WELCOME!!!

RICE GRASSHOPPERS (ACRIDIDAE AND PYRGOMORPHIDAE: CAELIFERA, ORTHOPTERA) DIVERSITY WITH A NEW RECORD FOR NEPAL

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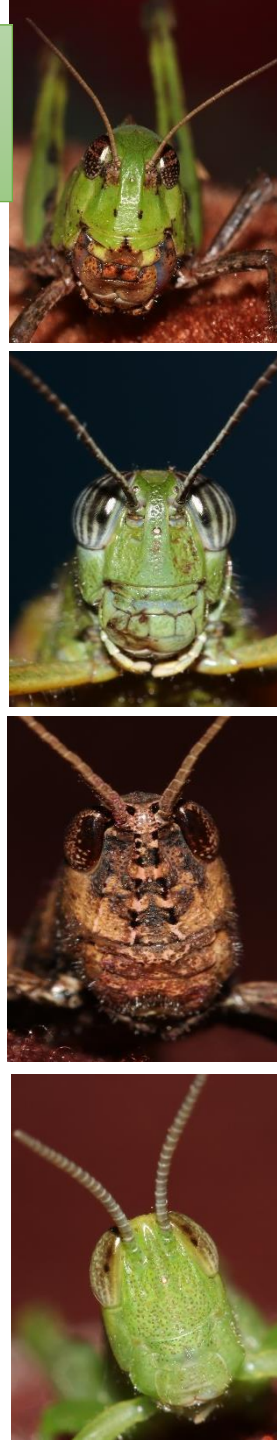
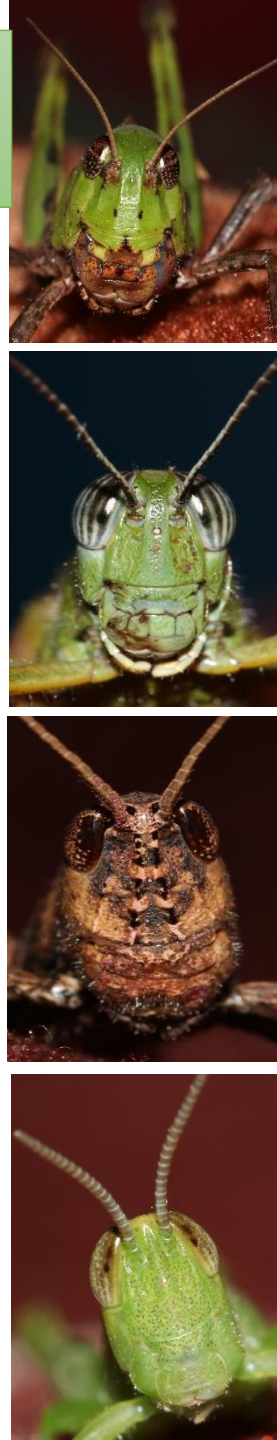
INTRODUCTION

- Grasshoppers and crickets are present throughout the world with **29,198** species described world wide (Cigliano, Braun, Eades, & Otte, 2021)
- **Latereille** created the order Orthoptera in 1793 AD
- Orthoptera is the **largest extant polyneopteran** order
- **311 species** of orthoptera are reported from Nepal (Ingrisch, 2006)
- Members of the order are characterized by the presence of cryptopleuron, saltatorial legs, tegmina and tympana.
- Comprises of two sub-order:
  - **Caelifera:** Short antennae with less than 25 segments, tympana on the first abdominal segment, femoro-tegminal stridulation and short ovipositor
  - **Ensifera:** long antennae with more than 30 segments, tympana on fore tibiae, tegminal stridulation and long ovipositor

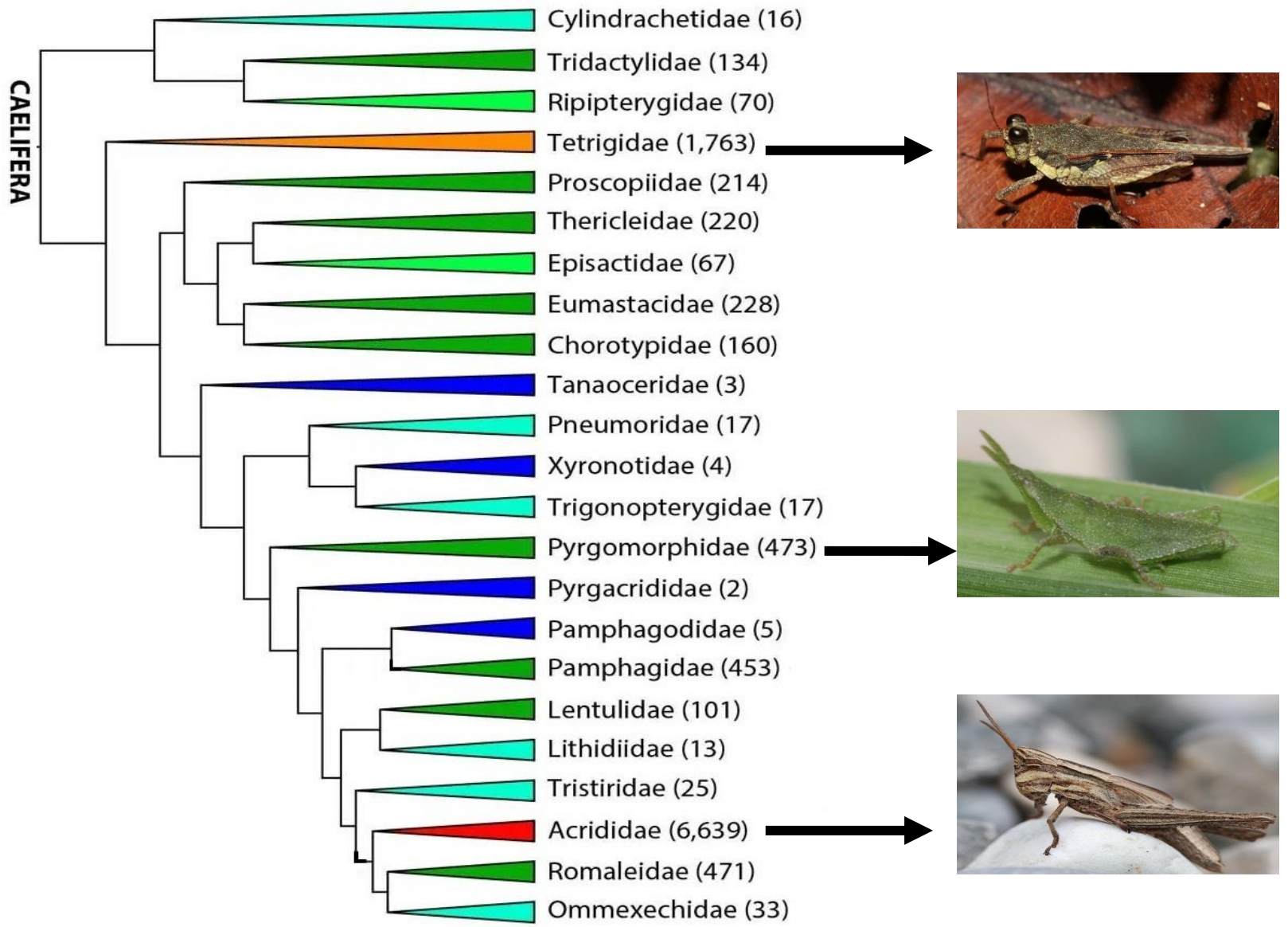


…INTRODUCTION

- Rice, a major staple diet, grown from an altitude of **60 to 3,050 masl** in Nepal (Paudel, 2011)
- Grasshoppers are abundantly present in the rice ecosystem (Ansari, Aryal, & Dangi, 2015)
- Very few works have been carried out regarding the diversity of Orthoptera fauna on rice crop in Nepal
- Current classifications are based on the protocols of Orthoptera species file version 5.0/5.0; online orthoptera database (Cigliano et. al, 2021)
- This presentation covers Acrididae & Pyrgomorphidae of rice crop along altitudinal gradient of Chitwan and Parbat districts, Nepal

