

**TAXONOMIC STUDIES ON THE FAMILY MUTILLIDAE
(HYMENOPTERA: VESPOIDEA) OF CENTRAL AND SOUTHERN
WESTERN GHATS AND IT'S ADJACENT AREAS**

*Thesis submitted to the University of Calicut in partial fulfilment
of the requirements for the award of the degree of*

DOCTOR OF PHILOSOPHY IN ZOOLOGY

BY

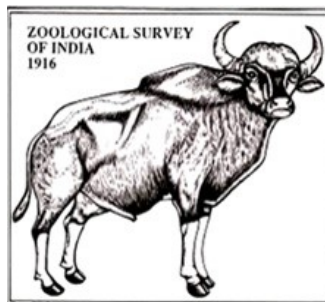
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**ZOOLOGICAL SURVEY OF INDIA
WESTERN GHAT REGIONAL CENTRE
KOZHIKODE
MARCH 2025**



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Ministry of Environment, Forest & Climate Change

ദാമത ജന്തുശാസ്ത്ര പഠനവേദക
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CERTIFICATE

This is to certify that this thesis entitled "TAXONOMIC STUDIES ON THE FAMILY MUTILLIDAE (HYMENOPTERA: VESPOIDEA) OF CENTRAL AND SOUTHERN WESTERN GHATS AND IT'S ADJACENT AREAS" submitted to the University of Calicut for the award of the degree of Doctor of Philosophy in Zoology (Faculty of Science), is an authentic research work done by **Mr. Terine Joshua Benjamin** from Zoological Survey of India, Western Ghat Regional Centre, Kozhikode, under my supervision and guidance. This work has not been previously formed the basis for any other degree, diploma or similar titles.

It is further certified that the candidate has passed the Ph. D. qualifying examination of the University of Calicut held in December, 2020.

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DECLARATION

I hereby declare that the work presented in the thesis entitled “**TAXONOMIC STUDIES ON THE FAMILY MUTILLIDAE (HYMENOPTERA: VESPOIDEA) OF CENTRAL AND SOUTHERN WESTERN GHATS AND IT’S ADJACENT AREAS**” is based on the original work done by me under the guidance of Dr. Girish Kumar P., Scientist–D, Zoological Survey of India, Western Ghat Regional Centre, Kozhikode, and has not been included in any other thesis submitted previously for the award of any degree. The contents of the thesis are undergone plagiarism check using **iThenticate** software at C.H.M.K. Library, University of Calicut, and the similarity index found within the permissible limit. I also declare that the thesis is free from AI generated contents.

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Date: *25/03/2025*

ACKNOWLEDGEMENTS

With immense gratitude, I sincerely thank all the exceptional individuals who played a crucial role in the successful completion of my Ph.D.

First and foremost, I would express my deepest and heartfelt indebtedness to my mentor and guide Dr. Girish Kumar P., Scientist-D, Zoological Survey of India (ZSI), Western Ghat Regional Centre (WGRC), Kozhikode. His unwavering patience, motivation, expert guidance, and timely assistance have been invaluable. His continuous encouragement and insightful suggestions throughout my study were instrumental in advancing my research. I regard his mentorship as a rare privilege and consider his support a key factor in the success of this journey.

My deepest respect and gratitude to Dr. Dhriti Banerjee, Director, Zoological Survey of India, Kolkata, Dr. V. D. Hegde, Scientist-F and Officer-in-Charge at the Zoological Survey of India, Western Ghat Regional Centre, Kozhikode, Dr. Kailash Chandra, former Director, Zoological Survey of India, Kolkata and Dr. P.M. Sureshan, Scientist-Emeritus and former Officer-in-Charge, Zoological Survey of India, Western Ghat Regional Centre, Kozhikode. I am truly grateful for their unwavering support and the exceptional research environment provided, which were pivotal in the successful completion of my Ph.D. work.

I would like to express my heartfelt gratitude to the Research Advisory Committee (RAC) members, Dr. M. Nasser (Former Subject Expert), Former Pro-Vice Chancellor and Professor (retd.), Department of Zoology, University of Calicut; Dr. Sabu K. Thomas (Subject Expert), Director, UGC-HRDC, and Professor, Department of Zoology, University of Calicut; Dr. Y. Shibu Vardhanan, (VC nominee), Professor, Department of Zoology, University of Calicut and Dr. C.C. Harilal (Dean, Faculty of Science), Professor, Department of Botany, University of Calicut for their invaluable comments, suggestions and support during the research period. I'm also grateful to Dr. P.K. Prasad (Professor (Retd.), Department of Zoology, Kannur University) for serving as the external examiner for my Preliminary Qualifying Examination (PQE) and the Viva-Voce, as well as Dr. U.K.A. Saleem, Associate Professor, Govt. Arts and Science College, Meenchanda, Kozhikode for serving as the external examiner for the JRF to SRF upgradation assessment. Additionally, I acknowledge the authorities of the University of Calicut for permitting me to undertake this research by means of Ph. D., as well as, the financial support provided by the Council of Scientific and Industrial Research (CSIR), Government of India, New Delhi through CSIR-JRF fellowship (09/1297(0002)/2019-EMR-I).

I am deeply grateful to Dr. Arkady S. Lelej (Principal Investigator, Federal Scientific Center of the East Asia Terrestrial Biodiversity, Russia), Dr. Kevin A. Williams (Associate Insect Biosystematist, California Department of Food and Agriculture, USA), and Dr. Denis J. Brothers (Professor Emeritus, University of KwaZulu-Natal, Durban, South Africa) for their invaluable insights, generous knowledge sharing, and collaborative support.

I thank Dr. Gavin Broad (Principal Curator (Hymenoptera)) and the Trustees of the Natural History Museum, Cromwell Road, London, UK, and Dr. James Hogan (collection manager of the Lepidoptera and Hymenoptera section), and Trustees of the Oxford University Museum of Natural History, UK, for providing digital loan of type specimens.

My heartfelt gratitude goes to Dr. Bindu L. (Scientist-E, ZSI, Kozhikode), Dr. Sheela S. (Scientist-E & Officer-in-Charge, Central Entomology Laboratory, ZSI, Kolkata), Dr. K. Rajmohana (Scientist-E & Officer-in-Charge, Isoptera Section, ZSI, Kolkata), Dr. A. Rameshkumar (Scientist-D and Officer-in-Charge, Hymenoptera Section, ZSI, Kolkata), Dr. K.A. Subramanian (Scientist-F & Officer-in-Charge, ZSI, SRC, Chennai), Dr. K.G. Emiliyamma (Scientist-E (Retd.), ZSI, Kolkata), Dr. B.H.C.K. Murthy (Scientist-D (Retd.), ZSI, Kozhikode), Dr. Mohammed Jafer Palot (Scientist-C, ZSI, Kozhikode), Dr. Souvik Sen (Scientist-E, ZSI, Kolkata), Dr. M. Kamalakannan (Scientist C, ZSI, Kolkata), Mr. Sreejith S. Kumar (Assistant Zoologist, ZSI, Kozhikode), Mr. Amal S. (Senior Zoological Assistant, ZSI, Kozhikode) and Dr. Dipanwita Das (Senior Zoological Assistant, ZSI, Kolkata) for their support.

I thank Mr. Ratnakaran, P. (Jr. A.O. (Retd.), ZSI, Kolkata), Mr. Sakthi, P.P. (UDC, ZSI, SRC, Chennai), Mrs. Smitha Jose (UDC, ZSI, Kozhikode), Ms. Devu S. Nair (MTS, ZSI, Kozhikode), Ms. Pooja, U. (MTS, ZSI, Kozhikode), and Mrs. Sujitha, V.V. (Data Entry Operator, ZSI, Kozhikode) for all the administrative and technical support they provided.

I thank Mr. Madhavan, M. (Field Collector (Retd.), ZSI, Kozhikode), Mr. V. Manikantan Nair (Motor Driver (Retd.), ZSI, Kozhikode), Mr. Charesh C. (former Laboratory Attendant, ZSI, Kozhikode), Mr. Surendran (Driver, ZSI, Kozhikode), and Mr. Dinesan, K.A. (Field Attendant, ZSI, Kozhikode), for their help in specimen collections. I extend my gratitude to Mr. Valsan M. (Security, ZSI, Kozhikode), Mr. Hareesh C. (Security, ZSI, Kozhikode), Mr. Santhosh Kumar M.K. (Electrician, ZSI, Kozhikode), Mr. Sugunan E.P. (STP operator, ZSI, Kozhikode) and Mrs. Divya Velayudhan (Housekeeping staff, ZSI, Kozhikode) for their support.

Also, it is my pleasure to extend my sincere words of gratitude to my colleagues, Dr. Kashmeera N. A. (Assistant Professor, Dr. Hari Singh Gour Vishwavidyalaya, Sagar, Madya Pradesh), Dr. Prabitha Mohan (former PDF, ZSI, Kozhikode), Dr. Sobhana K.A. (former PDF, ZSI, Kozhikode), Dr. Ayisha Mawadda N.V. (Former SRF, ZSI, Kozhikode), Dr. Tessy Rajan (Former SRF, ZSI, Kozhikode), Dr. Anagha S. (Former SRF, ZSI, Kozhikode), Dr. Swafvan Kananchery (former SRF, ZSI, Kozhikode), Mrs. Hanima Raveendran K.P. (Former SRF, ZSI, Kozhikode), Dr. C. Binoy (Former SRF, University of Calicut), Mrs. Kamila A.P. (SRF, ZSI, Kozhikode), Mr. Viswanath T.K. (SRF, ZSI, Kozhikode), Ms. Surya K.S. (SRF, ZSI, Kozhikode), Mr. Nazurius Anand (SRF, ZSI, Kolkata), Ms. Theertha P.V. (SRF, ZSI, Kolkata), Ms. Sushama V. (SRF, ZSI, Kolkata), Dr. Vasanth, M. (Former SRF, ZSI, Chennai) and Mrs. Jwala, R. (SRF, ZSI, Kozhikode).

I am grateful to the forest officials of Karnataka, Kerala, and Tamil Nadu for granting necessary collection permissions. My sincere thanks also go to the dedicated watchers who guided me through the forests during specimen collection. Additionally, I extend my appreciation to Mr. David Raju (Naturalist & Managing Director, Wayanad Wild- CGH Earth, Vythiri) for his generous hospitality and permission to collect specimens from their areas.

I extend my sincere gratitude to Dr. Jiji Joseph V. (Professor, Brennen College, Thalassery) for permitting me to use stereoscopic imaging microscope and Mr. Saroop K.P. (SRF, Brennen College, Kannur) for helping me to take images using stereoscopic imaging microscope.

I thank my teachers Dr. Mary Anithalatha S. (Former HOD, Department of Zoology, Malabar Christian College, Kozhikode), Dr. Lambert Kishore (Former HOD, Department of Zoology, Malabar Christian College, Kozhikode), Dr. Mohammed Rafeeq A.P.M. (Former HOD, Department of Zoology, Malabar Christian College, Kozhikode), Dr. Ranjini K.R. (Associate Professor, Department of Zoology, Malabar Christian College, Kozhikode), Dr. Sachin P. James (Assistant Professor & Principal, Malabar Christian College, Kozhikode), Dr. Santhosh Shreevihar (Assistant Professor & HOD, Department of Zoology, Malabar Christian College, Kozhikode), Mr. Vineesh Sebastian (Assistant Professor, Nirmalagiri College, Kuthuparamba), Mr. Kiran Kumar Radheyam (Director, Life Science Academy, Kuthuparamba) and Mr. Deepak M.S. (Director, Life Science Academy, Kuthuparamba).

I am deeply grateful to my parents, Mr. Reginold Gilson Para and Mrs. Beena Benjamin, and my sister Ms. Telma Reginold for their immense support, trust, patience, and love throughout these years.

I thank my friends Mr. Sharun V., Mr. Aswanth R.A., Mr. Amal S., Mr. Charesh C., Ms. Aishwarya, Ms. Suhada A., Mr. Sangeeth K., Ms. Dhriya P., Mr. Appu Jayaram, Mr. Abhinand K.K., Ms. Haripriya Baburaj, Mrs. Dilna M.T., Ms. Manjima Baburaj, Mrs. Manju Rolant, Mr. Rolant M.U., Mr. Jismon Jose, Mrs. Shyama P., Ms. Dinsha P.K., Mr. Viswanath T.K., Mr. Saroop K.P., Mrs. Kamila A.P., Ms. Aneena, Mr. Arooj T., Mr. Dej Vignesh & Ms. Lishiba P.P. for uplifting me during my lows, generous help, and valuable suggestions. Special thanks to Mr. Charesh C. for the cover page design.

I thank Mr. Shylesh (Digital Image, Calicut) for printing and layout setting of this thesis.

Finally, I deeply thankful to each mutillids that gave its life for this research, contributing to the advancement of scientific knowledge and a deeper understanding of their world.

Terine Joshua Benjamin

*Look deep into nature and
you will understand
everything better*

Albert Einstein

CONTENTS

PAGE NO.

1. INTRODUCTION

1.1. Taxonomy	1
1.2. Hymenoptera	2
1.3. Vespoidea	2
1.4. Mutillidae	2-3
1.5. Scope and significance of the present study	3-4
1.6. Thesis Objectives	4

2. REVIEW OF LITERATURE5-16

3. MATERIALS AND METHODS

3.1. Study area: Central, and Southern Western Ghats and its adjacent areas	17
3.2. Collection Methods	18-19
3.2.1. Active collection methods	18
3.2.1.1. Hand Picking	18
3.2.1.2. Sweep Nets	18
3.2.2. Passive collection methods	18-19
3.2.2.1. Moericke Trap	18-19
3.2.2.2. Malaise Trap	19
3.3. Collection Equipment	19-20
3.4. Preservation in Alcohol	20
3.5. Processing	20
3.6. Sorting	20
3.7. Relaxing	20
3.8. Mounting and Pinning	20-21
3.9. Labelling and Registering	21
3.10. Identification	21-22
3.11. Preservation	22

3.12. Illustrations and Measurements	22
3.13. Morphological Terms	22–25
3.14. Abbreviations	
3.14.1. Abbreviations used for Morphological terms	25
3.14.2. Abbreviations used for the Museums	25–26
3.15. Digital loan of Specimens	26
3.16. Collection localities	26–27
Plates.....	28–34

4. RESULTS

Chapter 1. Family Mutillidae	35
1.1. General Morphology	35
1.2. Systematic Position	35–36
1.3. Key to the Indian subfamilies of Mutillidae	37–38
Chapter 2. Subfamily MYRMOSINAE Fox, 1894	39–47
I. Genus <i>Kudakrumia</i> Krombein, 1979	39
i. <i>Kudakrumia mirabilis</i> Krombein, 1979	40–42
ii. <i>Kudakrumia rangnekari</i> Girish Kumar & Lelej, 2019	42–43
Plates	44–47
Chapter 3. Subfamily MUTILLINAE Latreille, 1802	48–174
I. Tribe Ctenotillini Brothers & Lelej, 2017	49
I. Genus <i>Cephalotilla</i> Bischoff, 1920	49–50
i. <i>Cephalotilla (Cephalotilla) manikandani</i> Terine, Lelej & Girish Kumar, 2024	50–52
Plate	53–54
II. Tribe Zeugomutillini Waldren, 2023	55
I. Genus <i>Strangulotilla</i> Nonveiller, 1979	55–56
i. <i>Strangulotilla sureshani</i> Terine, Lelej & Girish Kumar, 2021	56–57
Plate	58–60
II. Genus <i>Zeugomutilla</i> Chen, 1957	61
i. <i>Zeugomutilla bainbriggei</i> (Turner, 1911)	62–63

ii. <i>Zeugomutilla spinulosa</i> (André, 1898)	63–65
Plates	66–68
III. Tribe Smicromyrmini Bischoff, 1920	69
I. Genus <i>Andreimyrmex</i> Lelej, 1995	71
i. <i>Andreimyrmex paniya</i> Terine, Lelej & Girish Kumar, 2021	72–73
Plate	74–75
II. Genus <i>Nemka</i> Lelej, 1985	76
i. <i>Nemka horai</i> (Hammer, 1962)	77–78
ii. <i>Nemka pondicherensis</i> (Sichel and Radoszkowski, 1870)	78–79
Plates	80–82
III. Genus <i>Promecilla</i> André, 1902	83
i. <i>Promecilla pulchriventris</i> (Cameron, 1892)	84–86
ii. <i>Promecilla regia</i> (Smith, 1855)	86–88
iii. <i>Promecilla yerburghi</i> (Cameron, 1892)	88–91
Plates	92–96
IV. Genus <i>Smicromyrme</i> Thomson, 1870	97
i. <i>Smicromyrme bicolor</i> Hammer, 1962	98–99
ii. <i>Smicromyrme durga</i> (Bingham, 1897)	99–100
iii. <i>Smicromyrme nigrigena</i> (André, 1894)	100–102
iv. <i>Smicromyrme (Eremotilla) neglecta</i> Hammer, 1962	102–103
v. <i>Smicromyrme (Eremotilla) ocellata</i> (Saussure, 1867)	103–104
vi. <i>Smicromyrme (Eremotilla) sexmaculatus</i> Hammer, 1962	105–106
vii. <i>Smicromyrme (Eremotilla) williamsi</i> Terine & Girish Kumar, 2023	106–107
Plates	108–115
IV. Tribe Mutillini Latreille, 1802	116
I. Genus <i>Kurzenkotilla</i> Lelej, 2005	116–117
i. <i>Kurzenkotilla cicatricifera</i> (André, 1894)	118–119
Plate	120–121
II. Genus <i>Storozhenkotilla</i> Lelej, 2005	122

i. <i>Storozhenkotilla aurofasciata</i> (André, 1907)	123–125
ii. <i>Storozhenkotilla binghami</i> (Lelej, 2005)	125–126
Plates	127–129
V. Tribe Trogaspidiini Bischoff, 1920	130
I. Genus <i>Karlissaidia</i> Lelej, 2005	132
i. <i>Karlissaidia nana</i> (Hammer, 1962)	133
ii. <i>Karlissaidia sexmaculatus</i> (Swederus, 1787)	134–136
Plates	137–140
II. Genus <i>Krombeinidia</i> Lelej, 1996	141
i. <i>Krombeinidia agnata</i> (André, 1894)	142–143
ii. <i>Krombeinidia albopunctata</i> (André, 1907)	143–145
iii. <i>Krombeinidia lilliputiana</i> (André, 1894)	145–147
Plates	148–152
III. Genus <i>Trogaspidia</i> Ashmead, 1899	153
i. <i>Trogaspidia agelia</i> (Cameron, 1900)	154–156
ii. <i>Trogaspidia aulica</i> (Smith, 1855)	156–157
iii. <i>Trogaspidia intermedia</i> (Saussure, 1867)	158–159
iv. <i>Trogaspidia kolabensis</i> (André, 1894)	159–161
v. <i>Trogaspidia pulchriceps</i> (Cameron, 1892)	161–162
vi. <i>Trogaspidia ruficrus</i> (Magretti, 1892)	162–164
vii. <i>Trogaspidia villosa</i> (Fabricius, 1775)	164–166
Plates	167–174
Chapter 4. Subfamily MYRMILLINAE Bischoff, 1920	175–199
I. Genus <i>Bischoffitilla</i> Lelej, 2002	176
i. <i>Bischoffitilla serratula</i> (Cameron, 1892)	177–178
ii. <i>Bischoffitilla smithi</i> Lelej, 2005	178–180
iii. <i>Bischoffitilla veda</i> (Cameron, 1892)	180–181
Plates	182–185
II. Genus <i>Brahmatilla</i> Lelej, 2005	186

i. <i>Brahmatilla krishna</i> Lelej, 2005	186–188
Plate	189–190
III. Genus <i>Spilomutilla</i> Ashmead, 1903	191
i. <i>Spilomutilla eltola</i> (Cameron, 1898)	193–194
ii. <i>Spilomutilla cotesii</i> (Cameron, 1897)	195–196
Plates	197–199
Chapter 5. Subfamily Odontomutillinae Lelej, 1983	200–211
I. Genus <i>Odontomutilla</i> Ashmead, 1899	200
i. <i>Odontomutilla pulchrina</i> (Smith, 1855)	203–204
ii. <i>Odontomutilla sairandhriensis</i> Terine, Girish Kumar & Lelej, 2020	204–206
iii. <i>Odontomutilla vishwanathi</i> Terine & Girish Kumar, 2024	206–207
Plates	208–211
Chapter 6. Subfamily TICOPLINAE Nagy, 1970	212–221
VI. Tribe Smicromyrmillini Argaman, 1988	212
I. Genus <i>Eosmicromyrmilla</i> Lelej & Krombein, 2001	212–213
i. <i>Eosmicromyrmilla balakrishnani</i> Terine, Lelej & Girish Kumar, 2021	213–215
ii. <i>Eosmicromyrmilla subbuka</i> Terine, Lelej & Girish Kumar, 2021	215–216
Plates	217–221
Chapter 7. Subfamily Rhopalomutillinae Schuster, 1949	222–225
I. Genus <i>Pherotilla</i> Brothers, 2015	222
i. <i>Pherotilla subterranea</i> Terine & Girish Kumar, sp. nov.	222–223
Plate	224–225
5. SUMMARY AND CONCLUSION	226–228
5.1. New species	226–227
5.2. New country records	227
5.3. New state records	227–228
5.3.1. Karnataka	227

5.3.2. Kerala	227
5.3.3. Tamil Nadu	228
5.4. Future Prospects	228
6. REFERENCES	229–242

LIST OF PLATES

	PAGE NO.
1. Collection methods	28
2. Morphological terms	29
3. Morphological terms	30
4. Morphological terms	31
5. Morphological terms	32
6. Morphological terms	33
7. Morphological terms	34
8. Species distribution of the genus <i>Kudakrumia</i> Krombein from Central and Southern Western Ghats and it's adjacent areas	44
9. <i>Kudakrumia mirabilis</i> Krombein, 1979 (male)	45
10. <i>Kudakrumia mirabilis</i> Krombein, 1979 (female)	46
11. <i>Kudakrumia rangnekari</i> Girish Kumar & Lelej, 2019 (male)	47
12. Species distribution of the genus <i>Cephalotilla</i> Bischoff from Central and Southern Western Ghats and it's adjacent areas	53
13. <i>Cephalotilla (Cephalotilla) manikandani</i> Terine, Lelej & Girish Kumar, 2024 (female)	54
14. Species distribution of the genus <i>Strangulotilla</i> Nonveiller from Central and Southern Western Ghats and it's adjacent areas	58
15. <i>Strangulotilla sureshani</i> Terine, Lelej & Girish Kumar, 2021 (male)	59
16. <i>Strangulotilla sureshani</i> Terine, Lelej & Girish Kumar, 2021 (male)	60
17. Species distribution of the genus <i>Zeugomutilla</i> Chen from Central and Southern Western Ghats and it's adjacent areas	66
18. <i>Zeugomutilla bainbriggei</i> (Turner, 1911) (female)	67
19. <i>Zeugomutilla spinulosa</i> (André, 1898) (female)	68
20. Species distribution of the genus <i>Andreimyrmex</i> Lelej from Central and Southern Western Ghats and it's adjacent areas	74
21. <i>Andreimyrmex paniya</i> Terine, Lelej & Girish Kumar, 2021 (female)	75
22. Species distribution of the genus <i>Nemka</i> Lelej from Central and Southern Western	80

Ghats and it's adjacent areas	
23. <i>Nemka horai</i> (Hammer, 1962) (female)	81
24. <i>Nemka pondicherensis</i> (Sichel and Radoszkowski, 1870) (female)	82
25. Species distribution of the genus <i>Promecilla</i> André from Central and Southern Western Ghats and it's adjacent areas	92
26. <i>Promecilla pulchriventris</i> (Cameron, 1892) (female)	93
27. <i>Promecilla regia</i> (Smith, 1855) (female)	94
28. <i>Promecilla yerburghi</i> (Cameron, 1892) (female)	95
29. <i>Promecilla yerburghi</i> (Cameron, 1892) (male)	96
30. Species distribution of the genus <i>Smicromyrme</i> Thomson from Central and Southern Western Ghats and it's adjacent areas	108
31. <i>Smicromyrme bicolor</i> Hammer, 1962 (female)	109
32. <i>Smicromyrme durga</i> (Bingham, 1897) (female)	110
33. <i>Smicromyrme nigrigena</i> (André, 1894) (female)	111
34. <i>Smicromyrme (Eremotilla) neglecta</i> Hammer, 1962 (female)	112
35. <i>Smicromyrme (Eremotilla) ocellata</i> (Saussure, 1867) (female)	113
36. <i>Smicromyrme (Eremotilla) sexmaculatus</i> Hammer, 1962 (female)	114
37. <i>Smicromyrme (Eremotilla) williamsi</i> Terine & Girish Kumar, 2023 (female)	115
38. Species distribution of the genus <i>Kurzenkotilla</i> Lelej from Central and Southern Western Ghats and it's adjacent areas	120
39. <i>Kurzenkotilla cicatricifera</i> (André, 1894) (female)	121
40. Species distribution of the genus <i>Storozhenkotilla</i> Lelej from Central and Southern Western Ghats and it's adjacent areas	127
41. <i>Storozhenkotilla aurofasciata</i> (André, 1907) (male)	128
42. <i>Storozhenkotilla binghami</i> (Lelej, 2005)	129
43. Species distribution of the genus <i>Karlissaidia</i> Lelej from Central and Southern Western Ghats and it's adjacent areas	137
44. <i>Karlissaidia nana</i> (Hammer, 1962) (female)	138
45. <i>Karlissaidia sexmaculatus</i> (Swederus, 1787) (female)	139
46. <i>Karlissaidia sexmaculatus</i> (Swederus, 1787) (male)	140

47. Species distribution of the genus <i>Krombeinidia</i> Lelej from Central and Southern Western Ghats and it's adjacent areas	148
48. <i>Krombeinidia agnata</i> (André, 1894) (female)	149
49. <i>Krombeinidia albopunctata</i> (André, 1907) (female)	150
50. <i>Krombeinidia lilliputiana</i> (André, 1894) (female)	151
51. <i>Krombeinidia lilliputiana</i> (André, 1894) (male)	152
52. Species distribution of the genus <i>Trogaspidia</i> Ashmead from Central and Southern Western Ghats and it's adjacent areas	167
53. <i>Trogaspidia agelia</i> (Cameron, 1900) (female)	168
54. <i>Trogaspidia aulica</i> (Smith, 1855) (female)	169
55. <i>Trogaspidia intermedia</i> (Saussure, 1867) (female)	170
56. <i>Trogaspidia kolabensis</i> (André, 1894) (female)	171
57. <i>Trogaspidia pulchriceps</i> (Cameron, 1892) (female)	172
58. <i>Trogaspidia ruficrus</i> (Magretti, 1892) (female)	173
59. <i>Trogaspidia villosa</i> (Fabricius, 1775) (female)	174
60. Species distribution of the genus <i>Bischoffitilla</i> Lelej from Central and Southern Western Ghats and it's adjacent areas	182
61. <i>Bischoffitilla serratula</i> (Cameron, 1892) (female)	183
62. <i>Bischoffitilla smithi</i> Lelej, 2005 (female)	184
63. <i>Bischoffitilla veda</i> (Cameron, 1892) (female)	185
64. Species distribution of the genus <i>Brahmatilla</i> Lelej from Central and Southern Western Ghats and it's adjacent areas	189
65. <i>Brahmatilla krishna</i> Lelej, 2005 (female)	190
66. Species distribution of the genus <i>Spilomutilla</i> Ashmead from Central and Southern Western Ghats and it's adjacent areas	197
67. <i>Spilomutilla eltola</i> (Cameron, 1898) (male)	198
68. <i>Spilomutilla cotesii</i> (Cameron, 1897) (female)	199
69. Species distribution of the genus <i>Odontomutilla</i> Ashmead from Central and Southern Western Ghats and it's adjacent areas	208
70. <i>Odontomutilla pulchrina</i> (Smith, 1855) (male)	209

71. <i>Odontomutilla sairandhriensis</i> Terine, Girish Kumar & Lelej, 2020 (female)	210
72. <i>Odontomutilla vishwanathi</i> Terine & Girish Kumar, 2024 (female)	211
73. Species distribution of the genus <i>Eosmicromyrmilla</i> Lelej & Krombein from Central and Southern Western Ghats and it's adjacent areas	217
74. <i>Eosmicromyrmilla balakrishnani</i> Terine, Lelej & Girish Kumar, 2021 (male)	218
75. <i>Eosmicromyrmilla balakrishnani</i> Terine, Lelej & Girish Kumar, 2021 (male)	219
76. <i>Eosmicromyrmilla subbuka</i> Terine, Lelej & Girish Kumar, 2021 (male)	220
77. <i>Eosmicromyrmilla subbuka</i> Terine, Lelej & Girish Kumar, 2021 (male)	221
78. Species distribution of the genus <i>Pherotilla</i> Brothers from Central and Southern Western Ghats and it's adjacent areas	224
79. <i>Pherotila subterranea</i> Terine & Girish Kumar, sp. nov. (female)	225

ABSTRACT

Family Mutillidae is commonly called “Velvet ants”. This family is represented by 216 genera with about 4,300 species worldwide (Noort & Broad, 2024). The males of mutillids are either macropterous, brachypterous, or apterous and females are apterous. Females are brightly colored with patterns of yellow/golden, orange, red, or white on black and often metallic colored. They also have very painful and potent stings and use bright colors as aposematic colorations. Sexual dimorphism is extreme in mutillids, gender association is only possible when caught in copulation pairs or by rearing. Mutillids are external parasitoids of enclosed larvae or pupae of other Hymenoptera, Diptera, Lepidoptera, Coleoptera, and Blattodea. Mutillidae have tough cuticles, this attribute helps them to escape from the stings of other wasps (Noort & Broad, 2024).

The present study attempts to uncover the mutillid fauna of the Central and Southern Western Ghats. The study resulted in documenting a total of 46 species belonging to 19 genera in 6 subfamilies of the family Mutillidae. Eight new species namely, *Andreimyrmex paniya* Terine, Lelej & Girish Kumar, 2021; *Cephalotilla (Cephalotilla) manikandani* Terine, Lelej & Girish Kumar, 2024; *Eosmicromyrmilla balakrishnani* Terine, Lelej & Girish Kumar, 2021 ; *Eosmicromyrmilla subbuka* Terine, Lelej & Girish Kumar, 2021; *Odontomutilla sairandhriensis* Terine, Girish Kumar & Lelej, 2020; *Odontomutilla vishwanathi* Terine & Girish Kumar, 2024; *Smicromyrmex (Eremotilla) williamsi* Terine & Girish Kumar, 2023 & *Strangulotilla sureshani* Terine, Lelej & Girish Kumar, 2021 were described and published from the study area. One species, *Pherotilla subterranea* sp. nov. is described as new in the thesis. Two genera, *Strangulotilla* Nonveiller, 1979 & *Andreimyrmex* Lelej, 1995 were recorded for the first time from India. Two species namely, *Krombeinidia albopunctata* (André, 1907) & *Spilomutilla eltola* (Cameron, 1898) were newly recorded from India. 13 species namely, *Bischoffitilla serratula* (Cameron, 1892); *Bischoffitilla smithi* Lelej, 2005; *Krombeinidia lilliputiana* (André, 1894); *Kurzenkotilla cicatricifera* (André, 1894); *Promecilla pulchriventris* (Cameron, 1892); *Promecilla yerburghi* (Cameron, 1892); *Smicromyrmex nigrigena* (André, 1894); *Spilomutilla cotesii* (Cameron, 1897); *Storozhenkotilla binghami* (Lelej, 2005); *Trogaspidia agelia* (Cameron, 1900); *Trogaspidia intermedia* (Saussure, 1867); *Trogaspidia ruficrus* (Magretti, 1892) & *Zeugomutilla bainbriggei* (Turner, 1911) were newly recorded from the Kerala state. Three species namely, *Bischoffitilla veda* (Cameron, 1892); *Smicromyrmex durga* (Bingham, 1897) & *Trogaspidia kolabensis* (André, 1894) were newly recorded from the Karnataka state. One species namely, *Promecilla pulchriventris* (Cameron, 1892) was newly recorded from the Tamil Nadu state. A dichotomous key to Indian subfamilies, genera, and species under each genus was provided. Diagnosis of species with distributional records was provided. Plates of photographs of all the examined species were prepared and provided. Coordinates using accurate GPS were noted for the collection site of mutillid specimens, and distribution maps were prepared using QGIS online software. The present study led to the publication of 10 international papers, two national papers, one book chapters and one online publication.

സംക്ഷിപ്തം

മ്യൂട്ടിലിഡേ (Mutillidae) കുടുംബത്തെ സാധാരണയായി “വെൽവെറ്റ് ഉറുമ്പുകൾ” എന്ന് വിളിക്കുന്നു. ലോകമെമ്പാടുമായി ഏകദേശം 4,300 ഇനങ്ങളുള്ള (species) 216 ജനുസുകളാണ് (genus) ഈ കുടുംബത്തെ (family) പ്രതിനിധീകരിക്കുന്നത് (നൂർട്ട് & ബ്രോഡ്, 2024). മ്യൂട്ടിലിഡുകളുടെ ആൺ വർഗ്ഗം ഒന്നുകിൽ മാക്രോപ്റ്ററസ് (macropterous), ബ്രാക്കിപ്റ്ററസ് (brachypterous) അല്ലെങ്കിൽ ആപ്റ്ററസ് (apterous) കളും പെൺ വർഗ്ഗം ആപ്റ്ററസ് (apterous) ഉം ആണ്. പെൺ വർഗ്ഗങ്ങൾക്ക് കറുപ്പിൽ കടും മഞ്ഞ/സ്വർണ്ണ നിറം, ഓറഞ്ച്, ചുവപ്പ് അല്ലെങ്കിൽ വെള്ള നിറങ്ങളിലുള്ള പാറ്റേണുകളും പലപ്പോഴും അവ ലോഹ നിറത്തിലും കാണപ്പെടുന്നു. കൂടാതെ അപ്പോസെമാറ്റിക് (aposematic) നിറങ്ങളായി കടും നിറങ്ങളും ഉപയോഗിക്കുന്നു. ഇവയുടെ കുത്തുകൾ വളരെ വേദനാജനകവും, ശക്തവുമാണ്. മ്യൂട്ടിലിഡുകളിൽ ലിംഗപരമായ വ്യത്യാസങ്ങൾ (sexual dimorphism) വളരെ പ്രകടമാണ്. ജോഡികൾ ഇണചേരുമ്പോഴോ, ഇവയെ വളർത്തുമ്പോഴോ (rearing) മാത്രമാണ് കൃത്യമായി ആൺ പെൺ ജോഡികളെ തിരിച്ചറിയാൻ സാധിക്കുന്നത്. മറ്റു കടന്നലുകളും തേനീച്ചകളും (Hymenoptera), ഈച്ചകൾ (Diptera), ശലഭങ്ങൾ (Lepidoptera), വണ്ടുകൾ (Coleoptera), പാറ്റകൾ (Blattodea) എന്നിവയുടെ അടഞ്ഞ ലാർവകളുടെയോ (enclosed larva) പ്യൂപ്പകളുടെയോ ബാഹ്യ പരന്ന ഭോജികളാണ് (external parasitoids) മ്യൂട്ടിലിഡുകൾ. മ്യൂട്ടിലിഡുകൾക്ക് വളരെ കട്ടിയുള്ള പുറം തൊലിയുണ്ട്. ഇത് മറ്റ് കടന്നലുകളുടെ കുത്തുകളിൽ നിന്ന് രക്ഷപ്പെടാൻ അവയെ സഹായിക്കുന്നു (നൂർട്ട് & ബ്രോഡ്, 2024).

മധ്യ- തെക്കൻ പശ്ചിമഘട്ടത്തിലെ മ്യൂട്ടിലിഡ് കടന്നലുകളുടെ വൈവിധ്യം കണ്ടെത്താനാണ് ഈ പഠനത്തിലൂടെ ശ്രമിക്കുന്നത്. മ്യൂട്ടിലിഡേ കുടുംബത്തിലെ 6 ഉപകുടുംബങ്ങളിലായി (subfamilies) 19 ജനുസുകളിൽപ്പെടുന്ന 46 ഇനങ്ങൾ ഈ പഠനത്തിന്റെ ഫലമായി കണ്ടെത്തി. ആന്ദ്രമിർമെ പണിയ ടെറിൻ, ലെലെജ് & ഗിരീഷ് കുമാർ, 2021 (*Andreimyrmex paniya* Terine, Lelej & Girish Kumar, 2021) സെഫാലോട്ടില്ല (സെഫാലോട്ടില്ല) മണികണ്ഠാനി ടെറിൻ, ലെലെജ് & ഗിരീഷ് കുമാർ, 2024 (*Cephalotilla (Cephalotilla) manikandani* Terine, Lelej & Girish Kumar, 2024), ഇയോസ്മിക്രോമിർമില്ല ബാലകൃഷ്ണനി ടെറിൻ, ലെലെജ് & ഗിരീഷ് കു

മാർ, 2021 (*Eosmicromyrmilla balakrishnani* Terine, Lelej & Girish Kumar, 2021), ഇയോസ്മിക്രോമിർമില്ല സുബ്ബുക ടെറിൻ, ലെലെജ് & ഗിരീഷ് കുമാർ, 2021 (*Eosmicromyrmilla subbuka* Terine, Lelej & Girish Kumar, 2021), ഒഡോന്റോമൂട്ടില്ല സൈരന്ദ്രിയൻസിസ് ടെറിൻ, ഗിരീഷ് കുമാർ & ലെലെജ്, 2020 (*Odontomutilla sairandhriensis* Terine, Girish Kumar & Lelej, 2020), ഒഡോന്റോമൂട്ടില്ല വിശ്വനാഥി ടെറിൻ & ഗിരീഷ് കുമാർ, 2024 (*Odontomutilla vishwanathi* Terine & Girish Kumar, 2024), സ്മൈക്രോമൈർമൈ (എറെമോട്ടില്ല) വില്യംസി ടെറിൻ & ഗിരീഷ് കുമാർ, 2023 (*Smicromyrme (Eremotilla) williamsi* Terine & Girish Kumar, 2023), സ്ത്രാങ്കുലോട്ടില്ല സുരേഷാനി ടെറിൻ, ലെലെജ് & ഗിരീഷ് കുമാർ, 2021 (*Strangulotilla sureshani* Terine, Lelej & Girish Kumar, 2021) എന്നിങ്ങനെ എട്ട് പുതിയ ഇനങ്ങളെ ഈ പഠനത്തിന്റെ ഭാഗമായി കണ്ടെത്തുകയും പ്രസിദ്ധീകരിക്കുകയും ചെയ്തു. ഫെറോട്ടില്ല സബ്ടെറേനിയ sp. nov. (*Pherotilla subterranean* sp. nov.) എന്ന ഒരു ഇനത്തെ ഈ പ്രബന്ധത്തിൽ പുതിയതായി വിവരിച്ചിരിക്കുന്നു. സ്ത്രാങ്കുലോട്ടില്ല നോൺവീലർ, 1979 (*Strangulotilla Nonveiller, 1979*), ആൻഡ്രിമിർമൈ ലെലെജ്, 1995 (*Andreimyrme Lelej, 1995*) എന്നീ രണ്ട് ജനുസുകൾ ഇന്ത്യയിൽ നിന്ന് ആദ്യമായി കണ്ടെത്തിയവയാണ്. ക്രോബൈനിഡിയ അൽബോപൻക്റ്റാറ്റ (ആൻഡ്രെ, 1907) (*Krombeinidia albopunctata* (André, 1907)), സ്പിലോമൂട്ടില്ല എൽറ്റോള (കാമറൺ, 1898) (*Spilomutilla eltola* (Cameron, 1898)) എന്നീ രണ്ട് ഇനങ്ങൾ ഇന്ത്യയിൽ നിന്ന് പുതുതായി കണ്ടെത്തിയവയാണ്. ബിഷോഫിറ്റില്ല സെറാറ്റുല (കാമറൺ, 1892) (*Bischoffitilla serratula* (Cameron, 1892)), ബിഷോഫിറ്റില്ല സ്മിതി ലെലെജ്, 2005 (*Bischoffitilla smithi* Lelej, 2005), ക്രോബൈനിഡിയ ലില്ലിപുട്ടിയന (ആന്ദ്രെ, 1894) (*Krombeinidia lilliputiana* (André, 1894)), കുർസെക്കോട്ടില്ല സികാട്രിഫെറ (ആന്ദ്രെ, 1894) (*Kurzenkotilla cicatricifera* (André, 1894), പ്രോമെസില്ല പുൾക്രിവെൻട്രിസ് (കാമറൺ, 1892) (*Promecilla pulchriventris* (Cameron, 1892)), പ്രോമെസില്ല യെർബർഗി (കാമറൺ, 1892) (*Promecilla yerburghi* (Cameron, 1892)), സ്മൈക്രോമൈർമൈ നിഗ്രിജന (ആന്ദ്രെ, 1894) (*Smicromyrme nigrigena* (André, 1894)), സ്പിലോമൂട്ടില്ല കോട്ടേസി (കാമറൺ, 1897) (*Spilomutilla cotesii* (Cameron, 1897)), സ്റ്റോറോഷെൻകോട്ടില്ല ബിംഗ്ഹാമി (ലെലെജ്, 2005) (*Storozhenkotilla binghami* (Lelej, 2005)), ട്രോഗാസ്പിഡിയ അജെലിയ (കാമറൺ, 1900) (*Trogaspidia agelia* (Cameron, 1900)), ട്രോഗാസ്പിഡിയ ഇന്റർമീഡിയ (സോസൂർ, 1867) (*Trogaspidia intermedia* (Saussure, 1867)), ട്രോഗാസ്പിഡിയ റൂഫി

ക്രസ് (മാഗ്രെറ്റി, 1892) (*Trogaspidia ruficrus* (Magretti, 1892)), സ്യൂഗോമൂട്ടില്ല ബെയിൻബ്രിഗ്ഗി (ടർണർ, 1911) (*Zeugomutilla bainbriggei* (Turner, 1911)) എന്നീ 13 ഇനങ്ങൾ കേരളത്തിൽ നിന്ന് പുതുതായി കണ്ടെത്തിയവയാണ്. ബിഷോഫിറ്റില്ല വേദ (കാമറൺ, 1892) (*Bischoffitilla veda* (Cameron, 1892)), സ്മിക്രോമിർമേ ദുർഗ (ബിംഗ്ഹാം, 1897) (*Smicromyrme durga* (Bingham, 1897)), ട്രോഗാസ്പിഡിയ കൊളാബെൻസിസ് (ആന്ദ്രേ, 1894) (*Trogaspidia kolabensis* (André, 1894)) എന്നീ 3 ഇനങ്ങൾ കർണ്ണാടകയിൽ നിന്ന് പുതുതായി കണ്ടെത്തിയതാണ്. പ്രോമെസില്ല പൾക്രിവെൻട്രിസ് (കാമറൺ, 1892) (*Promecilla pulchriventris* (Cameron, 1892)) എന്ന ഇനം തമിഴ്നാട്ടിൽ നിന്ന് പുതുതായി കണ്ടെത്തിയതാണ്. ഈ പഠനത്തിൽ ഇന്ത്യയിലെ ഉപകുടുംബങ്ങളേയും, ജനുസുകളേയും, ഇനങ്ങളേയും തിരിച്ചറിയുന്നതിനുള്ള ഡൈക്കോട്ടോമസ് കീകൾ (Dichotomous keys) നൽകിയിട്ടുണ്ട്. എല്ലാ ഇനങ്ങളേയും തിരിച്ചറിയാനുള്ള സവിശേഷ സ്വഭാവങ്ങളും അവയെല്ലാം ഏതെല്ലാം സ്ഥലങ്ങളിൽ കാണപ്പെടുന്നു എന്നതും രേഖപ്പെടുത്തിയിരിക്കുന്നു. പരിശോധിച്ച എല്ലാ ഇനങ്ങളുടെയും ഫോട്ടോഗ്രാഫുകൾ തയ്യാറാക്കിയിട്ടുണ്ട്. മ്യൂട്ടിലിഡ് സ്പെസിമനുകളുടെ കളക്ഷൻ സൈറ്റുകളും, ഡിസ്ട്രിബ്യൂഷൻ മാപ്പുകളും ക്യൂജിസ് (QGIS) സോഫ്റ്റ് വെയറിന്റെ സഹായത്തോടെ തയ്യാറാക്കി. ഈ പഠനത്തിൽ നിന്നും പത്ത് അന്തർദേശീയ പേപ്പറുകളും, രണ്ട് ദേശീയ പേപ്പറുകളും, ഒരു പുസ്തക അദ്ധ്യായവും, ഒരു ഓൺലൈൻ പ്രസിദ്ധീകരണവും ഇതിനകം ഉരുതിരിഞ്ഞു വന്നിട്ടുണ്ട്.

INTRODUCTION

1. INTRODUCTION

1.1. Taxonomy

Taxonomy is the fundamental and most inclusive part of science. It is essential because scientific discussion of any organism is impossible without a clear classification of that organism. Taxonomy in its various forms comprehends, organizes, and encompasses their morphology, physiology, and ecology for classifying and naming the organism (Simpson, 1945). The term “Taxonomy” originated from the Greek words “Taxis” and “nomos”, which means “arrangements” and “law” respectively (Mayr, 1971). The main objective of taxonomic studies and taxonomists is to record every species they encounter. However, for a taxonomist, to study even a single taxon and describe all undescribed species would take years (Bouchet, 2006). The systematic positioning of organisms guides the researchers and provides essential information about the taxon being studied, without these inputs on the taxon and its correct name, further research cannot be conducted effectively.

Studies have indicated that over 27,000 species perish from our planet every year, with one average is 74 species per day or roughly three species every hour (Wilson, 1992; Narendran, 2006), this rate is alarming. This again pronounces the need for taxonomists in every area of flora and fauna but still, the rate of work in taxonomy is scanty. Today taxonomy is majorly focused on vertebrates only, and the works on invertebrates is pushed to the grey areas. Funding for studies for the smaller invertebrates are much lesser compared to vertebrates. The number of taxonomists who work on smaller invertebrates are much less compared to the ones which works on vertebrates and also when compared to the diversity of invertebrates. The major impediments in invertebrate taxonomy are funding for work, lack of manpower and struggle to get the type images from museums across the world.

India is regarded as one of the megadiverse countries in the world, encompassing a wide variety of ecosystems, from deserts to evergreen forests, which host novel organisms with unique genes (Hariharan & Balaji, 2002). Cataloging the indigenous biodiversity of the country is an urgent necessity, especially considering the rate of species extinction. In India, taxonomic data remains scanty for many fauna and floral groups, which are crucial in maintaining ecological balance and overall biological diversity. One such group is Hymenoptera, an insect class that plays vital roles in pollination, predators, parasitoids, and seed dispersion.

1.2. Hymenoptera

Hymenoptera is the third largest insect order after Coleoptera and Lepidoptera with more than 1,50,000 described species (Aguiar et al., 2013). The word “Hymenoptera” comes from the Greek word “Hymen” means membranous and “Pteron” means wings. However, the term membranous wings are not informative because many other insect groups have membranous wings. The unique feature of Hymenoptera, which was their key evolutionary success, is the possession of an ovipositor. The wasps, bees and ants also possess a unique hook-like projection termed hamuli, which helps in wing coupling during flight (Noort & Broad, 2024). The order Hymenoptera is divided into two major suborders: Apocrita (with ants, bees and wasps) and Symphyta (with Saw flies, wood wasps and horn tails). The major difference between these two suborders is that Apocrita has a short or narrow connection between the propodeum and abdomen, but Symphyta has a broad connection between the propodeum and abdomen. Apocrita is further divided into Aculeata and Parasitica. Aculeata represents wasps with an ovipositor for stinging prey or enemies but rather Parasitica represents with ovipositor for egg-laying function. Aculeata is in turn divided into superfamilies Apoidea, Vespoidea and Chrysidoidea.

1.3. Vespoidea

This superfamily contains five large families (Formicidae, Mutillidae, Pompilidae, Tiphidae, and Vespidae) and five relatively small families (Bradynobaenidae, Rhopalosomatidae, Sapygidae, Scoliidae, and Sierolomorphidae) (Huber, 2009). Species of Vespoidea showcase a diverse array of behaviors, such as parasitoids, predators, scavengers and specialised phytophages. They exhibit a range of social structures, from solitary living to complex colonies. Notable behavioural and morphological caste differentiation is much pronounced in colonial forms. More than 48,000 species are described belong to Vespoidea (Goulet & Huber, 1993), mainly from tropical regions with more than 20,000 described species (Huber, 2009).

1.4. Mutillidae

Family Mutillidae are commonly called “Velvet ants”, because of their hairy appearance. This family is represented by 216 genera with about 4,300 species worldwide (Noort & Broad, 2024). The females of mutillids are apterous, and males are either macropterous, brachypterous or apterous. Females are brightly colored; patterns of yellow/golden, orange, red or white on black and often metallic colored forms are also seen. They also have very

painful and potent stings and use bright colors as aposematic colorations. *Dasymutilla occidentalis*, a north American species is called “cow killer” because of its painful sting. The female mutillids found in the same region are found to have the same color patterns, like golden and black, mostly seen in the Western Ghats; this serves as müllerian mimicry, reducing predation incidents during predator learning. Sexual dimorphism is extreme in mutillids, gender association is only possible when caught in copulation pairs or by rearing.

Mutillids are external parasitoids of enclosed larvae or pupae of other wasps, Diptera, Lepidoptera, Coleoptera and Blattodea. Mutillids tend to evolve according to their environment, one such example is *Dasymutilla gloriosa*, from the southwestern United States which resembles the seed of Creosote Bush. Mutillidae have very hard cuticles, this attribute helps them to escape from the stings of other wasps (Noort & Broad, 2024). Some mutillids, usually bigger ones tend to exhibit death-feigning behaviour in response to threats by rolling into a ball.

1.5. Scope and significance of the present study

Mutillidae are ecologically important groups because they regulate other arthropod populations in the ecosystem. Arthropods are known to reproduce rapidly; this kept uncontrolled, can affect the ecosystem's carrying capacity (Gaston & Lawton, 1988). Mutillids are known to be ectoparasitoids of enclosed larvae or pupae of other Hymenoptera, Diptera, Lepidoptera, Coleoptera and Blattodea. Mutillids are ectoparasitoids of higher wasps which are not parasite by other insects because of their sting, this pronounce the need of mutillids in controlling the higher wasps population to maintain the carrying capacity. These are only the known information about the host, but considering the diversity of Family Mutillidae the host data will increase. Further studies have to be done to unearth the host data.

The taxonomic data of Family Mutillidae from India is still scanty. Considering the biodiversity and different ecosystems in India, the diversity of mutillids will be much higher than what is described now. A thorough study is required in various ecosystems in India, considering the affinity of Indian species with Afrotropical and Palearctic species. This preliminary study concentrates on the analysis of mutillid species of the central and southern Western Ghats of India. This study can be a reference to future studies, giving enough knowledge about subfamilies, genera and species. It also provides taxonomic keys up to the species level for further identification. Photographs highlighting the critical characters for

identifying mutillids are also provided. Considering the diversity of mutillids, several species can be unearthed.

1.6. Thesis Objectives

- Collection and identification of wasps of the family Mutillidae from the central and southern Western Ghats of India
- Describing new taxa encountered and redescribing little-known taxa.
- Preparation of dichotomous keys for subfamily, tribe, genera and species level identifications.
- Compilation of the data on the distribution of genera and species with distributional maps.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

Only limited data is available on the mutillid wasps worldwide, especially in India. Taxonomy of mutillid wasps is difficult due to their extreme sexual dimorphism, so they seem less studied taxonomically compared to other vespoid families. The first record of reporting mutillid wasp dates to the time of Linnaeus (1758), who described *Mutilla indica* (erroneously cited from "Indiis", which was from South America), which was transferred later into the genus *Traumatomutilla* André. The first Oriental mutillid was described by Fabricius in his *Systema Entomologia* (1775), he described the species *Sphex villosa* from Southern India which is now transferred to the genus *Trogaspidia*. Then in 1793, Fabricius in his 'Entomologia systematica' described the species *Mutilla erythrocephala*, which was actually from Sri Lanka but was cited from *America meridionali*, also this species is currently regarded as *Trogaspidia intermedia* (Saussure, 1867). In 1787, Swederus described a new species *Mutilla sexmaculata* from Bengal, it was later transferred to the genus *Radoszkowskii*, and again in 2008, Lelej & Brothers synonymised the genus *Radoszkowskii* Ashmead to the genus *Wallacidia* Lelej and Brothers, 2008. Megerle in his *Catalogus insectorum quae Viennae Austriae die IX et sequentibus Novembris MDCCCII* (1802) and *Appendix ad Catalogum insectorum, quae mense Novembris MDCCCII* (1803) described five new species from Bengal. A major study on Mutillidae was by Smith (Assistant Keeper of the Department of Entomology of British Museum, London), he described 72 mutillids in his 15 research papers from 1855–1879. The Russian entomologist Motschulsky in 1863 described two species from Sri Lanka and Southern India. Another important contribution to the Family Mutillidae was by Cameron, during the years 1892–1909, he described 146 species in his seventeen research papers, mainly from India and Sri Lanka. Bingham (1897) studied the Mutillidae of India, Sri Lanka, and Myanmar, he recorded and keyed 119 species, these species were all placed in the genus *Mutilla* in his research article *Catalogus Hymenoptera*. Ashmead during the years (1899, 1900–1904) proposed the classification of Aculeate Hymenoptera, which included the Family Mutillidae. He also proposed 31 new mutillid genera. André (1894–1909) an old-world authority of Family Mutillidae, analysed the classification of Ashmead and rejected some genera but later workers in Mutillidae resurrected them. During the years 1894–1909, André classified the Mutillidae into 28 genera and a total of 270 Oriental species are listed, he also described 50 Oriental species in his 13 research papers. Mickel in 1935 studied the Mutillidae of Taiwan, the Philippine Islands, and Eastern Asia. He also proposed keys to species of those regions.

Chen in 1957, described 58 species from the Chinese fauna. A notable study of Indian mutillids was by Hammer in 1962, he described 44 species. However, later Peterson studied these type specimens and commented in letters to Lelej that some of these may fall as synonyms. In 1971a, Brothers revised the descriptions of the genus *Typhoctes*, with the description of a new species *T. aphelonyx* from Chile and Argentina. Brothers in 1971b, described a new genus *Ascetotilla* with the description of eight species from New Guinea. In 1974, Brothers placed the genus *Protomutilla* in the subfamily Myrmosinae. In 1985, Lelej published 'Velvet ants of the USSR and neighbouring countries', which consist of 224 species in 36 genera. In 1995, Lelej studied mutillids of Rajasthan, India and resulted in four new species: *Pseudophotopsis indica*, *Tricholabiodes nursei*, *T. tharensis*, *Dentilla kompantesi*. Lelej in 1996, studied the collections of Yamane in Malaysia and Indonesia, resulted in 38 species in 12 genera, out of this, he erected four new species (*Petersenidia dayak*, *Sinotilla lambirensis*, *Smicromyrme bomeo* and *Andreimyrme sarawakensis*) and one new genus (*Yamanetilla*). In 1997, Lelej & Nemkov studied the Phylogeny, evolution and classification of Mutillidae and provided new classification for Ephutinae and Mutillinae. Mitchell & Brothers in 1998 revised the Afrotropical genus *Areotilla* Bischoff, 1920 and described the females for the first time. Lelej & Krombein in 1999 discovered two new genera (*Cockerellidia* and *Karlidia*) and one new species (*Karlidia peterseni*) from Thailand. Lelej & Krombein newly reported subfamily Ticoplinae from the Oriental Region in 2001, discovered four new species and three new genera, also a key to Oriental and Palaeartic genera of the tribe Smicromyrmillini was provided. In the same year, a review of Mutillidae of Korea was done by Lelej *et al.*, which listed 12 species and three species *Cystomutilla teranishii* Mickel, *Smicromyrme bidenticulata* Chen and *Nemka wotani* (Zavattari) are newly recorded for the fauna of Korea. Mitchell & Brothers in 2002 analysed the subfamily Ticoplinae using 21 characters, which yielded two tribes Ticoplini & Smicromyrmillini. They also provided the key to the tribe and genera. In the same year, Lelej catalogued the Palaeartic Mutillidae, which contains 523 species in 54 genera, it is first of a kind catalogue which included the whole of the Palaeartic mutillids. Brothers in 2003 described the first fossil species of the subfamily Mutillinae (*Ephuta clavigera*) from the Dominican amber. Lelej & Osten in 2004 studied mutillids of Iran and listed 21 species in thirteen genera, they also described three new species (*Dentilla osteni*, *Smicromyrme standfussorum*, and *Trogaspidia tobiasi*) and the genus *Eotrogaspidia* Lelej and six species (*Eotrogaspidia dives* (Smith), *Ephutomma angustata* (Skorikov), *Physetopoda portschinskii* (Radoszkowski), *Smicromyrme minuta* Lelej, *Neotrogaspidia hammeri* (Suárez), and *Macroocula sinaica*

(Invrea)) were newly recorded for Iran. After the completion of the Palearctic catalogue in 2002, Lelej in 2005 catalogued the Oriental Mutillidae, which listed 637 species in 64 genera, with 16 new species and 11 new genera. In the same year, Lelej & Schmid Egger studied mutillids of Central Europe, listed 34 species in 54 genera and provided a key to species. In 2006, Lelej & Van Harten reviewed the mutillids of Yemen and recorded 40 species in 19 genera, three new genera were described (*Paglianotilla*, *Rasnitsynitilla*, and *Vanhartenidia*) and ten new species were described (*Arnoldtilla achterbergi*, *Dentilla ehrenbergi*, *Paglianotilla hogenesi*, *Rasnitsynitilla brachyptera*, *R. invreai*, *R. schmideggeri*, *Vanhartenidia arabica*, *V. felix*, *V. tihama*, and *Spinulomutilla yemenita*). In 2007, Lelej *et al.* described three new species (*Smicromyrmilla margalla*, *Andreimyrmex pakistanensis* and *Ephutomma himalayana*), and four genera (*Smicromyrmilla* Suárez, *Storozhenkotilla* Lelej, *Andreimyrmex* Lelej, and *Ephutomma* Ashmead) were recorded for the first time from Pakistan and the species *Storozhenkotilla semiviolacea* (André) was recorded for the first time from Pakistan. In 2008, Lelej *et al.*, studied mutillids of West Iran which resulted in one new species (*Smicromyrmex (Erimyrmex) zagrosensis* Lelej) and four new records in Iran (*Myrmilla (Myrmilla) etzchmiadzini* (Radoszkowski, 1885), *Myrmilla (Pseudomutilla) skorikovi* Lelej, 1985, *Smicromyrmex (Eremotilla) mesasiaticus* Lelej, 1985 and *Tropidotilla cypriadis* Invrea, 1940). Lelej & Brothers in 2008 reviewed the genus-group names and concluded with 238 valid names, out of these 208 are generic, 30 are subgeneric, 161 are known from both sexes, 40 from males only and 30 from females only. Also, they proposed a new genus *Wallacidia* Lelej & Brothers with type species *Mutilla oculata* Fabricius, 1804 for *Radoszkowskii* sensu Lelej, 1996; *Mutilla triguttata* Lelej & Brothers was proposed for *Mutilla africana* André, 1895; *Peringueyella* Nonveiller & Četković, 1995 and *Peringueyotilla* Nonveiller & Četković, 1997 are synonymized under *Acanthomutilla* Nonveiller, 1995 and was raised to the generic status; *Paralletilla* Pagliano, 2005 was synonymized with *Ronisia* Costa, 1858; *Mutilla lobicornis* André, 1907 was synonymized with *Mutilla argenteopicta* Sichel & Radoszkowski, 1869; *Pristomutilla curtispinosa* Bischoff, 1921 and *Lophotilla makalanga* Bischoff, 1920 were synonymized with *Lophotilla comparanda* Bischoff, 1920; several new combinations were proposed such as *Apteromutilla aethra* (Péringuey, 1899) (from *Mutilla*), *Ceratotilla feminaeformis* (Bischoff, 1920) (from *Myrmilla*), *Ceratotilla inalata* (Bischoff, 1920) (from *Myrmilla*) and *Trogaspidia cooki* (André, 1895) (from *Mutilla* and *Timulla*). Lelej & Yildirim in 2009 reviewed Mutillidae of Turkey and listed 65 species in 21 genera, also described a new species, *Skorikovia anatolica* Lelej. In 2009, Pitts *et al.*, studied the diversity of nocturnal velvet ants at the Philip L. Boyd Deep Canyon Desert

Research Center of Southern California, a total of 35 species and four new species were discovered from this region. Wilson *et al.*, in 2010 studied the mutillids near the dune-restricted plant *Croton californicus* var. *mohavensis* (Euphorbiaceae) and discovered the nectaring behaviour of Nocturnal velvet ants. Williams *et al.*, (2011a) described a new genus *Gogoltilla* and seven new species of the genus *Tobantilla* (*T. aleatrix* from Argentina, *T. andrikos* from Colombia, *T. drosos* from Argentina, *T. ephemerus* from Argentina and Uruguay, *T. kolasma* from Venezuela, *T. krима* from Colombia, and *T. xouthos* from Venezuela). Williams *et al.*, (2011b) studied and reconstructed the phylogeny of *Dasymutilla*, and the study showed reasonable changes in the old phylogeny. They also studied dual sex-limited mimicry, Batesian mimicry by males, and Mullerian mimicry complexes among females. Wilson *et al.*, in 2012 studied the overlapping mimicry rings among North American velvet ants by repeated evolution and they found out that 65 species of the mutillid genus *Dasymutilla* can be placed into one of six morphologically distinct and geographically delimited mimicry rings and they also inferred that müllerian colour patterns are primarily independent evolutions rather than shared phylogenetic history. Later in 2012, Lelej described a new species (*Rhopalomutilla striganovae*) from South Vietnam and provided the key to the species of Oriental females of *Rhopalomutilla*. Brothers in 2012 described a new genus *Ancistrotilla* and this is the first mutillid described from Vanuatu, on Esiritu Santo. Nithya & Debjani again in 2023a reviewed the species of *Kurzenkotilla* Lelej from India. Nithya & Debjani in 2023b redescribed *Trispilotilla indostana* (Smith) from India. In 2014, Amini *et al.*, reared two species of mutillids, *Smicromyrme* (*Astomyrme*) *nikolskajae* Lelej, 1985 and *S. (Eremotilla) tekensis* Skorikov, 1935 from puparia of ber fruit fly (*Carpomya vesuviana* Costa) and these two species were also new distributional records from Iran. Cambra *et al.* (2014) described a new species, *Hoplognathoca jinotega* from Nicaragua and Guatemala, and the then-unknown male of *H. costarricensis* are described and illustrated. Luz & Williams in 2014 proposed the sex association of four species: *D. amabilis* (Gerstaecker, 1874); *D. bejaranoi* Casal, 1968; *D. debilis* (Gerstaecker, 1874); and *D. felina* (Burmeister, 1854), and new diagnosis and descriptions are given for the genus *Darditilla*. Tu *et al.* (2014a) studied the genus *Dasylabris* of China and recorded five species for the first time in China (*Dasylabris adversa* Skorikov, 1935; *D. gussakovskii* Sorikov, 1935; *D. sungora* (Pallas, 1773); *D. regalis* (Fabricius, 1793); and *D. zimini* Skorikov, 1935), also provided a key to the species of the genus *Dasylabris*. Tu *et al.* (2014b) reviewed the genus *Cystomutilla* André, 1896 from China. They described a new genus *Hemutilla* with the type species *Hemutilla granulata* Tu, Lelej et Chen 2014 and described four new species (*H.*

tuberculata Tu, Lelej et Chen from Henan, Shaanxi; *H. ferrugineipes* Tu, Lelej et Chen from Hunan; *H. granulata* Tu, Lelej et Chen from Zhejiang; and *H. cheni* Tu et Lelej from Fujian). In 2015, Bartholomay *et al.*, corrected some of the misidentified *Traumatomutilla* and listed the host records of the same. Wilson *et al.* (2015) analysed the extent of mutillid mimicry complex beyond the genus *Dasymutilla*, they examined 351 species and out of these 336 species exhibited some morphological similarities. With this, they hypothesized eight distinct mimicry rings which included two newly documented mimicry rings, red-headed *Timulla* and black-headed *Timulla*. In 2015, Turrisi *et al.*, studied the phylogeny of the genera *Blakeius* Ashmead, 1903 and *Liomutilla* André, 1907 and two new genera were described (*Bidecoloratilla* and *Matteini*) with four species. Brothers (2015) revised the subfamily Rhopalomutillinae with the description of three new genera (*Rimulotilla*, *Pherotilla* and *Bischoffiella*). Lelej & Schlyakhtenok in 2015 studied the velvet ants of Eastern European countries, the cluster analysis of this data yielded two major clusters, one is the South European and the other Central and North European. They concluded that mutillids, being a thermophilic group, exhibit a significant reduction in number from south to north. Das & Girish Kumar in 2015 *Odontomutilla speciosa* Smith, 1855 from the Indian fauna. In 2015, Tu *et al.* reviewed the genus *Taiwanomyrme* Tsuneki, 1993 from China and described two new species (*T. latisquamula* and *T. impressoides*), also provided key to males and females of *Taiwanomyrme* and key to females of tribes Peterseniini and Trogaspidiini. Brothers *et al.* (2016) revised the genus *Frigitilla* and described a new species of the same genus from Panama. In 2016, Luz *et al.*, proposed a species group named *Dasymutilla paradoxa* to include eight species: *D. fasciventris*, *D. guanacaste*, *D. naranjo*, *D. paradoxa*, *D. paraparadoxa*, *D. phya*, *D. relata* and *D. slipepniri*, three new combinations are proposed and a key to species were also provided. Lelej *et al.*, in 2016a, studied the mutillids of the Crimean Peninsula, which yielded 38 species in 15 genera and they proposed two new synonymies for *Nemka viduata* (Pallas, 1773) and *Dasylabris petiolate* (Baer, 1848). Lelej *et al.*, 2016b studied and reviewed the genus *Promecidia* Lelej, 1996 from China, the genus was newly recorded in China and two new species were described (*P. abnormis* and *P. chui*), they also proposed a new combination for *P. boopis* (Kohl, 1882). Das *et al.*, 2017 described a new species *Odontomutilla paderua* from India. In 2017a, Lelej *et al.*, studied the mutillids of Russia, two genera *Artiotilla* Invrea, 1959 and *Neotrogaspidia* Lelej, 1996 and four species (*Myrmilla etzchmiadzini* (Radoszkowski, 1885), *Ephutomma angustata* (Skorikov, 1935), *Artiotilla biguttata* (Costa, 1859), and *Neotrogaspidia hammeri* (Suárez, 1959) are newly recorded from the fauna of Russia. Lelej *et al.* in 2017b reviewed the genus *Zeugomutilla*

