Zoological and Entomological Letters

E-ISSN: 2788-8428
P-ISSN: 2788-8436
ZEL 2024; 4(1): 104-110
Received: 03-11-2023
Accepted: 04-12-2023

Senthilkumar N
Institute of Forest Genetics and Tree Breeding, Coimbatore, Tamil Nadu, India

Suresh Babu D
Institute of Forest Genetics and Tree Breeding, Coimbatore, Tamil Nadu, India

Sumathi R
Institute of Forest Genetics and Tree Breeding, Coimbatore, Tamil Nadu, India

Suresh Chand D
Zoological Survey of India, New Alipore, Kolkatta, West Bengal, India

Correspondence
Senthilkumar N
Institute of Forest Genetics and Tree Breeding, Coimbatore, Tamil Nadu, India

Inventory of Tettigoniidae (Orthoptera) in India

Senthilkumar N, Suresh Babu D, Sumathi R and Suresh Chand D

DOI: https://dx.doi.org/10.22271/letters.2024.v4.i1b.89

Abstract
In four Indian states-Bihar, Odisha, Jharkhand, and West Bengal-sixteen species of Tettigoniidae, representing ten genera and five subfamilies, have been identified in various habitats, including forestlands, grasslands, arable lands, and grasslands that fall under distinct agroclimatic zones. The observations were made by recurrent monthly visits to the respective states during a three-year period, from January 2021 to December 2023. Conocephalinae was the subfamily with the greatest number of species (7 species), followed by Phaneropterinae (5 species) and Hexacentrinae (2 species). Pseudophyllinae and Mecopodinae, on the other hand, each had only one species. According to any IUCN, 2023-1 category, none of the species discovered in the research region are recognized to be threatened.

Keywords: Orthoptera, Tettigoniidae, long-horned grasshopper, Indian states, inventory

Introduction
The approximately 1.5 million insect species found worldwide, just 6% are restricted to India, meaning that many groups remain unexplored. Among the greatest orders in the class Insecta, Orthoptera is one such group. Among them are the well-known locusts, crickets, katydids, mantids, and grasshoppers. Their enormous diversity, functional significance, sensitivity to disturbance, and simplicity of sampling make them potentially valuable bioindicators for land management. They constitute a dominating group of herbivorous insects worldwide. Some of the most noticeable and prevalent insects in tropical insect populations are tettigoniids, also known as long-horned grasshoppers or katydids (Superorder: Orthopteroidea; Order: Orthoptera; Suborder: Ensifera; Superfamily: Tettigonoidea; Family: Tettigoniidae). Currently, the Tettigoniidae family has more than 6200 recognized species, which are divided into more than 1000 genera (Naskrecki and Otte, 1999) [11]. The majority of them are found in the world's tropical and subtropical regions. As they are consumed by birds, rodents, bats, monkeys, amphibians, and reptiles, they play a significant role in the food web in the tropics. There are currently around 6200 identified species in the Tettigoniidae family, organized into over 1000 genera (Naskrecki and Otte, 1999) [11]. Most of them are found in the tropical and subtropical regions of the planet. They are an important part of the tropical food web since they are eaten by reptiles, amphibians, birds, rodents, bats, and monkeys.

Materials and Methods
Inventory of Tettigoniidae has been carried out in four different habitats *viz*., forestlands, grasslands, arablelands and grasslands falling under different agro climatic zones of four states, which are depicted in the map mentioned below, in nineteen different locations in six districts of Odisha; thirteen different locations in four districts of Bihar; thirteen different locations in six districts of Jharkhand and forty eight different locations in four districts of West Bengal, (India) during January 2021 to December, 2023 (Fig.1).

Inventorying protocol
Plots for surveys were established once representative habitat types were chosen. Five of the 10 x 10 m quadrates that were created from each survey plot were selected at random for sampling. Sweep nets were set up to gather samples after the ground level vegetation was examined and the insects were manually removed. To count the nocturnal species, this exercise was conducted from 0600 to 0800 and then again from 1800 to 2000 hours. In addition to the nightly sample, a light trap-a portable light trap-was used, in accordance with Sanjayan's (1994) [16] recommendations for Orthoptera.