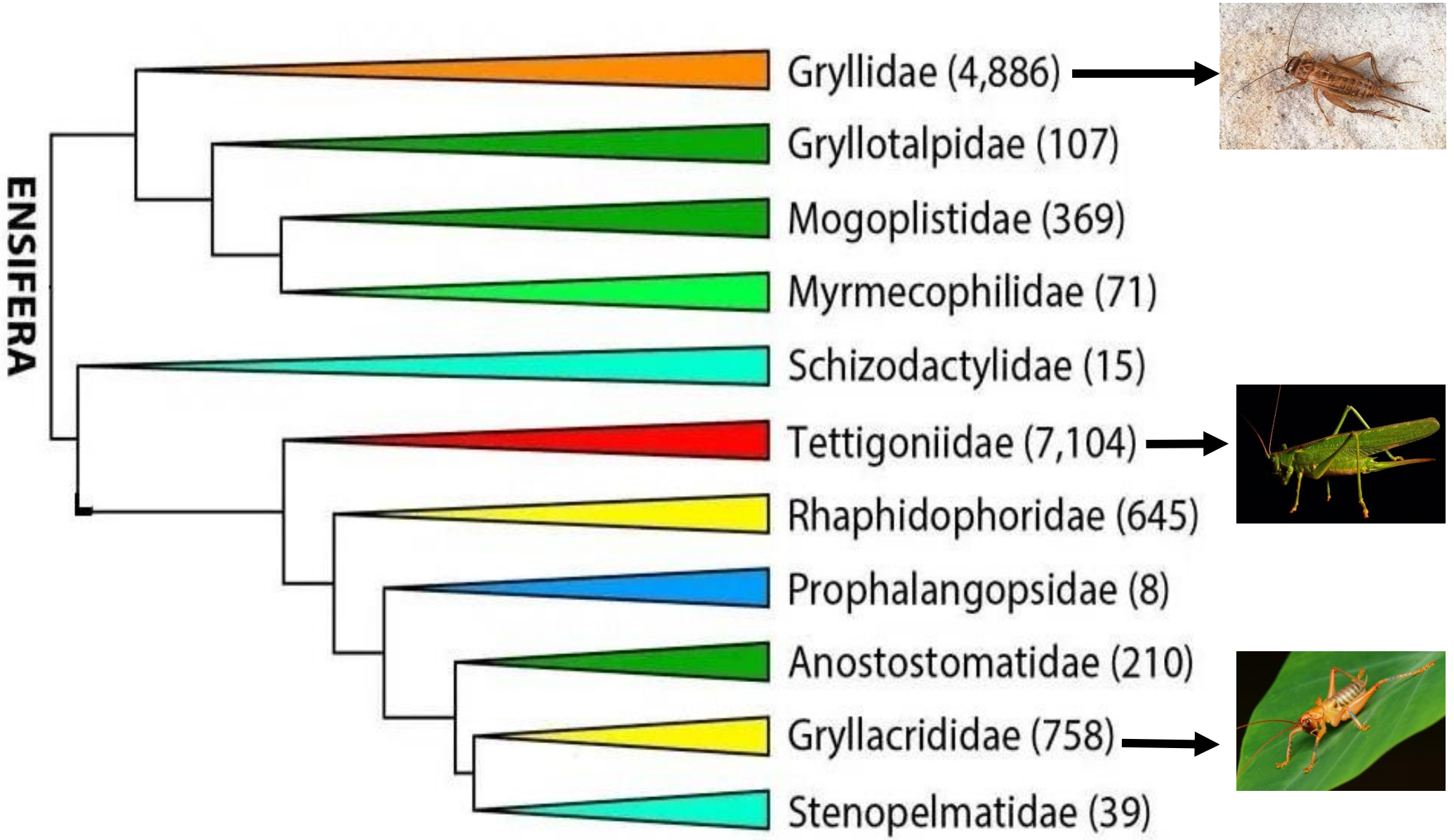


FAMILY TREE OF SUB-ORDER CAELIFERA



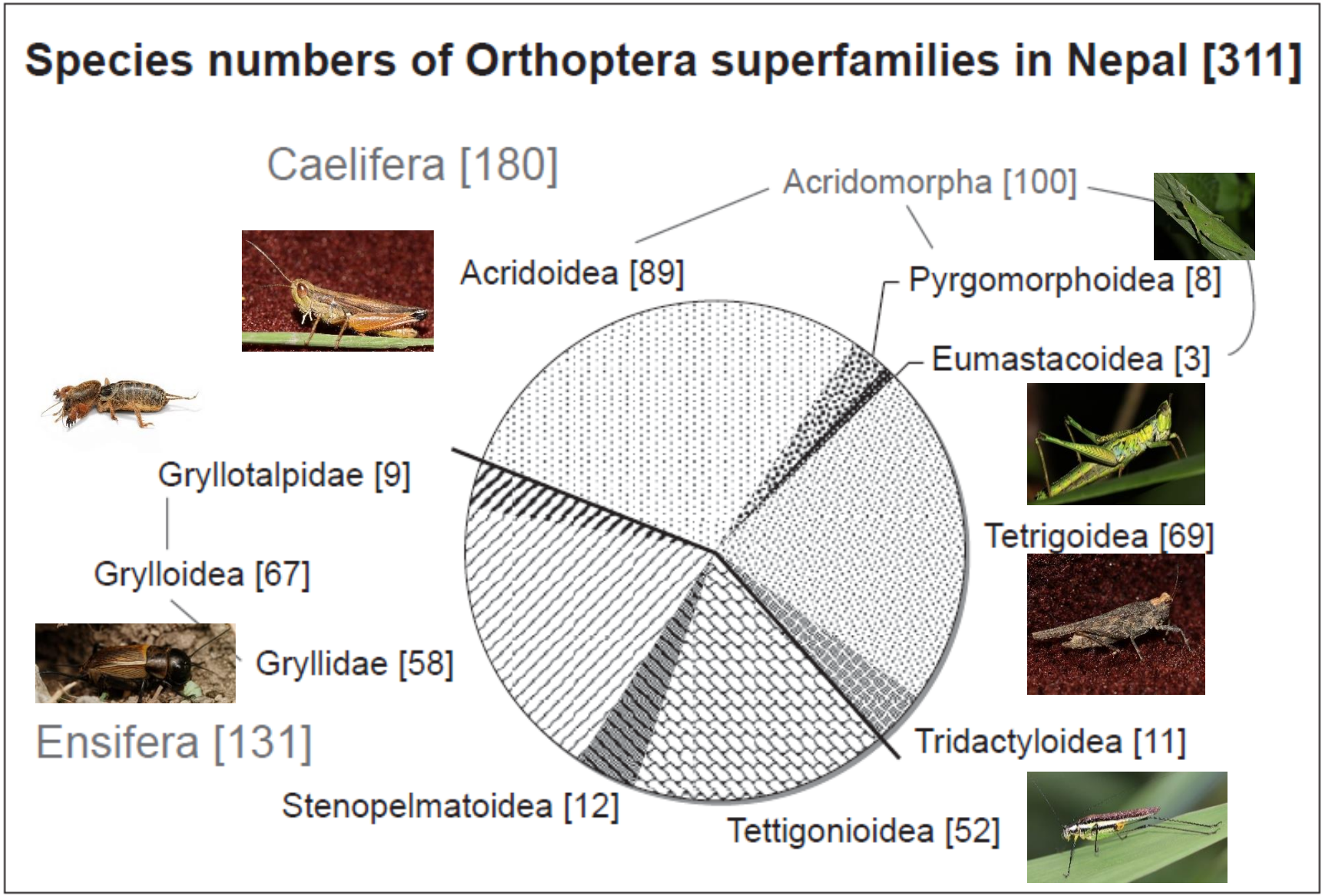
Source: Song et.al, 2015

FAMILY TREE OF SUB-ORDER ENSIFERA



Source: Song et. al, 2015

OVERVIEW OF ORTHOPTERA FAUNA FROM NEPAL



Source: Ingrisch, 2006




- Published a checklist of Nepali orthoptera (2006)
- ❖ Total species: 311 (Caelifera: 180, Ensifera: 131)
- ❖ 51 Caelifera & 31 Ensifera species endemic to Nepal
- Reported and described **59 new** species from Nepal

Dr. Sigfrid Ingrisch, a father figure to Nepali Orthoptera

OBJECTIVES

- Provide an overview of grasshoppers present in rice eco-system
- Provide an identification key to the grasshoppers present in rice eco-system
- Provide a brief description of a species with new record for Nepal

MATERIAL AND METHODS

Table 1. Study sites in Chitwan and Parbat districts, Nepal

Study sites	masl	Latitude	Longitude
Rampur, Chitwan	258±10	$27^0$38´43"N	$84^0$21´2" E
Modibeni, Parbat	758±10	$28^0$12’6” N	$83^0$40’23”E
Kairimta, Parbat	1258±10	$28^0$16’12” N	$83^0$43’4”E
Kalimati, Parbat	1758±10	$28^0$16’34” N	$83^0$42’10”E



