Voyage Journal of Scientific Research and Exploration (VJSRE) *Vol 2. Issue 1*
ISSN (Online): 3007-3898, ISSN (Print): 3007-388X, April to September 2025

ASSESSING THE UPDATED DIVERSITY OF ORTHOPTERA IN NARA DESERT

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Abstract

During the present study, approximately 4,079 specimens were collected from various localities of the Nara Desert, Sindh, between 2022 and 2024. These specimens were sorted into 11 subfamilies, 25 genera, and 36 species. The identified species include: Acrida exaltata (Walker, 1859), Truxalisfitzgeraldi (Dirsh, 1950), Schistocerca gregaria (Forskål, 1775), Heteracris littoralis (Rambur, 1838), Chorthippus angulatus (Tarbinsky, 1927), Gonista rotundata (Uvarov, 1933), Hieroglyphus oryzivorus (Carl, 1916), H. nigrorepluteus (Bolívar, 1912), H. perpolita (Uvarov, 1933), Leptacrisazghar loonesis (Tokhai, et al.,, 1999), Acrotylus humbertianus (Saussure, 1884), A. longipes longipes (Charpentier, 1845), Sphingonotus (Sphingonotus) savignyi (Saussure, 1884), Locusta migratoria (Linnaeus, 1758), Trilophidia annulat (Thunberg, 1815), Oxyahyla (Serville,1831), Oxyafus covittata (Marschall, 1836), Chrotogonus (Chrotogonus) trachypterus (Blanchard,1836), Pyrgomorpha (Pyrgomorpha) bispinosa deserti (Bey-Bienko, 1951), Atractomorpha acutipennis blanchardi (Bolívar, 1905), Poekilocerus pictus (Fabricius, 1775), Callogryllus ovilongus (Saeed, Saeed and Yousuf, 2000), C. saeedi (Malik, et al.,, 2013), Gryllodes supplicans (Walker, 1859), G. sigillatus (Walker, 1869), Gryllus (Gryllus) campestris (Linnaeus, 1758), G. (Gryllus) bimaculatus (De Geer, 1773), G.(Gryllus) assimilis (Fabricius, 1775), Acheta domesticus (Linnaeus, 1758), Teleogryllus (Brachyteleogryllus) occipitalis (Serville, 1838), T. (Brachyteleogryllus) commodus (Walker, 1869), T. (Brachyteleogryllus) emma (Ohmachi and Matsuura, 1951), Euconocephalus pallidus (Redtenbacher, 1891), Schizodactylus monstrosus (Drury, 1773), and Schizodactylus minor (Ander, 1938). Among these species, Acheta domesticus had the highest number of specimens recorded, followed by Gryllodes sigillatus, while Teleogryllus occipitalis had the lowest. Other species exhibited notable population variability, with some becoming locally dominant and even acting as temporary keystone species. Overall, Orthopteran communities play essential roles in ecosystem functioning over extended periods. The findings indicate that agricultural lands have the potential to support insect diversity and may serve as effective refuges for certain species from adjacent rocky habitats. Given the ecological significance of these environments, the study recommends prioritizing their conservation to promote Orthopteran biodiversity and maintain ecological balance in the region.

Keywords: Orthopteran Biodiversity, Population variability, Keystone species

Introduction

The Nara Desert, located in the Khairpur district of Sindh, Pakistan, is characterized by its arid climate and unique biodiversity. Among its diverse fauna, the Orthoptera, particularly the subfamily Oedipodinae (band-winged grasshoppers) exhibits notable diversity. Understanding the seasonal distribution of these grasshoppers is essential for ecological research and conservation efforts in the region. The urgency of conservation has grown alongside increasing global awareness of biodiversity protection (Willis *et al*., 2007). Conservation not only aims to safeguard individual species but also seeks to maintain entire ecosystems and the vital services they provide (Tallis *et al*., 2008). Providing safe havens for

wildlife through protected areas, such as national parks and reserves, is a fundamental conservation strategy (Baron *et al*., 2009). Furthermore, international collaboration and agreements are critical to addressing global biodiversity challenges (Dight and Scherl, 1997). The ecological importance of Orthoptera extends far beyond their distinctive songs and behaviors. Grasshoppers are significant herbivores that influence vegetation structure, regulate plant populations, and contribute to nutrient cycling through their feeding and excretion (Belovsky and Slade, 2018). Crickets aid in the decomposition of organic destruction and nutrient recycling and are also known for their role in nighttime acoustic activity (Kvassay, 2014). Katydids, with their excellent mimicry, play crucial roles in food webs by serving as prey for a wide range of predators (Chahil *et al*., 2018). These complex ecological interactions make Orthoptera indispensable to ecosystem health (Fartmann *et al*., 2012). Despite their ecological significance, Orthoptera species face numerous threats, primarily due to human activities (Bidau, 2014). Habitat loss and fragmentation caused by infrastructure development, urbanization, and agriculture pose significant challenges to their survival (Muluneh, 2021). The widespread use of pesticides in agricultural areas not only harms Orthoptera directly but also disrupts the ecological balance of their habitats (Rajak *et al*., 2023). Moreover, climate change through shifts in temperature and precipitation pattern scan significantly affect the distribution, abundance, and life cycles of Orthoptera species (Fumy *et al*., 2020). Technological advancements have provided new tools for monitoring and conserving Orthoptera populations (Van-Klink *et al*., 2022). Remote sensing technologies, such as satellite imagery, help assess changes in land cover and habitat quality (Nagendra *et al*., 2013). Genetic techniques facilitate the identification of distinct populations and support targeted conservation strategies (Schwartz *et al*., 2007). Acoustic monitoring using automated recording devices enables researchers to study Orthoptera communities and evaluate their responses to environmental changes (Gomez-Morales and Acevedo-Charry, 2022). The integration of these technologies into conservation programs enhances our ability to understand and preserve Orthoptera diversity (Byerly *et al*., 2023). Orthoptera conservation presents both challenges and opportunities. Because ecosystems are interconnected, the protection of one species can have cascading effects on others (Hintz and Garvey, 2012). Besides this many earlier researchers *i.e.* (Sultana *et al*., 2020c), contributed to the study of Orthoptera. Subsequent works by (Bhanger *et al*., 2024), (Samiullah and Sultana 2023), and (Sultana *et al*., 2024, 2021, 2019) have further explored various aspects of Orthoptera diversity and ecology from Aisa. Additional contributions include studies by (Samejo, 2021) and (Barkat *et al*., 2024), which have expanded the understanding of Orthoptera in different ecological contexts (Sultana and Lecoq 2020a, b). The present study is the first of its kind conducted in this region.

