP	7
8	**Aphaenogaster cristata* (Forel, 1902)	PAL	OPP	3
9	*#Aphaenogaster pachei* (Forel, 1906)	PAL	OPP	1,3
10	*Aphaenogaster prudens* (Forel, 1902)	INM	OPP	1

11	*Aphaenogaster smythiesii* (Forel, 1902)	PAL	OPP	3
12	**Bothroponera tesseronoda* (Emery, 1877)	INM	SP	3,7
13	[t]*Brachyponera chinensis* (Emery, 1895)	INM	SP	3,4,5,6,7
14	**Brachyponera luteipes* (Mayr, 1862)	INM	SP	3
15	*Brachyponera nigrita* (Emery, 1895)	INM	SP	3
16	**Buniapone amblyops* (Emery, 1887)	INM		4
17	*Camponotus angusticollis* (Jerdon, 1851)	INM	SC	3
18	*Camponotus compressus* (Fabricius, 1787)	INM	SC	3,4
19	*Camponotus dolendus* Forel, 1892	INM	SC	3,4
20	*Camponotus himalayanus* Forel, 1893	INM	SC	1
21	**Camponotus irritans* (Smith, 1857)	INM	SC	3
22	*Camponotus lamarckii* Forel, 1892	INM	SC	3,4,5
23	**Camponotus lasiselene* Wang & Wu, 1994	PAL	SC	3
24	**Camponotus mutilarius* Emery 1893	INM	SC	4,7
25	**Camponotus nicobarensis* Mayr, 1865	INM	SC	3,4
26	**Camponotus nirvanae* Forel, 1893	INM	SC	3
27	**Camponotus opaciventris* Mayr, 1879	INM	SC	3,5
28	*Camponotus rufoglaucus* (Jerdon, 1851)	INM	SC	1,3,4
29	**Camponotus selene* (Emery, 1889)	INM	SC	3
30	**Camponotus sericeus* (Fabricius, 1798)	AFR	SC	2,4
31	*Camponotus singularis* (Smith, 1858)	INM	SC	4
32	*Camponotus wroughtonii* Forel, 1893	INM	SC	3
33	[t]*Cardiocondyla emeryi* Forel, 1881	NEO	OPP	3
34	*Cardiocondyla itsukii* Seifert, Okita & Heinze, 2017	PAL	OPP	3,4
35	[t]*Cardiocondyla kagutsuchi* Terayama, 1999	PAL	OPP	3,4
36	[t]*Cardiocondyla mauritanica* Forel, 1890	PAL	OPP	4
37	[t]*Cardiocondyla minutior* Forel, 1899	OCE	OPP	3
38	[t]*Cardiocondyla obscurior* Wheeler, 1929	INM	OPP	4
39	[t]*Cardiocondyla wroughtonii* (Forel, 1890)	INM	OPP	4
40	**Carebara affinis* (Jerdon, 1851)	INM	CRY	6
41	*Carebara bengalensis* (Forel, 1902)	INM	CRY	3
42	*Carebara diversa* (Jerdon, 1851)	INM	CRY	4
43	*Carebara lignata* Westwood, 1840	INM	CRY	3
44	*Cataglyphis emeryi* (Karavaiev, 1910)	PAL	HCS	?
45	*Cataulacus granulatus* (Latreille, 1802)	INM	TCS	4
46	**Centromyrmex feae* Emery, 1889	INM	CRY	4
47	**Cerapachys sulcinodis* Emery, 1889	INM	SP	3
48	*Chronoxenus dalyi* (Forel, 1895)	INM	CCS	1
49	**Chronoxenus wroughtonii* (Forel, 1895)	INM	CCS	3
50	**Colobopsis longi* (Forel, 1902)	INM	SC	3
51	**Colobopsis rothneyi* (Forel, 1893)	INM	SC	3
52	**Colobopsis vitrea* (Smith, 1860)	AUS	SC	1
53	*Crematogaster binghamii* Forel, 1904	INM	GM	1,3

54	*Crematogaster flava* Forel, 1886	INM	GM	1,3
55	*Crematogaster himalayana* Forel, 1902	INM	GM	1,3
56	**Diacamma indicum* Santschi, 1920	INM	OPP	4
57	*Diacamma rugosum* (Le Guillou, 1842)	INM	OPP	2,3
58	**Diacamma scalpratum* (Smith, 1858)	INM	OPP	1
59	**Diacamma sikkimense* Forel, 1903	INM	OPP	4
60	*Diacamma vagans* (Smith, 1860)	AUS	OPP	?
61	*Dolichoderus affinis* Emery, 1889	INM	TCS, CCS	3
62	*Dolichoderus taprobanae* (Smith, 1858)	INM	TCS	1,3
63	*Dorylus labiatus* Schuckard, 1840	INM	TCS	3
64	*Dorylus orientalis* Westwood, 1835	INM	TCS	3
65	**Ectomomyrmex annamitus* (Andre, 1892)	INM	SP	4
66	**Ectomomyrmex striolatus* (Donisthorpe, 1933)	INM	SP	3,4
67	*#[e]Emeryopone franzi* (Baroni Urbani, 1975)	INM	CRY	3,4
68	*Formica candida* Smith, 1878	PAL	CCS, OPP	4
69	*Formica fusca* Linnaeus, 1758	PAL	CCS, OPP	4
70	*Formica picea* Nylander, 1846	PAL	CCS, OPP	4
71	**Harpegnathos venator* (Smith, 1858)	INM	SP	4,5
72	**Hypoponera confinis* (Roger, 1860)	INM	CRY	3
73	*[l]Iridomyrmex anceps* (Roger, 1863)	INM	DD	4
74	*Lasius alienoflavus* Bingham, 1903	PAL	CCS	6
75	*Lasius crinitus* (Smith, 1858)	INM	CCS	1
76	*Lasius magnus* Seifert, 1992	INM	CCS	1,3
77	*Lasius niger* (Linnaeus, 1758)	PAL	CCS	1,4
78	*Lepisiota lunaris* (Emery, 1893)	INM	OPP	1,3
79	**Lepisiota mayri* Wachkoo et al., 2021	INM	OPP	3
80	**Lepisiota modesta* (Forel, 1894)	INM	OPP	3
81	**Lepisiota opaca* (Forel, 1892)	INM	OPP	3,4
82	**Lepisiota rothneyi* (Forel, 1894)	INM	OPP	3,4
83	**Lepisiota sericea* (Forel, 1892)	INM	OPP	3
84	*Lepisiota rothneyi watsonii* (Forel, 1894)	INM	OPP	1,3
85	*#[e]Leptanilla buddhista* Baroni Urbani, 1977	INM	CRY	3,4
86	**Leptogenys birmana* Forel, 1900	INM	SP	3
87	**Leptogenys chinensis* (Mayr, 1870)	INM	SP	3
88	**Leptogenys dentilobis* Forel, 1900	INM	SP	3
89	*Leptogenys diminuta* (Smith, 1857)	INM	SP	3,4
90	**Leptogenys kitteli* (Mayr 1870)	INM	SP	3,4
91	**Leptogenys laeviceps* (Smith, 1857)	INM	SP	3,4,5
92	*Lophomyrmex ambiguus* Rigato, 1994	INM	TCS	4
93	*Lordomyrma bhutanensis* (Baroni Urbani, 1977)	INM	TCS	?
94	*#Mayriella transfuga* Baroni Urbani, 1977	INM	CRY	3
95	*Meranoplus bicolor* Guerin-Meneville, 1844	INM	HCS	1,2,3,4,7