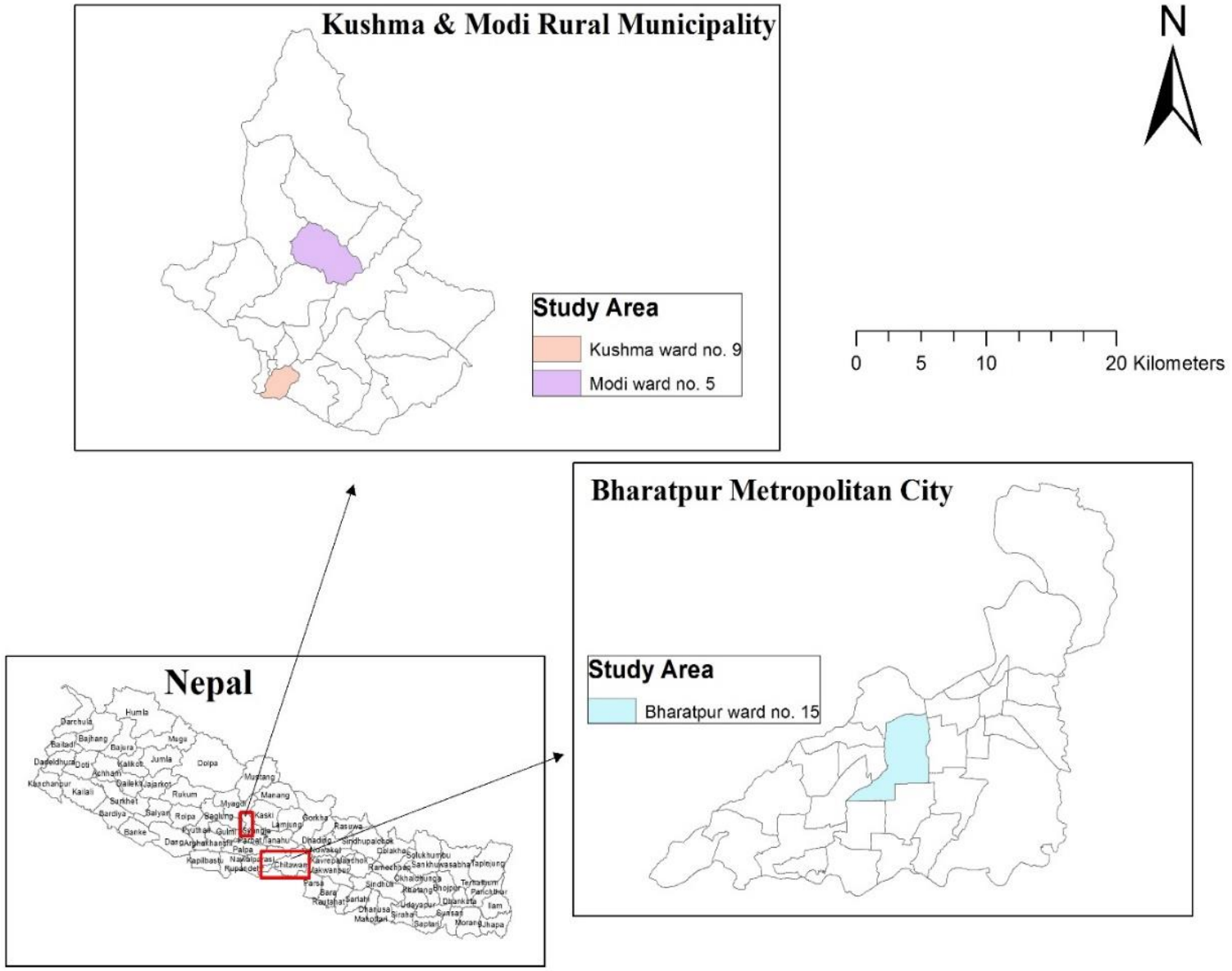
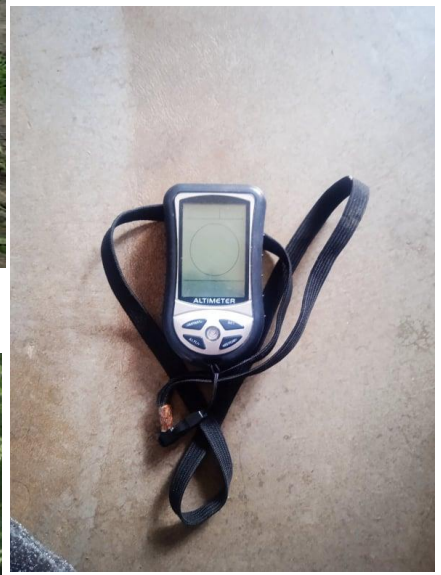



Figure 1. Map of Nepal showing study sites in Chitwan and Parbat districts, Nepal




Rampur, Chitwan (258 ±10 masl)



DA-8 Altimeter

Modibeni, Parbat (758 ±10 masl)

Kairimta, Parbat (1258 ±10 masl)

Kalimati, Parbat (1758 ±10 masl)

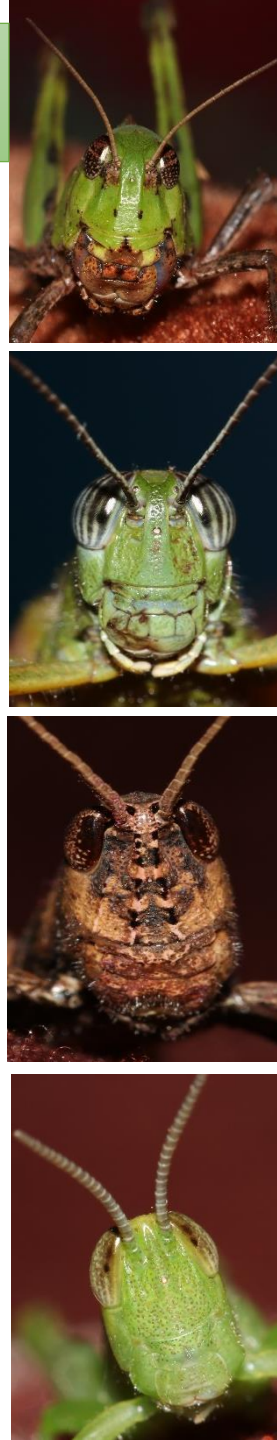
Table 2. Topography and salient features of the study sites

Features	Rampur, Chitwan	Modibeni, Parbat	Kairimta, Parbat	Kalimati, Parbat
Location	**Inner Terai**	**Foot hills**	**Mid hills**	**High Hills**
Climate	**Sub-tropical** & humid with cool winters & hot summers	**Sub-tropical** & humid with cool winters & warm summers	**Sub-temperate** & humid with cold winters & warm summers	**Temperate** & humid with cold winters & cool summers
Topography	Fertile **plains** under the command of Narayani river	Fertile **plains** under the command of Modi and Kaligandaki river	**Sloppy uplands & lowlands** terrain irrigated by rainfall and natural streams	**Sloppy uplands & lowlands** terrain irrigated by rainfall and natural streams
Vegetation	*Sal, Khair, Sisso, Simal*	Pine, Alder, *Chilaune, Katush*	Alder, *Chilaune*, Pine, *Katush*	Rhododendron, Wild Himalayan cherry, Alder, *Chilaune*, Pine




Sampling grasshoppers in rice fields

- Transects walked at a **slow pace (1.2 km/hr)** with visual observations in an identical fashion as per Isern-Vallverdu, Pedrocchi-Renault, and Voisin (1993)
- Time taken for each transect walk: **60 seconds**
- Extensive exploration of each plot carried out for about **half an hour** to identify adults, their sex, and to determine the species as suggested by Voisin (1980)
- Photographs taken with field camera (**Canon Eos 80 D with canon macro lens 100mm 1:2.8 USM**)
- Selected study sites surveyed once a month from nursery to ripening stages of rice **(June to October, 2019)**
- Collection time: **0600 to 1100** hours as per Chitra, Soundararajan, and Gunathilagaraj (2000)



Insect collecting net

Photographing Orthoptera in field

Rearing of species in plastic jars

Feeding the grasshoppers

Orthoptera collection

Studying morphology of specimens

Taxonomic studies

- Nymphs reared in plastic jars feeding **cogon grass** (*Imperata cylindrica* (L.) Raeusch)
- Dry mounts prepared by **pinning** the specimens with phusis stainless steel insect pins (size #4 and #5), **labelled** and kept in display boxes
- Morphology studied under **Leica GZ6 Stereo Zoom Microscope**
- Specimens kept in **ethyl alcohol (75%)** for further study (if necessary)
- Morphometric measurements made using **Vernier calipers** (8" Digital Vernier Caliper x1)
- Taxonomy studies followed the works of Uvarov (1921, 1942, 1966); Dirsh (1956, 1961); Hollis (1965); Kevan and Chen (1969); Hollis (1971); Ingrisch (1987, 1990, 2002, 2006); Ingrisch and Garai (2001); Nayeem, and Usmani (2012); Kumar, Usmani, Rafi and Kumari (2014); Kumar, and Usmani (2015); Gupta and Chandra (2016); Khan and Usmani (2016); Swaminathan, Nagar, and Swaminathan (2018); Gupta and Chandra (2018)




GRASSHOPPER FAUNA ASSOCIATED WITH RICE ECO-SYSTEM

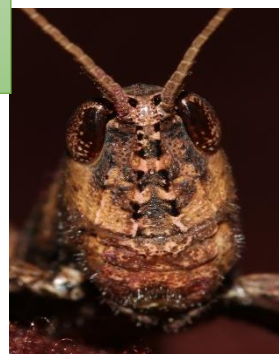


Table 3. Grasshopper species recorded from rice fields in Chitwan and Parbat districts (Jun-Oct, 2019)

Species	Family	Sub-family	Location
Acrida exaltata Walker, 1859	Acrididae	Acridinae	M
Atractomorpha crenulata Fabricius,1793	Pyrgomorphidae	Pyrgomorphinae	Kr, M
Aulacobothrus sp. Walker, 1871	Acrididae	Gomphocerinae	Kr
Ceracris nigricornis Walker, 1870	Acrididae	Oedipodinae	Kr
Chrotogonus trachypterus Blanchard, 1836	Pyrgomorphidae	Pyrgomorphinae	M
Diabolocatantops innotabilis Walker, 1870	Acrididae	Catantopinae	R
Eyprepocnemis alacris Serville, 1838	Acrididae	Eyprepocnemidinae	Kr
Gastrimargus africanus Saussure, 1888	Acrididae	Oedipodinae	R
Heteropternis respondens Walker, 1859	Acrididae	Oedipodinae	Kr
Hieroglyphus banian Fabricius, 1798	Acrididae	Hemiacridinae	M
Nepalocaryanda latifrons Ingrisch, 1990	Acrididae	Oxyinae	Km
Oxya fuscovittata Marschall, 1836	Acrididae	Oxyinae	R