Following conventional protocols and identification, collected specimens were narcotized with menthol (Naphthalene) crystals and transported into the laboratory where they were air-dried for preservation. Specimens were recognized according to the following: Senthilkumar *et al*. (2001, 2002) [19-20], Senthilkumar and Divya (2020) [24], Divya and Senthilkumar (2020) [2], Raja Ganesh and Senthilkumar (2020) [13], and Rentz (1979) [14], Naskrecki (1994, 1996, 2000) [9-10, 12], Ingrisch and Shishodia (1997, 1998, 2000) [25], Shishodia (2000a, b) [25, 26].

Courtesy: https://www.geeksforgeeks.org/political-map-of-india/

Fig 1: Map of the study area indicating surveyed states in India

Results and Discussion

In four Indian states-Bihar, Odisha, Jharkhand, and West Bengal-a total of sixteen species of Tettigoniidae, representing ten genera and five subfamilies, have been identified in various habitats, including forestlands, grasslands, arablelands, and grasslands that fall under distinct agroclimatic zones (Table 1). They are Conocephalus (Anisoptera) maculatus (Le Guillou, 1841), Conocephalus (Anisoptera) melaenus (Haan, 1843), Conocephalus (Anisoptera) fasciatus (De Geer, 1773), Conocephalus (Anisoptera) longipennis (Haan, 1843), Conocephalus (Anisoptera) strictus (Scudder, 1875), Euconocephalus pallidus (Redtenbacher, 1891), Euconocephalus indicus (Redtenbacher, 1891), Ducetia japonica (Thunberg, 1815), Trigonocorypha unicolor (Stoll, 1787), Letana linearis Walker, 1869, Letana gracilis Ingrisch, 1990, Phaneroptera (Phaneroptera) gracilis Burmeister, 1838, Hexacentrus unicolor Serville, 1831, Khaoyaiana nitens Ingrisch, 1990, Phyllozelus siccus (Walker, 1869), and Mecopoda elongata (Linnaeus, 1758) (plate 1). More variety was seen in the subfamily Conocephalinae across all habitats. The highest number of tettigoniid species (15) was found in West Bengal, with Odisha (12 species), Jharkhand (10 species), and Bihar (8 species) following. The number of Orthoptera species found in forest lands was higher (15 species), then in grasslands (12 species), arable lands (5 species), and wastelands (3 species). Commonly observed in nearly all habitats were six species: Euconocephalus pallidus (Redtenbacher, 1891), Euconocephalus indicus (Redtenbacher, 1891), Ducetia japonica (Thunberg, 1815), Letana gracilis Ingrisch, 1990, and Phaneroptera (Phaneroptera) gracilis Burmeister, 1838. These species are Conocephalus (Anisoptera) maculatus (Le Guillou, 1841), Conocephalus (Anisoptera) longipennis (Haan, 1843), and Euconocephalus pallidus (Redtenbacher, 1891). Ten species were found in both grasslands and forests, then seven in both grasslands and arable areas, and six in each of the two habitat types. The following species were only found in forests: Conocephalus (Anisoptera) maculatus (Le Guillou, 1841), Conocephalus (Anisoptera) longipennis (Haan, 1843), Euconocephalus pallidus (Redtenbacher, 1891), Ducetia japonica (Thunberg, 1815), Phaneroptera (Phaneroptera) gracilis Burmeister, 1838, and Conocephalus (Anisoptera) melaenus (Haan, 1843),

fasciatus (De Geer, 1773), Conocephalus (Anisoptera) strictus (Scudder, 1875), Trigonocorypha unicolor (Stoll, 1787), Letana linearis Walker, 1869, Hexacentrus unicolor Serville, 1831, Khaoyaiana nitens Ingrisch, 1990, Phyllozelus siccus (Walker, 1869), and Mecopoda elongata (Linnaeus, 1758) were only found in forests. In the four states of India, a higher diversity of long-horned grasshoppers was found in the habitats of forestlands, grasslands, and arablelands. The host plant distribution theory is supported by this (Cornell & Lawton 1992). According to Senthilkumar *et al*. (2009) [22], the ecosystems of savannah and grasslands enable higher species inhabitation, which is related to the diversity of orthoptera. Grasshoppers that can survive on grasses despite their high silica content seek sanctuary in grasslands (Chand & Muralirangan 2006) [1]. Populations of orthopterans oscillate within specific bounds in a stable and well-balanced habitat that is based on heterogeneous conditions (Senthilkumar *et al*. 2006) [21]. This observation aligns with the research conducted by Senthilkumar *et al*. (2009) [22] on acridid diversity in Tamilnadu. According to Mulkern (1967) [8], the majority of grasshoppers are very discriminating when it comes to their host plants or habitats, as evidenced by the discovery that some species are unique in particular ecosystems. Because host plants were available, *C. maculatus*, *E. pallidus*, *E. indicus*, *P. gracilis*, and *D. japonica* were represented in grasslands and arable fields (Sanjayan *et al*., 2002) [17].