96	#[e]*Meranoplus nepalensis* Schödl, 1998	INM	HCS	1,3
97	*Meranoplus rothneyi* Forel, 1902	INM	HCS	1
98	*[t]*Monomorium floricola* (Jerdon, 1851)	INM	OPP	4
99	*[t]*Monomorium pharaonis* (Linnaeus, 1758)	PAL	OPP	3,4
100	*Monomorium sahlbergi* Emery, 1898	PAL	OPP	2,3
101	*Myrmica aimonissabaudiae* Menozzi, 1939	INM	OPP	3,4
102	#*Myrmica alperti* Elmes & Radchenko, 2009	INM	OPP	1
103	*Myrmica bactriana* Ruzsky, 1915	PAL	OPP	1,3
104	#[e]*Myrmica boltoni* Radchenko & Elmes, 2009	INM	OPP	1,3,4
105	#*Myrmica brancuccii* Radchenko, Elmes & Collingwood, 2009	INM	OPP	1,4
106	*Myrmica hecate* Weber, 1947	PAL	OPP	3,4
107	*Myrmica indica* Weber, 1950	PAL	OPP	1,3
108	*Myrmica kozlovi* Ruzsky, 1915	PAL	OPP	1,3
109	#[e]*Myrmica martensi* Radchenko & Elmes, 1998	PAL	OPP	3
110	#*Myrmica pachei* Forel, 1906	PAL	OPP	1
111	**Myrmica rhytida* Radchenko & Elmes, 1999	INM	OPP	3
112	*Myrmica ritae* Emery, 1889	INM	OPP	4
113	*Myrmica rugosa* Mayr, 1865	PAL	OPP	3,4
114	*Myrmica rupestris* Forel, 1902	PAL	OPP	1,3,4
115	*Myrmica smythiesii* Forel, 1902	PAL	OPP	1,3
116	#*Myrmica weberi* Elmes & Radchenko, 2009	PAL	OPP	1
117	**Myrmicaria brunnea* Saunders, 1842	INM	GM	1,4,5,7
118	**Nylanderia birmana* (Forel, 1902)	INM	OPP	3
119	*[t]*Nylanderia bourbonica* (Forel, 1886)	MAL	OPP	3
120	*Nylanderia indica* (Forel, 1894)	INM	OPP	3
121	**Nylanderia smythiesii* (Forel, 1894)	INM	OPP	3,4,7
122	**Nylanderia taylori* (Forel, 1894)	INM	OPP	1,3
123	*[t]*Ochetellus glaber* (Mayr, 1862)	AUS	OPP	1,3
124	*Odontomachus monticola* Emery, 1892	INM	SP	3
125	**Odontoponera denticulata* (Smith, 1858)	INM	SP	3,4,5,7
126	*Odontoponera transversa* (Smith, 1857)	INM	SP	4
127	*Oecophylla smaragdina* (Fabricius, 1775)	INM	TCS	1,2,3,4,5,6,7
128	[t]*Ooceraea biroi* (Forel, 1907)	INM	CRY?	2,4
129	**Parasyscia wighti* (Bharti & Akbar, 2013)	INM	SP?	3
130	[t]*Paratrechina longicornis* (Latreille, 1802)	AFR	OPP	3,4,5,7
131	*Perissomyrmex monticola* De Andrade, 1993	INM	TCS	1
132	*Pheidole indica* Mayr, 1879	INM	GM	1,3
133	*Pheidole jucunda* Forel, 1885	INM	GM	1,3
134	**Pheidole nodus* Smith 1874	PAL	GM	3
135	*Pheidole parva* Mayr, 1865	INM	GM	1
136	*Pheidole sagei* Forel, 1902	INM	GM	1,3
137	*Pheidole smythiesii* Bingham, 1903	INM	GM	3,4
138	**Plagiolepis jerdonii* Forel, 1894	INM	CRY	3,4

139	*Polyrhachis dives* Smith, 1857	INM	SC	1
140	**Polyrhachis hippomanes* Smith 1861	INM	SC	3
141	*Polyrhachis illaudata* Walker, 1859	INM	SC	4
142	*Polyrhachis lacteipennis* Smith, 1858	INM	SC	1,3,4,5,7
143	**Polyrhachis laevissima* Smith 1858	INM	SC	1
144	**Polyrhachis punctillata* Roger, 1863	INM	SC	3,4
145	*Polyrhachis rastellata* (Latreille, 1802)	INM	SC	3,4
146	**Polyrhachis saevissima argentea* Mayr 1862	INM	SC	3
147	*Polyrhachis thompsoni* Bingham, 1903	INM	SC	3
148	*Polyrhachis tibialis parsis* Emery, 1900	INM	SC	3,4
149	**Polyrhachis tyrannica* Smith, 1858	INM	SC	3,4
150	*#Prenolepis darlena* Williams & LaPolla, 2016	INM	CCS	4
151	*Prenolepis naoroji* Forel, 1902	INM	CCS	2,3,4
152	*#[e]Prenolepis nepalensis* Williams & LaPolla, 2018	INM	CCS	4
153	*#[e]Prenolepis rinpoche* Williams, 2022	PAL	CCS	4
154	*Pristomyrmex sulcatus* Emery, 1895	INM	TCS	1
155	**Pseudolasius familiaris* (Smith, 1860)	INM	TCS	1
156	**Pseudoneoponera bispinosa* (Smith, 1858)	INM	SP	4,5,7
157	*Pseudoneoponera rufipes* (Jerdon, 1851)	INM	SP	4
158	*Recurvidris recurvispinosa* (Forel, 1890)	INM	CRY	3
159	*#[e]Stenamma gurkhale* DuBois, 1998	INM	CCS	3
160	**Stictoponera bicolor* (Emery, 1889)	INM	TCS	4
161	*Stigmatomma pertinax* (Baroni Urbani, 1978)	INM		1
162	*#[e]Strumigenys buddhista* De Andrade, 2007	PAL	CRY	4
163	*Strumigenys caniophanoides* De Andrade, 2007	INM	CRY	1
164	*#Strumigenys exilirhina* Bolton, 2000	INM	CRY	1
165	**[t]Strumigenys godeffroyi* Mayr 1866	OCE	CRY	3
166	*#Strumigenys hemisobek* Bolton, 2000	INM	CRY	1
167	*#[e]Strumigenys hindu* De Andrade, 2007	INM	CRY	4
168	*[t]Strumigenys membranifera* Emery, 1869	PAL	CRY	?
169	*#Strumigenys nepalensis* De Andrade, 1994	INM	CRY	3,4
170	*#Strumigenys podarge* Bolton, 2000	INM	CRY	3
171	**Strumigenys virgila* Bolton, 2000	PAL	CRY	3
172	**[t]Tapinoma melanocephalum* (Fabricius, 1793)	NEO	OPP, DD	3,4,7
173	*Technomyrmex elatior* Forel, 1902	INM	OPP	3,4,7
174	*Technomyrmex obscurior* Wheeler, 1928	PAL	OPP	1,3,4
175	**Temnothorax wroughtonii* (Forel, 1904)	PAL	CCS	7
176	*[t]Tetramorium bicarinatum* (Nylander, 1846)	NEA	OPP	3,4
177	*#Tetramorium difficile* Bolton, 1977	INM	OPP	1
178	*[t]Tetramorium lanuginosum* Mayr, 1870	INM	OPP	1,2,3
179	**Tetramorium obesum* Andre, 1887	INM	OPP	7
180	**Tetraponera aitkenii* (Forel, 1902)	INM	TCS	1
181	*Tetraponera allaborans* (Walker, 1859)	INM	TCS	1,3,4