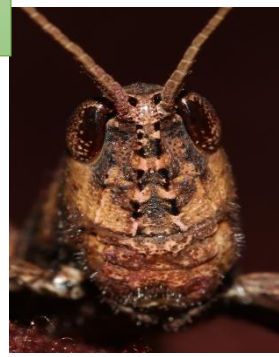
Note: R= Rampur, Chitwan; M= Modibeni, Parbat; Kr= Kairimta, Parbat; Km= Kalimati, Parbat




Species	Family	Sub-family	Location
Oxya hyla Serville, 1831	Acrididae	Oxyinae	Kr, M
Oxya japonica Thunberg, 1815	Acrididae	Oxyinae	M
Oxya velox Fabricius, 1787	Acrididae	Oxyinae	Kr, M
Peripolus nepalensis Uvarov, 1942	Acrididae	Calliptaminae	Km
Phlaeoba antennata antennata Brunner von Wattenwyl, 1893	Acrididae	Acridinae	R
Phlaeoba infumata Brunner von Wattenwyl, 1893	Acrididae	Acridinae	Kr, M
Spathosternum prasiniferum Walker, 1871	Acrididae	Spathosterninae	Km, Kr, M, R
Stenocatantops splendens Thunberg, 1815	Acrididae	Catantopinae	Kr, M
Tagasta indica Bolívar, 1905	Pyrgomorphidae	Pyrgomorphinae	R
Trilophidia annulata Thunberg, 1815	Acrididae	Oedipodinae	Km, Kr, M, R
Xenocatantops humilis Serville, 1838	Acrididae	Catantopinae	Km, Kr, M

Note: R= Rampur, Chitwan; M= Modibeni, Parbat; Kr= Kairimta, Parbat; Km= Kalimati, Parbat

IDENTIFICATION KEY OF SOME GRASSHOPPER GENERA ASSOCIATED WITH RICE FROM NEPAL



1. Head, in profile, generally coned headed (Plate 1,2); fastigium and vertex with medial groove dorsally (Plate 3) **2**

Plate 1

Plate 2

Plate 3

- Head, in profile, generally vertical (Plate 4), or slightly oblique (Plate 5) ; fastigium and vertex without medial groove dorsally (Plate 6) **4**

Plate 4

Plate 5

Plate 6

2. Body never depressed; prosternum without reflexed, collar like anterior margin **3**

- Body depressed (Plate 7); prosternum with reflexed, collar-like anterior margin (Plate 8) ..... *Chrotogonus* Serville,1838

3. A row of tubercle in the lateral side of the head large and irregular; eyes oval (Plate 9) .....*Tagasta* Bolívar, 1905

- Tubercles on head and pronotum small; eyes elliptical and normal (Plate 10)..... ..... *Atractomorpha* Saussure, 1862

Plate 7

Plate 8

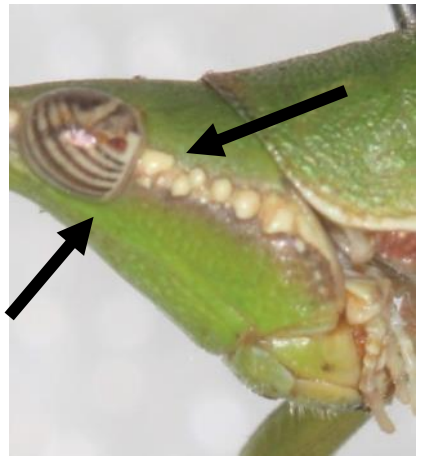


Plate 9

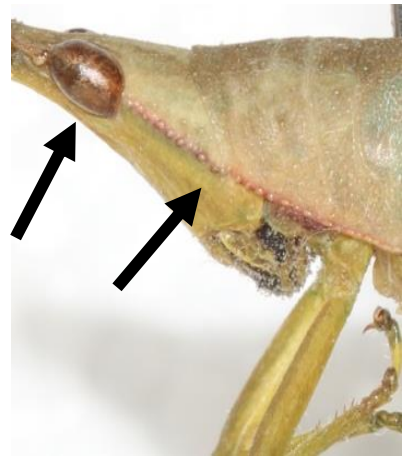


Plate 10

4. Prosternal process present (Plate 11, 12, 13); hind tibiae with or without dorso-external apical spine **5**

- Prosternal process often absent (Plate 14), if present, body strongly elongate and antennae ensiform (Plate 15); hind tibiae without dorso-external apical spine **10**

5. Lower knee lobe of hind femora never spined; valves of ovipositor never serrate or spined; hind tibiae never flattened..... **6**

- Lower knee lobe of hind femora spined (Plate 16) or not; valves of ovipositor serrate or spined (Plate 17); hind tibiae flattened (Plate 18).....**12**

Plate 11

Plate 12

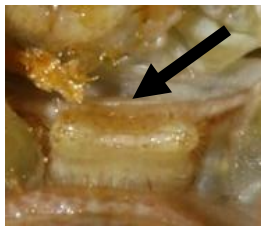


Plate 13

Plate 14

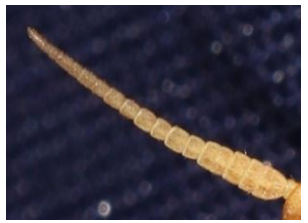


Plate 15

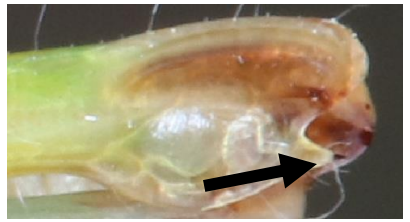


Plate 16

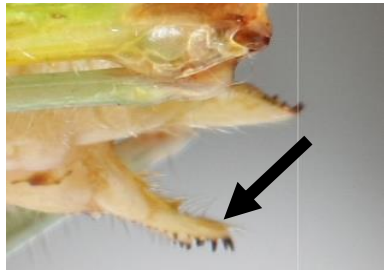


Plate 17

Plate 18

6. Hind femora never considerably robust (Plate 19), often reaching beyond apex of abdomen; male cercus never toothed apically (Plate 21) **7**

- Hind femora considerably robust (Plate 20), never reaching beyond apex of abdomen; male cercus large, strong, curved and toothed apically (Plate 22) .... *Peripolus* Martínez y Fernández-Castillo, 1898

7. Radial area of tegmina without transverse stridulatory veinlets **9**

- Radial area of tegmina with transverse stridulatory veinlets (Plate 23) **8**

Plate 19

Plate 20

Plate 21

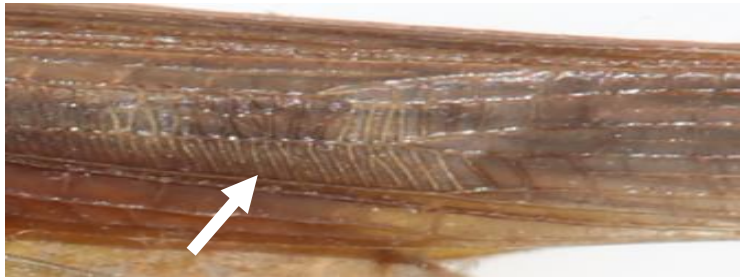


Plate 22

Plate 23

8.Radial area of tegmina with some parallel, thickened, transverse stridulatory veinlets (Plate 24) ; prosternal process not spatulate ……. ……. *Hieroglyphus* Krauss, 1877

- Radial area of tegmina with a series of regular, parallel, considerably condensed (densely packed) transverse stridulatory veinlets (Plate 25); prosternal process spatulate (Plate 26) ……. *Spathosternum* Krauss, 1877

9. Pronotum with lateral carinae linear (Plate 27); male cercus strongly compressed, apex downcurved (Plate 28) ……. *Eyprepocnemis* Fieber, 1853

- Pronotum without lateral carinae (Plate 29), if present, never linear; male cercus variable, never strongly compressed, apex normal ……. **13**

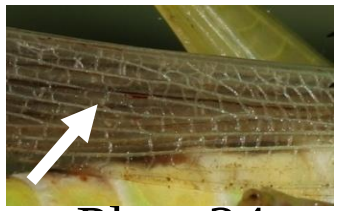


Plate 24

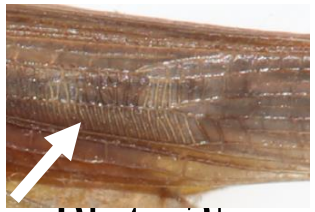


Plate 25


Plate 26


Plate 27

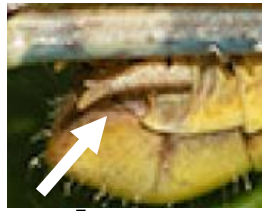


Plate 28

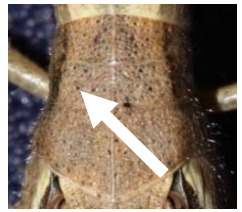


Plate 29

10. Stridulatory serrations on inner side of hind femora absent..... **11**

- Stridulatory serrations on inner side of hind femora present (Plate 30) .... *Aulacobothrus* Bolívar, 1902

It is represented by a single species *Aulacobothrus* sp.