Material and Methods

Study Area

A survey of the Orthoptera assemblage was conducted at eight sampling sites within the Nara Desert region. The selected sites included Choondiko (27.1616°N, 68.9602°E), Sikandarabad (27.1975°N, 69.0362°E), Pharario (27.2102°N, 68.9844°E), Village Lal Bux Chakhrani (27.2618°N, 69.0060°E), Sunharo (27.2284°N, 68.9950°E), Salehpat (27.51590°N,

69.0524°E), Goth Moosvi (27.2500° N, 69.0300° E) and Goth Bhambhro (27.4572°N, 69.0250°E). The Nara Desert, forming a taluka (administrative subdivision) of Khairpur District in Sindh, spans approximately two-thirds of the district's total area around 15,910 km².

Sampling, Killing, and Preservation Protocol

Orthoptera specimens were collected between 2022 and 2024 using an entomological sweep net (8.89 cm in diameter and 50.8 cm in length) across various habitat types. Sampling was conducted at monthly intervals, typically spanning a week. The collected specimens were immediately transported to the laboratory for killing and preservation. The protocol adopted followed the methods described by Sultana and Wagan, (2012, 2015), Sultana *et al*., (2013), and Sultana and Song, (2024). In the laboratory, specimens were killed using potassium cyanide in standard entomological killing bottles. To preserve coloration particularly in green grasshopper species specimens were not left in the cyanide for more than 30 minutes. After a short interval post-killing, mounting was carried out carefully to avoid damage to delicate body parts. Standard entomological procedures were followed, including pinning, wing spreading, and body alignment. Fully dried specimens were stored in labeled entomological boxes, indicating collection locality, date, and collector's name. Naphthalene balls were placed in the boxes to prevent insect or ant infestation.

Identification of Specimens

Specimens were examined under a stereoscopic dissecting binocular microscope and sorted into their respective taxa (genera and species). Identification was performed using taxonomic keys and descriptions available in literature and on the Orthoptera Species File Online (http://www.orthoptera.org), as well as keys provided by (Sultana and Wagan, 2015).

Meteorological Variables

The climate of the Nara Desert in Khairpur, Sindh, is classified as subtropical, dry, and arid. The temperature in the region varies significantly across seasons, with a minimum of approximately 13°C recorded in December and a maximum of up to 47°C observed in June. Average temperature and relative humidity data for the study period were obtained from the Meteorological Department, Khairpur, to assess the influence of climatic conditions on Orthoptera distribution and activity.

Results and Discussion

The seasonal and inter-annual analysis of Orthoptera assemblages across the Nara Desert from 2022 to 2024 (Tables 2-5) reveals consistent species richness with minor fluctuations, highlighting Gryllinae as the most dominant subfamily, followed by Pyrgomorphinae and Oedipodinae. Species such as *Gryllus bimaculatus*, *Acheta domesticus*, *Chrotogonus trachypterus*, and *Gryllodes sigillatus* showed peak abundance during the warmer months of April to September, with May to August consistently marking the highest activity period (Table 1). In 2023, several species exhibited a marked increase in population *Gryllodes supplicans* (99 to 316), *Gryllus bimaculatus* (191 to 401), and *Acheta domesticus* (181 to

359) suggesting favorable ecological conditions (Tables 3-5). However, 2024 reflected a general decline, with reduced counts (e.g. *Gryllodes supplicans* to 139, *Gryllus bimaculatus* to 151), possibly due to environmental stress, resource limitations, or sampling constraints. Some species were absent in 2024, indicating potential local extinctions. Diversity indices (Table 6) showed Shannon_H = 0 and Evenness = 1 for all species, reflecting low diversity at the site level and even individual distribution likely due to dominance by a few species. Fisher Alpha values remained low, while Dominance_D = 1 for all species, further confirming this skewed population structure. Geographical distribution analysis (Table 1) revealed distinct site preferences, with *Heteracris littoralis* common in SP, GM, VL, and PH, and *Poekilocerus pictus* widely distributed across VL, SU, PH, and CH. In contrast, species like *Leptacrisazghar loonesis* and *Trilophidia annulata* showed highly localized occurrences, pointing to specific habitat requirements. Overall, the findings emphasize a strong link between Orthopteran abundance and climatic seasonality and underline concerns regarding biodiversity health, urging habitat management to protect less dominant and habitat-restricted species.