182	*Tetraponera binghami* (Forel, 1902)	INM	TCS	2
183	**Tetraponera difficilis* (Emery, 1900)	INM	TCS	3
184	*Tetraponera nigra* (Jerdon, 1851)	INM	TCS	2
185	*Tetraponera rufonigra* (Jerdon, 1851)	INM	TCS	1,2,3,4,5,7
186	[t]*Trichomyrmex destructor* (Jerdon, 1851)	INM	OPP	1,3,5,7

* New record for Nepal reported during this study, # Species described from Nepalese specimens, [e] Species endemic to Nepal, [t]Tramp species; Functional groups (FG): CCS: Cold Climate Specialists, CRY: Cryptic Species, DD: Dominant Dolichoderinae, GM: Generalized Myrmicinae, HCS: Hot Climate Specialists, OPP: Opportunists, SC: Subordinate Camponotini, SP: Specialized predators, TCS: Tropical Climate Specialists; Provinces of Nepal: 1: Province 1, 2: Madhesh Province, 3: Bagmati Province, 4: Gandaki Province, 5: Lumbini Province, 6: Karnali Province, 7: Sudurpashchim Province; Bioregions: AFR: Afrotropics, AUS: Australasia, INM: Indomalaya, MAL: Malagasy, NEA: Nearctic, NEO: Neotropics, OCE: Oceania, PAL: Paleotropics, NEO: Neotropics.

Appendix IV: Ant species recorded in Ranibari Community Forest, Tribhuvan University Campus, and Shivapuri-Nagarjun National Park.

SN	Species	TUC	RCF	NAG	SHI	SUN
1	*Aenictus aitkenii* Forel, 1901	0	0	0	0	1
2	*Aenictus binghamii* Forel, 1900	0	0	0	1	0
3	*Aenictus ceylonicus gr.* NP-IPS-01	0	0	1	0	0
4	*Aenictus fergusoni* Forel, 1901	1	0	0	0	0
5	*Aenictus hodgsoni* Forel, 1901	0	0	1	0	0
6	*Aenictus nepalensis* sp. nov.	0	0	1	0	0
7	*Aphaenogaster (Attomyrma)* NP-IPS-05	0	1	0	0	0
8	*Aphaenogaster cristata* (Forel, 1902)	0	0	0	0	1
9	*Aphaenogaster* NP-IPS-04	0	1	0	0	0
10	*Aphaenogaster* NP-IPS-05	0	0	0	0	1
11	*Aphaenogaster* NP-IPS-APH01	0	0	1	1	1
12	*Aphaenogaster* NP-IPS-APH02	0	0	1	1	0
13	*Aphaenogaster* NP-IPS-APH03	0	0	0	1	0
14	*Aphaenogaster smythiesii* (Forel, 1902)	0	0	1	1	1
15	*Bothroponera tesseronoda* (Emery, 1877)	0	0	1	1	0
16	*Brachyponera chinensis* (Emery, 1895)	1	1	1	1	1
17	*Brachyponera luteipes* (Mayr, 1862)	0	0	1	0	0
18	*Brachyponera nigrita* (Emery, 1895)	0	0	1	1	0
19	*Camponotus (Myrmentoma)* NP-IPS-01	0	0	1	0	1
20	*Camponotus (Tanaemyrmex)* NP-IPS-02	0	0	1	0	0
21	*Camponotus compressus* (Fabricius, 1787)	0	0	1	0	0
22	*Camponotus dolendus* Forel, 1892	0	1	0	0	0
23	*Camponotus irritans* (Smith, 1857)	1	1	1	1	1
24	*Camponotus lamarckii* Forel, 1892	0	0	0	0	1
25	*Camponotus lasiselene* Wang & Wu, 1994	0	1	0	0	0

26	*Camponotus nicobarensis* Mayr, 1865	1	1	1	0	1
27	*Camponotus nirvanae* Forel, 1893	0	1	0	1	0
28	*Camponotus* NP-IPS-01	1	0	0	0	0
29	*Camponotus rufoglaucus* (Jerdon, 1851)	1	1	0	1	1
30	*Camponotus selene* (Emery, 1889)	1	0	0	0	1
31	*Cardiocondyla itsukii* Seifert, Okita & Heinze, 2017	0	1	0	0	0
32	*Cardiocondyla kagutsuchi* Terayama, 1999	0	0	1	0	0
33	*Cardiocondyla* NP-IPS-01	0	0	0	1	0
34	*Carebara* NP-IPS-01	1	1	1	0	0
35	*Carebara* NP-IPS-02	0	0	0	0	1
36	*Cerapachys sulcinodis* Emery, 1889	0	0	1	0	0
37	*Chronoxenus wroughtonii* (Forel, 1895)	0	0	0	1	0
38	*Colobopsis longi* (Forel, 1902)	0	1	1	1	0
39	*Colobopsis rothneyi* (Forel, 1893)	1	0	0	0	0
40	*Crematogaster flava* Forel, 1886	1	0	0	0	0
41	*Crematogaster himalayana* Forel, 1902	1	1	1	1	1
42	*Crematogaster* NP-IPS-01	0	0	0	0	1
43	*Crematogaster* NP-IPS-02	1	0	1	0	0
44	*Crematogaster* NP-IPS-03	0	1	0	1	0
45	*Dolichoderus affinis* Emery, 1889	1	1	0	0	0
46	*Dolichoderus thoracicus* gr. NP-IPS-01	0	1	0	0	1
47	*Dorylus orientalis* Westwood, 1835	1	0	0	0	0
48	*Ectomomyrmex* cf. *astutus*	0	0	0	0	1
49	*Ectomomyrmex striolatus* (Donisthorpe, 1933)	0	0	1	0	0
50	*Emeryopone franzi* (Baroni Urbani, 1975)	0	0	1	0	0
51	*Hypoponera confinis* (Roger, 1860)	0	0	0	1	0
52	*Lasius magnus* Seifert, 1992	0	0	1	0	0
53	*Lepisiota lunaris* (Emery, 1893)	0	0	0	1	1
54	*Lepisiota mayri* Wachkoo et al., 2021	1	0	0	0	1
55	*Lepisiota modesta* (Forel, 1894)	0	0	1	1	1
56	*Lepisiota opaca* (Forel, 1892)	1	0	0	0	0
57	*Lepisiota sericea* (Forel, 1892)	1	1	0	0	0
58	*Leptogenys birmana* Forel, 1900	0	0	1	0	0
59	*Leptogenys chinensis* (Mayr, 1870)	0	1	0	0	0
60	*Leptogenys dentilobis* Forel, 1900	1	1	0	0	0
61	*Leptogenys diminuta* gr. NP-IPS-LEP01	0	1	0	0	0
62	*Leptogenys diminuta* (Smith, 1857)	0	0	1	0	0
63	*Leptogenys kitteli* (Mayr 1870)	0	0	1	0	0
64	*Leptogenys laeviceps* (Smith, 1857)	1	1	1	1	1
65	*Meranoplus bicolor* Guerin-Meneville, 1844	0	0	0	1	0
66	*Meranoplus nepalensis* Schödl, 1998	1	1	0	0	0
67	*Monomorium pharaonis* (Linnaeus, 1758)	1	0	0	1	0
68	*Myrmica indica* Weber, 1950	0	0	0	1	0