Chen, 1957, described two new species *Zeugomutilla angkorensis* Williams, 2017 from Cambodia, Thailand, Vietnam and *Z. pangi* Lelej, 2017 from China. They also newly recorded *Z. bainbriggei* (Turner, 1911) and *Z. horni* (André, 1898) from India (Tamil Nadu); *Z. pycnopyga* Chen, 1957 from Thailand and *Z. saepes* (Chen, 1957) from Cambodia and Thailand. A key to the males and females of *Zeugomutilla* was also provided. Zhou *et al.*, in 2017 discovered the subfamily Rhopalomutillinae from China and also described a new species *Pherotilla brothersi*. Brothers & Lelej in 2017, critically analyzed 101 genera and subgenera based on 230 morphological characters in various ways to produce most parsimonious trees. This analysis resulted in the recognition of eight subfamilies: Myrmosinae (with the tribes Kudakrumiini and Myrmosini); Pseudophotopsidinae, Rhopalomutillinae, Ticoplinae (with the tribes Smicromyrmillini and Ticoplini); Sphaerophthalminae (with the tribes Sphaerophthalmini, Dasymutillini and Pseudomethocini); Myrmillinae, Dasylabrinae (with the tribes Apteromutillini and Dasylabrini) and Mutillinae (with the tribes Ctenotillini, Smicromyrmini, Mutillini and Trogaspidiini). Okayasu in 2017 described two new species of the genus *Sinotilla* Lelej, 1995 (*Sinotilla calopoda* from Indonesia, Jawa Barat and *S. ohbayashii* from China, Fujian) with a key to species (females). Brothers in 2018 described a new genus *Aglaotilla* from the Australian fauna and proposed 13 new combinations. Cambra *et al.*, in 2018 studied the *Dasymutilla* of Panama, one new species and four new synonyms and a key to the species were provided. They also studied the seasonal flight activity based on six years of continuous malaise trap data. Bartholomy *et al.*, in 2018 described five new species (*T. fratres*, *T. anhangana*, *T. barathra*, *T. poranga* and *T. pantherina*) and redescribed *Traumatomutilla tabapua* Casal, 1969; *T. luscooides* André, 1908 and *T. integella* (Cresson, 1902). In 2018, Wilson *et al.*, compared the mimicry rings of African and North American velvet ants and discovered four mimicry rings in Africa, i.e. lower mimetic diversity. Zhou *et al.*, in 2018 newly recorded the genera *Cystomutilla* André, 1896; *Promecilla* André, 1902; *Kurzenkotilla* Lelej, 2005; *Nonveilleridia* Lelej, 1996 and the species *Cystomutilla teranishii* Mickel, 1935; *Kurzenkotilla annamensis* Lelej, 2005; *Nonveilleridia bataviana* André, 1909; and *Mickelomyrme exiloides* (Magretti) from China. In the same year Zhou *et al.*,^b reviewed the genus *Zavatilla* Tsuneki, 1993; and described two new species, *Z. xuzaiyai* Zhou, Lelej et Williams, 2018 from China, Vietnam and *Z. nepalensis* Zhou et Lelej, 2018 from Nepal. Okayasu *et al.*, in 2018 described a new species *Sinotilla nigrothoracica* from Taiwan, also they discussed the black-headed color syndrome and red-headed color syndrome in mutillids, and concluded that the black-headed color syndrome is mostly in Trogaspidiini and red-headed color syndrome in Mutillini. Barthélémy

et al., in 2018 studied the mutillids of Hongkong, which resulted in 12 species in nine genera, six species are newly recorded from Hongkong also hitherto unknown male of *Bischoffitilla lamellate* (Mickel, 1933) were described. Okayasu in 2018 reviewed Chen's described species in the genus *Smicromyrme*, Chen has described 28 species and 10 subspecies in the 1957 revision of China and Taiwan. Okayasu transferred *Sinotilla serpa columnata* (Chen, 1957), *Si. spinicauda* (Chen, 1957) and *Si. trisecta* (Chen, 1957) from *Smicromyrme* to *Sinotilla*. Also, from this studies *Smicromyrme (Erimyrme) triguttatus* Mickel, 1933 was newly recorded from Vietnam and Laos and *Mickelomyrme kuznetsovi* Lelej, 1996 from China. Taylor *et al.*, in 2019 described four new species of the genus *Aglaotilla* of the Australian mutillid fauna. In 2019, Williams *et al.*,a conducted a major study from Thailand. This study resulted in 17 new species (*Bischoffitilla cambrai* Williams, 2019; *Bischoffitilla tokay* Williams, 2019; *Mickelomyrme puttasoki* Williams, 2019; *Mickelomyrme kinguri* Williams, 2019; *Nordeniella maleeae* Williams, 2019; *Smicromyrme helarctos* Williams, 2019; *Smicromyrme borkenti* Williams, 2019; *Smicromyrme thaochani* Williams, 2019; *Krombeinidia agricola* Williams, 2019; *Krombeinidia chang* Williams, 2019; *Krombeinidia baanmaka* Williams, 2019; *Orientidia manleyi* Williams, 2019; *Orientidia thoawanae* Williams, 2019; *Petersenidia modkhong* Williams, 2019; *Petersenidia leleji* Williams, 2019; *Trogaspidia pittsi* Williams, 2019 and *Trogaspidia wilsoni* Williams, 2019). They also proposed three new synonyms, one new combination and 23 new country records (twelve from Thailand, four from Vietnam, four from Laos, two from Cambodia and one from Indonesia). Williams *et al.*b in 2019, described three new species, *Kudakrumia malaenglek*, *Kudakrumia loaibonho*, and *Krombeinella brothersi* from Southeastern Asia, with this Myrmosinae is newly recorded from Southeast Asia. They also provided the keys to Old World genera of Myrmosinae and males of *Kudakrumia* and *Krombeinella*. Bartholomay *et al.*,a in 2019 revised the species group *Traumatomutilla americana* and details on its biology, host associations were provided and the key to the species was provided. Again in the same year Bartholomay *et al.*,b revised the species group *Traumatomutilla juvenilis* with the description of a new species *Traumatomutilla juvenindica* and the key to the species of the group. Hearn *et al.*, in 2019 described a new species *Ephutomorpha tyla* and found the host-parasite association between mutillids and hylaeine bee species. Williams *et al.*,c in 2019 described a new genus *Atlantilla* and reviewed the genus *Leucospilomutilla* with detailed illustrations and keys. In 2019, Girish Kumar *et al.*, recorded the genus *Kudakrumia* Krombein, 1979 for the first time in India with the description of one new species, *K. rangnekari* Girish Kumar & Lelej, 2019 (Goa, Kerala), also provided an Oriental key to the

genera and species of tribe Kudakrumiini. In 2019, Brothers *et al.*, revised the findings and updated the genus-group names and other errors of Lelej & Brothers (2008). Also provided details for 38 genus-group name and for 14 names additional information is provided other than in 2008 findings. Manely *et al.*, in 2020 reviewed the Nearctic *Dasymutilla* with the description of one new species and fourteen new synonyms. Also, the changes in this genus after Mickel and Krombein (1979) were noted. In 2020, Pagliano *et al.*, listed the Mutillidae of the world, with a checklist of eight subfamilies, 220 genera and 4,603 species. Also, they illustrated some selected species. In 2020, Cambra *et al.*, described a new species *Calomutilla panamensis* from Panama and Venezuela, also an unknown male was described and illustrated. Waldren *et al.*, in 2020 revised the genus *Invreia* with the description of 11 new species, five species groups and an illustrated key to species also provided. In 2020, Okayasu studied the tribe Smicromyrmini Bischoff from Japan, from this study the genus *Smicromyrme* is recognized from Japan by the species *Smicromyrme lewisi* Mickel, 1935; the genus *Nemka* Lelej, 1985 from *Nemka yasumatsui* (Mickel, 1936); the genus *Mickelomyrme* Lelej, 1995 from *M. hageni* (Zavattari, 1913); the genus *Andreimyrme* Lelej, 1995 from *A. substriolata* (Chen, 1957); the genus *Ephucilla* Lelej, 1995 from *E. yoshitakei* Okayasu, 2020 and *Sinotilla* Lelej, 1995 from *Sinotilla jambar* Okayasu, 2020. The genera *Andreimyrme* and *Sinotilla* were newly recorded from the Japanese fauna. Six new country records are reported: *Mickelomyrme athalia* (Pagden, 1934) from China and Vietnam; *M. bakeri* (Mickel, 1934) from Malaysia and Indonesia; *M. pusillaeformis* (Hammer, 1962) from Indonesia; *Andreimyrme sarawakensis* Lelej, 1996 from Peninsular Malaysia and *A. substriolata* from Laos, Thailand, Peninsular Malaysia and Indonesia. Okayasu inferred three distributional patterns of Japanese Smicromyrmini species as Asian continental-Palaeartic Japan, Taiwan-Ryûkyû and Asian continental-Ryûkyû. Lelej (2020a), newly recorded the genera *Artiotilla* invrea, *Radoszkowskitilla* Lelej, *A. afghanica* (Suárez), *R. aulica* (Smith) from Pakistan and *A. afghanica* from Iran. He described and illustrated *Taiwanomyrme cheni* (China: Yunnan) and provided a key to the species of males and females of the genera *Radoszkowskitilla* and females of *Taiwanomyrme*. Lelej *et al.*, 2020 reviewed the genus *Odontomutilla* Ashmead, 1899 of the Indian subcontinent. In this study, a review of 12 species, one subspecies is provided and *O. sairandhriensis* Terine, Girish Kumar & Lelej (India: Kerala) and *O. fletcheri* Lelej, Terine & Girish Kumar (Sri Lanka) and the hitherto unknown male of *O. trichocondyla* (André, 1894) are described and illustrated. *Mutilla indiga* Bingham, 1908 is transferred from the genus *Odontomutilla* to *Smicromyrme* Thomson, 1870 and *Odontomutilla speciosa* (Smith, 1855) is excluded from the Indian subcontinent fauna. Also,

keys to 12 species and one subspecies (males and females) of the genus are provided. Lelej again in 2020b described three new species *Ephucilla hejunhuai* (China: Guangdong), *Promecilla ovtchinnikovi* (Pakistan: Khyber Pakhtunkhwa), and *Smicromyrme (Eremotilla) burgeri* (India: Karnataka). Lelej also described the unusual color syndrome with T2 ferruginous-red cuticle, this color pattern approximately coincides with the Eastern mimicry ring in North America in these species. In 2021, Bartholomay *et al.*, revised the species group *Traumatomutilla gemelli* with the description of one new species. Okayasu *et al.*, 2021a reviewed the genus *Eotrogaspidia* Lelej, 1996 and described four new species: *E. adhabar* (India, Nepal), *E. buddha* (India, Nepal, Pakistan, Sri Lanka), *E. hauseri* (India, Nepal) and *E. melanopleura* (China). Three species were transferred to *Eotrogaspidia* from *Trogaspidia*: *E. lena* (Cameron, 1899), *E. rubripes* (André, 1901) and *E. saussurei* (Lelej, 2005), and *Mutilla ekka* Nurse, 1902 from India transferred from *Eotrogaspidia* to *Vanhartenidia*. Eight new country records were presented: *Trogaspidia mackieae* (Cockerell, 1928) from China, *E. auroguttata* (Smith, 1855) and *E. oryzae* (Smith, 1855) from Laos, *Trogaspidia mackieae* (Cockerell, 1928) from Vietnam, *E. auroguttata* (Smith, 1855) and *Eotrogaspidia saussurei* (Lelej, 2005) from India, *E. rubripes* (André, 1901) from Iran and Afghanistan. Also key to all known *Eotrogaspidia* species and related genera are provided. Okayasu in 2021 described the genus *Arkaditilla* based on male specimens, this genus includes six species: *A. bagrada* (Cameron, 1902) (Indonesia, Malaysia), *A. depressicornis* (Mickel, 1935), (Malaysia), *A. frim* Okayasu, 2021 (Malaysia), *A. gibba* 2021 (Indonesia), *A. leleji* Okayasu, 2021 (Indonesia), and *A. nallinia* (Zavattari, 1914) (Indonesia). The species of the genus *Arkaditilla* was formerly placed in genus *Krombeinidia*, a key to the species of the genus *Arkaditilla* were also provided. A key to the species of the genus *Arkaditilla* were also provided. In 2021a, Terine *et al.* newly recorded the genus *Andreimyrme* Lelej, 1995 with the description of one new species, *A. paniya* from Kerala. The rare color pattern of this species is also discussed, with the notes on similarity of such color syndromes occur in two species of the tribe Smicromyrmini and two species of the subfamily Dasylabrinae. An updated diagnosis of males of *Andreimyrme* were also provided. Lelej (2021a) discovered a new species *Petersenidia mikhailovi* from Indonesia. Also, the lectotype of *Mutilla macassarica* Zavattari, 1914 was designated. Lelej (2021b) newly recorded another genus *Odontomyrme* Lelej, 1983 from New Guinea with the description of a new species *Odontomyrme rasnitsyni*. Lelej *et al.*, in 2021 discovered two new species from India: *Eosmicromyrmilla subbuka* and *E. balakrishnani*. *Eosmicromyrmilla* is newly recorded from Pakistan instead of the genus *Smicromyrmilla* Suárez, 1965. Keys to the Old-World genera of the tribe Smicromyrmillini

and species of *Eosmicromyrmilla* were provided. Diagnosis for males of *Eosmicromyrmilla* is updated and photos of male genitalia for the genus were also given and a new combination for *E. margalla* (Lelej & Ullah, 2007) were proposed. Terine *et al.*, in 2021b, newly recorded the genus *Strangulotilla* Nonveiller, 1979 from India with the description of a new species *Strangulotilla sureshani* from Karnataka. This genus was previously reported only from Sri Lanka in the Oriental Region, and a key to the Oriental *Strangulotilla* was provided. Okayasu *et al.*, 2021 reviewed the genus *Andreimyrmex* Lelej, 1995 with the discovery of nine new species (*A. auricoma* Okayasu, 2021 (Malaysia), *A. laminatihumeralis* Okayasu, 2021 (Indonesia, Malaysia), *A. matsumotoi* Okayasu, 2021 (Vietnam), *A. naturalis* Williams, 2021 (Indonesia), *A. rong* Williams, 2021 (Thailand, Vietnam), *A. silvorientalis* Okayasu, 2021 (Indonesia), *A. takensis* Okayasu, 2021 (Thailand), *A. ursasolaris* Williams, 2021 (Indonesia), and *A. yotoi* Okayasu, 2021). He extended the genus definitions to incorporate *A. borkenti* (Williams, 2019) and nine new species. In 2021, In 2022, Okayasu described the species *Nordeniella sumbawaensis* from Sumbawa and this discovery extends the geographical range of the genus *Nordeniella* beyond the Wallace Line. In 2022, Cambra *et al.*, studied the types and non-types of the genus *Horcomutilla* with the description of two new species and updated the key to species. Williams *et al.* (2022) revised the genus *Cephalomutilla* with the description of one new species, three new sex associations and four new synonyms. Bartholomay *et al.*, in 2022 reviewed the species group *Traumatomutilla indica* with the redescription of twenty-nine species and a key to the species group. Thaochan *et al.*, in 2022 described three new species (*Mickelomyrme leleji*, *Nordeniella dokbua* and *Smicromyrmex songkhwa*) and one species (*Bischoffitilla selangorensis* (Pagden)) were newly recorded from Thailand. Lelej *et al.*, in 2022 recorded 58 species in 19 genera. Two new synonyms (*Mutilla sinuata* Olivier, 1811 (= *M. binotata* Radoszkowski, 1879; and *M. araratica* Radoszkowski, 1890) and *Smicromyrmex atrithorax* (André, 1902) (= *S. kurdus* Skorikov, 1935) and seven new lectotypes are designated (*Agama caucasica* Radoszkowski, 1885; *Ephutomma radoszkovskii* Skorikov, 1935; *Mutilla armeniaca* Kolenati, 1846; *M. elongate* Radoszkowski, 1885; *M. binotata* Radoszkowski 1879; *M. araratica* Radoszkowski, 1890 and *M. villosa* Klug, 1829). 14 species are recorded for the first time from Azerbaijan (*Dasylabris (Inbaltilla) regalis* (Fabricius, 1793); *D. (I.) popovi* Skorikov, 1935; *D. (I.) shelkovnikovi* Lelej, 1985; *Dentilla erronea* (André, 1900); *Myrmilla (M.) calva* (Villers, 1789); *M. (Pseudomutilla) glabrata* (Fabricius, 1775); *M. (P.) vutshetitshi* Skorikov, 1927; *Physetopoda daghestanica* (Radoszkowski, 1885); *Pseudophotopsis armeniaca* (Skorikov, 1935); *Smicromyrmex (Astomyrmex) ausonius* Invrea 1950; *S. (Eremotilla) novaki* Invrea,

1954; *S. (Smicromyrme) ruficollis ruficollis* (Fabricius, 1793); *S. (S.) rufipes* (Fabricius, 1787); and *S. (S.) tristis* Lelej, 1984). In 2023, Lelej *et al.*, reviewed the tribe Mutillini of the Oriental region, 14 species were reviewed and keyed from the genera *Kurzenkotilla* Lelej, 2005; *Mutilla* Linnaeus, 1758; *Standfussidia* Lelej, 2005, and *Storozhenkotilla* Lelej, 2005. One new species *Storozhenkotilla nathani* Lelej, 2023 was described from Karnataka and Kerala. Six species are newly recorded from different countries (*Kurzenkotilla niveosignata* (André, 1894) from Pakistan, *K. annamensis* Lelej, 2005 from Thailand, *K. visrara* (Cameron, 1898) from India, *K. scrobiculata* (Hammer, 1962) from Nepal, *K. rufodorsata* (Cameron, 1897) from Nepal, and *Storozhenkotilla binghami* Lelej, 2005 from Sri Lanka). *Mutilla Mikado* is designated as the sole member of the genus *Mutilla* from the Oriental region and a key to the Oriental Mutillini is provided. Okayasu (2023a) reviewed the genus *Neotrogapidia* Lelej, 1996 of Northeast Asia, he proposed two new combinations, two new synonyms and provided an updated genus description with a key to the species. Waldren *et al.*, 2023, studied Phylogenomic inference of the higher classification of Mutillidae. Williams (2023) studied the diurnal velvet ants of USA with the description of two new species and catalogued six species of *Dasymutilla*, six species of *Pseudomethoca*, and one species of *Ephuta*. In 2023, Manley *et al.*, studied the velvet ants of Leslie & Bernardio national wildlife refuges and described eight new species, a total of a hundred species were catalogued and one new combination was proposed. Okayasu (2023b) studied the mutillid fauna of Nepal with the specimens collected during faunal surveys conducted from 1965 to 1983 by Hokkaido University, and described two new species *Strangulotilla dubia* and *Zeugomutilla curvicarinata*, the genus *Zeugomutilla* were newly recorded from Nepal. Lelej in 2023 reviewed the tribe Ctenotillini with the description of two new genera *Denistilla* and *Williamstilla*. Five new combinations were proposed (*Cephalotilla porcella* (Turner, 1911), comb. n., *Denistilla pauli* (André, 1898), comb. n., *Lehritilla ianthis* (Turner, 1911), comb. n., *L. locascioi* (Lelej, 2005), comb. n., and *Williamstilla guangdongensis* (Lelej, 1992), comb. n.). The genus *Pristomutilla* Ashmead, 1903 was excluded from the Oriental fauna and the genus *Cephalotilla* was newly recorded from the Oriental region. The key to the species of tribe Ctenotillini was provided. Terine & Girish Kumar in 2023 newly recorded the species *Spilomutilla eltola* from the Indian fauna. Okayasu in 2023c newly recorded the genus *Orientilla* Lelej, 1979 from Laos with the description of one new species *O. tamaderai*, one known species *O. vietnamica*, Lelej, 1979 and additionally, one new species *O. nitens* was described from India, Tamil Nadu. Lelej & Williams in 2023 reviewed the tribe Smicromyrmini Bischoff, 1920 with the description of 26 genera and five subgenera. The

unknown female of *Rasnitsynitilla* Lelej in Lelej & van Harten, 2006 was described. They also proposed two new combinations (*Rasnitsynitilla bartolozzii* (Lo Cascio et Grita, 2014), comb. nov. (from the genus *Smicromyrme* Thomson, 1870) and *Skorikovia sanguinicornis* (Klug, 1829), comb. nov. (from the genus *Ephutomma* Ashmead, 1899)). The genus *Indratilla* Lelej, 1993 was newly recorded from India and the subgenus *Eremotilla* Lelej, 1985 was newly recorded from the Oriental Region. A key to females and males of Smicromyrmini were provided. In 2023, Lelej discovered the genus *Odontomutilla* Ashmead, 1899 from Myanmar with the description of a new species (*Odontomutilla listopadovi*). Also, *Krombeinidia margheritae* (Hammer, 1962), *Trogaspidia fimbriata* Hammer, 1962, and *Odontomutilla familiaris trimaculata* Hammer, 1962 are excluded from Myanmar fauna. Terine *et al.*, 2024a newly recorded *Andreimyrme substriolata* (Chen, 1957) and *Odontomutilla fletcheri* Lelej, Terine & Girish Kumar, 2020. Terine *et al.* (2024b) discovered the genus *Cephalotilla* Bischoff, 1920 from India with the discovery of a new species *Cephalotilla (Cephalotilla) manikandani*, also a key to the species of the Oriental *Cephalotilla* was provided. Terine & Girish Kumar (2024a) discovered three new species (*Odontomutilla jaferpaloti* (India: Karnataka), *O. vishwanathi* (India: Karnataka), and *O. himalayensis* (India: Uttarakhand), of the genus *Odontomutilla* Ashmead, 1899 from India. Terine & Girish kumar in 2024b newly recorded *Krombeinidia albopunctata* from the Indian fauna.

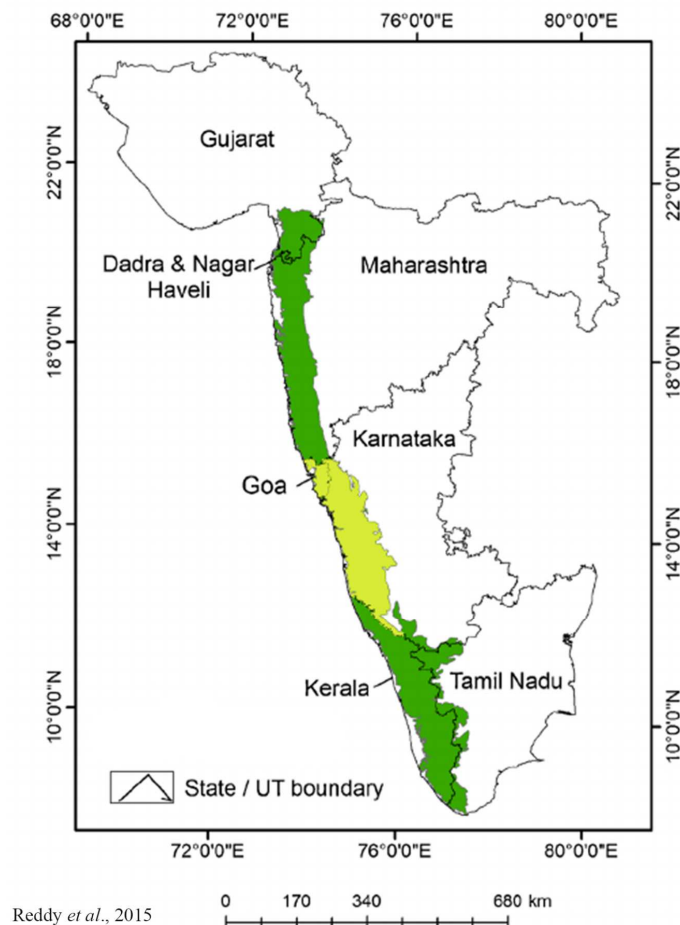
MATERIALS AND METHODS

3. MATERIAL AND METHODS

3.1. Study area: Central and Southern Western Ghats and its adjacent areas

The Western Ghats, the range of hills which runs north-south parallel to the Malabar coast of the Arabian sea. It passes through Tamil Nadu, Kerala, Karnataka, Goa, Maharashtra and Gujarat. The Western Ghats of India were included among the first 18 global biodiversity hotspots due to high levels of species endemism (Gunawardene *et al.*, 2007). The ghats span over an area of around 1,40,000 km² in a 1,600 km long stretch which is interrupted only at the Palghat Gap of 30 km at around 11°N. The Western Ghats have an average rainfall of 2,500 mm (Gadgil, 1994, 1996a, b), precipitation varies across the ghats ranging from < 1,000 mm to > 7,600 mm per annum.

The Western Ghats are topographically divided into three distinct regions: northern, central, and southern Western Ghats. The central Western Ghats lies between 12° to 16°N and the Southern Western Ghats lies between 8 ° to 12°N (Danankar *et al.*, 2004; Ramesh & Pascal, 1996; Subramanian & Shivaramakrishnan, 2002). The area under the present study is the central and southern Western Ghats and their adjacent areas.



3.2. Collection Methods (Plate 1)

Intensive collections of mutillid wasps were performed by using both active collection methods and passive collection methods from as many ecosystems as possible.

3.2.1. Active collection methods

3.2.1.1. Hand Picking

This method involves collecting specimens using hands, empty vials, or forceps. This method is most suitable for collecting female mutillid wasps because they are wingless. Extensive searching of mutillids in soil, on plants or branches was performed to locate the specimens; after locating the specimens, bare hands are used to collect mutillids by capturing between the propodeum and tergum; in this way, the wasp will not be able to sting, or it is preferred to use cut-resistant safety gloves to protect from the sting of mutillids. Another method is to use an empty vial or forceps to collect mutillids, but both these methods, when employed, result in damage in some specimens collected.

3.2.1.2. Sweep Nets

Two types of sweep nets were used in the present investigation: one is commonly called a butterfly net, and the other is a triangular net. (a). Butterfly Net: This net has a ring diameter of 30 cm and is fitted with a net bag of fine mesh attached to a detachable telescopic handle that is adjustable from 55 cm up to 180 cm. After spotting the wasp, the net is swept to capture it and is flipped over the rim to trap the insect inside. The wasp collected was narcotized by using a killing jar containing ethyl acetate. This method is suitable for collecting males of mutillids. (b). Triangular Net: This net has a triangular frame dimension of 48×22×46 cm with a detachable handle about 110 cm long. The net bag is made of 60 cm cotton white cloth. The net was swept as in the figures of 8 on the grasses, litter and other plants. The specimens thus collected were examined for mutillids, and when found, they were narcotized by using a killing jar containing ethyl acetate. This method is suitable for collecting both male and female mutillids resting on plants, grasses, and litter.

3.2.2. Passive collection methods

3.2.2.1. Moericke Trap

Moericke trap or Pan trap method is suitable for collecting ground-dwelling and low-flying arthropods. The trap is of a colored pan of different sizes; in this study, yellow pans with diameter sizes of 27 cm and 2 cm depth were employed. Ortiz-Sanchez & Aguirre-Segura

(1993) stated that yellow pan traps are more suitable for collecting hymenopterans. The trap is filled with water and 2-3 drops of detergent to break the surface tension; this enables the insects that fall into the trap to sink quickly and die. Pans are placed in areas that are likely to be productive for mutillids. Care has been taken to avoid interference from animals, humans, or other weather phenomena. During summer, care has been taken to fill the water sufficiently so that the water does not dry off. In case the pans are kept for 2-3 days in the field, salt will be sprinkled in all pans to keep the specimen intact.

A fine sieve strainer was used to strain the specimens trapped, washed in clear water and stored in 70 percent alcohol for study. This method mainly yields male mutillids, but female mutillids are rarely found.

3.2.2.2. Malaise Trap

This trap is the most promising method, using a passive flight-intercept method for collecting insects. The malaise trap is a tent-like trap designed by R. Malaise (Malaise, 1937), and it has undergone various modifications over the past few decades. In this study, Townes's design was used; it consists of fine mesh-like material weaved into a tent shape, with a large opening at the base for insects to fly in, a central wall (dark colored) separating the two compartments and a roof (light colored) that tapers to the apical end where the killing fluid is placed in a bottle. The shape of this trap is such that it intercepts insects in flight and forces them to move upwards to the collection fluid (70% isopropanol) in the jar provided. The trap is designed in such a manner that the phototropic nature of insects is capitalized here to collect them; this is the principle behind the malaise trap. There are certain factors to note when setting the trap, and the collection head should be placed in the direction of light. The area where the trap is placed should be devoid of any bushes; if there are any, they should be cut short. Care should be taken to prevent interference from other mammals and humans; traps must be periodically checked for the same. At regular intervals, the specimens have to be collected, and collection fluid/killing fluid has to be changed. Collection samples retrieved are labelled with locality details, time, and date. In this study, this trap was laid in different collection localities.

3.3. Collection Equipment

Equipment used in the study include:

- Sweep nets (butterfly net and triangular net), Pan traps, Vials (50 ml Tarson tubes) and cut-resistant safety gloves.

- Alcohol vials for storing collected specimens.
- Killing jar with cotton ball impregnated with ethyl acetate (killing agent).
- Locality label and Water-resistant pen or pencil to note down details.
- Forceps and hairbrush to disentangle stuck specimens from net and sieve.

3.4. Preservation in Alcohol

All collected specimens are labelled and stored in 70% alcohol in separate vials according to their collection site. The alcohol is changed periodically to prevent specimen deterioration. For long-term preservation, the vials are kept in cold conditions.

3.5. Processing

Collected specimens as sorted, relaxed, mounted, pinned, labelled, identified and registered.

3.6. Sorting

Specimens stored in alcohol are retrieved, poured into a Petri dish and examined under a stereo zoom microscope with appropriate magnification. Males and females of mutillids are sorted, with careful attention given to ensuring that small mutillids are not overlooked. After sorting, the remaining collection were preserved in 70% alcohol and kept in cold conditions for further studies.

3.7. Relaxing

Most specimens become rigid and brittle over prolonged treatment with alcohol or ethyl acetate. For mutillids, the characters on mesopleuron and genitalia are essential in identification. Most specimens, after killing, tend to have folding legs and wings; these have to be spread suitably. To prevent breakage during this process, specimens must be relaxed beforehand. For this, specimens are kept contained with acetic acid vapours overnight. Depending on the size and age of specimens, the treatment time will vary. For a bigger specimen, keeping it in warm water for 10-15 minutes is suitable.

3.8. Mounting and Pinning

Mounting and pinning are the most crucial steps in taxonomic studies, and they need expertise and care because these steps decide the specimen's dimensions. Before mounting, the relaxed specimens are kept on blotting paper under a table lamp (with an incandescent

bulb of 60 to 100 watts) for a few minutes for the liquid to dry. For mounting, a thick ivory triangular card pinned with an entomological pin and a drop of glue (water soluble) were placed on the far corner of the triangular card. The specimen is carefully placed on the glue so that either the left or right half is evident. The water-soluble glues are used because they easily enable the entomologist to remount the specimen. For pinning, standard entomological pins of different sizes were used based on the specimen size. The pins were inserted through the thorax of specimens. The thorax of female mutillids is so hard that inserting pins through the thorax is much more difficult. Care was taken not to damage the specimens during pinning. There must be enough space left above the specimen for handling and below the specimen for labelling. After pinning and mounting, the antennae, legs and wings are spread and dried either under the table lamp or in an oven.

3.9. Labelling and Registering

In taxonomy, specimens without locality data are irrelevant. Proper labelling of each specimen with all the information on the specimen is essential. Printed or handwritten (with Rotring pen or Artline pen of 0.1 microtip) labels in small rectangular ivory cards can be used. The critical information that should be included on the first label are: location where the specimen was collected (Country name in uppercase, name of the state, name of district and name of collection locality), date of collection (day/month/year; month should be written in roman numerals), and name of the collector. The second should be the determination label with the scientific name, author name and year, and the determiner's name and the year of identification. The third label should include the registration number. The specimens are registered in the specified register in a national depository with scientific name, locality name, collector name, determiner name, date of determination and collection number. All the labels should be pinned beneath the specimen using a pinning block to attain symmetry. Beneath the specimen, the first label should be the one with the date of collection and locality details, the second should be the determination label, and the third label should be with a registration number.

3.10. Identification

The specimens were examined using a stereo zoom microscope, either a Leica S8AP0 or a Labomed CZM6, depending on the availability or size of the specimen. The specimens were identified with the aid of taxonomic keys and published descriptions for the relevant taxa.

- Taxonomic keys for identifying Family Mutillidae provided by Goulet & Huber, 1993 were used.
- For the subfamily level and the genus level identifications, keys provided by Lelej (2005) and Williams et al. (2019) were used.
- For species level identification, descriptions of Hammer (1962), Lelej (2005) and Williams et al. (2019) were majorly used.

Note.

- For some genera, workable keys were not available, so attempts were made to prepare them in this study.
- Keys modified from published materials by different authors were also provided.

3.11. Preservation

Dried specimens were stored in air-tight insect boxes. These boxes are articulated with cotton balls impregnated with a mixture of phenol and camphor in a 3:1 ratio. Periodic checking and reimpregnation of chemicals were done to protect specimens from fungal and mite attacks.

Wet collections were stored in 70% alcohol in cold conditions. Periodic change of alcohol was done to keep the specimens intact.

3.12. Illustrations and Measurements

The photographs of specimens were captured using camera Leica DFC 500, 450 attached to a Leica 205 A stereo zoom microscope, and some were captured using camera Leica Flexcam C3 connected to a Leica 205 C stereo zoom microscope. The images captured at varying depths were stacked using Leica LAS V3.80 software to attain a multi-focus single image. The images were post-processed only to improve contrast and exposure using Adobe ® Photoshop ® CC 14.2.1 software.

3.13. Morphological Terms (Plate 2–7)

The terminology mostly follows Babu & Girish Kumar (2011) and the Hymenoptera Anatomy Ontology (2013).

Head

Antennae: paired movable sensory appendage, segmented. Located above clypeus.

Carina: raised line, ridge or a keel-like structure.

Clypeus: medial sclerite immediately above labrum.

Flagellomeres: individual subdivision of flagellum of antenna distally located from pedicel.

Frons: the area located dorsal to the ventral margin of the antennal rim and ventral to the anterior ocellus, situated medially between the inner margins of the eye and malar line.

Gena: lateral portion of head below eyes, between the eyes and mandibular insertion.

Genal carina: carina that extend lateral to oral foramen and extends on to gena.

Hypostomal carina: carina that separates hypostoma from cranium, ending base of mandible.

Mandible: paired lateral appendage of mouthparts.

Occipital carina: subcircular carina which surrounds the occiput dorsolaterally.

Ocelli: simple eyes located on vertex, with multi tissue structure composed of corneal lens, pigment cells, rhabdoms and synaptic plexus.

Pedicel: second segment of antenna, basally connected to scape and apically to flagellomeres.

Scape: first segment of antenna, which is then connected to pedicel.

Vertex: crown of head, between anterior occipital suture and eyes.

Mesosoma

Mesopleural suture: carina that extends between mid coxal articulation and base of the wing, or anterior spiracle or mid spiracle.

Mesopleuron: area located laterally of mesothorax.

Mesoscutum: dorsal sclerite behind prothorax.

Metanotum: dorsal sclerite behind scutellum.

Metapleuron: area located laterally to metathorax.

Notauli: paired longitudinal lines extends sub medially on mesoscutum.

Parapsidal line: paired longitudinal short lines extends laterally on mesoscutum.

Propodeum: sclerite behind metanotum, that connects to tergum.

Scutellum: sclerite behind mesoscutum.

Suture: groove that marks the fusion of ancestral sclerites.

Metasoma

Hypopygidium: last abdominal sternite.

Lateral felt line: the longitudinal line of setae on metasomal segment 2 is either in T2 or S2 or on both.

Petiole: first metasomal segment modified a stock or stem.

Pygidium: a plate defined by carina on the T6 of females and T7 of males.

Terga: a segment of tergum.

Tergum: dorsal metasomal segments.

Sterna: a segment of sternum.

Sternum: ventral metasomal segments.

Wings

Jugal lobe: basal fold on fore wing.

Stigma: sclerotized patch on the anterior margin of fore wing.

Submarginal cell: cell adjacent to stigma.

Tegula: sclerite covering forewing base.

Legs

Coxa: first segment of leg, articulates from base of thorax.

Femur: third segment of leg.

Spur: The process that is surrounded by the conjunctiva, is evaginated, and has a sclerotized base.

Tarsi: fifth segment of leg.

Tarsomere: one of the segments of tarsus.

Tibia: fourth segment of legs.

Trochanter: second segment of leg.

Genitalia

Cuspis: process located on the free distal end of the volsellar plate.

Digitus: curved or hooked process projecting over volsellar plate.

Gonostylus: stylus located distally of the genital segment, also called paramere.

Penial valves: process at the middle of the male genitalia of insects.

3.14. Abbreviations

3.14.1. Abbreviations used for Morphological terms

F1–F7: Flagellomeres 1 to 7.

Mm: Millimeter.

OOL: Ocelloocular distance.

POL: Posterior ocellar distance.

RS vein: Radial sector vien.

SC vein: Subcostal vien.

T1–T6: Metasomal terga 1 to 6.

3.14.2. Abbreviations used for the Museums

CZM: Zoological Museum, University of Copenhagen, Denmark.

MNHN: Muséum National d'Histoire Naturelle, Paris, France.

MSNG: Museo Civico di Storia Naturale Giacomo Doria, Geneva, Switzerland.

NHMW: Natural History Museum, Vienna, Austria.

NHMUK: Natural History Museum, London, United Kingdom.

NMNH: National Museum of Natural History, Washington DC, USA.

NZC: National Zoological Collections of the Zoological Survey of India, Kolkata, India.

SMNS: Staatliches Museum für Naturkunde, Stuttgart, Germany.

OUMNH: The Oxford University Museum of Natural History, United Kingdom.

ZSIK: National Zoological Collections of the Western Ghat Regional Centre, Zoological Survey of India, Kozhikode, India.

3.15. Digital loan of Specimens

Photographs of Type specimens from NHMUK, OUMNH, NZC, and NHMW were examined to confirm the identification of some species.

3.16. Collection localities

States	Districts	Localities
Kerala	Thiruvananthapuram	Neyyar Wildlife Sanctuary; Peppara Wildlife Sanctuary; Ponmudi.
	Pathanamthitta	Goodrical range of Ranni forest division.
	Kollam	Shasthamkotta; Shendurney Wildlife Sanctuary.
	Kottayam	Cherpunkal.
	Idukki	Thekkadi, Kumarikulam; Chinnar Wildlife Sanctuary, Kootaram; Kulamavu.
	Ernakulam	Thattekkad Bird Sanctuary.
	Palakkad	Silent Valley National Park; Parambikulam Tiger Reserve; Pudungaram.
	Thrissur	Elanad; Vallakkunnu.
	Malappuram	Calicut University Campus; Kerala Forest Research Institute Campus, Nilambur; Punchakolly.
	Kozhikode	Chengottukavu; Elathur; Edakkara; Kakkadampoyil; Chaliyam Forest Depot; Cherukulam; Malabar Wildlife Sanctuary, Kakkayam; Madappally; Vadakkara, Moorad; Balussery, Kuttiady; Nanminda; Peruvayal; Ponkunnu hills; Purameri; Sarovaram Biopark; Thiruvallur; Janakikadu; Poyilkavu; Nambikulam.

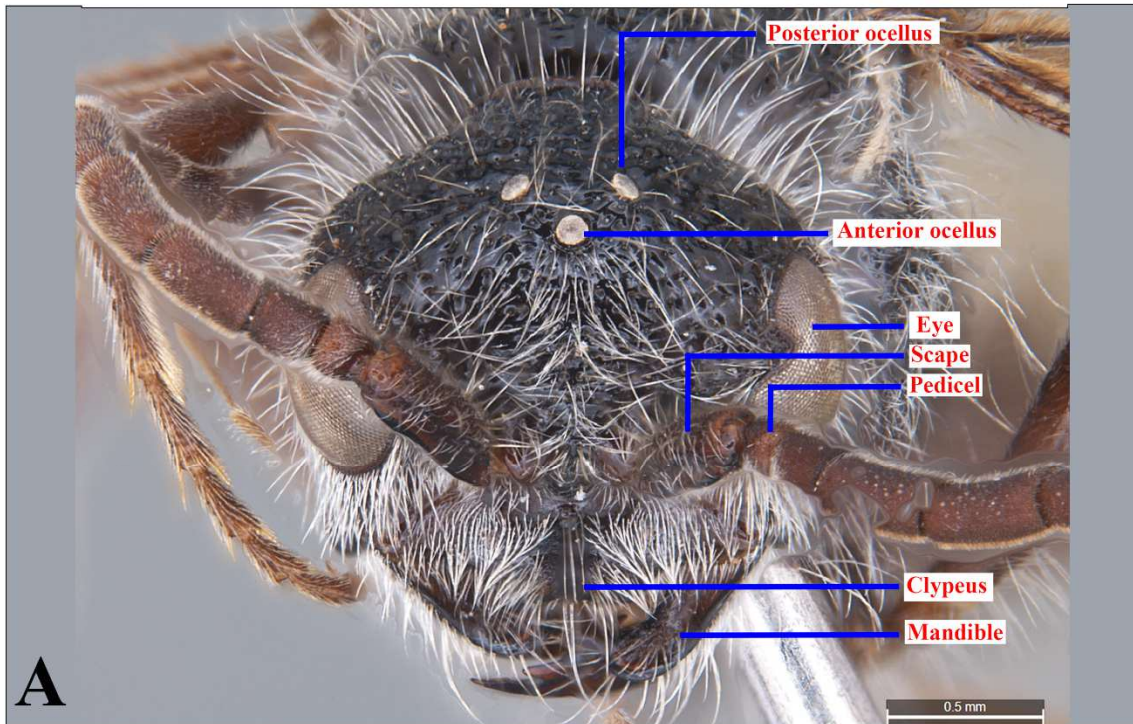
	Kannur	Aralam Wildlife Sanctuary; Kannapuram; Madayipara Hills; Kottiyoor Wildlife Sanctuary.
	Wayanad	Wayanad Wildlife Sanctuary (Chandanathodu, Edavambam, Muthanga, and Ponkuzhi); Kuruva Island; Moolankavu; Periya Camp shed; Wayanad wild resort, Vythiri; Thirunelli, Pottumoola.
	Kasargod	Ranipuram.
Tamil Nadu	Coimbatore	Anamalai.
	Nilgiris	Coonoor.
	Tenkasi	Agasthyalai Biosphere Reserve, Ukkonam.
	Tirunelveli	Kodumudiyar dam site; Kalakad Mundanthurai Tiger Reserve, Kadayam; Ramanadi dam site.
	Kodagu	Talakaveri Wildlife Sanctuary; Thondoor; Bettathur; Madikeri.
	Udupi	Beedikeri.
	Chikmagalur	Bygoor.
Goa	Shimoga	Mookambika Wildlife Sanctuary (Abbi Falls, Balehaklu, Hulikal Forest Rest House, Herate, Yaduru, Balamane, Malayalli, and Masthigate).
	North Goa	Madei Wildlife Sanctuary.
	North Goa	Bondla Wildlife Sanctuary.
	South Goa	Kotigao wildlife sanctuary.

PLATE 1



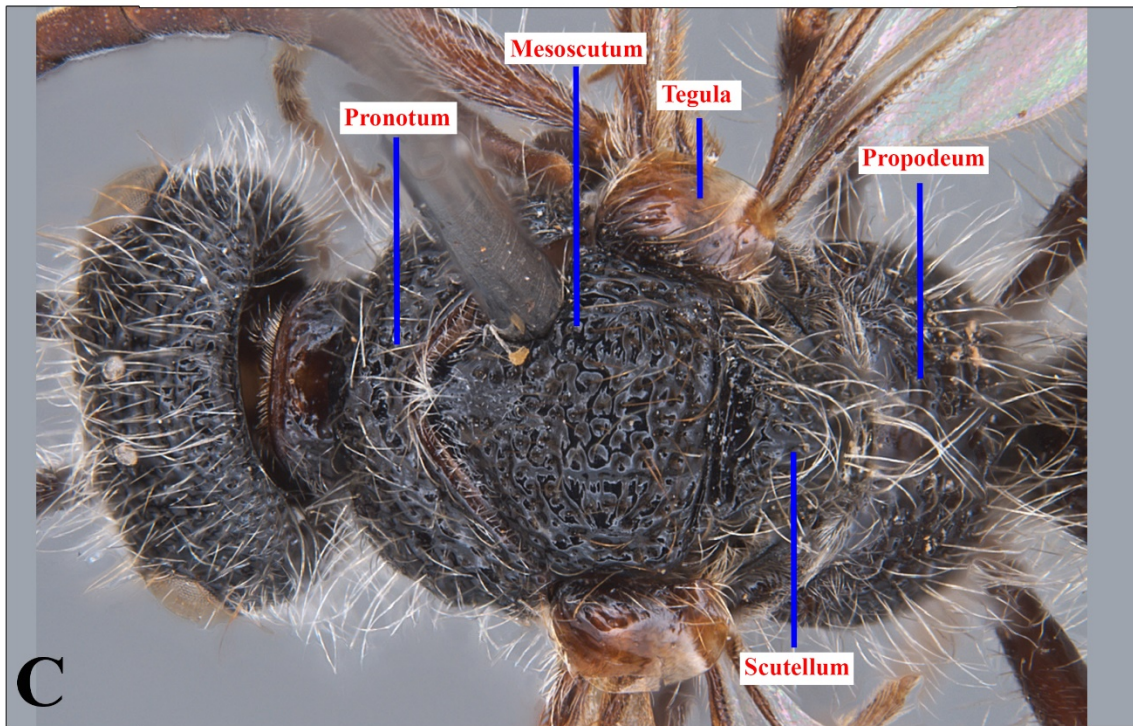
A. Hand Picking; B. Sweeping; C. Bottle used for hand picking; D. Cut resistant gloves; E. Triangular Net; F. Yellow Pan Trap; G. Malaise Trap

PLATE 2



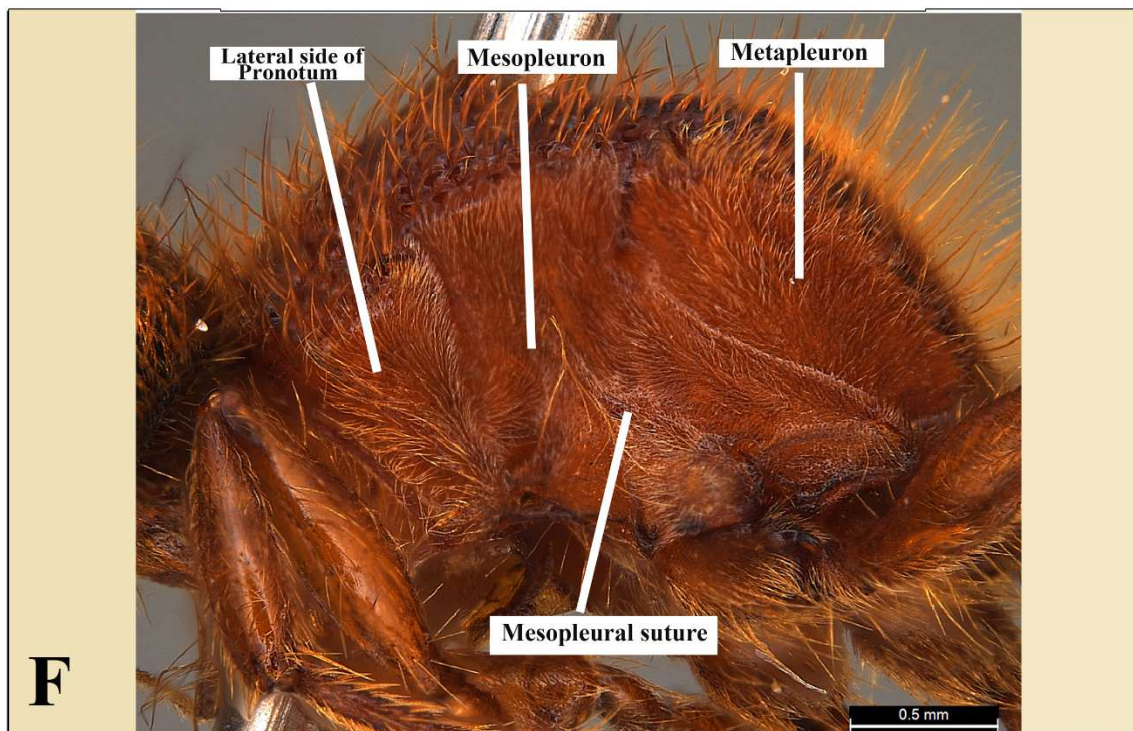
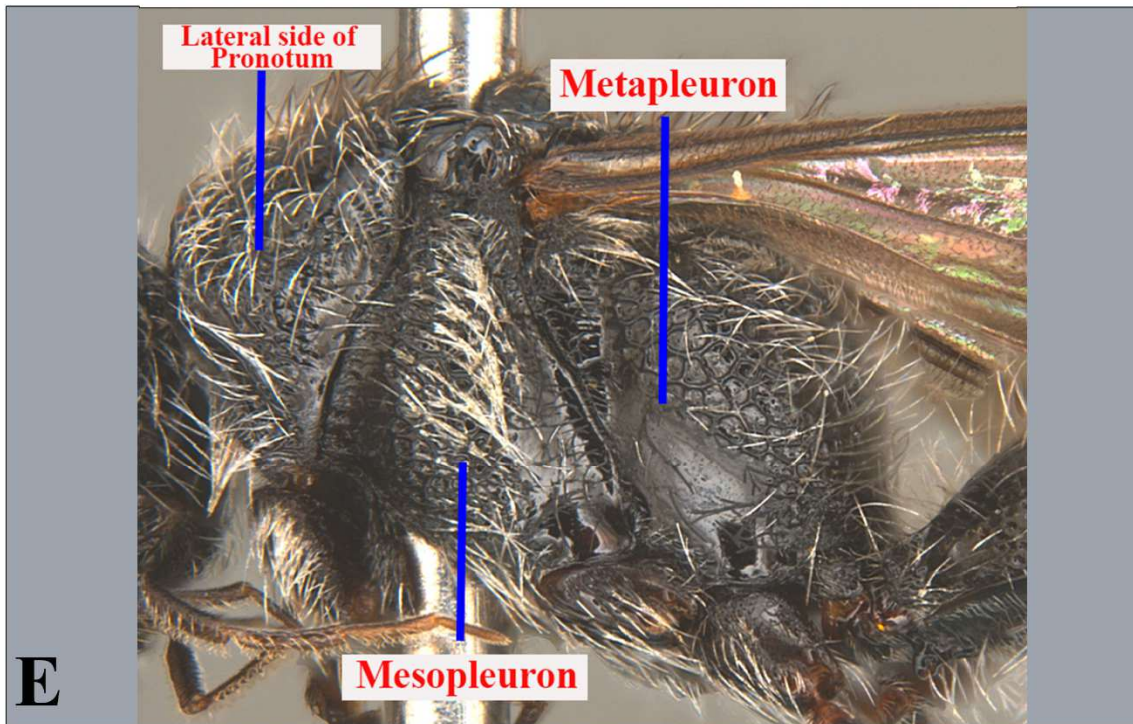
A. Male; Head, frontal view; B. Female: Head, frontal view.

PLATE 3



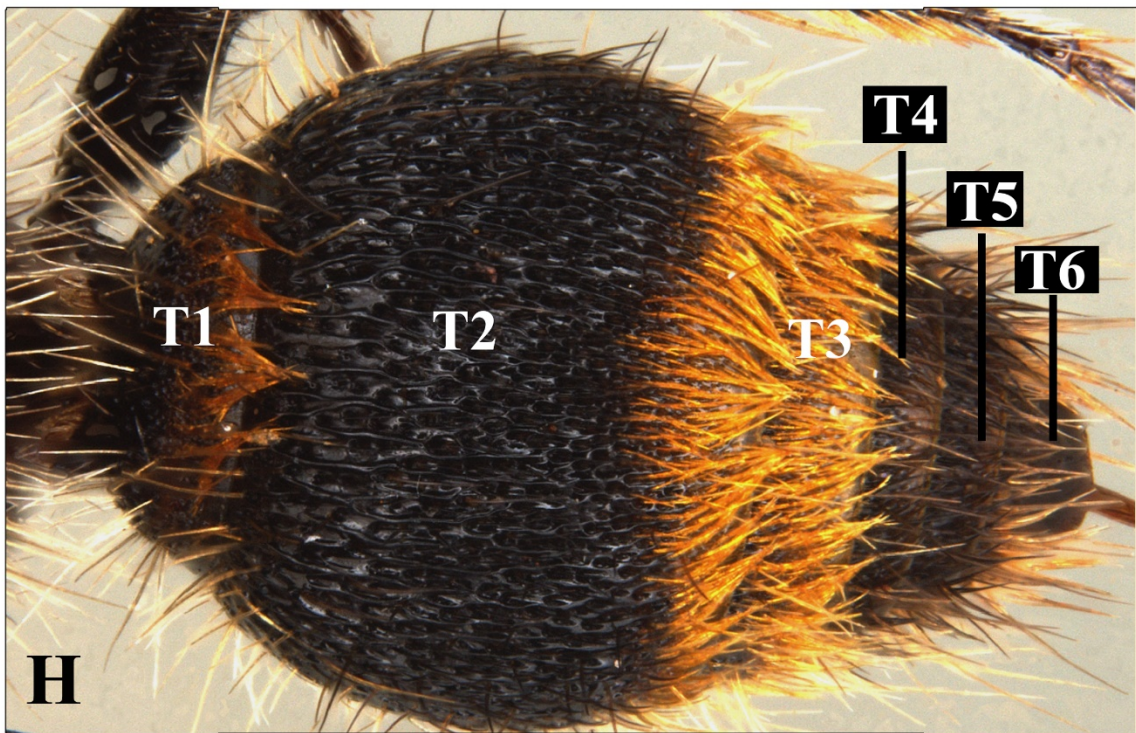
C. Male; Mesosoma, dorsal view; D. Female: Mesosoma, dorsal view.

PLATE 4



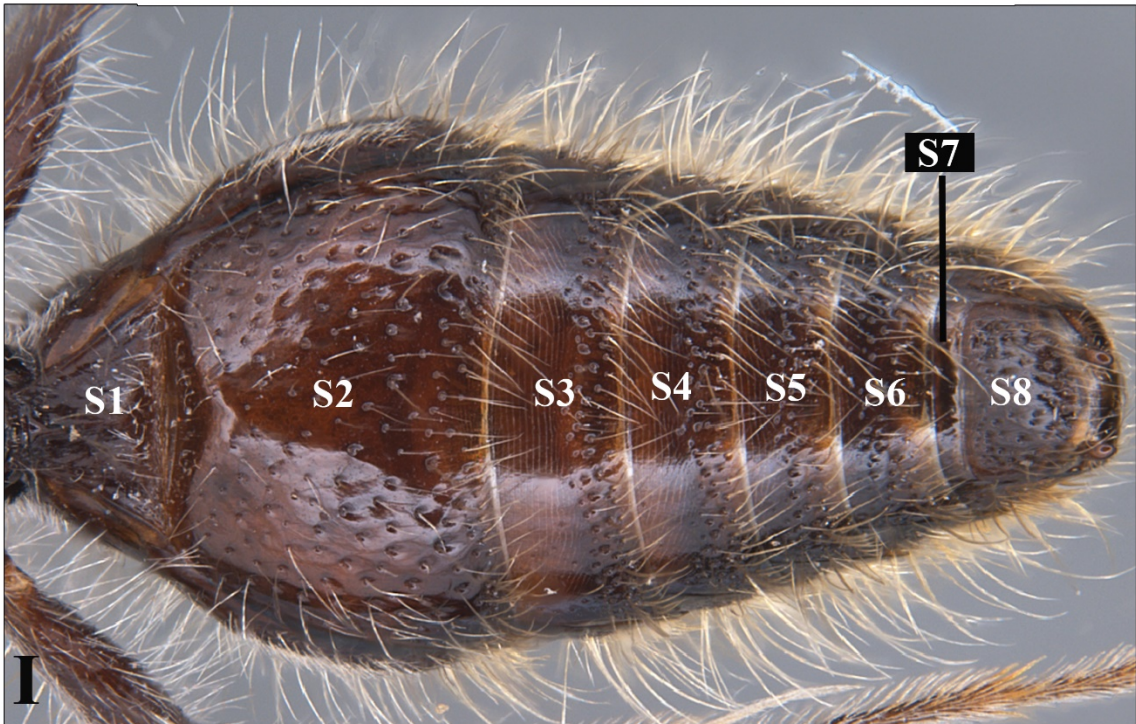
E. Male; Mesosoma, lateral view; F. Female: Mesosoma, lateral view.

PLATE 5



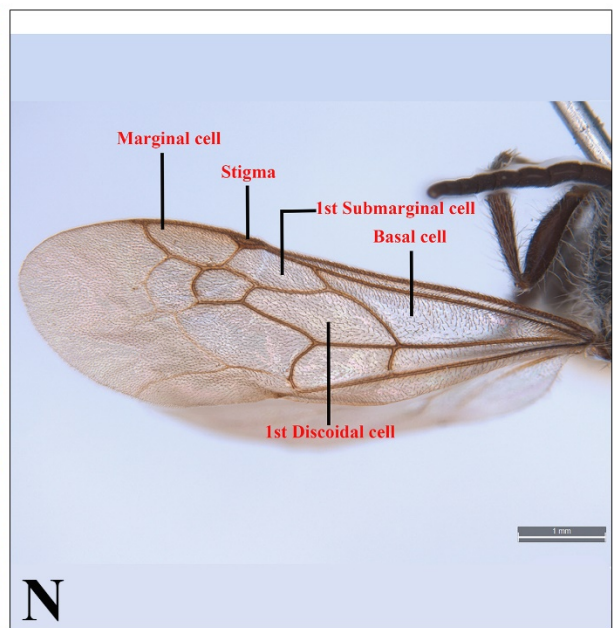
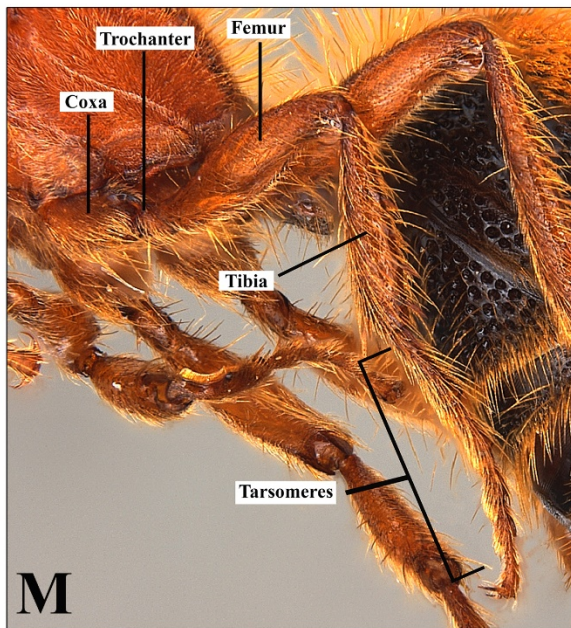
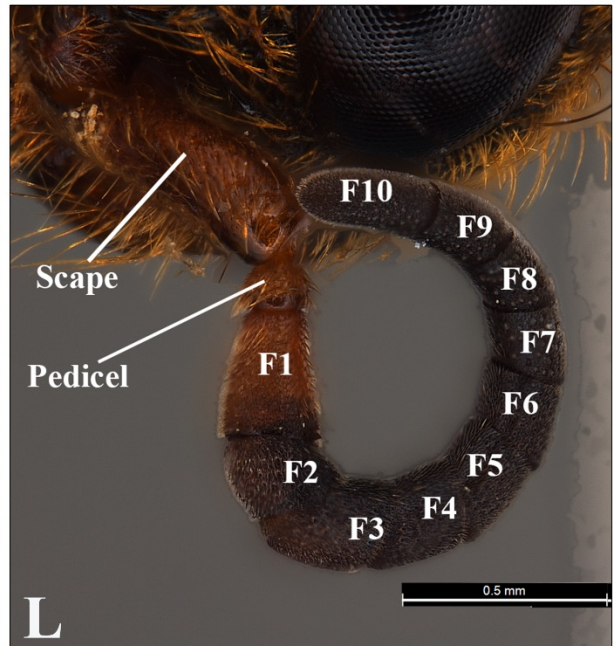
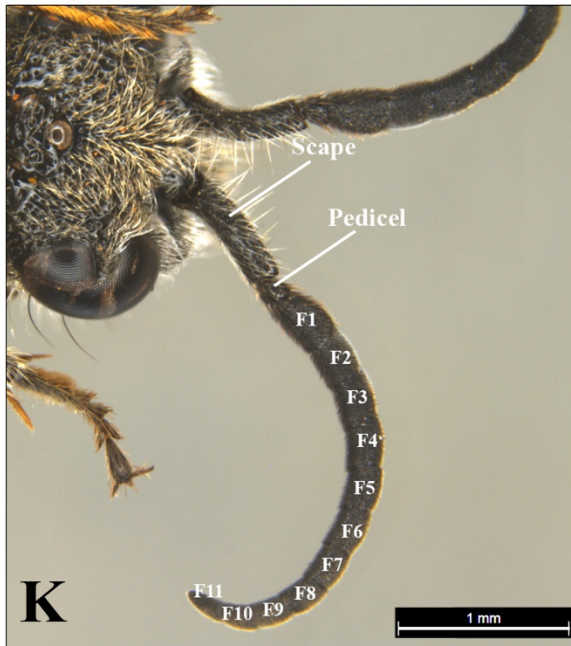
G. Male; Metasoma, dorsal view; H. Female: Metasoma, dorsal view.

PLATE 6



I. Male; Metasoma, ventral view; J. Female: Metasoma, ventral view.

PLATE 7



K. Male, Antenna; L. Female, Antenna; M. Legs; N. Male, Fore Wing

RESULTS

CHAPTER 1
FAMILY MUTILLIDAE

1. Family Mutillidae

Mutillidae is commonly called as “velvet ants” due to its hairy appearance. Mutillids are a cosmopolitan family of solitary wasps with about 4,300 species worldwide (Noort & Broad, 2024). Females are apterous and usually with dense pubescent of black, brown or reddish, with spots or bands of white, golden or red setae (Goulet & Humber, 1993) and some species are with metallic coloration. Males usually macropterous, rarely brachypterous and apterous. The females have painful sting as a defense against predators and these are advertised using aposematic coloration and by squeaky sound via stridulations. Female mutillids lays their eggs in other wasps’ nest and in another insect’s nest. The larvae of mutillids are ectoparasitoids of immatures (usually larvae of pupae) of other aculeate, Diptera, Lepidoptera, Coleoptera and Blattodea (Goulet & Humber, 1993).

1.1 General Morphology

Eyes with inner margin convex more or less straight in female and emarginated or straight in males. Males with hind wings without distinct claval lobe and jugal lobe (Jugal lobe rarely present). Metasoma sessile but short-petiolate in some. Metasomal segment–1 without a true node. Metasomal segment–2 usually with a lateral felt line on T2 or S2 or in both, but in some lateral felt line absent. Males with S8 usually simple, rarely modified. Sexual dimorphism is extreme, Females are apterous, but males are usually macropterous, rarely brachypterous and apterous. Brachypterous and apterous forms have different mesosoma than in macropterous form, with mesosoma dorsally with distinct suture traces and pronotum and mesothorax usually fused but rarely freely articulating, metanotum and propodeum usually fused (Goulet & Humber, 1993).

1.2 Systematic Position (up to tribes)

CLASS: INSECTA

ORDER: HYMENOPTERA

SUPERFAMILY: VESPOIDEA

Family: Mutillidae Latreille, 1802

Subfamily: Myrmosinae Fox, 1894

- Tribe Kudakrumiini Krombein, 1979

- Tribe Myrmosini Fox, 1894

Subfamily: Pseudophotopsidinae Bischoff, 1920

Subfamily: Ticoplinae Nagy, 1970

- Tribe Smicromyrmillini Argaman, 1988

- Tribe Ticoplini Nagy, 1970

Subfamily: Rhopalomutillinae Schuster, 1949

Subfamily: Sphaerophthalminae Schuster, 1949 (1903)

- Tribe Sphaerophthalmini Schuster, 1949 (1903)
- Tribe Dasymutillini Brothers & Lelej, 2017
- Tribe Pseudomethocini Brothers, 1975

Subfamily: Dasylabrinae Invrea, 1964

- Tribe Apteromutillini Brothers & Lelej, 2017
- Tribe Dasylabrini Invrea, 1964

Subfamily: Myrmillinae Bischoff, 1920

Subfamily: Mutillinae Latreille, 1802

- Tribe Ctenotillini Brothers & Lelej, 2017
- Tribe Smicromyrmini Bischoff, 1920
- Tribe Mutillini Latreille, 1802
- Tribe Trogaspidiini Bischoff, 1920

Subfamily: Odontomutillinae Lelej, 1983

1.3. Key to the Indian subfamilies of Mutillidae

Males

1. Macropterous. 2
 - Brachypterous and apterous. 9
2. Metasomal segment–2 without lateral felt line on tergum or sternum. S8 modified. 3
 - Metasomal segment–2 with lateral felt line on tergum or sternum. 4
3. S7 not exposed. Fore wing with elongate broad pterostigma completely sclerotized.....
 - **Myrmosinae**
 - S7 concealed. fore wing with narrow pterostigma, Sclerotization reduced.....
 - **Rhopalomutillinae**
4. Hind wing with anal lobe. **Pseudophotopsidinae**
 - Hind wing without anal lobe. 5
5. Second radio-medial cell petiolate or absent. **Ticoplinae**
 - Second radio-medial cell not petiolate, developed always. 6
6. Inner eye margin with notch. 7
 - Inner eye margin without notch. 8
7. Gonostylus curved down. **Myrmillinae**
 - Gonostylus straight or sometimes slightly curved upwards at apex. **Dasylabrinae**
8. Posterolateral scutellar angle produced. Metasomal segment–1 cylindrical.....
 - **Odontomutillinae**
 - Posterolateral scutellar angle not produced. Metasomal segment–1 wide or campaniform...
 - (never cylindrical) **Mutillinae**
9. Apterous..... 10
 - Brachypterous. 13
10. Propodeum wider than pronotum. S2 with lateral felt line. **Ticoplinae**

– Mesothorax wider than pronotum and propodeum. T2 with lateral felt line. ... **Myrmillinae**

13. Head large, much broader than mesosoma. **Myrmillinae**

– Head not large, more or less equal to mesosomal width. **Mutillinae**

Females

1. Eyes with short setae, sometimes setae sparse visible only under large magnification.
..... 2

– Eyes without any setae. 3

2. Pronotum fused with other mesosomal segments, dorsally with suture traces between pronotum and other mesosomal segments. **Ticoplinae**

– Pronotum not fused with other mesosomal segments, movable. Ocelli lacking.
..... **Myrmosinae**

3. Mesosoma dorsum with suture traces. Claws with denticles. **Psedophotopsidinae**

– Mesosoma dorsum without suture traces. Claws without any denticles. 4

4. Maxillary and labial palpi small, 2+2. **Rhopalomutillinae**

– Maxillary and labial palpi long, 6+4. 5

5. Mesopleura concave. Mesothorax not wider. 6

– Mesopleura convex. Mesothorax wider. 7

6. Metasomal segment–1 petiolate, never cylindrical. **Dasylabrinae**

– Metasomal segment–1 wide, cylindrical. **Odontomutillinae**

7. Head modified, evidently wider than pronotum. Mesopleural suture ends at mid spiracle.
..... **Myrmillinae**

– Head not modified, slightly wider than pronotum. Mesopleural suture ends at anterior spiracle. **Mutillinae**

CHAPTER 2
SUBFAMILY MYRMOSINAE

2. Subfamily MYRMOSINAE Fox, 1894

Tribe Kudakrumiini Krombein, 1979

Key to the Indian genera of subfamily Myrmosinae Fox, 1894

Females (males unknown for *Nothomyrmosa*)

1. Eye setae long, evidently visible. Distance between posterior vertex margin and posterior rim of eyes $2 \times$ longitudinal eye diameter. *Nothomyrmosa* Krombein, 1979
- Eye setae short, visible under larger magnification only. Distance between posterior vertex margin and posterior rim of eyes equals longitudinal eye diameter.
..... *Kudakrumia* Krombein, 1979

I. Genus *Kudakrumia* Krombein, 1979

Kudakrumia Krombein, 1979: 74; Lelej, 2005: 20; Lelej & Brothers, 2008: 31; Girish Kumar *et al.*, 2019: 261; Pagliano *et al.*, 2020: 14.

Type species *Kudakrumia mirabilis* Krombein, 1974, by original designation and by monotypy.

Diagnosis. Female. Head $1.1 \times$ as wide as pronotum. Clypeus medially with a lobe, apically rounded. Eyes small. Ommatidia large. Microtrichiae short, rarely visible at $100 \times$. Pronotum $0.9 \times$ propodeal width. Mesonotal width $1.2 \times$ pronotal width. Propodeum divergent posterad. Dorsal propodeal face and posterior propodeal face separated by strong carina. Propodeum medially with short strong carina.

Male. Flagellomeres short, as wide as long except last segment. Antenna lacking tyloides. Ommatidia small. Microtrichia present, visible at $32 \times$. Metanotum with short, deep anterior transverse depression. T2 with basal short transverse depression bearing longitudinal ridges.

Diversity & Distribution. The genus is represented by two valid species worldwide. This genus is only recorded from the Oriental Region, *Kudakrumia rangnekari* Girish Kumar & Lelej, 2019 from India and *Kudakrumia mirabilis* Krombein, 1979 from India & Sri Lanka (Lelej, 2005, Pagliano *et al.*, 2020 & Girish Kumar *et al.*, 2019).

Key to Indian species of *Kudakrumia* Krombein, 1979 (Female unknown for *K. rangnekari* Girish Kumar & Lelej, 2019)

1. Males. 2

-
- Females: longitudinal eye diameter equals distance between posterior vertex margin and posterior eye margin. *K. mirabilis* Krombein, 1979
 - 2. Femur yellowish. Tibia rufous. Metapleuron apically with transverse striae.....
..... *K. mirabilis* Krombein, 1979
 - Legs rufous, hind femur and tibia black. Metapleuron punctate, medially smooth.....
..... *K. rangnekari* Girish Kumar & Lelej, 2019

Species from the Central and Southern Western Ghats and its adjacent areas

i. *Kudakrumia mirabilis* Krombein, 1979

(Plates 9 & 10, Figs. 1–11)

Kudakrumia mirabilis Krombein, 1979: 74, ♂, ♀, holotype ♀, (Type locality: Palatupana Tank, Sri Lanka) [NMNH].

Description: Female. Body length. 2.3 mm. Coloration and Setation. Head ferruginous. Antennae pale yellowish. Pronotum ferruginous, latter part black. Legs pale yellowish. T1 ferruginous. T2 black, apically ferruginous. T3–6 ferruginous. Head with short appressed silver setae, sparser on frons. Mesosoma and metasoma with dense appressed short silver setae. Legs dorsally with dense appressed yellowish short setae.

Structure and sculpture. Head. Quadrangular in frontal view, coarsely and finely punctate. Eyes small, oval. Scape, pedicel and flagellomeres micro-punctate. Minimal distance between eyes $2.25 \times$ longitudinal eye diameter.

Mesosoma. Propodeum wider than pronotum. Mesosoma dorsum and posterior propodeal face finely punctate. Scutellar scale absent. Mesopleura finely shagreen. Propodeal slope abrupt/steep, rugose. Lateral propodeal margin without any teeth. Mesopleura concave. Mid and hind tibia without any row of spines.

Metasoma. T2 slightly wider than T1. T1 and T2 with coarse fine punctures. T3 and T4 sparsely punctate. T6 finely shagreen. S2 with large punctures. S3 and S4 with fine coarse punctures.

Male. Body length 4.08 mm. Coloration and Setation. Head and clypeus black. Antennal tubercles, scape, pedicel, F1 and mandibles ferruginous. F2–11 brownish. Mesosoma black. Tegulae yellowish. Frontal leg yellowish. Mid and hind coxa black, latter yellowish. T1–5

black. T6 brownish. T7 apically yellowish, latter part brownish. S1–6 black. S7 brownish. S8 apically yellowish, latter part black. Head with sub-erect short silver setae. Gena with appressed short silver setae. Clypeus with sub-erect short yellowish-silver setae. Scape with short yellowish setae. Flagellomeres with silvery micro-pubesence. Mandible ventrally with dense sub-erect pale yellowish setae. Mesosoma with sub-erect and appressed short silvery setae. Tegulae with short sub-erect yellowish setae. Mesopleuron with sparse sub-erect short silvery setae. Legs with sub-erect and appressed pale yellowish setae. T1–6 with sparse erect and dense appressed short silvery setae. S1 with sparse erect and sub-erect silvery setae. S7 and 8 with sparse sub-erect and appressed yellowish setae.

Structure and sculpture. Head. Almost hexagonal in frontal view, conical at vertex, sculptures irregular. Eyes large-sized, oval, bulged, slightly emarginated. Scrobal carina not developed. Clypeus convex. Antennal tubercles sparsely punctate. Scape laterally flattened. Pedicel and flagellomeres micro-punctate. Ocelli small, POL $0.52 \times$ OOL. Ratio of pedicel to flagellomeres 1 to 3 is 0.30: 0.33: 0.32: 0.30. Minimal distance between eyes $1.36 \times$ longitudinal eye diameter. Mandible apically acuminate.

Mesosoma. Pronotal width $0.92 \times$ head width behind eyes. Propodeal width $0.86 \times$ pronotal width. Pronotum and mesoscutellum imbricate. Mesoscutum imbricate with punctures. Propodeum coarsely punctate. Tegulae micro-punctate, lateral margin emarginated. Notauli present, almost touching anterior mesoscutal border. Parapsids present, present at apical half of mesoscutum. Mesopleuron imbricate with punctures, except median smooth area. Metapleuron smooth with transverse striae basally.

Wings. Hyaline. Tubular veins extending to apical margin.

Metasoma. T2 width $1.80 \times$ T1 width. T1 apically striate, latter part imbricate with fine punctures. T2 basally flattened. T2–8 imbricate with fine punctures. S1 coarsely rugose. S2–3 imbricate with fine punctures. S4 and 5 with basal half punctate, latter imbricate. S6–8 imbricate.

Genitalia. Gonostyle long, laterally with sparse setae. Digitus and cuspis merged. Penis valve stout, apically triangular.

Materials examined. Kerala: 7 ♂, Kozhikode district, East Hill, Latitude: 11.2927 N, Longitude: 75.7780 E, Altitude: 36 m, 25.iii.2015 & 10.vii.2015, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV.12170–12176; 1 ♂, Thrissur district, Elanad, Latitude: 10.6277 N,

Longitude: 76.3963 E, Altitude: 66 m, 19.ix.2018, Coll. N.V. Ayisha Mawadda, ZSI/WGRC/IR/INV.12177.

Distribution. India: Kerala; *Elsewhere:* Sri Lanka (Lelej, 2005; Girish Kumar *et al.*, 2019).

ii. *Kudakrumia rangnekari* Girish Kumar & Lelej, 2019

(Plate 11, Figs. 12–18)

Kudakrumia rangnekari Girish Kumar & Lelej 2019: 261, ♂, Holotype ♂ (Type locality: Kotigao Wildlife Sanctuary, South Goa district, Goa, India) [ZSIK].

Description: Male. Body length 3.28 mm. Coloration and Setation. Head and clypeus black. Antennal tubercles, scape, pedicel and mandibles ferruginous. Flagellomeres brownish. Mesosoma black. Tegulae yellowish. Pro and mid legs yellowish, except mid coxa dorsally black. Hind legs brownish, except hind coxa black. Metasoma black. Head with dense appressed short silvery setae. Clypeus with sub-erect short yellowish setae. Scape and pedicel with sub-erect yellowish setae. Flagellomeres with silvery micro-pubesence. Mandible ventrally with dense sub-erect pale yellowish setae. Mesosoma with dense sub-erect and appressed short silvery setae. Tegulae with short sub-erect yellowish setae. Meospleuron medially with sparse sub-erect short silvery setae. Legs with sub-erect and appressed yellowish setae. T1–8 short, black and with silvery setae and laterally with erect long pale yellowish setae. S1–8 with sparse silvery sub-erect setae and sparse apical fringe of silvery setae.

Structure and sculpture. Head. Oval in frontal view, conical at vertex, imbricate. Vertex imbricate with sparse punctures. Eyes large-sized, oval, slightly emarginated. Scrobal carina not developed. Clypeus flattened. Antennal tubercles sparsely punctate. Scape, pedicel and flagellomeres micro-punctate. Ocelli small, POL 0.45 × OOL. Ratio of pedicel to flagellomeres 1 to 3 is 0.38: 0.39: 0.42: 0.40. Minimal distance between eyes 1.22 × longitudinal eye diameter. Mandible apically with three teeth.

Mesosoma. Pronotal width 1.007 × head width behind eyes. Propodeal width 0.58 × pronotal width. Pronotum, mesoscutum and mesoscutellum imbricate with polygonal cells. Propodeum coarsely punctate. Tegulae micro-punctate, lateral margin emarginated, medially with a fovea. Notauli present, almost touching anterior mesoscutal border. Parapsids present,

two third length of mesoscutum. Meso and metapleuron coarsely punctate, except median smooth area.

Wings. Hyaline. Tubular veins extending to apical margin. Basal part of medial vein of hindwing curved.

Metasoma. T2 width 1.76 × T1 width. T1 and 2 with small coarse punctures. T5–7 imbricate with small punctures. T2 and S2 without any long lateral felt line. S1 with a distinct process, coarsely punctate. sparse punctures and fine rugae. S2–6 imbricate-punctate. S7 not visible. S8 without any tubercles or carina, imbricate with fine rugae.

Genitalia. Gonostyle long, medially dilated, apically acuminate. Penis valve stout, apically triangular.

Female. Unknown.

Material examined. Goa: 1♂, South Goa district, Kotigao wildlife sanctuary, Latitude: 14.9766 N, Longitude: 74.2061 E, Altitude: 108 m, 18.v.2018, Coll. P. Girish Kumar, ZSI/WGRC/IR/INV.12178. Kerala: 1♂, India: Kerala, Kasaragod district, Ranipuram Hill, Latitude: 12.4156 N, Longitude: 75.3530 E, Altitude: 901 m, 21.i.2018, Coll. P.M. Rajan, ZSI/WGRC/IR/INV.12179.

Distribution. India: Goa, Kerala (Girish Kumar *et al.*, 2019).