Table 1. Collection of Orthoptera from various localities of the Nara desert during the year 2022, 2023 and 2024

Subfamily Species	SP	GM	GB	VL	SU	PH	SA	CH
Acridinae								
1. *Acrida exaltata*	13	0	0	31	9	5	11	I7
2. *Truxalisfitzgeraldi*	11	0	0	0	15	17	9	6
Cyrtacanthacridinae								
3. *Anacridiumaegyptium*	0	11	0	7	0	0	0	0
4. *Schistocerca gregaria*	2	0	0	0	13	0	0	9
Eyprepocnemidinae								
5. *Heteracris littoralis*	93	37	23	0	0	63	0	8
Gomphocerinae								
6. *Chorthippus angulatus*	13	5	3	0	0	9	3	0
7. *Gonistarotundata*	3	1	1	3	5	7	9	0
Hemiacridinae								
8. *Hieroglyphusperpolita*	13	5	0	0	1	0	0	0
9. *Hieroglyphusoryzivorus*	4	0	0	0	5	0	0	9
10. *Hieroglyphusnigroreplteus*	0	5	0	0	9	0	3	0
11. *Leptacrisazgharloonesis*	0	0	13	0	0	0	2	0
Oedipodinae								
12. *Acrotylus humbertianus*	19	13	0	0	9	13	12	14
13. *Acrotylus longipes longipes*	13	0	0	0	11	9	3	11
14. *Sphingonotus (Sphingonotus) savignyi*	0	0	0	0	11	0	2	0
15. *Locusta migratoria*	11	0	0	0	3	9	0	5
16. *Trilophidia annulata*	6	8	9	11	0	0	0	0
Oxyinae								
17. *Oxya hyla*	9	3	0	0	0	0	0	11
18. *Oxyafuscovittata*	0	0	0	5	3	1	0	0
Pyrgomorphinae								
19. *Chrotogonus (Chrotogonus) trachypterus*	55	79	23	15	0	0	6	5

20. *Pyrgomorpha (Pyrgomorpha) bispinosa deserti*	11	15	19	23	17	19	7	9
21. *Atractomorpha acutipennis blanchardi*	7	5	0	0	0	3	4	11
22. *Poekilocerus pictus*	8	13	9	34	23	17	0	19
Gryllinae								
23. *Callogryllus ovilongus*	4	5	3	9	0	0	0	0
24. *Callogryllus saeedi*	11	13	15	17	9	3	0	22
25. *Gryllodes supplicans*	171	0	123	159	0	0	0	101
26. *Gryllodes sigillatus*	81	89	93	79	0	113	121	0
27. *Gryllus* (*Gryllus*) *campestris*	6	9	13	13	0	0	0	11
28. *Gryllus* (*Gryllus*) *bimaculatus*	45	77	89	99	123	233	77	0
29. *Gryllus* (*Gryllus*) *assimilis*	7	9	11	0	0	13	15	0
30. *Acheta domesticus*	122	103	107	0	0	99	113	119
31. *Teleogryllus* (*Brachyteleogryllus*) *occipitalis*	3	5	7	0	0	3	0	0
32. *Teleogryllus* (*Brachyteleogryllus*) *commodus*	0	0	7	5	0	5	0	0
33. *Teleogryllus* (*Brachyteleogryllus*) *emma*	11	0	0	0	9	0	0	1
Conocephalinae								
34. *Euconocephalus pallidus*	9	0	0	0	0	5	2	7
Schizodactylinae								
35. *Schizodactylus monstrosus*	3	5	0	0	0	3	0	0
36. *Schizodactylus minor*	5	0	0	0	11	0	3	2

Note: Salehpat (SP), Goth Moosvi (GM), Goth Bhambhro (GB), Village Lal Bux Chakhrani (VL), Sunharo (SU), Pharario (PH), Sikendarabad (SA) and Chunduiko (CH)

Table 2. Check list of Orthoptera from Nara desert

No.	Subfamily	Genus	Species
01.	**Acridinae**	*Acrida*	*Acrida exaltata*
		Truxalis	*Truxalis fitzgeraldi*
02.	**Cyrtacanthacridinae**	*Anacridium*	*Anacridium aegyptium*
		Schistocerca	*Schistocerca gregaria*
03.	**Eyprepocnemidinae**	*Heteracris*	*Heteracris littoralis*
04.	**Gomphocerinae**	*Chorthippus*	*Chorthippus angulatus*
		Gonista	*Gonistarotundata*
05.	**Hemiacridinae**	*Hieroglyphus*	*Hieroglyphus perpolita*
			Hieroglyphus oryzivorus
			Hieroglyphus nigroreplteus
		Leptacris	*Leptacris azgharloonesis*
06.	**Oedipodinae**	*Acrotylus*	*Acrotylus humbertianus*
			Acrotylus longipes longipes
		Sphingonotus	*Sphingonotus (Sphingonotus) savignyi*
		Locusta	*Locusta migratoria*
		Trilophidia	*Trilophidia annulata*
07.	**Oxyinae**	*Oxya*	*Oxya hyla*
			Oxyafuscovittata
08.	**Pyrgomorphinae**	*Chrotogonus*	*Chrotogonus (Chrotogonus) trachypterus*
		Pyrgomorpha	*Pyrgomorpha (Pyrgomorpha) bispinosadeserti*
		Atractomorpha	*Atractomorpha acutipennis blanchardi*

		Poekilocerus	*Poekilocerus pictus*
09.	**Gryllinae**	*Callogryllus*	*Callogryllus ovilongus*
			Callogryllus saeedi
		Gryllodes	*Gryllodes supplicans*
			Gryllodes sigillatus
		Gryllus	*Gryllus* (*Gryllus*) *campestris*
			Gryllus (*Gryllus*) *bimaculatus*
			Gryllus (*Gryllus*) *assimilis*
		Acheta	*Acheta domesticus*
		Teleogryllus	*T.* (*Brachyteleogryllus*) *occipitalis*
			T. (*Brachyteleogryllus*) *commodus*
			T. (*Brachyteleogryllus*) *emma*
10.	**Conocephalinae**	*Euconocephalus*	*Euconocephalus pallidus*
11.	**Schizodactylinae**	*Schizodactylus*	*Schizodactylus monstrosus*
			Schizodactylus minor