69	*Myrmica pachei* gr. NP-IPS-01	0	0	1	0	0
70	*Myrmica rhytida* Radchenko & Elmes, 1999	0	0	0	1	0
71	*Myrmica rugosa* Mayr, 1865	0	0	1	1	1
72	*Myrmica rupestris* Forel, 1902	0	0	1	0	0
73	*Myrmica smythiesii* Forel, 1902	0	0	1	0	0
74	*Nylanderia birmana* (Forel, 1902)	1	1	1	1	1
75	*Nylanderia bourbonica* (Forel, 1886)	0	0	1	0	1
76	*Nylanderia indica* (Forel, 1894)	0	0	1	0	1
77	*Nylanderia smythiesii* (Forel, 1894)	0	0	1	0	0
78	*Ocetellus glaber* (Mayr, 1862)	1	0	0	0	0
79	*Odontomachus monticola* Emery, 1892	0	1	1	1	1
80	*Oecophylla smaragdina* (Fabricius, 1775)	0	0	0	1	0
81	*Paraparatrechina* NP-IPS-01	1	0	0	0	0
82	*Parasyscia wighti* (Bharti & Akbar, 2013)	0	1	0	0	0
83	*Paratrechina longicornis* (Latreille, 1802)	0	1	1	1	0
84	*Pheidole jucunda* Forel, 1885	0	0	1	1	1
85	*Pheidole nodus* Smith 1874	0	0	1	0	0
86	*Pheidole* NP-IPS-01	0	0	0	0	1
87	*Pheidole* NP-IPS-02	1	0	0	0	0
88	*Pheidole sagei* Forel, 1902	0	1	0	0	0
89	*Pheidole smythiesii* Bingham, 1903	0	0	1	0	0
90	*Polyrhachis dives* Smith, 1857	0	0	1	0	0
91	*Polyrhachis hippomanes* Smith 1861	0	1	1	0	0
92	*Polyrhachis lacteipennis* Smith, 1858	1	1	1	1	1
93	*Polyrhachis rastellata* (Latreille, 1802)	0	0	1	0	0
94	*Polyrhachis saevissima argentea* Mayr 1862	0	0	1	0	0
95	*Polyrhachis thompsoni* Bingham, 1903	0	0	0	0	1
96	*Polyrhachis tibialis parsis* Emery, 1900	0	0	1	0	0
97	*Prenolepis naoroji* Forel, 1902	1	0	1	0	0
98	*Prenolepis* NP-IPS-01	1	0	0	0	0
99	*Prenolepis* NP-IPS-02	0	0	0	0	1
100	*Prenolepis* NP-IPS-03	0	0	0	1	1
101	*Prenolepis* NP-IPS-04	0	0	0	1	0
102	*Strumigenys godeffroyi* Mayr 1866	0	0	1	0	0
103	*Strumigenys nepalensis* De Andrade, 1994	0	1	0	0	0
104	*Strumigenys virgila* Bolton, 2000	0	1	0	0	0
105	*Tapinoma melanocephalum* (Fabricius, 1793)	0	1	0	1	0
106	*Technomyrmex elatior* Forel, 1902	0	1	0	0	0
107	*Technomyrmex obscurior* Wheeler, 1928	0	0	1	0	0
108	*Temnothorax buddha* sp. nov.	0	0	1	0	0
109	*Temnothorax* cf. *indra*	0	0	0	1	0
110	*Temnothorax kathmanduensis* sp. nov.	1	0	0	0	1
111	*Temnothorax nepalensis* sp. nov.	0	1	0	0	0

112	*Tetramorium bicarinatum* (Nylander, 1846)	1	0	1	0	0
113	*Tetramorium angulinode* gr. NP-IPS-01	0	0	1	1	1
114	*Tetramorium* NP-IPS-02	0	1	0	0	0
115	*Tetramorium* NP-IPS-03	1	0	0	1	0
116	*Tetraponera allaborans* (Walker, 1859)	1	0	1	0	0
117	*Tetraponera difficilis* (Emery, 1900)	1	0	0	0	0
118	*Tetraponera rufonigra* (Jerdon, 1851)	1	1	1	0	0
119	*Trichomyrmex destructor* (Jerdon, 1851)	0	0	0	1	0

Notes: RCF: Ranibari Community Forest, TUC: Tribhuvan University Campus, NAG: SNNP Nagarjun Sector, SHI: SNNP Shivapuri Sector, SUN: SNNP Sundarijal Sector, 1: Species present, 0: Species absent

Appendix V: Ant species recorded in selected forests of Tarai, Siwaliks, and Hills of eastern, central and western regions of Nepal

SN	Species	Eastern	Central	Western
1	*Aphaenogaster beesoni* Donisthorpe, 1933	0	0	1
2	*Bothroponera tesseronoda* (Emery, 1877)	0	0	1
3	*Brachyponera chinensis* (Emery, 1895)	0	0	1
4	*Camponotus* (*Taenaemyrmex*) NP-IPS-01	0	0	1
5	*Camponotus* (*Taenaemyrmex*) NP-IPS-02	1	1	1
6	*Camponotus* (*Taenaemyrmex*) NP-IPS-03	0	1	0
7	*Camponotus mutilarius* Emery 1893	0	1	1
8	*Camponotus rufoglaucus* (Jerdon, 1851)	1	1	1
9	*Camponotus sericeus* (Fabricius, 1798)	0	1	0
10	*Cardiocondyla* NP-IPS-01	0	1	1
11	*Cardiocondyla wroughtonii* (Forel, 1890)	0	1	0
12	*Carebara affinis* (Jerdon, 1851)	0	0	1
13	*Colobopsis vitrea* (Smith, 1860)	1	0	0
14	*Crematogaster binghamii* Forel, 1904	1	0	0
15	*Crematogaster flava* Forel, 1886	1	0	1
16	*Crematogaster himalayana* Forel, 1902	1	1	0
17	*Crematogaster* NP-IPS-01	1	1	1
18	*Crematogaster* NP-IPS-02	1	1	1
19	*Diacamma scalpratum* (Smith, 1858)	1	0	0
20	*Diacamma sikkimense* Forel, 1903	0	1	0
21	*Iridomyrmex anceps* (Roger, 1863)	0	1	0
22	*Iridomyrmex* NP-IPS-01	1	0	0
23	*Lasius magnus* Seifert, 1992	1	0	1
24	*Lasius* NP-IPS-01	1	0	0
25	*Lepisiota lunaris* (Emery, 1893)	1	0	1
26	*Lepisiota opaca* (Forel, 1892)	0	1	0
27	*Lepisiota rothneyi* (Forel, 1894)	0	1	0
28	*Leptogenys diminuta* (Smith, 1857)	0	1	0
29	*Lophomyrmex ambiguus* Rigato, 1994	1	1	1