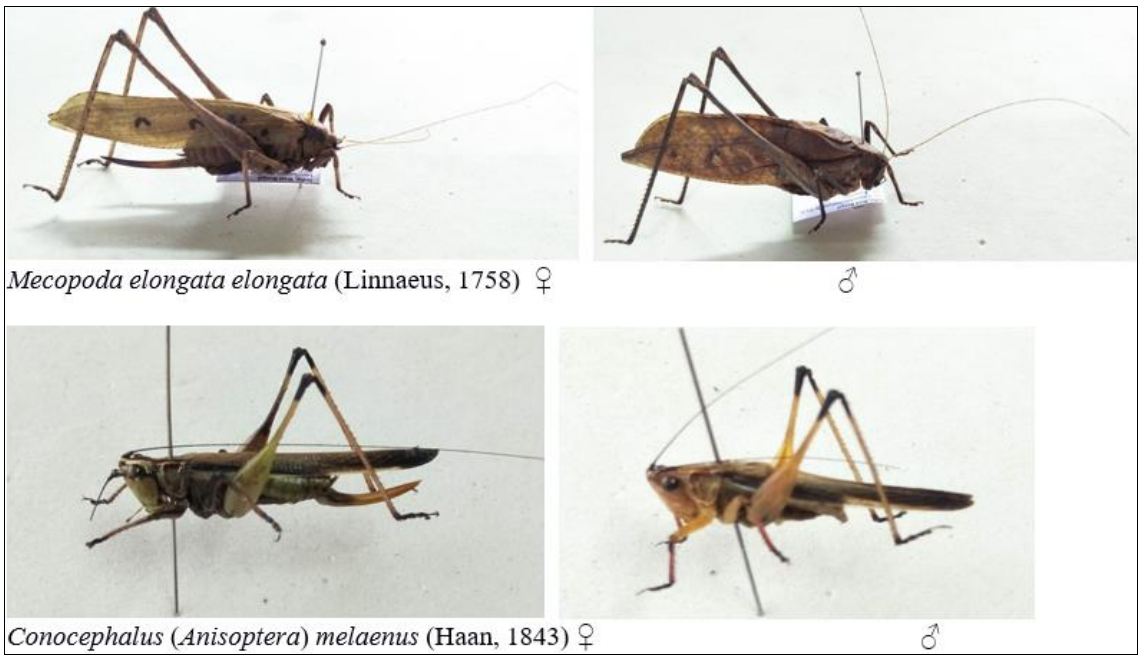
Table 1: Tettigoniids collected in Odisha, Bihar, Jharkhand and West Bengal, India