Table 3. Seasonal distribution of Orthoptera in Nara Desert during the year 2022

Subfamily/Species	**Year 2022**												
	JA	**FE**	**MA**	**AP**	**MA**	**JU**	**JL**	**AU**	**SE**	**OC**	**NO**	**DE**	**TOTAL**
Acridinae													
A. exaltata	0	0	2	3	5	2	1	7	1	0	0	0	21
T. fitzgeraldi	0	0	1	1	3	1	1	9	3	0	0	0	19
Cyrtacanthacridinae													
A. aegyptium	0	0	0	1	2	0	0	1	2	0	0	0	6
S. gregaria	0	0	1	1	1	0	0	2	1	0	0	0	6
Eyprepocnemidinae													
H. littoralis	0	0	3	5	11	1	3	17	7	2	0	0	49
Gomphocerinae													
C. angulatus	0	0	0	2	3	0	0	4	1	1	0	0	11
G. rotundata	0	0	0	2	3	0	0	2	2	0	0	0	9
Hemiacridinae													
H. perpolita	0	0	0	1	1	0	0	1	2	0	0	0	5
H. oryzivorus	0	0	1	2	1	0	1	1	1	0	0	0	7
H. nigroreplteus	0	0	1	1	2	1	0	1	2	0	0	0	8
L, azgharloonesis	0	0	0	1	1	0	0	2	0	0	0	0	4
Oedipodinae													
A. humbertianus	0	0	1	3	5	0	0	2	5	2	0	0	18
A. longipes longipes	0	0	1	1	3	0	0	3	3	2	0	0	13
S. (Sphingonotus) savignyi	0	0	0	0	2	0	0	1	1	0	0	0	4
L. migratoria	0	0	0	1	2	0	0	3	2	0	0	0	8
T. annulata	0	0	0	3	5	0	0	2	1	0	0	0	11
Oxyinae													
O. hyla	0	0	0	0	0	0	0	2	1	0	0	0	3
O. fuscovittata	0	0	0	0	0	0	0	0	0	0	0	0	0

Pyrgomorphinae													
C. (Chrotogonus) trachypterus	0	0	7	9	13	2	3	11	21	7	0	0	73
P. (Pyrgomorpha) bispinosa deserti	0	0	0	4	9	2	1	7	13	0	0	0	36
A. acutipennis blanchardi	0	0	0	1	2	0	0	1	1	0	0	0	5
P. pictus	0	0	1	3	7	0	0	7	5	4	0	0	27
Gryllinae													
C. ovilongus	0	0	0	1	1	0	0	0	1	0	0	0	3
C. saeedi	0	0	0	3	7	0	0	7	9	3	0	0	29
G. supplicans	0	0	9	13	29	3	5	17	21	2	0	0	99
G. sigillatus	0	0	19	21	37	7	9	23	41	16	0	0	173
G. (Gryllus) campestris	0	0	0	2	3	0	0	3	1	0	0	0	9
G. (Gryllus) bimaculatus	0	0	21	33	46	9	11	19	31	21	0	0	191
G. (Gryllus) assimilis	0	0	0	3	7	0	0	3	6	2	0	0	21
A. domesticus	0	0	11	26	37	7	13	21	43	23	0	0	181
T. (Brachyteleogryllus) occipitalis	0	0	0	1	2	0	0	1	2	1	0	0	7
T. (Brachyteleogryllus) commodus	0	0	0	0	1	0	0	0	0	0	0	0	1
T. (Brachyteleogryllus) emma	0	0	0	1	1	0	0	1	2	0	0	0	5
Conocephalinae													
E. pallidus	0	0	1	2	2	0	0	3	1	0	0	0	9
Schizodactylinae													
S. monstrosus	0	0	0	0	1	0	0	1	1	0	0	0	3
S. minor	0	0	0	0	1	0	0	0	1	0	0	0	2

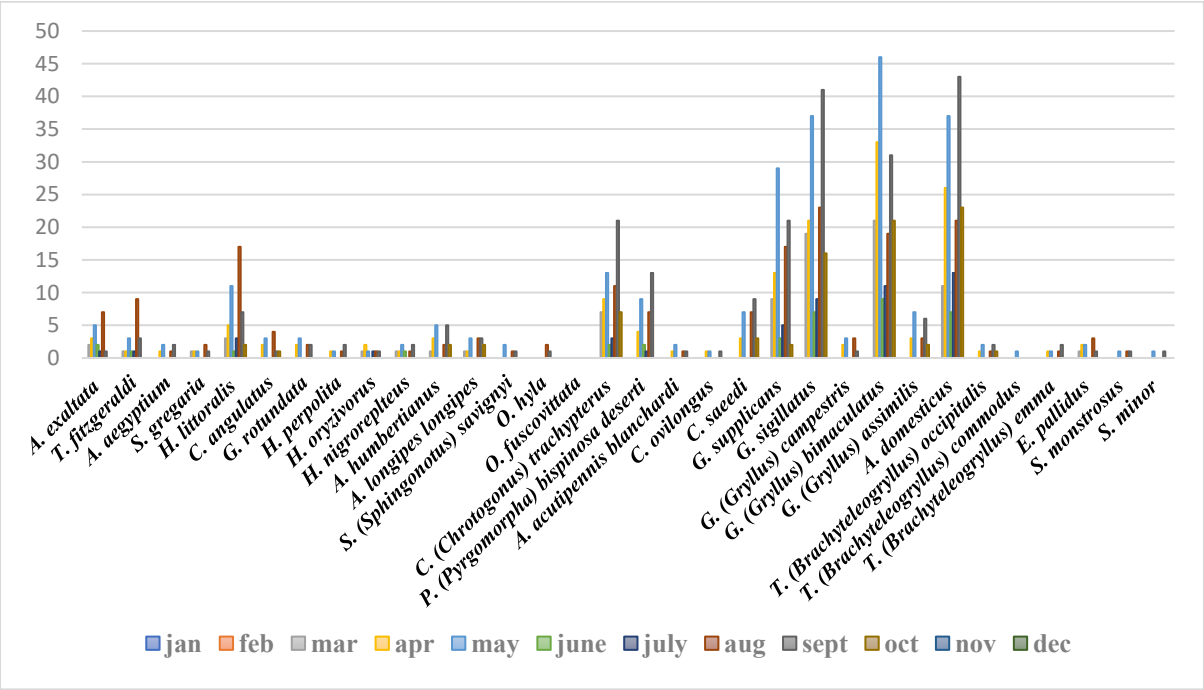

Figure 1. Distribution of Orthoptera Species from Nara desert during the year 2022