PLATE 8

Species distribution of the genus *Kudakrumia* Krombein from Central and Southern Western Ghats and its adjacent areas

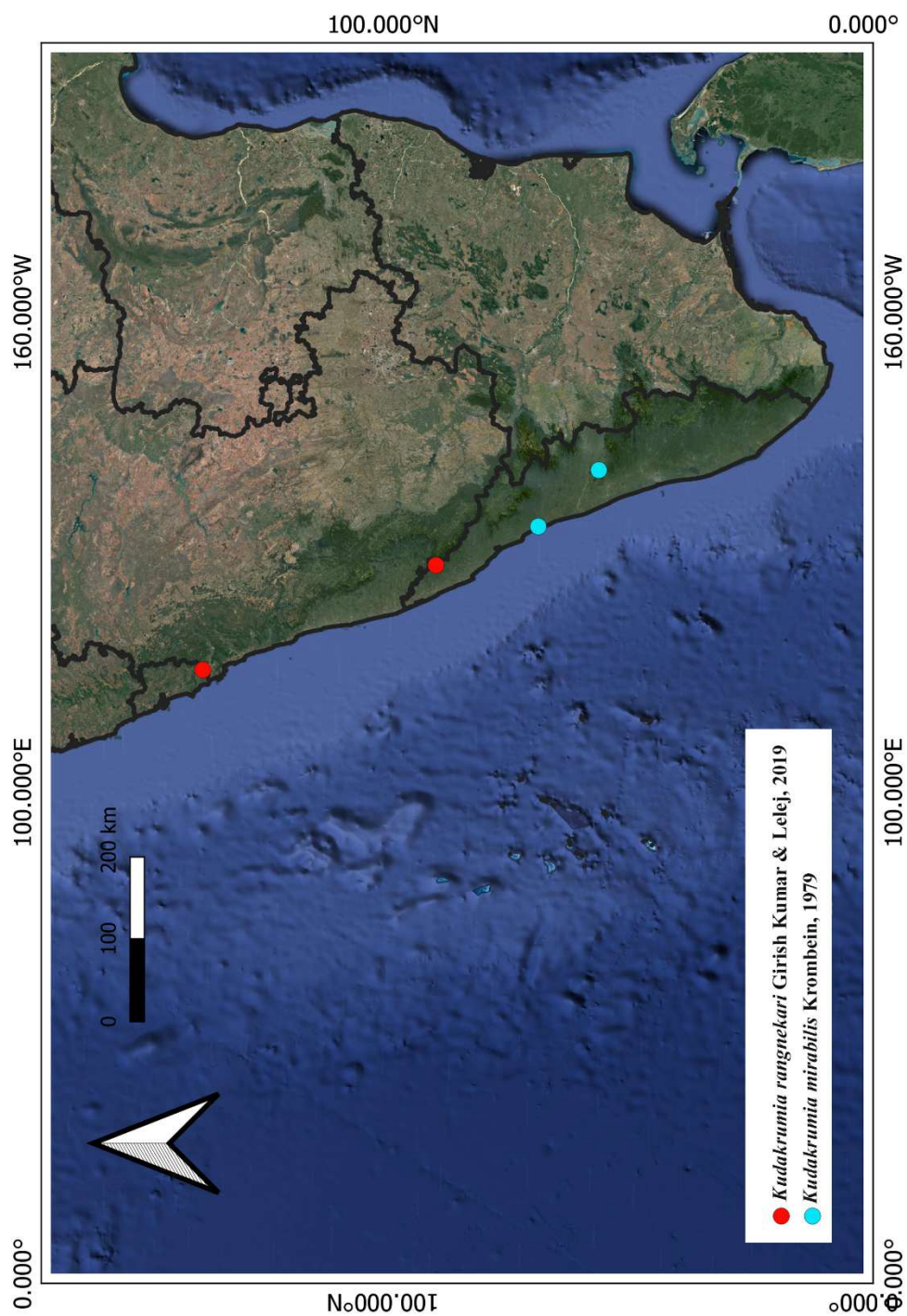
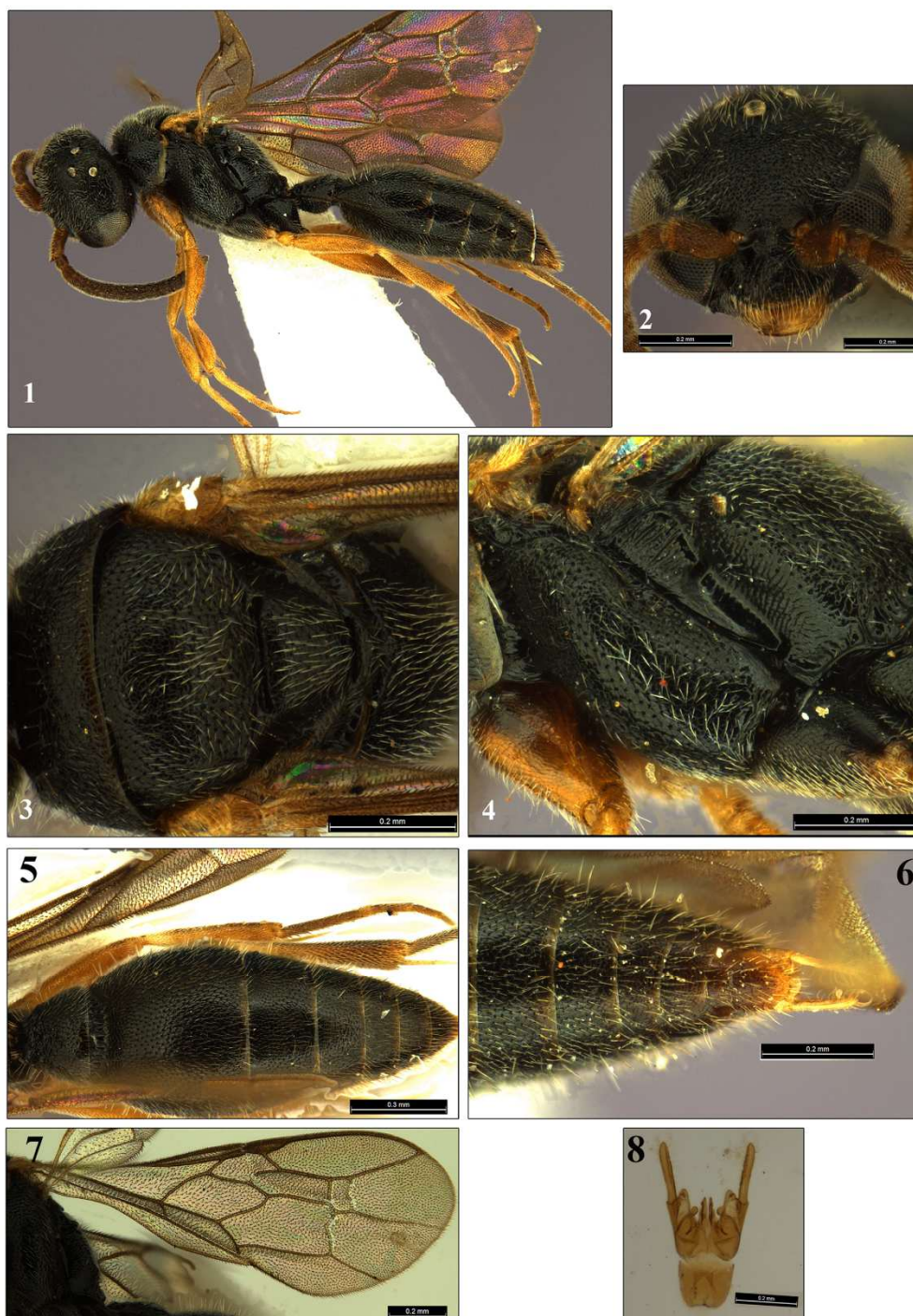
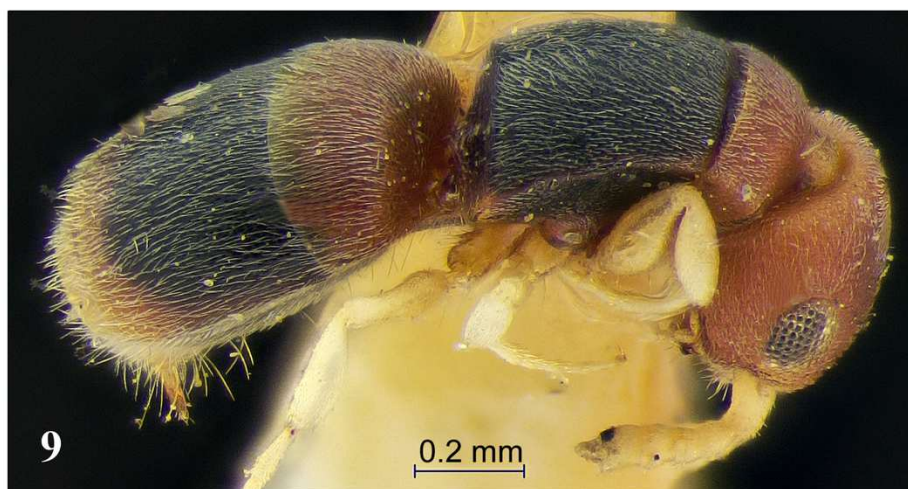


PLATE 9



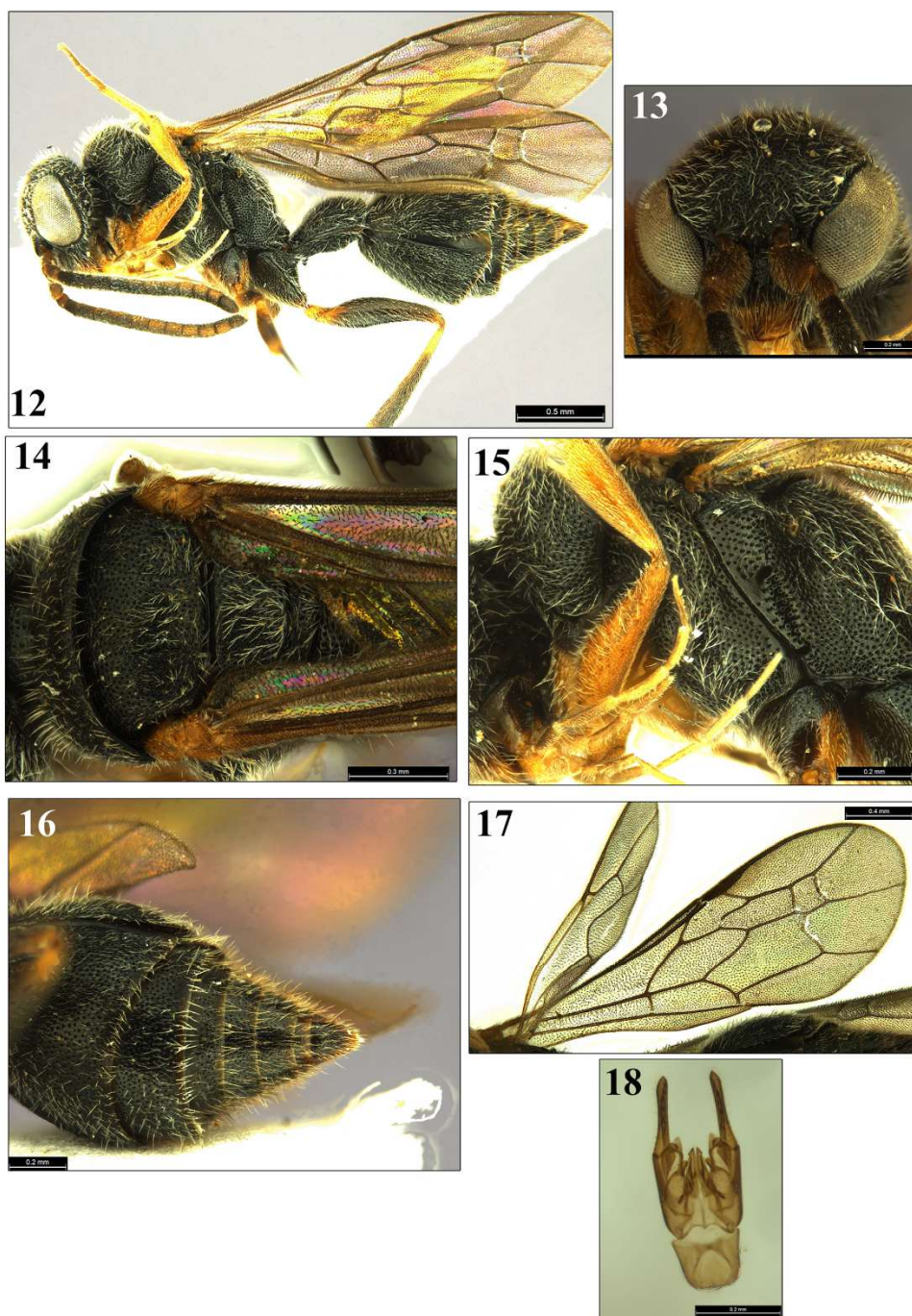
Kudakrumia mirabilis Krombein, 1979 (Male). 1. Body, lateral view. 2. Head, frontal view. 3. Mesosoma, dorsal view. 4. Mesosoma, lateral view. 5. Metasoma, dorsal view. 6. Metasoma, ventral view. 7. Fore wing. 8. Genitalia.

PLATE 10



Kudakrumia mirabilis Krombein, 1979 (Female). 1. Body, lateral view. 2. Head & mesosoma, lateral view. 3. Head, dorsal view.

PLATE 11



Kudakrumia rangnekari Girish Kumar & Lelej, 2019 (Male). 12. Body, lateral view. 13. Head, frontal view. 14. Mesosoma, dorsal view. 15. Mesosoma, lateral view. 16. Metasoma, ventral view. 17. Fore wing. 18. Genitalia.

CHAPTER 3
SUBFAMILY MUTILLINAE

3. Subfamily MUTILLINAE Latreille, 1802

Key to the Indian tribes of subfamily Mutillinae Latreille, 1802

Males

1. Tegula long, reaching over mesoscuto-scutellar suture (if short, then eye emargination weak). 2
 - Tegula not projecting over mesoscuto-scutellar suture. Metasomal segment–1 narrow. 3
2. Metasomal segment–1 cylindrical, wide. **Mutillini**
 - Metasomal segment–1 not cylindrical, sometimes wide. **Ctenotillini**
3. F2 1.5– 2.0 × longer than F1. The distance between the stigmatic cell base and the vein SC RS origin is nearly twice the stigmatic cell length or more than twice the first abscissa RS length. **Smicromyrmini**
 - F2 length equals F1 length. The distance between the stigmatic cell base and the vein SC RS origin equals stigmatic cell length or the first abscissa RS length. **Trogaspidiini**

Females

1. Propodeum with row of denticles or metasomal segment–1 wide. Head large. 2
 - Propodeum without row of denticles or metasomal segment–1 not wide. Head not large. 3
2. T1 wide cylindrical. **Mutillini**
 - T1 not cylindrical, sometimes wide. **Ctenotillini**
3. T2 basally with one or three spots of setae. If without basal spots of setae, then mesosoma posteriorly convergent (in some *Promecilla*) **Smicromyrmini**
 - T2 basally with two spots of setae. Rarely without any such spots (in some *Wallacidia* and *Trogaspidia*). **Trogaspidiini**

I. Tribe Ctenotillini Brothers & Lelej, 2017

Key to the Indian genera of tribe Ctenotillini Brothers & Lelej, 2017 (Modified from Lelej, 2023a)

Males

1. T4–6 with medial longitudinal carina. 2
 - T4–6 without medial longitudinal carina. *Lehritilla* Lelej, 2005
2. S7 with lateral tubercles. 3
 - S7 without lateral tubercles. *Ctenotilla* Bischoff, 1920
3. S8 with a medial concavity, boarded by tuft of setae
 - *Cephalotilla* Bischoff, 1920
 - S8 with a triangular emargination, boarded by carina. *Denistilla* Lelej, 2005

Females

1. T2 without two sub-basal white spots disposed transversely. 2
 - T2 with two basal spots of white setae disposed transversely. *Denistilla* Lelej, 2005
2. T1 width equal to propodeum width. Postgenal carina anteriorly without dent.....
 - *Ctenotilla* Bischoff, 1920
 - T1 width much less than propodeum width. Postgenal carina anteriorly with dent.....
 - *Cephalotilla* Bischoff, 1920

I. Genus *Cephalotilla* Bischoff, 1920

Cephalotilla Bischoff, 1920: 24; 1921, 86(4): 509; Nonveiller, 1979: 81; Lelej & Brothers, 2008: 14; Brothers & Lelej, 2017: 95; Pagliano *et al.*, 2020: 157; Lelej, 2023a: 6; Terine *et al.*, 2024b: 191. *Ctenotilla*: Brothers, 1975: 592.

Type species: *Cephalotilla kamogana* Bischoff, 1921, ♂, by subsequent designation of Bischoff, 1921: 509.

Diagnosis. *Female.* Mandible without any sub-basal denticle. Pygidial plate granulose or micro-reticulate. T2 without two sub-basal white spots disposed transversally. T2 apically and

T3 with a band of yellowish or white setae, band on T2 widened medially. Propodeum wider than T1 width. Postgenal carina anterad with dent.

Male. T4–6 with medial longitudinal carina. S2 invaginated, with a distinct lateral longitudinal carina and medial longitudinal carina. S7 visible, with lateral tubercle. S8 medially deeply concave, lateral border with tuft of carina, without any sub-lateral tubercles.

Diversity & Distribution. The genus is represented by 56 valid species worldwide. Most of the species i.e. 54 species are recorded from the Afrotropical region (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2024). Two species (*Cephalotilla (Cephalotilla) porcella* (Turner, 1911) (Sri Lanka) and *Cephalotilla (Cephalotilla) manikandani* Terine, Lelej & Girish Kumar, 2024 (India)) are recorded from the Oriental Region. Only one species (*Cephalotilla (Cephalotilla) manikandani* Terine, Lelej & Girish Kumar, 2024) has been recorded from India.

Note: Only one species is recorded from India, so key to Indian species is not provided.

Species from the Central and Southern Western Ghats and its adjacent areas

i. *Cephalotilla (Cephalotilla) manikandani* Terine, Lelej & Girish Kumar, 2024

(Plate 13, Figs. 19–24)

Cephalotilla (Cephalotilla) manikandani Terine, Lelej & Girish Kumar, 2024: 191, ♀, Holotype (Type locality: Punchakolly, Malappuram district, Kerala, India) [ZSIK].

Description: Female. Body length 7.35–7.84 mm. Coloration and Setation. Head black, frons ferruginous. Antennal tubercle and scape ferruginous. Flagellomere black. Clypeus ferruginous. Mandible basal two-third ferruginous, latter part black. Mesosoma ferruginous. Legs brownish black. Metasoma black. S1 brownish-black. Head with erect and sub-erect golden setae. Gena with dense appressed silvery setae. Clypeal margin with erect long dense golden setae. Basal half of mandible with long sub-erect golden setae. Antennal tubercles and scape with long dense golden setae. Pedicel and flagellomeres with pale golden micro pubescence. Mesosoma dorsum with dense erect and sub-erect black setae. Propodeal declivity with long erect golden setae. Meso and metapleuron with sparse white and golden micro pubescence. Legs with erect and sub-erect golden and silver setae. T1 apically with

fringe of dense appressed golden setae and latter portion with appressed black setae. T2 apically with fringe of dense appressed golden setae, medially widened. T4 with dense appressed golden setae. T5 and 6 with sub-erect and appressed long black and golden setae. T6 with fringe of long erect golden setae bordering pygidial area. S1 with short sparse pale golden setae. S2 with sparse sub-erect pale silver setae. S2–5 with apical fringe of golden setae.

Structure and sculpture. Head. Oval in frontal view, slightly conical at vertex, coarsely and deeply alveolate-rugose. Eyes medium-sized, oval. Scrobal carina well developed, straight. Clypeus apical half depressed, apically flattened. Antennal tubercle rugose. Scape sparsely punctate. Flagellomeres with minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.16: 0.56: 0.33: 0.39. Minimal distance between eyes $1.34 \times$ longitudinal eye diameter. Mandible narrowed towards apex.

Mesosoma. Pronotal width $1.10 \times$ head width behind eyes. Propodeal width $0.93 \times$ pronotal width. Mesosoma dorsum rugose-alveolate, width of alveolae on the mesosomal dorsum $3.19 \times$ width of punctures on head. Scutellar scale absent. Propodeal slope abrupt/steep, alveolate. Propodeum with rows of denticles. Meso and metapleuron with fine rugose. Mid and hind tibia with two rows of spines, four in each row.

Metasoma. T2 width $1.66 \times$ T1 width. T1–5 rugose-punctate. T2 with a long lateral felt line, felt line $0.49 \times$ T2 length. Pygidium elongate, granulate. S1 with sparse small punctures and with a small blunt tooth medially. S2–6 punctate, S2 basally with minute punctures. S3–6 coarsely punctate.

Male. Unknown.

Materials examined. Kerala: 3♀, Malappuram district, Nilambur, Punchakolly, Latitude: 11.383 N, Longitude: 76.3773 E, Altitude: 117 m, 22.iv.2022, Coll. Terine J.B., ZSI/WGRC/IR/INV. 24790, 24791, 24792; 1♀, Kozhikode district, Elathur, Latitude: 11.3555 N, Longitude: 75.7690 E, 28 m, 27.xii.2020, Coll. C. Binoy, ZSI/WGRC/IR/INV. 24793.

Distribution. Kerala (Terine *et al.*, 2024).

Remarks. Terine *et al.* (2024) recorded the genus *Cephalotilla* Bischoff, 1920 for the first time from India, describing this species from Kerala. This genus currently includes only two valid species from the Oriental region (*Cephalotilla (Cephalotilla) porcella* (Turner, 1911), ♂, ♀ (Sri Lanka) and *Cephalotilla (Cephalotilla) manikandani* Terine, Lelej & Girish Kumar, 2024 ♀ (India)), the other 54 species are from the Afrotropical Region.

PLATE 12

Species distribution of the genus *Cephalotilla* Bischoff from Central and Southern Western Ghats and its adjacent areas

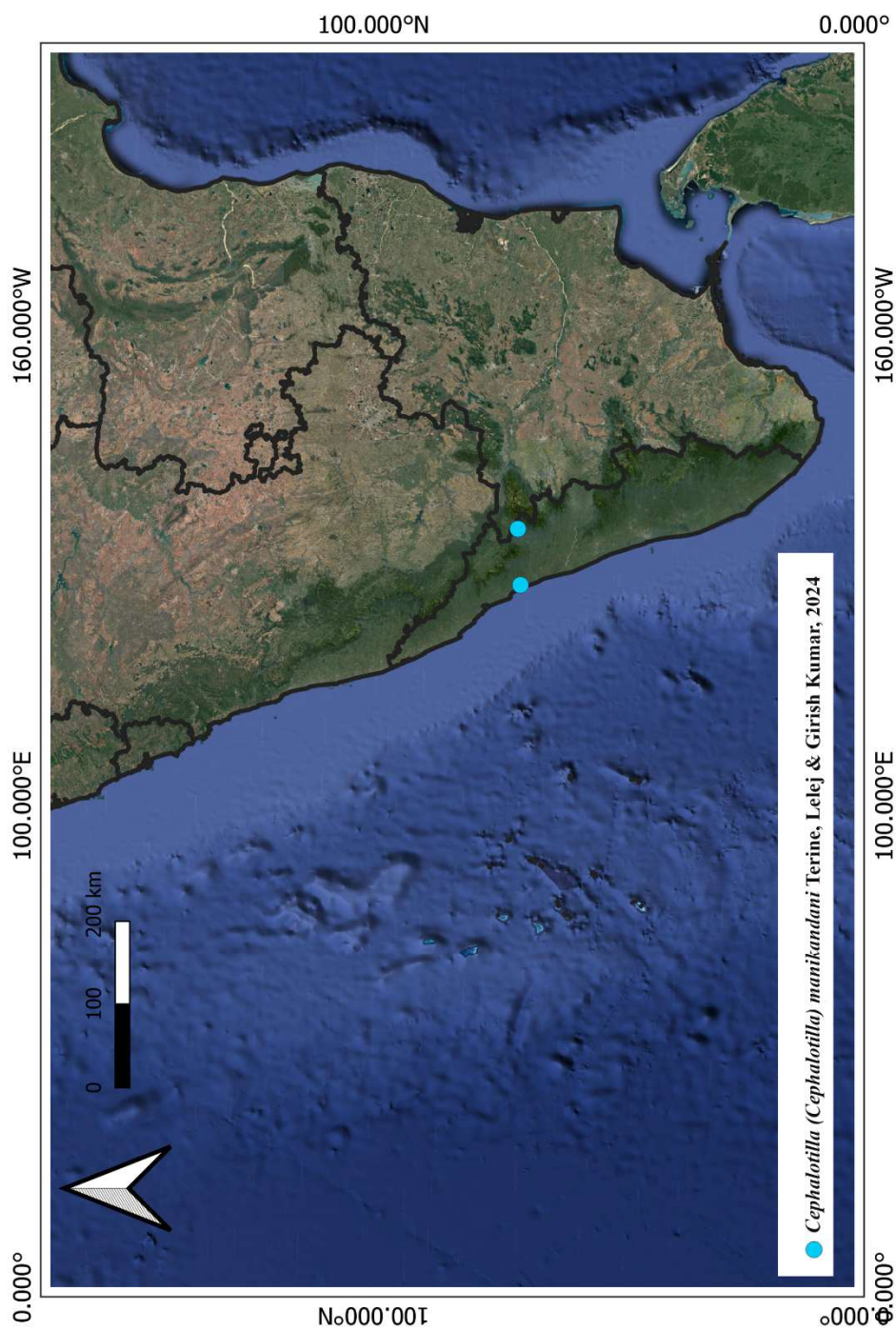
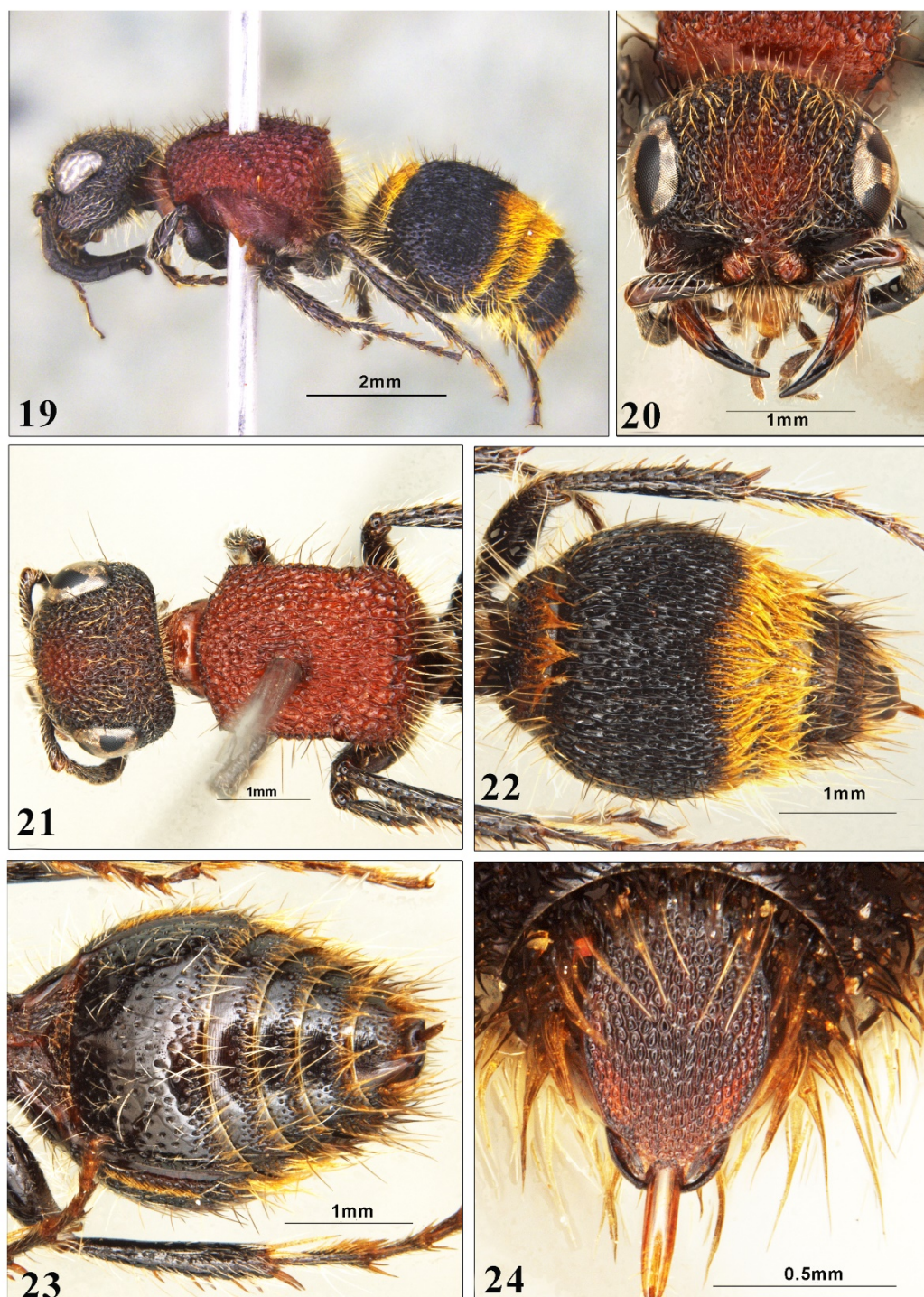


PLATE 13



Cephalotilla (Cephalotilla) manikandani Terine, Lelej & Girish Kumar, 2024 (Female). 19. Body, lateral view. 20. Head, frontal view. 21. Head & Mesosoma, dorsal view. 22. Metasoma, dorsal view. 23. Metasoma, ventral view. 24. Pygidium.

II. Tribe Zeugomutillini Waldren, 2023

Key to the Indian genera of tribe Zeugomutillini Waldren, 2023

Males

1. S7 with tubercles. *Zeugomutilla* Chen, 1957
 – S7 without any tubercles. *Strangulotilla* Nonveiller, 1979

Females

1. T2 basal half with two pale spots disposed transversely. *Zeugomutilla* Chen, 1957
 – T2 without two pale setae spots, medially at most with a spot of pale setae.....
 *Strangulotilla* Nonveiller, 1979

I. Genus *Strangulotilla* Nonveiller, 1979

Strangulotilla Nonveiller, 1979: 23, 24, 26; Lelej & Nemkov, 1997: 4, 18; Lelej & van Harten, 2006: 15; Lelej & Brothers, 2008: 60; Brothers & Lelej, 2017: 95; Pagliano *et al.*, 2020: 132, 167; Terine *et al.*, 2021b: 430. *Ctenotilla* Bischoff, 1920: 28; 1921: 585; Bradley & Bequaert, 1928: 72, 116. Type species: *Mutilla thoracosulcata* Magretti, 1906, ♂, by original designation.

Diagnosis. Female. Head posterolateral angles rounded. Mesosomal lateral margin parallel or slightly dilated at propodeum. Mesosomal posterior margin with 7–12 spines. Scutellar scale absent. T1 without defined dorsal surface. T2 without two spots of setae, at most with a median spot of setae. T6 with well-developed pygidial plate, glabrous-shiny or weakly shagreen, laterally carinated.

Male. Head quadrangular. Eyes deeply emarginated. Prementum flat. Mandible bidentate, inner margin with strong tooth. Metasomal sternum modified, rarely simple. T2 with lateral felt line. S2 without any lateral felt line. S7 not modified. S8 with elongate curved carina, rarely ecarinate. Gonostyle apically acuminate, rounded and slightly flattened.

Diversity & Distribution. The genus is represented by 21 valid species and one subspecies worldwide. Most of the species are recorded from the Afrotropical region. From the Oriental region only two species are recorded. Only one species has been recorded from India (*Strangulotilla sureshani* Terine, Lelej & Girish Kumar, 2021) (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2021b).

Note: Only one species is recorded from India, so key to Indian species is not provided.

Species from the Central and Southern Western Ghats and its adjacent areas

i. *Strangulotilla sureshani* Terine, Lelej & Girish Kumar, 2021

(Plates 15 & 16, Figs. 25–37)

Strangulotilla sureshani Terine, Lelej & Girish Kumar, 2021b: 430, 432–433, ♂, Holotype ♂
(Talakaveri Wildlife Sanctuary, Kodagu district, Karnataka, India) [ZSIK].

Description: Male. Body length 7.73 mm. Coloration and Setation. Head black. Antennal tubercles, antennae and clypeus dark ferruginous. Mandible dark ferruginous, margins black. Clypeus black. Mesosoma black. Tegulae yellowish brown. Metasoma brownish. Head with dense appressed and erect long silvery setae. Gena and below eyes with appressed dense silvery setae. Clypeus with dense appressed silvery setae. Scape with sub-erect silvery setae. Pedicel and flagellomeres with silvery micro-pubesence. Mandible with dense sub-erect silvery setae. Pronotum with sparse sub-erect silvery setae and marginally with erect long silvery setae. Mesoscutum with sparse sub-erect brownish setae. Scutellum with long erect silvery setae. Propodeum with long erect silvery setae. Legs with dense erect and appressed silvery short setae. Mesopleuron with dense appressed sparse silvery setae. T1 with erect long silvery setae. T2–8 with dense appressed pale yellowish setae and laterally with erect long pale yellowish setae. S1 and S2 with sparse sub-erect silvery setae. S2–8 with apical fringe of silvery setae.

Structure and sculpture. Head. Oval in frontal view, conical at vertex, coarsely punctate. Eyes medium-sized, oval, emarginated. Scrobal carina well developed. Clypeus medially with a longitudinal depression. Antennal tubercles sparsely punctate. Scape punctate, laterally flattened with slight rugae and ventrally bicarinate. Pedicel and flagellomeres with minute punctures. Ocelli small, POL $0.50 \times$ OOL. Ratio of pedicel to flagellomeres 1 to 3 is 0.27: 0.37: 0.58: 0.63. Minimal distance between eyes $1.83 \times$ longitudinal eye diameter. Mandible bidentate apically, basally with a strong tooth. Occipital carina developed.

Mesosoma. Pronotal width $0.80 \times$ head width behind eyes. Propodeal width $1.11 \times$ pronotal width. Pronotum, mesoscutum and mesoscutellum with dense coarse large punctures and fine rugae. Propodeum reticulate, reticulae larger medially. Tegulae large, projecting over scuto-scutellar carinae and with sparse small punctures, latter part smooth and shiny. Notauli

present on posterior two-third of mesoscutum. Parapsids present on posterior half of mesoscutum. Meso and metapleuron with fine rugae.

Wings. Flavo-hyaline. Tubular veins not extending to apical margin.

Metasoma. T2 width $1.91 \times$ T1 width. T1–5 with small coarse punctures. T2 with a long lateral felt line, felt line $0.42 \times$ T2 length. S2 without any lateral felt line. S1 with sparse punctures and fine rugae. S2–8 punctate. S7 not visible. S8 without any tubercles or carina.

Genitalia. Gonostyle long, curved, apex rounded and laterally flattened. Cuspis wide, curved, lamellate, rounded apically and with long dense setae ventrally and apically. Digitus stick-like with sparse long sub-erect setae apically. Penis valve stout, apically triangulate and ventrally with an acuminate tooth.

Female. Unknown.

Material examined. Karnataka: ♂, Kodagu district, Talakaveri Wildlife Sanctuary, Latitude: 12.4326 N, Longitude: 75.4555 E, Altitude: 374 m, 5.ii.2013, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV. 17107.

Distribution. India: Karnataka (Terine *et al.*, 2021b).

Remarks. Terine *et al.* (2021b) recorded the genus *Strangulotilla* Nonveiller, 1979 for the first time from India, describing this species from Karnataka.

PLATE 14

Species distribution of the genus *Strangulotilla* Nonveiller from Central and Southern Western Ghats and its adjacent areas

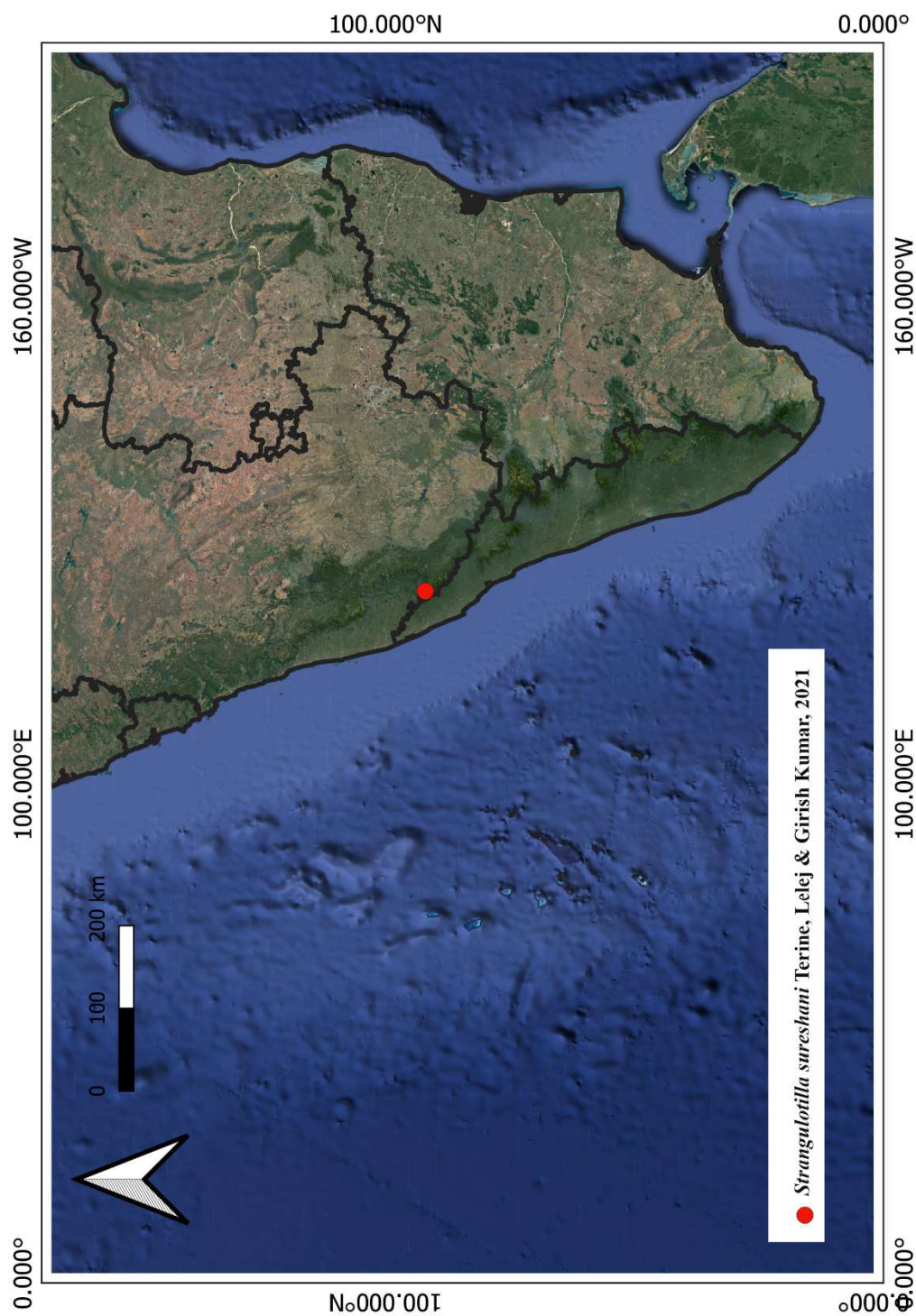
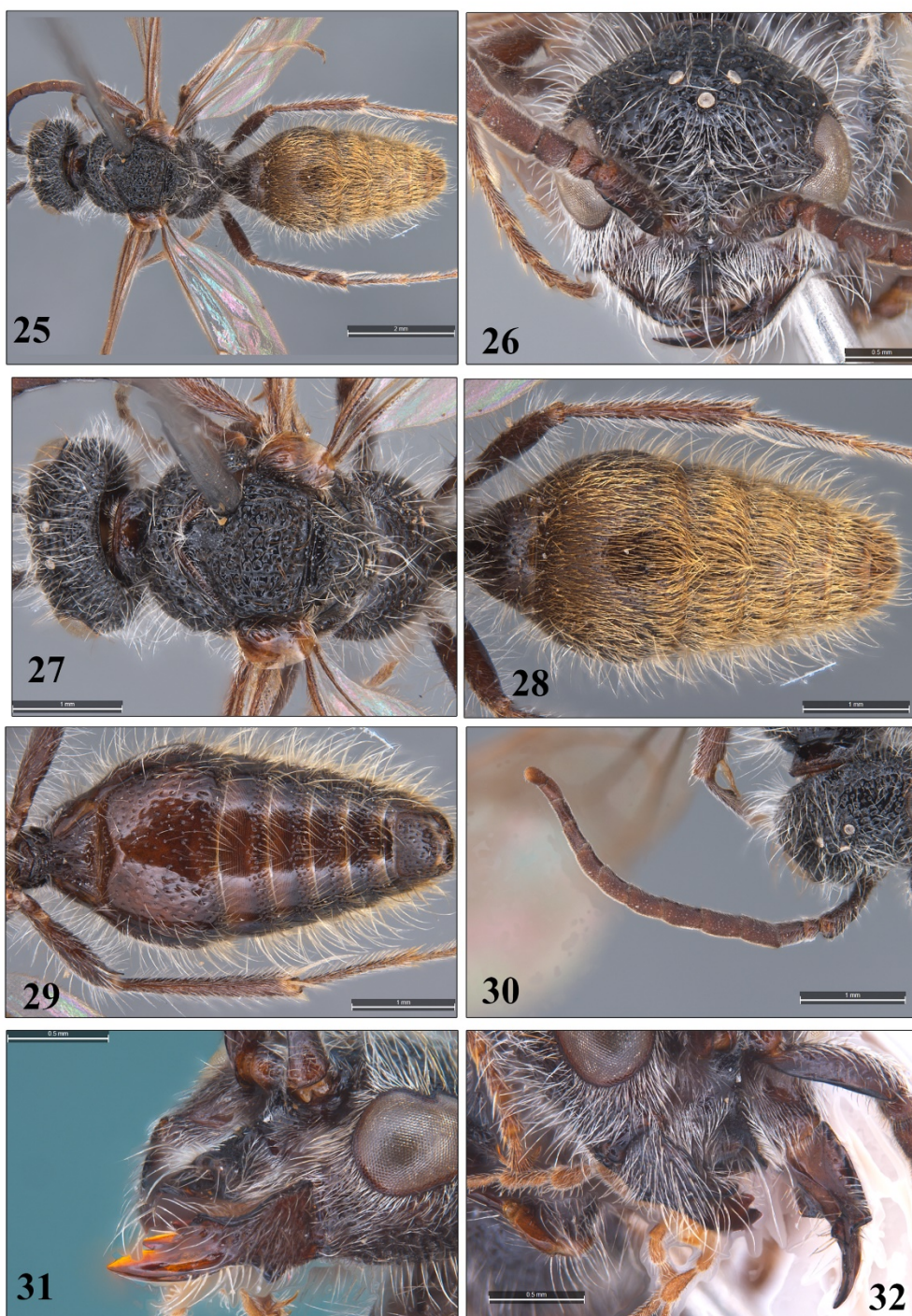
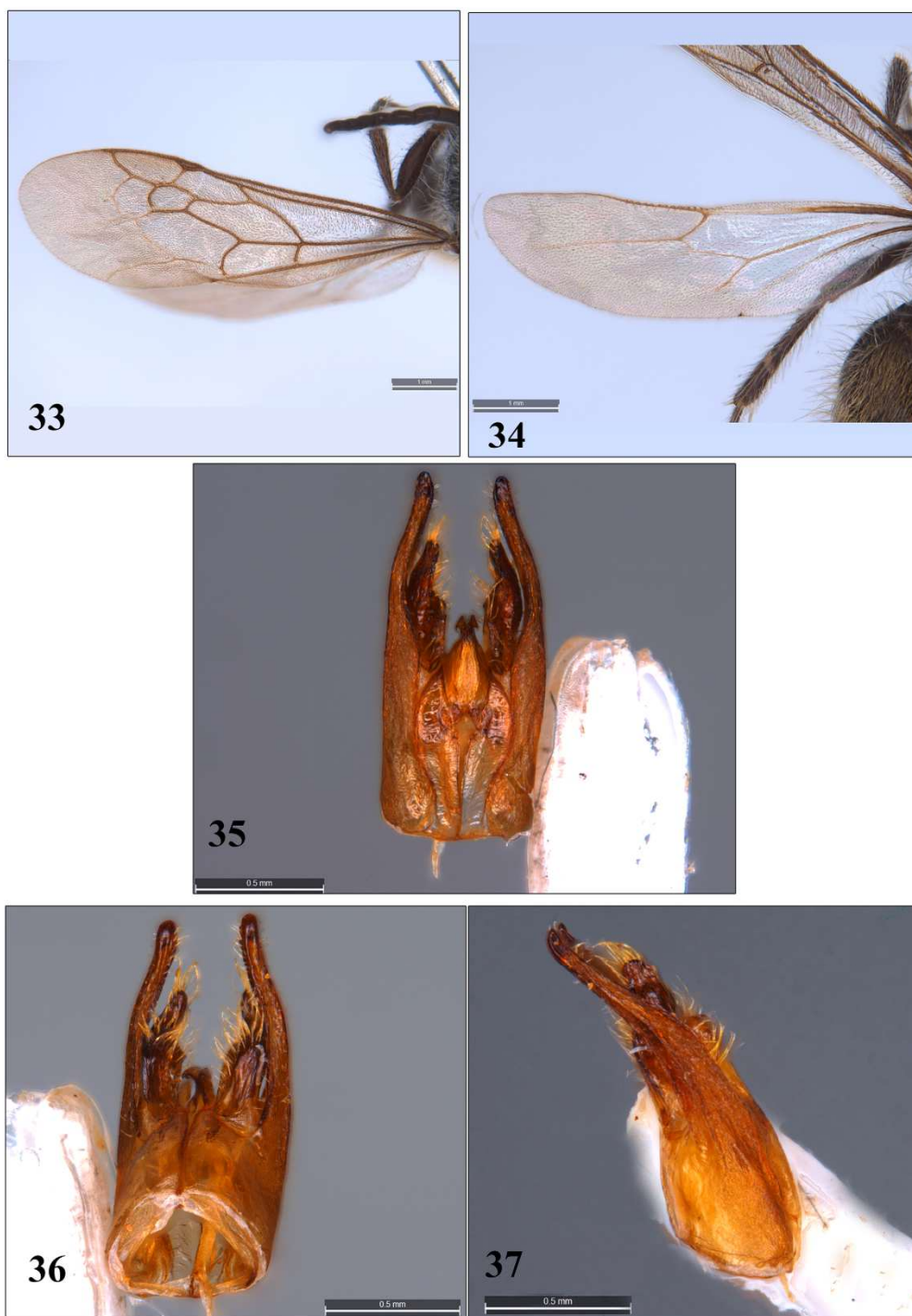


PLATE 15



***Strangulotilla sureshani* Terine, Lelej & Girish Kumar, 2021 (Male).**
 25. Body, dorsal view. 26. Head, frontal view. 27. Head & Mesosoma, dorsal view. 28. Metasoma, dorsal view. 29. Metasoma, ventral view. 30. Antennae. 31, 32. Mandible.

PLATE 16

***Strangulotilla sureshani* Terine, Lelej & Girish Kumar, 2021 (Male).**
33. Forewing. 34. Hindwing. 35. Genitalia, dorsal view. 36. Genitalia, ventral view. 37. Genitalia, lateral view.

II. Genus *Zeugomutilla* Chen, 1957

Zeugomutilla, Chen 1957: 139, 157; Lelej, 1992: 284; He, 2004: 940; Lelej, 2005: 37; Lelej & Brothers, 2008: 66, ♂, ♀; Lelej *et al.*, 2017b: 2; Williams *et al.*, 2019a: 16; Pagliano *et al.*, 2020: 168.

Type species: *Zeugomutilla pycnopyga* Chen, 1957, ♂, by original designation.

Diagnosis. Female. Mandible bidentate, with sub-basal tooth. Prementum basally tuberculate. Pronotum with lateral and humeral tubercles. Propodeum wider than pronotum. Propodeum with row of teeth, median tooth largest. Posterior propodeal slope abrupt. Scutellar scale absent. Metacoxa medially carinate. T2 basally with two transverse spots of setae. Pygidial plate with apical half laterally carinate, wide, smooth and shiny or finely longitudinally striae and apically smooth.

Male. Mandible bidentate, with sub-basal inner tooth and small sub-basal tubercle beneath. Occipital carina dorsally well developed and projecting overhead. T2 with long lateral felt line. S2 without any lateral felt line. S2 with longitudinal median carina posteriorly developed to a tooth. Tegulae large, posteriorly narrower and apical fourth emarginated inward. S7 with a lateral tubercle. S8 with strong tri tuberculate transverse basal carina. Penial valve short. Paramere apically rounded and upcurved.

Diversity & Distribution. The genus is represented by eight valid species, all from the Oriental region. Three species are recorded from India (Lelej, 2005; Williams *et al.*, 2019a & Pagliano *et al.*, 2020).

Key to Indian species of females of *Zeugomutilla* Chen, 1957 (modified from Lelej *et al.*, 2017b & Okayasu, 2023b)

1. Spots of setae on T2 conjugated. – Posterior propodeal border dorsally with median blunt tooth and three shorter teeth laterally. *Z. horni* (André, 1907)
- Spots of setae on T2 distinctly separated. 2
2. Pygidial area anteriorly longitudinally striate, apically smooth.....
..... *Z. bainbriggei* (Turner, 1911)
- Pygidial area basal sculpture obscure, apically smooth. – Frons and vertex with reddish-brown spot, head dark brown. *Z. spinulosa* (André, 1898)

Species from the Central and Southern Western Ghats and its adjacent areas**i. *Zeugomutilla bainbriggei* (Turner, 1911)****(Plate 18, Figs. 38–43)**

Mutilla bainbriggei Turner, 1911: 144, ♀, Syntypes (Hambantota, Ceylon, Sri Lanka) [NHMUK] (synonymized under *Zeugomutilla* by Lelej, 2005: 37).

Description: Female. Body length 4.53mm. Coloration and Setation. Head dark ferruginous, gena black. Antennal tubercle dark ferruginous, scape, pedicel and basal half of F1 ferruginous. F2–10 black. Clypeus ferruginous. Mandible basal two-third ferruginous, latter part black. Mesosoma dark ferruginous. Coxa dark ferruginous. Femur, tibia and tarsomeres brownish black. Metasoma black. S1 brownish. Head with short sub-erect and erect pale golden setae. Gena with appressed silvery setae. Clypeal margin with sub-erect pale golden setae. Base of mandible with long sub-erect golden setae. Scape with long sparse pale golden setae. Pedicel and flagellomeres with pale silvery micro pubescence. Mesosoma dorsum with sub-erect black setae. Propodeal declivity with silvery setae. Meso and metapleuron with silvery micro pubescence. Legs with appressed and sub-erect long pale golden and silvery setae. T1 with erect silvery setae and short black setae. T2 with two spots of silvery setae, not coalescing at middle, latter portions with coarse sub-erect black setae. T3 and T4 completely with a band of sub-erect pale silvery setae. T4 black, with erect and sub-erect black setae. T5 black, with sparse black setae. T6 with fringe of long erect black setae bordering pygidial area. S1 with sparse brownish setae and a small apical fringe of silvery micro pubescence. S2–5 with apical fringe of pale silvery setae. Sternal segments with sparse silvery setae.

Structure and sculpture. Head. Almost rectangular in frontal view, vertex convex, coarsely foveolate-rugose. Eyes large, oval. Scrobal carina well developed, straight. Clypeus basal half elevated with a medial tubercle, apical half concave. Antennal tubercle rugose with sparse punctures. Scape sparsely punctate. Pedicel and flagellomeres punctate-rugose. Ratio of pedicel to flagellomeres 1 to 3 is 0.24: 0.39: 0.29: 0.33. Minimal distance between eyes $1.18 \times$ longitudinal eye diameter. Mandible narrowed towards apex, apically with a small preapical tooth and basally with a sub-basal tooth. Occipital carina developed.

Mesosoma. Propodeum wider than pronotum. Pronotal width $1.06 \times$ head width behind eyes. Propodeal width $1.10 \times$ pronotal width. Mesosoma dorsum foveolate-rugose, Width of

alveolae on the mesosomal dorsum $1.8 \times$ width of punctures on head. Scutellar scale absent. Propodeal slope abrupt/steep, rugose. Posterior propodeal margin with a row of denticles, medial one longer. Mesosomal margin crenulated. Meso and metapleuron with minute punctures. Mesopleura concave; mesopleural suture reaching anterior spiracle. Mid and hind tibia with two rows of spines, four in each row.

Metasoma. T2 width $1.73 \times$ T1 width. T1–5 coarsely punctate-rugose. T2 with a lateral felt line, felt line $0.32 \times$ T2 length. Pygidium longitudinally striate, apex medially smooth. S1 with a small blunt tooth medially. S2–6 punctate, punctures on S2 large.

Male. Unknown.

Material examined. Kerala: 1♀, Malappuram district, Nilambur, Punchakolly, Latitude: 11.38493 N, Longitude: 76.3801 E, Altitude: 117 m, 22.iv.2022, Coll. Terine J. B., ZSI/WGRC/IR/INV. 26152.

Distribution. India: Kerala (New record), Tamil Nadu. *Elsewhere:* Sri Lanka (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

ii. *Zeugomutilla spinulosa* (André, 1898)

(Plate 19, Figs. 44–49)

Mutilla spinulosa André, 1898a: 26, ♀, Holotype (Type locality: Karachi, Pakistan) [MNHN] (Synonymized under *Pristomutilla* by Lelej, 2005: 36).

Pristomutilla spinulosa (André, 1898) in Lelej 2005: 36 (Synonymized under *Zeugomutilla* by Lelej *et al.*, 2017b: 13).

Description: Female. Body length 5.24–5.46 mm. Coloration and Setation. Head dark ferruginous, gena black. Antennal tubercle, scape and pedicel ferruginous. Basal two-third of F1 ferruginous, latter part black. F2–10 black. Clypeus ferruginous. Mandible basal two-third ferruginous, latter part brownish. Mesosoma ferruginous. Propodeal row of denticles dark ferruginous. Coxa ferruginous. Femur, tibia and tarsomeres black. Metasoma black. S1 ferruginous. Head with short and long, sub-erect and erect pale golden setae and black setae. Gena with appressed silver setae. Clypeal margin with sparse sub-erect pale golden setae. Mandible ventrally and dorsally with long sub-erect pale golden setae. Scape with long dense

appressed and sub-erect pale golden setae. Pedicel and F1 with short sparse golden setae. F2–10 with silvery micro-pubesence. Mesosoma dorsum with sub-erect black setae. Meso and metapleuron with silvery micro pubescence. Propodeal declivity with long erect silvery setae. Legs with appressed and sub-erect long pale silvery setae. Metasoma laterally with dense erect silvery setae. T1–5 with dense short appressed black setae. T2 medially with two small spots of silvery setae, not coalescing at middle. T3 and T4 completely with a band of pale yellowish-silvery setae. T5 with sparse pale yellowish-silvery setae, latter part with dense appressed black setae. T6 with fringe of long erect golden setae bordering pygidial area. S1 with sparse pale golden setae. S2 with sparse silvery setae. S2–5 with apical fringe of pale silvery setae.

Structure and sculpture. Head. Oval in frontal view, vertex convex, coarsely foveolate-rugose. Eyes large, oval. Scrobal carina well developed, curved. Clypeus medially elevated with a medial tubercle, laterally without any denticle. Antennal tubercle rugose with sparse punctures. Scape sparsely punctate. Pedicel and flagellomeres micro-punctate. Ratio of pedicel to flagellomeres 1 to 3 is 0.26: 0.35: 0.38: 0.24. Minimal distance between eyes $1.33 \times$ longitudinal eye diameter. Mandible narrowed towards apex, basally with a sub-basal tooth.

Mesosoma. Propodeum wider than pronotum. Pronotal width $1.11 \times$ head width behind eyes. Propodeal width $1.03 \times$ pronotal width. Mesosoma dorsum foveolate-rugose, Width of alveolae on the mesosomal dorsum $1.5 \times$ width of punctures on head. Scutellar scale absent. Propodeal slope abrupt/steep, alveolate. Posterior propodeal margin with a row of denticles, medial one longer. Mesosomal margin crenulated. Meso and metapleuron with fine rugae. Mesopleura concave; mesopleural suture reaching anterior spiracle. Mid and hind tibia with two rows of spines, four in each row.

Metasoma. T2 width $1.60 \times$ T1 width. T1–5 coarsely punctate. T2 with a lateral felt line, felt line $0.38 \times$ T2 length. Pygidium longitudinally striate, except medially and apically smooth. S1 with a small blunt tooth medially. S2 coarsely foveolate, fovea larger medially. S3–6 micro-punctate.

Male. Unknown.

Materials examined. Kerala: 1 ♀, Kozhikode district, Chaliyam timber depot, Latitude: 11.1601 N, Longitude: 75.8086 E, Altitude: 30 m, 06.iv.2023, Coll. Terine J. B., ZSI/WGRC/IR/INV. 23868; 1 ♀, Kozhikode district, Elathur, Latitude: 11.3422 N,

Longitude: 75.7522 E, Altitude: 37 m, 20.xi.2020, Coll. Binoy C., ZSI/WGRC/IR/INV. 24065 [ZSIK]; 1 ♀, Kozhikode district, Elathur, Latitude: 11.3422 N, Longitude: 75.7522 E, Altitude: 37 m, 01.ii.2020, Coll. Binoy C., ZSI/WGRC/IR/INV. 24995.

Distribution. India: Maharashtra, Kerala, Tamil Nadu (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

PLATE 17

Species distribution of the genus *Zeugomutilla* Chen from Central and Southern Western Ghats and its adjacent areas

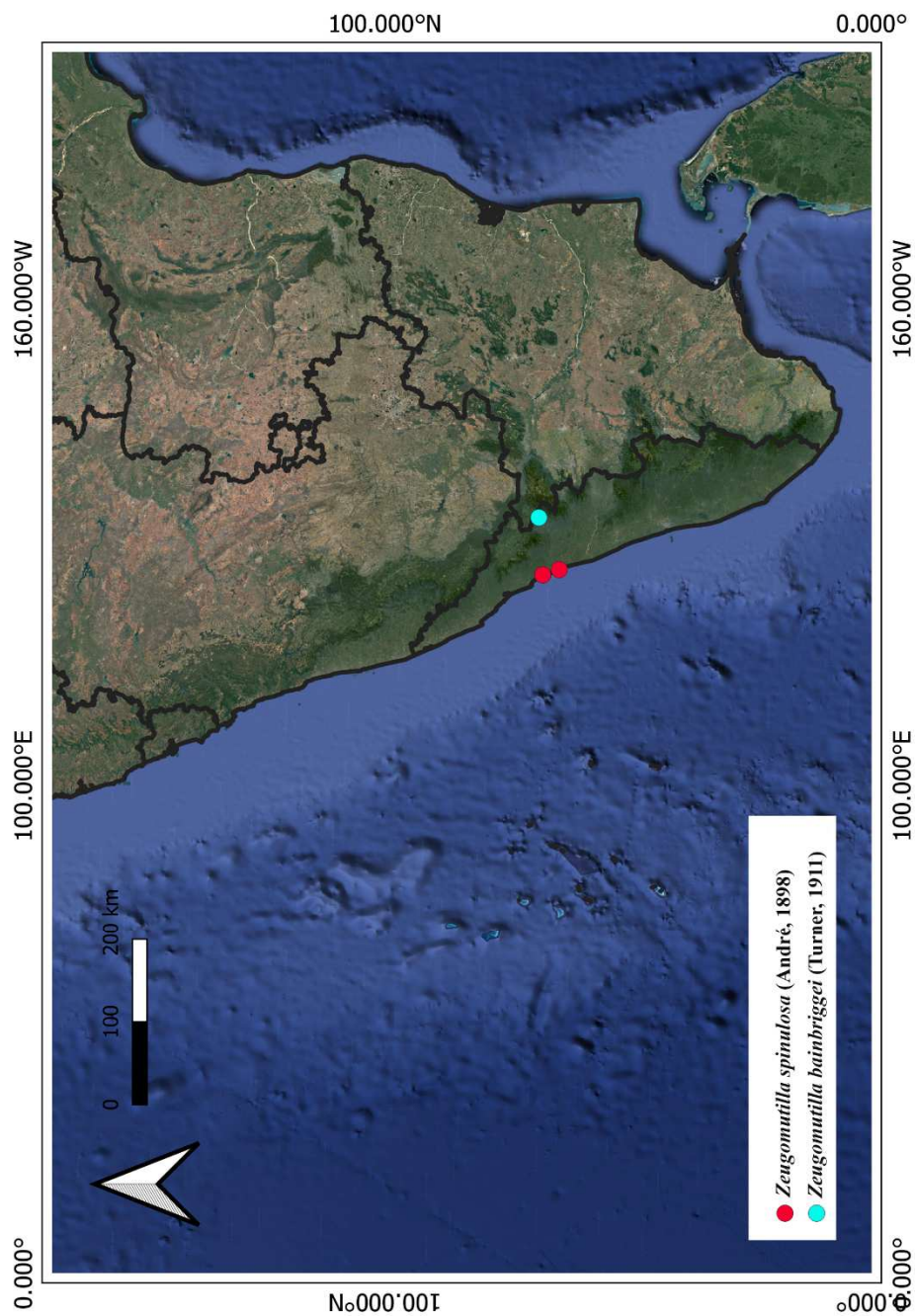
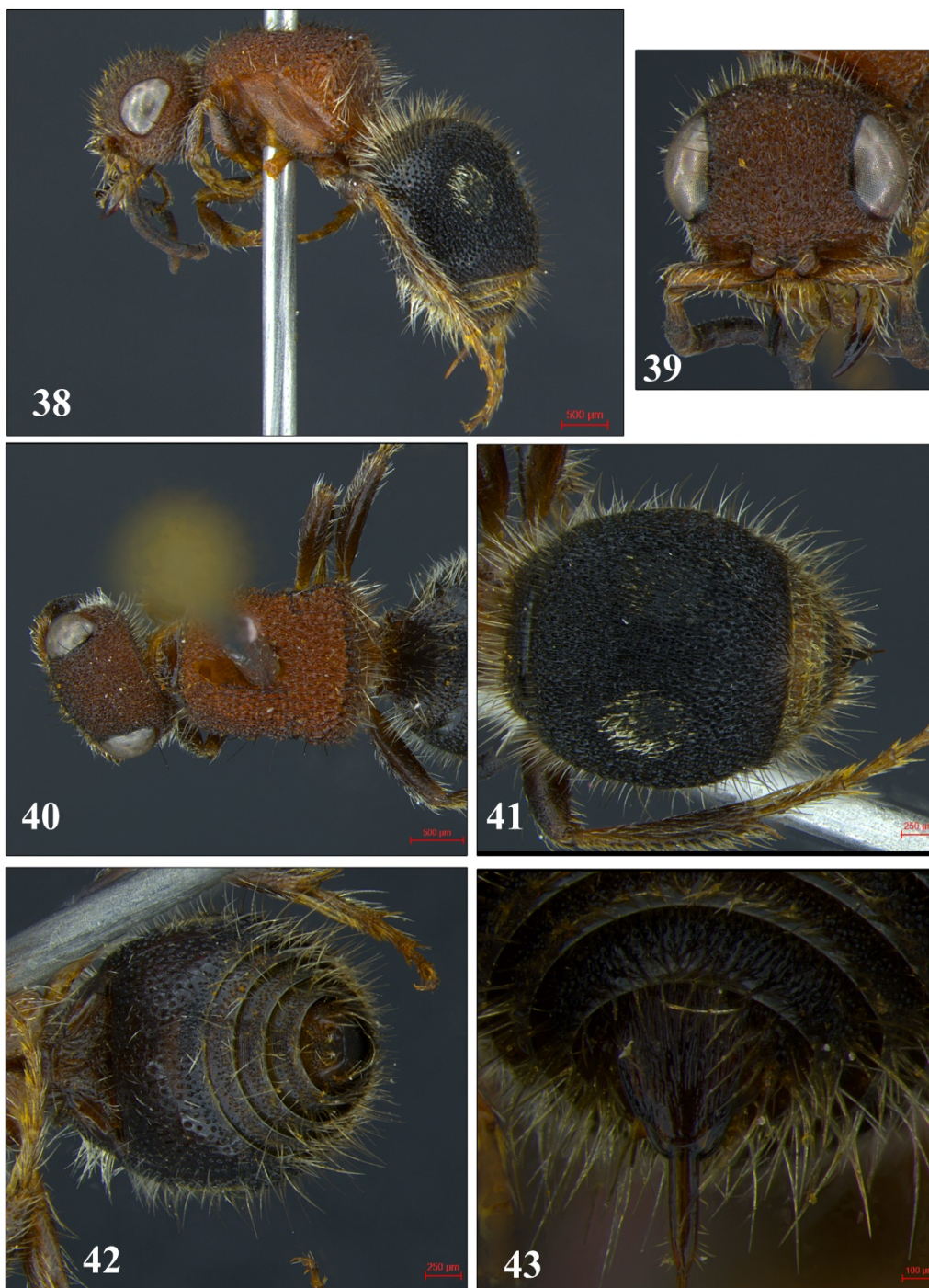


PLATE 18



Zeugomutilla bainbriggei (Turner, 1911) (Female). 38. Body, lateral view. 39. Head, frontal view. 40. Head & Mesosoma, dorsal view. 41. Metasoma, dorsal view. 42. Metasoma, ventral view. 43. Pygidium.

PLATE 19



Zeugomutilla spinulosa (André, 1898) (Female). 44. Body, lateral view. 45. Head, frontal view. 46. Head & Mesosoma, dorsal view. 47. Metasoma, dorsal view. 48. Metasoma, ventral view. 49. Pygidium.

III. Tribe Smicromyrmini Bischoff, 1920

Key to the Indian genera of tribe Smicromyrmini Bischoff, 1920

Males

1. Apterous. –T1 with distinct dorsal region. T2 with medial pale setal spot and apically with two lateral spots. Volsella short. *Indratilla* Lelej, 1993
- Alates. 2
2. S2 without any lateral felt line. 3
- S2 with short lateral felt line or sometimes reduced to few small punctures.8
3. Mandible apically strongly widened, preapical inner tooth larger or equal to apical tooth. – Mandible not excised beneath. F1 length $0.7 \times$ maximal width...*Andreimyrmex* Lelej, 1995
- Mandible apically narrowed, preapical inner tooth smaller than apical tooth. 4
4. Mandible beneath without any lobes, sub-basally with a small lobe. – T2 without medial spot of pale setae. *Nordeniella* Lelej, 2005
- Mandible beneath with large sub-basal lobe. 5
5. Macropterous. Distance between the stigmatic cell base and the vein SC RS origin more than stigmatic cell length. Propodeum medially without any teeth..... 6
- Brachypterous. Distance between the stigmatic cell base and the vein SC RS origin equals stigmatic cell length. Propodeum medially with two sharp teeth.....*Karunaratnea* Lelej, 2005
6. Volsella with basal lobe wider, setae longer than cuspis. 7
- Volsella without wide basal lobe, setae shorter than cuspis. *Ephucilla* Lelej, 1995
7. Volsella with dense basal setae, not longer than gonostylus apex. Mandible excised beneath *Promecilla* André, 1902
- Volsella with dense basal setae, longer than gonostylus. Mandible not excised beneath *Physetopoda* Schuster, 1949
8. Mandible apically strongly widened. –Stigmatic cell $1.4 \times$ stigmatic cell base and the vein SC RS origin. *Dentilla* Lelej in Lelej & Kabakov, 1980
- Mandible apically acuminate. 9
9. Volsella without basal lobe or cuspis narrow, long. Volsella basally without any setae or with short setae. 10
- Volsella with basal lobe. Cuspis narrow, long. 11

-
10. F1 length $0.6 \times F2$. F1 length equals F1 width. *Smicromyrme* Thomson, 1870
 – F1 length $0.3\text{--}0.4 \times F2$. F1 length $0.5\text{--}0.6 \times F1$ maximal width. *Sinotilla* Lelej, 1995
11. Mandible apically bidentate. *Mickelomyrme* Lelej, 1995
 – Mandible apically tridentate. *Nemka* Lelej, 1985

Females

1. Pygidial plate flattened, laterally carinate. 2
 – Pygidial plate not distinct. 7
2. Scutellar scale more or less developed. 3
 – Scutellar scale absent. *Andreimyrme* Lelej, 1995
3. Pygidial plate $0.3 \times T6$ width. –Scutellar scale well developed, nail-like.....
 *Ephutomma* Ashmead, 1899
 – Pygidial plate $0.5 \times T6$ width. 4
4. Pygidial plate elongate, parallel sided or basally wide. 5
 – Pygidial plate short, oval. *Nemka* Lelej, 1985
5. T2 basally with three spots of pale setae in horizontal line, apically with median pale patch
 of setae. –Scutellar scale $2 \times$ as wide as long. *Mickelomyrme* Lelej, 1995
 – T2 basally with a medial spot of pale setae (if lateral spots present, disposed posterior to
 medial patch), apically with fringe of pale setae. 6
6. Pronotum without projecting humeral part. *Smicromyrme* Thomson, 1870
 – Pronotum with projecting humeral part, wider than propodeum.....
 *Dentilla* Lelej in Lelej & Kabakov, 1980
7. Scutellar scale absent. 8
 – Scutellar scale more or less developed. 9
8. Mesosoma posteriorly narrowed. –Pygidial plate convex, without sculptures and not
 carinated laterally. *Promecilla* André, 1902
 – Mesosoma parallel sided or posteriorly widened. *Nordeniella* Lelej, 2005
9. Scutellar scale weak, but visible. 10
 – Scutellar scale well developed. – Mesosoma parallel sided or widened posterad.....
 *Karunaratnea* Lelej, 2005
10. T6 medially shiny, glabrous, laterally not carinate, basally convergent.....
 *Sinotilla* Lelej, 1995
 – T6 glabrous, shiny, laterally weakly carinate. 11
-

-
11. F1 length 1.3 × F2 length. T1 with distinct dorsal region, with lateral spots of pale setae.
 *Indratilla* Lelej, 1993
 – F1 length equals F2 length. T1 without lateral pale spots of setae. . *Ephucilla* Lelej, 1995

I. Genus *Andreimyrmex* Lelej, 1995

Mutilla: André, 1898: 28; André, 1902: 39; Cameron, 1909: 146.

Smicromyrme: Mickel, 1933: 321; Mickel, 1934: 195; Mickel, 1935: 277; Chen, 1957: 201; Williams *et al.*, 2019a: 28.

Andreimyrmex Lelej, 1995b: 5; Lelej, 1996: 100; Lelej, 2002: 50; Lelej, 2005: 38; Lelej, 2007: 88; Lelej *et al.*, 2007: 56; Lelej & Brothers, 2008: 7; Lo Cascio, 2015: 544; Brothers & Lelej, 2017: 95; Okayasu *et al.*, 2018: 303; Williams *et al.*, 2019a: 16; Okayasu, 2020: 56; Pagliano *et al.*, 2020: 169; Terine *et al.*, 2021a: 185; Okayasu *et al.*, 2021: 3.

Type species. *Andreimyrmex long* Lelej, 1995, ♂, by original designation.

Diagnosis. Female. Genal carina developed, forming a distinct tooth with hypostomal carina. Clypeus with sub-apical transverse carina. Mandible variable; slender tridentate, wide tridentate or wide. Prementum with a posterior round tubercle. Mesosomal lateral margins either convergent posteriorly or sub-parallel. Scutellar scale not developed. Metanotal-propodeal suture absent. Protarsus with comb of long spines. T1 without any setal spot. T2 with or without baso-medial spot of setae, apically with a narrow band of pale setae. T3 with or without wide band of setae. Pygidial plate elongate, weakly carinate laterally, smooth or finely longitudinally rugose.

Male. Frons punctate. Clypeus concave. Mandible wide, tridentate, with a large inner tooth at base beneath. Scape bicarinate beneath. Notauli full, parapsidial furrow weakly developed. Mesoscutellum punctate. Mesopleuron anteriorly with median depression. S2 without baso-medial carina and lateral felt line (except *A. daividi*, with trace of felt line). S8 without any tubercles or carina. Volsella wide, without basal lobe, with long setae on inner and outer margins.

Diversity & Distribution. The genus is represented by 20 valid species and two subspecies worldwide. Most of the species are recorded in South East Asian countries. Two species are recorded from Palearctic China and one species *A. pakistanensis* is recorded from Pakistan (Islamabad) (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2021a). Only two species (*A. paniya* Terine, Lelej & Girish Kumar, 2021 & *Andreimyrmex substriolata* (Chen, 1957)) have been recorded from India.

Key to Indian species of females of *Andreimyrmex* Lelej, 1995 (Males unknown for *A. paniya* Terine, Lelej & Girish Kumar, 2021 & *A. substriolata* (Chen, 1957)).

1. Body ferruginous-red, vertex with black tint. Pygidial plate sub-ovate, laterally carinate, sub-apically wider, smooth & shiny. T2 apically with narrow band of setae, medially interrupted. *A. paniya* Terine, Lelej & Girish Kumar, 2021.
– Head and metasoma black. Mesosoma ferruginous. Pygidial plate finely longitudinally rugose on lateral 1/3, medially and apically smooth. T2 basally with a pale spot and apically with band of setae, not interrupted. *A. substriolata* (Chen, 1957).

Species from the Central and Southern Western Ghats and its adjacent areas

i. *Andreimyrmex paniya* Terine, Lelej & Girish Kumar, 2021

(Plate 21, Figs. 50–57)

Andreimyrmex paniya Terine, Lelej & Girish Kumar, 2021: 185, ♀, holotype (Type locality: Periya, Wayanad District, Kerala, India) [ZSIK].

Description: Female. Body length 4.76 mm. Coloration and Setation. Head and antennal tubercles ferruginous-red. Vertex with a black tint. Antenna dorsally black, ventrally reddish. Clypeus ferruginous, apically black. Mandible basal two-third ferruginous, latter part black. Mesosoma ferruginous, posterior propodeal slope black. Coxa, tibia and tarsomeres brownish-black, femur ferruginous-brown. Metasoma ferruginous-red. Pygidium apically black. Frons with erect black setae. Vertex with appressed silvery and sub-erect black setae. Gena with appressed silvery setae. Scape with long appressed silvery setae. Pedicel and flagellomeres with short silvery micro-pubescence. Clypeus with long yellowish and silvery setae. Base of mandible with long sub-erect silvery setae. Mesosoma dorsum with sub-erect and erect black setae. Posterior propodeal slope with erect long silvery setae. Pronotum with transverse row of silvery setae. Meso and metapleuron with dense appressed silvery setae. Legs with appressed and sub-erect silvery setae, setae denser on tarsomeres. T1 with erect long silvery setae. T2 with appressed dense black setae and apically with a fringe of silvery setae medially interrupted. T3–5 with erect black setae and laterally with erect silvery setae. Pygidium bordered by sparse erect silvery setae. S2–5 with apical fringe of sparse silvery setae. Sternal segments with sparse silvery setae.

Structure and sculpture. Head. Oval in frontal view, coarsely punctate, gena reticulate. Eyes large, oval. Scrobal carina well developed, slightly curved. Clypeus medially elevated with a small basal tubercle. Antennal tubercle sparsely punctate. Scape sparsely deeply punctate. Flagellomeres with minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.27: 0.34: 0.52: 0.53. Minimal distance between eyes $0.97 \times$ longitudinal eye diameter. Genal carina well developed, forming raised small distinct tooth with hypostomal carina. Mandible narrowed towards apex, tridentate.

Mesosoma. Pronotum wider than propodeum. Pronotal width $0.87 \times$ head width behind eyes. Propodeal width $0.94 \times$ pronotal width. Mesosoma dorsum foveolate. Scutellar scale absent. Propodeal face reticulate. Meso and metapleuron with coarse small punctures. Mesopleura concave; mesopleural suture reaching anterior spiracle. Posterior propodeal slope reticulate. Mid and hind tibia with two rows of spines, four in each row.

Metasoma. T2 width $2.36 \times$ T1 width. T1 with sparse fine punctures. T2–5 coarsely punctate. T2 with a lateral felt line, $0.31 \times$ T2 length. Pygidium sub-ovate, smooth, laterally with a carina. S1 with fine rugae and with a small blunt tooth medially. S2–6 punctate, punctures on S2 larger.

Male. Unknown.

Material examined. Kerala: 1 ♀, Wayanad district, Periya, Camp shed, Latitude: 11.851405 N, Longitude: 75.78959 E, Altitude: 594 m, 10.ii.2021, Coll. K.A. Subramanian & Party, ZSI/WGRC/IR/INV. 17336.

Distribution. India: Kerala (Terine *et al.*, 2021a).

Remarks. Terine *et al.* (2021a) recorded the genus *Andreimyrmex* Lelej, 1995 for the first time from India, describing this species from Kerala.