SL. No.	Locality	District	State	No. of Tettigoniidae species recorded
1	Balakati village	Khordha	Odisha	8
2	Soubhagyanagar			8
3	Kausalya Nagar			9
4	Salepur	Cuttack		5
5	Nandini Nagar	Kendrapara		8
6	Parsa Village	Patna	Bihar	7
7	Gariakhana			4
8	Rakhsha Village	Muzaffarpur		12
9	Bathna Village			10
10	Bhagawanpur Desua	Samastipur		4
11	Birnama Village			8
12	Mohua Tola	Gopalgunj		3
13	Domahata			4
14	Kukurati Village	East Singbhum	Jharkhand	7
15	Namkum Village	Ranchi		4
16	Kuru	Lohardaga		6
17	Tiko Village			1
18	Dharampur Village	Latehar		1
19	Polpol Village	Palamu		1
20	Singra Khurd			9
21	Bandua Village			3
22	Panchparwa	Garhwa		5
23	Bahudarara Village	Bhadrak	Odisha	10
24	Rangamatia Village	Mayurbhanj		11
25	Sahada Village	Balasore		12
26	Fulari Village			12
27	Rudranagar	South 24 P.G.S	West Bengal	5
28	Ramnagar			8
29	Jayanti Beat (BTR)	Alipurduar		1
30	Bala River Bed (BTR)			5
31	Towards 23 Miles (BTR)			5
32	Panbari Watch Tower (BTR)			10
33	25 Mile (BTR)			1
34	Tikbari Bamboo Forest (GNP)	Jalpaiguri		6
35	Tikbari Bamboo Forest 2nd Stn.(GNP)			14
36	Yatraprasad (GNP)			4
37	Chukchuki Watch Tower (GNP)			9
38	Tundu Camp (GNP)			10
39	Khunia Beat (GNP)			2
40	Soumen Roy Beat (MWLS)	Darjeeling		4
41	Latpanchar (MWLS)			13
42	Gulma ¼ tower (MWLS)			11
43	Chamta Beat (MWLS)			5
44	Bonnie Sundarikati Eco Conservation Camp (Afternoon)	South 24 PGS (Sunderban Biosphere Reserve)	West Bengal	2
45	Bonnie Sundarikati Eco Conservation Camp (Morning)			16
46	Kalas Camp			4
47	Lothian Island			4
48	Kaikhali			2

Tettigoniidae from the above mentioned areas of four states namely Odisha, West Bengal, Bihar and Jharkhand is 589 individual.

List of tettigoniids

1. *Conocephalus* (*Anisoptera*) *maculatus* (Le Guillou, 1841)-Conocephalinae.
2. *Conocephalus* (*Anisoptera*) *melaenus* (Haan, 1843)-Conocephalinae.
3. *Conocephalus (Anisoptera) fasciatus* (De Geer, 1773)-Conocephalinae.
4. *Conocephalus (Anisoptera) longipennis* (Haan, 1843)-Conocephalinae.
5. *Conocephalus* (Anisoptera) *strictus* (Scudder, 1875)-Conocephalinae.
6. *Euconocephalus pallidus (*Redtenbacher, 1891)-Conocephalinae.
7. *Euconocephalus indicus* (Redtenbacher, 1891)-Conocephalinae.
8. *Ducetia japonica* (Thunberg, 1815)-Phaneropterinae
9. *Trigonocorypha unicolor* (Stoll, 1787)-Phaneropterinae.
10. *Letana linearis* Walker, 1869-Phaneropterinae.
11. *Letana gracilis* Ingrisch, 1990-Phaneropterinae.
12. *Phaneroptera* (*Phaneroptera*) *gracilis* Burmeister, 1838-Phaneropterinae.
13. *Hexacentrus unicolor* Serville, 1831-Hexacentrinae.
14. *Khaoyaiana nitens* Ingrisch, 1990-Hexacentrinae.
15. *Phyllozelus siccus* (Walker, 1869)-Pseudophyllinae.
16. *Mecopoda elongata* (Linnaeus, 1758)-Mecopodinae.