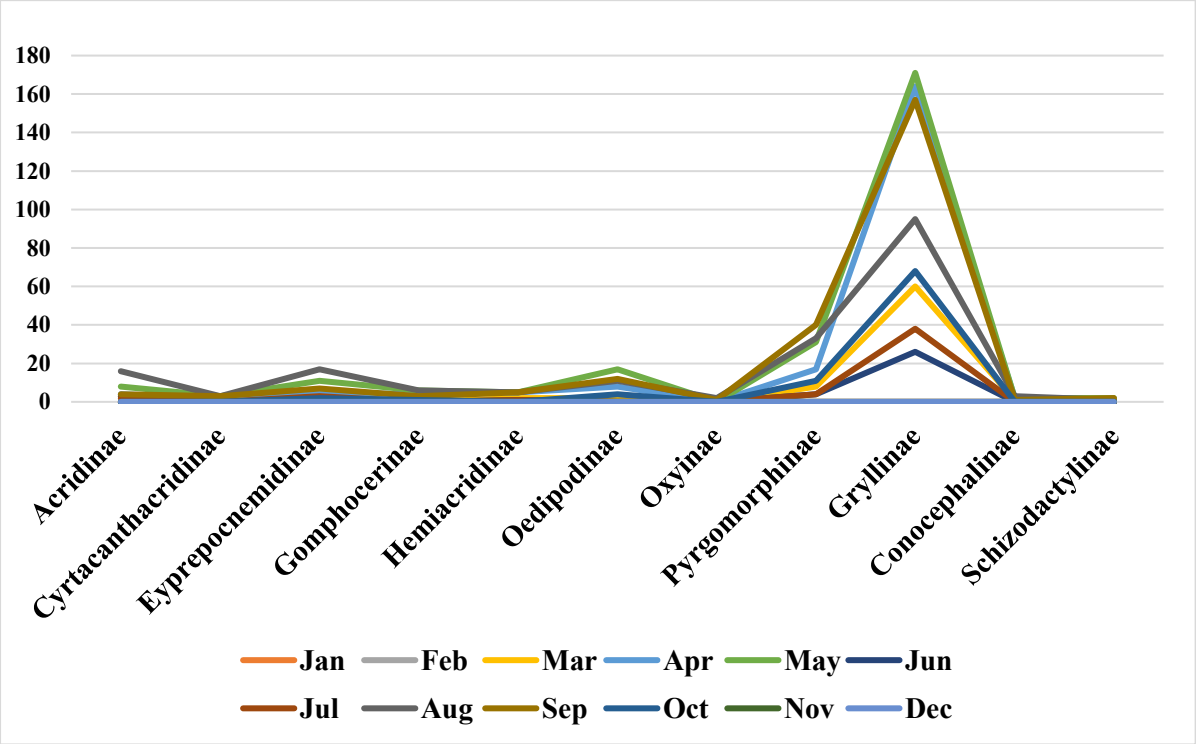

Figure 2. Distribution of Orthoptera Subfamily from Nara desert during the year 2022

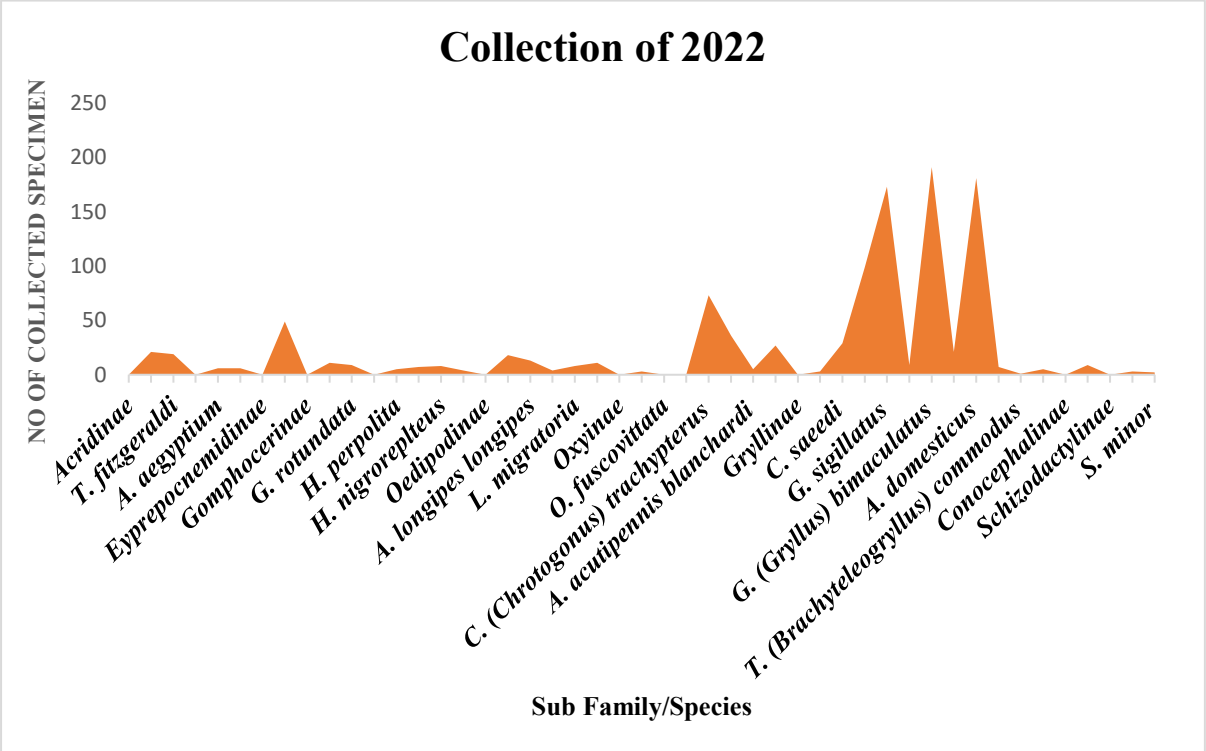

Figure 3. Distribution of Orthoptera Species/Subfamily from Nara desert the year 2022