PLATE 20

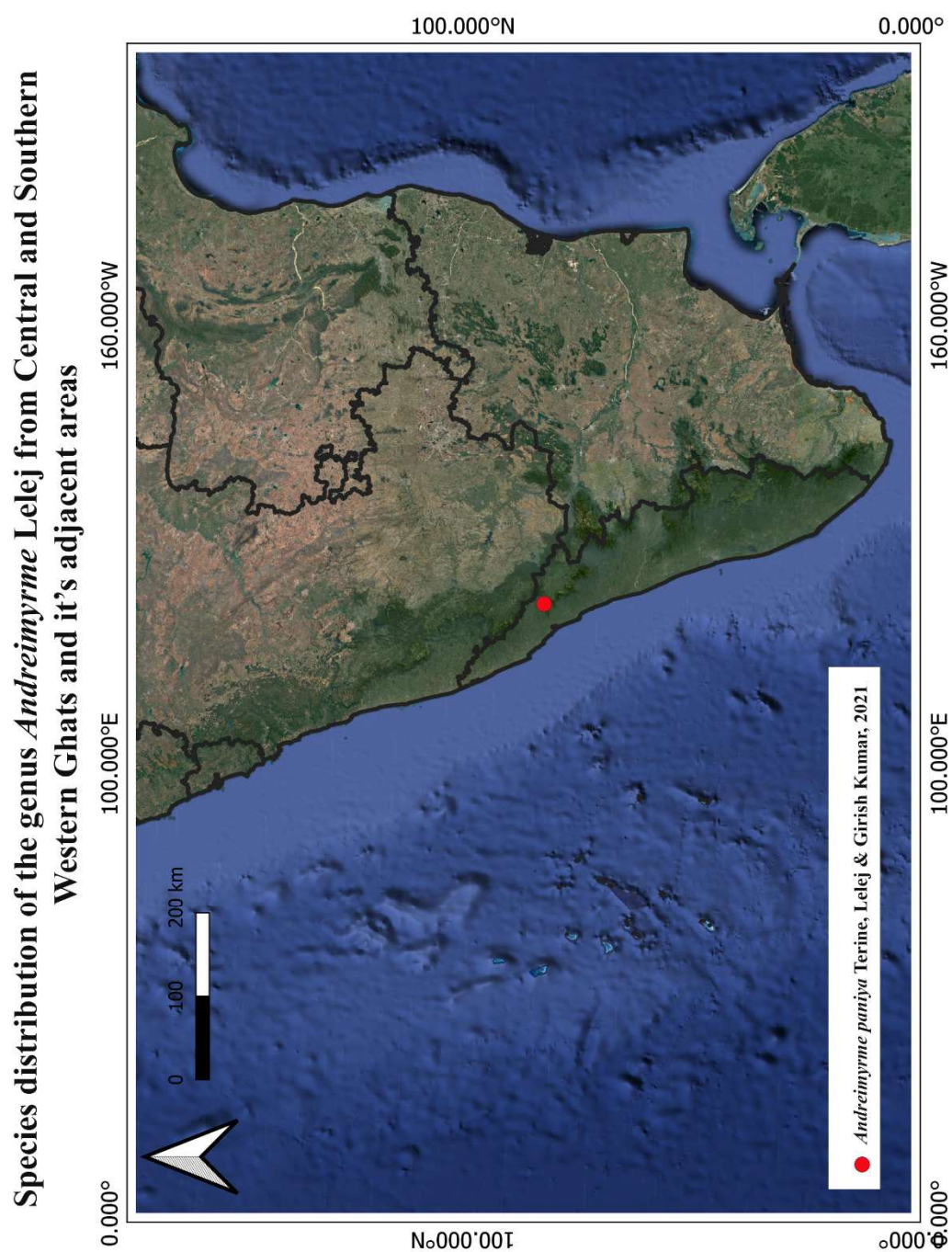
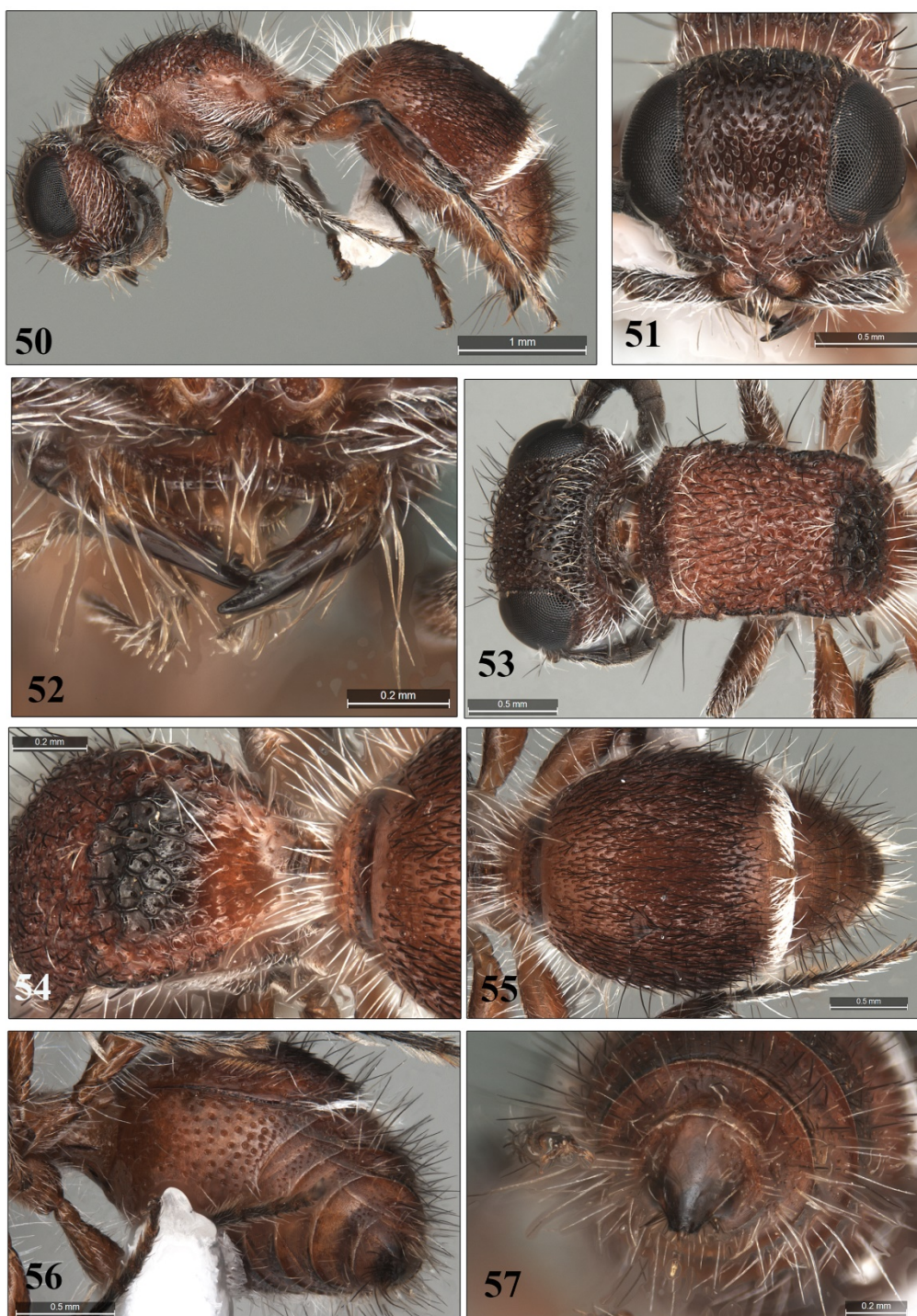


PLATE 21



Andreimyrmex paniya Terine, Lelej & Girish Kumar, 2021 (Female).
50. Body, lateral view. 51. Head, frontal view. 52. Mandible & Clypeus
53. Head & Mesosoma, dorsal view. 54. Mesosoma. 55. Metasoma, dorsal
view. 56. Metasoma, ventral view. 57. Pygidium.

II. Genus *Nemka* Lelej, 1985

Nemka Lelej, 1985: 240 (as subgenus of *Smicromyrme* Thomson); 1995c: 2; Lelej & Brothers, 2008: 39; Brothers & Lelej, 2017: 95; Williams *et al.*, 2019a: 22; Pagliano *et al.*, 2020: 169; 176; Okayasu, 2020: 24.

Horaia Tsuneki, 1993: 43 (as subgenus of *Smicromyrme* Thomson).

Type species *Smicromyrme (Horaia) chihpenchius* Tsuneki, 1993 by original designation. Junior homonym of *Horaia Tonnoir*, 1930 (Diptera). Junior subjective synonym of *Nemka* Lelej, 1985 according to Lelej, 1995c: 2.

Type species: *Mutilla viduata* Pallas, 1773, ♂, by original designation.

Diagnosis. Female. Fore tarsi with long, flat spines. Apical spine on first tarsus 1.5 × second tarsus length. Scutellar scale well developed. T2 with one basal and one apical spots of setae; sometimes with apical pale band of setae, variably widened medially. T3 with wide pale band. Pygidial plate short oval, laterally carinate, longitudinally rugose-striate.

Male. Frons and vertex usually punctate, never longitudinally striate. Mandible apically tridentate, excised beneath forming tooth basally. F1 0.6 × F2. Clypeus laterally depressed. Ocelli small. Scape weakly bicarinate ventrally. Mesopleura posteriorly with one or two pairs of tubercles. Tegulae posteriorly rounded. Wings dark fuscous. Abdomen red or yellowish-red usually. T2 with long lateral felt line and S2 with short lateral felt line. Cuspis long, slender.

Diversity & Distribution. The genus is represented by 18 valid species worldwide. 16 species are recorded from the Oriental Region and two from the Palaeartic region. Five species are recorded from India (Lelej, 2005, Williams *et al.*, 2019a & Pagliano *et al.*, 2020).

Key to Indian species of *Nemka* Lelej, 1985 (Males unknown for *N. horai* (Hammer, 1962), *N. pondicherensis* (Sichel and Radoszkowski, 1870), *N. pulla* (André, 1894) & *N. maritima* (Hammer, 1962). Female unknown for *N. philippa* (Nurse, 1903))

1. Males. – Head, mesosoma and T1 black, latter red. *N. philippa* (Nurse, 1903)
- Females. 2
2. Vertex with ferruginous spot. 3
- Vertex without ferruginous spot. 4
3. Pygidial area with fine longitudinal stripes, apically smooth. *N. horai* (Hammer, 1962)
- Pygidial area rugose. *N. pondicherensis* (Sichel and Radoszkowski, 1870)

-
4. T2 baso-medially with a golden spot of setae. *N. pulla* (André, 1894)
 – T2 baso-medially with a silvery spot of setae. *N. maritima* (Hammer, 1962)

Species from the Central and Southern Western Ghats and its adjacent areas

i. *Nemka horai* (Hammer, 1962)

(Plate 23, Figs. 58–60)

Smicromyrme horai Hammer, 1962: 39, ♀, Holotype ♀ (Type locality: Karunagapalli, Kerala, India) [NZC]. Type examined.

Description: Body length 7 mm. Coloration and Setation. Head black, vertex behind eyes ferruginous. Antennal tubercles, scape and pedicel ferruginous. Flagellomeres brownish black. Mandible basally ferruginous, latter part ferruginous. Mesosoma ferruginous. Legs reddish brown. Scutellar scale ferruginous. Metasoma dorsum black. Sternal segments dark ferruginous. Head with sparse erect silver setae. Mesosoma dorsum with sub-erect silvery setae, propodeal declivity with dense setae. Metapleural suture with sub-erect silvery setae. Legs with sub-erect and appressed silvery setae. T2 baso-medially and one apico-medially with a spot of pale silvery setae. T3 with a band of pale silvery setae. T4–5 black, with sparse long appressed pale silvery setae. T6 with fringe of long erect pale silvery setae bordering pygidial area. S2–5 with apical fringe of silvery setae.

Structure and sculpture. Head. Almost as broad as thorax, coarsely punctate. Eyes medium-sized, oval. Mandible narrowed towards apex.

Mesosoma. Almost square shaped. Lateral edges not crenulated. Mesosoma dorsum coarsely punctate. Scutellar scale present. Lateral side of pronotum and propodeal sides punctate. Mesopleura smooth and concave, mesopleural suture not reaching anterior spiracle, ending just below the spiracle.

Metasoma. T2 width $1.9 \times$ T1 width. T1–5 coarsely punctate. Pygidium oval, with fine longitudinal striae, laterally with well-developed carina. S1 with a short keel in the middle sparsely punctate. S2 sparsely punctate S3–6 micro-punctate.

Male. Unknown.

Material examined. Type specimen ♀, Holotype (Type locality: Karunagapalli, Kollam district, Kerala, India) [NZC: 2069/H3].

Distribution. India: Kerala (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2020).

ii. *Nemka pondicherensis* (Sichel and Radoszkowski, 1870)

(Plate 24, Figs. 61–66)

Mutilla pondicherensis Sichel and Radoszkowski, 1870: 204, ♀, Holotype ♀ (Type locality: Pondichery, India) [NHMV].

Mutilla blanda Smith, 1855: 32, ♀ (Type locality: India) [NHMUK], Synonymized under *blandula* by Dalla Torre, 1897: 17.

Mutilla rufitarsis Smith, 1879: 199, ♀ (Type locality: India) [NHMUK], Synonymized under *pondicherensis* by Turner, 1911: 143.

Mutilla taprobanae Cameron, 1892: 122, 125, ♀ (Type locality: Trincomalia, Sri Lanka) [OUMNH], Synonymized under *rufitarsis* by Bingham, 1897: 18.

Mutilla blandula Dalla Torre, 1897: 17, New name for *Mutilla blanda*, Synonymized under *pondicherensis* by Lelej, 2005: 47.

Description: Body length 5.85 mm. Coloration and Setation. Head black, vertex ferruginous. Antennal tubercles, scape and pedicel dark ferruginous. Flagellomeres brownish black. Clypeus brownish-black. Mandible basal half dark ferruginous, latter part black. Mesosoma dorsum, Meso and metapleuron ferruginous. Posterior propodeal face dark ferruginous. Legs dark ferruginous. Scutellar scale black. Metasoma dorsum black. Sternal segments brownish. Head with appressed silvery setae and erect sparse pale golden setae. Gena with appressed and sub-erect silvery setae. Clypeal margin with sub-erect shot pale golden and silvery setae. Base of mandible with long sub-erect pale golden setae. Scape with long dense sub-erect and appressed silvery setae. Pedicel and flagellomeres with pale white micro pubescence. Mesosoma dorsum with appressed dense pale golden setae. Propodeal declivity with sub-erect pale golden setae. Metapleural suture with tuft of pale golden setae. Legs with sub-erect and appressed silvery setae. T1 with appressed long pale golden setae. T2 with two spots of pale silvery setae, on basally and one apically. T3 with a band of pale silvery setae. T4–5 black, with sparse long appressed pale silvery setae. T6 with fringe of long erect pale golden setae bordering pygidial area. S2–5 with apical fringe of silvery setae.

Structure and sculpture. Head. Oval in frontal view, flattened at vertex, coarsely punctate. Eyes medium-sized, oval. Scrobal carina not developed. Clypeus slightly elevated medially

with a small tubercle, margins straight. Antennal tubercle irregularly rugose. Scape deeply punctate. Flagellomeres with minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.29: 0.46: 0.47: 0.65. Minimal distance between eyes $1.6 \times$ longitudinal eye diameter. Mandible narrowed towards apex.

Mesosoma. Pronotum wider than propodeum. Pronotal width $1.01 \times$ head width behind eyes. Propodeal width $0.99 \times$ pronotal width. Mesosoma dorsum foveolate. Scutellar scale well developed. Propodeal slope abrupt/steep, areolate. Meso and metapleuron impunctate. Mesopleura concave; mesopleural suture not reaching anterior spiracle, ending just below the spiracle. Mid and hind tibia with two rows of spines, three in hind tibia and four in mid tibia.

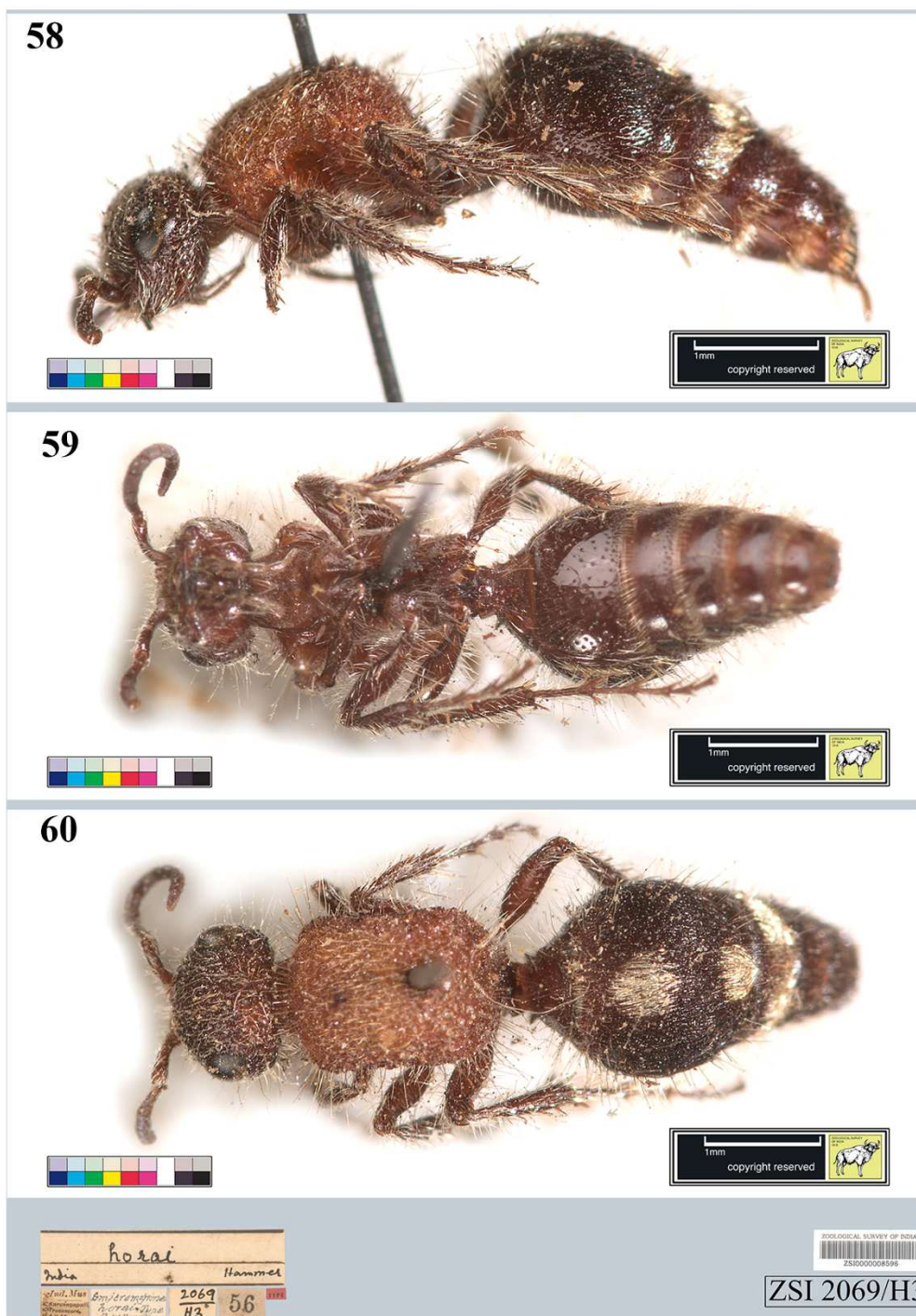
Metasoma. T2 width $2.07 \times$ T1 width. T1–5 coarsely punctate. T2 with a lateral felt line, felt line $0.37 \times$ T2 length. Pygidium oval, rugose, laterally with well-developed carina. S1 sparsely punctate. S2–6 punctate.

Male. Unknown.

Material examined. Kerala: 1 ♀, Kozhikode district, Thiruvallur, Latitude: 11.5920 N, Longitude: 75.6726 E, Altitude: 39 m, 12.viii.1982, Coll. K. N. Nair & Party, ZSI/WGRC/IR/INV. 19851.

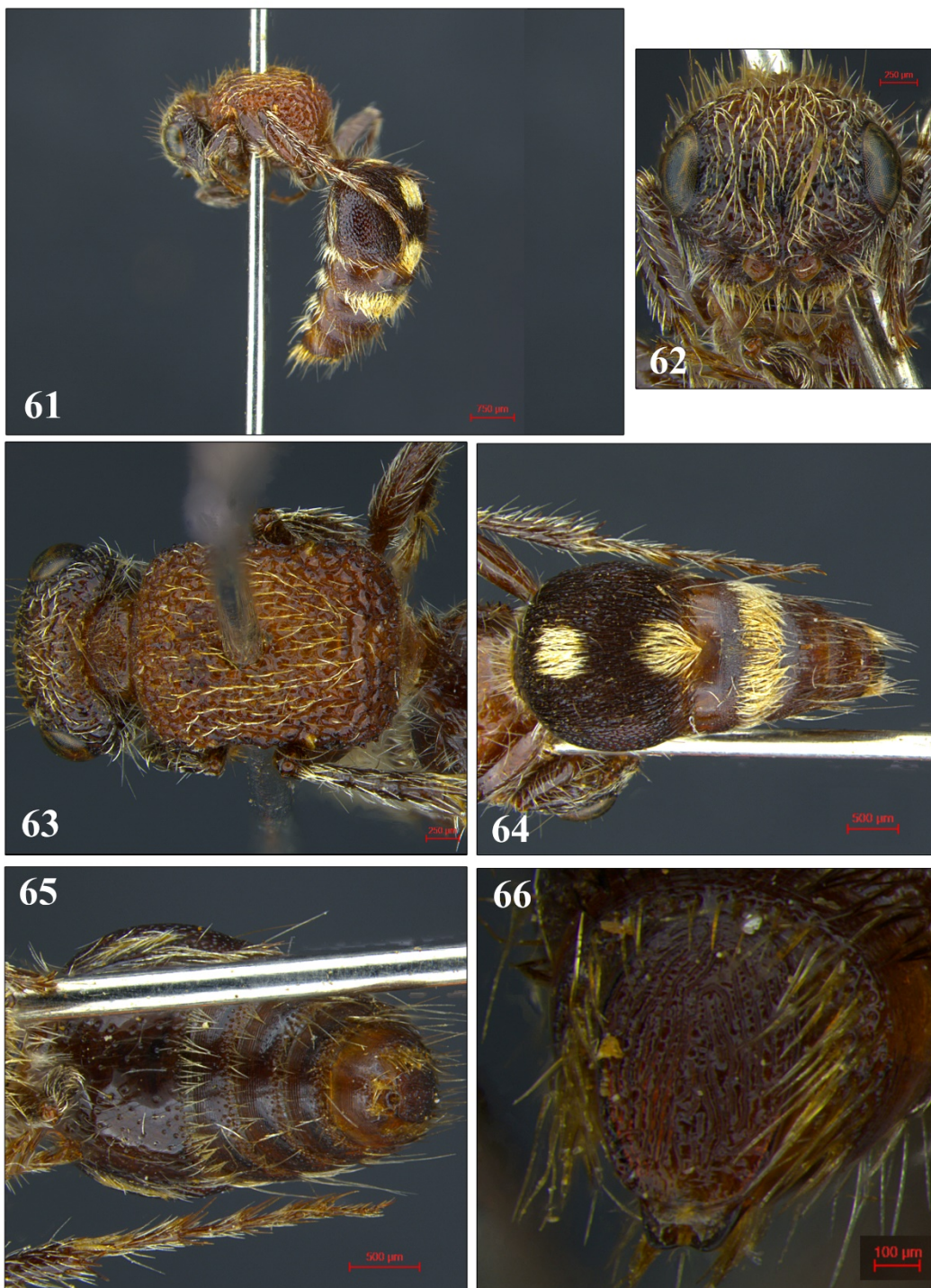
Distribution. India: Bihar, Delhi, Kerala (New record), Pondicherry. *Elsewhere.* Iran, Pakistan, Sri Lanka (Lelej, 2005; Nithya, 2013; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

PLATE 23



Nemka horai (Hammer, 1962) (Female). 58. Body, lateral view. 59. Body, ventral view. 60. Body, dorsal view.

PLATE 24



Nemka pondicherensis (Sichel and Radoszkowski, 1870) (Female).
61. Body, lateral view. 62. Head, frontal view. 63. Head & Mesosoma, dorsal view. 64. Metasoma, dorsal view. 65. Metasoma, ventral view. 66. Pygidium.

III. Genus *Promecilla* André, 1902

Promecilla André, 1902: 14, 30; Cameron, 1902c: 271; Lelej & Brothers, 2008: 48; Brothers & Lelej, 2017: 96; Pagliano *et al.*, 2020: 182; Lelej & Williams, 2023: 122.

Diagnosis. Female. F1 length 1.6 × maximal width. F2 2 × longer than F1. Eye weakly emarginated. Clypeus basally with median tubercle. Propodeum narrower than pronotum. Propodeum sloping gently. Scutellar scale absent. Mesopleura slightly convex, with row of punctures. T6 without distinct pygidial plate, glabrous, posteriorly widened, apically at most weakly carinate. Metasoma usually metallic blue.

Male. Clypeus with well-developed transverse preapical carina. F2 longer than F1. Mandible tridentate, beneath with sub-basal lobe. Wings fuscous. Stigmatic cell unsclerotized. T2 with lateral felt line. S2 without any lateral felt line. S8 not modified. Head, mesosoma, antenna and legs usually black, latter pale orange.

Diversity & Distribution. The genus is represented by 29 valid species worldwide. Most are from the Oriental Region and some are recorded from the Palaearctic and Afrotropical Region. 12 species are recorded from India (Lelej, 2005; Pagliano *et al.*, 2020; Williams *et al.*, 2019a & Lelej & Williams, 2023).

Key to Indian species of *Promecilla* André, 1902 (Males unknown for *P. maculiceps* (André, 1894); *P. differens* Hammer, 1962; *P. phaola* (Cameron, 1900); *P. tau* (Dalla Torre, 1897); *P. ariel* (Cameron, 1897); *P. gravelyi* Hammer, 1962; *P. magretti* Lelej, 2005; *P. perfecta* Hammer, 1962; *P. subglabrata* (André, 1894) & *P. pulchriventris* (Cameron, 1892))

1. Males. 2
- Females. 3
2. Body metallic blue. *P. yerburghi* (Cameron, 1892)
- Metasomal segments 1 and 7 black, latter brownish. *P. regia* (Smith, 1855)
3. Head with a spot of silver. *P. maculiceps* (André, 1894)
- Head without a spot of silver. 4
4. T2 with apical medial spot. 5
- T2 with apical fringe. 8
5. T2 apically with spots on each side. 6
- T2 apically without spots on each side. 7
6. Mesosoma basally with two quadrate spots of silver setae. *P. regia* (Smith, 1855)
- Mesosoma without any spots of setae. –Head dusky red. *P. differens* Hammer, 1962

7. T5 with a spot of silver setae.	<i>P. phaola</i> (Cameron, 1900)
– T5 without any spot of silver setae. – T3 without any spot of silver setae.	<i>P. tau</i> (Dalla Torre, 1897)
8. T1 with two spots of setae on each side.	<i>P. ariel</i> (Cameron, 1897)
– T1 without any spots of setae.	9
9. T3 with a band of silvery setae.	<i>P. gravelyi</i> Hammer, 1962
– T3 without any band of setae.	10
10. T2 with an apical band of setae.	11
– T2 without any apical band of setae.	13
11. T2 with a basal spot.	12
– T2 without any basal spot.	<i>P. magrettii</i> Lelej, 2005
12. Head dusky red.	<i>P. perfecta</i> Hammer, 1962
– Head black.	<i>P. subglabrata</i> (André, 1894)
13. Head coppery, metallic with greenish tint.	<i>P. yerburghi</i> (Cameron, 1892)
– Head red.	<i>P. pulchriventris</i> (Cameron, 1892)

Species from the Central and Southern Western Ghats and its adjacent areas

i. *Promecilla pulchriventris* (Cameron, 1892)

(Plate 26, Figs. 67–72)

Mutilla pulchriventris Cameron, 1892: 121, 127, ♀ Syntypes (Poona, Maharashtra, India) [NHMUK].

Description. Female. Body length. 3.34 – 4.42 mm. Coloration and Setation. Head red, frons and vertex brownish-black. Antennal tubercles, scape, pedicel and flagellomeres ferruginous. Clypeus ferruginous, apical margin brownish-black. Mandible two-third ferruginous, apical part black. Mesosoma dorsum red, mesosoma middle and propodeal face brownish-black. Meso and metapleuron ferruginous, medially brownish-black. Legs ferruginous, spines brownish. Metasoma black, except T1 and S1 ferruginous. S2 apico-medially pale ferruginous. Frons and vertex with erect and sub-erect black setae. Gena with sub-erect silvery setae. Clypeus with long sub-erect pale golden setae. Base of mandible with long sub-erect pale golden setae. Scape with appressed long and sub-erect short silvery setae. Pedicel and flagellomeres with short pale silvery setae. Mesosoma dorsum with erect short black

setae and appressed silvery setae. Propodeal face with long erect silvery setae. Meso and metapleuron with appressed dense silvery setae. Legs with sub-erect dense silvery setae. T1 with dense erect silvery setae. T2 with dense erect and appressed black setae and laterally with long silvery setae, basally with small elongate spot of silvery setae and apical band of silvery setae medially interrupted and sometimes reaching lateral ends. T3–5 with dense long erect and appressed short black setae. T6 basally with long erect silvery setae and laterally with sparse erect long black setae. S2–6 with apical fringe of pale sparse silvery setae. S1 and S2 with sparse silvery setae.

Structure and sculpture. Head. oval in frontal view, coarsely foveolate and between fovea with minute sparse punctures. Eyes large, oval, not emarginated. Scrobal carina well developed, not reaching the base of eyes. Clypeus medially with a small blunt tubercle, laterally without any denticles. Antennal tubercle with sparse minute punctures, latter part smooth and shiny. Scape with sparse punctures. Pedicel and flagellomeres with sparse minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.29: 0.39: 0.47: 0.42. Minimal distance between eyes $0.96 \times$ longitudinal eye diameter. Mandible apically acuminate, with a weak pre-apical denticle.

Mesosoma. Propodeum narrower than pronotum. Pronotal width $1.11 \times$ head width behind eyes. Propodeal width $0.93 \times$ pronotal width. Mesosoma dorsum coarsely foveolate. Width of fovea on the mesosomal dorsum $1.63 \times$ width of punctures on head. Scutellar scale absent. Posterior propodeal face with large reticulae. Mesopleuron and metapleuron with coarse small punctures. Mesopleura concave, mesopleural suture reaching anterior spiracle, ending at the spiracle. Legs with minute sparse punctures. Mid and hind tibia with two rows of spines, four in each row.

Metasoma. T2 width $1.92 \times$ T1 width. T1–5 with small coarse punctures. T2 with a lateral felt line, felt line $0.20 \times$ T2 length. Pygidial area weakly carinated apically, short, with small sparse punctures. S1 with a ridge medially, with fine rugae. S2–6 with coarse punctures.

Male. Unknown.

Materials examined. Tamil Nadu: 1♀, Thenkasi district, Agasthymalai Biosphere Reserve, Ukkonam, Latitude: 8.7741 N, Longitude: 77.2300 E, Altitude: 1370 m, 28.ii.2020, Coll. Souvik Sen & Party, ZSI/WGRC/IR/INV. 28209. Kerala: 1♀, Kannur district, Kannapuram, Latitude: 11.9690 N, Longitude: 75.3208 E, Altitude: 32m, 23.iv.2019, Coll. C. Charesh,

ZSI/WGRC/IR/INV. 28112; 1♀, Kannapuram district, Latitude: 11.9690 N, Longitude: 75.3208 E, Altitude: 32m, 22.ix.2019, Coll. C. Charesh, ZSI/WGRC/IR/INV. 23867.

Distribution. Kerala (New record), Tamil Nadu (New record), Maharashtra (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

ii. *Promecilla regia* (Smith, 1855)

(Plate 27, Figs. 73–74)

Mutilla regia Smith, 1855: 38, ♀, Syntypes (Northern India) [NHMUK].

Mutilla officia Nurse, 1903: 399, ♂, Syntypes (Deesa, Gujarat, India) [NHMUK]
(Synonymized by Lelej, 2005: 53).

Description. Female. Body length. 4 mm. Coloration and Setation. Head, antennal tubercles, scape, pedicel and flagellomeres ferruginous. Mesosoma ferruginous. Meso and metapleuron ferruginous, medially slightly darker. Legs ferruginous, spines brownish. Metasoma black, with a purple metallic tint, T1 with a greenish tint. S2–6 black. Head with appressed silver setae and black erect setae. Gena with dense appressed and sub-erect silvery setae. Frons with long and short erect black setae. Scape with appressed pale silver setae. Flagellomeres and pedicel with dense silvery micro-pubesence. Mesosoma dorsum with erect and sub-erect black setae. Mesothorax baso-medially with a quadrate spot of appressed silvery setae. Propodeal face with long erect silvery setae. Meso and metapleuron medially with appressed dense silvery setae. Legs with sub-erect dense silvery setae, denser on tarsomeres. T1 with dense erect silvery setae. T2 dense appressed black setae. T2 baso-medially with oblong spot of silvery setae and apico-medially with large ovate spot of appressed silvery setae. T3–5 with dense long erect and appressed short black setae. T6 basally with long erect black setae. T2 with long lateral felt line of short appressed pale golden setae. T4 and 5 medially with appressed silvery setae.

Structure and sculpture. Head. oval in frontal view, coarsely foveolate. Eyes large, oval, not emarginated. Scape, pedicel and flagellomeres with sparse minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.5: 1.25: 0.6: 0.7.

Mesosoma. Propodeum narrower than pronotum. Pronotal width $1.2 \times$ head width behind eyes. Propodeal width $0.8 \times$ pronotal width. Mesosoma dorsum coarsely foveolate. Width of fovea on the mesosomal dorsum $1.16 \times$ width of punctures on head. Scutellar scale absent.

Posterior propodeal face with large fovea than in mesosoma dorsum. Mesopleuron and metapleuron with sparse small punctures. Mesopleura concave; mesopleural suture reaching anterior spiracle, ending at the spiracle. Coxa with small punctures. Femur and tibia foveolate. Mid and hind tibia with two rows of spines, Five in mid tibia and four in hind tibia.

Metasoma. T2 width $1.86 \times$ T1 width. T1–5 with small coarse punctures, T2 laterally foveolate.

Male. (Description is based on the original description and Nithya, 2013). Body Length 9.35 – 12.58 mm. Coloration and Setation. Head black. Antennal tubercles and ocelli brownish. Scape, pedicel, flagellomeres and clypeus black. Mandibles dark ferruginous, apical end black. Mesosoma and legs black. Metasoma pale ferruginous, except T1 and T7 black. Head with dense appressed silvery setae. Clypeus and base of mandible with dense sub-erect long silvery setae. Scape dense appressed long and sub-erect short silvery setae. Pedicel and flagellomeres with dense short pale silvery setae. Pronotum with dense erect silvery setae. Mesonotum and mesoscutellum with erect short black setae. Propodeal face with long erect and sub-erect silvery setae. Legs with erect silvery setae, denser on tarsomeres. T1 with dense long erect silvery setae. T2–6 dense erect and sub-erect pale golden setae, apically with fringe of same colourant setae. T2 with long lateral felt line of appressed golden setae. T7 and S7 with sub-erect long black setae. T3–5 with dense long erect and appressed short black setae. T6 basally with long erect silvery setae and laterally with sparse erect long black setae. S2–7 with apical fringe of pale golden setae.

Structure and sculpture. Head. Conical at vertex, foveolate. Eyes large, oval, emarginated. Scrobal carina well developed, emarginated inwards. Clypeus medially slightly elevated. Antennal tubercle with sparse minute punctures and basally with fine rugae. Scape foveolate. Pedicel and flagellomeres with sparse minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 1: 0.51: 0.32: 0.41. Minimal distance between eyes $0.95 \times$ longitudinal eye diameter. Mandible apically acuminate, with a small sub-apical tooth and with a large basal lobe.

Mesosoma. Propodeum narrower than mesonotum. Pronotal width $1.06 \times$ head width behind eyes. Propodeal width $1.01 \times$ pronotal width. Pronotum and mesonotum foveolate. Mesoscutellum foveolate reticulate. Notauli well developed, wider posteriorly. Parapsidal line short on either side. Tegula with small coarse punctures. Propodeum reticulate, with a U-shaped carina. Mesopleuron foveolate reticulate. Metapleuron with coarse small punctures. Legs with minute punctures.

Metasoma. T2 width $1.9 \times$ T1 width. T1 foveolate. T2–6 with small coarse punctures. T2 with a lateral felt line, felt line $0.52 \times$ T2 length.

Genitalia. Paramere acuminate and curved at apex. Cuspis longer than digitus. Base of digitus with long erect dense setae. Penial valve curved to outside at apex, with one apical and sub-basal tooth.

Material examined. Digital image of the type specimen ♀, Holotype (Type locality: Northern India) [NHMUK: 015215523].

Distribution. Delhi, Gujarat, Karnataka (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

iii. *Promecilla yerburghi* (Cameron, 1892)

(Plates 28 & 29, Figs. 75–86)

Mutilla yerburghi Cameron, 1892: 123, 135, ♂, Syntypes (Type locality: Mahaagang, Sri Lanka) [OUMNH].

Mutilla metallica Cameron, 1892: 120, 128, ♀, Syntypes (Type locality: Trincomalia, Sri Lanka) [NHMUK] (Synonymized by Dalla Torre, 1897: 7).

Mutilla aenescens Dalla Torre, 1897: 7, New name for *Mutilla metallica* Cameron, 1892 (Synonymized by Lelej, 2005: 54).

Description. Female. Body length 4.37– 5.35 mm. Coloration and Setation. Head coppery-ferruginous, with greenish tint, gena ferruginous. Antennal tubercles dark ferruginous. Scape and pedicel pale ferruginous. Flagellomeres brownish-black. Clypeus ferruginous, apical margin brownish-black. Mandible two-third ferruginous, latter part black. Mesosoma coppery-ferruginous, with metallic tint. Meso and metapleuron with metallic tint. Legs ferruginous, spines brownish. Metasoma metallic purple, except T1 and S1 ferruginous, T1 apically with greenish tint. Gena with sub-erect silver setae. Clypeus with erect long black and silvery setae on apical margin. Base of mandible with long sub-erect pale silvery setae and laterally with pale long erect golden setae. Scape with appressed and sub-erect silvery setae. Pedicel and flagellomeres with short pale golden setae. Mesosoma dorsum with dense sub-erect short pale golden setae and erect black setae. Meso and metapleural suture basally with appressed silver setae and latter portion with sparse silvery setae. Coxa, femur and tibiae with dense sub-erect silvery setae. Tarsomeres with dense appressed pale golden setae. T1 with erect silvery setae. T2 basally with small elongate spot of silvery setae and apical band

of silvery setae medially interrupted and not reaching lateral ends. T2–5 with dense long erect and appressed short black setae. T6 basally with long sub-erect pale golden setae and laterally with sparse erect long black setae. S2–6 with apical fringe of pale golden setae. S1 and S2 with sparse golden setae.

Structure and sculpture. Head. Almost circular in frontal view, coarsely punctate. Eyes large, oval, slightly emarginated. Scrobal carina well developed. Clypeus medially with a small tubercle, laterally without any denticles. Antennal tubercle with sparse minute punctures and fine rugae. Scape punctate and laterally with a carina. Pedicel and flagellomeres with sparse minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.25: 0.45: 0.36: 0.34. Minimal distance between eyes $0.95 \times$ longitudinal eye diameter. Mandible apically acuminate, with a pre-apical weak denticle.

Mesosoma. Propodeum narrower than pronotum. Pronotal width $1.20 \times$ head width behind eyes. Propodeal width $0.90 \times$ pronotal width. Mesosoma dorsum coarsely foveolate. Width of fovea on the mesosomal dorsum $1.82 \times$ width of punctures on head. Scutellar scale absent. Posterior propodeal face reticulate. Mesopleuron with sparse puncture and with fine rugae. Metapleuron with minute punctures. Mesopleura concave; mesopleural suture reaching anterior spiracle, ending at the spiracle. Legs with minute coarse punctures. Mid and hind tibia with two rows of spines, four in each row.

Metasoma. T2 width $2.07 \times$ T1 width. T1–5 with small coarse punctures. T2 with a lateral felt line, felt line $0.47 \times$ T2 length. Pygidial area weakly carinated apically, short, finely imbricate. S1 with a ridge medially and with minute punctures. S2 with coarse large punctures. S3–6 with minute coarse punctures.

Male. Body length 9.84 mm. Coloration and Setation. Head metallic blue. Antennal tubercles brownish-black. Antennae and clypeus black. Mandible brownish-black, medially dark red. Mesosoma, metasoma and legs metallic blue. S1 brownish. Head with dense appressed and sparse erect silvery setae. Clypeus and mandible basally with dense sub-erect pale silvery setae. Scape with appressed and sub-erect silvery and pale golden setae. Pedicel and flagellomeres with short dense black setae. Mesosoma dorsum with sparse sub-erect short and erect silvery setae, pronotum with dense sub-erect silvery setae. Meso and metapleuron appressed silvery setae medially and latter portion with sparse silvery setae. Legs with dense sub-erect silvery setae. Metasoma with erect silvery setae. T2–7 and S2–7 with apical fringe of sparse silvery setae. T2 with a lateral felt line on appressed golden-brown setae.

Structure and sculpture. Head. Almost oval in frontal view, vertex conical, sparsely foveolate. Vertex with small punctures. Eyes large, oval, deeply emarginated. Median ocellus larger than lateral ocellus. Scrobal carina well developed, curved. Clypeus medially slightly elevated, apical margin almost straight. Antennal tubercle with sparse minute punctures and fine granulation. Scape foveolate. Pedicel and flagellomeres micropunctate. Ratio of pedicel to flagellomeres 1 to 3 is 0.20: 0.41: 0.77: 0.72. Minimal distance between eyes $1.2 \times$ longitudinal eye diameter. Mandible apically acuminate, beneath with a large lobe.

Mesosoma. Propodeum narrower than mesonotum. Pronotal width $1.28 \times$ head width behind eyes. Propodeal width $0.98 \times$ pronotal width. Pronotum and mesonotum foveolate. Mesoscutellum foveolate-reticulate. Tegula with minute punctures. Propodeum reticulate, medially with larger cells. Notauli complete, groove broader at posterior end. Short parapsidial line on either side on notauli. Mesopleuron foveolate-reticulate, just above mid-coxae with fine rugae. Metapleuron foveolate-reticulate. Mesopleural suture reaching anterior spiracle, ending at the spiracle. Legs with minute coarse punctures.

Metasoma. T1 medially deeply foveolate, latter portion punctate. T2–7 coarsely punctate, laterally foveolate. T2 with a lateral felt line, felt line $0.46 \times$ T2 length. S1 with blunt tooth medially, foveolate. S2 foveolate, fovea larger medially. S3–7 coarsely punctate.

Genitalia. Paramere broad at base, curved at apex, inner margin with short sparse setae. Cuspis shorter than paramere, with short dense erect setae. Digitus and para-cuspis small, with sparse setae at apex. Penial valve shorter but longer than digitus, with a small sub-basal hook.

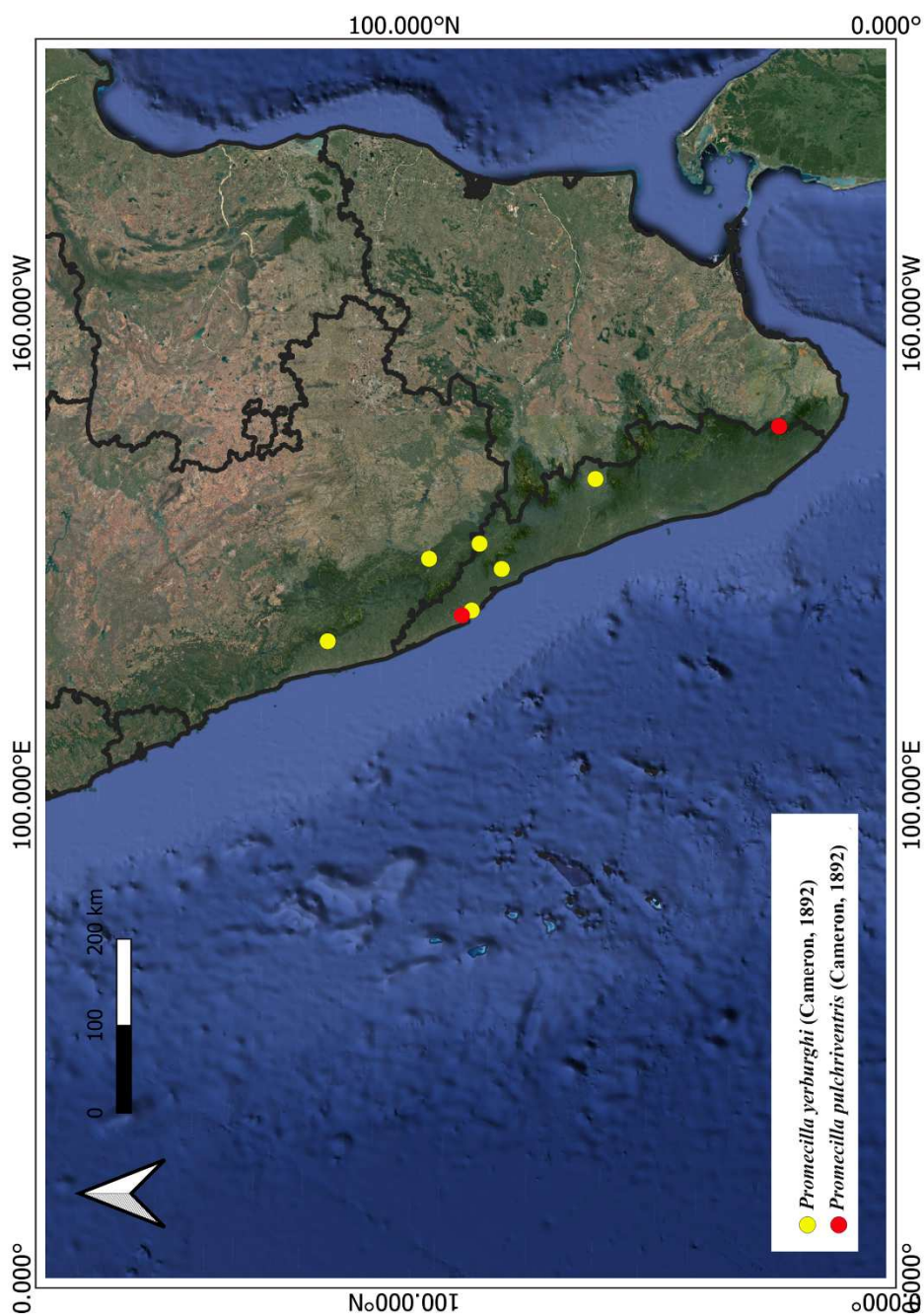
Material examined. Kerala: 1♀, Kannur district, Kannapuram, Latitude: 11.9690 N, Longitude: 75.3208 E, Altitude: 32 m, 02.vi.2019, Coll. C. Charesh, ZSI/WGRC/IR/INV. 24994; 1♀, Kannur district, Kannapuram, Latitude: 11.9690 N, Longitude: 75.3208 E, Altitude: 32m, 24.vi.2019, Coll. C. Charesh, ZSI/WGRC/IR/INV. 27985; 1♀, Palakkad district, Pudukkottai, Latitude: 10.6829 N, Longitude: 76.68378 E, Altitude: 134 m, 02.vi.2019, Coll. C. Bijoy, ZSI/WGRC/IR/INV. 28116; 1♀, Wayanad district, Thirunelli, Pottumoola, Latitude: 11.8872 N, Longitude: 76.0132 E, Altitude: 799 m, 23.viii.2020, Coll. M. Jafer Palot, ZSI/WGRC/IR/INV. 28114; 1♀, Wayanad district, Thirumell, Pottumoola, Latitude: 11.8872 N, Longitude: 76.0132 E, Altitude: 799 m, 23.viii.2020, Coll. M. Jafer Palot, ZSI/WGRC/IR/INV. 28113; 1♀, Kozhikode district, Chaliyam, Latitude: 11.9690 N, Longitude: 75.3208 E, Altitude: 32m, 02.xii.2020, Coll. A.P. Kamila, ZSI/WGRC/IR/INV.

23867; 1 ♀, Kozhikode district, Kuttiady, Latitude: 11.6569 N, Longitude: 75.75033 E, Altitude: 55m, 02.ii.2021, Coll. Terine J. B., ZSI/WGRC/IR/INV. 28115. Karnataka: 1 ♀, Udupi district, Beedikeri, Latitude: 13.4650 N, Longitude: 75.0014 E, Altitude: 115m, 02.ix.2022, Coll. V. D. Hegde & Party, ZSI/WGRC/IR/INV. 25813; 1 ♂, Kodagu district, Thondoor, Latitude: 12.4119 N, Longitude: 75.8565 E, Altitude: 936 m, 22.xii.2019, Coll. Girish Kumar & Party, ZSI/WGRC/IR/INV. 27208.

Distribution. Delhi, Jharkhand, Karnataka (New record), Kerala (New record), Odisha. *Elsewhere:* Sri Lanka (Lelej, 2005; Nithya, 2013 & Pagliano *et al.*, 2020a).

PLATE 25

Species distribution of the genus *Promecilla* André from Central and Southern Western Ghats and its adjacent areas



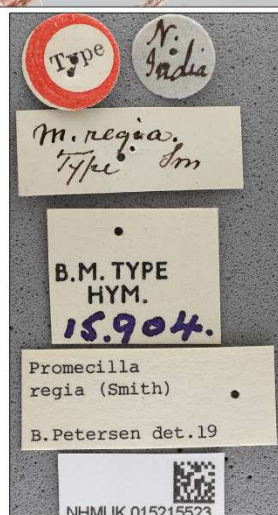
Note. The exact collection locality of *Promecilla regia* (Smith, 1855) from Karnataka is unknown, distributional details are from Lelej, 2005.

PLATE 26



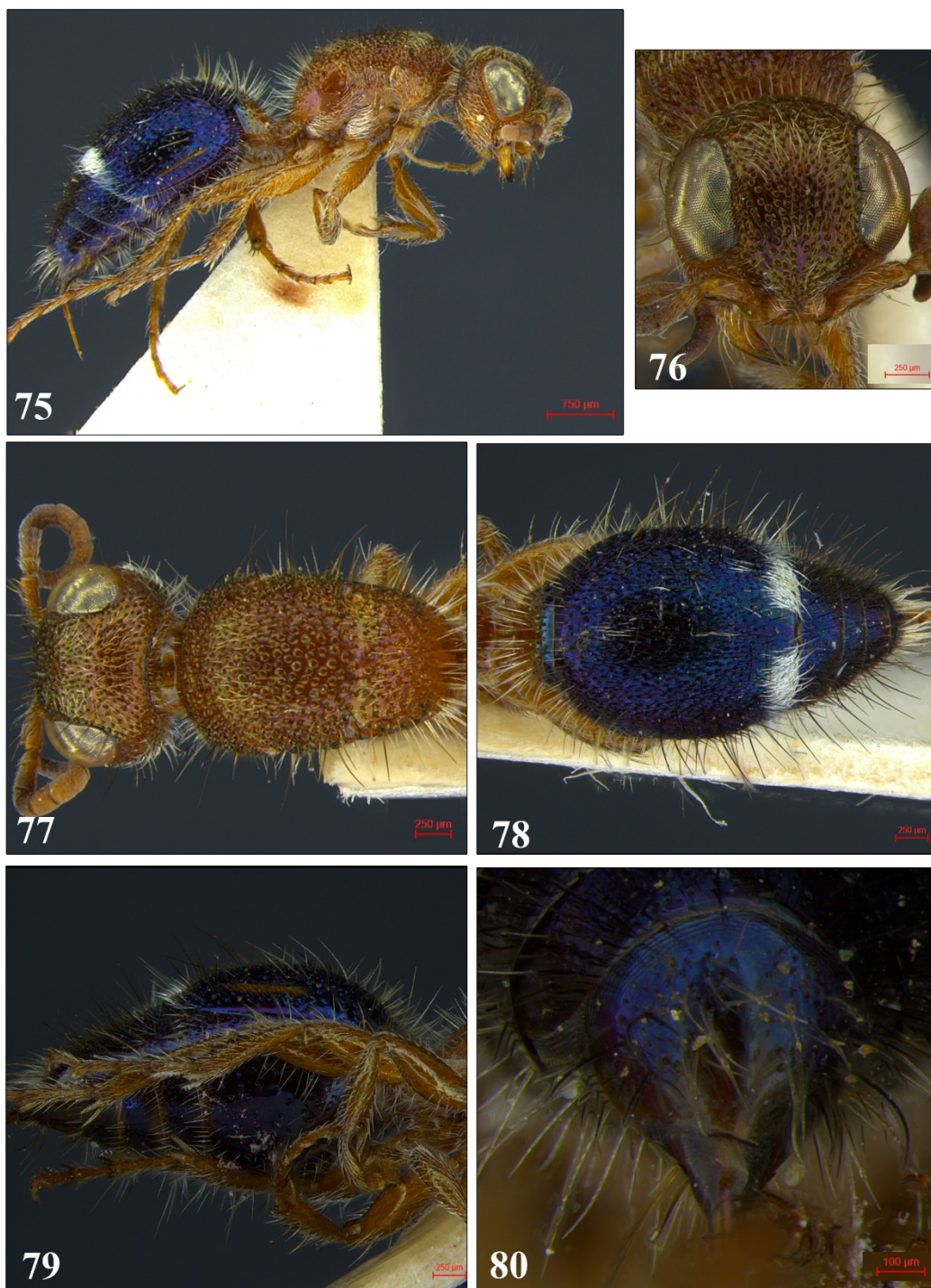
Promecilla pulchriventris (Cameron, 1892) (Female). 67. Body, lateral view. 68. Head, frontal view. 69. Head & Mesosoma, dorsal view. 70. Metasoma, dorsal view. 71. Metasoma, ventral view. 72. Pygidium.

PLATE 27



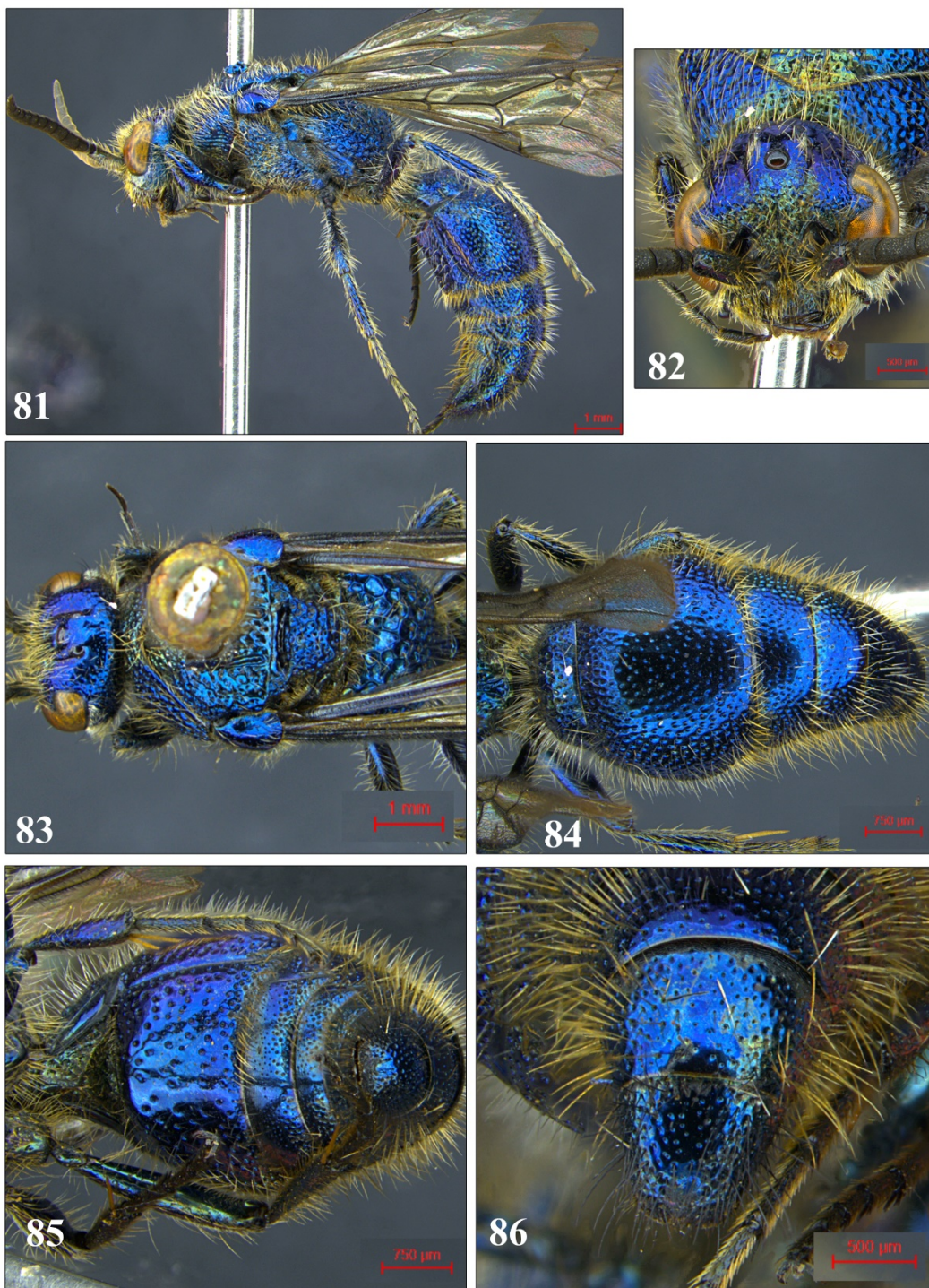
Promecilla regia (Smith, 1855) (Female). 73. Body, lateral view. 74. Body, dorsal view.

PLATE 28



Promecilla yerburghi (Cameron, 1892) (Female). 75. Body, lateral view. 76. Head, frontal view. 77. Head & Mesosoma, dorsal view. 78. Metasoma, dorsal view. 79. Metasoma, ventral view. 80. Pygidium.

PLATE 29



Promecilla yerburghi (Cameron, 1892) (Male). 81. Body, lateral view. 82. Head, frontal view. 83. Head & Mesosoma, dorsal view. 84, 86. Metasoma, dorsal view. 85. Metasoma, ventral view.

IV. Genus *Smicromyrme* Thomson, 1870

Smicromyrme Thomson, 1870: 208; Lelej & Brothers, 2008: 56; Brothers & Lelej, 2017: 96; Okayasu, 2018: 480; Williams *et al.*, 2019a: 26; Pagliano *et al.*, 2020: 187; Okayasu, 2020: 8; Thaochan *et al.*, 2022: 160; Lelej & Williams, 2023: 128; Terine & Girish Kumar, 2023: 83.

Type species. *Mutilla rufipes* Fabricius, 1787, ♀, by monotypy.

Diagnosis. Female. Minimal distance between eyes more than $1.4 \times$ longitudinal eye diameter. Hypostomal tooth and genal carina absent. Clypeus with transverse sub-apical ridge. Mandible acuminate. Scutellar scale well-developed, wide. Pronotum lacking humeral angle projection. T1 without any spots of setae. T2 with one or three sub-basal spots and apical band of setae. T6 with distinct pygidial plate, elongate, parallel sided or widened basally, laterally carinate, striate entirely or with smooth apically.

Male. Head not large. Frons and vertex coarsely punctate. Vertex raised posteriorly. Clypeus concave or flattened. F1 as broad as long. Mandible apically acuminate, bidentate or tridentate, apical tooth larger than sub-apical tooth. Mandible beneath basally with large sub-basal tooth. Mesopleuron without pre-coxal tubercles. Propodeum without pair of dorsal medial tooth. T2 with long lateral felt line and S2 with short lateral felt line. S8 not modified. Gonostylus with tubercles on inner margin.

Diversity & Distribution. The genus is represented by 273 valid species. 113 species are from the Palaearctic Region, 90 are from the Afrotropical Region, and 71 are from the Oriental region. 25 species are recorded from India ((Lelej, 2005; Pagliano *et al.*, 2020; Williams *et al.* 2019a; Lelej & Williams, 2023 & Terine & Girish Kumar, 2023).

Key to the *coromandelica* group-species (females only) (Modified from Lelej, 2005)

1. Head entirely ferruginous. 2
 - Head black, ferruginous behind eyes, upper vertex to occipital carina, extending acutely anterad towards central vertex and over gena and postgena.
..... *S. (E.) williamsi* Terine & Girish Kumar, 2023
2. Metasomal tergum 2 posterad with pale band, which widened medially. 3
 - Metasomal tergum 2 posterad with three pale spots (medial is larger). 5
3. Head dorsally with sparse black hairs, mesosoma dorsally with sparse black hairs medially and sparse silver hairs laterally. *S. (E.) frederici* (André, 1898)

-
- Head and mesosoma dorsally with sparse yellowish hairs. 4
 - 4. Legs with yellowish femur. Posterior band on metasomal tergum 2 very narrow (like fascia). Lateral setae on metasomal tergum 6 black or brownish.....
..... *S. (E.) coromandelica* (Motschulsky, 1863)
 - Legs with brownish-red femur. Posterior band on metasomal tergum 2 wider. Lateral setae on metasomal tergum 6 white. *S. (E.) neglecta* Hammer, 1962
 - 5. Pygidial area oval. Medial pale spot located on metasomal tergum 5.....
..... *S. (E.) ocellata* (Saussure, 1867)
 - Pygidial area elongated. Medial pale spot located on metasomal terga 4 and 5. 6
 - 6. Metasomal tergum 2 with developed basal medial pale spot.....
..... *S. (E.) sexmaculata* Hammer, 1962
 - Metasomal tergum 2 at most with tuft of pale hairs. *S. (E.) desiderata* (Turner, 1911)

Species from the Central and Southern Western Ghats and its adjacent areas

i. *Smicromyrme bicolor* Hammer, 1962

(Plate 31, Figs. 87–89)

Smicromyrme bicolor Hammer, 1962: 43, ♀, Holotype (Type locality: Tuppur forest, Karnataka, India) [NZC]. Type examined.

Description. Female. Coloration and Setation. Head ferruginous. Antennal tubercles, scape and pedicel ferruginous. F1–3 ferruginous. F4–10 black. Mesosoma ferruginous (darker than head), pronotum and propodeal slope darker. Head with erect silvery and sparse black setae. Flagellomeres with short silvery setae. Mesosoma with erect and sub-erect silvery setae, setae on pronotal slope and propodeal slope denser. Legs ferruginous. T1 and S1 ferruginous. T2 and S2 metallic blue. T3–6 and S3–6 blackish. T2 apically with a silvery band, medially triangular. T3 with sparse apical fringe of silvery setae. Pygidium black. S2 with silvery apical fringe of setae. Legs with sparse silvery setae, spur lighter.

Structure and sculpture. Head. Slightly wider than thorax. Posterior angles rounded. Head with coarse fine punctuations. Mandible acuminate apically.

Mesosoma. Propodeum rounded. Propodeal slope steep. Propodeum densely punctate. Scutellar scale small. Meso and metapleura smooth. Legs with sparse fine punctures. Pronotum slightly wider than propodeum.

Metasoma. T1 sparsely punctate. T2–6 with coarse fine punctures. Pygidium shiny. S1 with a medial keel. S2 with large punctures. S3–6 with fine coarse punctures.

Male. Unknown.

Material examined. Type specimen ♀, Holotype (Type locality: Tuppur Forest, Karnataka, India) [NZC: 2073/H3].

Distribution. Karnataka (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

ii. *Smicromyrme durga* (Bingham, 1897)

(Plate 32, Figs. 90–95)

Mutilla durga Bingham, 1897: 18, ♀, New name for *Mutilla dives* Cameron, 1897 (Synonymized under *durga* by Lelej, 2005).

Mutilla dives Cameron, 1897: 75, ♀, Holotype (Type locality: Barackpore, Bangla, India) [OUMNH] (Synonymized by Bingham, 1897: 18).

Description: Female. Body length 6.2–6.7 mm. Coloration and Setation. Head black. Antennal tubercles dark ferruginous. Scape and pedicel brownish black. Flagellomeres black. Clypeus black. Mandible basal half ferruginous, latter part black. Mesosoma dorsum dark ferruginous, marginally black. Meso and metapleura black. Legs black, spines brownish. Scutellar scale dark ferruginous. Metasoma black. S1 brownish black. Pygidial area dark ferruginous. Head with appressed silvery setae and sub-erect black setae. Gena with dense long silvery setae than in frons. Clypeal with long erect silvery setae. Base of mandible with long sub-erect silvery setae. Scape with long sub-erect silvery setae. Pedicel with short sub-erect silvery setae and flagellomeres with silvery micro-pubesence. Mesosoma dorsum with appressed yellowish setae and erect black setae. Meso and metapleuron apically with appressed white setae. Legs with dense sub-erect silvery setae. T1 with erect silvery setae and apically with a slight fringe of silvery setae. T2 basally and apically with a medial spot of silvery setae, latter portion with dense appressed short black setae and with long erect silvery setae. T3 with a band of appressed silvery setae. T4 and T5 with long appressed black setae. T6 with fringe of long erect silvery setae bordering pygidial area. S1 with sparse erect silvery

setae. S2 with an apical fringe, and latter portion with sparse sub-erect silvery setae. S3–5 with sparse silvery setae, apically with a fringe of same colorant.

Structure and sculpture. Head. Almost square in frontal view, coarsely rugose-foveolate. Eyes medium-sized, oval. Scrobal carina weakly developed. Clypeus medially elevated with a tubercle. Antennal tubercle rugose, scape sparsely deeply foveolate, flagellomeres with minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.44: 0.85: 0.60: 0.71. Minimal distance between eyes $1.55 \times$ longitudinal eye diameter. Mandible narrowed towards apex.

Mesosoma. Propodeum wider than pronotum. Pronotal width $1.45 \times$ head width behind eyes. Propodeal width $0.99 \times$ pronotal width. Mesosoma dorsum rugose-foveolate, width of fovea on the mesosomal dorsum $1.41 \times$ width of punctures on head. Scutellar scale well developed. Propodeal slope abrupt/steep, rugose-foveolate. Lateral propodeal margin crenulate. Meso and metapleuron with sparse minute punctures, latter parts smooth and shiny. Mesopleura concave; mesopleural suture reaching anterior spiracle. Mid and hind tibia with two rows of spines, four in each row.

Metasoma. T2 width $2.04 \times$ T1 width. T1–5 with coarsely punctate. T2 with a lateral felt line, felt line $0.46 \times$ T2 length. Pygidial area oval, laterally carinated, irregularly rugose. S1 with a blunt tooth medially. S2–6 punctate, S2 medially sparsely, medial punctures larger and laterally coarsely punctate, S3–6 coarsely punctate.

Male. Unknown.

Material examined. Karnataka: 4♀, Shimoga district, Mookambika Wildlife Sanctuary, Herate, Latitude: 13.7666 N, Longitude: 75.0443 E, Altitude: 617 m, 04.xii.2022, Coll. V.D. Hegde & Party, ZSI/WGRC/IR/INV. 22934, 22935, 22936, 22937.

Distribution. Bihar, Karnataka (New record), West Bengal (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

iii. *Smicromyrme nigrigena* (André, 1894)

(Plate 33, Figs. 96–101)

Mutilla nigrigena André, 1894: 464, 471, ♀, Syntypes (Kanara, Karnataka, India) [MNHN].

Description: Female. Body length 2.97–5.28 mm. Coloration and Setation. Head black, frons, gena and vertex dark ferruginous. Antennal tubercles pale ferruginous. Scape and flagellomeres brownish-black. Pedicel pale ferruginous. Clypeus pale ferruginous. Mandible

basal half ferruginous, latter part black. Mesosoma dark ferruginous, mesopleural suture black. Legs brownish-black. Spines brownish. Scutellar scale brownish. Metasoma black. S1 brownish. S2 brownish-black, apical one-third ferruginous. S3–6 brownish-black. Pygidial area black, apically pale ferruginous. Head with appressed pale silvery setae and erect brownish-black setae. Gena with dense appressed silvery setae. Clypeal with appressed brownish setae. Base of mandible with long sub-erect brownish setae. Scape with long sub-erect silvery setae. Pedicel with short appressed brownish setae and flagellomeres with silvery micro-pubesence. Mesosoma dorsum with dense appressed black and sparse silvery setae and with erect black setae, laterally with long erect black setae. Meso and metapleuron with sparse appressed long silvery setae. Coxa with long appressed and sub-erect silvery setae and latter segments with dense appressed silvery setae. T1–5 with dense appressed black setae and erect black setae. T2 basally with small spot of silvery setae and apically with a large medial spot of silvery setae and apico-laterally with silvery setal spots on each side, latter portion with dense appressed short black setae. T3 with dense appressed black setae. T4 and T5 with a medial spot of silvery setae. T6 with a fringe of brownish-black setae bordering the pygidial area. S1 with dense sub-erect long silvery setae. S2 with an apical fringe of long silvery setae, and latter portion with sparse sub-erect and erect long silvery setae. S3–5 with sparse silvery setae, apically with a fringe of long silvery setae.

Structure and sculpture. Head. Quadrangular shaped in frontal view, coarsely foveolate, vertex with fine sparse rugae. Eyes large, oval. Scrobal carina weakly developed at base of antennal tubercle. Clypeus medially elevated with a small tubercle. Antennal tubercle with sparse minute punctures, latter part shiny. Scape and pedicel sparsely foveolate. Flagellomeres with minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.32: 0.44: 0.52: 0.51. Minimal distance between eyes $1.26 \times$ longitudinal eye diameter. Mandible narrowed towards apex, with weakly developed sub-apical tooth.

Mesosoma. Propodeum slightly narrower than pronotum. Pronotal width $1.15 \times$ head width behind eyes. Propodeal width $0.99 \times$ pronotal width. Mesosoma dorsum rugose-foveolate, propodeal slope reticulate. Width of fovea on the mesosomal dorsum $1.77 \times$ width of punctures on head. Scutellar scale well developed. Mesosomal margin slightly crenulate. Meso and metapleuron punctate, mesopleuron with fine rugae and latter parts smooth and shiny. Mesopleura concave; mesopleural suture not reaching anterior spiracle, ending just below the spiracle. Coxa, femur and tarsomeres with minute coarse punctures. Tibia foveolate. Mid and hind tibia with two rows of spines, five in each row.

Metasoma. T2 width $2.28 \times$ T1 width. T1–5 coarsely punctate. T2 with a lateral felt line, felt line $0.5 \times$ T2 length. Pygidial area parallel-sided, apically rounded, longitudinally striated and divergent medially, apically smooth. S1 with a blunt tooth medially and with minute coarse punctures. S2–6 punctate, S2 medially sparsely, medial punctures larger and laterally coarsely punctate, S3–6 with minute coarse punctures.

Male. Unknown.

Materials examined. Karnataka: 2♀, Kodagu district, Bettathur, Latitude: 12.4077 N, Longitude: 75.6608 E, Altitude: 1194 m, 23.xii.2019, Coll. P. Girish Kumar & Party, ZSI/WGRC/IR/INV. 21784, 21785; 1♀, Kodagu district, Bettathur, Latitude: 12.4077 N, Longitude: 75.6608 E, Altitude: 1194 m, 25.xii.2019, Coll. P. Girish Kumar & Party, ZSI/WGRC/IR/INV. 23376. Kerala: 1♀, Kannur district, Kannapuram, Latitude: 11.9694 N, Longitude: 75.3218 E, Altitude: 30 m, 23.xi.2019, Coll. C. Charesh, ZSI/WGRC/IR/INV. 21786; 1♀, Kozhikode district, Vilangad, Latitude: 11.772 N, Longitude: 75.75401 E, Altitude: 314 m, 05.i.2020, Coll. Anju K., ZSI/WGRC/IR/INV. 24636; 1♀, Malappuram district, Nilambur, Punchakolli, Latitude: 11.38234 N, Longitude: 76.3561 E, Altitude: 93 m, 22.iv.2022, Coll. Terine J.B., ZSI/WGRC/IR/INV. 21628.

Distribution. Karnataka, Kerala (New record), West Bengal (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

iv. *Smicromyrme (Eremotilla) neglecta* Hammer, 1962

(Plate 34, Figs. 102–104)

Smicromyrme neglecta Hammer, 1962: 41, ♀, Holotype (Type locality: Barkuda, Chilka Lake, Orissa, India) [NZC]. Type examined.

Description. Female. Body length 5 mm. Coloration and Setation. Head, antennal tubercles, scape, pedicel and flagellomeres ferruginous. Mandible basally ferruginous, latter part black. Mesosoma and legs ferruginous. Metasoma and pygidium brownish red. S1 ferruginous. S2–6 brownish black. Head with sparse erect silvery setae. Gena with appressed long dense silvery setae. Mesosoma dorsum and pleura with erect and sub-erect silvery setae. Propodeal and pronotal declivity with sub-erect silvery setae. Legs with sparse short sub-erect silvery setae. T1 apically with fringe of silvery setae and latter part with sub-erect silvery setae. T2 basally with a spot of silvery setae and apically with a band of silvery setae, slightly

broadened medially. T2 with a long lateral felt line of silvery setae. T3 and T4 with sparse apical band of silvery setae. S2–6 with sparse fringe of silvery setae,

Structure and sculpture. Head. Almost broader than thorax. Head not elongated behind eyes, posterior angles rounded. Mandible acuminate apically. F2 longer than F3.

Mesosoma. Almost rectangular in shape. Mesosomal length one and a quarter time longer than wide. Propodeal slope steep. Mesosomal dorsum coarsely, largely punctate rugose. Propodeum finely granulated. Scutellar scale present, punctate. Lateral side of pronotum, propodeal sides and mesopleura smooth. Legs sparsely punctate.

Metasoma. Metasoma with fine coarse punctures. Pygidium delimited by lateral carina, longitudinally striated. S1 short with a medially raised keel.

Male. Unknown.

Material examined. Type specimen ♀, Holotype (Type locality: Barkuda, Chilka Lake, Odisha, India) [NZC: 2070/H3].

Distribution. Karnataka, Odisha. *Elsewhere.* Sri Lanka (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

v. *Smicromyrme (Eremotilla) ocellata* (Saussure, 1867)

(Plate 35, Figs. 105–110)

Mutilla ocellata Saussure, 1867: 356, ♀, Syntypes (Ceylon, Sri Lanka) [NHMW].

Description: Female. Body length 7.5 mm. Coloration and Setation. Head ferruginous. Antennal tubercles, scape and pedicel ferruginous. Flagellomeres brownish-black. Clypeus ferruginous, apically dark ferruginous. Mandible basal half ferruginous, latter part black. Mesosoma ferruginous, dorsally dark ferruginous. Legs ventrally ferruginous, dorsally brownish black, spines brownish. Scutellar scale dark ferruginous. Metasoma black. Sternal segments ferruginous. Pygidial area basal half ferruginous, latter part black. Head with appressed pale silvery setae and sub-erect black setae. Gena with dense appressed silvery setae. Clypeal with long sub-erect black setae. Base of mandible with long sub-erect pale golden setae. Scape with long appressed dense silvery setae. Pedicel with short appressed silvery setae and flagellomeres with silvery micro-pubesence. Mesosoma dorsum with dense appressed and erect black setae. Meso and metapleuron with sparse appressed silver setae. Coxa, femur and tibia with dense sub-erect silvery setae. Tarsomeres with dense appressed

pale golden setae. T1 with erect black and silvery long setae and appressed black setae. T2 basally and apically with a medial spot of silvery setae, latter portion with dense appressed short black setae, apico-laterally with a fringe of silvery setae. T3 and T4 with dense appressed black setae. T5 with a medial spot of silvery setae. T6 with laterally with a fringe of long erect pale golden and black setae bordering pygidial area. S1 with dense erect silvery setae. S2 with an apical fringe, and latter portion with sparse sub-erect and erect silvery setae. S3–5 with sparse silvery setae, apically with a fringe of silvery setae.

Structure and sculpture. Head. Almost square in frontal view, rounded at vertex, coarsely foveolate. Eyes medium-sized, slightly emarginated. Scrobal carina weakly developed. Clypeus medially elevated with a tubercle, without any denticle apico-laterally. Antennal tubercle rugose. Scape sparsely deeply foveolate and flagellomeres with minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.35: 0.62: 0.68: 0.62. Minimal distance between eyes $1.38 \times$ longitudinal eye diameter. Mandible narrowed towards apex, apically with a weak sub-apical tooth.

Mesosoma. Propodeum slightly wider than pronotum. Pronotal width $1.28 \times$ head width behind eyes. Propodeal width $1.02 \times$ pronotal width. Mesosoma dorsum foveolate, width of fovea on the mesosomal dorsum $1.65 \times$ width of punctures on head. Scutellar scale well developed. Propodeal slope abrupt/steep, areolate. Mesosomal margin crenulate. Meso and metapleuron with sparse minute punctures, latter parts smooth and shiny. Mesopleura concave; mesopleural suture reaching anterior spiracle. Mid and hind tibia with two rows of spines, four in each row of hind tibia and three in each row of mid tibia.