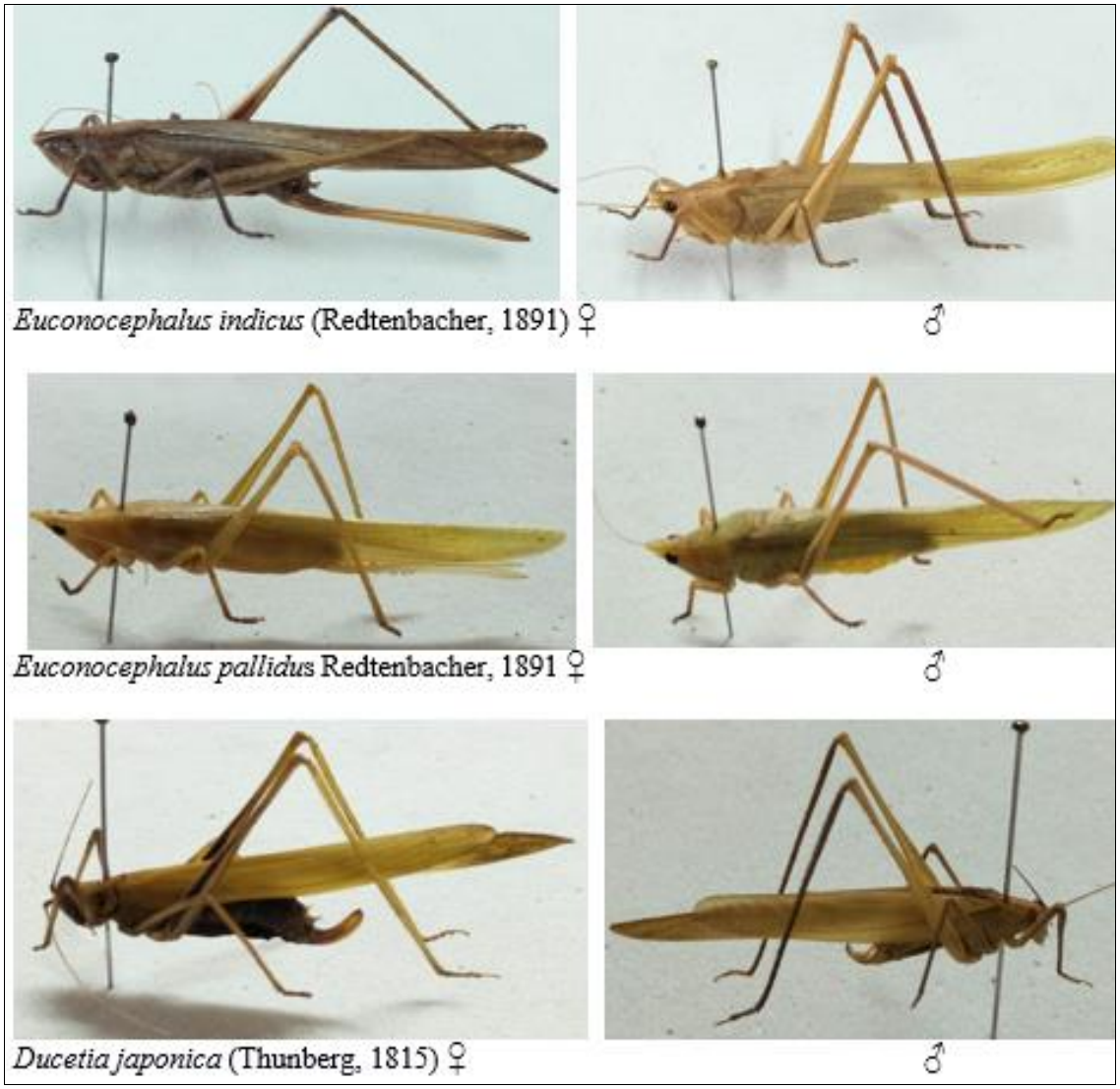


Mecopoda elongata elongata (Linnaeus, 1758) ♀ ♂

Conocephalus (*Anisoptera*) *melaenus* (Haan, 1843) ♀ ♂

Phyllozelus (*Phyllozelus*) *siccus* (Walker, 1869) ♀ ♂

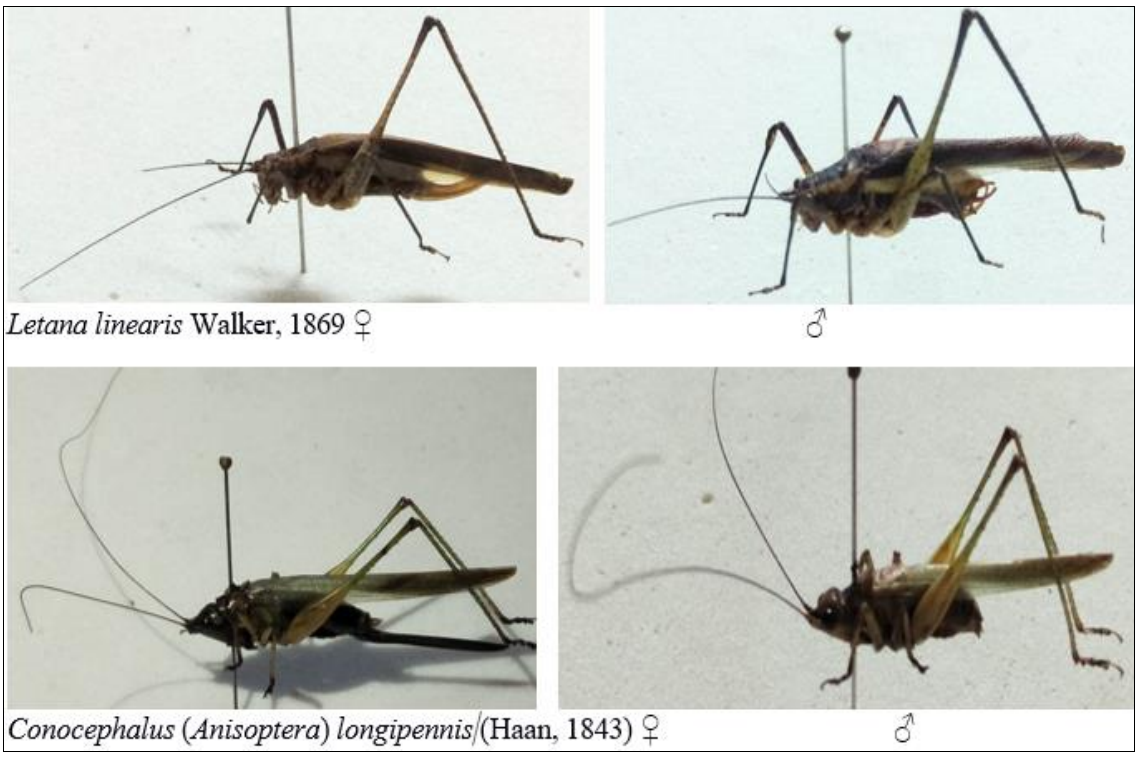
Hexacentrus unicolor Serville, 1831 ♀ ♂



Euconocephalus indicus (Redtenbacher, 1891) ♀ ♂

Euconocephalus pallidus Redtenbacher, 1891 ♀ ♂

Ducetia japonica (Thunberg, 1815) ♀ ♂



Letana linearis Walker, 1869 ♀ ♂

Conocephalus (*Anisoptera*) *longipennis*/(Haan, 1843) ♀ ♂

Plate 1: Tettigoniids collected from the said four states

Acknowledgments
The Ministry of Environment, Forests, and Climate Change (MoEF& CC) (No.22018/03/2015-RE) provided financing for the project, for which the authors are appreciative. The directors of the Zoological Survey of India and the Institute of Forest Genetics and Tree Breeding (Coimbatore, India) are acknowledged by the authors for their support and provision of the required resources. We also owe a debt of gratitude to the State Forest Departments of Odisha, Bihar, West Bengal, and Jharkhand for their assistance and permission in carrying out the current work.

Conclusion
The inventory of Tettigoniidae in four Indian states-Odisha, Bihar, Jharkhand, and West Bengal-has revealed a diverse array of species across various habitats. With sixteen identified species belonging to ten genera and five subfamilies, this study sheds light on the richness of Orthoptera in the region. Notably, the Conocephalinae subfamily exhibited the highest diversity across forestlands, grasslands, arable lands, and wastelands. The findings underscore the importance of these insects in maintaining ecosystem balance and highlight the role of host plant distribution in shaping their distribution patterns. Acknowledgments are extended to funding agencies and supporting institutions, including the Ministry of Environment, Forests, and Climate Change, and the State Forest Departments, for their invaluable contributions to this research endeavor.