Table 4. Seasonal distribution of Orthoptera in Nara Desert during the year 2023

Subfamily/Species	Year 2023												
	JA	FE	MA	AP	MA	JU	JL	AU	SE	OC	NO	DE	TOTAL
Acridinae													
A. exaltata	0	0	0	3	7	0	0	7	11	3	0	0	31
T. fitzgeraldi	0	0	0	3	9	0	0	3	7	5	0	0	27
Cyrtacanthacridinae													
A. aegyptium	0	0	0	1	3	0	0	1	2	0	0	0	7
S. gregaria	0	0	0	3	5	0	0	2	3	2	0	0	15
Eyprepocnemidinae													
H. littoralis	0	0	0	1	3	0	0	1	2	0	0	0	117
Gomphocerinae													
C. angulatus	0	0	0	2	6	0	0	3	2	0	0	0	13
G. rotundata	0	0	0	1	5	0	0	2	3	0	0	0	11
Hemiacridinae													
H. perpolita	0	0	0	1	3	0	0	2	3	0	0	0	9
H. oryzivorus	0	0	0	1	2	0	0	1	3	0	0	0	7
H. nigroreplteus	0	0	0	1	3	0	0	2	3	0	0	0	9
L, azgharloonesis	0	0	0	1	2	0	0	1	2	0	0	0	6
Oedipodinae													
A. humbertianus	0	0	3	5	9	1	3	11	7	0	0	0	39
A. longipes longipes	0	0	1	3	7	0	0	5	7	0	0	0	23
S. (Sphingonotus) savignyi	0	0	0	1	3	0	0	2	3	0	0	0	9
L. migratoria	0	0	0	2	2	0	0	3	4	0	0	0	11
T. annulata	0	0	0	1	5	0	0	2	8	1	0	0	17
Oxyinae													
O. hyla	0	0	0	3	5	0	0	3	2	0	0	0	13
O. fuscovittata	0	0	0	1	2	0	0	1	2	0	0	0	6
Pyrgomorphinae													
C. (Chrotogonus) trachypterus	0	0	5	12	25	3	3	11	18	4	0	0	81
P. (Pyrgomorpha) bispinosa deserti	0	0	3	3	11	2	3	9	13	9	0	0	53
A. acutipennis blanchardi	0	0	1	2	5	1	1	2	4	0	0	0	16
P. pictus	0	0	3	9	13	2	3	11	13	3	0	0	57
Gryllinae													
C. ovilongus	0	0	0	1	2	0	0	3	3	2	0	0	11
C. saeedi	0	0	3	5	11	2	3	7	13	5	0	0	49
G. supplicans	0	7	19	41	55	21	19	41	79	31	3	0	316
G. sigillatus	0	0	16	27	47	11	21	31	37	25	0	0	215
G. (Gryllus) campestris	0	0	5	7	8	0	0	6	5	0	0	0	31
G. (Gryllus) bimaculatus	0	19	21	57	69	17	23	39	97	59	0	0	401
G. (Gryllus) assimilis	0	0	0	5	7	1	3	3	6	0	0	0	25
A. domesticus	0	0	27	43	78	19	23	69	67	33	0	0	359
T. (Brachyteleogryllus) occipitalis	0	0	0	1	3	0	0	2	3	0	0	0	9
T. (Brachyteleogryllus) commodus	0	0	0	1	4	0	0	3	2	1	0	0	11
T. (Brachyteleogryllus) emma	0	0	0	1	1	0	0	3	3	1	0	0	9
Conocephalinae													
E. pallidus	0	0	0	2	3	0	0	3	5	0	0	0	13
Schizodactylinae													
S. monstrosus	0	0	0	1	1	0	0	1	2	0	0	0	5
S. minor	0	0	0	3	5	0	0	2	7	0	0	0	17