30	*Meranoplus bicolor* Guerin-Meneville, 1844	1	1	1
31	*Monomorium sahlbergi* Emery, 1898	0	1	0
32	*Monomorium pharaonis* (Linnaeus, 1758)	1	0	1
33	*Myrmica indica* Weber, 1950	1	0	0
34	*Myrmica weberi* Elmes & Radchenko, 2009	1	0	0
35	*Myrmicaria brunnea* gr. sp 1	1	0	1
36	*Myrmicaria brunnea* Saunders, 1842	0	1	0
37	*Nylanderia birmana* (Forel, 1902)	1	1	1
38	*Nylanderia smythiesii* (Forel, 1894)	0	1	1
39	*Nylanderia taylori* (Forel, 1894)	1	0	0
40	*Ocetellus glaber* (Mayr, 1862)	1	0	0
41	*Odontoponera denticulata* (Smith, 1858)	0	0	1
42	*Oecophylla smaragdina* (Fabricius, 1775)	1	1	1
43	*Paratrechina longicornis* (Latreille, 1802)	0	1	1
44	*Pheidole nodus* Smith 1874	0	1	0
45	*Pheidole* NP-IPS-01	1	0	1
46	*Pheidole* NP-IPS-02	0	1	1
47	*Pheidole* NP-IPS-03	1	0	1
48	*Pheidole* NP-IPS-04	0	1	1
49	*Plagiolepis jerdonii* Forel, 1894	0	1	0
50	*Polyrhachis lacteipennis* Smith, 1858	1	1	1
51	*Polyrhachis laevissima* Smith 1858	1	0	0
52	*Polyrhachis punctillata* Roger, 1863	0	1	0
53	*Prenolepis* NP-IPS-03	0	1	0
54	*Prenolepis naoroji* Forel, 1902	0	1	1
55	*Pseudolasius familiaris* (Smith, 1860)	1	0	0
56	*Pseudoneoponera bispinosa* (Smith, 1858)	0	0	1
57	*Stictoponera bicolor* (Emery, 1889)	0	1	0
58	*Tapinoma melanocephalum* (Fabricius, 1793)	0	1	1
59	*Technomyrmex elatior* Forel, 1902	0	0	1
60	*Technomyrmex obscurior* Wheeler, 1928	1	1	0
61	*Temnothorax pathibharensis* sp. nov.	1	0	0
62	*Temnothorax taplejungensis* sp. nov.	1	0	0
63	*Temnothorax wroughtonii* (Forel, 1904)	0	0	1
64	*Tetramorium angulinode* gr. sp 1	0	1	1
65	*Tetramorium lanuginosum* Mayr, 1870	1	1	0
66	*Tetramorium obesum* Andre, 1887	1	0	1
67	*Tetraponera aitkenii* (Forel, 1902)	1	0	0
68	*Tetraponera allaborans* (Walker, 1859)	0	1	0
69	*Tetraponera rufonigra* (Jerdon, 1851)	1	0	1
70	*Trichomyrmex destructor* (Jerdon, 1851)	0	0	1

Notes: 1: Species present, 0: Species absent

Appendix VI: Conferences attended and papers presented

1. **Participation and oral presentation**: The World Ant Forum 2019, 11-15 Nov. 2019, Kasetsart University, Bangkok, Thailand, organized by International Network for the Study of Asian Ants (ANeT). Title of presentation: "An updated checklist of Nepalese ants (Hymenoptera: Formicidae)".
2. **Participation and oral presentation**: National Conference on Zoology: Biodiversity in a Changing World, 28-30 Nov. 2020, organized by Central Department of Zoology (CDZ, TU), and Alumni Association of Central Department of Zoology Tribhuvan University (AACDZTU). Title of presentation: "Preliminary checklist of ants of Nagarjun Forest, Shivapuri-Nagarjun National Park, Central Nepal".
3. **Participation and oral presentation**: International Conference on Zoology 2021: Himalayan Biodiversity in the Face of Global Change, 29 November – 1 December 2021, organized by CDZ, TU, and AACDZTU. Title of presentation: "Expanding our knowledge of Nepalese ants: new records and worker-based keys for the predatory subfamily Dorylinae".
4. **Participation and poster presentation**: XVI Congreso Internacional de Mirmecología, Taxomara 2021 Virtual, 11–12 December 2021, organized by Iberian Association of Mirmecology (AIM). Title of presentation: "A generic synopsis of Ponerine ants of Nepal (Hymenoptera: Formicidae, Ponerinae), with new faunal records and redescription of a rare endemic ant, *Emeryopone franzi* (Baroni Urbani, 1975)".

Appendix VII: Scientific publications

The following seven papers based on this Ph.D. work are also appended to this thesis (front page of each paper), five of which were published in SCI rank impact factor journals and two in JPPS two-star rated peer-reviewed journals.