11. Body often slender; frons oblique (Plate 31); medial area of tegmen often without intercalary vein, if present, never serrated in both sexes **15**

- Body rather sturdy; frons often vertical (Plate 32); medial area of tegmen with intercalary vein often serrated.....**16**

12. Ventral genicular lobes of posterior femora unspined, fastigium of vertex very broad and with indication of foveolae (Plate 33)..... *Nepalocaryanda* Ingrisch, 1990

- Ventral genicular lobes of posterior femora spined (Plate 34); fastigium of vertex short, without mid longitudinal carinula (Plate 35); frontal ridge sulcate..... ***Oxya***


Plate 30

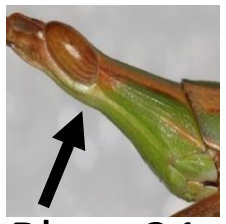


Plate 31


Plate 32


Plate 33

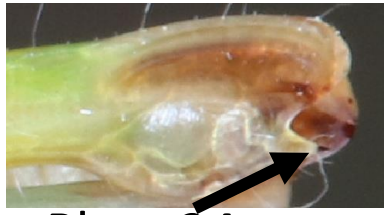


Plate 34


Plate 35

13. Prosternal process short…….. *Stenocatantops* Dirsh, 1953

- Prosternal process cylindrical, conical or antero-posteriorly compressed ….. **14**

14. Pronotum slightly constricted in prozona (Plate 36); prosternal process acutely conical (Plate 38)…….. *Xenocatantops* Dirsh, 1953

- Pronotum sub-cylindrical (Plate 37), never constricted in middle; prosternal process slightly antero-posteriorly compressed (Plate 39) ……. ……. *Diabolocatantops* Jago, 1984

Plate 36

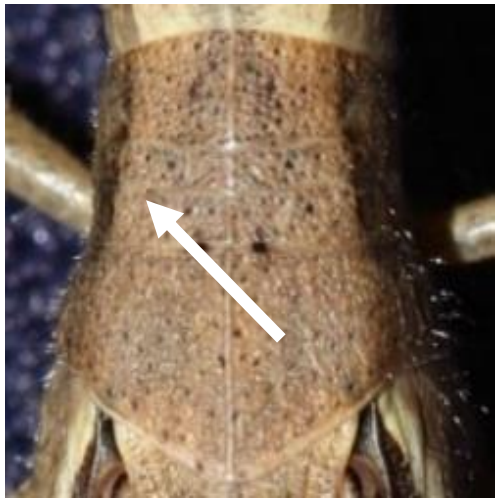


Plate 37

Plate 38

Plate 39

15. Body–medium, Head normal (Plate 40); frontal ridge deeply sulcate (Plate 42)…… *Phlaeoba* Stål, 1861

- Body strongly elongate; head acutely elongate (Plate 41; frontal ridge shallowly sulcate (Plate 43) …… *Acrida* Linnaeus, 1758

16. Pronotum with median carina crossed by two transverse sulci (Plate 44)…… ……*Trilophidia* Stål, 1873

- Pronotum with median carina crossed by one transverse sulci (Plate 45) …… **17**

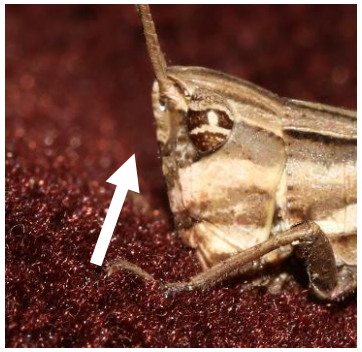


Plate 40

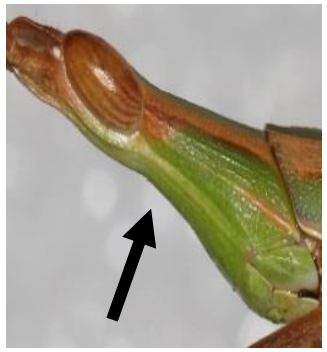


Plate 41

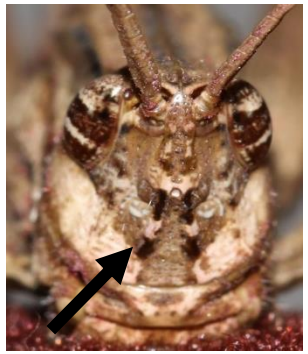


Plate 42


Plate 43

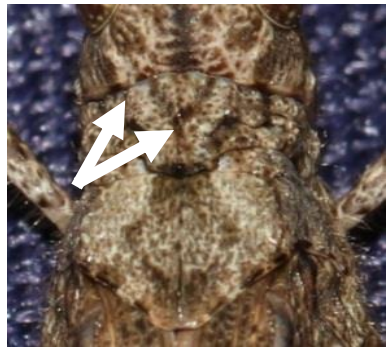


Plate 44


Plate 45

17. Inner spur on inner side of hind tibiae simple not much longer than external one; medial area of tegmina not specialized …… **18**

- Inner spur on inner side of hind tibiae much longer than external one, with small pre-apical projection; medial area of tegmina with dense, thickened, oblique, parallel veinlets (Plate 46) …….. *Heteropternis* Stål, 1873

18. Pronotum strongly crest-like, anteriorly projecting above vertex (Plate 47) …….. *Gastrimargus* Saussure, 1884

- Pronotum never crest like, never projecting above vertex (Plate 48)…….. …… *Ceracris* Walker, 1870

Plate 46

Plate 47

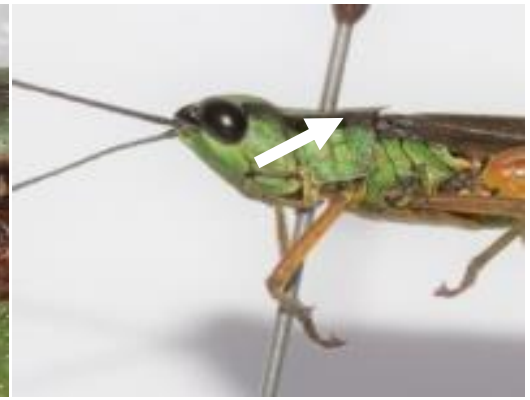
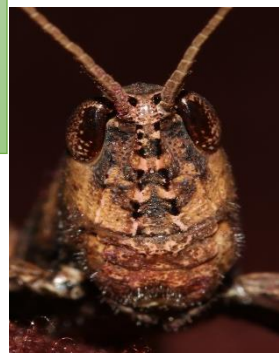
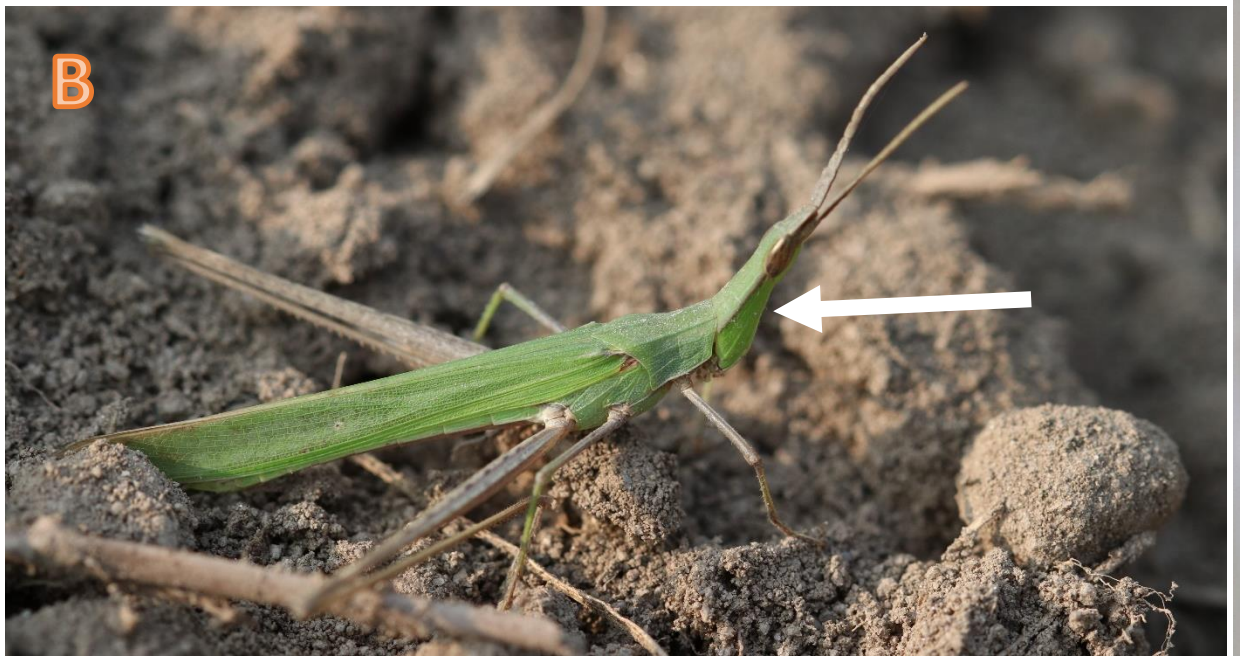