Metasoma. T2 width $2.13 \times$ T1 width. T1–5 with coarsely punctate. T2 with a lateral felt line, felt line $0.52 \times$ T2 length. Pygidial area oval, laterally carinated, circularly striated. S1 with a long ridge forming a blunt tooth medially. S2–6 punctate, S2 less densely punctate than latter sternal segments.

Male. Unknown.

Material examined. Karnataka: 1♀, Shimoga district, Mookambika Wildlife Sanctuary, Yaduru, Latitude: 13.6851 N, Longitude: 75.0723 E, Altitude: 641 m, 04.xii.2022, Coll. V.D. Hegde & Party, ZSI/WGRC/IR/INV. 23373.

Distribution. Karnataka. *Elsewhere.* Sri Lanka (Lelej, 2005).

vi. *Smicromyrme (Eremotilla) sexmaculatus* Hammer, 1962**(Plate 36, Figs. 111–116)**

Smicromyrme sexmaculatus Hammer, 1962: 41, ♀, Holotype ♀ (Chiplun, Vashishti valley, Maharashtra, India) [NZC].

Description: Female. Body length 5.37 mm. Coloration and Setation. Head ferruginous. Antennal tubercles dark ferruginous. Scape and pedicel pale ferruginous. Flagellomeres brownish-black. Clypeus dark ferruginous. Mandible basal one-third ferruginous, latter part black. Mesosoma ferruginous. Coxa and femur ferruginous, latter segments dark ferruginous to brownish black, spines brownish. Scutellar scale brownish. Metasoma black. Sternal segments ferruginous. Pygidial area black. Head with appressed pale silvery setae, gena with dense appressed silvery setae. Clypeus with appressed black setae. Base of mandible with long sub-erect pale golden setae and ventrally with long erect black setae. Scape with long appressed dense silver setae. Pedicel with short appressed silvery setae and flagellomeres with silvery micro-pubesence. Mesosoma dorsum with dense appressed and erect black setae, laterally with long erect black setae. Meso and metapleuron with sparse appressed long silvery setae. Coxa with long appressed silvery setae and latter segments with dense appressed silvery setae. T1–5 with dense appressed black setae and erect black setae. T2 basally and apically with a medial spot of silvery setae and apico-laterally with silver setal spots on each side, latter portion with dense appressed short black setae. T3 and T4 with dense appressed black setae. T5 with a medial spot of silvery setae, with spot emarginated on to apical T4. T6 without any setal fringe laterally bordering the pygidial area. S1 with dense sub-erect long silvery setae. S2 with an apical fringe of long silvery setae, and latter portion with sparse sub-erect and erect long silvery setae. S3–5 with sparse silvery setae, apically with a fringe of long silvery setae.

Structure and sculpture. Head. Quadrangular shaped in frontal view, coarsely foveolate. Eyes medium-sized, oval. Scrobal carina weakly developed. Clypeus medially elevated without any tubercle. Antennal tubercle rugose. Scape and pedicel sparsely foveolate. Flagellomeres with minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.27: 0.41: 0.59: 0.64. Minimal distance between eyes $1.17 \times$ longitudinal eye diameter. Mandible narrowed towards apex.

Mesosoma. Propodeum slightly narrower than pronotum. Pronotal width $1.02 \times$ Head width behind eyes. Propodeal width $0.93 \times$ pronotal width. Mesosoma dorsum rugose-foveolate,

width of fovea on the mesosomal dorsum $1.09 \times$ width of punctures on head. Scutellar scale well developed, arched. Base of pronotum rugose. Propodeal margin slightly crenulate. Meso and metapleuron punctate, latter parts smooth and shiny. Mesopleura concave; mesopleural suture reaching anterior spiracle. Coxa with minute coarse punctures. Femur and tibia with sparse punctures. Mid and hind tibia with two rows of spines, five in each row.

Metasoma. T2 width $2.12 \times$ T1 width. T1–5 coarsely punctate. T2 with a lateral felt line, felt line $0.48 \times$ T2 length. Pygidial area parallel-sided, apically rounded, longitudinally striated. S1 without any blunt tooth medially. S1–6 punctate, S2 medially sparsely, medial punctures larger and laterally coarsely punctate, S3–6 with minute coarse punctures.

Male. Unknown.

Material examined. Karnataka: 1♀, Shimoga district, Mookambika Wildlife Sanctuary, Yaduru, Latitude: 13.6851 N, Longitude: 75.0723 E, Altitude: 641 m, 05.xii.2022, Coll. V.D. Hegde & Party, ZSI/WGRC/IR/INV. 23372.

Distribution. Karnataka, Maharashtra, Tamil Nadu; *Elsewhere*: Sri Lanka (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

vii. *Smicromyrme (Eremotilla) williamsi* Terine & Girish Kumar, 2023

(Plate 37, Figs. 117–122)

Smicromyrme (Eremotilla) williamsi Terine & Girish Kumar, 2023: 83–86, ♀, Holotype ♀ (Sairandri, Silent Valley National Park, Palakkad district, Kerala, India) [ZSIK].

Description. Female. Body length 9.02–9.05 mm. Coloration and Setation. Head black; gena, vertex and head behind eyes ferruginous. Antennal tubercles dark ferruginous. Scape, pedicel and flagellomeres brownish-black. Clypeus ferruginous. Mandible basal half ferruginous, latter part black. Mesosoma ferruginous, spiracles dark ferruginous. Legs black, procoxa and profemur black, meso and metafemur ferruginous, spines brownish. Scutellar scale dark ferruginous. Metasoma black, except T1 and S1 ferruginous. S2–6 black, S2 and S3 apico-medially ferruginous. Head with appressed golden setae and sparse black setae. Gena with appressed silver setae. Clypeus with tuft of erect golden and silver setae. Base of mandible with long sub-erect golden setae. Scape with appressed dense silver setae. Pedicel and flagellomeres with short white setae. Mesosoma dorsum with dense appressed black and sub-erect golden setae. Meso and metapleuron with sparse appressed silvery setae. Legs with dense appressed silvery setae and sparse black setae. T1–5 with dense appressed black setae

and sub-erect golden setae. T1 with fringe of golden setae. T2 basally with spot of golden setae and apical band of golden setae, emarginated medially touching the basal spot. T3 with dense appressed black setae. T4 and T5 with a band of golden setae. T6 baso-laterally with a fringe of golden setae. S2–6 with apical fringe of golden setae. S1 and S2 with sparse golden setae. S6 laterally with a tuft of golden setae on each side.

Structure and sculpture. Head. Oval in frontal view, coarsely punctate-reticulate, vertex with fine sparse rugae. Eyes large, oval. Scrobal carina weakly developed. Clypeus medially weakly emarginated, with a small tubercle. Antennal tubercle and pedicel with sparse minute punctures, latter part shiny. Scape sparsely foveolate. Flagellomeres with minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.16: 0.26:0.22: 0.23. Minimal distance between eyes $1.31 \times$ longitudinal eye diameter. Mandible apically acuminate, with two pre-apical weak denticles.

Mesosoma. Propodeum slightly narrower than pronotum. Pronotal width $1.25 \times$ head width behind eyes. Propodeal width $0.93 \times$ pronotal width. Mesosoma dorsum punctate reticulate. Width of reticulae on the mesosomal dorsum $1.74 \times$ width of reticulae on head. Scutellar scale well developed, arcuate. Posterior propodeal face reticulate. Mesopleuron with fine rugae and metapleuron with minute punctures. Mesopleura concave; mesopleural suture not reaching anterior spiracle, ending at the spiracle. Legs with minute coarse punctures. Mid and hind tibia with two rows of spines, four in each row.

Metasoma. T2 width $1.95 \times$ T1 width. T1–5 with small coarse punctures. T2 with a lateral felt line, felt line $0.48 \times$ T2 length. Pygidial area parallel-sided, apically rounded, longitudinally striated and divergent, apically rugose. S1 with a tooth medially and with sparse minute punctures. S2 with coarse large punctures. S3–6 with minute coarse punctures.

Male. Unknown.

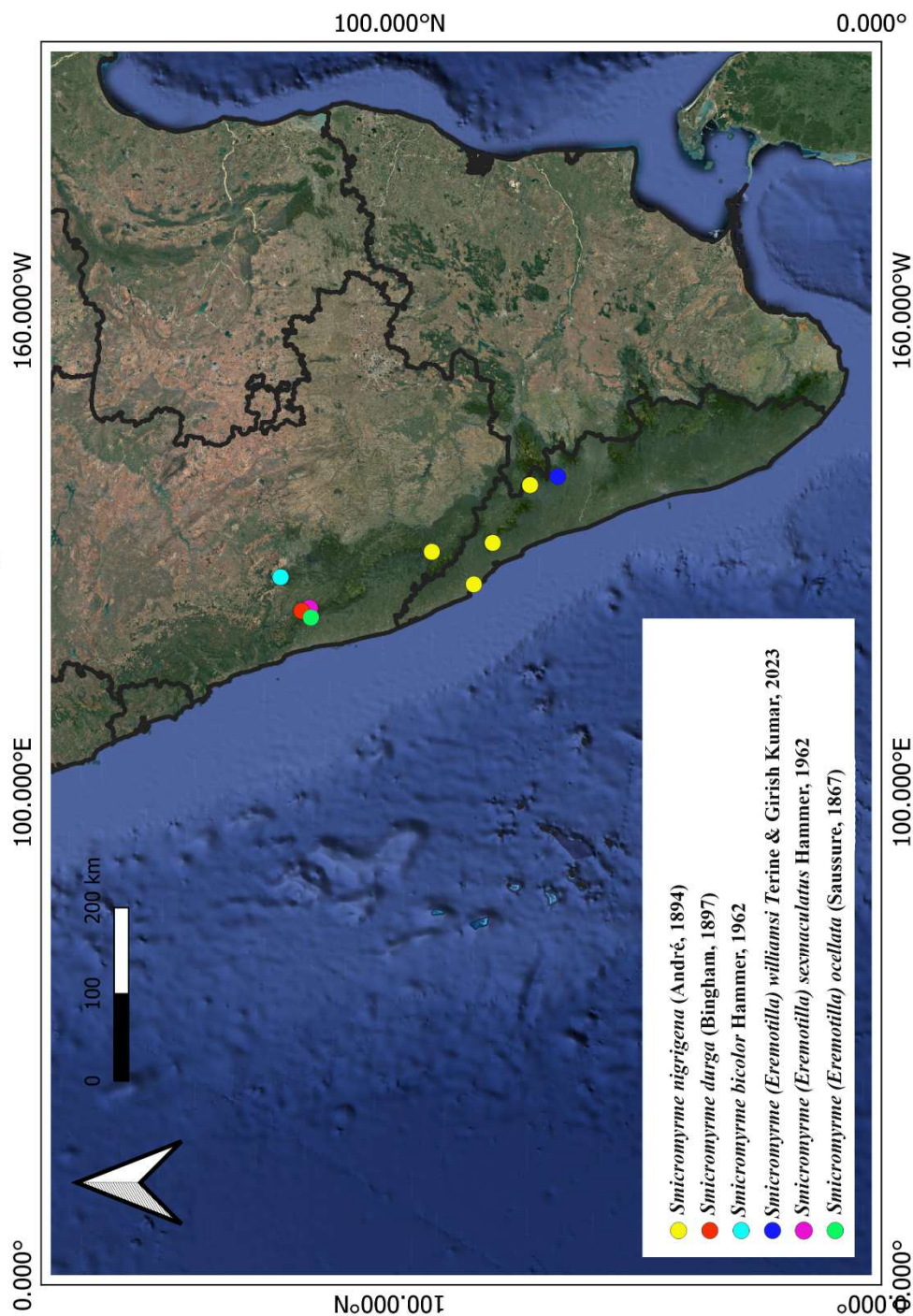
Material examined. Kerala: 2♀, Palakkad district, Silent Valley National Park, Sairandri, Latitude: 11.093 N, Longitude: 76.446 E, Altitude: 1038 m, 12.iii.2021, Coll. A.P. Kamila, ZSI/WGRC/IR/INV. 23871, 23872.

Distribution. Kerala (Terine & Girish Kumar, 2023).

Remarks. Terine & Girish Kumar (2023) described and published this species.

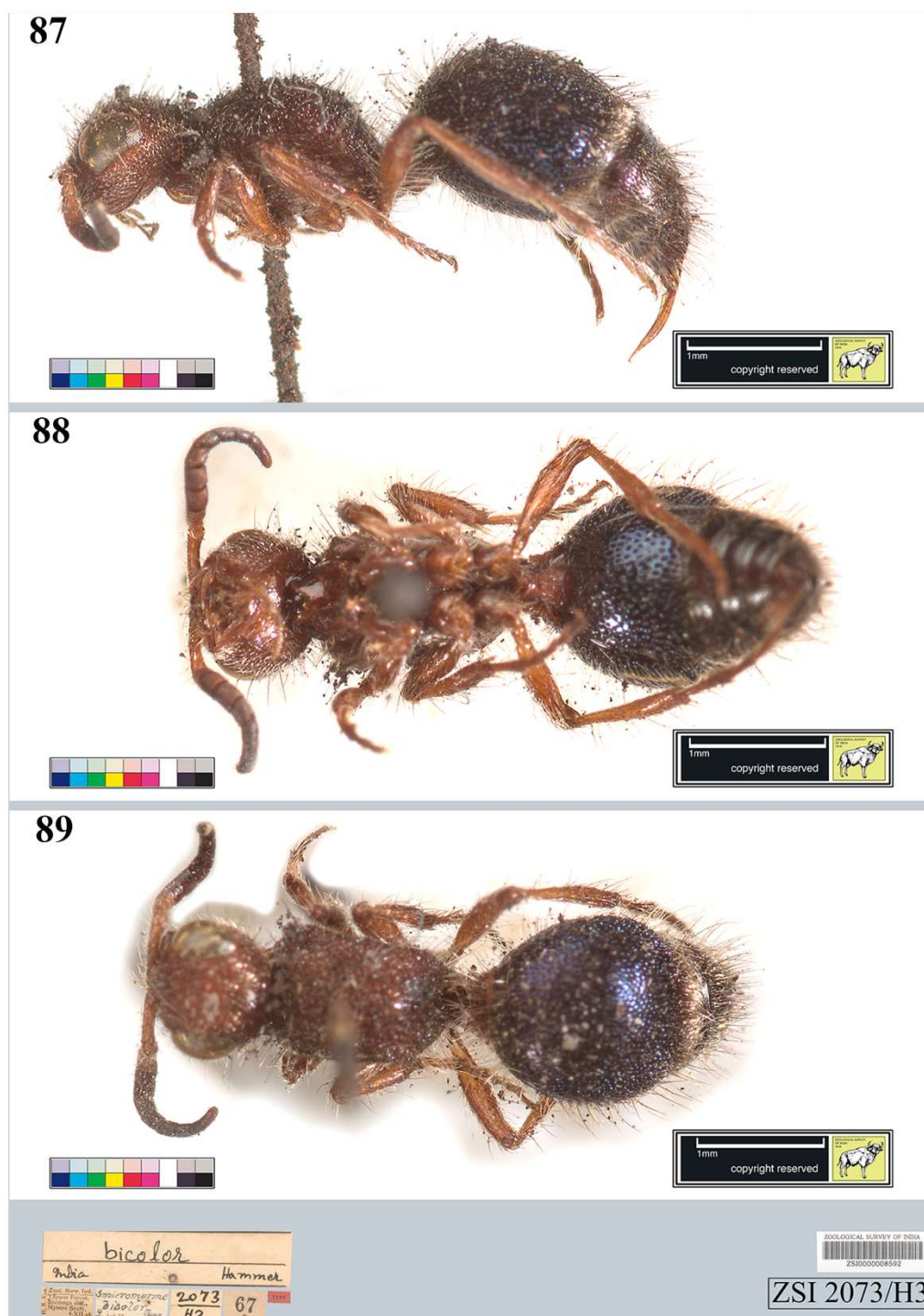
PLATE 30

Species distribution of the genus *Smicromyrme* Thomson from Central and Southern Western Ghats and its adjacent areas



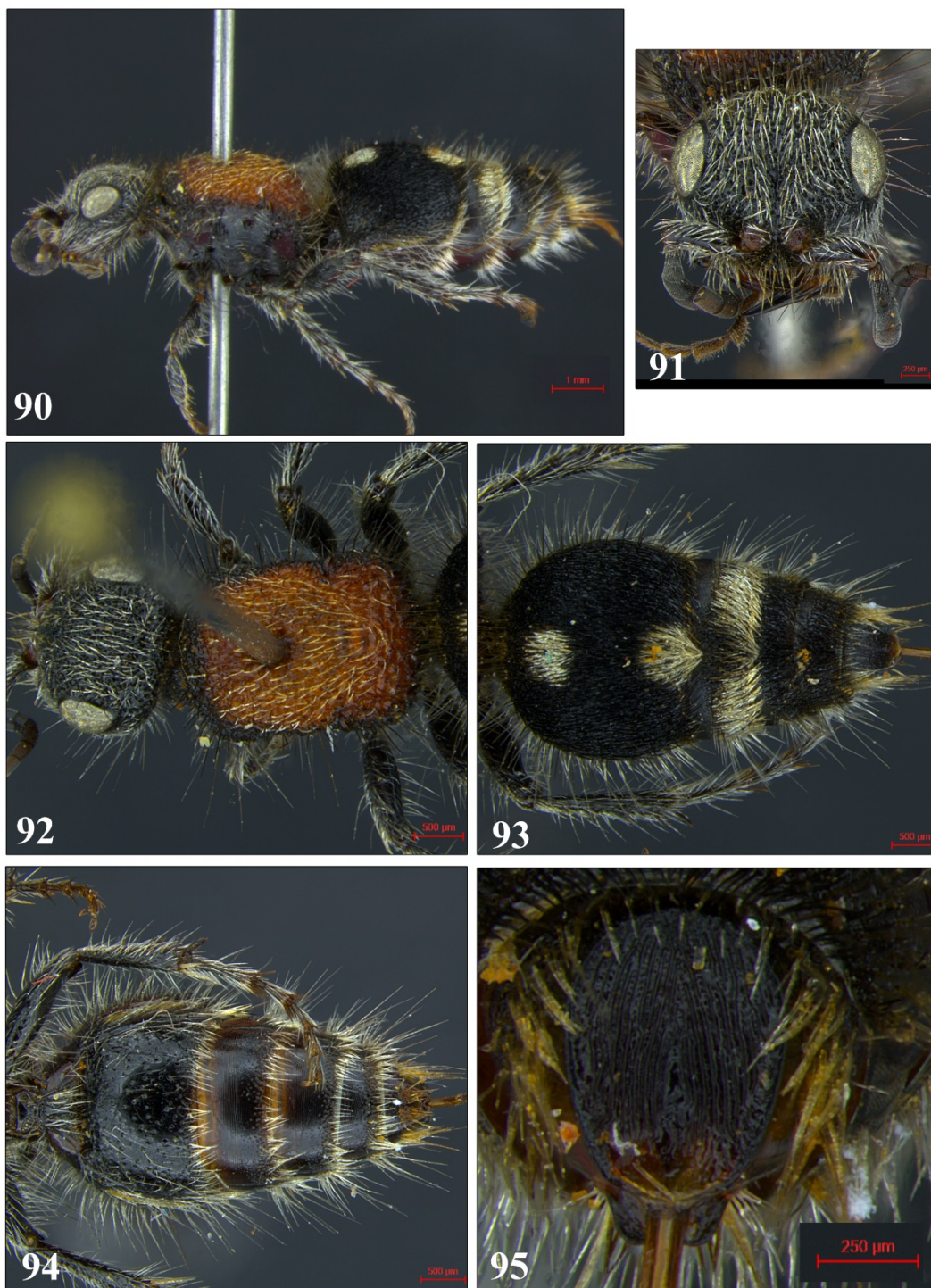
Note. The exact collection locality of *Smicromyrme (Eremotilla) neglecta* Hammer, 1962 from Karnataka is unknown, distributional details are from Lelej, 2005.

PLATE 31



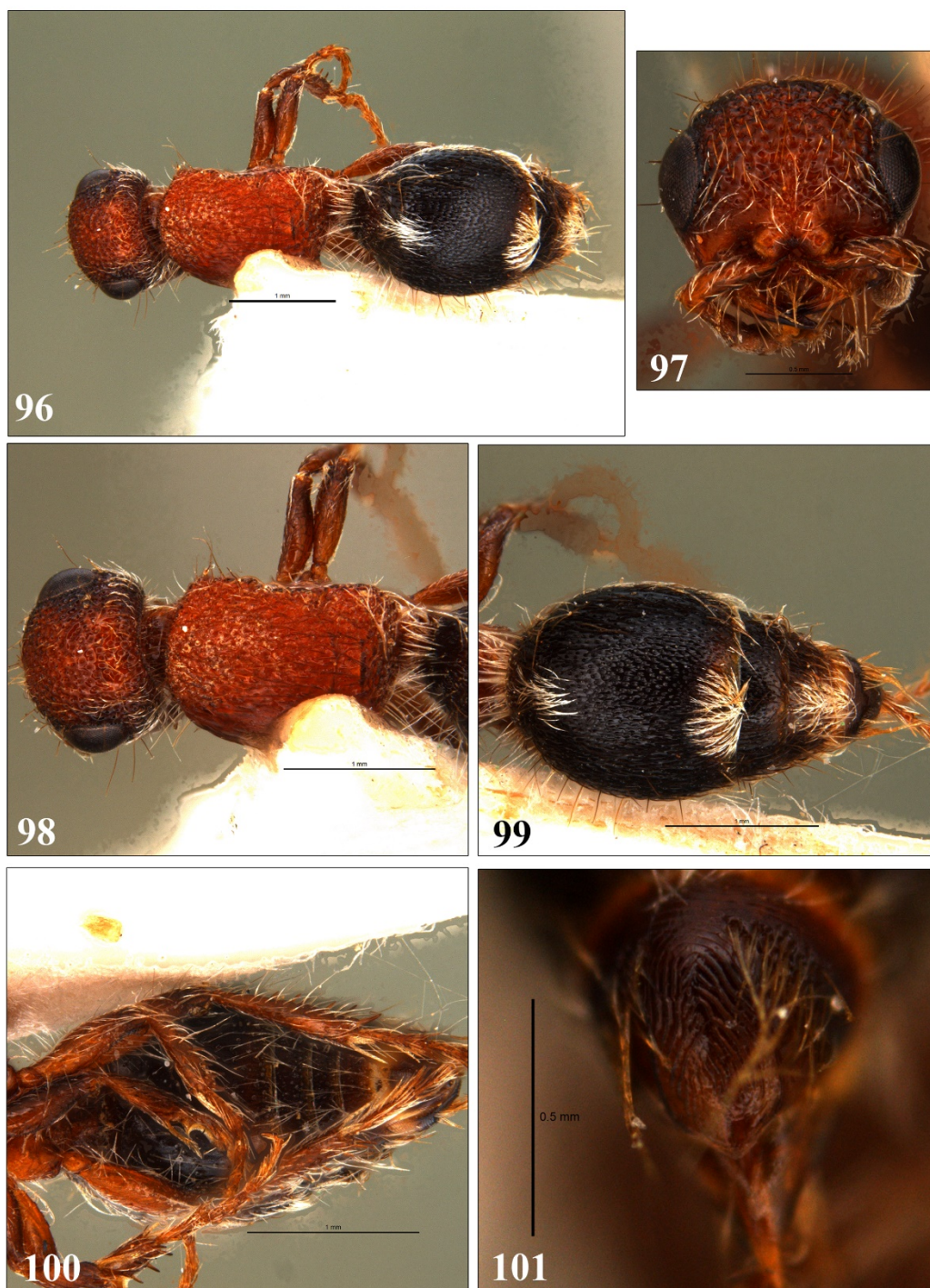
Smicromyrme bicolor Hammer, 1962 (Female). 87. Body, lateral view. 88. Body, ventral view. 89. Body, dorsal view.

PLATE 32



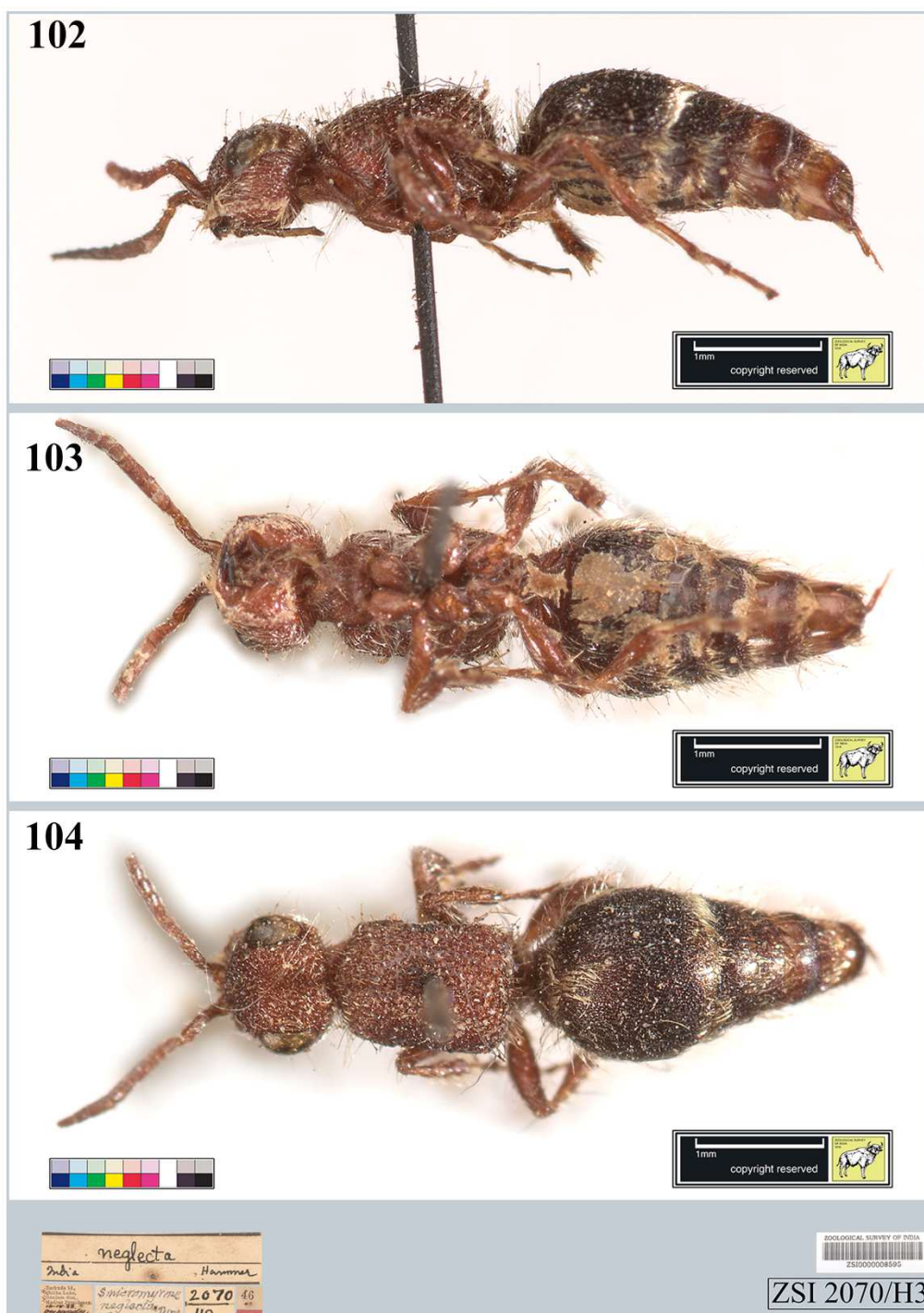
Smicromyrme durga (Bingham, 1897) (Female). 90. Body, lateral view. 91. Head, frontal view. 92. Head & Mesosoma, dorsal view. 93. Metasoma, dorsal view. 94. Metasoma, ventral view. 95. Pygidium.

PLATE 33



Smicromyrme nigrigena (André, 1894) (Female). 96. Body, lateral view. 97. Head, frontal view. 98. Head & Mesosoma, dorsal view. 99. Metasoma, dorsal view. 100. Metasoma, ventral view. 101. Pygidium.

PLATE 34



Smicromyrme (Eremotilla) neglecta Hammer, 1962 (Female). 102. Body, lateral view. 103. Body, ventral view. 104. Body, dorsal view.

PLATE 35



Smicromyrme (Eremotilla) ocellata (Saussure, 1867) (Female). 105. Body, lateral view. 106. Head, frontal view. 107. Head & Mesosoma, dorsal view. 108. Metasoma, dorsal view. 109. Metasoma, ventral view. 110. Pygidium.

PLATE 36



Smicromyrme (Eremotilla) sexmaculatus Hammer, 1962 (Female). 111. Body, lateral view. 112. Head, frontal view. 113. Head & Mesosoma, dorsal view. 114. Metasoma, dorsal view. 115. Metasoma, ventral view. 116. Pygidium.

PLATE 37



Smicromyrme (Eremotilla) williamsi Terine & Girish Kumar, 2023 (Female).
117. Body, lateral view. 118. Head, frontal view. 119. Head & Mesosoma, dorsal view. 120. Metasoma, dorsal view. 121. Metasoma, ventral view. 122 Pygidium.

IV. Tribe Mutillini Latreille, 1802

Key to the Indian genera of Tribe Mutillini Latreille, 1802

Males

1. Head rounded posteriorly. Prementum with longitudinal medial ridge.....
 *Kurzenkotilla* Lelej, 2005
- Head not rounded posteriorly. Prementum without any tubercles.
 *Storozhenkotilla* Lelej, 2005

Females

1. T6 without distinct pygidial area. T2 basally with spots of pale setae, disposed transversely.
 *Kurzenkotilla* Lelej, 2005
- T6 with distinct pygidial area, apico-laterally weakly carinate. T2 basally with pale band,
 medially emarginated posteriorly. *Storozhenkotilla* Lelej, 2005

I. Genus *Kurzenkotilla* Lelej, 2005

Kurzenkotilla Lelej, 2005: 170; Lelej & Brothers, 2008: 31; Nithya & Dey, 2013a: 289, Brothers & Lelej, 2017: 96; Terine *et al.*, 2020a: 3; Terine *et al.*, 2020b: 446; Pagliano *et al.*, 2020: 225; Lelej *et al.*, 2023c: 458.

Type species: *Artiotilla ariana* Lelej in Lelej & Kabakov, 1980 by original designation.

Diagnosis. Female. Head equals pronotal width, elongated behind eyes. Eyes large. Hypostomal carina slightly widened medially. Prementum not tuberculate. F1 length 1.5–2.0 × F2 length. Mandible wide, bidentate (In *K. annamensis* and *K. harmandi* tridentate). Mesopleuron concave. Scutellar scale absent. Mid and hind tibia with two rows of spines. T1 wide. T2 with lateral felt line. S2 latero-apically bulged (In *K. ariana*, bulge ends in tooth). T2 with basal small or large spots of setae transversely. T3 with lateral spots of wide band of setae. T6 with pygidial plate weakly developed, sometimes micro-granulate. S6 with two apical tubercles.

Male. Head rounded posterad, width lesser than pronotal width. Occipital carina dorsally well developed. Eyes weakly notched. Ocelli small. Mandible bidentate, without sub-basal inner and outer tooth. F1 shorter than F2. Prementum with medial longitudinal ridge. Parapsids and

notauli present. Tegulae longer than lateral pronotal length, projecting over mesoscuto-scutellar suture. Pterostigma closed, large. Mid and hind tibia with two rows of spines. Mesoscutellum not gibbous, simple. Propodeal posterior slope with median longitudinal carina. T1 and T2–3(4) posterad with band of pale setae. T2 with lateral felt line. S2 without any lateral felt line. S8 without any tubercles. T7 usually smooth, with triangular smooth area postero-medially. Gonostylus wide. Penial valve usually longer than volsella. Volsella with cuspis and digitus. Cuspis wide. Digitus short, finger-like. Penial valves symmetrical.

Diversity & Distribution. The genus is represented by nine valid species worldwide. Most of them are recorded from the Oriental region. Six species from India (Lelej, 2005, Pagliano *et al.*, 2020 & Lelej *et al.*, 2023c).

Key to Indian species of *Kurzenkotilla* Lelej, 2005 (Males unknown for *K. cicatricifera* (André, 1894), *K. niveosignata* (André, 1894), *K. scrobiculata* (Hammer, 1962), *K. visrara* (Cameron, 1898). Females unknown in *K. rufodorsata* (Cameron, 1897) & *K. semiviolacea* (André, 1896)).

- | | |
|--|---------------------------------------|
| 1. Female..... | 2 |
| – Males. | 5 |
| 2. Head black. | 3 |
| – Head ferruginous. | <i>K. cicatricifera</i> (André, 1894) |
| 3. Mesosoma laterally black. | 4 |
| – Mesosoma laterally ferruginous. | <i>K. scrobiculata</i> (Hammer, 1962) |
| 4. T4 with two spots of silvery setae. T1 with dense fulvous setae..... | |
| | <i>K. niveosignata</i> (André, 1894) |
| – T4 without any spots of setae. T1 apically with fringe of fulvous setae. | |
| | <i>K. visrara</i> (Cameron, 1898) |
| 5. T7 brownish-black. Antenna and legs black. | <i>K. rufodorsata</i> (Cameron, 1897) |
| – T7 ferruginous. Antenna and legs ferruginous. | <i>K. semiviolacea</i> (André, 1896) |

Species from the Central and Southern Western Ghats and its adjacent areas
i. *Kurzenkotilla cicatricifera* (André, 1894)**(Plate 39, Figs. 123–130)**

Mutilla cicatricifera André, 1894: 466, 477, ♀, holotype ♀ (Type locality: Kanara, Karnataka, India) [MNHN] (synonymized under *Storozhenkotilla* by Lelej, 2005: 37).

Storozhenkotilla cicatricifera (André, 1894): 37, ♀ (synonymized under *Kurzenkotilla* by Lelej *et al.*, 2023c: 463).

Description: Female. Body length 18.1–18.9 mm. Coloration and Setation. Head, antennal tubercles, antenna and clypeus ferruginous. Mandible basally and apically black, medially ferruginous. Mesosoma ferruginous. Coxa brownish. Femur, tibia and tarsomeres ferruginous. Metasoma black. S1 brownish-black. Frons with sub-erect golden setae and erect black setae. Vertex with erect black setae. Gena with appressed golden setae. Clypeus with dense long golden setae. Base of mandible with long golden setae. Scape with long dense appressed golden setae. Pedicel and flagellomeres with short golden setae. Mesosoma dorsum with erect and sub-erect black and golden setae. Propodeal declivity with long golden erect setae. Meso and metapleuron with golden micro pubescence. Coxa, femur and tibia with dense golden setae. Tarsomeres with appressed golden setae. T1 basally with erect dense golden setae, latter portion with appressed black setae. T2 basally with two spots of golden setae, conjoined medially, not reaching lateral edge. T2 laterally with long lateral felt line of golden setae, T2 apically with fringe of golden setae. T3 wholly with band of golden setae. T4 and T5 black and with appressed black setae. T4 with sparse appressed golden setae. T3–5 laterally with long erect golden setae. T6 with long erect golden setae, bordering the pygidial area. S2–5 with apical fringe of golden setae.

Structure and sculpture. Head. Oval in frontal view, flattened, coarsely rugose-foveolate. Eyes small, oval. Scrobal carina well developed, slightly curved. Clypeus medially deeply emarginated, latter portion straight. Genal carina well developed. Antennal tubercle sparsely punctate. Scape punctate. Pedicel and flagellomeres with minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.39: 0.95: 0.66: 0.41. Minimal distance between eyes $1.9 \times$ longitudinal eye diameter. Mandible narrowed towards apex, bidentate.

Mesosoma. Propodeum slightly wider than pronotum. Pronotal width $1.01 \times$ head width behind eyes. Propodeal width $1.05 \times$ pronotal width. Mesosoma dorsum alveolate, Width of alveolae on the mesosomal dorsum $1.37 \times$ width of punctures on head. Scutellar scale

absent. Propodeal slope abrupt/steep, rugose. Lateral mesosomal margin crenulated. Mesopleuron rugose punctured. Metapleuron smooth. Mesopleura concave; mesopleural suture reaching anterior spiracle. Mid and hind tibia with two rows of spines, five in each row in mid tibia and six in each row in hind tibia.

Metasoma. T2 width $1.5 \times$ T1 width. T1–5 coarsely punctate. T2 with a lateral felt line, felt line $0.49 \times$ T2 length. T6 basally punctate. Pygidium rugose. S1 with a blunt tooth medially. S2 rugose punctate. S3–6 punctate.

Male. Unknown.

Material examined. Kerala: 1 ♀, Kannur district, Kottiyoor, Latitude: 11.900077 N, Longitude: 75.887628 E, Altitude: 882 m, 12.iv.2022, Coll. Siva K., ZSI/WGRC/IR/INV.21261. Karnataka: 1 ♀, Kodagu district, Bettathur, Latitude: 12.417675 N, Longitude: 75.666364 E, Altitude: 958 m, 23.xii.2019, Coll. P. Girish Kumar & Party, ZSI/WGRC/IR/INV.21260; 1 ♀, Shimoga district, Abbi falls, Mookambika Wildlife Sanctuary, Latitude: 13.7074 N, Longitude: 75.0687 E, Altitude: 620, 20.vi.2022, Coll. V. D. Hegde & Party, ZSI/WGRC/IR/INV.2268.

Distribution. Karnataka, Kerala (New record) (Lelej, 2005; Pagliano *et al.*, 2020; Terine *et al.*, 2020a; Lelej *et al.*, 2023c).

PLATE 38

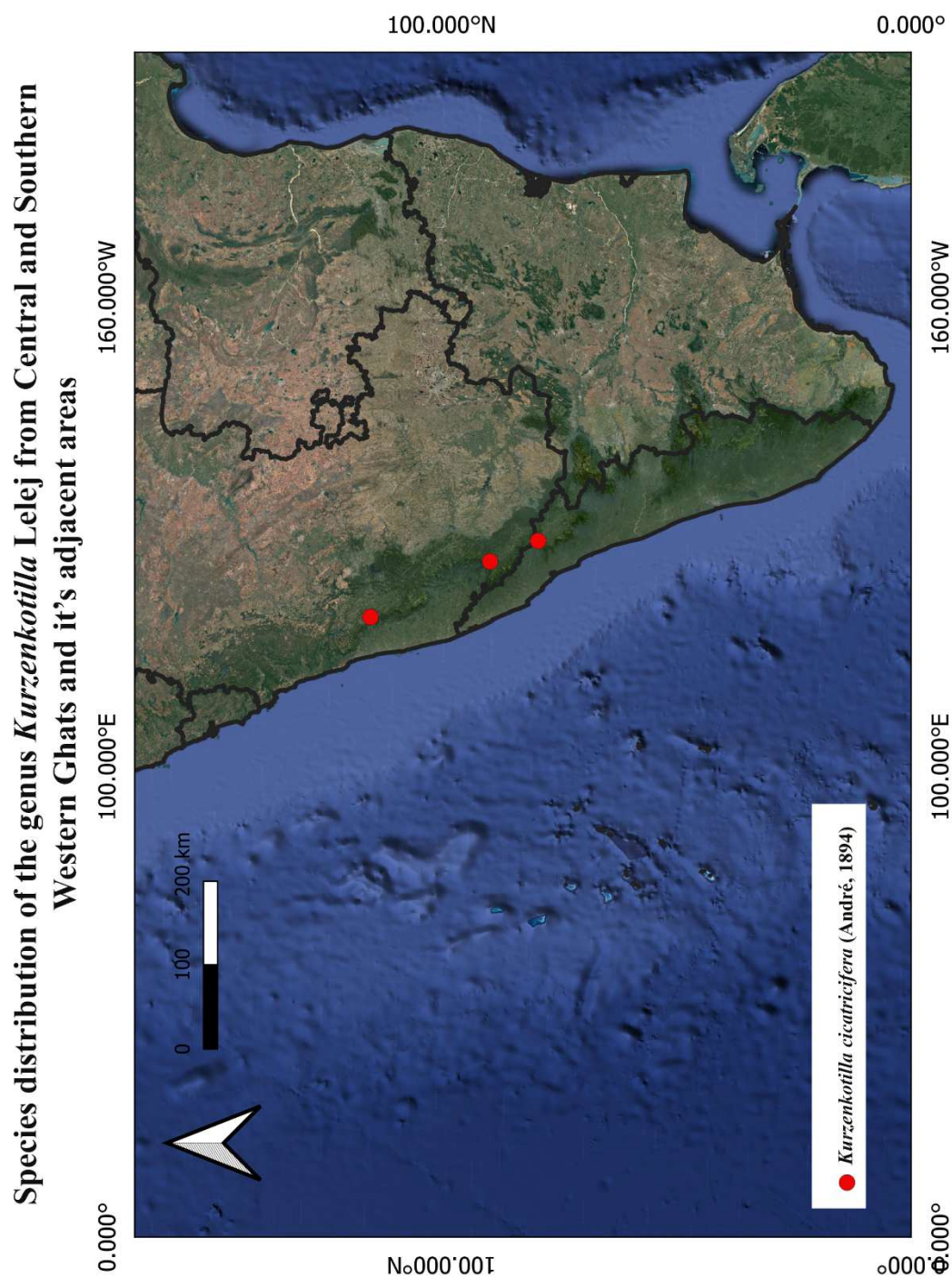
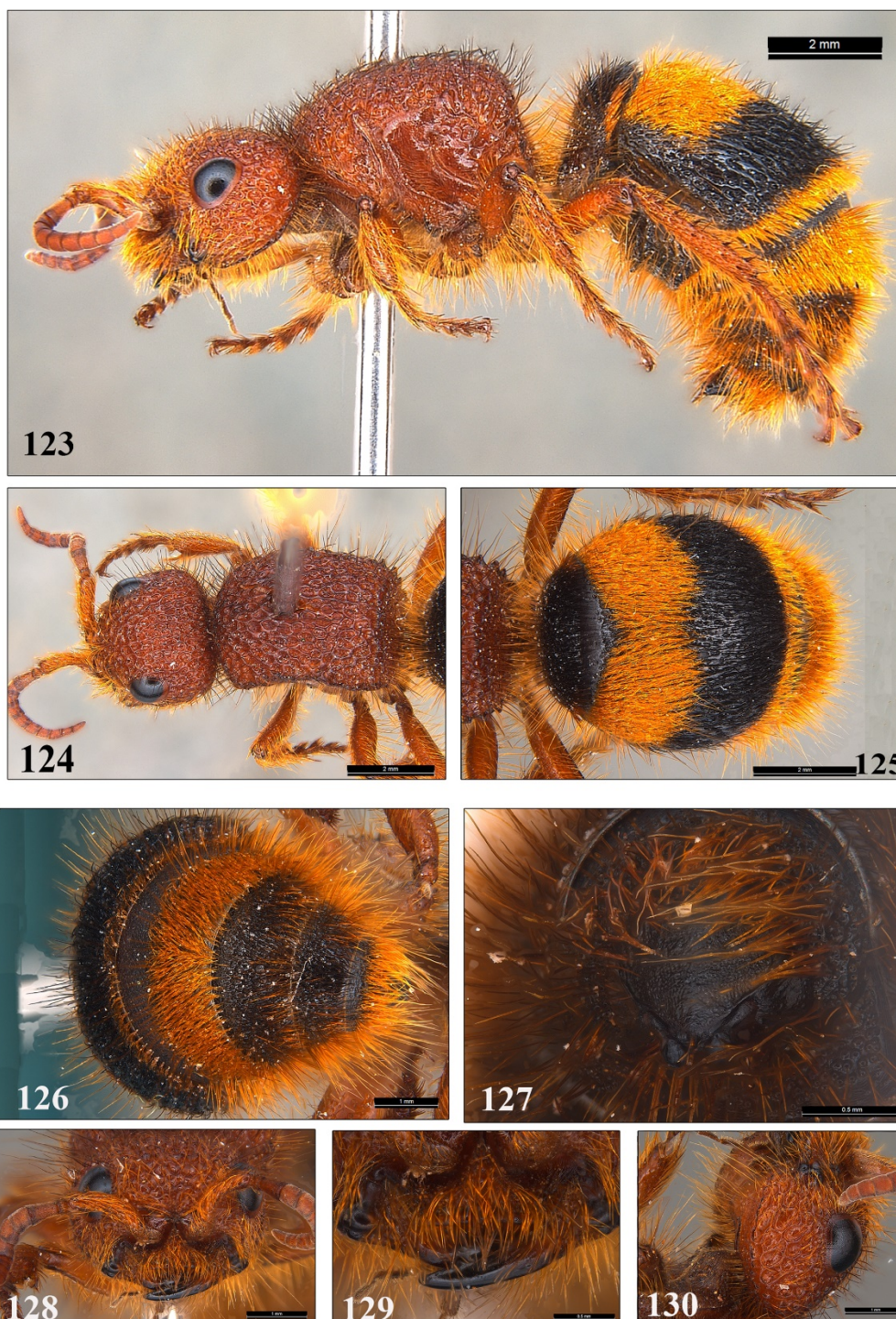


PLATE 39



Kurzenkotilla cicatricifera (André, 1894) (Female). 123. Body, lateral view. 124. Head & Mesosoma, dorsal view. 125, 126. Metasoma, dorsal view. 127. Pygidium. 128. Head, frontal view. 129. Mandible. 130. Head, lateral view.

II. Genus *Storozhenkotilla* Lelej, 2005

Storozhenkotilla Lelej, 2005: 37, 176; Lelej *et al.*, 2007: 56; Brothers & Lelej, 2017: 96; Pagliano *et al.*, 2020: 236; Lelej *et al.*, 2023c: 470.

Type species: *Mutilla aurofasciata* André, 1907a by original designation.

Diagnosis. Female. Head large, posteriorly widened, elongated behind eyes. Pronotum slightly wider than head. Genal carina present. Hypostomal carina medially widened. F1 1.5 × F2. Mandible bidentate, sub-basal tooth absent. Mesopleuron concave, with supracoxal carina. Scutellar scale absent. Mid and hind tibia with two rows of spines. T1 wide. T2 with lateral felt line. T2 basally with a band of setae emarginated medially and with apical narrow band of setae. T3 with wide band of setae. T6 with well developed pygidial plate, latero-apically weakly carinate, shagreen or shiny. S6 modified with two tubercles.

Male. Head width less than pronotal width. Preoccipital carina well developed dorsally. Eye weakly emarginated. Ocelli small. Mandible bidentate, without basal tooth. F2 length 1.3 × F1. Notauli and parapsids present. Tegulae long, projecting over mesoscuto-scutellar suture. Mesoscutellum simple. Propodeal slope posteriorly with strong longitudinal medial carina. T1 wide. T2 with long lateral felt line. S2 without any felt line. T2–3(4) apically with band of setae. T7 and S8 simple, not modified. Gonostylus wide. Penial valve longer than volsella. Cuspis wide.

Diversity & Distribution. The genus is represented by five valid species, all are from the Oriental region alone. Four species are from India (Lelej, 2005, Pagliano *et al.*, 2020 & Lelej *et al.*, 2023c).

Key to Indian species of *Storozhenkotilla* Lelej, 2005 (Male unknown for *Storozhenkotilla binghami*. Female unknown for *S. nathani* Lelej, 2023)

1. Male. 2
 – Female. 3
2. Head black with bluish metallic luster. Pronotum and metallic blue metasoma.....
 *S. nathani* Lelej, 2023
- Head and meosoma black. *S. aurofasciata* (André, 1907)

-
3. Promesonotal suture distinctly carinated and distinct. T2 with non-interrupted transverse band of golden setae. *S. aurofasciata* (André, 1907)
- Promesonotal suture not distinct and not carinated. T2 with transverse band of golden setae medially interrupted. *S. binghami* (Lelej, 2005)

Species from the Central and Southern Western Ghats and its adjacent areas

i. *Storozhenkotilla aurofasciata* (André, 1907)

(Plate 41, Figs. 131–139)

Mutilla aurofasciata André, 1907a: 255, ♀, Holotype, ♀, (Type locality: Pankulam, Ceylon, Sri Lanka) [MNHN].

Description: Female (Description as in André, 1907). Body length 11 mm. Coloration and setation. Head black. Gena red. Antennal tubercles, scape, pedicel and flagellomeres red. Mandible red, apically black. Thorax black. Legs ferruginous. Metasoma black. T1 apically with sparse golden setae. T2 basally with broad band of golden setae. T3 entirely with golden setae. Whole body with sparse brownish setae. Legs with sparse pale yellowish setae.

Structure and sculpture. Head. Sub-quadrangular in shape, slightly narrower than thorax, slightly elongated behind eyes. Frons and vertex longitudinally wrinkled reticulate. Eyes small, oval. F2 longer than F3.

Mesosoma. Short, sub-rectangular, narrower than apex, laterally not crenulated. Pronotum basally slightly arched. Pronotum dorsally transversely wrinkled. Mesonotum and pronotum separated by a distinct arcuate ridge. Meso and metanotum wrinkled -reticulate dorsally. Scutellar scale absent.

Metasoma. Oval in shape. S1 with a medial elongate keel. Pygidial area shiny, smooth, without any sculpture.

Male. Body length 6.84 mm. Coloration and Setation. Head black. Antennal tubercles, scape and pedicel brownish black. Clypeus black. Mandible dark ferruginous, margins black. Mesosoma and legs black. Tegulae yellowish brown. Metasoma black. Head with dense appressed and sub-erect pale yellowish setae. Mandible basal half with appressed pale yellowish setae. Clypeus with dense appressed pale yellowish setae. Scape with sub-erect pale yellowish setae. Pedicel and flagellomeres with pale yellowish micro-pubescence.

Pronotum with pale yellowish setae and baso-medially sparse. Mesoscutum with sparse sub-erect pale yellowish setae. Scutellum apical margin with long erect yellowish setae. Propodeum with long erect yellowish setae, denser apically. Legs with dense erect and appressed yellowish short setae. Mesopleuron with scattered appressed and sub-erect short yellowish setae. T1–8 with erect yellowish setae. T1 and T2 with an apical fringe of appressed yellowish setae. T3 wholly with a band of yellowish dense setae. T4 with sparse long yellowish setae. T5–8 with scattered black setae. S2–8 with apical fringe of yellowish setae. S1–8 with sparse sub-erect short yellowish setae.

Structure and sculpture. Head. Almost triangular in frontal view, conical at vertex, shallowly foveolate-rugose. Frons with sparsely foveolate. Eyes medium-sized, oval, emarginated. Scrobal carina not well developed. Pre occipital carina developed. Clypeus long flattened, medially emarginated. Antennal tubercles basally sparsely punctate, apically coarsely punctate. Scape sparsely foveolate, bicarinate beneath. Pedicel and flagellomeres with minute punctures. Ocelli small, POL $0.60 \times$ OOL. Ratio of pedicel to flagellomeres 1 to 3 is 0.279: 0.46: 0.60: 0.48. Minimal distance between eyes $1.88 \times$ longitudinal eye diameter. Mandible bidentate.

Mesosoma. Pronotal width $1.83 \times$ head width behind eyes. Propodeal width as long as $1.0 \times$ pronotal width. Pronotum baso-medially granular, latter part shallowly foveolate. Mesoscutum shallowly foveolate. Mesoscutellum foveolate. Propodeum reticulate, reticulae larger medially. Tegulae large, projecting over scuto-scutellar carinae, punctate-rugose. Notauli present on posterior two-third of mesoscutum. Parapsids present at middle of mesoscutum. Meso and metapleuron foveolate.

Wings. Hyaline. Tubular veins not extending to apical margin.

Metasoma. T2 width $1.57 \times$ T1 width. T1–5 with coarse punctures. T2 with a long lateral felt line, felt line $0.56 \times$ T2 length. S2 without any lateral felt line. S1–8 punctate. S7 not visible.

Genitalia. Gonostyle long, apically flattened, basally with long erect pale yellowish setae. Penial valves asymmetrical, longer than digitus and cuspis. Digitus curved inwards. Cuspis and digitus laterally with erect short setae.

Materials examined. Tamil Nadu: 1 ♂, Kodaikanal, Palani Hills, Latitude: 10.2182 N, Longitude: 77.4887 E, Altitude: 1981 m, 04.v.1953, Coll. P.S. Nathan & K.V. Krombein collection, [USNM]; 1 ♀, Coimbatore district, Latitude: 10.9919 N, Longitude: 76.6994 E, Altitude: 1362 m, VIII.1963, Coll. P. S. Nathan, [FSCA]; 1 ♂, Tirunelveli district,

Kodumundiyar dam site, Latitude: 8.4288 N, Longitude: 77.5022 E, Altitude: 472 m, 26.ix.2018, Coll. P. Girish Kumar, ZSI/WGRC/IR/INV. 21298.

Distribution. Karnataka, Pondicherry, Tamil Nadu. *Elsewhere.* Sri Lanka (Lelej *et al.*, 2023c).

ii. *Storozhenkotilla binghami* (Lelej, 2005)

(Plate 42, Figs. 140–145)

Mutilla valida Cameron, 1897: 71, ♀, syntypes (Barrackpore, West Bengal, India), [OUMNH] (synonymized under *Mutilla binghami* by Lelej, 2005: 35 & synonymized under *Storozhenkotilla* by Lelej *et al.*, 2023c: 471).

Description: Female. Body length 9.57 mm. Coloration and Setation. Head, antennal tubercles, scape and flagellomeres dark ferruginous. Head above antennal tubercles with a patch of black cuticular color. Mandible basal half dark ferruginous, latter part black. Mesosoma black. Coxa black. Femur, tibia and tarsomeres dark ferruginous. Metasoma black. Head with erect long golden setae and short sub-erect blackish-brown setae, setae slightly denser. Gena with sub-erect golden short setae. Head margin with dense erect golden setae. Clypeus with dense sub-erect medium sized setae. Scape with dense appressed golden setae. Flagellomeres with micro-pubesence of golden setae. Mandible basally with sub-erect long golden setae. Mesosoma dorsum with dense sub-erect black setae. Pronotal and propodeal declivity with sub-erect golden setae, denser on propodeal declivity. Meso and metapleura with sparse long sub-erect golden setae. Legs with dense sub-erect and erect golden setae. T1 with an apical fringe of golden setae, medially slightly interrupted; latter portion with appressed black setae and sparse golden setae. T2 basally with two spots of golden setae laterally, not conjoined medially evidently separated, reaching lateral edge. T2 laterally with long lateral felt line of golden setae, T2 apically with fringe of golden setae medially interrupted. T3 wholly with band of golden setae. T4 and T5 black and with appressed black setae. T4 with sparse appressed golden setae. T3–5 laterally with sparse long erect golden setae. T6 with long erect black setae, bordering the pygidial area. S2–5 with apical fringe of golden setae. Sternum with sparse sub-erect golden setae.

Structure and sculpture. Head. Oval in frontal view, vertex flattened, coarsely rugose-foveolate. Eyes small, oval. Scrobal carina well developed. Clypeus medially slightly emarginated, latter portion straight. Genal carina well developed. Antennal tubercle and scape

sparsely punctate. Pedicel and flagellomeres with minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.32: 0.82: 0.49: 0.42. Minimal distance between eyes $1.8 \times$ longitudinal eye diameter. Mandible narrowed towards apex, bidentate.

Mesosoma. Propodeum more or less equal to pronotum. Pronotal width $1.03 \times$ head width behind eyes. Propodeal width $1.06 \times$ pronotal width. Mesosoma dorsum alveolate. Scutellar scale absent. Propodeal slope abrupt/steep, rugose-alveolate. Lateral mesosomal slightly margin crenulated. Mesopleuron punctate, medially with smooth area. Metapleuron below propodeum smooth. Mid tibia with two rows of spine with four in each row. Hind tibia with two rows of spines, five in each row.

Metasoma. T2 width $1.5 \times$ T1 width. T1–5 coarsely punctate. T2 with a lateral felt line, felt line $0.51 \times$ T2 length. T6 basally punctate. Pygidium rugose. S1 with a blunt tooth medially. S2 densely rugose punctate. S3–6 punctate.

Male. Unknown.

Materials examined. Kerala: 1 ♀, Wayanad district, Wayanad Wildlife Sanctuary, Usirikkandi thodu, Tiger Road, Vandikadavu, Latitude: 11.7134 N, Longitude: 76.3017 E, Altitude: 932 m, 08.xii.2025, Coll. Sreejith S. Kumar & Party, ZSI/WGRC/IR/INV. 28949 .

Distribution. Karnataka, Kerala (New record), Tamil Nadu, West Bengal. Elsewhere. Sri Lanka (Lelej *et al.*, 2023c).

PLATE 40

Species distribution of the genus *Storozhenkotilla* Lelej from Central and Southern Western Ghats and it's adjacent areas

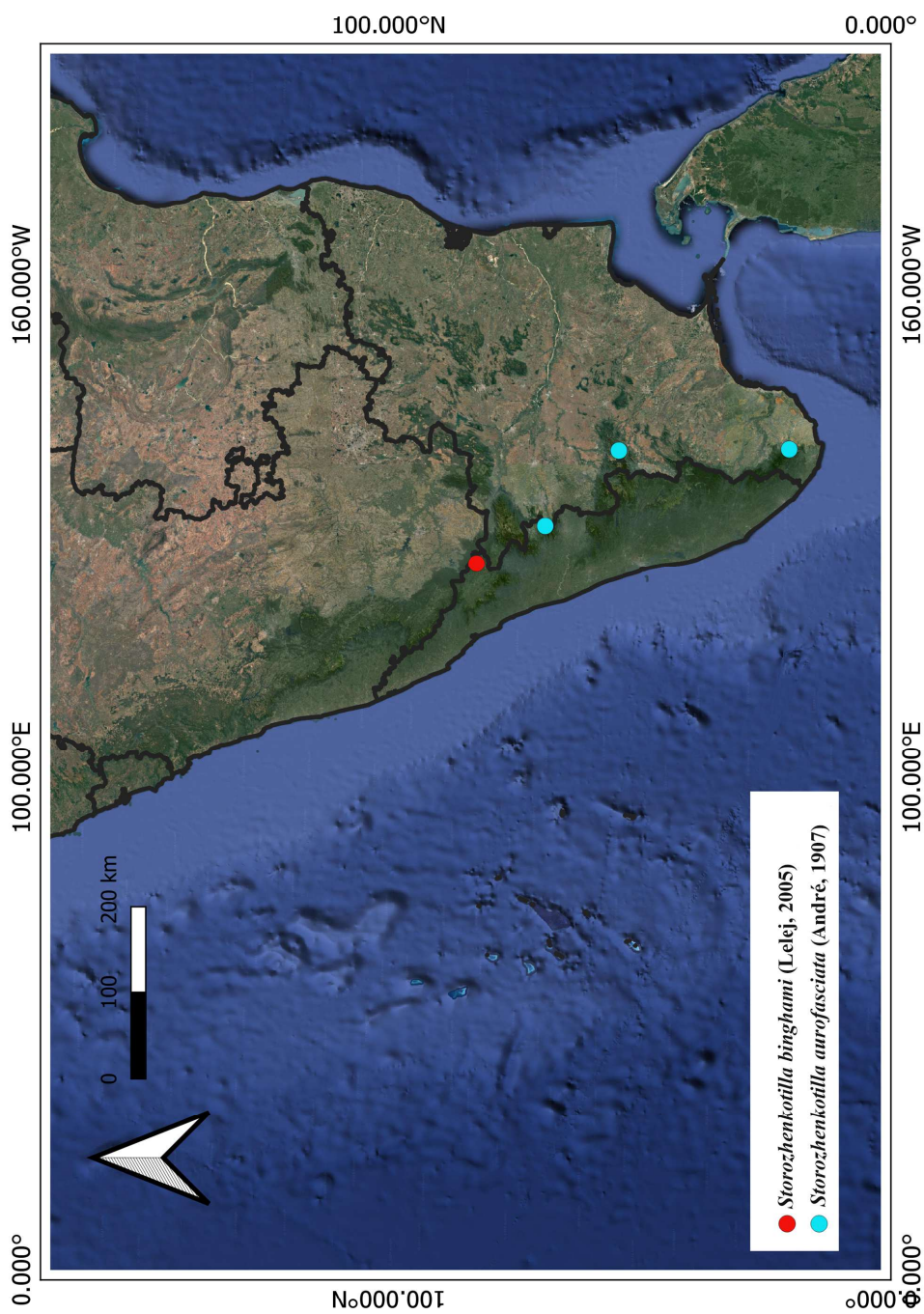


PLATE 41



Storozhenkotilla aurofasciata (André, 1907) (Male). 131. Body, lateral view. 132. Head & Mesosoma, dorsal view. 133. Metasoma, dorsal view. 134. Metasoma, ventral view. 135. Head, frontal view. 136. Genitalia, ventral view. 137. Genitalia, lateral view. 138. Genitalia, dorsal view. 139. Forewing.

PLATE 42



Storozhenkotilla binghami (Lelej, 2005) (Female). 140. Body, lateral view. 141. Head, frontal view. 142. Head & Mesosoma, dorsal view. 143. Metasoma, dorsal view. 144. Metasoma, ventral view. 145. Pygidium.

V. Tribe Trogaspidiini Bischoff, 1920
Key to the Indian genera of tribe Trogaspidiini Bischoff, 1920**Males**

1. Mesoscutellum convex. Penial valves asymmetrical. 2
 – Mesoscutellum not convex. Penial valves symmetrical. 6
2. Fore spur not modified. 3
 – Fore spur spatulate. Medio-lateral clypeal area elevated. *Pagdenidia* Lelej, 1996
3. Mandible ventrally without basal tooth. – Mesoscutellum with shiny line medially
 *Radoszkowskitilla* Lelej, 2005
 – Mandible ventrally with basal tooth. 4
4. Paracuspis stick-like. 5
 – Paracuspis absent. –Mesosoma black. *Petersenidia* Lelej, 1992
5. Scape ventrally bicarinate. S2 without lateral felt line. *Krombeinidia* Lelej, 1996
 – Scape ventrally with one carina. S2 with lateral felt line. *Zavatilla* Tsuneki, 1993
6. Mandible ventro-basally not excised, at most with weak tubercle. 7
 – Mandible ventro-basally excised with large tooth. 8
7. Propodeum laterally with a large tooth. *Trispilotilla* Bischoff, 1920
 – Propodeum laterally without any tooth, laterally at most acuminate.....
 *Wallacidia* Lelej & Brothers, 2008
8. Digitus curved. Scape ventrally with one carina. *Karlissaidia* Lelej, 2005
 – Digitus straight. Scape ventrally bicarinate. 9
9. F1 and hind coxa flattened. *Eotrogaspidia* Lelej, 1996
 – F1 not flattened. Hind coxa convex. *Trogaspidia* Ashmead, 1899

Females

1. Prementum tuberculate apically. T2 flattened, with lateral longitudinal carina.....
 *Radoszkowskitilla* Lelej, 2005
- Prementum not tuberculate. T2 not flattened, without lateral longitudinal carina. 2
2. Propodeum evidently broadest. 3
- Propodeal and pronotal width equal or pronotum broadest.7
3. Pygidial area irregularly rugose, lateral carina medially widened.....
 *Karlissaidia* Lelej, 2005
- Pygidial area with lateral carina not widened medially. 4
4. Pygidial area rugose wholly. 5
- Pygidial area apically smooth and basally striate or rugose. 6
5. T1 without medial pale spot. Propodeum without lateral denticle.....
 *Wallacidia* Lelej & Brothers, 2008
- T1 with medial pale spot. Propodeum with well-developed lateral denticle.....
 *Trispilotilla* Bischoff, 1920
6. Pygidial area apically smooth and basally irregularly rugose. –T2 with large pale spots of
 setae..... *Eotrogaspidia* Lelej, 1996
- Pygidial area apically micro granulate or sometimes smooth and basally longitudinally
 striate..... *Trogaspidia* Ashmead, 1899
7. Clypeus bidentate. Pygidial area basally longitudinally rugose and apically smooth or
 sometimes wholly smooth. *Pagdenidia* Lelej, 1996
- Clypeus weakly emarginated. Pygidial area smooth or not sculptured. 8
8. Scutellar scale $1/3 \times$ propodeal width. Pygidial area finely rugose-punctate.....
 *Zavatilla* Tsuneki, 1993
- Scutellar scale narrow. Pygidial area smooth or at most micropunctate. 9
9. T2 apically with wide band of setae. *Krombeinidia* Lelej, 1996

-
- T2 without apical band of setae, at most with sparse weak fringe of setae.....
 *Petersenidia* Lelej, 1992

I. Genus *Karlissaidia* Lelej, 2005

Karlissaidia Lelej, 2005: 193; Lelej & Brothers, 2008: 30; Brothers & Lelej, 2017: 96; Pagliano *et al.*, 2020: 250.

Type species: *Karlissaidia medvedevi* Lelej, 2005.

Diagnosis. Female. Head as wide as pronotum. Eyes bulged. Clypeus deeply impressed, with a dorsal arcuate carina. Mandible with a small pre-apical tooth. Hypostomal bridge with a medial rounded tubercle. Mesosoma divergent posterad. Scutellar scale well developed. Mesopleura with a developed pre-coxal carina. Fore tarsus with comb, fore coxa anteriorly tuberculate. T2 slightly flattened, with a lateral felt line. Pygidial plate laterally carinate, carina triangularly widened, irregularly rugose. T2 with two basal and two apical silver spots of setae.

Male. Clypeus strongly transversely concave. Ocelli small, POL lesser than OOL. Prementum not tuberculate. Hypostomal bridge with a medial rounded tubercle. Mandible bidentate, basally beneath with a large tooth. Notauli well developed. Parapsids visible posterad only. Mesoscutellum with a tubercle. T2 with a lateral felt line. S2 without any lateral felt line. S6 and 7 with lateral tubercle. S8 with lateral carina, apically convergent. Digitus short, curved. Paracuspis tuberculate.

Diversity & Distribution. The genus is represented by four valid species worldwide. Two species are recorded from Sri Lanka, and one is from Pakistan and Nepal. From India, two species are recorded (Lelej, 2005 & Pagliano *et al.*, 2020).

Key to Indian species of *Karlissaidia* Lelej, 2005 (Female unknown for *K. nana* (Hammer, 1962))

1. Males, wings fully developed. Paramere acuminate apically. Penial valve asymmetrical, apically hooked, left one longer. *K. sexmaculatus* (Swederus, 1787)
- Females, wings not developed. 2
2. Head and pygidium black. *K. sexmaculatus* (Swederus, 1787)
- Head and pygidium ferruginous. *K. nana* (Hammer, 1962)

Species from the Central and Southern Western Ghats and its adjacent areas**i. *Karlissaidia nana* (Hammer, 1962)****(Plate 44, Figs. 146–148)**

Trogaspidia nana Hammer, 1962: 17, ♀, Holotype (Type locality: Balighai near Puri, Odisha, India) [NZC]. Type examined.

Description: Female. Body length 6 mm. Coloration and setation. Head ferruginous. Antennal tubercles, scape and pedicel ferruginous. Flagellomeres darker. Mandible apically black, latter ferruginous. Mesosoma dorsum ferruginous. Meso and metapleuron darker. Legs dark ferruginous. T1–6 black. S1–6 ferruginous. Frons and gena with appressed silvery setae. Mesosoma dorsum with sparse erect silvery setae. T1–5 with dense appressed and erect black setae. T2 basally with an elongate oval two spots of silvery setae and apically with two small silvery spots of setae. T3 with two square spots on each side of silver setae. Pygidium ferruginous.

Structure and sculpture. Head. Almost oval in frontal view. Gena and frons finely wrinkled. Eyes large, oval. Vertex punctate. Mandible acuminate at apex.

Mesosoma. Pronotal width $1.09 \times$ head width behind eyes. Thorax coarsely wrinkled longitudinally striped. Scutellar scale large, flat. Propodeum crenulated. Mesopleura smooth. Legs sparsely punctate.

Metasoma. T1 not wider than T2. T2 width $2.19 \times$ T1 width. T1–5 coarsely with small punctures. T2 with a lateral felt line. T6 with well developed pygidial area, irregularly rugose, apically smooth. S1 with blunt tooth. S2 with large punctures. S3–6 with small coarse punctures.

Material examined. Type specimen ♀, Holotype (Type locality: Balighai near Puri, Odisha, India) [NZC: 1986/H3].

Distribution. India: Karnataka, Odisha, Tamil Nadu (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

Remarks. The exact collection locality from Karnataka and Tamil Nadu is unknown, distributional details are from Lelej, 2005.

ii. *Karlissaidia sexmaculatus* (Swederus, 1787)**(Plates 45 & 46, Figs. 149–159)**

Mutilla sexmaculata Swederus, 1787: 286, ♀ syntypes unknown (Bengal, India)
(synonymized with *Radoszkowskius sexmaculatus* by Lelej, 2005: 85).

Radoszkowskius sexmaculatus (Swederus, 1787): 85 (synonymized with *Karlissaidia sexmaculatus* by Nithya, 2013: 87).

Description: Female. Body length 9.60 – 12.42 mm. Coloration and setation. Head black. Antennal tubercles brownish-black. Scape, pedicel and flagellomeres black. Mandible basally and apically black, medially brownish black. Mesosoma dorsum dark ferruginous, mesosomal lateral margins black. Meso and meta pleuron and legs black. T1–6 black. S1–6 black. Frons and vertex with appressed silvery and black setae. Gena with appressed silvery setae. Clypeus with dense long silvery setae. Mandible basally and ventrally with long pale silvery setae. Scape with long appressed silvery setae. Pedicel with short appressed silvery setae and flagellomeres with silvery micro-pubescence. Mesosoma dorsum with dense erect black setae and appressed pale golden setae. Propodeal dorsum with long erect golden setae. Meso and metapleuron above coxae with dense appressed silvery micro pubescence. Legs with dense appressed and sub-erect silvery setae, tarsomeres with dense silvery setae. T1–5 with dense appressed and erect black setae. T2 sparse pale golden setae. T2 basally with an elongate oval two spots of silvery setae and apically with two small silvery spot of setae. T3 with two small spots on each side of silvery setae. Pygidium laterally on each sides with silvery setae. S2 with sparse sub-erect silvery setae. S2–6 with apical fringe of dense long appressed silvery setae.

Structure and sculpture. Head. Almost oval in frontal view except in mandible part, coarsely foveolate rugose. Eyes oval. Scrobal carina well developed. Clypeus medially elevated, with two denticles at lateral ends. Antennal tubercles apical half striate and latter part rugose. Scape coarsely foveolate. Flagellomeres with minute coarse punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.35: 0.89: 0.61: 0.78. Minimal distance between eyes $1.32 \times$ longitudinal eye diameter. Mandible acuminate at apex, with a small sub-apical tooth.

Mesosoma. Propodeum broader than pronotum. Pronotal width $1.07 \times$ head width behind eyes. Mesosoma dorsum coarsely foveolate rugose. Scutellar scale well developed. Propodeal slope abrupt/steep. Lateral mesosomal margin crenulated. Mesopleuron and metapleuron with coarse micro-punctate. Mesopleura concave; mesopleural suture reaching anterior spiracle.

Coxae and femur micro-punctate. Tibia foveolate. Mid and hind tibia with two row of spines, four in each row.

Metasoma. T1 not wider than T2. T2 width $1.76 \times$ T1 width. T1–5 coarsely with small punctures. T2 with a lateral felt line, felt line $0.40 \times$ T2 length. T6 with well developed pygidial area, rugose. S1 with blunt tooth. S2 convex, punctate. S3–6 with small coarse punctures.

Male. Body length 18.58 mm.

Coloration and setation. Head black. Antennal tubercles, scape, pedicel, flagellomeres and mandibles black. Mesosoma, legs and T1 black. T2–7 and S2–7 pale ferruginous. Frons and vertex with erect black setae. Gena and below eyes with dense appressed silver setae. Clypeus with dense long erect black and silver setae. Mandible basal half ventrally with dense appressed silvery setae. Scape dorsally with dense appressed silvery setae and ventrally with sparse sub-erect black setae. Pedicel with short appressed black setae and flagellomeres with silvery micro-pubescence. Mesosoma dorsum with dense erect black setae. Meso and metapleuron, and propodeum with dense erect black setae. Coxa and femur with dense sub-erect black setae. Tibiae with sub-erect black and silvery setae. Tarsomeres with dense sub-erect pale silvery setae. T1 and T2 basally with sub-erect dense black setae. T2 latter part and T3–7 with sub-erect pale golden setae. T2–7 and S2–7 with a fringe of pale golden setae.

Structure and sculpture. Head. Almost oval in frontal view, coarsely foveolate rugose. Eyes oval, emarginated. Scrobal carina well developed, and deeply emarginated. Clypeus flattened, slightly concave medially, sub-apical margin shallowly punctate. Scrobal carina extends to antennal tubercles, antennal tubercles rugose-striate. Scape coarsely foveolate and with small sparse punctures, ventrally bicarinate. Flagellomeres with minute coarse punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.17: 0.49: 0.46: 0.48. Minimal distance between eyes $1.18 \times$ longitudinal eye diameter. Mandible acuminate at apex, with a small sub-apical tooth.

Mesosoma. Pronotal width $1.04 \times$ head width behind eyes. Pronotum and mesonotum foveolate rugose. Tegulae laterally with minute punctures, medially smooth and shiny. Mesoscutellum foveolate, medially with a blunt tooth. Propodeum medially with a U-shaped carina not reaching apex, latter part reticulate. Mesopleuron foveolate. Metapleuron reticulate. Coxae, femur and tibiae foveolate and micro-punctate. Tibiae punctate.