1. Subedi, I.P., Budha, P.B., Bharti, H., & Alonso, L. (2020). An Updated Checklist of Nepalese Ants (Hymenoptera, Formicidae). *ZooKeys*, **1006**: 99–136. https://doi.org/10.3897/zookeys.1006.58808
2. Subedi, I.P., Budha, P.B., Kunwar, R.M., Charmakar, S., Ulak, S., Pradhan, D.K., Pokharel, Y.P., Velayudhan, S.T., Sathyapala, S., & Animon, I. (2021). Diversity and Distribution of Forest Ants (Hymenoptera: Formicidae) in Nepal: Implications for Sustainable Forest Management. *Insects*, **12**: 1128. https://doi.org/10.3390/insects12121128
3. Subedi, I.P., Budha, P.B., & Yamane, Sk. (2022). Ants of the Genus *Leptogenys* Roger, 1861 (Hymenoptera: Formicidae, Ponerinae) from Nepal. *Far Eastern Entomologist*, **11**(448): 11–20. http://doi.org/10.25221/fee.448.2
4. Subedi, I.P., Budha, P.B., Bharti, H., Alonso, L., & Yamane, Sk. (2021). First Record of the Ant Subgenus *Orthonotomyrmex* of the Genus *Camponotus* from Nepal (Hymenoptera, Formicidae). *Zoodiversity*, **55**(4): 279–284. https://doi.org/10.15407/zoo2021.04.279
5. Subedi, I.P., Bharti, H., Budha, P.B., & Alonso, L. (2021). First Record of Two Doryline Ant Genera *Cerapachys* Smith, 1857 and *Parasyscia* Emery, 1882 (Hymenoptera: Formicidae) from Nepal. *Halteres*, **12:** 15–21. https://doi.org/10.5281/zenodo.537207
6. Subedi, I.P., Budha, P.B., & Thapa, V.K. (2022). Ant Genus *Tetraponera* Smith, 1852 in Nepal, with Two New Records and Keys to Workers (Formicidae: Psueudomyrmecinae). *Journal of Institute of Science and Technology*, **27**(1): 93–99. https://doi.org/10.3126/jist.v27i1.46661
7. Subedi, I.P., Budha, P.B., Yusupov, Z.M., & Bharti, H. (2022). Myrmicine Ants of Nepal with Six New Records and Updated Species List (Hymenoptera: Formicidae: Myrmicinae). *Nepalese Journal of Zoology*, **6**(1): 10–19. https://doi.org/10.3126/njz.v6i1.46749

ZooKeys 1006: 99–136 (2020)
doi: 10.3897/zookeys.1006.58808
https://zookeys.pensoft.net

CHECKLIST

A peer-reviewed open-access journal
ZooKeys
Launched to accelerate biodiversity research

An updated checklist of Nepalese ants (Hymenoptera, Formicidae)

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http://zoobank.org/A9C5018F-2597-40A6-97D4-067D5DF3C10E

Citation: Subedi IP, Budha PB, Bharti H, Alonso L (2020) An updated checklist of Nepalese ants (Hymenoptera, Formicidae). ZooKeys 1006: 99–136. https://doi.org/10.3897/zookeys.1006.58808

Abstract

The location of Nepal in the Central Himalaya promotes high habitat and species diversity. Ant diversity is likely high, but there have been few studies of the diversity and distribution of ants in Nepal. Here we present an updated checklist list of Nepalese ants that includes 128 named species in 48 genera and eight subfamilies. Among these species, 21 species have a type locality from Nepal, nine species are endemic to Nepal, and three are introduced species. We add six new ant records for Nepal, namely *Harpegnathos venator*, *Monomorium pharaonis*, *Nylanderia bourbonica*, *Odontoponera denticulata*, *Polyrhachis tyrannica* and *Pseudoneoponera bispinosa*. The checklist presents distribution records for Nepalese ant species and provides comparisons with the neighboring countries of China and India.

Keywords

Endemic, Himalaya, *Myrmica*, Nepal, *Strumigenys*, type locality

Introduction

Ants (family Formicidae) are one of the most successful groups of organisms on the planet (Hölldobler and Wilson 1990) and together with termites, have been found to make up 30% of animal biomass in the Amazon rain forest (Fittkau and Klinge 1973). Ants are present in almost all terrestrial ecosystems, with the peak of their diversity found within the tropical regions (Guénard 2013). Estimate of global ant species rich-

insects

MDPI

Article

Diversity and Distribution of Forest Ants (Hymenoptera: Formicidae) in Nepal: Implications for Sustainable Forest Management

Indra Prasad Subedi [1], Prem Bahadur Budha [1,*], Ripu Mardhan Kunwar [2,*], Shambhu Charmakar [3], Sunita Ulak [4], Dhirendra Kumar Pradhan [4], Yam Prasad Pokharel [4], Sajeev Thavalathadathil Velayudhan [5], Shiroma Sathyapala [6] and Illias Animon [7]

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Citation: Subedi, I.P.; Budha, P.B.; Kunwar, R.M.; Charmakar, S.; Ulak, S.; Pradhan, D.K.; Pokharel, Y.P.; Velayudhan, S.T.; Sathyapala, S.; Animon, I. Diversity and Distribution of Forest Ants (Hymenoptera: Formicidae) in Nepal: Implications for Sustainable Forest Management. *Insects* **2021**, *12*, 1128. https://doi.org/10.3390/insects12121128

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Simple Summary: There is little information available about the species diversity and distribution patterns of Nepalese ants, as well as their importance in maintaining forest health. A survey of forest ants was conducted in Nepal to learn about their diversity, distribution, and role in forest management. Ants were collected using vegetation beating, sweeping, and hand collection methods in eastern, central, and western Nepal. Seventy ant species from thirty-six genera and six subfamilies were recorded in the study. The research also discovered five genera and nine species new for the country, as well as eight tramp species, four of which are major ecological, agricultural, and/or household pests. The study discovered that western Nepal and the Siwalik region have a relatively high ant diversity. Ant diversity was found to decrease with increasing elevation. The assessment of ant diversity using multiple sampling methods that cover all seasons and forest types may be useful in obtaining complete ant diversity data. Early intervention through sustainable forest management initiatives would aid in preventing invasive ant incursions in the forests of Nepal.

Abstract: The information available on the diversity of ant species and their distribution and interaction with forest health in Nepal remains limited. As part of a nationwide project on forest health, we conducted inventories to assess the diversity and distribution of forest ants and their role in forest management in Nepal. Ants were collected from 187 plots of 10 m × 10 m size along the north–south belt transects in eastern, central, and western Nepal. We used vegetation beating, sweeping, and hand collection methods in selected forest types. In each transect, we designed six plots in each major forest type (Sal, *Schima–Castanopsis*, and broadleaf mixed forests) and three plots each in deodar, *Alnus*, riverine, and *Cryptomeria* forests. We recorded 70 ant species from 36 genera and six subfamilies. This includes five genera and nine species new for the country, as well as eight tramp species, four of which are major ecological, agricultural, and/or household pests. Our study indicates that forest ant species richness is high in western Nepal and the Siwaliks, and it decreases as elevation increases. The high diversity of ant species in the forests of Nepal needs to be assessed with further exploration using multiple sampling methods covering all seasons and forest types. Ants can be useful indicators for ecosystem management and human impacts on forests. Reports of invasive ants in Nepalese forests indicate the relevance of urgent interventions through sustainable forest management initiatives to prevent future incursions.

Far Eastern Entomologist

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http://zoobank.org/References/11C6CC55-AC59-46C9-850C-C9D1008230E0

ANTS OF THE GENUS *LEPTOGENYS* ROGER, 1861 (HYMENOPTERA: FORMICIDAE, PONERINAE) FROM NEPAL

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Summary. Six species of the genus *Leptogenys* Roger, 1861 are reported from Nepal. *Leptogenys laeviceps* (Smith, 1857), **stat. ressur.** is raised to species status. *Leptogenys birmana* Forel, 1900, *L. chinensis* (Mayr, 1870), *L. dentilobis* Forel, 1900, *L. kitteli* Mayr, 1870, and *L. laeviceps* (Smith, 1857) are recorded from Nepal for the first time. A key based upon the worker caste is provided for all Nepalese species. A map of the distribution of *Leptogenys* species in Nepal is presented.