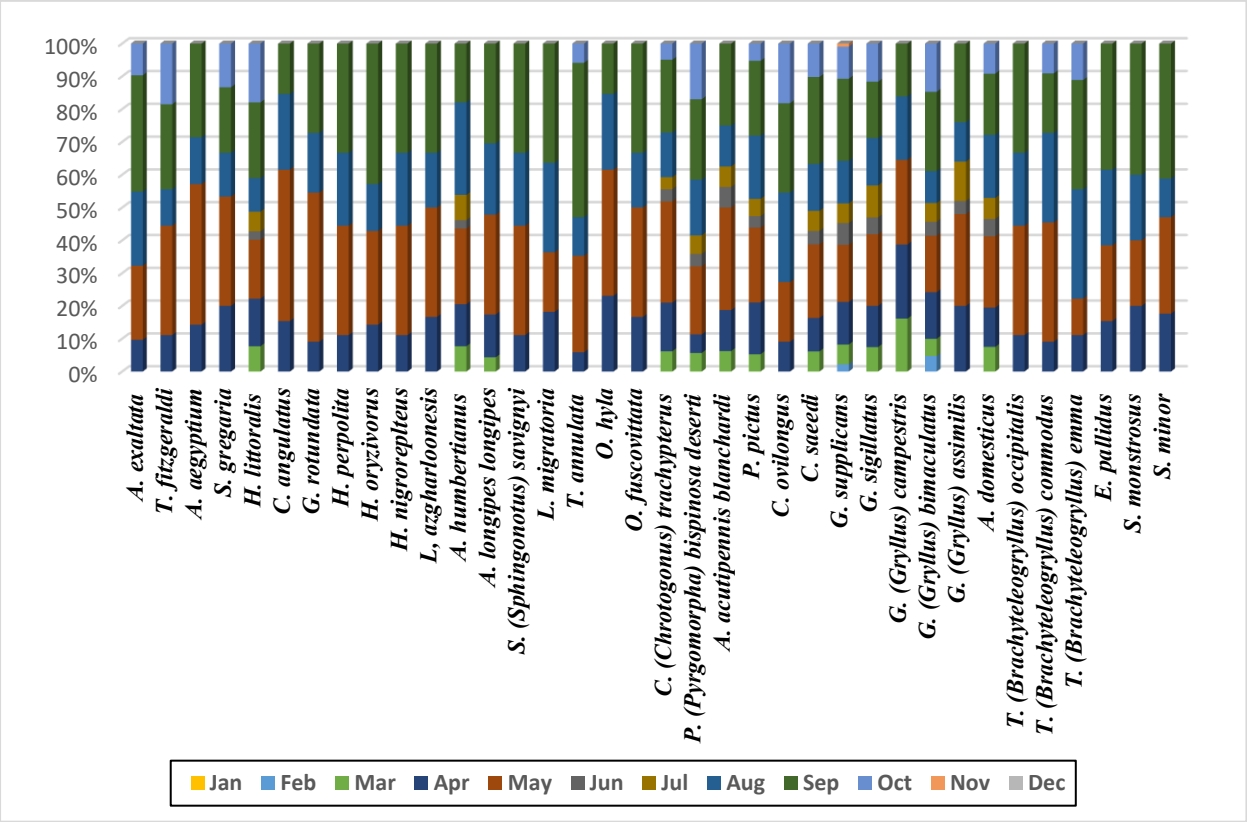

Figure 4. Distribution of Orthoptera Species from Nara desert during the year 2023

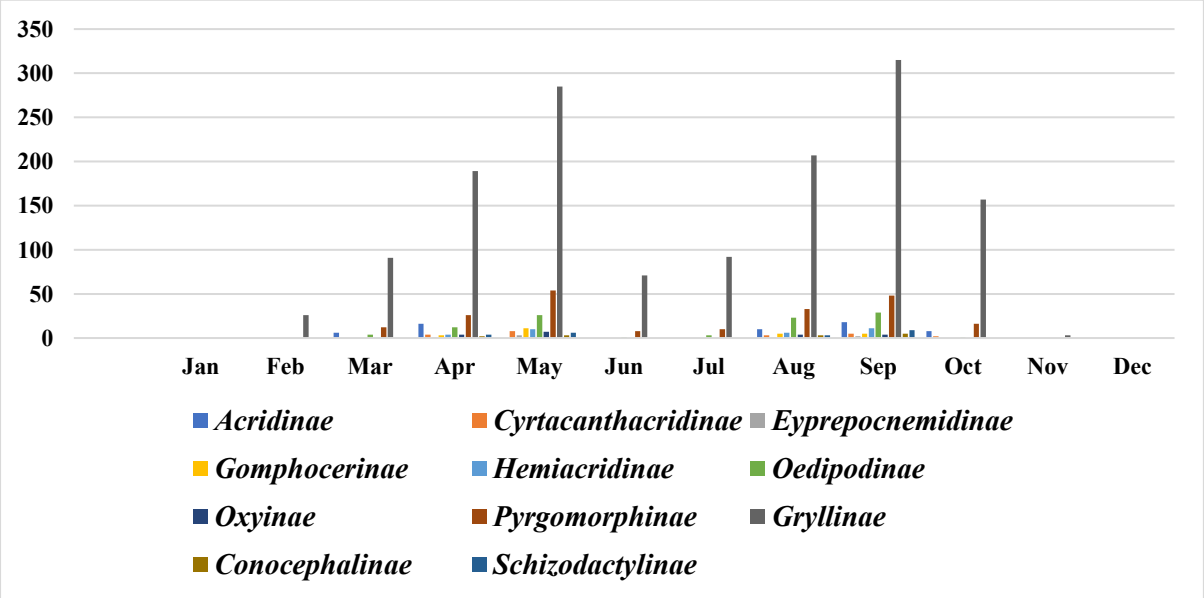

Figure 5. Distribution of Orthoptera Subfamily from Nara desert during the year 2023