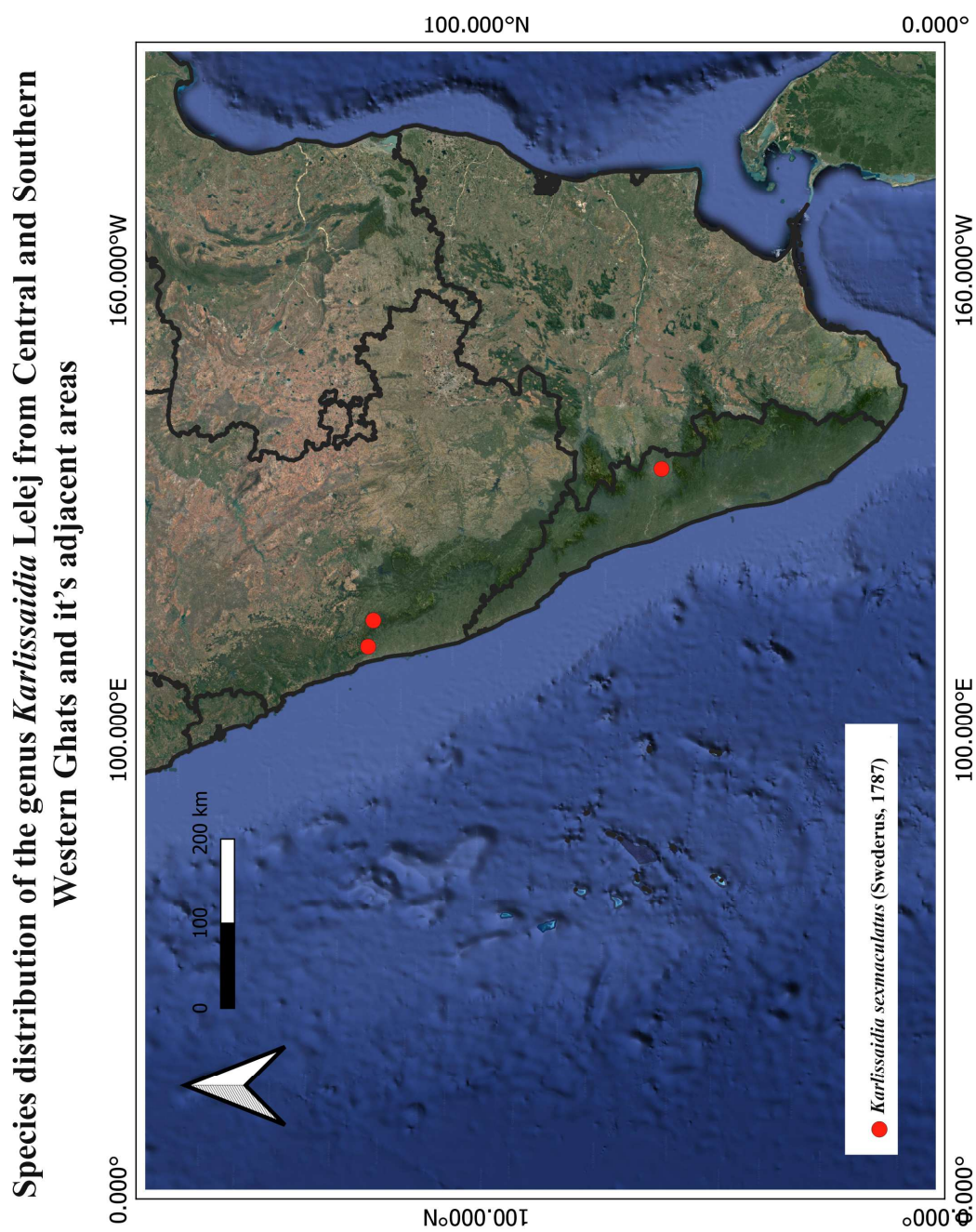
Metasoma. T1 not wider than T2. T2 width $1.72 \times$ T1 width. T1–5 coarsely with small punctures, T2 medially smooth. T2 with a lateral felt line, felt line $0.48 \times$ T2 length. Hypopygidium with a strong lateral carina. S1 with blunt tooth. S2–6 with small coarse punctures.

Genitalia. Paramere acuminate apically, with short sparse fine setae. Cuspis almost as long as paramere, apical half with dense fringe of short pale golden setae. Penial valve asymmetrical, apically hooked, left one longer.

Material examined. Kerala: 2♀, 1♂, Palakkad district, Pundungaram, Latitude: 10.6849 N, Longitude: 76.6774 E, Altitude: 123 m, 19.vii.2022, Coll. C. Bijoy, ZSI/WGRC/IR/INV. 20235, 20236, 20237; Karnataka: 1♀, Udupi district, Mookambika Wildlife Sanctuary, Beedikeri, Latitude: 13.8223 N, Longitude: 74.7801 E, Altitude: 104 m, 02.ix.2021, Coll. V. D. Hegde & Party, ZSI/WGRC/IR/INV. 18893; 1♀, Shimoga district, Mookambika Wildlife Sanctuary, Balamane, Latitude: 13.7669 N, Longitude: 75.0576 E, Altitude: 689 m, 19.vi.2023, Coll. Bindu L. & Party, ZSI/WGRC/IR/INV. 25200.

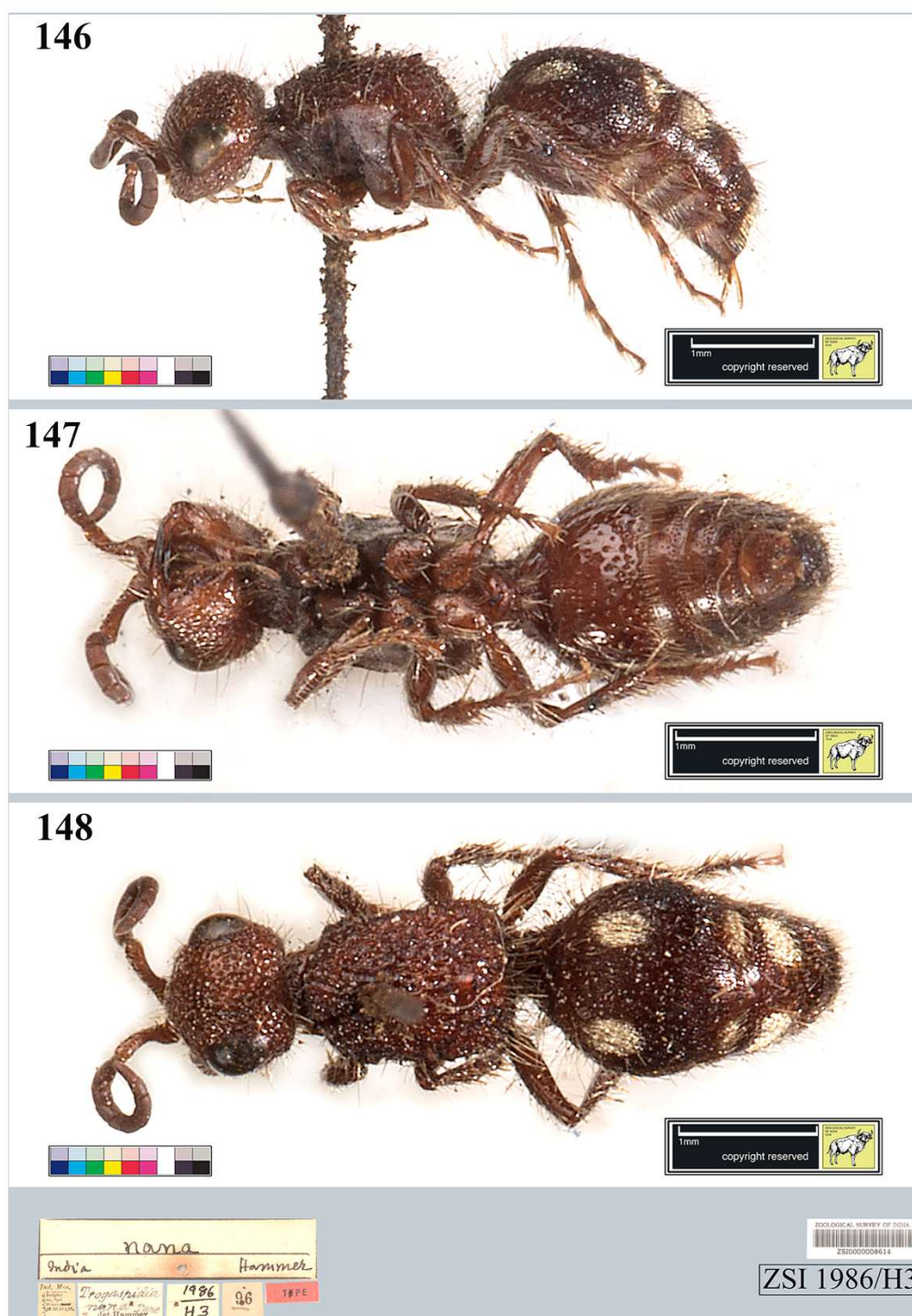
Distribution. Andhra Pradesh, Bihar, Haryana, Karnataka, Kerala, Madhya Pradesh, Odisha, Uttar Pradesh, West Bengal. *Elsewhere.* Nepal; Pakistan (Lelej, 2005; Nithya, 2013; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

PLATE 43



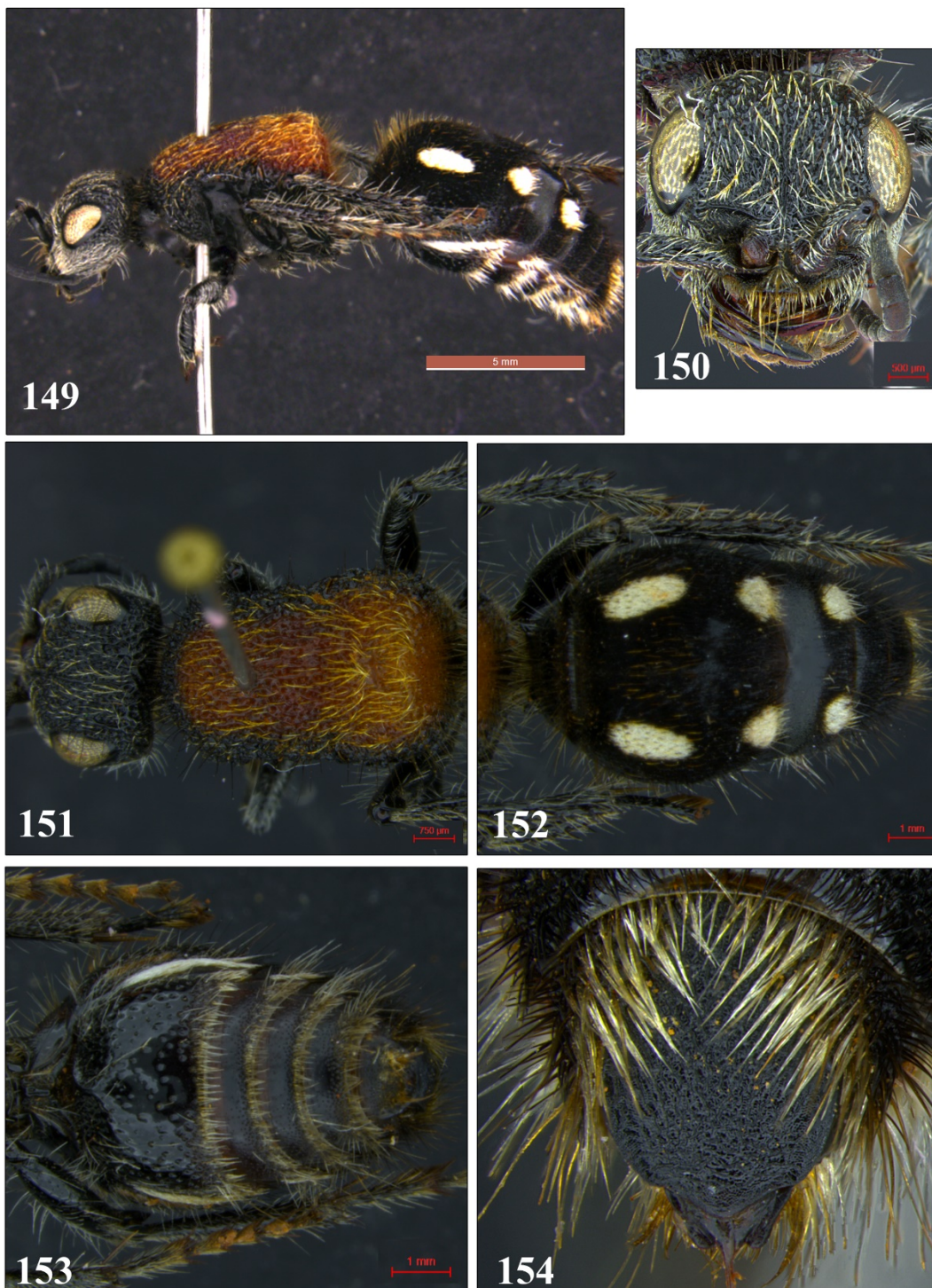
Note. The exact collection locality of *Karlissaidia nana* (Hammer, 1962) from Karnataka and Tamil Nadu is unknown, distributional details are from Lelej, 2005.

PLATE 44



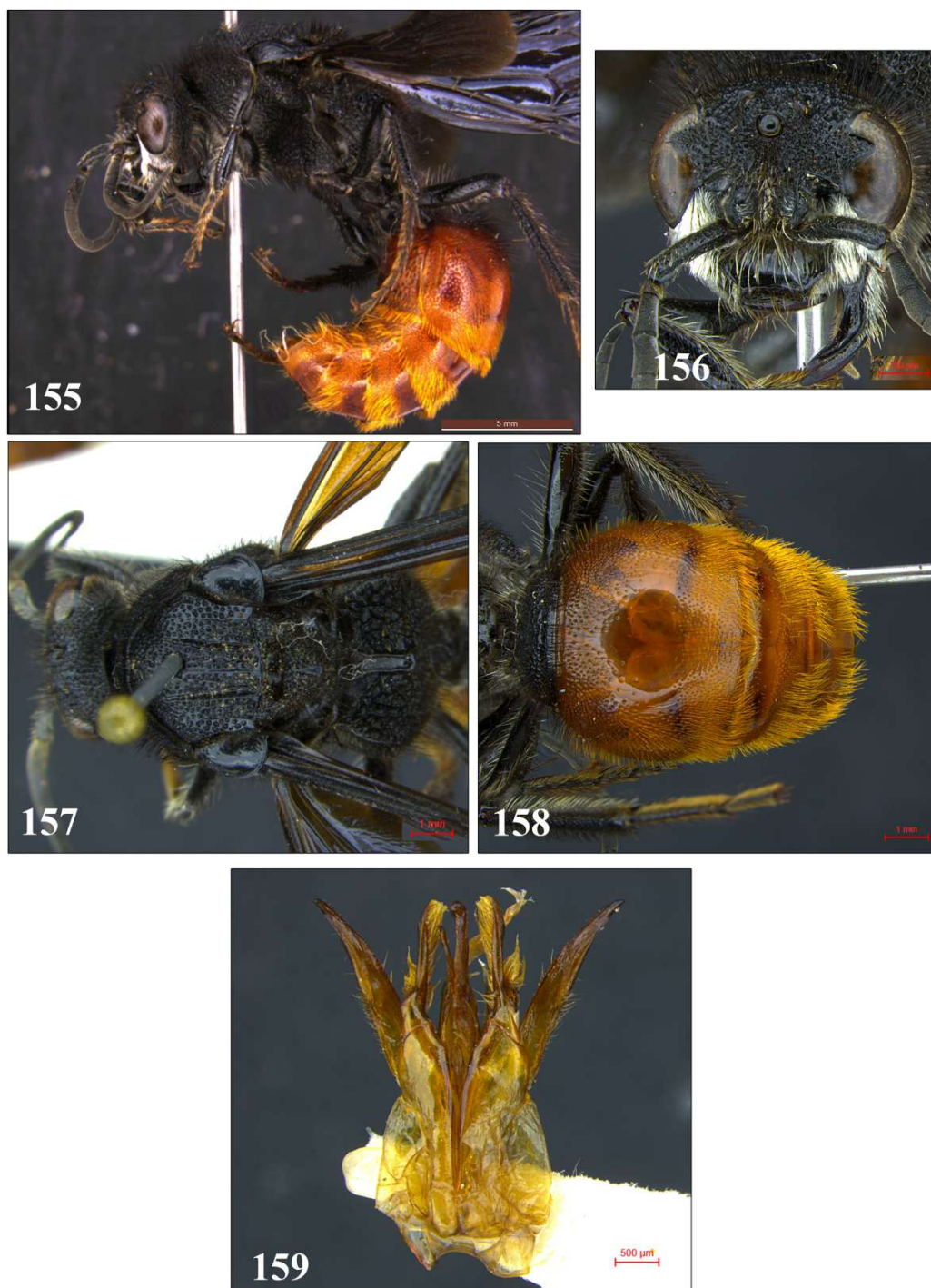
Karlissaidia nana (Hammer, 1962) (Female). 146. Body, lateral view. 147. Body, ventral view. 148. Body, dorsal view.

PLATE 45



Karlissaidia sexmaculatus (Swederus, 1787) (Female). 149. Body, lateral view. 150. Head, frontal view. 151. Head & Mesosoma, dorsal view. 152. Metasoma, dorsal view. 153. Metasoma, ventral view. 154. Pygidium.

PLATE 46



Karlissaidia sexmaculatus (Swederus, 1787) (Male). 155. Body, lateral view. 156. Head, frontal view. 157. Head & Mesosoma, dorsal view. 158. Metasoma, dorsal view. 159. Genitalia.

II. Genus *Krombeinidia* Lelej, 1996

Krombeinidia Lelej, 1996: 11; Lelej & Brothers, 2008: 31; Brothers & Lelej, 2017: 96; Williams *et al.*, 2019a: 33; Pagliano *et al.*, 2020: 250.

Type species: *Krombeinidia peterseni* Lelej, 1996 (original designation).

Diagnosis. Female. Prementum without any tubercles. Clypeus apically slightly emarginated, without any denticles. Mesosoma with propodeum narrower than or as wide as pronotum. Scutellar scale well developed. T2 with lateral spots of white to golden setae. T2 apically with a band of white to golden setae, band width variable in species. T3 with two pale spots or pale band of setae. Pygidium defined by strong lateral carina, sometimes smooth or finely sculptured. S6 without any tubercles.

Male. Scape ventrally bicarinate, furrow between carina glabrous. F1 longer than F2. F3 length $1.7 \times$ F3 maximal width. F3 length $1.3 \times$ F4 length. Clypeus laterally weakly elevated. Thorax black. Precoxal tubercles absent. Scutellum not gibbous, without median glabrous line. S2 without lateral felt line. S8 without any tubercles. T7 with median narrow glabrous area. Paracuspis stick-like. Cuspis and digitus present.

Diversity & Distribution. The genus is represented by 27 valid species worldwide. Mostly from the Oriental Region. 11 species are recorded from India (Lelej, 2005; Williams *et al.*, 2019a & Pagliano *et al.*, 2020).

Key to Indian species of *Krombeinidia* Lelej, 1996 (Based on females)

1. T2 basal half with band of setae. *K. agnata* (André, 1894)
 - T2 basal half with spot of setae. 2
2. T2 apically with fringe of setae, fringe sometimes wider. 3
 - T2 without apical fringe of setae.5
3. Mandible middle portion ferruginous, basal and apical ends black.....
 - *K. rutilipes* (Hammer, 1962)
 - Mandible apical end black, latter ferruginous. 4
4. T2 apically with broad apical fascia, medially widened. *K. lilliputiana* (André, 1894)
 - T2 apically with narrow fringe of setae. *K. versicolor* (Hammer, 1962)

-
5. T2 with two square shaped spots of silvery setae. *K. albopunctata* (André, 1907)
 – T2 with a band of silvery setae. *K. himalayana* (Hammer, 1962)

Species from the Central and Southern Western Ghats and its adjacent areas

i. *Krombeinidia agnata* (André, 1894)

(Plates 48, Figs. 160–165)

Mutilla agnata André, 1894: 466, 479, Syntype (Type locality: Kanara, Karnataka, India)
 [MNHN] (Synonymized under *Krombeinidia* by Lelej, 2005: 65).

Description: Female. Body length 6.98–6.27 mm. Coloration and setation. Head black. Antennal tubercles, scape and pedicel ferruginous. F1 basal two-third ferruginous; latter Flagellomeres black, medially ferruginous. Mandible basal two-thirds ferruginous and apex black. Mesosoma and legs ferruginous. T1–6 black. S1 brownish, S2–6 black. Frons, vertex and gena with dense sub-erect and appressed golden setae. Clypeus with dense long golden setae. Mandible basally and ventrally with long pale golden setae. Scape with short sub-erect golden setae. Pedicel with short appressed golden setae. Flagellomeres with silvery micro-pubescence. Mesosoma dorsum with dense erect and sub-erect golden setae. Propodeal dorsum with long erect golden setae. Meso and metapleuron above coxae with appressed golden micro pubescence. Coxa, femur and tibia with sparse appressed and sub-erect pale golden setae, tarsomeres with dense pale golden setae. T1–5 with short appressed black setae and erect golden setae. T2 basally with a wide band of golden setae and small apical band of golden setae. T3–5 with a band of golden setae. Pygidium laterally on each side with fringe of long golden setae. S2 with short sparse sub-erect pale golden setae. S2–5 with apical fringe of sparse long sub-erect golden setae.

Structure and sculpture. Head. Almost rectangular, vertex convex in frontal view, coarsely foveolate. Eyes large, bulged, and oval. Scrobal carina well developed, straight. Clypeus medially elevated and with a tubercle, without any denticles at lateral ends. Antennal tubercles basal half transversally rugose and apical half irregularly rugose. Scape coarsely foveolate. Flagellomeres with minute coarse punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.22: 0.51: 0.32: 0.31. Minimal distance between eyes 0.98× longitudinal eye diameter. Mandible acuminate at apex, without any small sub-apical tooth.

Mesosoma. Propodeum width equal to pronotal width. Pronotal width $0.90 \times$ head width behind eyes. Mesosoma dorsum coarsely foveolate-rugose. Scutellar scale well developed. Propodeal slope abrupt/steep. Lateral mesosomal margin slightly crenulated. Mesopleuron and metapleuron without any sculptures. Mesopleura concave; mesopleural suture not reaching anterior spiracle ending just below anterior spiracle. Legs with coarse micro-punctures. Mid and hind tibia with one row of spines, four in a row.

Metasoma. T1 not wider than T2. T2 width $1.92 \times$ T1 width. T1–5 coarsely with small punctures. T2 with a lateral felt line, felt line $0.23 \times$ T2 length. T6 with well developed pygidial area, with fine longitudinal rugae. S1 with blunt tooth. S2 convex, coarsely foveolate. S3–6 with small coarse punctures.

Male. Unknown.

Materials examined. Kerala: 1♀, Kozhikode district, Janakikadu, Latitude: 11.62743 N, Longitude: 75.7926 E, Altitude: 82 m, 30.iii.2018, Coll. Anand P.P., ZSI/WGRC/IR/INV. 19849; 2♀, Palakkad district, Silent Valley, Latitude: 11.0717 N, Longitude: 76.4254 E, Altitude: 992 m, 12.iii.2020, Coll. Kamila A. P., ZSI/WGRC/IR/INV. 20233. Karnataka: 1♀, Kodagu district, Bettathur, Latitude: 12.3906 N, Longitude: 75.6672 E, Altitude: 975 m, 24.xii.2019, Coll. Girish Kumar P. & Party, ZSI/WGRC/IR/INV. 22411;

Distribution. Karnataka, Kerala, Maharashtra, Tamil Nadu (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

ii. *Krombeinidia albopunctata* (André, 1907)

(Plates 49, Figs. 166–171)

Mutilla albopunctata André, 1907a: 256, ♀, Syntype (Type locality: Nalanda, Weligama (Sri Lanka)) [MNHN] (Synonymized under *Krombeinidia* by Lelej, 2005: 65).

Description: Female. Body length 3.9 mm. Coloration and setation. Head black. Antennal tubercles, scape and pedicel ferruginous. F1–10 black. Mandible basal two-third ferruginous and apical half black. Mesosoma dorsum dark ferruginous, mesosomal margin darker. Mesopleuron ferruginous. Metapleuron brownish. Coxa ferruginous. Femur, tibia and tarsomeres dorsally brownish-black and ventrally ferruginous. T1–6 black. S1 brownish, S2–6 black. Frons and vertex with dense sub-erect and erect brownish-black setae. Gena with dense appressed silvery setae. Antennal tubercles basally with sparse appressed silvery setae.

Scape with dense appressed silvery setae. Pedicel and flagellomeres with dense micro-pubescence of silvery setae. Clypeus with long pale golden setae. Mandible basally and ventrally with sparse long pale golden setae. Mesosoma dorsum with dense erect black setae. Propodeal dorsum with erect and appressed silvery setae. Meso and metapleuron with appressed silvery micro pubescence. Coxa with short appressed and laterally with sub-erect silvery setae. Femur, tibia and tarsomeres with dense appressed and sub-erect silvery setae. T1–5 with short appressed black setae and erect silvery setae. T2 basally with two spots of silvery setae. T3 with two square spots of setae not reaching lateral ends. Pygidium laterally on each side with fringe of long erect black setae and sparse silvery setae. S2 with short sparse sub-erect silvery setae. S2–5 with apical fringe of sparse long erect silver setae.

Structure and sculpture. Head. Almost oval, vertex convex in frontal view, coarsely foveolate. Eyes bulged, and oval. Scrobal carina well developed, slightly curved. Clypeus medially slightly elevated and with a tubercle, without any denticles at lateral ends. Antennal tubercles rugose. Scape coarsely foveolate. Pedicel and flagellomeres with minute coarse punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.33: 0.77: 0.33: 0.44. Minimal distance between eyes $1.4 \times$ longitudinal eye diameter Mandible acuminate apically, with small pre-apical teeth.

Mesosoma. Propodeum width equal to pronotal width. Pronotal width $1.03 \times$ head width behind eyes. Mesosoma dorsum punctate alveolate. Scutellar scale well developed. Propodeal slope abrupt/steep. Lateral mesosomal margin with slight crenulation. Mesopleuron and metapleuron micro-punctate. Mesopleura concave; mesopleural suture not reaching anterior spiracle ending at anterior spiracle. Legs with coarse micro-punctures. Mid and hind tibia with two row of spines, four in a row.

Metasoma. T1 not wider than T2. T2 width $2.19 \times$ T1 width. T1–5 coarsely with small punctures. T2 with a lateral felt line, felt line $0.31 \times$ T2 length. T6 with well-developed pygidial area, pygidial area smooth, latter area with longitudinal rugae. S1 with blunt tooth. S2 convex, coarsely foveolate. S3–6 with small coarse punctures.

Male. Unknown.

Material examined. Karnataka: 1♀, Mookambika Wildlife Sanctuary, Shimoga district, Malayalli, Latitude: 13.752422 N, Longitude: 75.047821 E, Altitude: 697.41 m, 19.vi.2023, Coll. Bindu L. & Party, ZSI/WGRC/IR/INV. 26560.

Distribution. Karnataka. *Elsewhere:* Sri Lanka (Lelej, 2005; Pagliano *et al.*, 2020, Terine *et al.*, 2020a; Terine & Girish Kumar, 2024b).

Remarks. Terine *et al.* (2024b) newly recorded this species from India.

iii. *Krombeinidia lilliputiana* (André, 1894)

(Plates 50 & 51, Figs. 171–182)

Mutilla lilliputiana André, 1894: 465, 476, ♀, Holotype ♀ (Type locality: Kolaba, Maharashtra, India) [MNHN] (synonymized under *Krombeinidia* by Lelej, 2005: 66).

Description: Female. Body length 5.21 mm. Coloration and setation. Head black. Antennal tubercles, scape and pedicel ferruginous. Flagellomeres black. Mandible basal two-thirds ferruginous and apex black. Mesosoma and legs ferruginous. T1–6 black. S2–6 black, S1 ferruginous. Frons and vertex with sub-erect black and pale golden setae, above antennal tubercles with appressed pale golden setae. Vertex with two maculae of pale golden setae. Gena with appressed short pale golden setae. Clypeus with sparse long pale golden setae. Mandible with long pale golden setae. Scape with long sub-erect golden setae. Pedicel with short appressed black setae and flagellomeres with silvery micro-pubesence. Mesosoma dorsum with sparse erect black setae, lateral margins with erect pale golden setae. Propodeal dorsum with long erect pale golden setae. Meso and metapleuron above coxae with dense appressed pale golden micro pubescence. Coxa, femur and tibia with sparse appressed and sub-erect pale golden setae, tarsomeres with dense pale golden setae. T1–5 with short appressed black setae. T1 with long erect pale golden setae. T2 basally with two spots of golden setae and apical band of golden setae, emarginated medially. T3 with a band of golden setae. Pygidium laterally on each side with pale golden setae. S2 with sparse sub-erect pale golden setae. S2–6 with apical fringe of sparse long sub-erect golden setae.

Structure and sculpture. Head. Almost oval, vertex slightly conical in frontal view, coarsely foveolate. Eyes large, bulged, and oval. Scrobal carina well developed, emarginated. Clypeus medially with a tubercle, with two denticles at lateral ends. Antennal tubercles with sparse small punctures, latter part smooth. Scape coarsely foveolate. Flagellomeres with minute coarse punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.23: 0.63: 0.51: 0.59. Minimal distance between eyes $1.03 \times$ longitudinal eye diameter. Mandible acuminate at apex, with a small sub-apical tooth.

Mesosoma. Propodeum width equal to pronotal width. Pronotal width $0.94 \times$ head width behind eyes. Mesosoma dorsum coarsely foveolate. Scutellar scale well developed. Propodeal slope abrupt/steep. Lateral mesosomal margin slightly crenulated. Mesopleuron and metapleuron with sparse micro-punctures. Mesopleura concave; mesopleural suture not reaching anterior spiracle ending just below anterior spiracle. Coxa, tibia and tarsomeres with coarse micro-punctures, femur with sparse micro-puncture. Mid and hind tibia with two row of spines, four in each row.

Metasoma. T1 not wider than T2. T2 width $2.09 \times$ T1 width. T1–5 coarsely with small punctures. T2 with a lateral felt line, felt line $0.26 \times$ T2 length. T6 with well developed pygidial area, with fine transverse rugae. S1 with blunt tooth. S2 convex, foveolate. S3–6 with small coarse punctures.

Male. Body length 7.58 mm.

Coloration and setation. Head, antennal tubercles, pedicel, scape, flagellomeres, mesosoma and legs black. T1–7 black and S2–7 pale ferruginous. S1 black. Frons with appressed long silvery setae. Vertex with erect pale golden setae. Gena and below eyes with dense appressed long silvery setae. Clypeus with dense long silvery setae, covering the sculpture and denticles. Mandible basal half ventrally with sub-erect black setae and latter half with sub-erect pale golden setae. Scape with dense appressed short silvery setae and sub-erect long silvery setae. Pedicel and flagellomeres with dense short appressed black setae. Pronotum with appressed short pale golden setae and apical margin with fringe of short appressed pale golden setae. Mesonotum and mesoscutellum with dark golden and black sub-erect setae. Mesopleuron with dense appressed and long sub-erect silvery setae. Propodeum with sparse appressed short silvery setae. Legs with dense sub-erect silvery setae. T1 and T2 basally with erect pale golden setae. T3 –7 with appressed pale golden setae. S1 with appressed silvery setae. S2–7 with sparse pale golden setae.

Structure and sculpture. Head. Almost triangular in frontal view, coarsely foveolate. Eyes oval, emarginated. Scrobal carina well developed. Clypeus medially with a tubercle, lateral ends with a denticle. Scape coarsely foveolate, ventrally bicarinate. Flagellomeres with minute coarse punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.50: 1.10: 0.83: 0.88. Minimal distance between eyes $1.13 \times$ longitudinal eye diameter. Mandible with a large sub-apical tooth.

Mesosoma. Pronotal width $0.90 \times$ head width behind eyes. Pronotum foveolate rugose. Mesonotum and mesoscutellum foveolate. Tegulae with sparse punctures. Propodeum reticulate, basally with two big reticulae and baso-medially with a U-shaped carina. Mesopleuron medially convex, foveolate, latter portion impunctate. Legs micro-punctate.

Metasoma. T1 not wider than T2. T2 width $1.83 \times$ T1 width. T1–5 coarsely with small punctures, T2 medially without any smooth area. T2 with a lateral felt line, felt line $0.37 \times$ T2 length. Hypopygidium foveolate. S1 with blunt tooth, sparsely foveolate. S2–6 with small coarse punctures.

Genitalia. Paramere acuminate apically, curved, laterally with short setae. Cuspis shorter than paramere, inner margin with dense fringe of setae. Penial valve asymmetrical, apically with small hook.

Materials examined. Kerala: 1♀, 2♂, Kozhikode district, Sarovaram Bio Park, Latitude: 11.2684 N, Longitude: 75.7931 E, Altitude: 28 m, 01.x.2019, Coll. K.P. Hanima, ZSI/WGRC/IR/INV. 13671, 13672, 13673; 1♀, Kozhikode district, Poyilkavu, Latitude: 11.4068 N, Longitude: 75.7125 E, Altitude: 41 m, 22.xi.2019, Coll. Terine J.B., ZSI/WGRC/IR/INV. 27937; 1♀, Kozhikode district, Cherukulam, Latitude: 11.3351 N, Longitude: 75.7727 E, Altitude: 36 m, 28.ii.2024, Coll. Viswanath T. K., ZSI/WGRC/IR/INV. 26628. Tamil Nadu: 1♀, Thenkasi district, Agasthyalai Biosphere Reserve, Ukkonam, Latitude: 8.7741 N, Longitude: 77.2300 E, Altitude: 1370 m, 27.vii.2019, Coll. B.H.C.K. Murthy & Party, ZSI/WGRC/IR/INV. 26574. Karnataka: 1♀, Shimoga district, Mookambika wildlife sanctuary, Hulikal, Latitude: 13.7253 N, Longitude: 75.0102 E, Altitude: 595 m, 06.ix.2021, Coll. V.D. Hegde & Party, ZSI/WGRC/IR/INV. 25199; 1♀, Shimoga district, Mookambika Wildlife Sanctuary, Masthigate, Latitude: 13.7368 N, Longitude: 75.0281 E, Altitude: 681 m, 07.xii.2022, Coll. V.D. Hegde & Party, ZSI/WGRC/IR/INV. 22410.

Distribution. Karnataka, Kerala (New record), Maharashtra, Tamil Nadu. *Elsewhere:* Sri Lanka (Lelej, 2005; Pagliano *et al.*, 2020, Terine *et al.*, 2020a).

PLATE 47

Species distribution of the genus *Krombeinidia* Lelej from Central and Southern Western Ghats and its adjacent areas

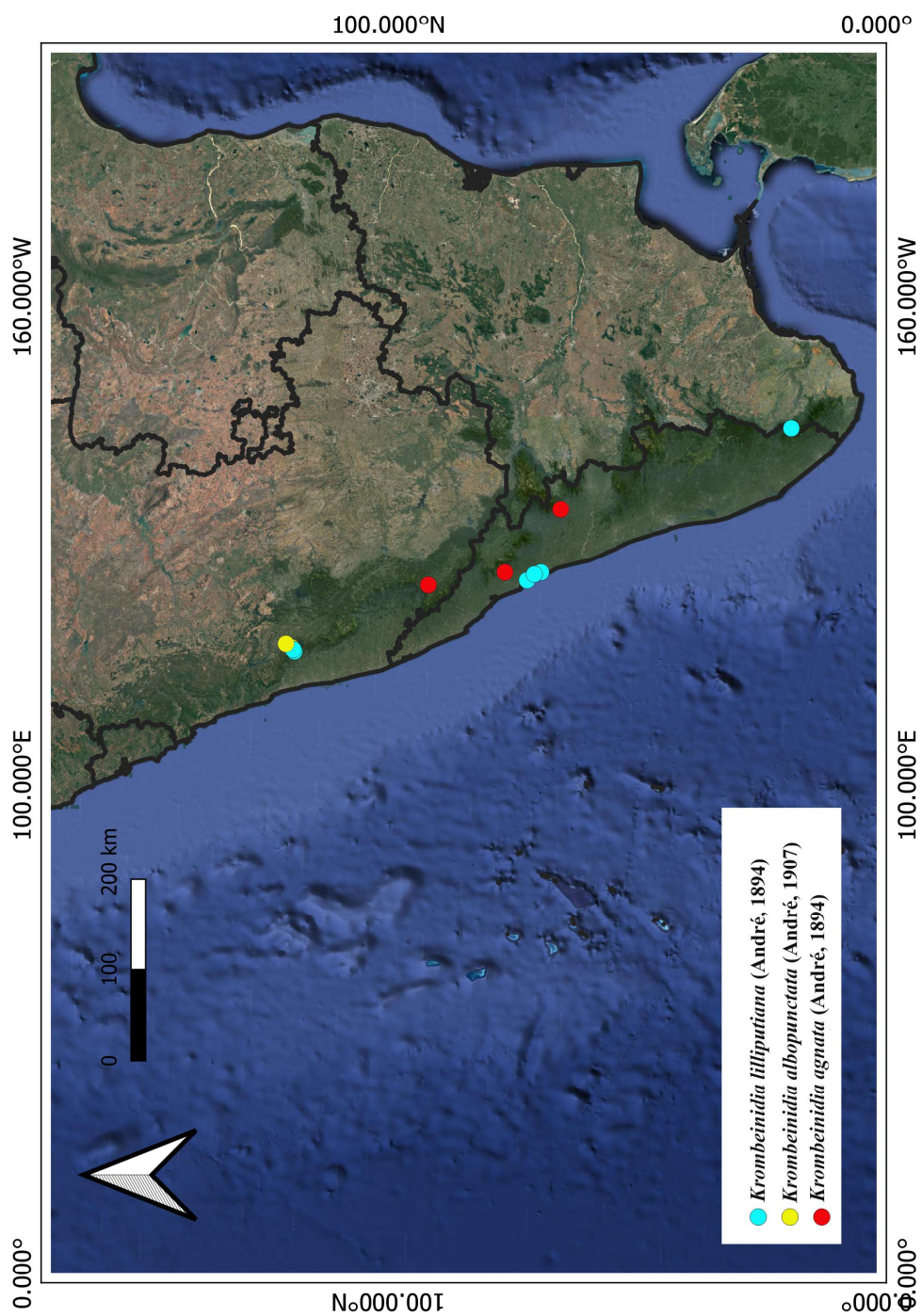
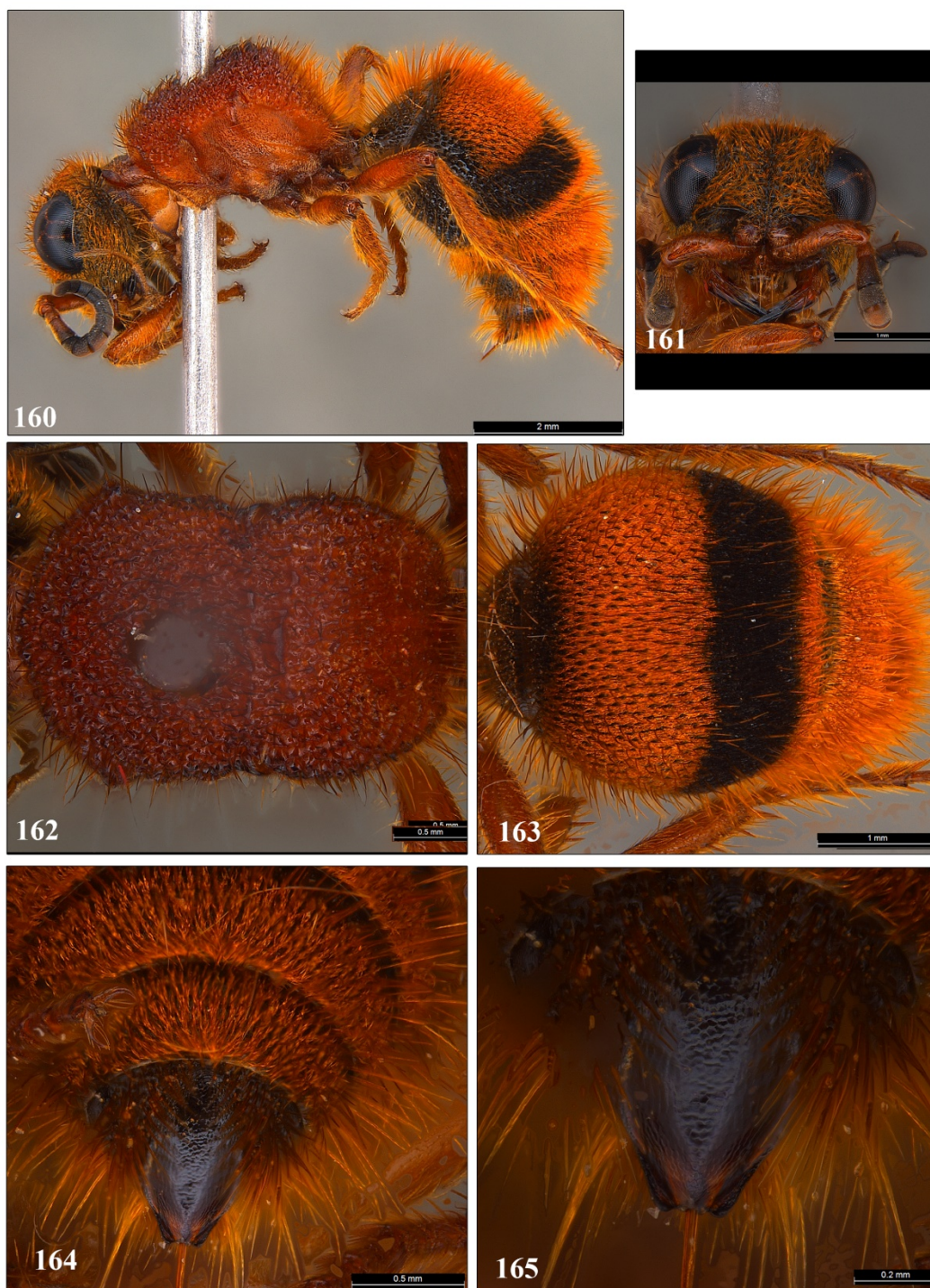
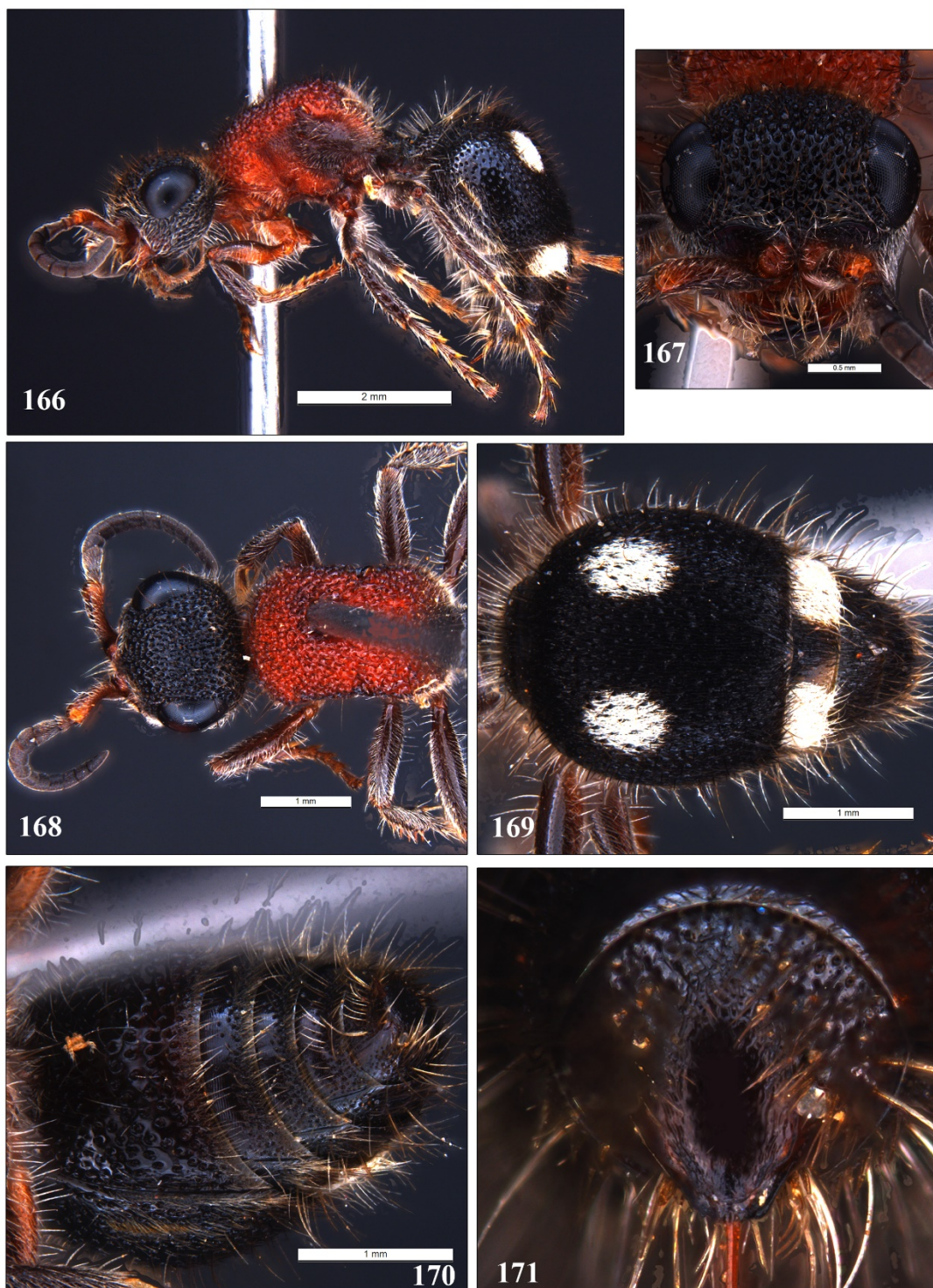


PLATE 48



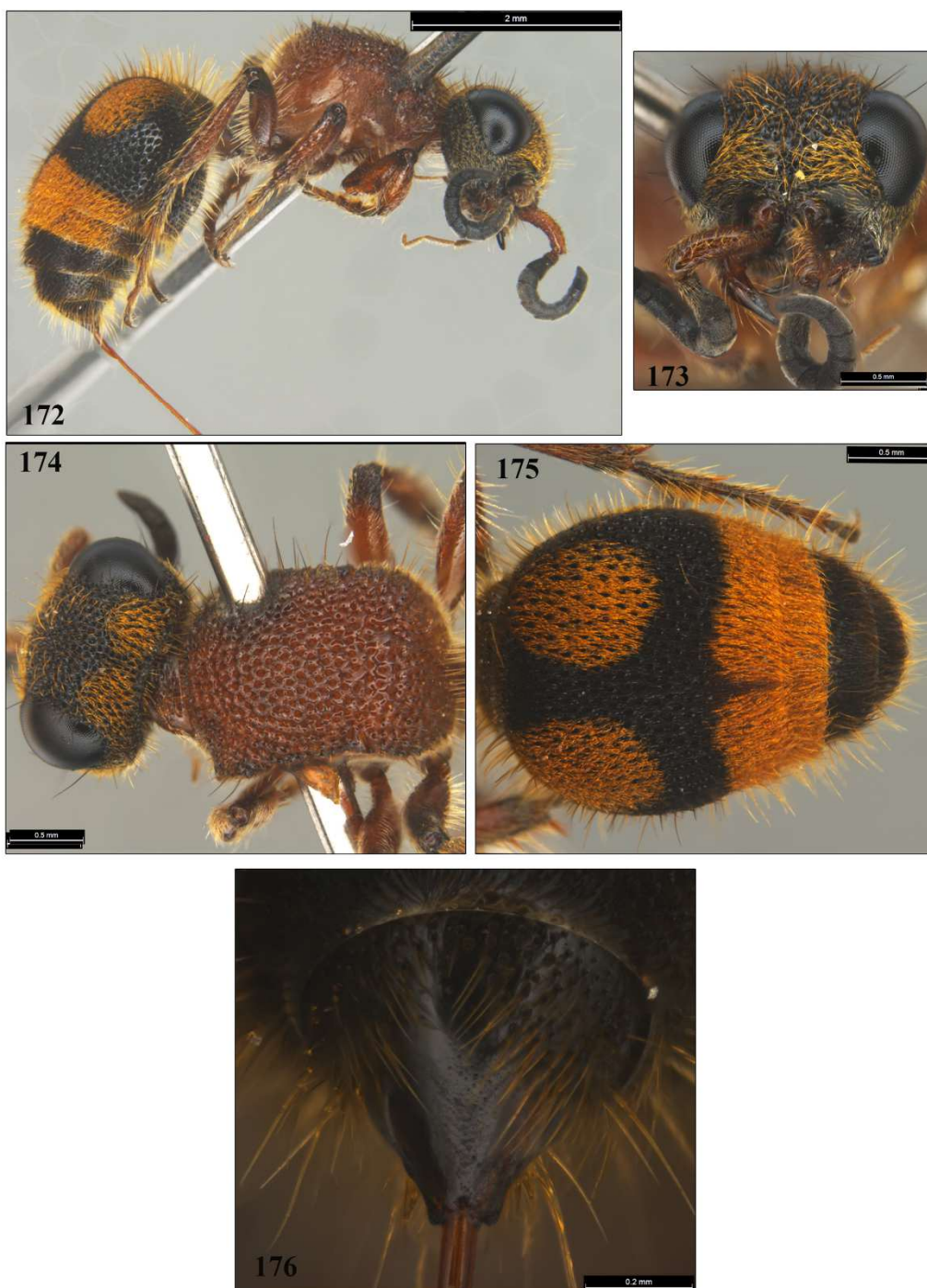
Krombeinidia agnata (André, 1894) (Female). 160. Body, lateral view. 161. Head, frontal view. 162. Mesosoma, dorsal view. 163, 164. Metasoma, dorsal view. 165. Pygidium.

PLATE 49



Krombeinidia albopunctata (André, 1907) (Female). 166. Body, lateral view. 167. Head, frontal view. 168. Head & Mesosoma, dorsal view. 169. Metasoma, dorsal view. 170. Metasoma, ventral view. 171. Pygidium.

PLATE 50



Krombeinidia lilliputiana (André, 1894) (Female). 172. Body, lateral view. 173. Head, frontal view. 174. Head & Mesosoma, dorsal view. 175. Metasoma, dorsal view. 176. Pygidium.

PLATE 51



Krombeinidia lilliputiana (André, 1894) (Male). 177. Body, lateral view. 178. Head, frontal view. 179. Head & Mesosoma, dorsal view. 180. Metasoma, dorsal view. 181. Metasoma, ventral view. 182. Genitalia.

III. Genus *Trogaspidia* Ashmead, 1899

Trogaspidia Ashmead, 1899: 58; Lelej & Brothers, 2008: 63; Brothers & Lelej, 2017: 96; Williams *et al.*, 2019a: 42; Pagliano *et al.*, 2020: 273. *Timulla* (non Ashmead, 1899): Mickel, 1933: 388; 1934: 143; 1935: 218.

Type species: *Mutilla medon* Smith, 1855 (original designation).

Diagnosis. Female. Scutellar scale present. Propodeum broader than pronotum and some have propodeum broader than mesonotum. T2 with two spots of setae transversely. Pygidial plate striate or longitudinally rugose, in some species apically microgranulate. S6 simple.

Male. Mandible beneath with tooth basally. Scape ventrally bicarinate. Metacoxa convex and punctate. Hypopygium modified with teeth or ridges. Mesoscutellum usually convex with longitudinal carina. T7 with longitudinal smooth area. S2 without lateral felt line.

Diversity & Distribution. The genus is represented by 351 valid species worldwide. More than 200 species are from the Afrotropical region (Bischoff, 1920) and over 140 from the Oriental region. 53 species are from India (Lelej, 2005; Williams *et al.*, 2019a & Pagliano *et al.*, 2020).

Key to the species of *Trogaspidia* Ashmead, 1899 from the Western Ghats (Based on females)

1. Head Black. 2
 - Head ferruginous or dark-ferruginous. 8
2. Vertex with a spot of silvery setae. 3
 - Vertex without any spots of silvery setae. 4
3. Pygidium rugose-rugulose. *T. aulica* (Smith, 1855)
 - Pygidium finely imbricate. *T. kolabensis* (André, 1894)
4. Metasoma with silvery spots of setae. 5
 - Metasoma with golden spots of setae. – Pygidium longitudinally rugose. *T. pulchriceps* (Cameron, 1892)

-
5. Mesosoma dorsum ferruginous. Mesosomal lateral margins, meso and metapleuron black...
..... 6
- Mesosoma entirely ferruginous.7
6. Pygidium apparently punctured, with dense setae. *T. wroughtoni* (Cameron, 1892)
- Pygidium area oval, carinated laterally, medially widened, longitudinally striated and apically with fine granulations.*T. villosa* (Fabricius, 1775)
7. Pygidium basally widened and narrowed towards apex, longitudinally striate (striae irregular) and apico-medially smooth and apico-laterally micro granulate.....
- *T. ruficrus* (Magretti, 1892)
- Pygidium area oval, carinated laterally, basally rugose and apically finely rugose.....
- *T. agelia* (Cameron, 1900)
8. Head ferruginous. 9
- Head dark-ferruginous. Pygidium medially widened and narrowed towards apex, longitudinally striated and striations divergent towards lateral sides, apically with micro granulations. *T. intermedia* (Saussure, 1867)
9. T2 with two spots of golden setae, not touching each other. Pygidium finely punctured.
..... *T. erythrocerca* (Cameron, 1892)
- T2 with two large spots of golden setae, touching each other, sometimes united. Pygidium longitudinally streaked. *T. nudiceps* (André, 1894)

Species from the Central and Southern Western Ghats and its adjacent areas

i. *Trogaspidia agelia* (Cameron, 1900)

(Plate 53, Figs. 183–188)

Mutilla agelia Cameron, 1900: 29, ♀, Syntypes (Type locality: Barrackpore, Bangla, India)
[OUMNH] (Synonymized under *Trogaspidia* by Lelej, 2005: 87).

Description: Female. Body length 4.53 mm. Coloration and Setation. Head black. Antennal tubercles ferruginous. Scape and flagellomeres black, scape shiny black. Clypeus black. Mandible medially ferruginous, latter parts black. Mesosoma ferruginous, lateral margins

dark. Coxa black, femur dark ferruginous, tibia and tarsomeres shiny brownish black. Scutellar scale brownish. Metasoma black. S1 dark ferruginous. Head with erect pale golden setae and black setae, gena with appressed white setae. Clypeal margin with long erect pale golden setae. Base of mandible with long sub-erect pale golden setae. Scape with long dense pale golden setae, pedicel and flagellomeres with pale white micro pubescence. Mesosoma dorsum with erect and sub-erect black setae. Propodeal declivity with pale golden sub-erect setae. Meso and metapleuron with dense white micro pubescence. Coxa, femur and tibia with appressed white setae. Tarsomeres with appressed dense pale golden setae. T1 apically with appressed pale golden setae and wholly with erect sparse black and pale golden setae. T2 with two spots of white setae, not coalescing at middle, latter portions with erect and appressed golden and brownish-black setae. T3 and T4 with square shaped silver spots, spots not coalesce at middle nor reaching lateral ends. T4 black, with erect and sub-erect golden setae, latter portion with appressed black setae. T5 with dense appressed black setae. T6 with fringe of long erect pale golden setae bordering pygidial area. S1 with sparse whitish micro pubescence. S2–5 with apical fringe of small pale golden setae. Sternal segments with sparse pale golden setae.

Structure and sculpture. Head. Oval in frontal view, coarsely punctate alveolate. Eyes small, oval. Scrobal carina well developed. Clypeus medially slightly elevated, with a medial flattened tubercle and lateral ends with denticle, clypeus rugose. Antennal tubercles basal two-thirds rugose-striate and apically finely rugose. Scape coarsely and deeply foveolate, between the fovea with minute punctures. Flagellomeres with minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.97: 0.48: 0.29: 0.33. Minimal distance between eyes $1.26 \times$ longitudinal eye diameter. Mandible narrowed towards apex, with sparse small punctures.

Mesosoma. Propodeum wider than pronotum. Pronotal width $1.01 \times$ head width behind eyes. Propodeal width $1.05 \times$ pronotal width. Mesonotum laterally concave. Mesosoma dorsum rugose-punctate, Width of punctures on the mesosoma dorsum $1.67 \times$ width of punctures on head. Pronotum with transverse rugose-punctate. Scutellar scale developed, scale width $2.3 \times$ scale length. Propodeal slope abrupt/steep, reticulate. Propodeal margin crenulated, almost forming small teeth. Meso and metapleuron without any punctures. Mesopleura concave; mesopleural suture not reaching anterior spiracle, ending just below the spiracle. Mid and hind tibia with two rows of spines, four in each row. Coxa coarsely micro-punctate, femur and tibia with sparse minute punctures.

Metasoma. T2 width $1.94 \times$ T1 width. T1–5 punctate, punctations small. T2 with a long lateral felt line, felt line $0.52 \times$ T2 length. Pygidium area oval, carinated laterally, basally rugose and apically finely rugose. S1 with a blunt tooth medially. S2 punctate, punctures size larger medially. S3–6 with small coarse punctures.

Male. Unknown.

Material examined. Kerala: 1♀, Kozhikode district, Nanminda, Latitude: 11.422281 N, Longitude: 75.830596 E, Altitude: 68 m, 30.x.2022, Coll. Girish Kumar P., ZSI/WGRC/IR/INV. 23374.

Distribution. West Bengal, Kerala (New record) (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

ii. *Trogaspidia aulica* (Smith, 1855)

(Plate 54, Figs. 189–194)

Mutilla aulica Smith, 1855: 37, ♀, Syntypes (Northern India) [NHMUK] (Synonymized under *Trogaspidia* by Lelej, 2005: 88).

Description: Female. Body length 6.35 mm. Coloration and Setation. Head black. Antennal tubercles, scape, flagellomeres and clypeus dark ferruginous. Mandible basal half black and apical half dark ferruginous. Mesosoma dorsum ferruginous, lateral margins dark. Meso and metapleuron black. Legs dark ferruginous, with some parts black. Scutellar scale black. Metasoma black. S1 dark ferruginous. Head with erect long brown setae with erect small silvery setae, gena with appressed dense silvery setae, with spot of silvery setae on vertex. Clypeal margin with long sub-erect silver setae. Base of mandible with long sub-erect silver setae and lateral sides of mandible with long sub-erect pale golden setae. Antennal tubercles and scape with short erect silvery setae, pedicel and flagellomeres with pale white micro pubescence. Mesosoma dorsum with sparse sub-erect black and silvery setae. Meso and metapleuron with appressed dense silvery setae. Legs with long sub-erect and short-appressed silvery setae. Metasoma with appressed dense black setae, laterally with long erect intermixed black and silvery setae. T2 with two spots of white setae on basal and apical margins, not coalescing at middle, latter portions with erect and appressed black setae with intermixed sparse brown and silver setae. T3 with two spots of silvery setae. T4 with dense

silvery setae. T5 with dense appressed black setae. T6 with fringe of long erect black setae bordering pygidial area. S1 with sparse whitish micro pubescence S2–5 with apical fringe of small pale silvery setae. Sternal segments with sparse pale silvery setae.

Structure and sculpture. Head. Sub-quadrate, coarsely punctate. Eyes sub-ovate. Scrobal carina well developed, slightly curved. Clypeus medially area elevated with a median tubercle, anterior medial margin wavy with anterior-lateral margins with denticles on either side. Antennal tubercles rugose. Scape coarsely punctate, ventrally with two carina on either side. Flagellomeres with minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.2: 0.45: 0.31: 0.33. Minimal distance between eyes $1.4 \times$ longitudinal eye diameter. Mandible narrowed towards apex, bidentate with a sub-apical tooth.

Mesosoma. Propodeum wider than pronotum. Pronotal width $1.1 \times$ head width behind eyes. Propodeal width $1.05 \times$ pronotal width. Mesonotum laterally concave. Mesosoma dorsum areolate, width of punctures on the mesosoma dorsum $1.87 \times$ width of punctures on head. Scutellar scale well developed. Propodeal slope abrupt/steep. Mesosomal margin crenulated, not almost forming small teeth. Meso and metapleuron punctate. Mesopleura concave; mesopleural suture reaching anterior spiracle. Mid and hind tibia with two rows of spines, four in each row. Coxa coarsely micro-punctate, femur and tibia with sparse minute punctures.

Metasoma. T2 width $1.87 \times$ T1 width. T1–5 coarsely punctate. T2 with a long lateral felt line, felt line $0.41 \times$ T2 length. Pygidium area oval, carinated laterally, weakly irregularly rugose. S1 with a small blunt tooth medially. S2 punctate, punctures sparse medially. S3–6 with small coarse punctures.

Male. Unknown.

Material examined. Tamil Nadu: 1♀, Tirunelveli district, Kalakad Mundanthurai Tiger Reserve, Kadayam, Latitude: 8.80878 N, Longitude: 77.30479 E, Altitude: 292 m, 30.ix.2018, Coll. Girish Kumar P., ZSI/WGRC/IR/INV. 24066.

Distribution. Bihar, Delhi, Maharashtra, Tamil Nadu (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

iii. *Trogaspidia intermedia* (Saussure, 1867)**(Plate 55, Figs. 195–200)**

Mutilla intermedia Saussure, 1867: 354, ♀, Holotype ♀ (Type locality: Ceylon, Sri Lanka) [NHMW] (synonymized under *Trogaspidia* by Lelej, 2005: 95).

Mutilla erythrocephala Fabricius, 1793: 371 (Type locality: in America meridionali) [CZM] (Synonymized under *intermedia* by Bischoff, 1931: 92).

Mutilla aureotrifasciata Sichel et Radoszkowski, 1869: 168, New name for *Mutilla erythrocephala* Fabricius, 1793, (Synonymized under *intermedia* by Bischoff, 1931: 92).

Mutilla simplicata Cameron, 1898: 5, ♀, Syntypes (Type locality: Mahaganay, Ceylon, Sri Lanka) [NHMUK] (synonymized under *Trogaspidia* by Lelej, 2005: 95).

Mutilla amitina Cameron, 1900: 26, ♀, Syntypes (Type locality: Ceylon, Sri Lanka) [NHMUK] (synonymized under *Trogaspidia* by Lelej, 2005: 95).

Description: Female. Body length 11.76–11.84 mm. Coloration and setation. Head, antennal tubercles and clypeus dark ferruginous, frons darker. Scape, pedicle and F1 ferruginous, latter segments black. Mandible basally ferruginous, two-third black, medially brownish-black. Mesosoma dorsum, meso and metapleuron black. Scutellar scale black. Coxa brownish-black, latter segments ferruginous. Metasoma black, S1 brownish. Frons and vertex with short erect black setae, gena with short sub-erect and appressed golden setae. Clypeus with dense long golden setae and short sparse brown setae. Mandible basal two-thirds with long erect golden setae. Scape with short appressed golden setae, pedicle and F1 with golden micro pubescence, Latter segments with white micro pubescence. Mesosoma dorsum with dense erect black setae, propodeal declivity with long erect golden setae. Meso and metapleuron with sparse white micro pubescence. Legs with dense appressed and sub-erect golden setae, tarsomeres with comb-like golden setae. T1 with appressed black setae and dense erect golden setae. T2 with two large oval spots of golden pubescence which coalesces at middle, latter parts with dense appressed black setae. T2 with a lateral felt line of golden setae. T3 and T4 with band of golden setae. T5 with long erect black setae. T6 basally with long erect black setae bordering the basal pygidial area. S1 with sparse long erect golden setae and golden micro pubescence. S2–6 with apical fringe of long appressed golden setae. S2 with sparse sub-erect golden setae.

Structure and sculpture. Head. Oval in frontal view, alveolate. Eyes medium-sized, oval. Scrobal carina well developed. Clypeus arched, medially slightly elevated, laterally on each

side with denticles. Antennal tubercles rugose striate, striae short. Scape foveolate-punctate, flagellomeres with minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.39: 0.82: 0.5: 0.43. Minimal distance between eyes $1.45 \times$ longitudinal eye diameter. Mandible narrowed towards apex, basal tooth blunt, not so developed.

Mesosoma. Propodeum wider than pronotum. Pronotal width $1.16 \times$ head width behind eyes. Propodeal width $1.08 \times$ pronotal width. Mesosoma dorsum rugose punctate. Width of punctures on the mesosomal dorsum $1.98 \times$ width of punctures on head. Scutellar scale well developed, small. Propodeal slope abrupt/steep, rugose-reticulate. Lateral mesosomal margin crenulated. Meso and metapleuron sparsely micro-punctate. Mesopleura concave; mesopleural suture not reaching anterior spiracle, ending just below the spiracle. Legs sparsely micro-punctate, mid and hind tibia with two rows of spines, four in each row.

Metasoma. T2 width $1.92 \times$ T1 width. T1–5 coarsely punctate. T2 with a lateral felt line, felt line $0.48 \times$ T2 length. Pygidium medially widened and narrowed towards apex, longitudinally striated and striations divergent towards lateral sides, apically with micro granulations. S1 with a blunt tooth medially, micro-punctate. S2 convex, S2 medially sparsely and laterally coarsely punctate. S3–6 coarsely punctate.

Male. Unknown.

Material examined. Kerala: 1♀, Kozhikode district, Balussery, Latitude: 11.422281 N, Longitude: 75.830596 E, Altitude: 68 m, 12.ii.2023, Coll. Amal S., ZSI/WGRC/IR/INV. 25431; 1♀, Kozhikode district, Nambikulam, Latitude: 11.341807 N, Longitude: 75.739146 E, Altitude: 30 m, 9.v.2019, Coll. Sandra Lishikumar, ZSI/WGRC/IR/INV. 19850.

Distribution. Karnataka, Kerala (New record) (Lelej, 2005; Nithya, 2013; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

iv. *Trogaspidia kolabensis* (André, 1894)

(Plate 56, Figs. 201–206)

Mutilla kolabensis André, 1894: 465, 475, ♀, Holotype (Type locality: Kolaba, Maharashtra, India) [MNHN].

Description: Female. Body length 6.12 mm. Coloration and Setation. Head black. Antennal tubercles dark ferruginous. Scape, pedicel and F1 brownish black. F2–10 black. Clypeus ferruginous, apical margin black. Mandible basal half ferruginous and apical half black.

Mesosoma medially dark ferruginous, latter black. Coxa dark ferruginous, latter part black. Scutellar scale black. Metasoma black. S1 dark ferruginous. Head with sub-erect black setae, gena with dense appressed white setae. Vertex with a spot of silver setae. Clypeal margin with long erect pale golden setae. Base of mandible, scape and antennal tubercles with long sub-erect silvery setae. Flagellomeres with micro-pubesence of silvery setae. Mesosoma dorsum with erect and sub-erect black and brown setae. Meso and metapleuron with dense appressed short silvery setae. Legs with appressed and sub-erect silvery setae, setae denser on tarsomeres. T1–5 with appressed dense black setae and sparse silvery setae. T2 with two spots of silvery setae, not coalescing at middle. T3 with square shaped silvery spots, spots not coalesce at middle nor reaching lateral ends. T4 black, with erect and sub-erect silvery setae, latter portion with appressed black setae. T5 with dense appressed black setae. T6 with fringe of long erect black setae bordering pygidial area. S1 with sparse whitish micro pubescence S2–5 with apical fringe of small pale silver setae. Sternal segments with sparse pale silvery setae.

Structure and sculpture. Head. Almost square shaped in frontal view, on vertex rounded, coarsely rugose-punctate. Eyes small, almost circular. Scrobal carina well developed, curved. Clypeus medially slightly elevated, with two medial tubercle and lateral ends with small blunt denticle. Antennal tubercles rugose. Scape deeply foveolate. Flagellomeres with minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.33: 0.77: 0.53: 0.54. Minimal distance between eyes $1.47 \times$ longitudinal eye diameter. Mandible narrowed towards apex, with sparse small punctures, bidentate with a small sub-apical tooth.

Mesosoma. Propodeum wider than pronotum. Pronotal width $1.06 \times$ head width behind eyes. Propodeal width $1.06 \times$ pronotal width. Mesosoma dorsum areolate, with sparse punctures in some areolae. Width of punctures on the mesosoma dorsum $0.32 \times$ width of punctures on head, pronotum and mesosoma medially with sparse transverse rugae. Scutellar scale developed. Propodeal slope abrupt/steep, rugose. Propodeal margin crenulated, not forming small teeth. Meso and metapleuron with fine rugose-punctures. Mesopleura concave; mesopleural suture not reaching anterior spiracle, ending just below the spiracle. Mid and hind tibia with one row of spines, five in each row. Coxa with coarse fine rugae and micro-punctate, femur and tibia punctate.

Metasoma. T2 width $1.74 \times$ T1 width. T1–5 with coarse small punctures. T2 with a long lateral felt line, felt line $0.52 \times$ T2 length. Pygidium area oval, carinated laterally, medially

wider, finely imbricate. S1 with a blunt tooth medially. S2 punctate, punctures size larger and sparser medially. S3–6 with small coarse punctures.

Male. Unknown.

Material examined. Karnataka: 1♀, Kodagu district, Bettathur, Latitude: 12.4055 N, Longitude: 75.6262 E, Altitude: 1198 m, 22.xii.2019, Coll. Girish Kumar P. & Party, ZSI/WGRC/IR/INV. 24068.

Distribution. Maharashtra, Karnataka (New record) (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

v. *Trogaspidia pulchriceps* (Cameron, 1892)

(Plate 57, Figs. 207–212)

Mutilla pulchriceps Cameron, 1892: 121, 130, ♀, Syntypes (Type Locality: Poona, Maharashtra, India) [NHMUK].

Description: Female. Body length 8.88–9.92 mm. Coloration and Setation. Head black. Antennal tubercle and scape ferruginous. Flagellomere 1 and 2 brownish black, latter segments black. Clypeus black. Mandible basal two-third ferruginous, latter part black. Mesosoma ferruginous. Coxa brownish-black, femur reddish-black, tibia and tarsomeres ferruginous. Scutellar scale brownish. Metasoma black. S1 brownish. Head with appressed golden setae, setae thickened on the vertex forming two round spots, posterior margin of head with a fringe of short golden sub-erect setae. Gena with dense golden setae than in frons. Clypeal margin with sub-erect golden setae. Base of mandible with long sub-erect golden setae. Antennal tubercles and scape with long dense golden setae, pedicel and first flagellomere with short golden yellow setae and remaining flagellomeres with pale white micro pubescence. Mesosoma dorsum and propodeal declivity with golden decumbent setae and sparse erect brown setae. Meso and metapleuron with white micro pubescence. Legs with erect appressed and sub-erect long and short golden setae. T1 with erect golden setae and short decumbent black setae. T2 with two spots of golden setae, not coalescing at middle, latter portions with coarse sub-erect golden and brownish-black setae. T3 and T4 completely covered with a band of golden setae. T5 black, with sparse golden setae. T6 with fringe of long erect golden setae bordering pygidial area. S1 with sparse brownish setae and a small apical fringe of whitish micro pubescence. S2–5 with apical fringe of golden setae. Sternal segments with sparse golden setae.

Structure and sculpture. Head. Oval in frontal view, coarsely and deeply punctate alveolate. Eyes medium-sized, oval. Scrobal carina well developed. Clypeus slightly arched, medially elevated with a small tubercle, with two denticles on lateral ends. Antennal tubercle rugose, scape sparsely punctate, flagellomeres with minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.37: 0.94: 0.52: 0.62. Minimal distance between eyes $1.45 \times$ longitudinal eye diameter. Mandible narrowed towards apex, apically with a small preapical tooth. Occipital carina developed.

Mesosoma. Propodeum wider than pronotum. Pronotal width $0.9 \times$ Head width behind eyes. Propodeal width $0.94 \times$ pronotal width. Mesosoma dorsum alveolate, Width of alveolae on the mesosomal dorsum $1.49 \times$ width of punctures on head. Scutellar scale well developed. Propodeal slope abrupt/steep, rugose. Lateral propodeal margin with four teeth. Meso and metapleuron with smooth rugae and minute punctures. Mesopleura concave; mesopleural suture not reaching anterior spiracle, ending just below the spiracle. Mid and hind tibia with two rows of spines, four in each row.

Metasoma. T2 width $1.8 \times$ T1 width. T1–5 punctate. T2 with a lateral felt line, felt line $0.35 \times$ T2 length. Pygidium basally widened and narrowed towards apex, longitudinally rugose and apically with micro granulations. S1 with a small blunt tooth medially. S2–6 punctate, S2 medially sparsely and laterally coarsely punctate, S3–6 coarsely punctate apically and basal two-third sparsely punctate.

Male. Unknown.

Materials examined. Kerala: 1♀, Kozhikode district, Nanminda, Latitude: 11.422281 N, Longitude: 75.830596 E, Altitude: 68 m, 06.viii.2017, Coll. Girish Kumar P., ZSI/WGRC/IR/INV. 22156; 1♀, Kozhikode district, Elathur, Latitude: 11.341807 N, Longitude: 75.739146 E, Altitude: 30 m, 29.x.2020, Binoy C., ZSI/WGRC/IR/INV. 26629.

Distribution. Karnataka, Kerala, Maharashtra. *Elsewhere.* Sri Lanka (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

vi. *Trogaspidia ruficrus* (Magretti, 1892)

(Plate 58, Figs. 213–218)

Mutilla ruficrus Magretti, 1892: 205, ♀, Syntypes (Type locality: Bhamo, Carin-Cheba) [MDG] (synonymized under *Trogaspidia* by Lelej, 2005: 101).

Description: Female. Body Length 5.89 mm. Coloration and Setation. Head black. Antennal tubercle, scape, pedicel and F1 ferruginous, latter segments black. Clypeus dark ferruginous, apically black. Mandible basal half ferruginous, latter part black. Mesosoma ferruginous, lateral edge darker. Legs ferruginous, tarsal spines darker. Scutellar scale brownish. Metasoma black, T6 apically brownish. S1 brownish. Frons and vertex with sparse appressed and erect brownish and pale yellowish setae. Gena and below eyes with dense silver setae. Scape and pedicel with sub-erect, short and long pale yellowish setae. F1 with micro pubescence of pale yellowish setae, latter segments with pale white micro pubescence. Clypeus with a tuft of long pale yellowish sub-erect setae, clypeal margin with sub-erect dense long golden setae. Mandible basally with sub-erect long erect pale yellowish setae. Mesosomal dorsum with sparse appressed small pale-yellow setae and erect long brown setae, mesopleurae with dense short appressed silvery setae. Propodeal declivity with dense long yellowish setae. Coxa with dense short silvery setae on each side, femur and tibia with sparse pale yellowish and silvery setae. Tarsomeres with dense yellowish setae. T1 with erect pale yellowish setae, apically with appressed black setae. T2 – 5 with short sub-erect black setae. T2 basally with two small spots of silvery setae and with long lateral felt line of yellowish setae. T3 and T4 with square shaped silvery spots, spots not coalesce at middle nor reaching lateral ends. T5 with dense black and brown intermixed setae. T6 basally with short sub-erect black setae and with a fringe of long erect pale yellowish setae bordering pygidial area. S1 with short appressed silvery setae and long erect pale yellowish setae. S2–5 with an apical fringe of pale yellowish and silvery setae.

Structure and sculpture. Head. Oval in frontal view, concave at posterior margin, coarsely and deeply punctate. Eyes large, oval. Scrobal carina well developed. Clypeus basally broadened and anteriorly narrowed, lateral ends blunt, clypeus punctate. Antennal tubercle rugose-striate and apically foveolate. Scape medially smooth, laterally sparse setigerous punctures, flagellomeres with minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.21: 0.64: 0.41: 0.38. Minimal distance between eyes $1.13 \times$ longitudinal eye diameter. Mandible narrowed towards apex, apically without any preapical tooth.

Mesosoma. Propodeum wider than pronotum. Pronotal width $1.21 \times$ head width behind eyes. Propodeal width $1.07 \times$ pronotal width. Mesonotum laterally concave. Mesosoma dorsum rugose punctate, width of punctures on the mesosoma dorsum $1.66 \times$ width of punctures on head, pronotum with slight rugae. Scutellar scale well developed. Propodeal slope abrupt/steep. Mesosomal margin crenulated, lateral propodeal margin with four small teeth.

Meso and metapleuron without any punctures. Mesopleura concave; mesopleural suture reaching anterior spiracle. Fore tarsi with a well-developed pectinate comb. Mid and hind tibia with two rows of spines, four in each row. Coxa coarsely micro-punctate, femur and tibia with sparse minute punctures.