References
1. Chand DS, Muralirangan MC. Food consumption of *Oxya nitidula* (Walker) on different rice cultivars. J Appl Zoolog Res. 2006;17:201-203.
2. Divya G, Senthilkumar N. Description of new species of the genus *Trigonocorypha* (Orthoptera: Tettigoniidae: Phaneropterinae) from Tamil Nadu, India. J Entomol Zool Stud. 2020;8(2):1736-1739. DOI: http://dx.doi.org/10.22271/j.ento
3. Divya G, Senthilkumar N. Contributions to the knowledge of the genus *Phaneroptera* (Tettigoniidae: Phaneropterinae) with a new record from Tamilnadu, India. Zootaxa. 2020;4860(3):425-434. DOI: https://doi.org/10.11646/zootaxa.4860.3.7
4. Ganeshaiah KN, Chandrasekara K, Kumar ARV. A new measure of biodiversity based on biological heterogenity of the communities. Curr Sci. 1997;73(2):128-133.
5. Ingrisch S, Shishodia MS. A new species of *Agraecinii* from Northeast India. Entomol Z. 1997;107(12):510-512.
6. Ingrisch S, Shishodia MS. New taxa and distribution records of Tettigoniidae from India. Mitt Muench Entomol Ges. 2000;90:5-37.
7. IUCN. The 2023-1 Red List of Threatened Species. http:// www.redlist.org. Published 2023.
8. Mulkern GB. Food selection by grasshoppers. Annu Rev Entomol. 1967;12:59-78.
9. Naskrecki P. The southern African *Mecopodiane*-their taxonomy, phylogeny and distribution (Orthoptera: Tettigoniidae). J Afr Zool. 1994;108:279-320.
10. Naskrecki P. Systematics of southern African *Meconematinae* (Orthoptera: Tettigoniidae). J Afr Zool. 1996;110:1-28.
11. Naskrecki P. An interactive key to katydids of La Selva Biological Station. Costa Rica; c1999. http://viccroy.eeb.uconn.edu/interkey/titlepg.
12. Naskrecki P. Katydids of Costa Rica 1. Systematics and Bioacoustics of the cone-head Katydids. The Orthopterist Society, USA; c2000. p. 163.
13. Rajaganesh R, Senthilkumar N. Diversity and distribution records of Orthoptera (Insecta) in Nagarhole

Tiger Reserve, Karnataka, India. Proc Zool Soc (PZOS). 2020;73:362-379.
DOI: https://doi.org/10.1007/s12595-020-00339-1
14. Rentz DCF. Comments on the classification of the Orthopteran Family Tettigoniidae with a key to subfamilies and description of two new subfamilies. Aust J Zool. 1979;27:991-1013.
15. Sanjayan KP, Muralirangan MC, Senthilkumar N, Karthikeyan A. Complementarity and taxic difference estimates and priority analysis for an insight into tettigoniid (Orthoptera: Tettigoniidae) diversity in Chennai, Tamil Nadu (India). Beitr Ent. 2002;52(2):449-460.
16. Sanjayan KP. Relationship between grasshopper and crops in an agro ecosystem of Tamil Nadu, India. Beitraege zur Entomologie. 1994;44(1):232-241.
17. Sanjayan KP, Murlairangan MC, Senthilkumar N, Karthikeyan A. Complimentarity and taxic difference estimates and priority analysis for an insight into tettigoniid (Orthoptera: Tettigoniidae) diversity in Chennai, Tamil Nadu. Beitraege zur Entomologie. 2002;52(2):449-460.
18. Schweizerischen Entomologischen Gesellschaft. 71:355.
19. Senthilkumar N, Karthikeyan A, Muralirangan MC, Mahalingam V. *Tettigoniidae* of Tamil Nadu. Insect Environ. 2001;7(2):56-57.
20. Senthilkumar N, Karthikeyan A, Muralirangan MC, Mahalingam V, Sanjayan KP. Tettigoniids of Tamil Nadu: A study on biodiversity. Proceedings on the vistas of entomological research for the new millennium. 2002, 37-45.
21. Senthilkumar N, Barthakur ND, Borah NJ. Orthoptera fauna of the gibbon wild life sanctuary, Assam. Zoo's Print J. 2006;21(8):2347-2349.
22. Senthilkumar N, Prakash R, Sanjayan KP, Mahalingam V, Muralirangan MC. Diversity and distributional pattern of acridids (Orthoptera: Acrididae) in Tamil Nadu, India. Indian J Forestry. 2009;32(2):277-284.
23. Senthilkumar N, Barthakur ND, Borah NJ. Orthoptera fauna of the gibbon wild life sanctuary, Assam. Zoo's Print. 2006;21(8):2347-2349.
24. Senthilkumar N, Divya G. A new species of the genus *Trigonocorypha* (Orthoptera: Tettigoniidae: Phaneropterinae) from Tamil Nadu, India. Zootaxa. 2020;4802(1):189-195.
DOI: https://doi.org/10.11646/zootaxa.4802.1.13
25. Shishodia MS. Short and long-horned grasshoppers and crickets of Bastar District, Madhya Pradesh, India. Rec Zool Surv India. 2000;98(1):27-80.
26. Shishodia MS. Orthoptera (Insecta) fauna of Andaman and Nicobar Islands. Rec Zool Surv India. 2000;98(3):1-24.