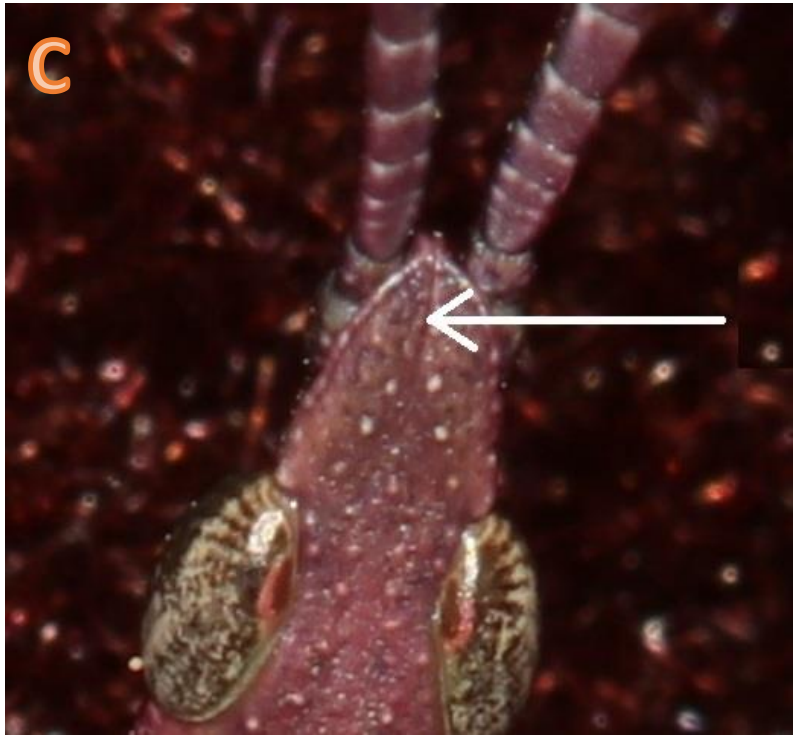
Plate 48

PHOTO GALLERY:
COMMON RICE GRASSHOPPERS OF NEPAL





Acrida exaltata Walker, 1859

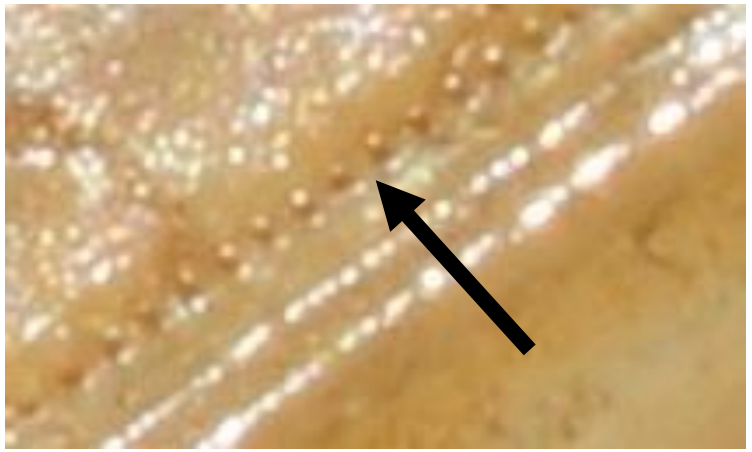


Atractomorpha crenulata Fabricius, 1793

A

B

C

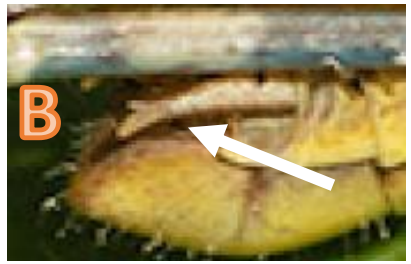


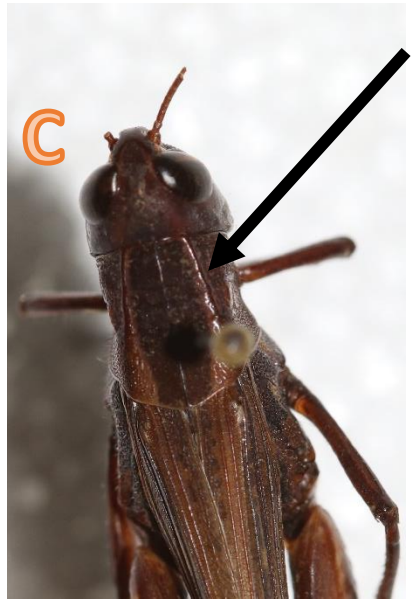
Aulacobothrus sp.

Ceracris fasciata Brunner von Wattenwyl, 1893 *Ceracris nigricornis* Walker, 1871

Chrotogonus trachypterus Blanchard, 1836

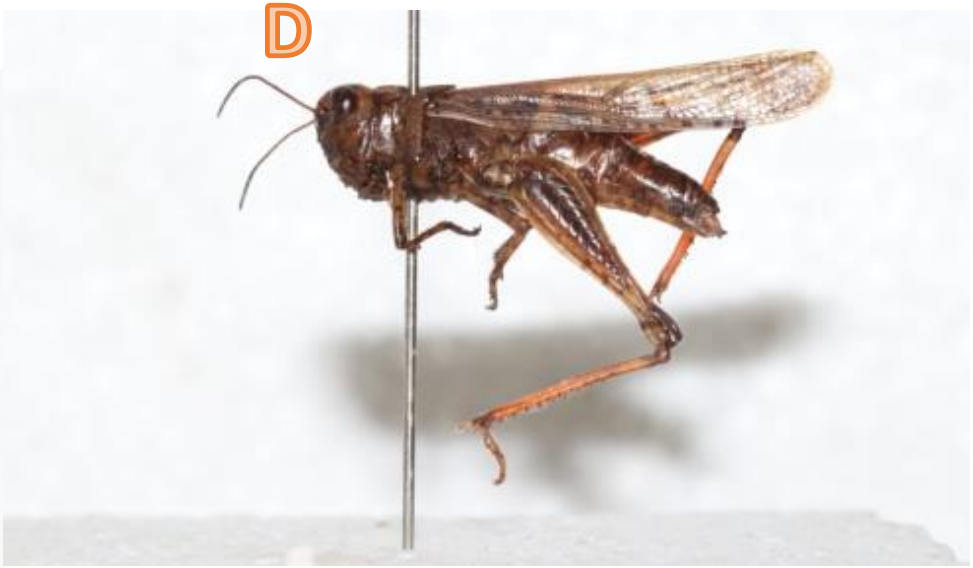
Diabolocatantops innotabilis, Walker 1870