Metasoma. T2 width $1.9 \times$ T1 width. T1–5 punctate, punctations hidden by setae. T2 with a long lateral felt line, felt line $0.53 \times$ T2 length. Pygidium basally widened and narrowed towards apex, longitudinally striate (striae irregular) and apico-medially smooth and apico-laterally micro granulate. S1 with a blunt tooth medially. S2 foveolate, fovea size larger medially. S3–6 with small coarse punctures.

Male. Unknown.

Material examined. Kerala: 1♀, Kozhikode district, Peruvayal, Latitude: 11.262565 N, Longitude: 75.905296 E, Altitude: 39 m, 26.vii.2008, Coll. K. Rajmohana, ZSI/WGRC/IR/INV. 24067.

Distribution. Bihar, Kerala (New record), West Bengal. *Elsewhere.* Myanmar (Lelej, 2005; Nithya, 2013; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

vii. *Trogaspidia villosa* (Fabricius, 1775)

(Plate 59, Figs. 219–224)

Sphex villosa Fabricius, 1775: 352, ♂ (Type locality: Habitat in littoral Malabarica) [CZM].

Mutilla hexaops Saussure 1867: 356, ♀ (Type locality: Nattan, Sri Lanka) [NHMW]
(Synonymized under *Trogaspidia* by Lelej, 2005: 104).

Mutilla ceylanensis (Sichel et Radoszkowski 1870: 247, ♀, Syntypes (Type locality: Ceylon, Sri Lanka) [Inst. Syst. Exper. Zool., Krakow.] (Synonymized under *hexaops* by André, 1899: 34).

Mutilla acidalia Cameron 1897: 56, ♀, ♂, Syntypes (Type locality: Trincomali, Ceylon, Sri Lanka) [NHMUK] (Synonymized under *ceylanensis* by André, 1899: 34).

Mutilla violenta Cameron 1900: 35, ♀, Syntypes (Type locality: Ceylon, Sri Lanka) [NHMUK] (Synonymized under *Trogaspidia* by Lelej, 2005: 105).

Description: Female. Body length 7.46 mm. Coloration and Setation. Head ferruginous. Antennal tubercles ferruginous. Scape and pedicel brownish black. Clypeus ferruginous, apical margin black. Mandible basal two-third ferruginous and latter part black. Mesosoma dorsum ferruginous, lateral margins black. Meso and metapleuron black. Mid and frontal legs

black, hind legs brownish black. Metasoma black. S1 ferruginous. Head with erect black setae mixed with erect small silvery setae, gena with appressed dense silvery setae, vertex with denser setae. Clypeal margin with long sub-erect pale golden setae. Base of mandible with sub-erect silvery setae. Scape with long sub-erect pale golden setae. Scape, pedicel and flagellomeres with pale white micro pubescence. Mesosoma dorsum with appressed pale golden setae and sparse brownish setae. Meso and metapleuron with appressed dense pale silvery setae. Legs with sub-erect and short-appressed pale golden and silvery setae. Metasoma with appressed pale golden, brownish and black setae, laterally with long erect intermixed black and silvery setae. T2 basally with two spots of white setae, not coalescing at middle, latter portions with erect and appressed black setae with intermixed sparse brown and silver setae. T3 and T4 with two spots of silvery setae, not coalescing in middle and not reaching lateral sides. T5 with dense appressed black setae. T6 with fringe of long erect pale golden setae bordering pygidial area. S1 with sparse whitish micro pubescence S2–5 with apical fringe of small pale golden setae. Sternal segments with sparse pale silvery setae.

Structure and sculpture. Head. Oval in frontal view, almost square shaped, foveolate. Eyes oval. Scrobal carina well developed, curved. Clypeus medially elevated, with a medial tubercle and lateral ends with a denticle, clypeus rugose punctate. Antennal tubercles basal with fine rugae and latter finely granulated. Scape with sparse deep foveolae. Flagellomeres with minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.36: 0.86: 0.50: 0.40. Minimal distance between eyes $1.41 \times$ longitudinal eye diameter. Mandible narrowed towards apex, with small sub-apical tooth and a sub-basal tooth.

Mesosoma. Propodeum wider than pronotum. Pronotal width $1.18 \times$ head width behind eyes. Propodeal width $1.10 \times$ pronotal width. Mesonotum laterally concave. Mesosoma dorsum foveolate, width of punctures on the mesosoma dorsum $1.79 \times$ width of punctures on head. Scutellar scale well developed. Propodeal slope abrupt/steep. Mesosomal margin crenulated, not almost forming small teeth. Meso and metapleuron with sparse micro punctures. Mesopleura concave; mesopleural suture reaching anterior spiracle. Mid and hind tibia with two rows of spines, four in each row. Coxa with fine rugae, femur and tibia with sparse minute punctures.

Metasoma. T2 width $1.88 \times$ T1 width. T1–5 coarsely punctate. T2 with a long lateral felt line, felt line $0.48 \times$ T2 length. Pygidium area oval, carinated laterally, medially widened,

longitudinally striated and apically with fine granulations. S1 with a blunt tooth medially. S2 punctate, punctures sparse and large medially. S3–6 with small coarse punctures.

Male. (Description as in Cameron, 1897). Coloration and setation. Head and mesosoma black. Wings fuscous, at base pale. Frons and pronotum with dense silvery setae. Flagellomeres with sparse silvery setae. Scape with sparse silvery setae. Mesopleuron with dense long silvery setae. Legs with silvery setae. Metasoma ferruginous, except metasomal segment 1.

Head. Frons and vertex strongly punctate. F3 2 × F4. Scape laterally carinate.

Mesosoma. Lateral side of pronotum striolated, smooth beneath. Prothorax and mesonotum strongly punctured. Mesopleura coriaceous. Scutellum reticulate. Radial cell elongate. Basal abscissa of radius oblique, apically rounded. First cubital vein oblique. Second cubital vein curved widely.

Metasoma. S1 with a medial keel.

Material examined. Tamil Nadu: 1♀, Thirunelveli district, Ramanadi dam site, Latitude: 8.8412 N, Longitude: 77.2713 E, Altitude: 1059 m, 02.x.2018, Coll. Girish Kumar P., ZSI/WGRC/IR/INV. 23375.

Distribution: Karnataka, Maharashtra, Tamil Nadu, West Bengal. *Elsewhere.* Sri Lanka (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

PLATE 52

Species distribution of the genus *Trogaspidia* Ashmead from Central and Southern Western Ghats and it's adjacent areas

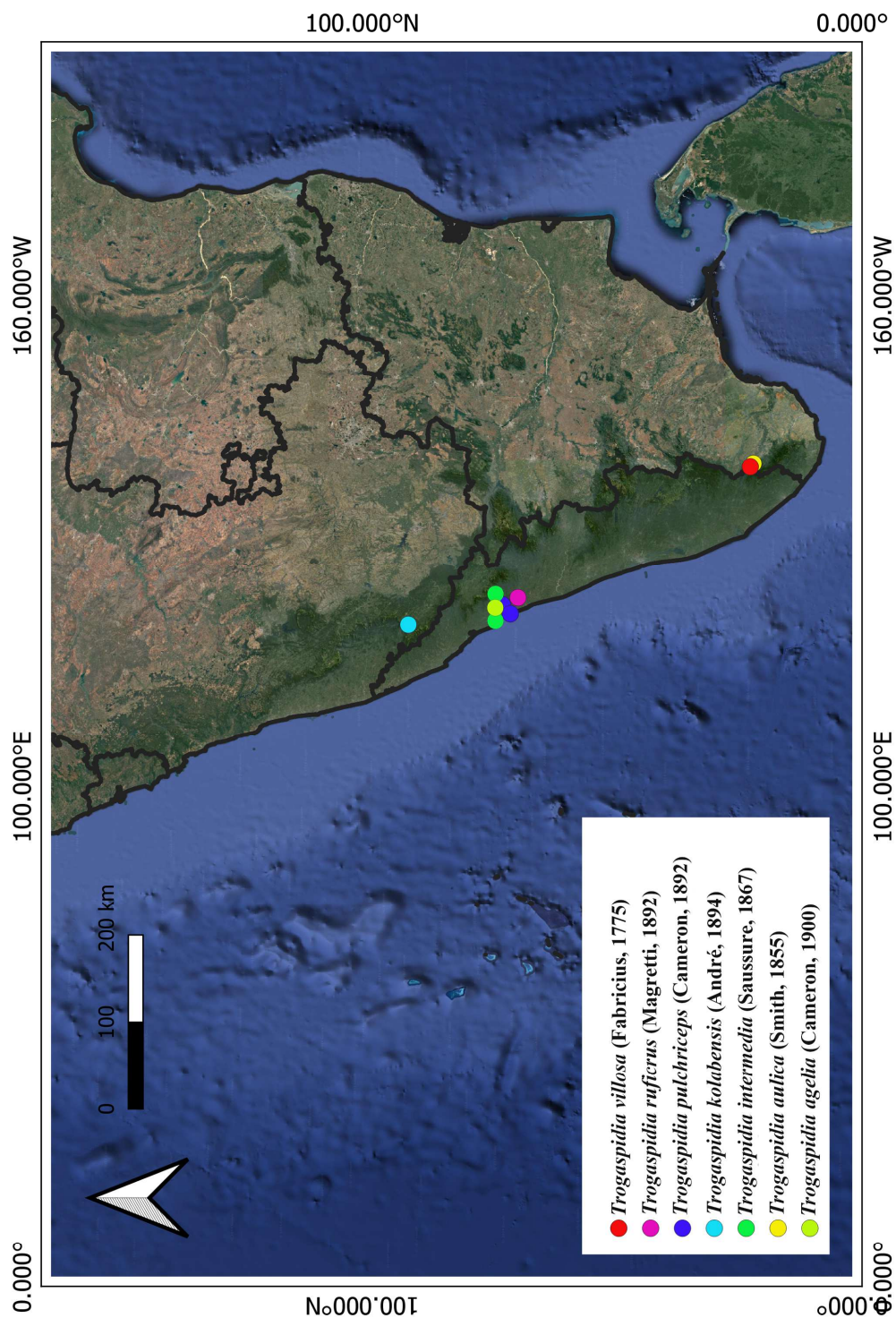
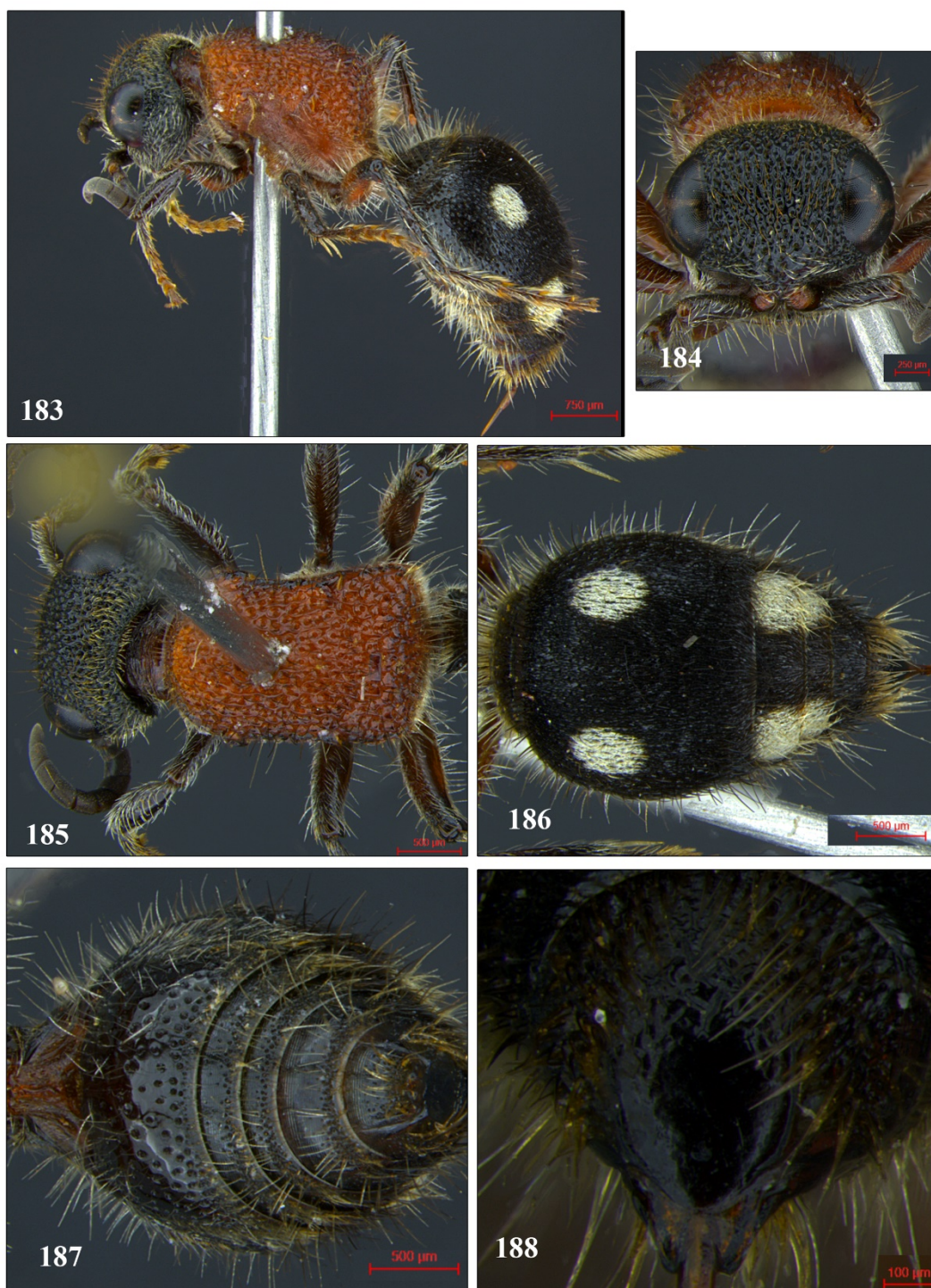
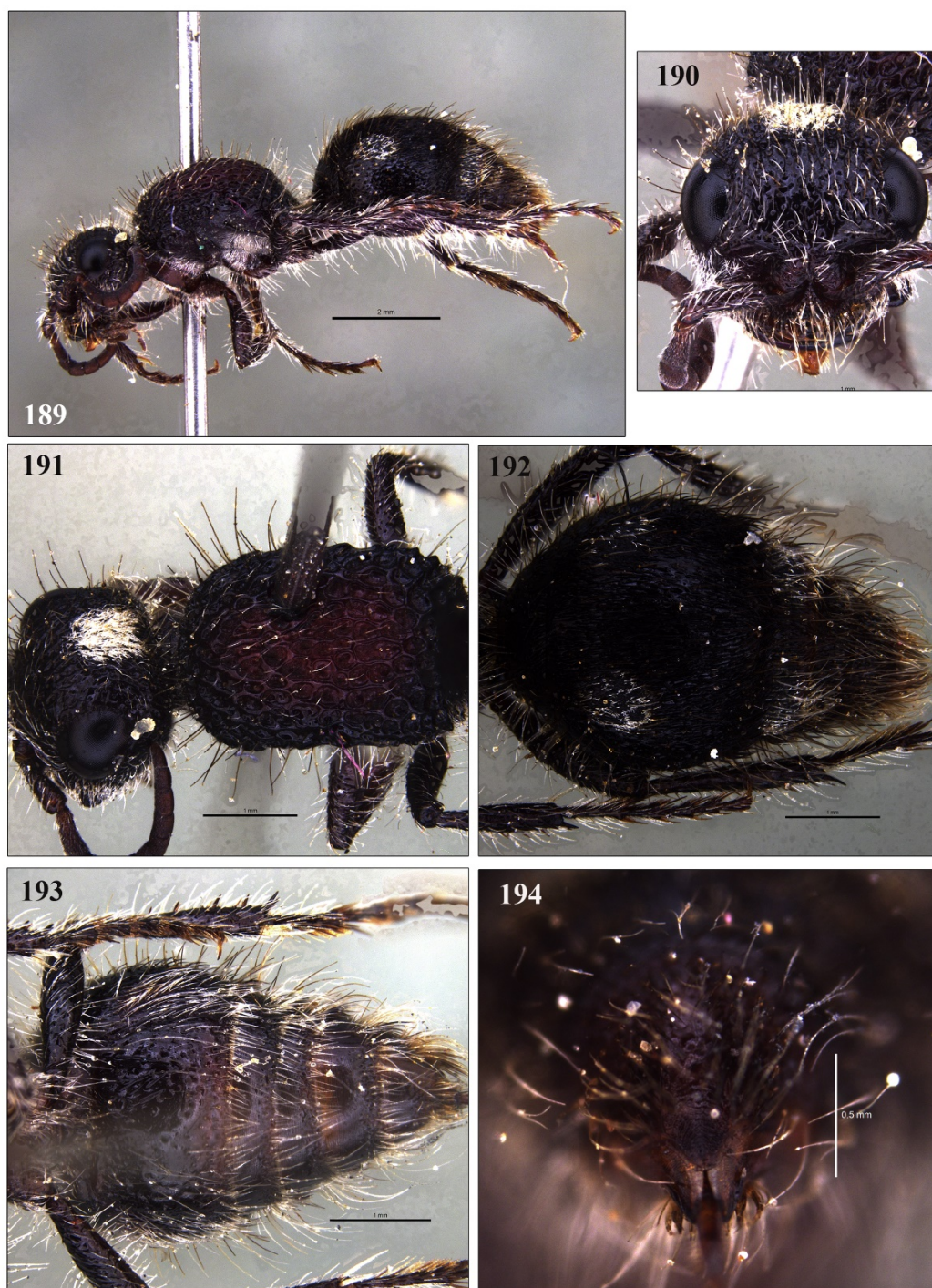


PLATE 53



Trogaspidia agelia (Cameron, 1900) (Female). 183. Body, lateral view. 184. Head, frontal view. 185. Head & Mesosoma, dorsal view. 186. Metasoma, dorsal view. 187. Metasoma, ventral view. 188. Pygidium.

PLATE 54



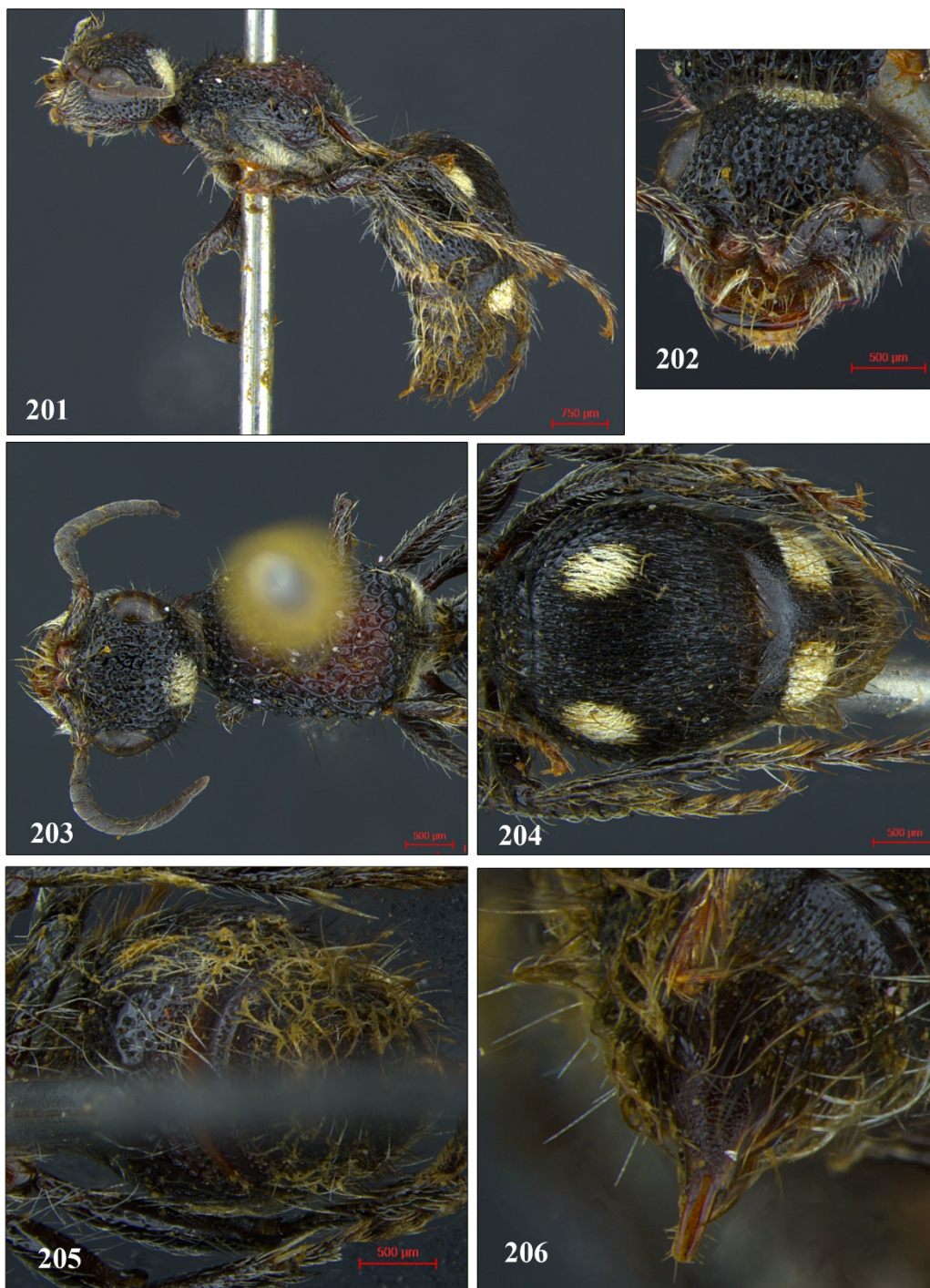
Trogaspidia aulica (Smith, 1855) (Female). 189. Body, lateral view. 190. Head, frontal view. 191. Head & Mesosoma, dorsal view. 192. Metasoma, dorsal view. 193. Metasoma, ventral view. 194. Pygidium.

PLATE 55



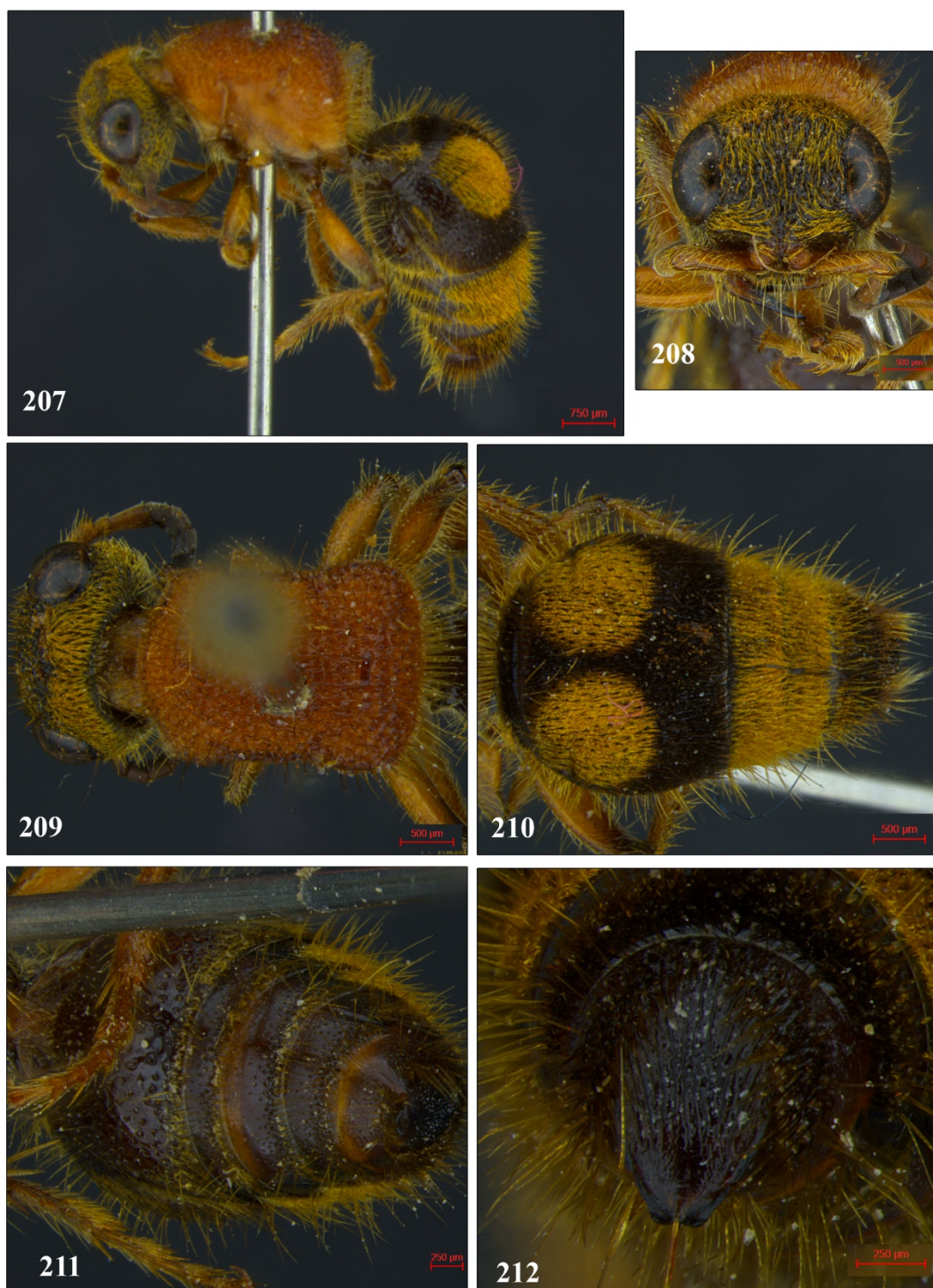
Trogaspidia intermedia (Saussure, 1867) (Female). 195. Body, lateral view. 196. Head, frontal view. 197. Head & Mesosoma, dorsal view. 198. Metasoma, dorsal view. 199. Metasoma, ventral view. 200. Pygidium.

PLATE 56



Trogaspidia kolabensis (André, 1894) (Female). 201. Body, lateral view. 202. Head, frontal view. 203. Head & Mesosoma, dorsal view. 204. Metasoma, dorsal view. 205. Metasoma, ventral view. 206. Pygidium.

PLATE 57



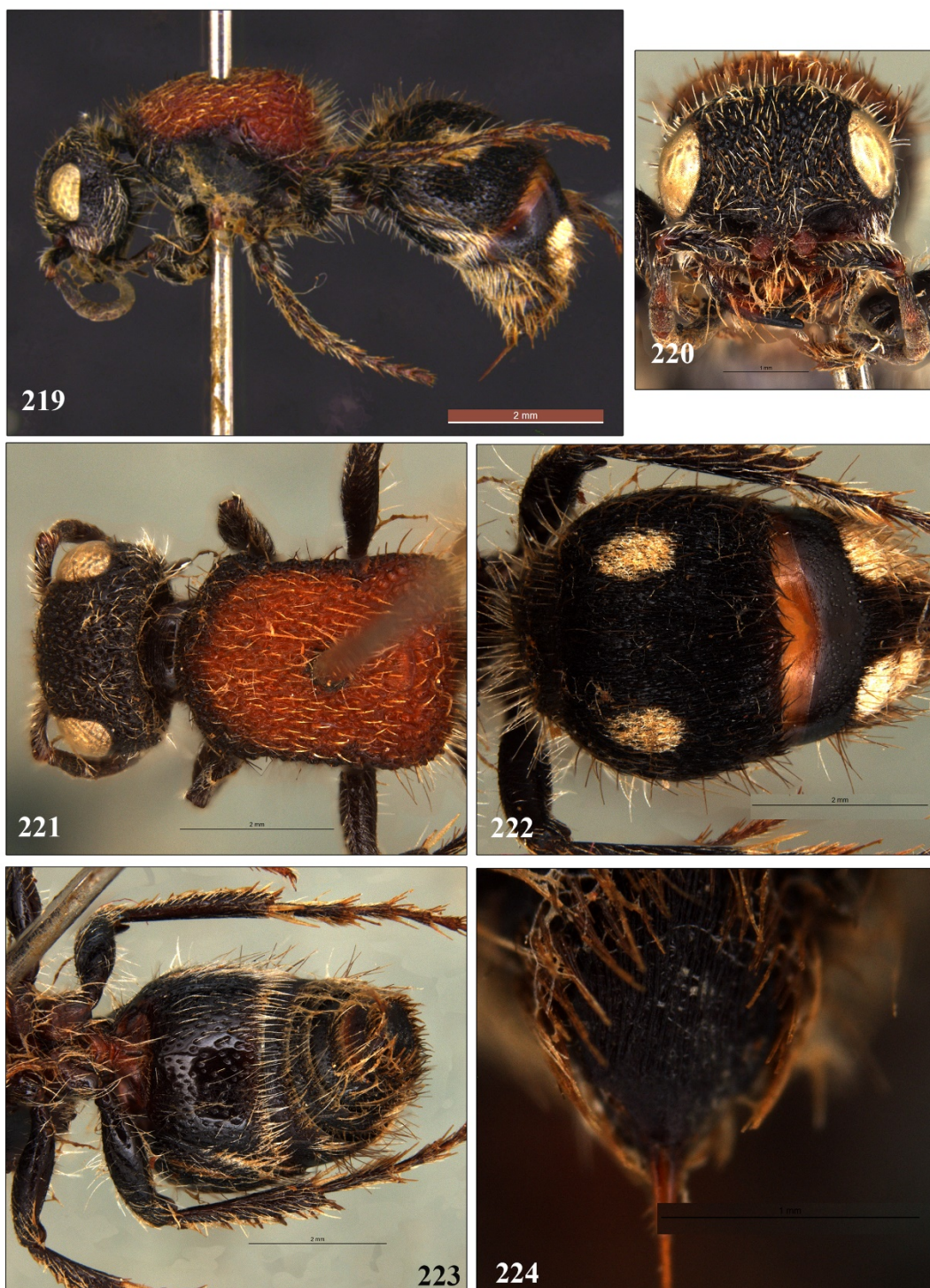
Trogaspidia pulchriceps (Cameron, 1892) (Female). 207. Body, lateral view. 208. Head, frontal view. 209. Head & Mesosoma, dorsal view. 210. Metasoma, dorsal view. 211. Metasoma, ventral view. 212. Pygidium.

PLATE 58



Trogaspidia ruficrus (Magretti, 1892) (Female). 213. Body, lateral view. 214. Head, frontal view. 215. Head & Mesosoma, dorsal view. 216. Metasoma, dorsal view. 217. Metasoma, ventral view. 218. Pygidium.

PLATE 59



Trogaspidia villosa (Fabricius, 1775) (Female). 219. Body, lateral view. 220. Head, frontal view. 221. Head & Mesosoma, dorsal view. 222. Metasoma, dorsal view. 223. Metasoma, ventral view. 224. Pygidium.

CHAPTER 4
SUBFAMILY MYRMILLINAE

4. Subfamily MYRMILLINAE Bischoff, 1920

Key to the Indian genera of subfamily Myrmillinae Bischoff, 1920

Males (unknown for *Brahmatilla*)

1. Apterous. 2
 - Macropterous. 3
2. T1 without distinct dorsal face, transverse carina lacking, rounded. Mandible apically not widened. *Myrmilla* Wesmael, 1851
 - T1 with distinct dorsal face, with transverse carina. Mandible apically widened.....
..... *Spilomutilla* Ashmead, 1903
3. Mandible apically widened, inner border with weak sub-basal tubercle.....
..... *Myrmilla* Wesmael, 1851
 - Mandible apically not widened, inner border with strong sub-basal tubercle.....
..... *Bischoffitilla* Lelej, 2002

Females

1. Mandibular ventral margin not excised, without ventral basal tooth.2
 - Mandibular ventral margin excised, with strong ventral basal tooth.....
..... *Brahmatilla* Lelej, 2005
2. Mandible apically acuminate, with inner sub-basal tooth. T2 posteriorly with a band of pale setae medially widened forming an obtuse angle. 3
 - Mandible apically widened, without inner sub-basal tooth. T2 posteriorly with wide band of setae slightly concave medially or with three spots of setae.....
..... *Spilomutilla* Ashmead, 1903
3. Propodeum without any denticles posteriorly or laterally. F1 2 × F2. Mandible apically widened. *Myrmilla* Wesmael, 1851
 - Propodeum with denticles posteriorly and laterally, if not dentate posteriorly and laterally then T2 with a spot on posterior margin and T3 with a smaller spot of setae.....
..... *Bischoffitilla* Lelej, 2002

I. Genus *Bischoffitilla* Lelej, 2002

Squamulotilla (non Bischoff, 1920): Mickel, 1933b: 383; 1934: 99; 1935: 183; Chen, 1957: 140; Krombein & Lelej, 1999: 144.

Bischoffitilla: Lelej, 2002: 126; Lelej, 2005: 23; Williams *et al.*, 2019a: 12; Pagliano *et al.*, 2020: 140.

Type species: *Squamulotilla exilipunctata* Chen, 1957 (original designation).

Diagnosis. Female. F1 1.5 × longer than F2. Mandible apically acuminate. Mesopleural suture ending at mesonotal tubercle. Propodeal slope abrupt. Mesosoma usually with denticle posterad (*B. puerilis* and *B. afghanica*) and laterad, if no denticles posteriorly then T2 apically with large spots of setae and T3 with a median small spot. T1 apically with a median spot of setae. T2 anteriorly with a band of setae medially widened. T3 black.

Male. F1 length almost equals F2 length. Mandible with two preapical tubercles, apically not wide. S2 with medial carina, slightly elevated. S8 medially carinate or laterally with two tubercles. Gonostylus long, apically acuminate, curved upward. Penial valves asymmetrical.

Diversity & Distribution. The genus is represented by 73 species worldwide. Mostly from the Oriental Region (73 species), two species are recorded from Palaeartic China and one species from Afghanistan and Pakistan. 10 species are recorded from India (Lelej, 2005; Williams *et al.*, 2019a & Pagliano *et al.*, 2020).

Key to Indian species of *Bischoffitilla* Lelej, 2002 (Based on females)

1. Head ferruginous. 2
- Head black or head with more red and less black. 7
2. Metasoma with Golden setal spots. 3
- Metasoma with silver or white setal spots. 5
3. T2 with apical band of setae. 4
- T2 with apical spot of setae. *B. puerilis* (Cameron, 1897)
4. T2 with a medial basal spot of setae. *B. veda* (Cameron, 1892)
- T2 without medial basal spot of setae. *B. lunarifasciata* (André, 1894)
5. Propodeum ferruginous. 6
- Propodeum black. *B. aversa* (Nurse, 1903)
6. Head ferruginous. *B. smithi* Lelej, 2005

-
- Head brownish, frons and vertex dark-red. *B. taylori* (André, 1894)
 7. Head black. *B. serratula* (Cameron, 1892)
 – Head more red and less black. *B. lethargia* (Cameron, 1900)

Species from the Central and Southern Western Ghats and its adjacent areas

i. *Bischoffitilla serratula* (Cameron, 1892)

(Plate 61, Figs. 225–230)

Mutilla serratula Cameron, 1892: 122, 133, ♀, Syntypes (Type locality: Pune district, Maharashtra, India) [NHMUK].

Description: Female. Body length 3.94 mm. Coloration and setation. Head black. Antennal tubercles, scape and pedicel ferruginous. Flagellomeres brownish-black. Mandible ferruginous, apically darker. Mesosoma dorsum ferruginous. Mesopleuron ferruginous and metapleuron dark ferruginous. Legs ferruginous. T1–5 black. T6 dark ferruginous. S1 brownish. S2–6 black. Gena and below eyes with appressed silvery setae. Frons and vertex with short sub-erect pale golden setae. Clypeus with dense erect pale golden setae. Mandible with long erect pale golden setae. Scape and pedicel with sub-erect dark golden setae. F1 with short black setae and latter flagellomeres with appressed short silvery setae. Mesosoma dorsum with sparse sub-erect pale golden and black setae. Propodeal dorsum with long erect pale golden setae. Meso and metapleuron with sparse appressed silvery setae. Legs with dense appressed and sub-erect pale golden setae, tarsomeres with dense setae of pale golden. T1–5 with dense appressed and sub-erect black setae. T1 with erect long pale golden setae and apically with a spot of pale golden setae. T2 apically with a band of pale golden setae emarginated medially. T3 and T4 with dense pale golden setae, not reaching lateral ends. T5 with long dark golden setae. T6 laterally with tuft of long dark golden setae. S2 with sparse long erect pale golden setae. S2–6 with apical fringe of sparse long sub-erect pale golden setae.

Structure and sculpture. Head. Quadrate in frontal view, slightly conical vertex, coarsely punctate, vertex with one or two rugae. Eyes small, oval. Scrobal carina well developed, curved. Clypeus medially slightly bended inwards. Antennal tubercles with small coarse punctures. Scape coarsely foveolate, with sparse small punctures. Pedicel and flagellomeres with small coarse punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.33: 0.57: 0.46: 0.43.

Minimal distance between eyes $1.51 \times$ longitudinal eye diameter. Mandible acuminate at apex, tridentate, apically with two sub-apical teeth and basally with sub-basal teeth.

Mesosoma. Propodeum more or less equal to pronotum. Head slightly wider than pronotum, pronotal width $0.81 \times$ head width behind eyes. Mesosoma dorsum coarsely rugose-foveolate. Mesosoma dorsum apically with a stout tooth. Scutellar scale absent. Propodeal slope abrupt/steep. Lateral mesosomal margin crenulated, laterally with eight teeth. Mesopleuron with small sparse punctures. Metapleuron with sparse large punctures. Mesopleura concave, mesopleural suture reaching mid spiracle. Legs punctate, coxae with sparse small punctures. Mid and hind tibia with one row of spines, four in mid tibiae and six in hind tibiae.

Metasoma. T1 wide, not wider than T2. T2 width $1.45 \times$ T1 width. T1–5 with coarse small punctures. T2 with a lateral felt line, felt line $0.32 \times$ T2 length. T6 with sparse small punctures. S1 depressed, with rugose. S2 convex, medially with small punctures, laterally with large punctures. S3–6 with coarse small punctures.

Male. Unknown.

Material examined. Kerala: 1 ♀, Kozhikode district, Chaliyam Forest Depot, Latitude: 11.16006 N, Longitude: 75.8083 E, Altitude: 31 m, 19.ii.2020, Coll. Terine J.B., ZSI/WGRC/IR/INV. 23304.

Distribution. Kerala (New record), Maharashtra (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

ii. *Bischoffitilla smithi* Lelej, 2005

(Plate 62, Figs. 231–236)

Mutilla rufiventris Smith, 1855: 36, ♀, Syntypes (Type locality: India) [OUMNH]
(Synonymized by Smith, 1856: 478).

Mutilla ruficeps Smith, 1856: 478, new name for *Mutilla rufiventris* Smith, 1855
(Synonymized under *Bischoffitilla* by Lelej, 2005: 29).

Description: Female. Body length 5.85 mm. Coloration and setation. Head dark ferruginous, gena and above scrobal carina black. Antennal tubercles ferruginous. Scape, pedicel and flagellomeres brownish-black. Mandible basal half dark ferruginous, latter part brownish black. Mesosoma dorsum dark ferruginous. Meso and metapleuron dark ferruginous, metapleuron medially brownish black. Coxa ferruginous. Femur, tibia and tarsomeres

brownish black. T1–5 black. T6 basally black, pygidial part dark ferruginous. S1 brownish. S2–6 black. Gena and below eyes with appressed silver setae. Frons and vertex with short appressed golden setae. Clypeus with dense long erect silvery setae. Mandible with long erect silvery setae. Scape and pedicel with appressed silvery setae. Flagellomeres with appressed short silvery setae. Mesosoma dorsum with dense sub-erect and appressed pale golden setae. Propodeal dorsum with long erect silvery setae. Meso and metapleuron with sparse appressed silvery micro pubescence. Legs with dense appressed and sub-erect silvery setae, tarsomeres with dense silvery setae. T1–5 with dense appressed and sub-erect black setae. T1 with erect long silvery setae and apically with a spot of silvery setae. T2 apically with a semicircular spot of silvery setae. T3 with a semicircular spot of silvery setae, larger than spot on T2. T6 with tuft of long silver setae. S2 with sparse long erect silvery setae. S2–6 with apical fringe of sparse long sub-erect silvery setae.

Structure and sculpture. Head. Sub-quadrate in frontal view, coarsely punctate. Eyes small, oval. Scrobal carina well developed, slightly curved. Clypeus medially slightly elevated, laterally with a small blunt denticle. Antennal tubercles with small sparse punctures, latter part smooth and shiny. Scape coarsely foveolate, apically smooth. Pedicel and flagellomeres with small coarse punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.32: 0.73: 0.47: 0.44. Minimal distance between eyes $1.82 \times$ longitudinal eye diameter. Mandible acuminate at apex, basally with sub-basal teeth and with two small weak sub-apical teeth.

Mesosoma. Propodeum wider than pronotum. Head slightly wider than pronotum, pronotal width $0.89 \times$ head width behind eyes. Mesosoma dorsum coarsely rugose-foveolate. Mesosoma dorsum without a medial longitudinal carina. Scutellar scale absent. Propodeal slope abrupt/steep. Lateral mesosomal margin crenulated, not developed into teeth. Mesopleuron and metapleuron with fine rugae. Mesopleura concave, mesopleural suture reaching mid spiracle. Legs punctate, coxae with sparse punctures. Mid and hind tibia with one row of spines, five in mid tibiae and six in hind tibiae.

Metasoma. T1 wide, not wider than T2. T2 width $1.33 \times$ T1 width. T1–5 with coarse small punctures. T2 with a lateral felt line, felt line $0.51 \times$ T2 length. T6 foveolate, pygidial area with dense setae, sculptures not visible. S1 depressed, with fine rugae. S2 convex, apically with dense coarse puncture, latter part with sparse punctures. S3–6 coarsely punctate.

Male. Unknown.

Material examined. Kerala: 1 ♀, Kozhikode district, Chaliyam Forest Depot, Latitude: 11.16006 N, 75.8083 E, Altitude: 31 m, 19.ii.2020, Coll. Terine J.B., ZSI/WGRC/IR/INV. 23305.

Distribution. Karnataka, Kerala (New record), Maharashtra (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

iii. *Bischoffitilla veda* (Cameron, 1892)

(Plate 63, Figs. 237–242)

Mutilla veda Cameron, 1892: 123, ♀, Holotype (Type locality: Pune district, Maharashtra, India) [NHMUK] (synonymized under *Bischoffitilla* by Lelej, 2005: 30).

Description: Female. Body length 5.1 mm. Coloration and setation. Head ferruginous, gena black. Antennal tubercles, scape and pedicel ferruginous. F1 basal half ferruginous, latter part black. F2–10 black. Mandible basal half ferruginous, latter part brownish black. Mesosoma dorsum, meso and metapleuron and legs ferruginous. T1 ferruginous. T2–5 black. T6 basally black, pygidial part ferruginous. S1 brownish. S2–6 ferruginous, apically darker. Frons and vertex with short erect and sub-erect golden setae and sparse black setae. Gena with short sub-erect golden setae, denser near base of mandible. Clypeus with dense long golden setae. Mandible basally with long erect golden setae and ventrally with long erect golden setae. Scape and pedicel with short appressed and sub-erect golden setae. F1 basal half with short sub-erect golden setae and latter part with short appressed black setae. F2–10 with short appressed black setae. Mesosoma dorsum with dense erect black setae and sparse sub-erect golden setae. Propodeal dorsum with long erect golden setae. Meso and metapleuron with sparse appressed golden micro pubescence. Legs with dense appressed and sub-erect golden setae, tarsomeres with dense golden setae. T1 with dense erect golden setae, T1 with a spot of golden setae, slightly widened on basal T2. T2 apically with a wide band of golden setae emarginated medially. T3 with a band of golden setae. T4 and T5 excluding lateral ends with spot of golden setae. T2 with a lateral felt line of golden setae. T6 basally with long erect golden setae bordering the basal pygidial area. S2 with sparse long erect golden setae. S2–6 with apical fringe of sparse long appressed golden setae.

Structure and sculpture. Head. Almost oval in frontal view, coarsely punctate. Eyes small, oval. Scrobal carina well developed, slightly curved. Clypeus medially emarginated, with a tubercle medially and with two denticles at lateral ends. Antennal tubercles with small sparse

punctures. Scape coarsely punctate. Flagellomeres with minute coarse punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.39: 0.75: 0.61: 0.58. Minimal distance between eyes $1.8 \times$ longitudinal eye diameter. Mandible acuminate at apex, with a small sub-apical tooth. Genal carina rudimentary.

Mesosoma. Propodeum more or less equal to pronotum. Head wider than pronotum, pronotal width $1.10 \times$ head width behind eyes. Mesosoma dorsum coarsely rugose-punctate. Mesosoma dorsum with a medial longitudinal carina. Scutellar scale absent. Propodeal slope abrupt/steep. Lateral mesosomal margin crenulated, medial and pronotal tooth larger. Mesopleuron and metapleuron with coarse punctures. Mesopleura concave; mesopleural suture reaching mid spiracle. Coxae with sparse small punctures. Femur, tibia and tarsomeres punctate (punctures larger than on coxa). mid and hind tibia with one row of spines, four in each row.

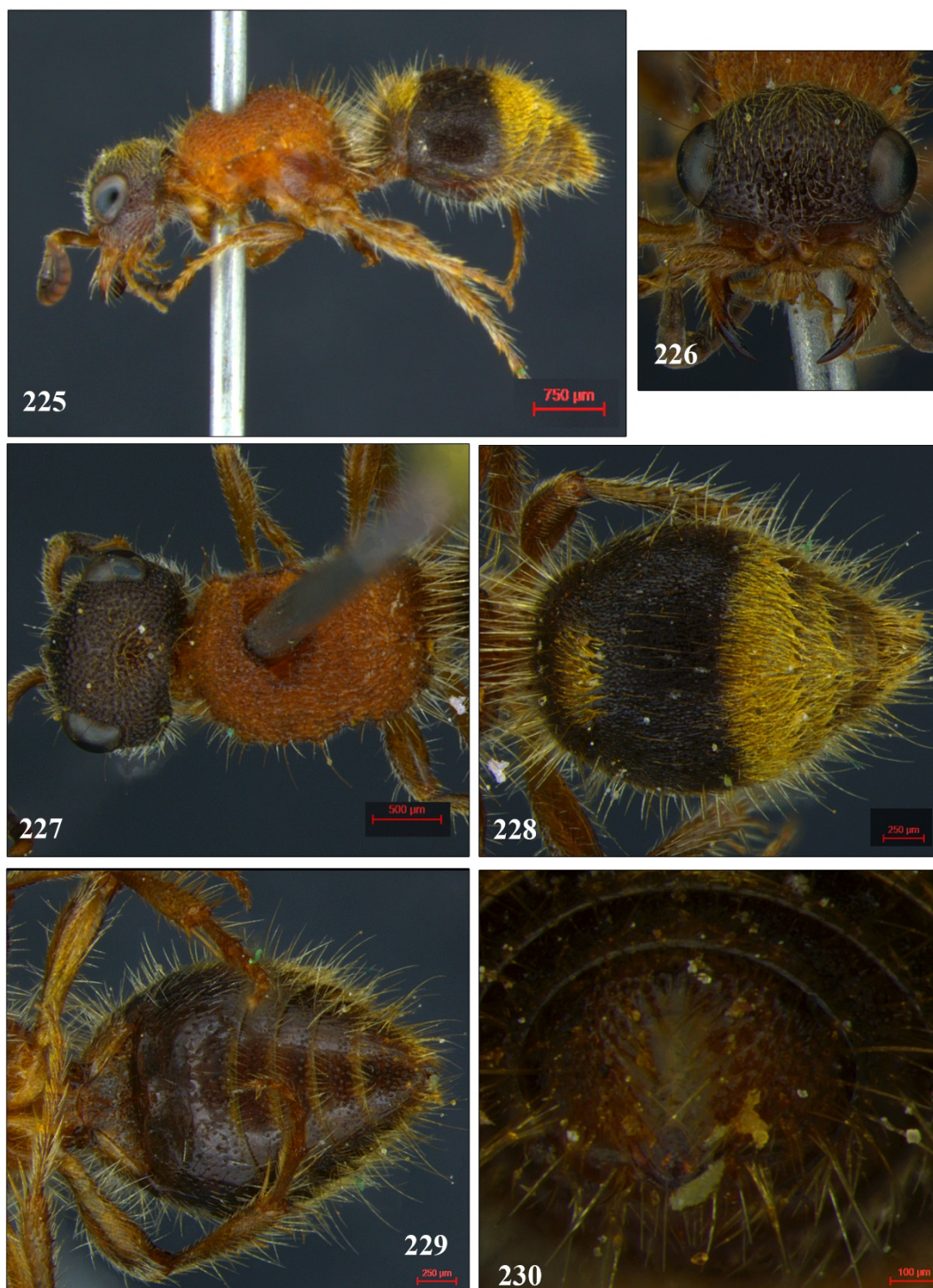
Metasoma. T1 wide, not wider than T2. T2 width $1.38 \times$ T1 width. T1–5 coarsely with small punctures. T2 with a lateral felt line, felt line $0.44 \times$ T2 length. T6 punctate with a short smooth pygidial area not carinated. S1 depressed, with coarse small punctures. S2 convex, medially with a small hump. S2–6 coarsely punctate.

Male. Unknown.

Material examined. Karnataka: 2♀, Shimoga district, Mookambika wildlife sanctuary, Balehaklu, Latitude: 13.735877, Longitude: 75.055803 E, Altitude: 663 m, 06.xii.2022, Coll. V. D. Hegde & Party, ZSI/WGRC/IR/INV. 26062, 26063.

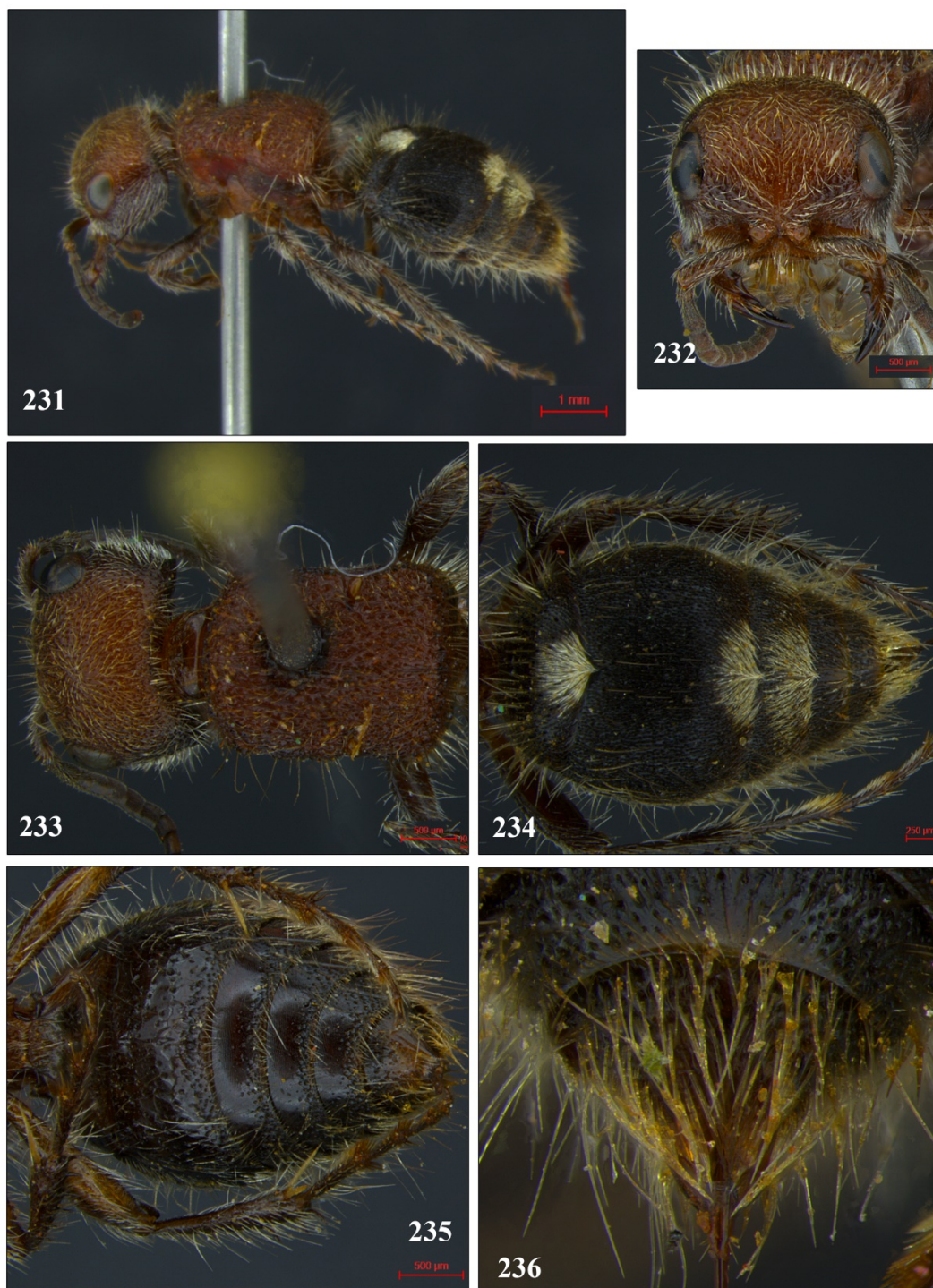
Distribution. Karnataka (New record), Maharashtra (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

PLATE 61



Bischoffitilla serratula (Cameron, 1892) (Female). 225. Body, lateral view. 226. Head, frontal view. 227. Head & Mesosoma, dorsal view. 228. Metasoma, dorsal view. 229. Metasoma, ventral view. 230. Pygidium.

PLATE 62



Bischoffitilla smithi Lelej, 2005 (Female). 231. Body, lateral view. 232. Head, frontal view. 233. Head & Mesosoma, dorsal view. 234. Metasoma, dorsal view. 235. Metasoma, ventral view. 236. Pygidium.

PLATE 63



Bischoffitilla veda (Cameron, 1892) (Female). 237. Body, lateral view. 238. Head, frontal view. 239. Head & Mesosoma, dorsal view. 240. Metasoma, dorsal view. 241. Metasoma, ventral view. 242. Pygidium.

II. Genus *Brahmatilla* Lelej, 2005

Brahmatilla Lelej, 2005: 163; Lelej & Brothers, 2008: 12; Brothers & Lelej, 2017: 95; Pagliano *et al.*, 2020: 144.

Type species: *Brahmatilla krishna* Lelej, 2005.

Diagnosis. Female. Head large, wider than mesosoma. Clypeus flattened, anteriorly with two denticles. Scape curved. F1 1.5 × longer than pedicel. F1 2 × longer than F2. Mandible tridentate, basally excised beneath with large tooth beneath. Genal carina well developed. Scrobal carina well developed. Sub-ocular carina well developed, with a small tubercle. Mesosoma laterad dentate. Propodeum posteriorly without transverse row of teeth. Precoxal carina well developed. Mid and hind tibia with one row of spines. T1 wide. T2 with lateral felt line. S2 without any lateral felt line. S2 with a basal median carina. S6 not modified. T6 without well developed pygidial plate, not carinated laterally, with smooth shiny longitudinal area.

Male. Unknown.

Diversity & Distribution. Genus is represented by only one species worldwide. The type of this species is recorded from Periyar WLS, Thekkady (Lelej, 2005 & Pagliano *et al.*, 2020). After that from this study, this species is recorded from Ponmudi shola, Thiruvananthapuram and Vythiri, Wayanad.

Species from the Central and Southern Western Ghats and its adjacent areas

i. *Brahmatilla krishna* Lelej, 2005

(Plate 65, Figs. 243–248)

Brahmatilla krishna Lelej, 2005: 163, ♀, Holotype (Type locality: Thekkady, Periyar WLS, Idukki district, Kerala, India) [SMNS].

Description: Female. Body length 4.56 – 5.40 mm. Coloration and setation. Head and antennal tubercles ferruginous. Scape and pedicel brownish. Flagellomeres black. Mandible two-third ferruginous, latter part black. Mesosoma dorsum, meso and metapleuron and legs ferruginous. Metasoma black, S1 brownish and T1 ferruginous. S2–6 medially ferruginous, laterally brownish. Frons and vertex with short erect black setae and sub-erect golden setae. Gena with short sub-erect and appressed golden setae, denser below the eyes. Clypeus with

dense long golden setae. Mandible basally and two-thirds with long erect golden setae. Scape with long appressed golden setae. Pedicle with short appressed golden setae. Flagellomeres with short appressed black setae. Mesosoma dorsum with dense erect black setae and sub-erect golden setae. Meso and metapleuron with sparse white micro pubescence. Legs with dense appressed and sub-erect golden setae, tarsomeres with dense setae of golden setae. T1 with band of dense golden setae, widened on basal T2. T2 apical half with a band of golden setae emarginated medially. T3 wholly and T4 and T5 excluding lateral ends with dense band of golden setae. T2 with a lateral felt line of dark golden setae. T6 basally with long erect golden setae bordering the basal pygidial area. S1 with sparse long erect golden setae and golden micro pubescence. S2–6 with apical fringe of long appressed golden setae. S2 with sparse erect golden setae.

Structure and sculpture. Head. Almost rectangular in frontal view, coarsely punctate. Eyes small, oval. Scrobal carina well developed, straight. Clypeus medially depressed and flattened apically. Antennal tubercles modified with a lateral blunt tooth and with sparse minute punctures. Scape sparsely punctate. Flagellomeres with minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.63: 0.92: 0.63: 0.46. Minimal distance between eyes 1.6× longitudinal eye diameter. Mandible wider towards apex, tridentate, with a large tooth at the base beneath. Genal carina developed.

Mesosoma. Propodeum more or less equal to pronotum. Head wider than pronotum, pronotal width $0.77 \times$ head width behind eyes. Mesosoma dorsum coarsely punctate. Width of punctures on the mesosomal dorsum $0.93 \times$ width of punctures on head. Scutellar scale absent. Propodeal slope abrupt/steep. Lateral mesosomal margin with six teeth on each side, middle tooth larger. Mesopleuron with sparse minute punctures. Metapleuron with coarse punctures. Mesopleura concave; mesopleural suture not reaching mid spiracle, ending just below the middle of spiracle. Coxae with fine rugae. Femur, tibia and tarsomeres with sparse punctures. mid and hind tibia with one row of spines, four in each row.

Metasoma. T2 width $1.39 \times$ T1 width. T1–5 coarsely with small punctures. T2 with a lateral felt line, felt line $0.34 \times$ T2 length. Pygidium not developed, not carinated and smooth. S1 depressed, without a blunt tooth medially, rugose. S2 with a medial basal carina, latter part punctate, punctures larger medially. S3–6 coarsely punctate.

Male. Unknown.

Material examined. Kerala: 1♀, Thiruvananthapuram district, Ponmudi Shola, Latitude: 8.7631 N, Longitude: 77.1140 E, Altitude: 1005 m, 12.xii.2015, Coll. K. Rajmohana, ZSI/WGRC/IR/INV. 20234; 2♀, Wayanad district, Vythiri, Wayanad wild resort, Latitude: 11.5152 N, Longitude: 76.0393 E, 872 m, 25.v.2024, Coll. David Raju, ZSI/WGRC/IR/INV. 26603, 26775; 1♀, Wayanad district, Vythiri, Wayanad wild resort, 11.5152 N, 76.0393 E, 872 m, 25.V.2024, Coll. Terine J. B., ZSI/WGRC/IR/INV. 26774.

Distribution. Kerala (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

PLATE 64

Species distribution of the genus *Brahmatilla* Lelej from Central and Southern Western Ghats and its adjacent areas

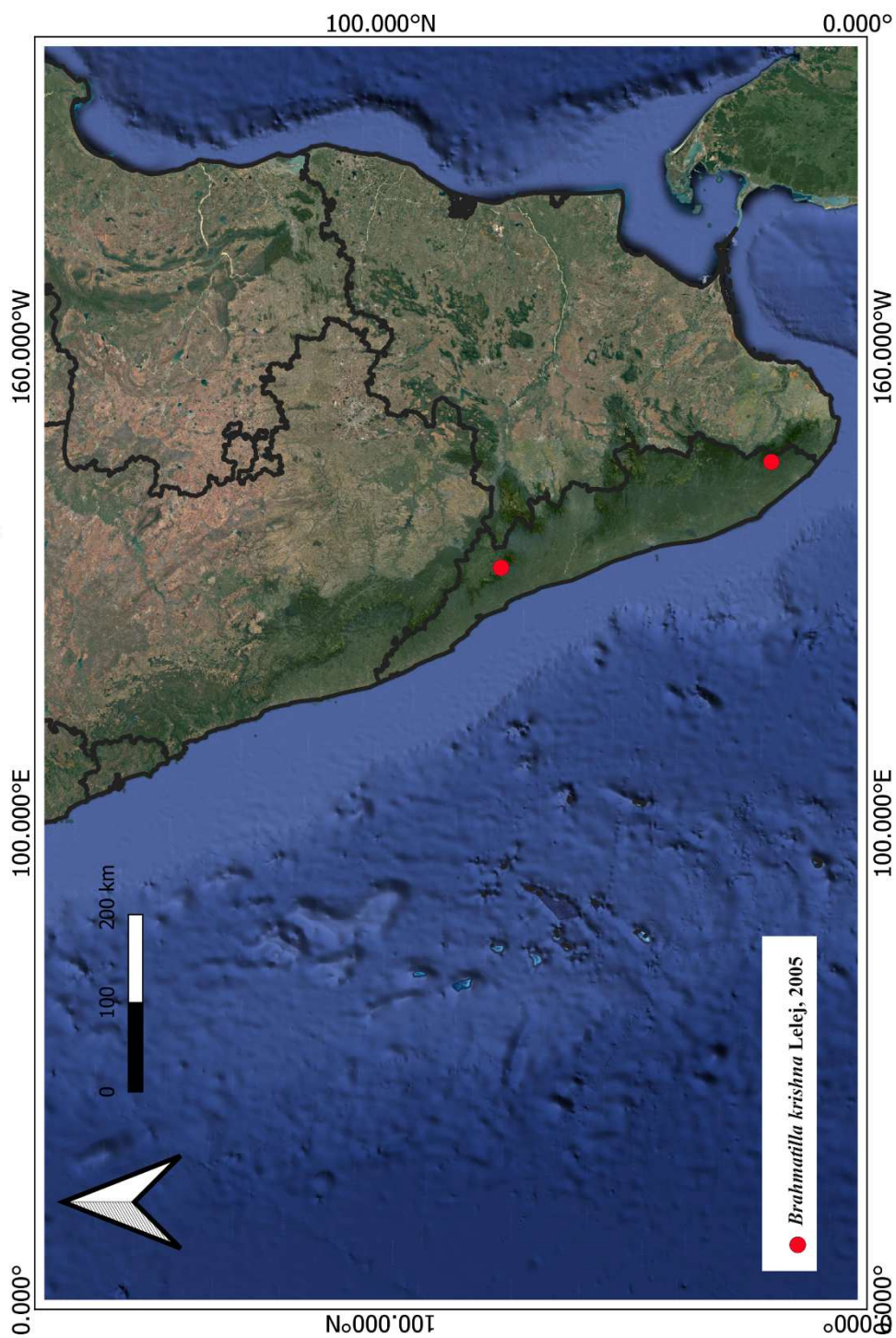
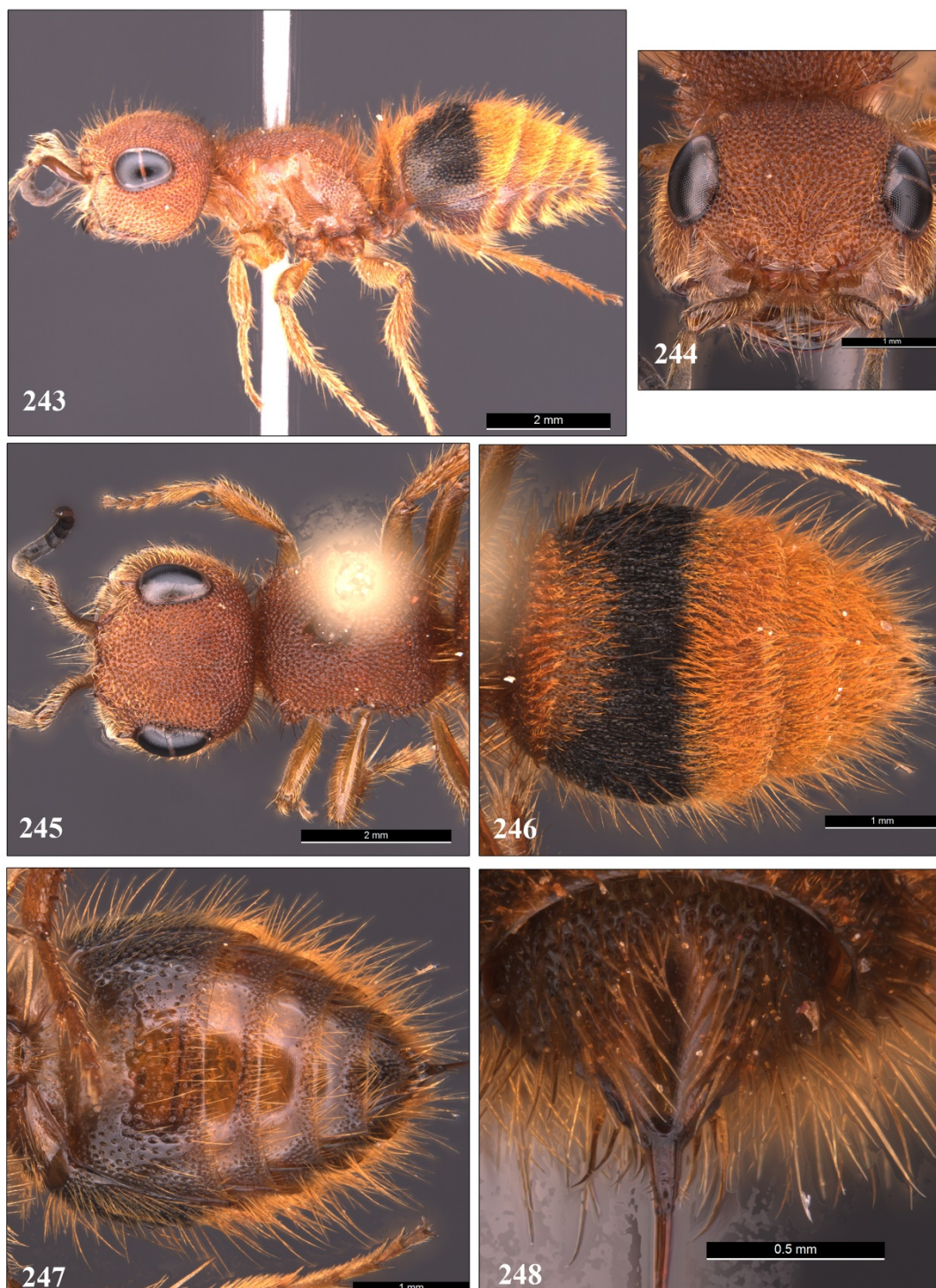


PLATE 65



Brahmatilla krishna Lelej, 2005 (Female). 243. Body, lateral view. 244. Head, frontal view. 245. Head & Mesosoma, dorsal view. 246. Metasoma, dorsal view. 247. Metasoma, ventral view. 248. Pygidium.

III. Genus *Spilomutilla* Ashmead, 1903

Ashmead, 1903: 324; André, 1907a: 251; Turner, 1911: 141; Hammer, 1962: 1; Brothers, 1975: 592; Lelej & Nemkov, 1997: 17; Krombein & Lelej, 1999: 144; Lelej, 2005: 166; Lelej & Brothers, 2008: 58; Brothers & Lelej, 2017: 95; Pagliano *et al.*, 2020: 156; Terine and Girish Kumar, 2023: 652.

Type species: *Mutilla pectinata* Sichel et Radoszkowski, 1870 (original designation).

Diagnosis. Female. Head wider than pronotum. Genal carina well developed, tuberculate. Mandible tridentate, with basal wide inner tooth. Scrobal carina well developed. Clypeus anteriorly with two teeth. Scape curved. Flagellomeres flattened. F1 length $2 \times$ F2 length. Mesosomal humeral angle acuminate, lateral margin dentate. Propodeum with row of denticles, sometimes with one median tooth or without teeth. Mid coxa tuberculate. Mid and hind tibia with one row of spines. T1 broad, disciform. T2 with long lateral felt line. S2 without lateral felt line. S2 and S6 with two basal and two apical tubercles. T6 without distinct pygidial plate, apically carinate, longitudinally with smooth elongate area from base to apex.

Male. Apterous. Head wider than pronotum. Mandible modified, pre-apically deeply emarginated. Eyes moderate size, not emarginated. F1 longer than F2. Mesosoma with well-developed suture traces, meso-metanotal suture present. Mesonotum deeply indented. Tegulae small. Propodeum posteriorly widened, laterally with more or less developed teeth. S1 broad, disciform. T1 baso-laterally with a dent. T2 with a long lateral felt line. S2 without lateral felt line. Hypopygium with a narrow, median sclerotized area, boarded with a lateral carina. Gonostylus spatulate, curved down. Cuspis, digitus and paraspis well-developed.

Diversity & Distribution. The genus is represented by 10 valid species. Nine are from the Oriental region and one from the Palearctic region. Five species are recorded from India (Lelej, 2005; Pagliano *et al.*, 2020 & Terine & Girish Kumar, 2023).

Key to Indian species of *Spilomutilla* Ashmead, 1903 (Male unknown for *S. humilis* (Cameron, 1897). Female unknown for *S. oedipus* (Cameron, 1897))

1. Males. 2
 – Females. 6

-
2. Hypostomal bridge not acuminate medially. – Head with vertex ferruginous and with a spot of sparse pale hairs on vertex and frons. *S. eltola* (Cameron, 1898)
- Hypostomal bridge medially acuminate. 3
3. Head with spot of pale hairs on vertex and frons. *S. cotesii* (Cameron, 1897)
- Head without spot of pale hairs on vertex and frons, at most with red cuticular spot on this place or ferruginous shortly above the antennal tubercles to the top of the eyes..... 4
- 4
4. T3 with a medial spot of setae. *S. oedipus* (Cameron, 1897)
- T3 without a medial spot of setae. 5
5. Volsellar cuspis length equals digitus and longer than penial vale. –Head widely red on vertex and frons. *S. rothneyi* (Cameron, 1897)
- Volsellar cuspis evidently longer than digitus and penial valve. –Mesosoma brownish-black. *S. consolidata* (Cameron, 1900)
- 7
6. Propodeum posterad without teeth. 7
- Propodeum posterad with one medial (sometimes small) or with 3-7 teeth..... 8
7. Hypostomal bridge not acuminate medially. S1 carina with acuminate tubercle anteriorly and posteriorly. *S. eltola* (Cameron, 1898)
- Hypostomal bridge acuminate medially. S1 carina with acuminate tubercle anteriorly only. *S. consolidata* (Cameron, 1900)
- 9
8. Propodeum posterad with 3-7 acute teeth (medial larger). 9
- Propodeum posteriorly with 1 acute medial tooth. *S. rothneyi* (Cameron, 1897)
- 9
9. Head black. *S. cotesii* (Cameron, 1897)
- Head red. *S. humilis* (Cameron, 1897)
-

Species from the Central and Southern Western Ghats and its adjacent areas**i. *Spilomutilla eltola* (Cameron, 1898)****(Plate 67, Figs. 249–254)**

Spilomutilla eltola Cameron, 1898: 3, ♀, Syntypes (Trincomalee: Eastern Province, Trincomalee district, Sri Lank) [OUMNH].

Description: Female. (Description as in Cameron, 1898) Body length: 7 mm. Coloration and setation. Head black. Frons between eyes red. Mandible ferruginous, apically black. Scape ventrally and base of F3 red. Antennal tubercles reddish-black. Propleura at apex black. Legs black. T1–6 black. S2 red. Head with sparse long fuscous with short silvery setae. Scape with long silvery setae. Flagellomeres with dense short silvery setae. Mandible with long pale golden setae. Meso and metapleurae basally with long silvery setae. Legs with dense silvery setae. T1 with silvery setal spot of setae. T2 apically with a medial and to lateral setal spots. T4 and T5 with silvery setae, broadly in centre. Pygidium with long black setae.

Structure and sculpture. Head. Frons and vertex strongly longitudinally striated, striae running into punctures near antennae. Behind eyes with stout, sharp striae. Gena without striae. Antennal tubercles smooth. Scape punctate. F2 length 2 × F4. Clypeus medially emarginated, forming two denticles laterally.

Mesosoma. Mesonotum longitudinally reticulated, reticulation wider at apex. Mesonotum laterally with five tooth, central one larger, basal one small, blunt. Pleurae smooth, shiny impunctate. Legs with sparse punctures.

Metasoma. Abdomen as long as head and thorax united. T1 finely punctate. T2–5 punctate, punctures moderately deep and separated. S1 with keel at apical three-fourth. S2 with moderately large punctures. S2 apically with a medial stout triangular tooth. S3–6 coarsely and finely punctate. Pygidium medially raised, impunctate.

Male. Body length 11.06 mm. Coloration and Setation. Head black, vertex ferruginous. Antennal tubercles and scape black. Pedicel and flagellomeres brownish-black. Clypeus brownish-black, apically black. Mandible basal black. Mesosoma dorsum ferruginous. Meso and meta pleura black. Legs black. Metasoma black. S1 dark ferruginous. Head with short sub-erect black setae. Gena with appressed silvery setae. Vertex with a spot of silvery setae. Clypeal margin with long sub-erect pale silvery setae. Mandible with sparse long pale silvery setae. Scape with dense pale silvery setae. Pedicel and flagellomeres with pale silvery micro

pubescence. Mesosoma dorsum with sub-erect black and pale silvery setae. Meso and metapleuron with silvery micro pubescence. Legs with appressed and sub-erect long pale silver setae. Metasoma with appressed black setae. Metasoma laterally with erect long pale silvery setae. T1 apico-medially with a spot of silver setae. T2 apically with three spots of silvery setae. T2 with a lateral felt line of pale golden setae. T3 without any spots of setae. T4 and T5 medially with a spot of pale silvery setae. T7 with fringe of long erect black setae bordering pygidial area. S2 with sub-erect black setae. S2–7 with apical fringe of pale silver setae.

Structure and sculpture. Head. Almost flattened in dorsal view, coarsely foveolate-rugose. Vertex rugose. Eyes small, oval. Scrobal carina developed, curved at base of antennal tubercles. Clypeus medially elevated, apically flattened. Antennal tubercle with sparse punctures, latter part smooth. Scape coarsely foveolate-punctate. Pedicel and flagellomeres punctate. Ratio of pedicel to flagellomeres 1 to 3 is 0.31: 0.97: 0.66: 0.72. Minimal distance between eyes $1.64 \times$ longitudinal eye diameter. Mandible widened apex, sparsely punctate.