Key words: ants, fauna, new records, taxonomy, worker diagnosis, key, Himalayas.

И. П. Субеди, П. Б. Будха, Ск. Ямане. Муравьи рода *Leptogenys* Roger, 1861 (Hymenoptera: Formicidae, Ponerinae) фауны Непала // Дальневосточный энтомолог. 2022. N 448. С. 11-20.

Резюме. Из Непала приводятся шесть видов муравьев рода *Leptogenys* Roger, 1861. *Leptogenys laeviceps* (Smith, 1857), **stat. ressur.** рассматривается в качестве самостоятельного вида. *Leptogenys birmana* Forel, 1900, *L. chinensis* (Mayr, 1870), *L. dentilobis* Forel, 1900, *L. kitteli* Mayr, 1870 и *L. laeviceps* (Smith, 1857) впервые указываются для Непала. Дана определительная таблица непальских видов. Также приводится карта-схема распространения видов рода *Leptogenys* в Непале.

INTRODUCTION

Leptogenys Roger, 1861 is one of the most speciose ponerine ant genera distributed mostly in tropical and subtropical regions and comprises over 314 species and 15 subspecies (Bolton, 2021) with over a hundred of undescribed taxa (AntWeb, 2021). The type species of the genus is *Leptogenys falcigera* Roger, 1861, which was first recorded from Sri Lanka (Roger, 1861). Some of the notable contributions to the genus include Bolton (1975), Xu (2000), Lattke (2011), Zhou *et al.* (2012), Bharti & Wachkoo (2013), Rakotonirina & Fisher (2014), Xu & He (2015), Arimoto (2017), Sharaf *et al.* (2017), Wachkoo *et al.* (2018), Arimoto & Yamane (2018).

Only one valid species *Leptogenys diminuta* has been reported from Nepal. *Leptogenys sarasinorum* (or *L. diminuta sarasinorum*) previously reported from Nepal (Collingwood, 1970; Thapa, 2015; Subedi *et al.*, 2020) is currently considered to be a junior synonym of *L.*

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UDC 595.796(541.35)

FIRST RECORD OF THE ANT SUBGENUS *ORTHONOTOMYRMEX* OF THE GENUS *CAMPONOTUS* FROM NEPAL (HYMENOPTERA, FORMICIDAE)

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First Record of the Ant Subgenus *Orthonotomyrmex* of the Genus *Camponotus* from Nepal (Hymenoptera, Formicidae). Subedi, I. P., Budha, P. B., Bharti, H., Alonso, L., Yamane, S. — The ant subgenus *Orthonotomyrmex* Ashmead, 1906 of the genus *Camponotus* is reported for the first time from Nepal. Five species from this subgenus are recognized as new records for Nepal, namely *Camponotus mutilarius* Emery, 1893, *C. opaciventris* Mayr, 1879, *C. sericeus* (Fabricius, 1798), *C. lasiselene* Wang & Wu, 1994 and *C. selene* (Emery, 1889). An identification key to all known Nepalese species of *Camponotus* (*Orthonotomyrmex*) based on the worker caste is presented.
Key words: Ant survey, Himalaya, new record, pitfall, taxonomic notes.

Introduction

Camponotus Mayr, 1861 is the world largest ant genus comprising over 1053 species, 443 subspecies, and 31 fossil species (Bolton, 2021) with hundreds of undescribed taxa (AntWeb, 2021). This widespread genus is known from all biogeographical regions (Hölldobler & Wilson 1990; Bolton, 2021; AntWeb, 2021). In Nepal, only eight species belonging to five subgenera have been formally recorded for this genus (Subedi et al., 2020). Thus, our knowledge of this genus in Nepal is incomplete, with many more species expected to be documented as additional ant surveys are undertaken.

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First record of two Doryline ant genera *Cerapachys* Smith, 1857 and *Parasyscia* Emery, 1882 (Hymenoptera: Formicidae) from Nepal

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Abstract

The presence of two ant genera, *Cerapachys* Smith, 1857 and *Parasyscia* Emery, 1882 is reported for the first time in Nepal. We collected two workers of *Parasyscia wighti* (Bharti & Akbar, 2013) from Ranibari Community Forest and one worker of *Cerapachys sulcinodis* Emery, 1889 from Nagarjun forest using pitfall traps. With this discovery, the total number of Doryline ant genera of Nepal has reached to five. Synoptic account of these two genera, worker description of the species and identification keys to Nepalese genera of the subfamily Dorylinae are provided. Images of all known species representing full-face, dorsal and profile views are provided.

Keywords: *Army ants, Dorylinae, Nepalese ants, new records, petiole.*

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Introduction

Ants (Hymenoptera: Formicidae) are one of the world's most successful insect groups, dominating in population, geography and ecology (Hölldobler & Wilson, 1990). They can be found in almost all terrestrial environments, with the greatest diversity in tropical areas (Guénard, 2013). Ants are frequently regarded as superorganisms due to their dominance in the environment (Hölldobler & Wilson, 2009). Ants have been classified into 17 subfamilies, 338 genera, and 13,981 species (Bolton, 2021), with thousands of undescribed taxa. Nepal has eight subfamilies, 48 genera, and 133 species formally recorded (Subedi *et al.*, 2020; 2021), but given the country's unique geography and ecological diversity with large unexplored areas, this figure is far from a complete list and many ant species have yet to be identified and described.

Dorylinae includes a monophyletic group of predatory ants found in tropical, subtropical, and warm temperate regions of the world (Borowiec, 2016) with 27 valid genera and 735 species (Bolton, 2021). Within the subfamily, these ants are highly diverse in both habits, morphology, nesting sites (subterranean or arboreal nests), and colony size, with a few dozen to millions of workers in a colony (Borowiec, 2016). Workers are either blind or have small to well-developed compound eyes, have short and long slender appendages, and coarse to shiny cuticle. Army ants are a fascinating group of organisms characterized by morphological and behavioral adaptations such as obligate collective foraging, nomadism and highly specialized queens (Brady, 2003; Brady *et al*., 2014). Borowiec (2019) revealed through phylogenetic studies that the army ants syndrome exemplifies both long-term evolutionary stasis and a remarkable case of convergent evolution. Dorylinae includes a variety of ants in addition to true army ants, which were previously kept in the subfamilies Cerapachyinae and Leptanilloidinae before the study of Brady *et al.* (2014). Borowiec (2016)

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Research Article

ANT GENUS *Tetraponera* SMITH, 1852 IN NEPAL, WITH TWO NEW RECORDS AND KEYS TO WORKERS (FORMICIDAE: PSEUDOMYRMECINAE)

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ABSTRACT

Tetraponera Smith, 1852 is one of the least studied ant genera in Nepal, with only four known species. A taxonomic study was carried out on Nepalese *Tetraponera* collected mostly from forested habitats ranging in elevation from 98 to 1400 m above sea level using pitfall trapping, baiting, beating low vegetation and hand collecting. The study reports four species – *Tetraponera aitkenii* (Forel, 1902) and *T. difficilis* (Emery, 1900) of *nigra* group as the first record, and *T. allaborans* (Walker, 1859) of *allaborans* group, and *T. rufonigra* (Jerdon, 1851) of *rufonigra* group as new distribution records for Nepal bringing the total number of known species to six. Taxonomic as well as distribution notes for all four species recorded in this study, and a distribution map of all Nepalese species, are provided. An identification key for Nepalese *Tetraponera* workers is also presented.