Eyprepocnemis alacris Serville,1838

Gastrimargus africanus africanus Saussure, 1888

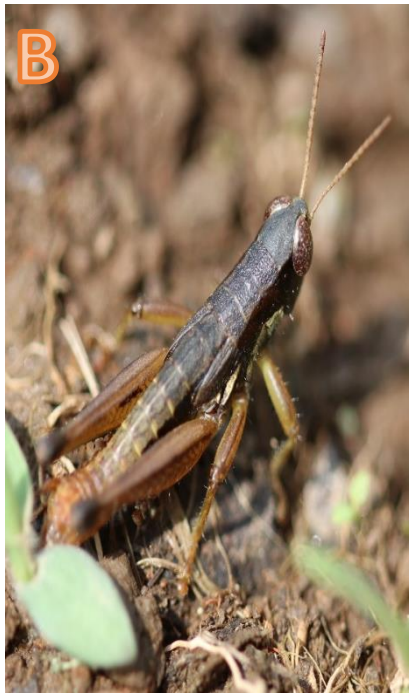


Female

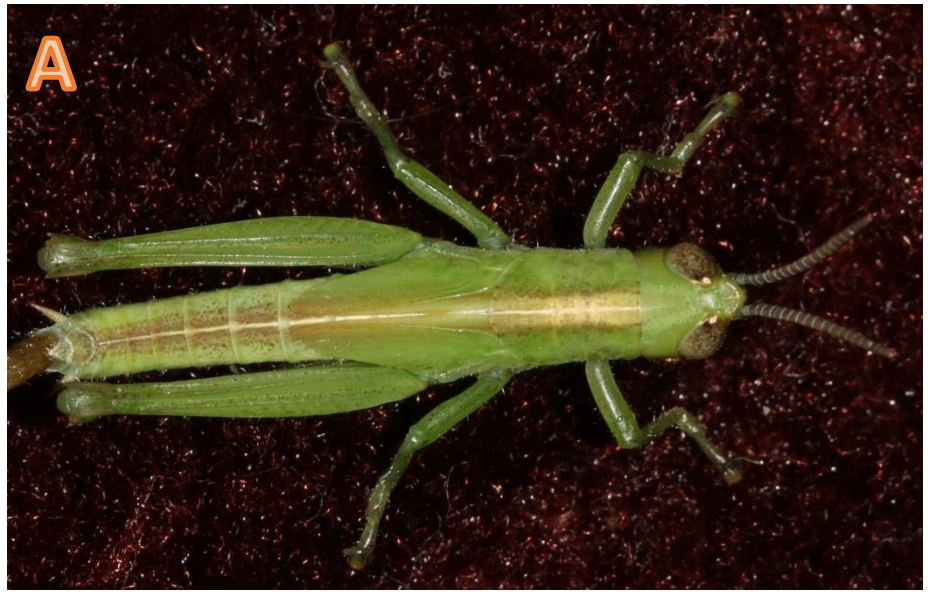
Male

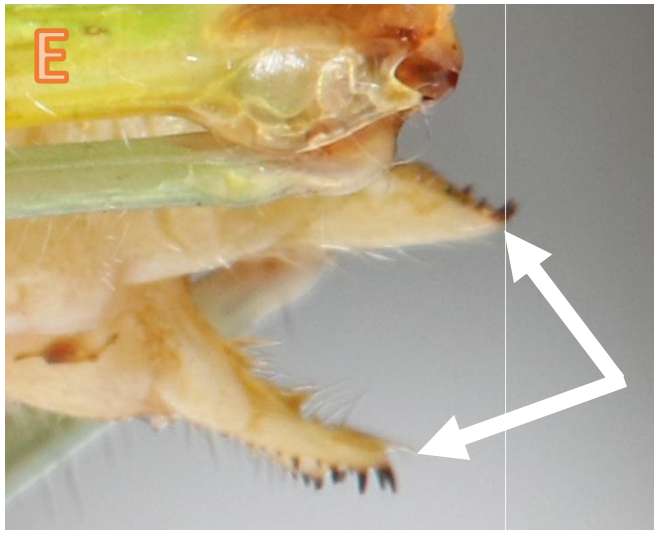
Heteropternis respondens Walker, 1859

Hieroglyphus banian Fabricius, 1798

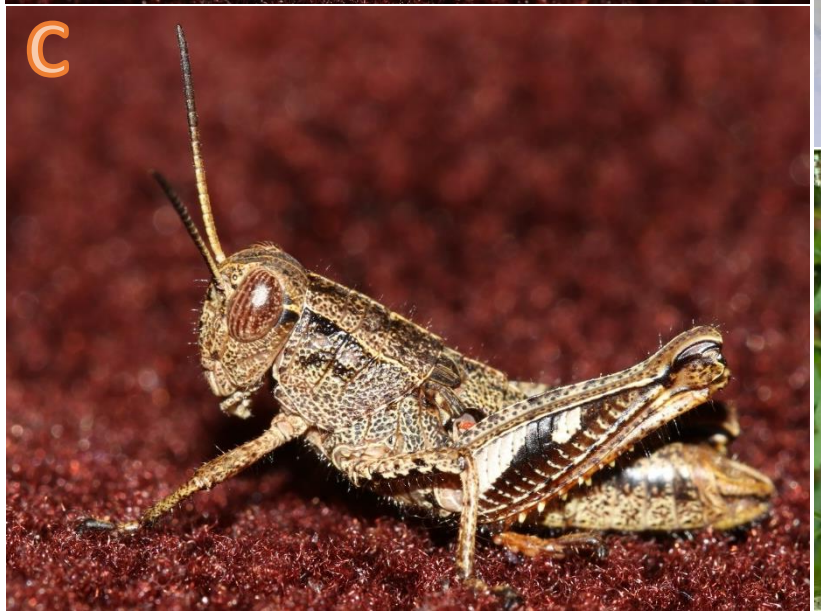


Nepalocaryanda latifrons Ingrisch, 2001





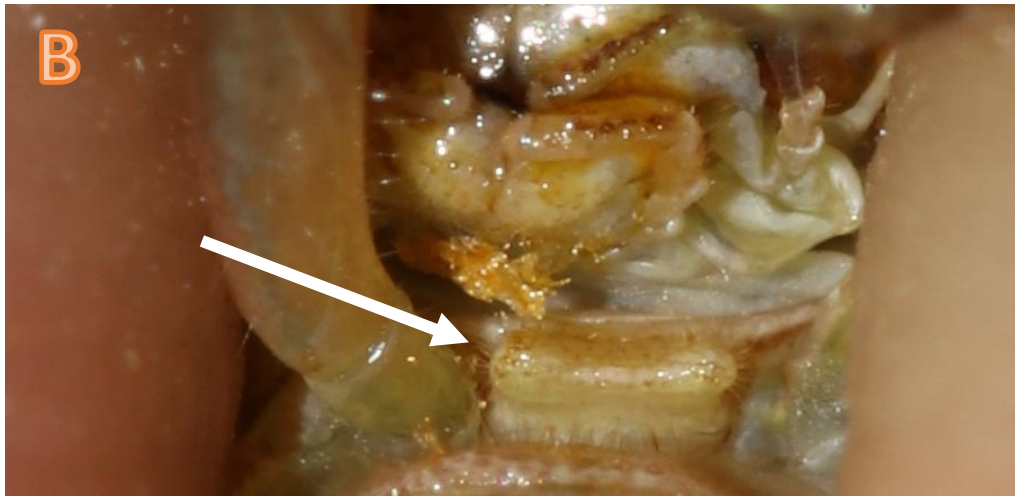
Oxya hyla Serville, 1831

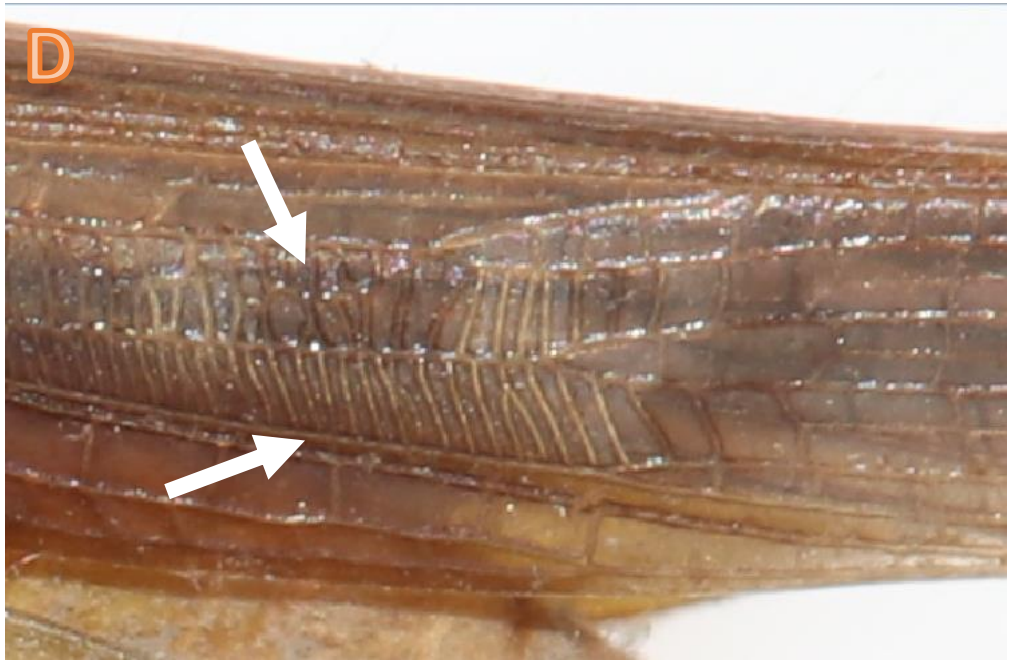


Peripolus nepalensis Uvarov, 1942

Phlaeoba antennata antennata Brunner von Wattenwyl, 1893

Phlaeoba infumata Brunner von Wattenwyl, 1893

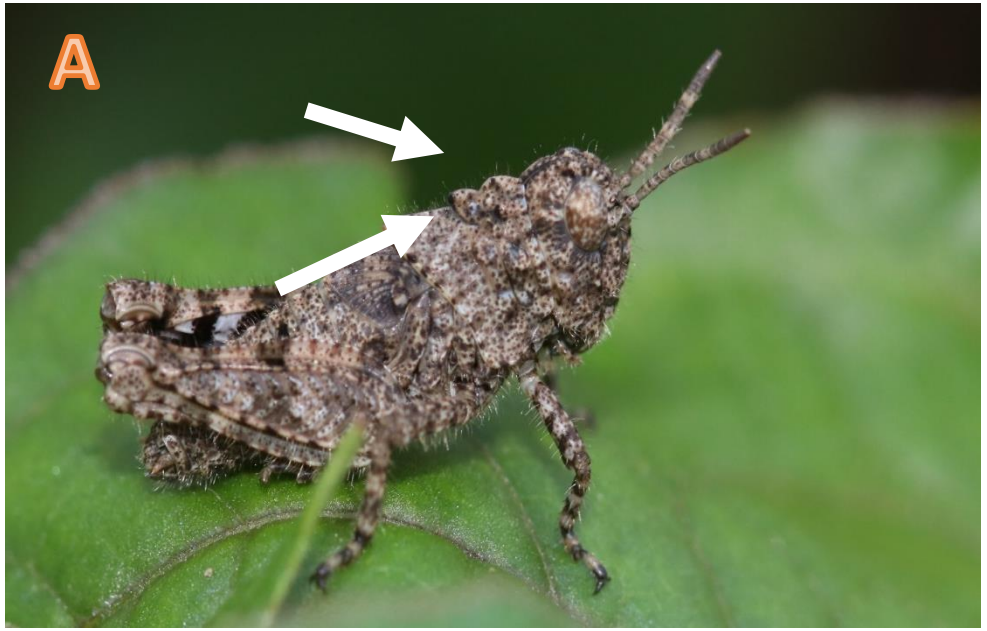


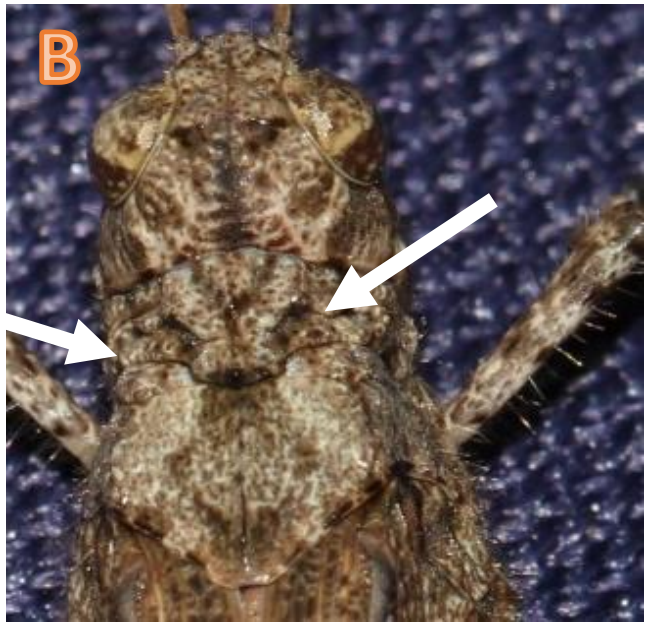


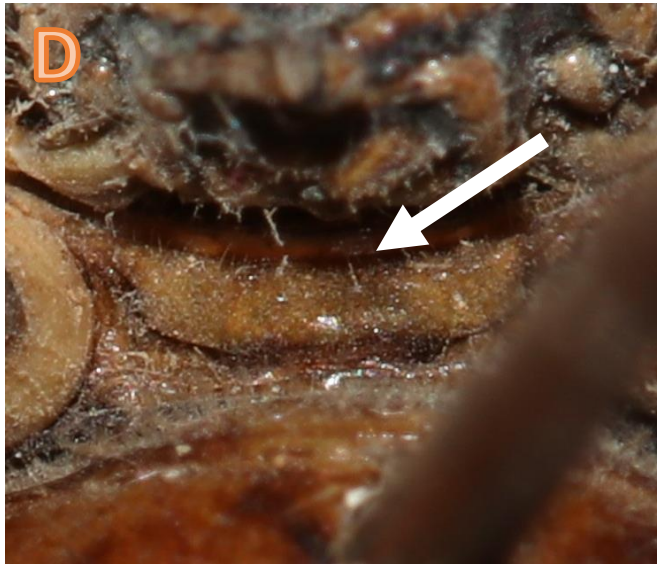
Spathosternum prasiniferum Walker, 1871

Stenocatantops splendens Thunberg, 1815

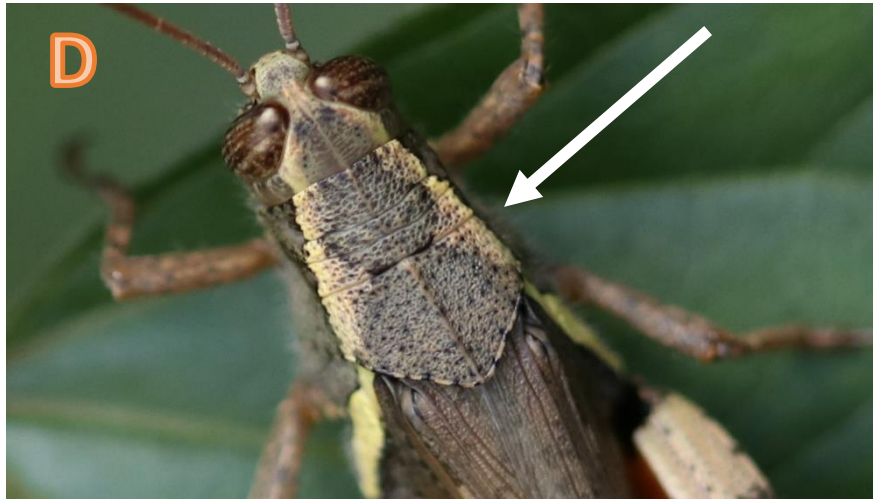
Tagasta indica Bolivar,1905







Trilophidia annulata, Thunberg 1815



Xenocatantops humilis Serville, 1838

NEW RECORD FOR NEPAL

Phlaeoba antennata antennata Brunner von wattenwyl, 1893

Brunner von Wattenwyl. 1893. Ann. Mus. Civ. Stor. Nat. Genova 2 13(33):125

Diagnostic characters: Tegmina narrow, the costa slightly expanded near the base, especially in the female, antennae ringed or tipped with obscure yellow

Materials examined:

- Chitwan, Rampur: 1♀, 1 ♂, 14-VI-2019; 1♀, 1 ♂, 28-VII-2019; 1♀, 1 ♂, 27-VIII-2019; 1♀, 1 ♂, 29-IX-2019; 1 ♂, 29-X-2019
- Churlingtar, Ghyalchok, Gorkha (27.808113, 84.719231): 2 ♀, 2 ♂, 5 nymphs, 6-VII-2020

Morphological measurements (mm):

Body parts	Male (♂)	Female (♀)
Total body length	24.12	32.46
Antenna length	12.63	14.76
Pronotum length	4.72	5.91
Hind femur length	14.94	18.56
Tegmina length	18.88	26.54

..NEW RECORD FOR NEPAL

Genus *Phlaeoba* Stål, 1861

Species previously reported from Nepal:

- *Phlaeoba infumata* Brunner von wattenwyl, 1893 (**Bey-Bienko, 1968; Chopard & Dreux, 1966; Ingrisch, 1987, 1990b, 2006; Ingrisch & Garai, 2001**)