Mesosoma. Propodeum wider than pronotum. Pronotal width $0.89 \times$ head width behind eyes. Propodeal width $1.02 \times$ pronotal width. Mesosoma dorsum with well developed suture traces, foveolate reticulate. Mesosoma laterally indented at meso-metasomal suture. Scutellar scale absent. Lateral mesosomal margin with a row of denticles. Meso and metapleuron with sparse minute punctures. Mid and hind tibia with one rows of spines, four in each row.

Metasoma. T2 width $1.44 \times$ T1 width. T1–5 coarsely punctate. T2 with a lateral felt line, felt line $0.51 \times$ T2 length. T7 medially smooth, latter part punctate-alveolate. S2 foveolate. S3–7 coarsely punctate.

Genitalia. Paramere apically curved. Cuspis slightly shorter than paramere, apically lobed. Penial valve asymmetrical.

Material examined. Tamil Nadu: 1♀, Agasthymalai Biosphere Reserve, Thenkasi district, Ukkonam, Latitude: 8.9517 N, Longitude: 77.2845 E, Altitude: 181 m, 27.vii.2019, Coll. BHCK Murthy & Party, ZSI/WGRC/IR/INV. 23150.

Distribution. Tamil Nadu. *Elsewhere.* Sri Lanka (Lelej, 2005; Pagliano *et al.*, 2020; Terine & Girish Kumar, 2023).

 ii. *Spilomutilla cotesii* (Cameron, 1897)

(Plate 68, Figs. 255–260)

Mutilla cotesii Cameron, 1897: 76, ♀, Syntypes (Barrackpore, Bangla, India) [OUMNH].

Description: Female. Body length 7.5 – 8.1 mm. Coloration and Setation. Head black. Antennal tubercles brownish black. Scape black, apically brownish. Pedicel and flagellomeres black. Clypeus brownish, apical margin black. Mandible brownish black. Mesosoma ferruginous. Coxa brownish. Femur, tibiae and tarsomeres black. Metasoma black. S1 brownish. Head with short sub-erect dense silvery setae and sparse sub-erect black setae. Gena with sub-erect and appressed dense silvery setae. Vertex with a spot of silvery setae. Clypeal margin with long sub-erect pale silvery setae. Mandible with sparse long pale silvery setae. Scape with dense appressed and sub-erect pale silvery setae. Pedicel and flagellomeres with pale silvery micro pubescence. Mesosoma dorsum with sub-erect and appressed black setae. Mesopleuron basally with silvery micro pubescence. Fore legs and hind legs with appressed and sub-erect long pale silvery setae. Mid femur and tibiae with sub-erect black setae, tarsomeres with silvery setae. Metasoma dorsally with sub-erect black setae. Metasoma laterally with erect pale silvery setae. T1 apico-medially with a spot of silver setae. T2 apically with three spots of pale silvery setae. T2 with a short lateral felt line of pale golden setae. T3 without any spots of setae. T4 and T5 medially with a spot of pale silvery setae, spots longer than on T2. T7 with fringe of long erect black setae bordering pygidial area. S2 with sub-erect silvery setae. S2–7 with apical fringe of pale silvery setae.

Structure and sculpture. Head. Slightly flattened in dorsal view, coarsely rugose-punctate. Eyes small, bulged, oval. Scrobal carina developed, curved. Clypeus apically with two large denticles. Antennal tubercle with sparse punctures, latter part smooth. Scape striate-punctate. Pedicel and flagellomeres punctate. Ratio of pedicel to flagellomeres 1 to 3 is 0.36: 1.2: 0.56: 0.37. Minimal distance between eyes $1.47 \times$ longitudinal eye diameter. Mandible widened apex, tridentate apically, sparsely punctate.

Mesosoma. Propodeum wider than pronotum. Pronotal width $0.92 \times$ head width behind eyes. Propodeal width $1.13 \times$ pronotal width. Mesosoma dorsum rugose-foveolate. Scale absent. Lateral mesosomal margin with a row of denticles. Meso and metapleuron with sparse minute punctures, latter part smooth. Mid and hind tibia with one row of spines, four in a row.

Metasoma. T2 width 1.36 × T1 width. T1–5 coarsely punctate. T2 with a lateral felt line, felt line 0.42 × T2 length. Pygidial area punctate. S1 with a small basal tubercle. S2 foveolate, medially with a smooth ridge. S3–7 coarsely punctate.

Male. Unknown.

Material examined. Kerala: 3♀, Kozhikode district, Nanminda, Ponkunnu Hills, Latitude: 11.3990 N, Longitude: 75.8087 E, Altitude: 268 m, 13.ii.2023, Coll. Terine J. B., ZSI/WGRC/IR/INV. 25432, 25434, 25433.

Distribution. West Bengal, Karnataka, Kerala (New Record), Tamil Nadu. *Elsewhere.* Sri Lanka (Lelej, 2005; Pagliano *et al.*, 2020 & Terine *et al.*, 2020a).

PLATE 67



Spilomutilla eltola (Cameron, 1898) (Male). 249. Body, lateral view. 250. Head, frontal view. 251. Head & Mesosoma, dorsal view. 252. Metasoma, dorsal view. 253. Metasoma, ventral view. 254. Pygidium.

PLATE 68



Spilomutilla cotesii (Cameron, 1897) (Female). 255. Body, lateral view. 256. Head, frontal view. 257. Head & Mesosoma, dorsal view. 258. Metasoma, dorsal view. 259. Metasoma, ventral view. 260. Pygidium.

CHAPTER 5
SUBFAMILY
ODONTOMUTILLINAE

5. Subfamily Odontomutillinae Lelej, 1983

I. Genus *Odontomutilla* Ashmead, 1899

Odontomutilla Ashmead, 1899: 55, 58. *Peringueya* Ashmead, 1903: 327, 329 (type species *Mutilla erinnys* Péringuey, 1898, ♂, by original designation). Junior subjective synonym of *Odontomutilla* Ashmead, 1899 according to Bischoff, 1920: 245. *Radoszkowskii* Ashmead, 1903: 327, 328 (type species *Mutilla simplicifascia* Sichel & Radoszkowski, 1869, ♀, ♂; lectotype ♀ designated by Lelej, 1996: 92) by original designation. Junior subjective synonym of *Odontomutilla* Ashmead, 1899 according to André, 1904a: 36 and confirmed by Lelej & Brothers, 2008: 52; Lelej, 2023b: 3; Terine & Girish Kumar, 2024a: 132.

Type species. *Odontomutilla abbottii* Ashmead, 1899 by original designation (= *Mutilla saussurei* Sichel et Radoszkowski, 1869, according to André 1901a: 329).

Diagnosis. Female. Body large (8–18 mm), stout. Mesonotum laterally forming tooth on each side. T1 wide, disciform. T2 with large deep anterolateral pubescence fovea.

Male. Body large (8-18 mm), stout. Tegulae posteriorly elongated over mesoscuto-scutellar suture, flattened. Mesoscutellum posteriorly bidentate. T1 wide, disciform.

Diversity & Distribution. The genus is represented by 107 valid species and 20 sub-species worldwide. Mostly from the Afrotropical and Oriental regions, some species are recorded from the Australian and Palaearctic regions. 35 species are recorded from the Oriental Region. 15 species are recorded from India ((Lelej, 2005, Pagliano *et al.*, 2020; Lelej *et al.*, 2020; Lelej, 2023; Terine *et al.*, 2023 & Terine & Girish Kumar, 2024).

Key to Indian species of *Odontomutilla* Ashmead, 1899 (Modified from Terine & Girish Kumar, 2024)

Males (unknown in *O. assamensis* Hammer, 1962, *O. buddha* (Cameron, 1892); *O. familiaris trimaculata* Hammer, 1962; *O. jaferpaloti* Terine & Girish Kumar, 2024; *O. sikkimensis* André, 1903; *O. spectra* (Bingham, 1908); *O. paderua* Das & Girish Kumar, 2017; and *O. vishwanathi* Terine & Girish Kumar, 2024).

1. T2 basal two thirds without any band or spots of pale setae. 2
- T2 basal two thirds with band or two spots of pale setae. 3

-
2. Propodeum black. Posterolateral dent with patch of dense long golden setae. Mesoscutellum with long (as long as mesoscutellum length) dense yellowish setae apically, oriented backward. *O. trichocondyla* (André, 1894)
- Propodeum ferruginous. Posterolateral dent with sparse long pale setae. Mesoscutellum apically with shorter (less than mesoscutellum length) sparse yellowish setae, oriented upward. *O. fletcheri* Lelej, Terine & Girish Kumar, 2020
3. T2 in basal two thirds with two lateral pale spots located transversely. 4
- T2 in basal two thirds with wide band of golden setae. 5
4. T1 with white apical setal spot. T3–4 with interrupted band of pale setae.....
..... *O. himalayensis* Terine & Girish Kumar, 2024
- T1 without any spot. T3–4 with non interrupted band of pale setae.....
..... *O. miranda* (Smith, 1855)
5. Mesoscutellum posterad and metapostnotum medially with long (as long as mesoscutellum length) dense golden setae oriented backward. *O. aurifex* (Smith, 1879)
- Mesoscutellum posterad and metapostnotum medially with short (less than mesoscutellum length) sparse golden setae oriented upward. *O. pulchrina* (Smith, 1855)

Females (unknown in *O. himalayensis* Terine & Girish Kumar, 2024 and *O. miranda* (Smith, 1855)).

1. T2 basally without spot(s) or wide band of setae. 2
- T2 basally with one (or three) spots or with wide band of pale setae. 5
2. T2 apically with band of pale setae, broadly interrupted. 3
- T2 apically with non-interrupted band of pale setae.....
..... *O. vishwanathi* Terine & Girish Kumar, 2024
3. Head and mesosoma black. *O. jaferpaloti* Terine & Girish Kumar, 2024
- Head and mesosoma ferruginous or brownish red. 4
4. Width of apicolateral spot on T2 at least twice the distance between spots. T2 length 0.80–0.84 × its maximum width. Propodeum postero-laterally longitudinally rugose. Mesosoma

dorsally ferruginous, lateral edges, pleurae and propodeum black.....	
.....	<i>O. trichocondyla</i> (André, 1894)
– Width of apicolateral spot on T2 equal or less than distance between spots. T2 length equals its maximum width. Propodeum postero-laterally with fine sparse punctures. Mesosoma ferruginous.	<i>O. fletcheri</i> Lelej, Terine & Girish Kumar, 2020
5. Head mostly ferruginous.	6
– Head black.	11
6. T1 medially with spot of pale setae.	7
– T1 medially without spot of pale setae.	10
7. T2 basal half with three spots of pale setae, located transversely.....	
.....	<i>O. spectra</i> (Bingham, 1908)
– T2 in basal half with wide transverse band of pale setae.	8
8. T3–4 with band of golden setae, medially narrowly interrupted. F1 length $1.5 \times F2$	9
– T3–4 with band of golden setae, both anteromedially slightly emarginated. F1 length $1.0-1.1 \times F2$	<i>O. sairandhriensis</i> Terine, Lelej & Girish Kumar, 2020
9. Basal wide golden band of T2 posteromedially rounded.	<i>O. pulchrina</i> (Smith, 1855)
– Basal wide golden band of T2 posteromedially acuminate.	<i>O. aurifex</i> (Smith, 1879)
10. T2 in basal half with one spot of pale setae; sides of T2 above broadly fringed with pale golden setae. T3 with band of pale setae, non interrupted	<i>O. perelegans</i> (Cameron, 1897)
– T2 in basal half with three spots of pale setae. T3 with widely interrupted band of pale setae.	<i>O. paderua</i> Das & Girish Kumar, 2017
11. T1 with medial spot of pale setae.	12
– T1 without medial spot of pale setae.	13
12. Legs black. T6 with pygidial plate defined by lateral carina.....	
.....	<i>O. assamensis</i> Hammer, 1962
– Legs ferruginous. Pygidial plate lacking.	<i>O. sikkimensis</i> André, 1903

13. T2 basally with small oval spot of pale setae, without posterolateral ones; T3 with non interrupted band of golden setae. *O. buddha* (Cameron, 1892)

– T2 basally with larger spot of pale setae and two smaller posterolateral ones; T3 with widely interrupted band of yellowish setae. *O. familiaris trimaculata* Hammer, 1962

Species from the Central and Southern Western Ghats and its adjacent areas

i. *Odontomutilla pulchrina* (Smith, 1855)

(Plate 70, Figs. 261–265)

Mutilla pulchrina Smith, 1855: 34, ♀, Syntypes (Type locality: Madras, Tamil Nadu, India) [NHMUK].

Mutilla pulcherina (!): Cameron 1892: 121, 136, ♀ (redescription of female and relation with *M. aurifex*).

Description: Female. (Description from Smith 1855 and Cameron 1892). Body length. 5.5–6 mm. Coloration and Setation. Head ferruginous. Antennae and legs reddish-black. Mandible black. Mesosoma ferruginous. Metasoma black. Vertex with black setae. Frons and gena with fulvous setae. Legs with golden setae. Metasoma with dense black setae. T1 with a small spot of golden setae. T2 apically with a broad fascia of golden setae emarginated medially. T3 & 4 with band of golden setae, narrowly interrupted medially.

Structure and sculpture. Head. Almost oval, longitudinally rugose. Head narrower than thorax, coarsely rugosely punctured. Antennal tubercles shiny, impunctate. Eyes small, oval. F1 one half × F2.

Mesosoma. Coarsely longitudinally irregularly striate. Mesopleura shiny, impunctate. Mesosoma laterally armed before middle with a stout tooth and a small round tubercle.

Metasoma. T2 wider than T1. T2 with a deep antero-lateral elongate oval fovea. Pygidium strongly aciculate. S2 coarsely transversely punctate. S3–6 with small punctures.

Male. Coloration and Setation. Head and mesosoma ferruginous, propodeum black. Scape black, apically reddish. Pedicel reddish. Mandible reddish-black. Metasoma black. Head and mesosoma with sub-erect golden setae. Propodeum with dense appressed golden setae. T1

with a wide band of golden setae, widened up to $\frac{3}{4}$ of T2. T3 and T4 with band of golden setae.

Structure and sculpture. Head. Almost oval, deeply and irregularly punctate. Scrobal carina well-developed. Antennal tubercles smooth. Eyes oval, emarginated. Scape pedicel and flagellomeres micro-punctate. Mandible at most tridentate, with blunt tooth. Clypeus punctate with slight rugae. Ocelli large.

Mesosoma. With coarse large irregular punctures. Tegulae long, apically flattened. Propodeum medially with unsculptured longitudinal area. Propodeum laterally and dorsally reticulate. Meso and metapleuron punctate. Legs with small punctures.

Metasoma. T1–7 coarsely punctate. S2 with large punctures. S3–7 with small coarse punctures.

Genitalia. Gonostylus long, apically acuminate, baso-ventrally with tuft of long erect black and yellowish setae, base-dorsally with sparse short setae. Penial valves symmetrical.

Material examined. Tamil Nadu: 2 ♂, Anamalai Tiger reserve, Topslip, Latitude: 10.39061 N, Longitude: 77.10401 E, Altitude: 2100 ft., 02.v.1977, T.R.S. Nathan leg. // *Odontomutilla pulchrina* (Smith), B. Petersen det., 1980 [IBSS].

Distribution. Tamil Nadu, Kerala, Karnataka (Lelej, 2005; Pagliano *et al.*, 2020; Terine *et al.*, 2020a; Lelej *et al.*, 2020).

ii. *Odontomutilla sairandhriensis* Terine, Girish Kumar & Lelej, 2020

(Plate 71, Figs. 266–271)

Odontomutilla sairandhriensis Terine, Girish Kumar & Lelej, 2020: 200–203, ♀, Holotype ♀ (Silent Valley National Park, Palakkad district, Kerala, India) [ZSIK].

Description: Female. Body length 13.5–14 mm. Coloration and Setation. Head and antennal tubercles ferruginous. Scape black, apically ferruginous. Flagellomeres black. Clypeus black. Mandible basal half ferruginous, apically black. Mesosoma ferruginous. Legs black. Metasoma black. Frons and vertex with erect short golden setae. Gena with appressed short golden setae. Scape with sub-erect short golden setae. Flagellomeres with micro-pubesence of pale yellowish setae. Clypeus with dense appressed golden setae. Base of mandible with long sub-erect golden setae. Mesosoma dorsum with sub-erect short golden setae. Humeral angles and propodeal declivity with long erect golden setae. Meso and metapleuron with

sparse golden sub-erect setae. Coxa and femur with erect long golden setae. Tibia and tarsomeres with dense appressed golden setae. Tergal segments laterally with erect golden setae, except T6. T1 baso-medially with a spot of golden setae, latter part with appressed black setae. T2 basally with a band of golden setae, projected postero-medially, latter part with appressed black setae. T3 and T4 with a band of dense appressed golden setae. T5 with appressed black setae. T6 basal half with erect black and golden setae. S1 with short sparse golden setae. Sternal segments laterally with sparse long erect golden setae. S2–4 with an apical fringe of golden setae. S5 with apical fringe of dark golden setae.

Structure and sculpture. Head. Almost quadrangular in dorsal view, irregularly rugose. Eyes small, oval and bulged. Scrobal carina well developed. Clypeus basally and apically depressed, lateral ends not developed into denticles. Antennal tubercles baso-medially punctate, latter portion with fine rugae. Scape punctate, apically smooth. Pedicel and flagellomeres with minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.27: 0.42: 0.39: 0.44. Minimal distance between eyes $1.44 \times$ longitudinal eye diameter. Mandible bidentate. Hypostomal carina tuberculate at anterior two-third.

Mesosoma. Pronotum wider than propodeum. Pronotal width $1.14 \times$ eye width behind eyes. Propodeal width $0.85 \times$ pronotal width. Mesosoma dorsum irregularly striate. Scutellar scale absent. Propodeal slope abrupt/steep. Lateral mesosomal margin with four teeth, middle tooth largest. Meso and metapleuron micro-punctate. Mid and hind tibia with two rows of spines, four in each row.

Metasoma. T2 width $1.51 \times$ T1 width. T1–5 coarsely punctate. T2 with a deep antero-lateral elongate oval fovea. Pygidium basal half with transverse irregular striations, latter part with irregular fine rugosity. S1 with an elongate blunt tooth medially. S2–6 punctate, S2 medially with large punctures.

Male. Unknown.

Materials examined. Kerala: 1 ♀, Palakkad district, Silent Valley National Park, Latitude: 11.0641 N, Longitude: 76.5378 E, Altitude: 553 m, 7.ii.1988, Coll. G.U. Kurup & Party, ZSI/WGRC/IR/INV.13568; 1 ♀, Kasaragod district, Ranipuram hills, Latitude: 12.4155 N, Longitude: 75.3530 E, Altitude: 901 m, 22.i.2020, Coll. Swafvan Kananchery, ZSI/WGRC/IR/INV.13630.

Distribution. Kerala (Lelej *et al.*, 2020).

Remarks. Lelej *et al.* (2020) described and published this species.

iii. *Odontomutilla vishwanathi* Terine & Girish Kumar, 2024

(Plate 72, Figs. 272–277)

Odontomutilla vishwanathi Terine & Girish Kumar, 2024a: 134–135 ♀, Holotype ♀ (Abbi Falls, Shimoga district, Karnataka, India) [ZSIK].

Description: Female. Body length 15.5–20.05 mm. Coloration and Setation. Head and antennal tubercles ferruginous. Scape, pedicel and flagellomeres black. Clypeus ferruginous. Mandible basal half dark ferruginous, apically black. Mesosoma ferruginous. Legs black. Metasoma black. Frons and vertex with erect short golden and black setae. Gena dense erect black setae and sparse golden setae. Scape with sub-erect short golden setae. Pedicel and flagellomeres with micro-pubesence of golden setae. Clypeus with dense appressed long golden setae. Base of mandible with long sub-erect golden setae. Mesosoma dorsum with erect short black setae, laterally erect golden setae. Humeral angles and propodeal declivity with long erect golden setae. Meso and metapleuron with sparse golden sub-erect setae. Legs with sub-erect and appressed dense golden setae. T1 with erect black setae, laterally with erect golden setae. T2 apically with a wide band of golden setae, latter part with erect black setae. T3 wholly with a band of dense golden setae. T4 and T5 with appressed black setae and sparse golden setae. T6 basally with sub-erect golden setae. S1 with short erect golden setae. S2 with sparse erect golden setae. S2–4 with an apical fringe of golden setae.

Structure and sculpture. Head. Oval in frontal view, foveolate rugose. Eyes small, oval and bulged. Scrobal carina well developed. Clypeus medially weakly emarginated, with two weak denticles. Antennal tubercles imbricate. Scape with scattered punctures. Pedicel and flagellomeres with minute puncture-rugose. Ratio of pedicel to flagellomeres 1 to 3 is 0.35: 0.50: 0.43: 0.43. Minimal distance between eyes $1.55 \times$ longitudinal eye diameter. Mandible acuminate apically, without any teeth. Hypostomal carina developed, not tuberculate at anterior two-third.

Mesosoma. Pronotum wider than propodeum. Pronotal width $1.07 \times$ eye width behind eyes. Propodeal width $0.85 \times$ pronotal width. Mesosoma dorsum foveolate and irregularly striate. Scutellar scale absent. Propodeal slope abrupt/steep. Lateral mesosomal margin with three teeth, middle tooth largest, latter ones blunt. Meso and metapleuron micro-punctate. Mid and hind tibia with one row of spines, four in a row.

Metasoma. T2 width 1.47 × T1 width. T1–5 with coarse small punctures, with fine rugae. T2 with a deep antero-lateral elongate oval fovea. Pygidium rugose. S1 basally with an elongate blunt tooth. S2 medially with large deep punctures, latter part with small punctures. S3–6 with small punctures.

Male. Unknown.

Materials examined. Karnataka: 1 ♀, Shimoga district, Abbi Falls, Latitude: 13.7074 N, Longitude: 75.0687 E, Altitude: 592 m, 20.vi.2022, Coll. V.D. Hegde & Party, ZSI/WGRC/IR/INV. 24163; 1 ♀, Shimoga district, Hulikal Forest Rest House, Latitude: 13.725153 N, Longitude: 75.010297 E, Altitude: 595 m, 06.xii.2022, Coll. V.D. Hegde & Party, ZSI/WGRC/IR/INV. 24164.

Distribution. Karnataka (Terine & Girish Kumar, 2024a).

Remarks. Terine & Girish Kumar (2024a) described and published this species.

PLATE 69

Species distribution of the genus *Odontomutilla* Ashmead from Central and Southern Western Ghats and its adjacent areas

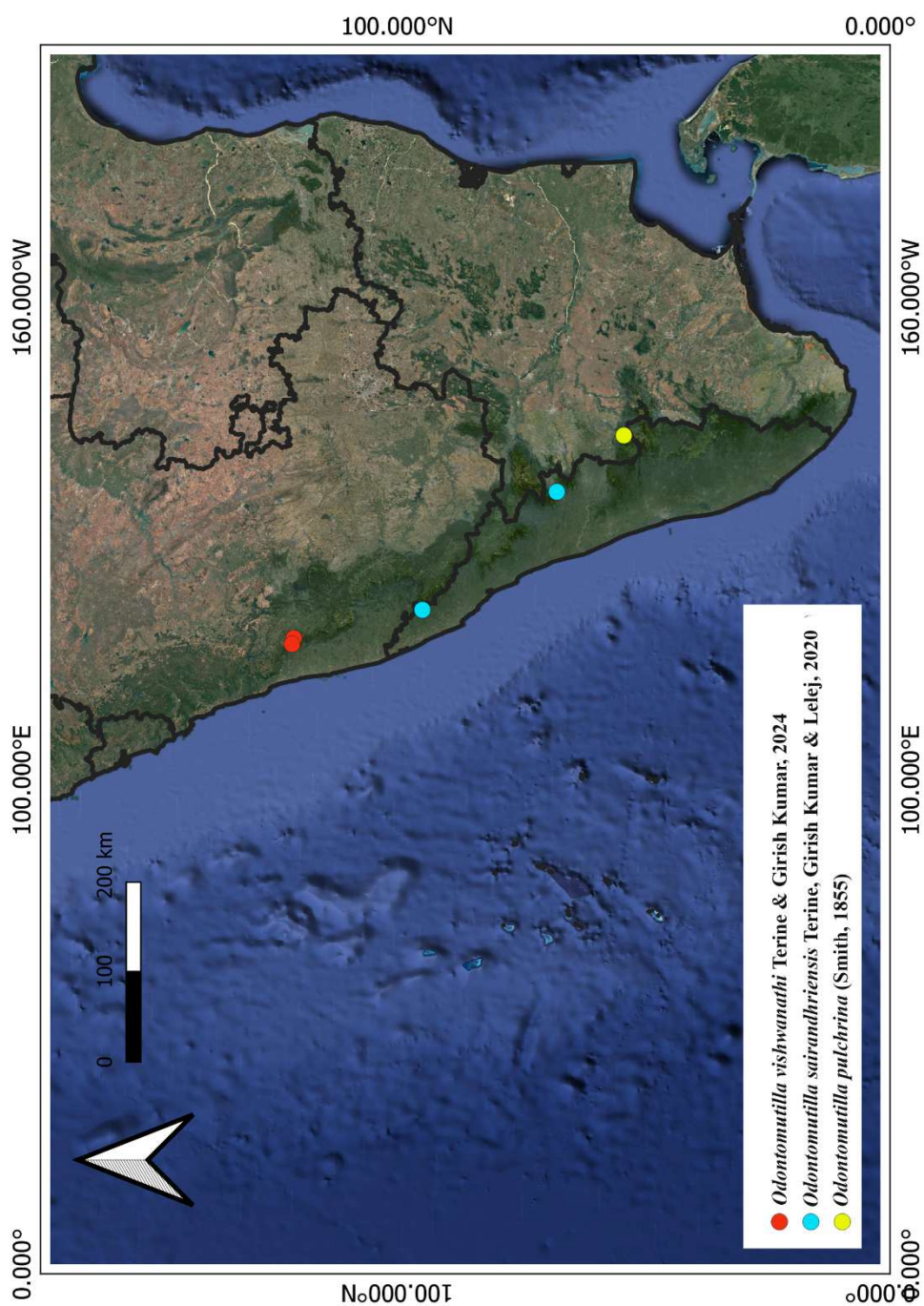
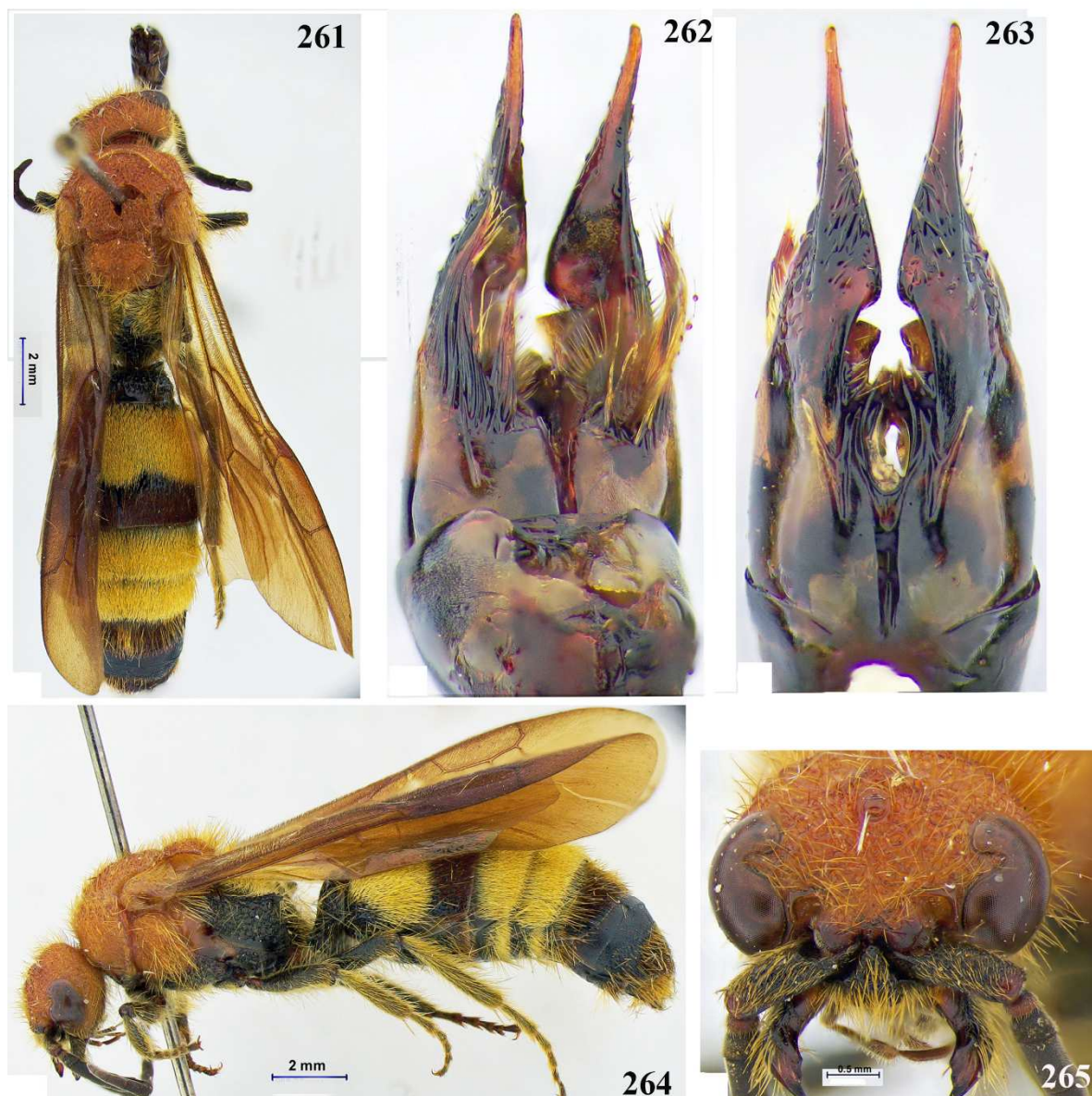
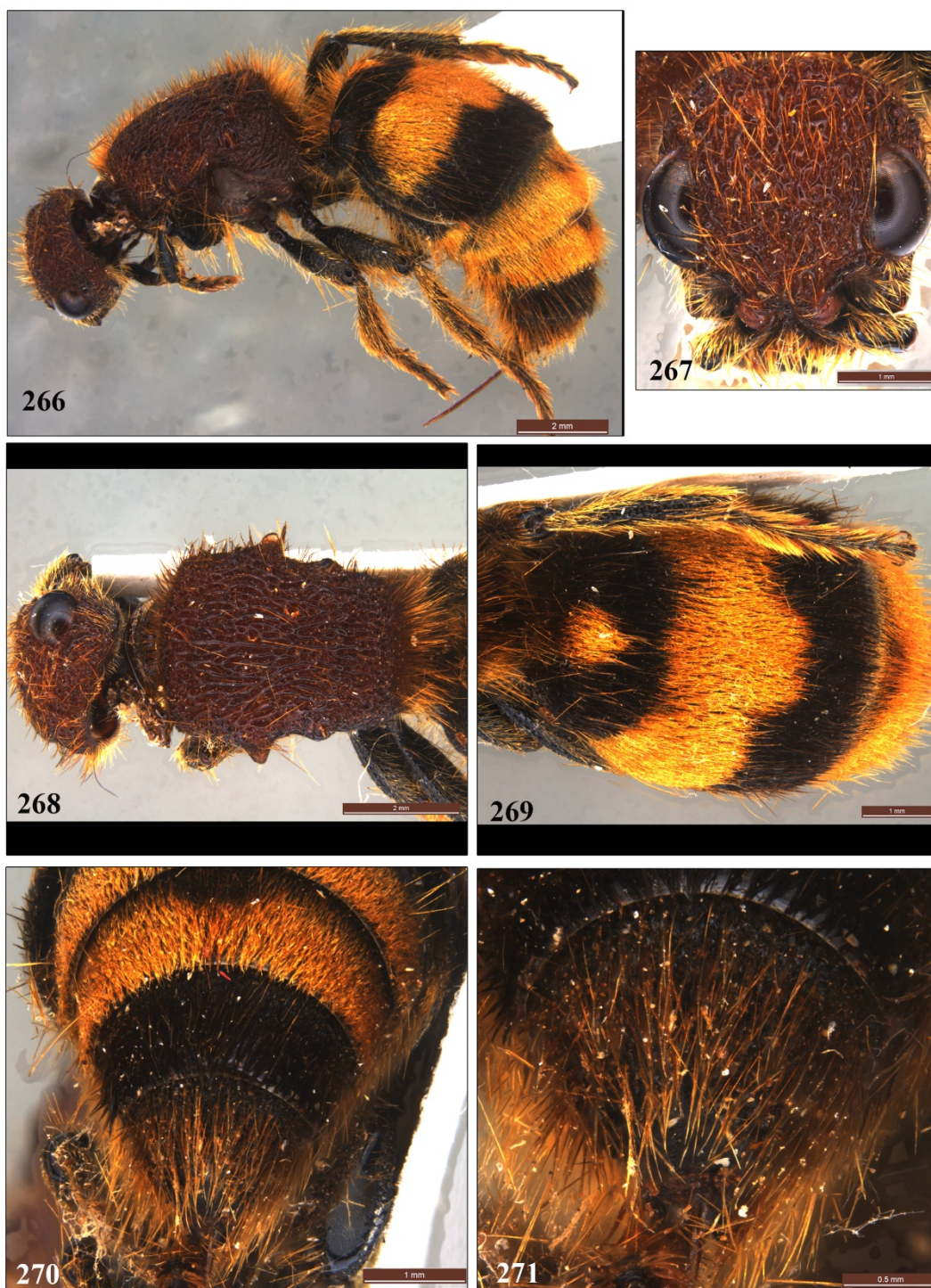


PLATE 70



Odontomutilla pulchrina (Smith, 1855) (Male). 261. Body, dorsal view. 262. Genitalia, ventral view. 263. Genitalia, dorsal view. 264. Body, lateral view. 265. Head, frontal view.

PLATE 71



Odontomutilla sairandhriensis Terine, Girish Kumar & Lelej, 2020 (Female).
266. Body, lateral view. 267. Head, frontal view. 268. Head & Mesosoma, dorsal view. 269, 270. Metasoma, dorsal view. 271. Pygidium.

PLATE 72



Odontomutilla vishwanathi Terine & Girish Kumar, 2024 (Female). 272. Body, lateral view. 273. Head, frontal view. 274. Head & Mesosoma, dorsal view. 275. Metasoma, dorsal view. 276. Metasoma, ventral view. 277. Pygidium.

CHAPTER 6
SUBFAMILY TICOPLINAE

6. Subfamily TICOPLINAE Nagy, 1970

Tribe Smicromyrmillini Argaman, 1988

Key to the Indian genera of Tribe Smicromyrmillini Argaman, 1988

Males

1. Macropterous. Propodeum with one large tooth (basally) and two short teeth.....
 *Eosmicromyrmilla* Lelej & Krombein, 2001
- Apterous. Propodeum laterally with two large teeth and two small tubercles.....
 *Hindustanilla* Lelej, 2001

Females

1. Propodeum laterally with micro sculptured, never reticulated. Mid and hind tibia with weak spines. T6 medially smooth, shiny, not carinate laterally.....
 *Eosmicromyrmilla* Lelej & Krombein, 2001
- Propodeum laterally reticulate. Mid and hind tibia with strong, well developed spines. T6 medially smooth, laterally weakly carinate, basally narrow.....
 *Hindustanilla* Lelej in Lelej & Krombein, 2001

I. Genus *Eosmicromyrmilla* Lelej & Krombein, 2001

Eosmicromyrmilla Lelej & Krombein, 2001: 4; Lelej, 2005: 22; Lelej & Brothers, 2008: 21; Brothers & Lelej, 2017: 93; Pagliano *et al.*, 2020: 22; Lelej *et al.*, 2021: 569.
Smicromyrmilla: Lelej *et al.*, 2007: 54.

Type species *Eosmicromyrmilla srilankiensis* Lelej & Krombein, 2001 (♂, ♀; holotype is ♂), by original designation.

Diagnosis. Female. Head 1.1 × wider than pronotum, narrower behind eyes. Antenna flattened, F1 1.1–1.2 × as long as pedicel. Mandible tridentate, with weak preapical tooth. Pronotum anteriorly carinate. Humeral angles acuminate. Propodeum wider than pronotum. Lateral propodeal face not reticulate, micro-sculptured. Mid and hind tibia with weak spines. T6 with median smooth shiny area, not carinated laterally.

Male. Body black or mesosoma mostly red. Head with 1.1 × pronotal width. Vertex medially concave. Eyes large, with short, sparse setae only visible under higher magnification. Scape beneath bicarinate. F1 short. Mandible apically tridentate. Pronotum with acuminate humeral

angle. Parapsids weakly present. Admedian line present. Notauli absent. Metanotum with medial longitudinal carina. Lateral and posterior propodeal faces separated by carina or carina with teeth. Scutellum laterally carinate, reticulate, posteriorly rounded, apically overhanging. S6 with narrow median emargination. S8 also with median narrow emargination, carinated laterally and basally narrowed to a notch at mid of carina. Volsella lamellate.

Diversity & Distribution. The genus is represented by six valid species worldwide. Five species are from the Oriental Region and one from the Palearctic Region. Only three species are recorded from India (Lelej, 2005, Pagliano *et al.*, 2020 & Lelej *et al.*, 2021).

Key to Indian species of *Eosmicromyrmilla* Lelej & Krombein, 2001 (Male unknown for *E. pulawskii* Lelej, 2005. Females unknown for *E. balakrishnani* Terine, Lelej & Girish Kumar, 2021 & *E. subbuka* Terine, Lelej & Girish Kumar, 2021)

1. Males, fully winged.2

– Females, wingless. T1 medially with a spot of silvery setae. T2 apically with three spots of silver setae. Mesosoma length $1.5 \times$ maximal pronotal width. *E. pulawskii* Lelej, 2005

2. S6 posteriorly with strong angulate concavity, anterior part of this concavity more or less transverse and parallel to posterior border of S7 or S5. Apical part of paramere $1.5 \times$ longer than paramere base. Penis valve with blunt tooth preapically.....
..... *E. balakrishnani* Terine, Lelej & Girish Kumar, 2021

– S6 posteriorly with strong non-angulate concavity, anterior part of this concavity curved and not parallel to posterior border of S7 or S5. Apical part of paramere almost $2 \times$ longer than paramere base. Penis valve without preapical tooth.....
..... *E. subbuka* Terine, Lelej & Girish Kumar, 2021

Species from the Central and Southern Western Ghats and its adjacent areas

i. *Eosmicromyrmilla balakrishnani* Terine, Lelej & Girish Kumar, 2021

(Plates 74 & 75, Figs. 278–289)

Eosmicromyrmilla balakrishnani Terine, Lelej & Girish Kumar, 2021: 573, ♂, Holotype
(Type locality: Ponkuzhi, Wayanad district, Kerala, India) [ZSIK].

Description: Male. Body length 5.79–8.27 mm. Coloration and Setation. Head, antennal tubercles, antennae and clypeus black. Mandible basally and apically black, medially brownish. Mesosoma, metasoma and legs black. Gena with dense appressed and erect silvery setae. Frons with appressed and sub-erect black setae. Vertex with erect black setae. Clypeus with dense appressed silvery setae. Scape ventrally with sub-erect silvery setae and dorsally with pale golden setae. Pedicel and flagellomeres with black micro-pubescence. Mandible with sparse long sub-erect silvery setae. Pronotum and mesoscutum with appressed silvery setae and erect sparse brownish-black setae. Scutellum laterally with erect silvery setae and dorsally with erect black setae. Propodeum basally with appressed silvery setae, and latter portion with sparse sub-erect silvery setae. Coxa, femur and tibia with dense sub-erect and appressed silvery setae. Tarsomeres with dense short pale golden setae. Mesopleuron with dense appressed silvery setae. Metapleuron with sparse sub-erect silvery setae. T1–4 with sparse long, erect silver setae. T5–7 with sparse long erect black setae. T1–4 and S2–5 with apical fringe of silvery setae. S6 and S8 with black setae and sparse silvery setae.

Structure and sculpture. Head. Oval in frontal view, conical at vertex, rugose punctate. Eyes large, oval, slightly emarginated. Scrobal carina well developed, emarginated. Clypeus convex, punctate. Antennal tubercles irregularly rugose and with sparse punctures. Scape foveolate-rugose. Pedicel and flagellomeres with minute punctures. Ocelli small, POL $0.55 \times$ OOL. Ratio of pedicel to flagellomeres 1 to 3 is 0.32: 0.47: 0.96: 0.87. Minimal distance between eyes $1.38 \times$ longitudinal eye diameter. Mandible narrowed towards apex, apically tridentate.

Mesosoma. Pronotal width $1.01 \times$ eye width behind eyes. Propodeal width $1.16 \times$ pronotal width. Pronotum foveolate-rugose. Mesoscutum punctate. Mesoscutum with parapsidal furrows, notauli lacking. Mesoscutellum produced overhanging the mesonotum, reticulate, posterior margin emarginated. Mesopleuron areolate-rugose. Metapleuron dorsally striate, medially with weak rugae and sparse punctures. Tegulae smooth, with sparse puncture laterally. Propodeal face reticulate, reticulae larger medially.

Wings. Forewing setose. Second sub-marginal cell petiolate, veins brown.

Metasoma. T2 width $1.3 \times$ T1 width. T1–5 punctate. T2 with a short lateral felt line, felt line $0.16 \times$ T2 length. S2 with a long lateral felt line, lateral felt line $0.42 \times$ S2 length. S1 rugose, basally with a small tubercle. S2–6 punctate. S6 medially emarginated, half the length of S6. S8 with median longitudinal emargination, carinated laterally and narrowed basally, with

notch at apical third of carina, and oblique carina from notch to latero-basal corner of S8, densely punctate.

Genitalia. Paramere compressed bilaterally, down curved and apically acuminate. Paramere baso-laterally with sparse short whitish setae. Penis valve lamellate, with a blunt tooth apically. Volsella lamellate, ventrally and apically with long yellowish setae.

Female. Unknown.

Material examined. Kerala: 1 ♂, India, Kerala, Wayanad district, Wayanad Wildlife Sanctuary, Muthanga, Ponkuzhi, Latitude: 11.6888 N, Longitude: 76.3906 E, Altitude: 844 m, 7.ii.2021, Coll. K.A. Subramanian & Party, ZSI/WGRC/IR/INV.17651; 2 ♂, Wayanad district, Wayanad Wildlife Sanctuary, Edavambam, Latitude: 11.6823 N Longitude: 76.3380 E, Altitude: 876 m, 20.ii.2021, Coll. K.A. Subramanian & Party, ZSI/WGRC/IR/INV.17652-17653.

Distribution. Kerala (Lelej *et al.*, 2021).

Remarks. Lelej *et al.* (2021) described and published this species.

ii. *Eosmicromyrmilla subbuka* Terine, Lelej & Girish Kumar, 2021

(Plates 76 & 77, Figs. 290–305)

Eosmicromyrmilla subbuka Terine, Lelej & Girish Kumar, 2021: 571, ♂, Holotype (Type locality: Madei Wildlife Sanctuary, North Goa district, Goa, India) [ZSIK].

Description: Male. Body length 5.55–7.40 mm. Coloration and Setation. Head, antennal tubercles, antennae and clypeus black. Mandible black, preapically brownish. Mesosoma black. Legs brownish-black. Metasoma black. Head with dense appressed silvery setae and erect brownish setae. Clypeus with dense appressed silvery setae. Scape with sub-erect silvery setae. Pedicel and flagellomeres with silvery micro-pubesence. Mandible with dense appressed silvery setae. Pronotum and mesoscutum with appressed silvery setae and erect sparse brownish setae. Scutellum laterally with erect silvery setae. Propodeum basally with appressed silvery setae. Legs with dense erect and appressed silvery setae. Mesopleuron with dense appressed silvery setae. T1–4 with sparse long, erect silver setae. T5–7 with sparse long erect black setae. T1–4 and S2–5 with apical fringe of silvery setae. S6 and S8 with black setae and sparse silvery setae.

Structure and sculpture. Head. Oval in frontal view, conical at vertex, with small punctures. Eyes large, oval, slightly emarginated. Scrobal carina well developed. Clypeus convex,

punctate. Antennal tubercles and scape punctate. Pedicel and flagellomeres with minute punctures. Ocelli small, POL $0.55 \times$ OOL. Ratio of pedicel to flagellomeres 1 to 3 is 0.26: 0.30: 0.67: 0.71. Minimal distance between eyes $1.29 \times$ longitudinal eye diameter. Mandible narrowed towards apex, apically tridentate.

Mesosoma. Pronotal width $0.91 \times$ eye width behind eyes. Propodeal width $1.09 \times$ pronotal width. Pronotum and mesoscutum punctate. Mesoscutum with parapsidal furrows, notauli lacking. Mesoscutellum produced overhanging the mesonotum, reticulate, posterior margin emarginated. Mesopleuron rugose. Tegulae smooth, with sparse puncture laterally. Propodeal face reticulate, reticulae larger medially.

Wings. Forewing setose. Second sub-marginal cell petiolate, veins brown.

Metasoma. T2 width $1.34 \times$ T1 width. T1–5 punctate. T2 with a short lateral felt line, felt line $0.26 \times$ T2 length. S2 with a long lateral felt line, lateral felt line $0.45 \times$ S2 length. S1 punctate, medially with a tubercle. S2–6 punctate. S6 medially emarginated, half the length of S6. S8 with median longitudinal emargination, carinated laterally and narrowed basally, with notch on half of carina, and oblique carina from notch to latero-basal corner of S8, densely punctate.

Genitalia. Paramere compressed bilaterally, downcurved and apically acuminate. Paramere baso-laterally with long dense whitish setae, apically with sparse whitish setae. Penis valve lamellate, apically rounded. Volsella lamellate, ventrally and apically with long pale yellowish setae.

Female. Unknown.

Material examined. Goa: 6♂, India, Goa, North Goa district, Madei Wildlife Sanctuary, Latitude: 15.5966 N, Longitude: 74.1877 E, Altitude: 800 m, 15.v.2018, Coll. P. Girish Kumar & Party, ZSI/WGRC/IR/INV. 15049–15054; 3♂, North Goa district, Bondla Wildlife Sanctuary, Latitude: 15.4401 N, Longitude: 74.1064 E, Altitude: 914.4 m, 16.v.2018, Coll. P. Girish Kumar & Party, ZSI/WGRC/IR/INV. 15055–15057. Karnataka: 1 ♂, Chikmagalur district, Bygoor, Kabbinahalli coffee estate, Latitude: 13.3513 N, Longitude: 75.7063 E, Altitude: 1208 m, 16.v.2018, Coll. P. Girish Kumar & Party, ZSI/WGRC/IR/INV. 15058.

Distribution. Goa, Karnataka (Lelej *et al.*, 2021).

Remarks. Lelej *et al.* (2021) described and published this species.

PLATE 73

Species distribution of the genus *Eosmicromyrmilla* Lelej & Krombein from Central and Southern Western Ghats and its adjacent areas

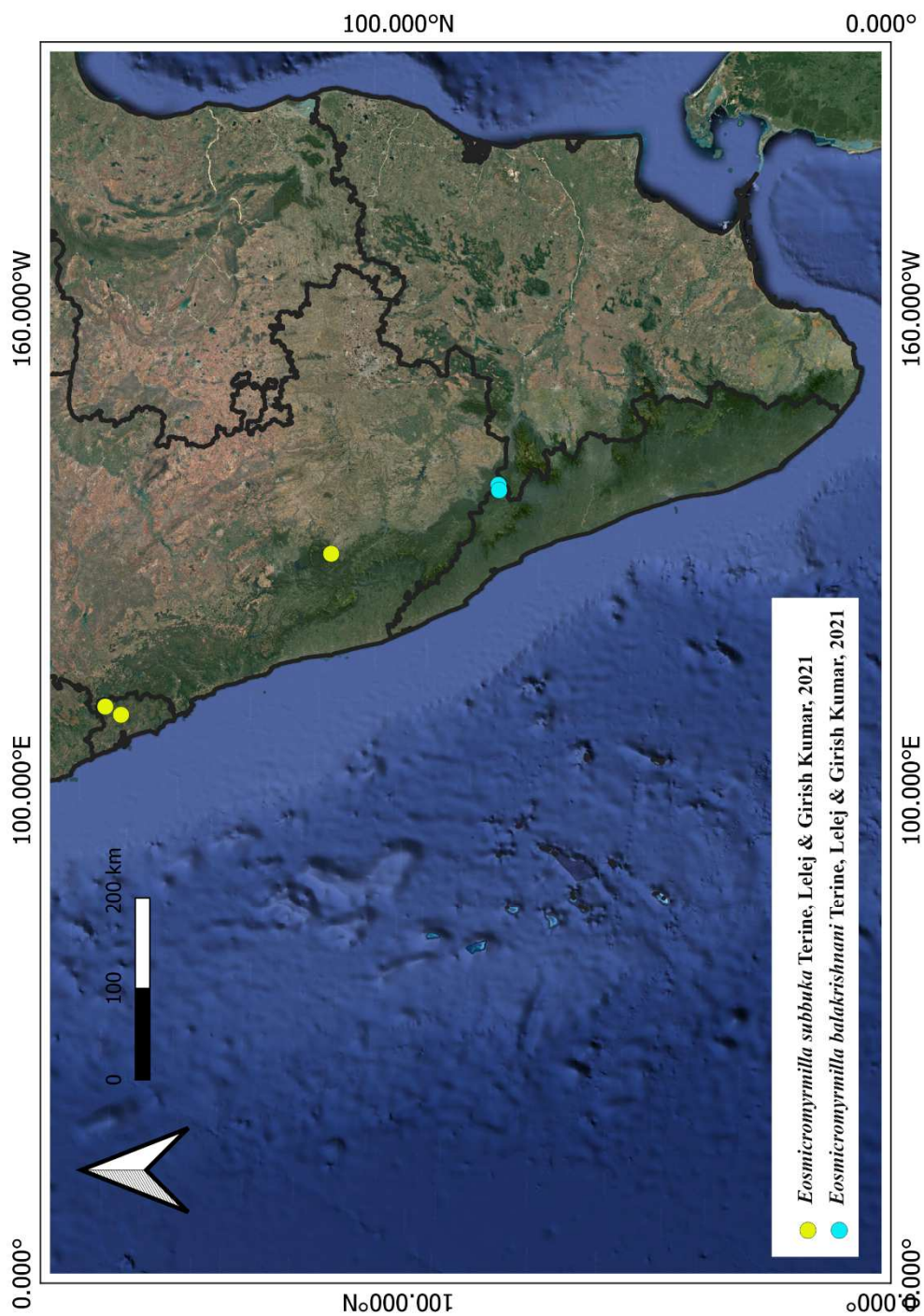
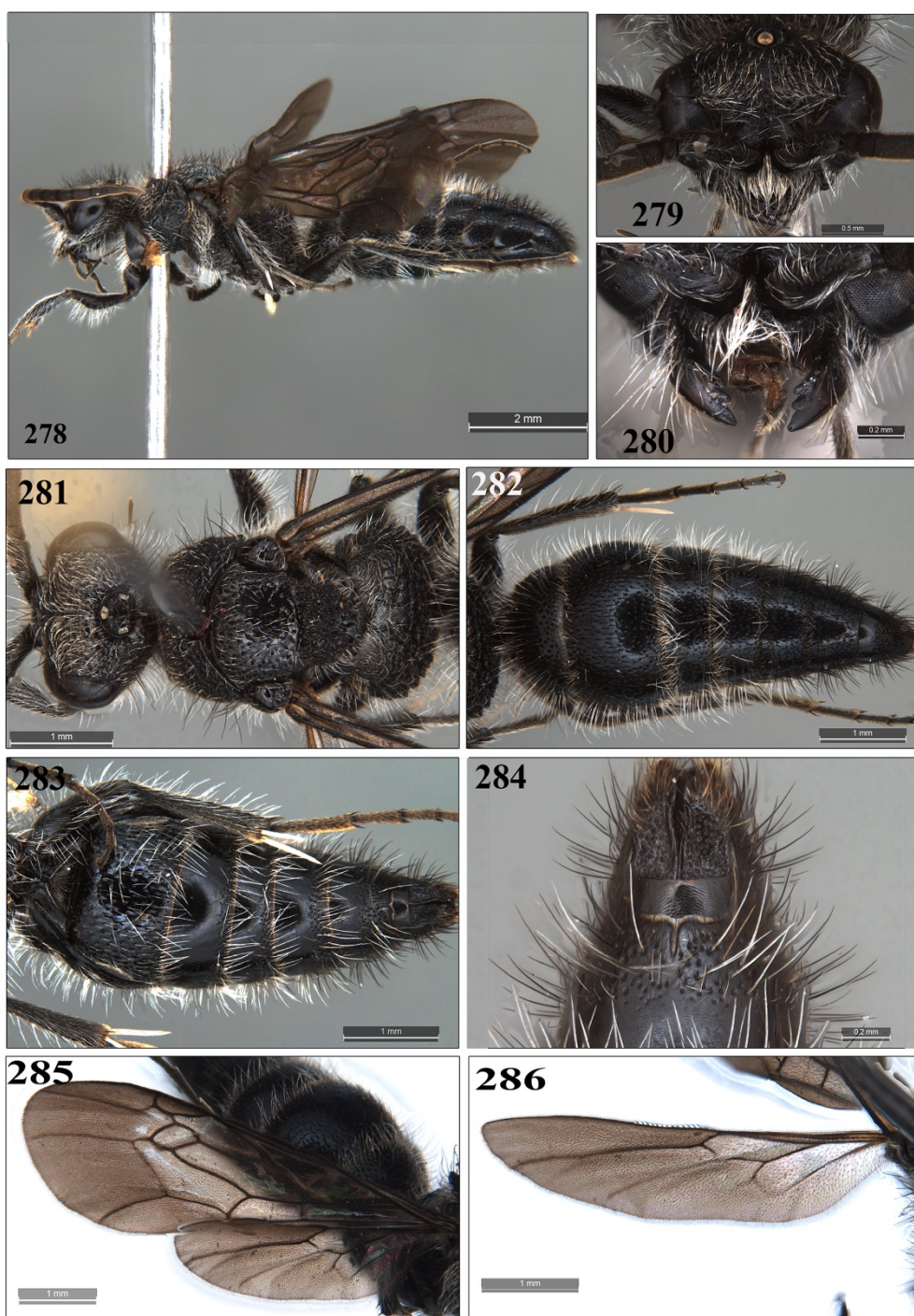


PLATE 74



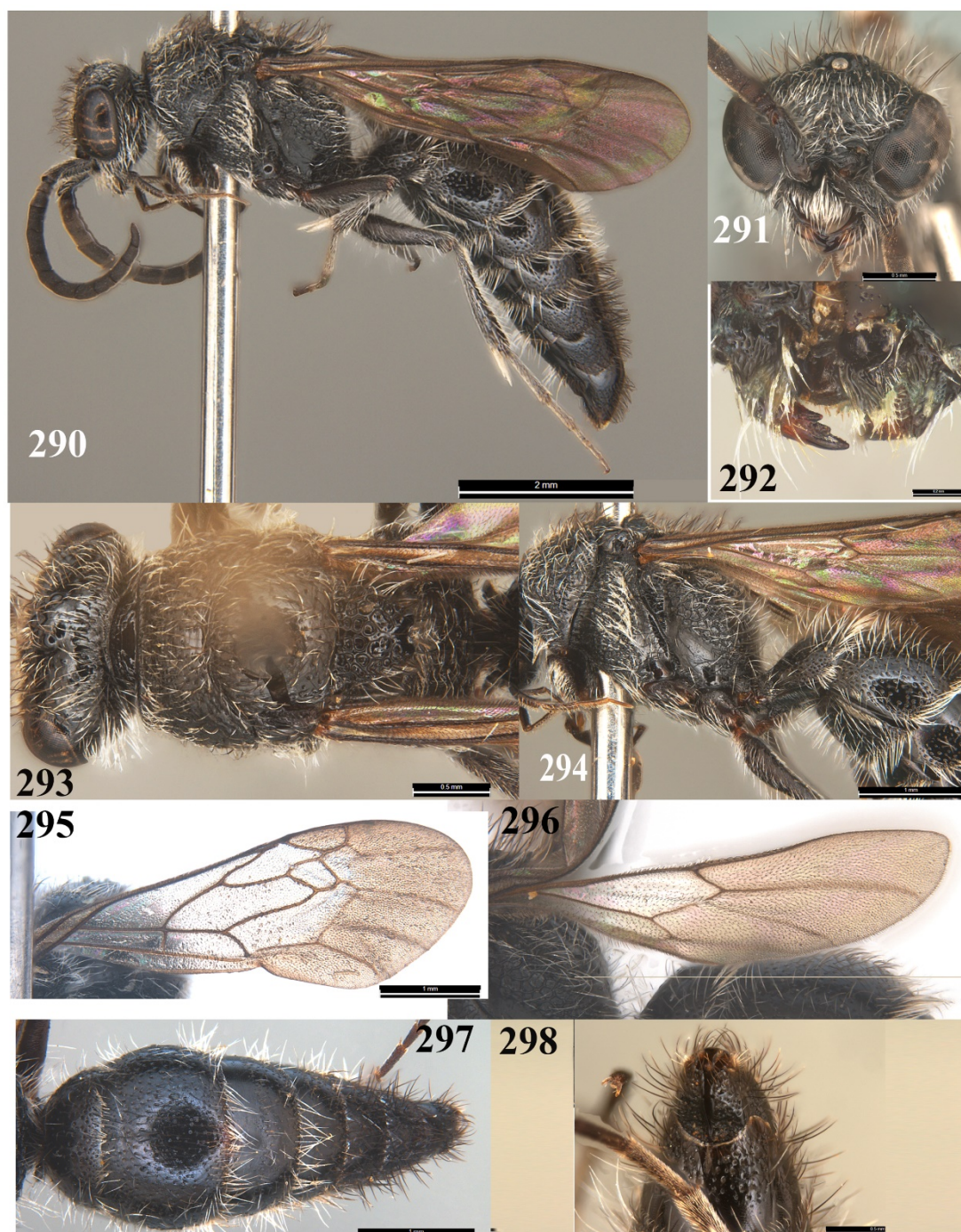
Eosmicromyrmilla balakrishnani Terine, Lelej & Girish Kumar, 2021
 (Male). 278. Body, lateral view. 279. Head, frontal view. 280. Mandible. 281.
 Head & Mesosoma, dorsal view. 282. Metasoma, dorsal view. 283, 284. Metasoma,
 ventral view. 285. Forewing. 286. Hindwing.

PLATE 75



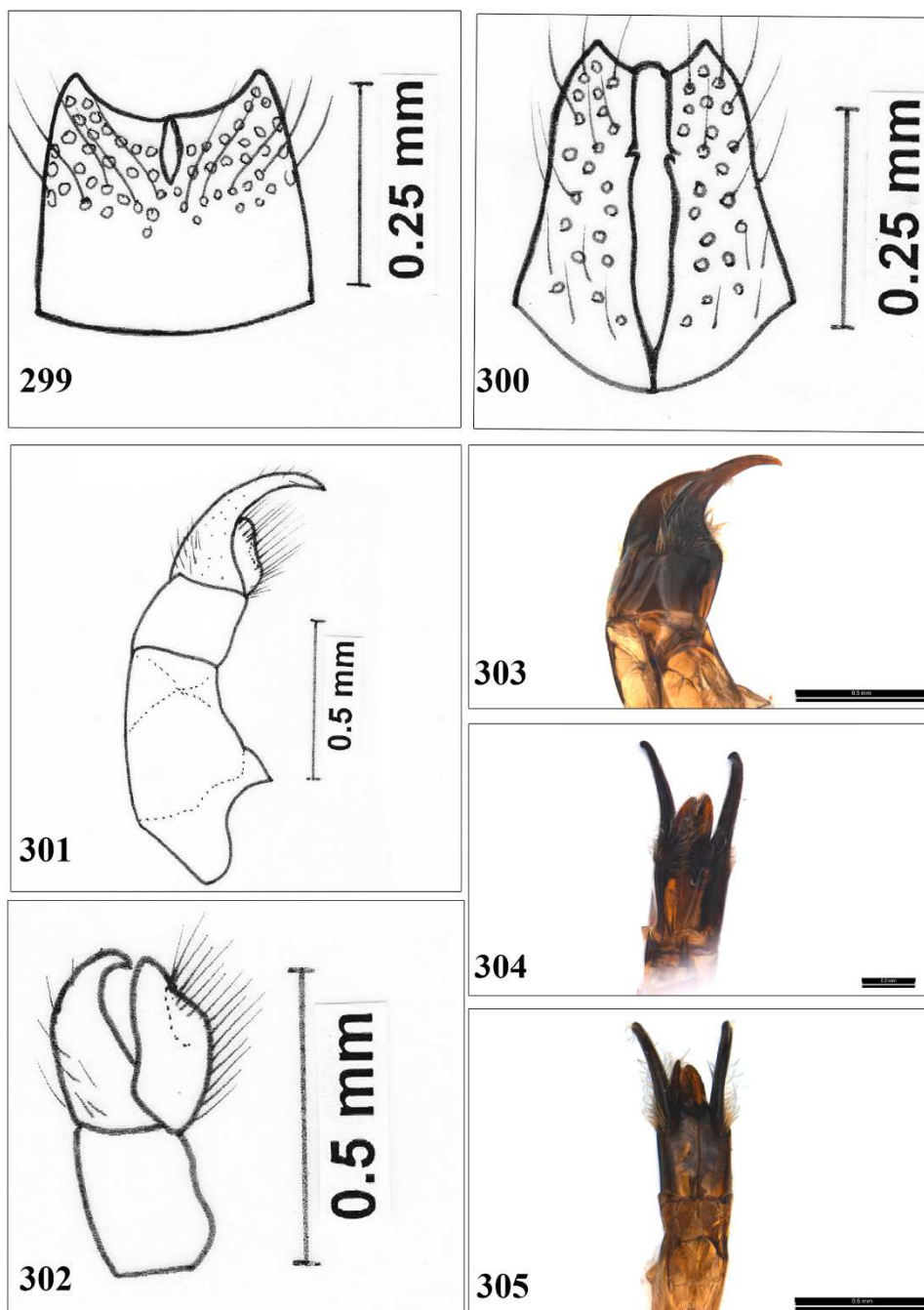
Eosmicromyrmilla balakrishnani Terine, Lelej & Girish Kumar, 2021
(Male). 287. Genitalia, dorsal view. 288. Genitalia, lateral view.
289. Genitalia, ventral view. 2

PLATE 76



Eosmicromyrmilla subbuka Terine, Lelej & Girish Kumar, 2021 (Male).
 290. Body, lateral view. 291. Head, frontal view. 292. Mandible. 293. Head & Mesosoma, dorsal view. 294. Mesosoma, lateral view. 295. Forewing. 296. Hindwing. 297. Metasoma, dorsal view. 298. Sternum 8.

PLATE 77



Eosmicromyrmilla subbuka Terine, Lelej & Girish Kumar, 2021 (Male).
299. Sternum 6. 300. Sternum 8. 301-305. Genitalia.

CHAPTER 7
SUBFAMILY
RHOPALOMUTILLINAE

7. Subfamily Rhopalomutillinae Schuster, 1949

I. Genus *Pherotilla* Brothers, 2015

Pherotilla Brothers, 2015: 10; Pagliano *et al.*, 2020: 25; Terine *et al.*, 2020a: 10.

Diagnosis. Female. Head as wide as long. Mesosoma squat, lateral margin crenulated, anteriorly strongly convex. Mesosoma with gradual sinuation between metathoracic spiracle and propodeal spiracle. Propodeum with a tooth at posterior lateral angle and without any median tubercle. T1 broad. Pygidial plate laterally carinate, oval, surface covered with dense recumbent setae. Male. Head vertex rounded evenly. Mandible tridentate. Genal carina absent. Mandible tridentate. Scutellum gibbous. S6 with posterior margin with a deep notch laterally. Penis valves with right valve larger than left (in some sometimes symmetrical). Paramere without dense setae but sometimes with sparse slightly stronger long setae near the base (Brothers, 2015).

Diversity & Distribution. The genus is represented by six valid species worldwide. Two are from the Afrotropical Region, one from the Palearctic region of China and three are from the Oriental Region. Only two species are recorded from India (Brothers, 2015 & Pagliano *et al.*, 2020).

Species from the Central and Southern Western Ghats and its adjacent areas

i. *Pherotilla subterranea* Terine & Girish Kumar, sp. nov.

(Plate 79, Figs. 306–311)

Description: Female. Body length 3.99 mm. Coloration and Setation. Head dark ferruginous, gena darker. Antennal tubercles, scape and flagellomeres yellowish. Mandible basal 3/4th yellowish, latter part black. Mesosoma dark ferruginous. Coxa black. Femur, tibia and tarsomeres yellowish. Metasoma dark ferruginous, with irregular shades of black. Head with erect and appressed short fine silvery setae. Clypeus with long silvery setae. Scape with dense appressed short silvery setae. Flagellomeres with micro-pubesence of silvery setae. Mandible basally with sub-erect long silvery setae and one or two long setae medio-laterally. Mesosoma dorsum and propodeal declivity with long erect fine silvery setae, denser on propodeal declivity. Meso and metapleuron with sparse sub-erect silvery setae. Legs with dense sub-erect and erect medium sized silver setae. T1–5 with dense appressed and erect

fine short silver setae. S2–6 with fringe of sparse fine silvery setae. Pygidium with setae running parallel to longitudinal rugae.

Structure and sculpture. Head. Rounded in frontal view, frons globous, coarsely punctate. Eyes very small, slightly oval. Scrobal carina not developed. Carina well developed between antennal tubercles. Antennal tubercle and scape sparsely punctate. Pedicel and flagellomeres with minute punctures. Ratio of pedicel to flagellomeres 1 to 3 is 0.42: 0.32: 0.24: 0.31. Minimal distance between eyes 4.4× longitudinal eye diameter. Mandible narrowed towards apex, bidentate.

Mesosoma. Mesonotum widest. Propodeum more or less equal to pronotum. Pronotal width 0.74 × head width behind eyes. Sinuate between mesonotum and propodeum. Mesosoma dorsum punctate, laterally with longitudinal rugae. Scutellar scale absent. Propodeal slope abrupt/steep, rugose-alveolate. Lateral mesosomal margin strongly crenulated. Meso and metapleuron sparsely punctate. Mid and hind tibia with two row of spine with five in each row.

Metasoma. T1 rugose, rugae converging apico-medially. T2 width 1.17 × T1 width. T2–5 coarsely punctate. Pygidium longitudinally rugose. S2–6 punctate, punctation on S2 slightly larger, medially smooth.

Male. Unknown.

Materials examined. Tamil Nadu: 1 ♀, Coimbatore district, Kullnadimedu, near Anamalai Tiger reserve, Latitude: 10.5766 N, Longitude: 76.9245 E, 2.i.2019, Coll. P. Girish Kumar, ZSI/WGRC/IR/INV. 28940.

Distribution. Tamil Nadu.

Etymology. The species name is derived from the word “Subterranean,” which means “Under the ground”. The species in the subfamily Rhopalomutillinae seem to spend most of their adult life underground.

PLATE 78

Species distribution of the genus *Pherotilla* Brothers from Central and Southern Western Ghats and its adjacent areas

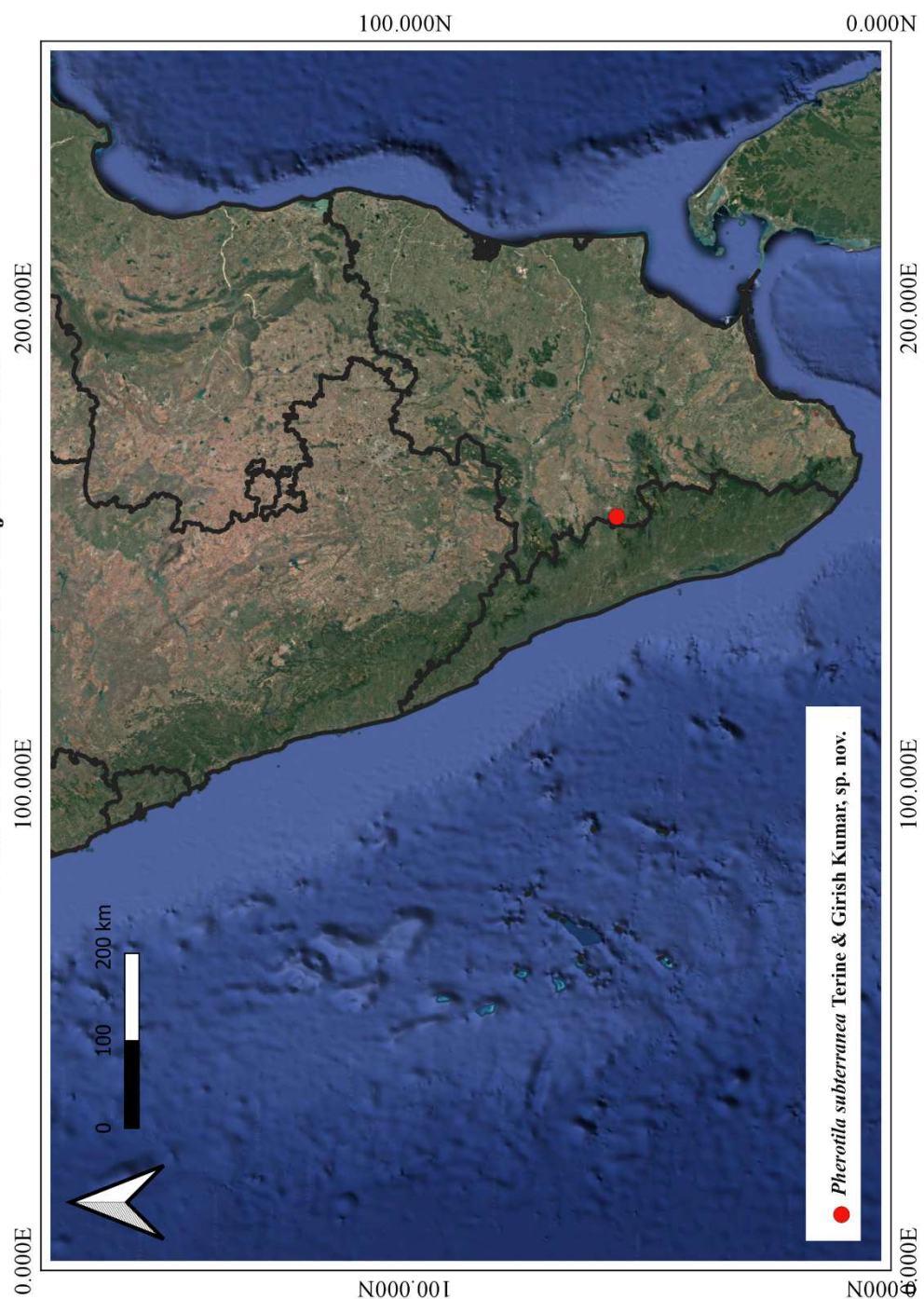


PLATE 79



Pherotila subterranea Terine & Girish Kumar, sp. nov. (Female). 306. Body, lateral view. 307. Head, frontal view. 308. Head & Mesosoma, dorsal view. 309. Metasoma, dorsal view. 310. Metasoma, ventral view. 311. Pygidium.

SUMMARY AND CONCLUSION

5. SUMMARY AND CONCLUSION

The findings of the present study include the following:

- A total of **46 species** belonging to **19 genera** in **6 subfamilies** of the family **Mutillidae** were recorded from the study area.
- **Eight new species** were described and published from the study area.
- **One species, *Pherotilla subterranea* sp. nov.** is described as new in the thesis.
- **2 genera, *Strangulotilla* Nonveiller, 1979 & *Andreimyrmex* Lelej, 1995** were recorded for first time from India.
- **2 species** were newly recorded from India.
- **13 species** were newly recorded from the Kerala state.
- **3 species** were newly recorded from the Karnataka state.
- **1 species** was newly recorded from the Tamil Nadu state.
- A dichotomous key to Indian subfamilies, genera and species under each genus were provided.
- Diagnosis of species with distributional records were provided.
- Plates of photographs of all the examined species were prepared and provided.
- Coordinates using accurate GPS were noted for the collection site of mutillid specimens, and distribution maps were prepared using QGIS online software.

5.1. New species

- *Andreimyrmex paniya* Terine, Lelej & Girish Kumar, 2021
- *Cephalotilla (Cephalotilla) manikandani* Terine, Lelej & Girish Kumar, 2024
- *Eosmicromyrmilla balakrishnani* Terine, Lelej & Girish Kumar, 2021
- *Eosmicromyrmilla subbuka* Terine, Lelej & Girish Kumar, 2021
- *Odontomutilla sairandhriensis* Terine, Girish Kumar & Lelej, 2020
- *Odontomutilla vishwanathi* Terine & Girish Kumar, 2024
- *Pherotilla subterranea* sp. nov.

- *Smicromyrme (Eremotilla) williamsi* Terine & Girish Kumar, 2023
- *Strangulotilla sureshani* Terine, Lelej & Girish Kumar, 2021

5.2. New country records

- *Krombeinidia albopunctata* (André, 1907)
- *Spilomutilla eltola* (Cameron, 1898)

5.3. New state records

5.3.1. Karnataka

- *Bischoffitilla veda* (Cameron, 1892)
- *Smicromyrme durga* (Bingham, 1897)
- *Trogaspidia kolabensis* (André, 1894)

5.3.2. Kerala

- *Bischoffitilla serratula* (Cameron, 1892)
- *Bischoffitilla smithi* Lelej, 2005
- *Krombeinidia lilliputiana* (André, 1894)
- *Kurzenkotilla cicatricifera* (André, 1894)
- *Promecilla pulchriventris* (Cameron, 1892)
- *Promecilla yerburghi* (Cameron, 1892)
- *Smicromyrme nigrigena* (André, 1894)
- *Spilomutilla cotesii* (Cameron, 1897)
- *Storozhenkotilla binghami* (Lelej, 2005)
- *Trogaspidia agelia* (Cameron, 1900)
- *Trogaspidia intermedia* (Saussure, 1867)
- *Trogaspidia ruficrus* (Magretti, 1892)
- *Zeugomutilla bainbriggei* (Turner, 1911)

5.3.3. Tamil Nadu

- *Promecilla pulchriventris* (Cameron, 1892)

5.4. Future Prospects

The present study will form an initial and basal reference work on mutillid fauna of the Central & Southern Western Ghats. Before this study, only 46 species (Terine *et al.*, 2020) were reported from Western Ghats, representing only a very minor fraction of the fauna of Western Ghats. Now the number has become **72** including 9 new species. Mutillid wasps play an important role in controlling the population of some members of other Hymenoptera, Diptera, Coleoptera and some Lepidoptera. So, future research work will give more insights into the studies on the biology of these wasps. The molecular and phylogenetic studies of these wasps are an exciting area yet to be investigated.

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