Keywords: Arboreal ants, distribution, Himalaya, species description, taxonomic notes

INTRODUCTION

The subfamily Pseudomyrmecinae constitutes a distinctive assemblage of large-eyed, slender, active and arboreal ants. They are widespread in the old and new world tropics (Ward, 2001). The subfamily includes three genera; a paleotropical *Tetraponera*, a neotropical and nearctic *Pseudomyrmex* and a south American *Myrcidris* (Ward, 1990; Ward & Downie, 2005). *Tetraponera* species are important in studying ant-plant interactions (Déjean *et al.*, 2008; Blatrix *et al.*, 2012; Kokolo *et al.*, 2019), biotic defense and toxicology (Qin *et al.*, 2017; Barassé *et al.*, 2019; Naephrai *et al.*, 2021), and nitrogen cycling endosymbiosis (Borm *et al.*, 2002; Stoll *et al.*, 2007).

Tetraponera workers may be diagnosed by the following character states: Usually monomorphic; mandible with distinct masticatory and basal margins, 3-6 teeth in masticatory and 0-2 teeth in basal margins; median clypeal lobe continuous, broadly convex and non-truncate, usually with toothed or crenulate anterior margin; antennae 12-segmented; large compound eyes with width 2/3 or more than length; metanotal groove distinctly impressed; sting apparatus membranous (Ward, 1990).

The ant genus *Tetraponera* has 89 extant species and seven fossil species distributed throughout old world tropics (Bolton, 2022). Ward (2001) revised this genus from the Oriental and Australian regions, revealing 33 species divided into four species groups: *allaborans* (11 species), *nigra* (20 spp.), *pilosa* (1 sp.) and *rufonigra* (1 sp.). Other noteworthy publications on these ants includes generic revision (Ward, 1990), phylogeny and evolution (Ward & Downie, 2005), species group revision (Ward, 2006; Ward, 2009), and regional keys for India (Bharti & Akbar, 2014) and China (Xu & Chai, 2004).

The earliest published record of *Tetraponera* species in Nepal, Collingwood (1970), includes two species, *Sima* (*Tetraponera*) *rufonigra* and *Sima* (*Tetraponera*) *allaborans*. Four Nepalese species, *Tetraponera allaborans* (Walker, 1859), *T. nigra* (Jerdon, 1851), *T. binghami* (Forel, 1902), and *T. rufonigra* (Jerdon, 1851) were mentioned in the Ward's comprehensive taxonomic revision of *Tetraponera* of Oriental and Australian regions (Ward, 2001). Thapa (2015) listed two *Tetraponera* species in his book, Insect diversity in Nepal. The most recent Nepalese ant checklist by Subedi *et al.* (2020) included four species along with new distribution record of *T. rufonigra* from Tanahun district. This paper reports two species, *Tetraponera aitkenii* (Forel, 1902) and *T. difficilis* (Emery, 1900) of *nigra* group as new records for Nepal bringing the total number of known species in the country to six. A brief worker diagnosis, morphometric measurements, and distribution of the species recorded in this study are provided. A dichotomous key to Nepalese *Tetraponera* workers is also presented.

MATERIALS AND METHODS

The specimens were collected in sporadic or systematic collections in different parts of Nepal applying different ant collection methods such as pitfall trapping, baiting, beating on lower vegetation, and handpicking in 2009, 2013, 2019 and 2020. Specific site location and collection dates are provided below in the specimens examined section. The point-mounted specimens were examined using a stereo zoom microscope (Coslab MSZ-115). Morphometric character measurements (in mm up to second decimal) of collected specimens were provided by using an ocular micrometer at 45× magnification. Images of profile and full face views were taken with a digital camera (Samsung SM-M625F). The point-mounted dry

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Research Article

Myrmicine ants of Nepal with six new records and updated species list (Hymenoptera: Formicidae: Myrmicinae)

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Abstract

Six ant species from the subfamily Myrmicinae are recorded as new to Nepal, namely *Myrmica rhytida* Radchenko & Elmes, 1999, *Myrmicaria brunnea* Saunders, 1842, *Pheidole nodus* Smith 1874, *Strumigenys godeffroyi* Mayr, 1866, *S. virgila* Bolton, 2000, and *Temnothorax wroughtonii* (Forel, 1904). The type locality, examined materials, worker diagnosis, and global distribution of each newly recorded species are provided, along with images of habitus in profile and head in full-face views. The list of 69 species of Myrmicine ants is provided with their province-specific distribution in Nepal.

Keywords: Checklist, Himalaya, Myrmicine ants, Provincial distribution, *Strumigenys*

1 | Introduction

Ants are the most diversified group of social insects, being the most common and ecologically dominant insects. Myrmicinae is the most successful of the 16 extant ant subfamilies in terms of ecological diversity and species richness, with 147 genera and 7075 extant species known throughout the world (Bolton 2022). Nepalese Myrmicine ants contain 21 genera and 63 species, making it the most diverse ant subfamily in the country, out of the 56 genera and 147 species of ants known from Nepal (Subedi et al. 2020; Subedi 2021; Subedi et al. 2021a, b, c; Subedi et al. 2022). The subfamily Myrmicinae, first described by Lepeletier de Saint-Fargeau in 1835, belongs to the Formicoid clade. The subfamily is divided into six monophyletic tribes on the basis of molecular phylogenetic studies (Ward et al. 2015). The members of this highly diverse subfamily inhabit all major terrestrial habitats and exhibit wide array of behaviors.

The Myrmicinae workers can be identified by a combination of the following characteristics (see Bolton (1994) for complete diagnosis): clypeus reduced, frontal lobes usually present and expanded laterally covering antennal sockets, eyes usually present, antenna 4–12 segmented, promesonotal suture absent (pronotum and mesonotum fused into a single plate), waist two-segmented (petiole and postpetiole). The five biggest genera, *Pheidole, Strumigenys, Crematogaster, Tetramorium* and *Temnothorax* account for more than half of the species of the subfamily Myrmicinae (Borowiec et al. 2020; Bolton 2022). All of these richly speciose genera have also been found in Nepal (Subedi et al. 2021c). This study reports one species each of *Myrmica*, *Myrmicaria, Pheidole*, and *Temnothorax*, and two species of *Strumigenys* as new records for Nepal.

Collingwood (1970) first provided the list of 34 species ants of Nepal which was later updated to 128 ant species, including 63 species of Myrmicinae (Subedi et al. 2020). However, this list is still incomplete. Nepal is predicted to have a high species diversity due to its unique geographical and ecological setting, but despite these efforts, ant fauna of the country is still massively underexplored and majority of species, yet to be known. So, it is presumable that several species exist in Nepal