- *Phlaeoba sikkimensis* Brunner von wattenwyl, 1893 (**Bey-Bienko, 1968; Ingrisch, 1987, 1990b**)

➢*Phlaeoba tenebrosa* Walker, 1871 (**Balderson & Yin, 1987**)

Peculiar generic characters:

➢Ensiform antennae

➢Head normal; vertex with distinct median carinula

➢Frons slightly oblique; frontal ridge deeply sulcate

➢Prosternal process absent

DIFFERENTIAL DIAGNOSIS

- Differs from *P. tenebrosa* in having **distinct lateral carina**, the latter with the lateral carina of pronotum indistinct or coarsely indicated or absent
- Differs from *P. infumata* in having **antennae ringed or tipped with obscure yellow**; posterior tibiae sordid blue or reddish, the latter with antennae unicolorous; posterior tibiae brownish testaceous
- Differs from *P. sikkimensis* in having the **sub-genital plate of male obtuse at apex** the latter having the sub-genital plate of male tapering at apex



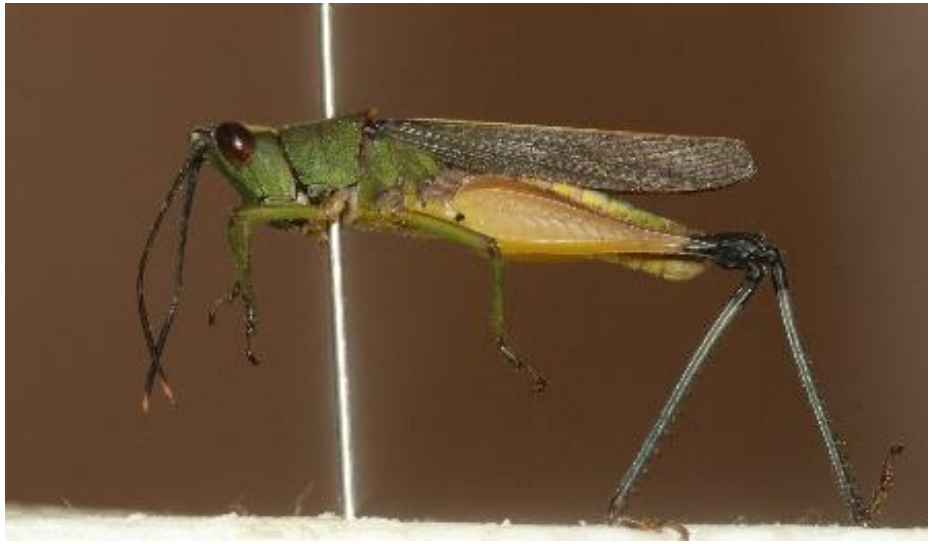

..NEW RECORD FOR NEPAL

Adult ♀

Nymph

P. antennata antennata in natural habitat

..NEW RECORD FROM NEPAL



Adult ♀

Adult ♂

P. antennata antennata

CONCLUSION

- A total of 23 species of Orthoptera fauna belonging to 2 families and 10 sub-families were recorded from rice fields of Chitwan and Parbat districts during the study period (June to October, 2019)

- One species *Phlaeoba antennata antennata* Brunner von wattenwyl, 1893 was reported as a species new to Nepal

- The association of taxonomically important morphological characters combined with external genitalia characters can reliably be used for distinguishing one species from another




ACKNOWLEDGEMENTS

- Agriculture and Forestry University
- The Orthopterists' Society
- IUCN SSC Grasshopper Specialist Group
- Plant Protection Society Nepal
- Plant Quarantine and Pesticide Management Centre
- Nepal Agriculture Research Council

THANK YOU!!!

ANY QUERIES??