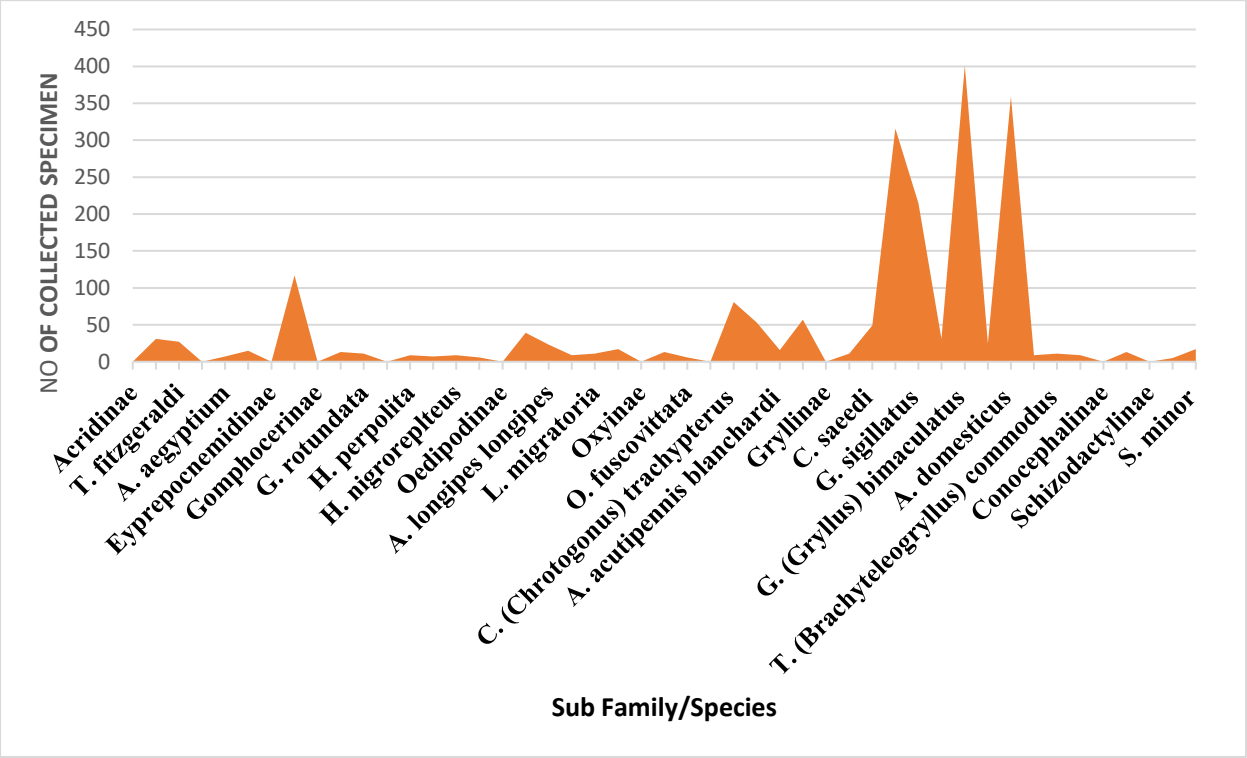

Figure 6. Distribution of Orthoptera Subfamily/Species from Nara desert the year 2023

Table 5. Seasonal distribution of Orthoptera in Nara Desert during the year 2024

Subfamily/Species	Year 2024												
	JA	FE	MA	AP	MA	JU	JL	AU	SE	OC	NO	DE	TOTAL
Acridinae													
A. exaltata	0	0	0	3	7	1	1	3	1	1	0	0	17
T. fitzgeraldi	0	0	1	2	3	0	0	3	2	1	0	0	12
Cyrtacanthacridinae													
A. aegyptium	0	0	0	0	1	0	1	2	1	0	0	0	5
S. gregaria	0	0	0	0	1	0	0	1	1	0	0	0	3
Eyprepocnemidinae													
H. littoralis	0	0	2	9	11	5	7	9	11	4	0	0	58
Gomphocerinae													
C. angulatus	0	0	2	9	11	5	7	9	11	4	0	0	58
G. rotundata	0	0	2	9	11	5	7	9	11	4	0	0	58
Hemiacridinae													
H. perpolita	0	0	0	1	1	0	0	1	1	1	0	0	5
H. oryzivorus	0	0	0	1	1	0	0	1	1	0	0	0	4
H. nigroreplteus	0	0	0	0	0	0	0	0	0	0	0	0	0
L, azgharloonesis	0	0	1	1	1	0	0	1	1	0	0	0	5
Oedipodinae													
A. humbertianus	0	0	2	3	7	1	1	3	5	1	0	0	23
A. longipes longipes	0	0	0	2	3	0	0	3	2	1	0	0	11
S. (Sphingonotus) savignyi	0	0	0	0	0	0	0	0	0	0	0	0	0
L. migratoria	0	0	0	2	2	1	1	2	1	0	0	0	9
T. annulata	0	0	0	1	2	0	0	2	1	0	0	0	6
Oxyinae													
O. hyla	0	0	1	1	2	0	0	1	2	0	0	0	7

O. fuscovittata	0	0	0	1	1	0	0	1	0	0	0	0	3
Pyrgomorphinae													
C. (Chrotogonus) trachypterus	0	0	2	7	13	1	2	2	2	0	0	0	29
P. (Pyrgomorpha) bispinosa deserti	0	0	5	9	11	1	1	2	2	0	0	0	31
A. acutipennisblanchardi	0	0	1	3	2	0	0	1	2	0	0	0	9
P. pictus	0	0	3	7	10	2	3	4	6	4	0	0	39
Gryllinae													
C. ovilongus	0	0	0	1	1	1	0	0	2	2	0	0	7
C. saeedi	0	0	1	2	2	0	0	2	3	2	0	0	12
G. supplicans	0	0	11	23	35	6	9	19	29	7	0	0	139
G. sigillatus	0	0	9	31	43	7	7	33	39	19	0	0	188
G. (Gryllus) campestris	0	0	0	3	5	0	0	2	2	0	0	0	12
G. (Gryllus) bimaculatus	0	0	7	5	49	5	3	51	17	14	0	0	151
G. (Gryllus) assimilis	0	0	0	2	3	0	0	2	1	1	0	0	9
A. domesticus	0	0	3	11	21	2	3	39	23	21	0	0	123
T. (Brachyteleogryllus) occipitalis	0	0	0	0	1	0	0	1	0	0	0	0	2
T. (Brachyteleogryllus) commodus	0	0	0	1	1	0	0	2	1	0	0	0	5
T. (Brachyteleogryllus) emma	0	0	0	2	1	0	0	1	2	1	0	0	7
Conocephalinae													
E. pallidus	0	0	0	0	0	0	0	1	0	0	0	0	1
Schizodactylinae													
S. monstrosus	0	0	0	0	0	1	0	0	1	1	0	0	3
S. minor	0	0	0	0	1	0	0	0	1	0	0	0	2

Note: January (JA), February (FE), March (MA), April (AP), May (MA), June (JU), July (JL), August (AU), September (SE), October (OC), November (NO), December (DE)

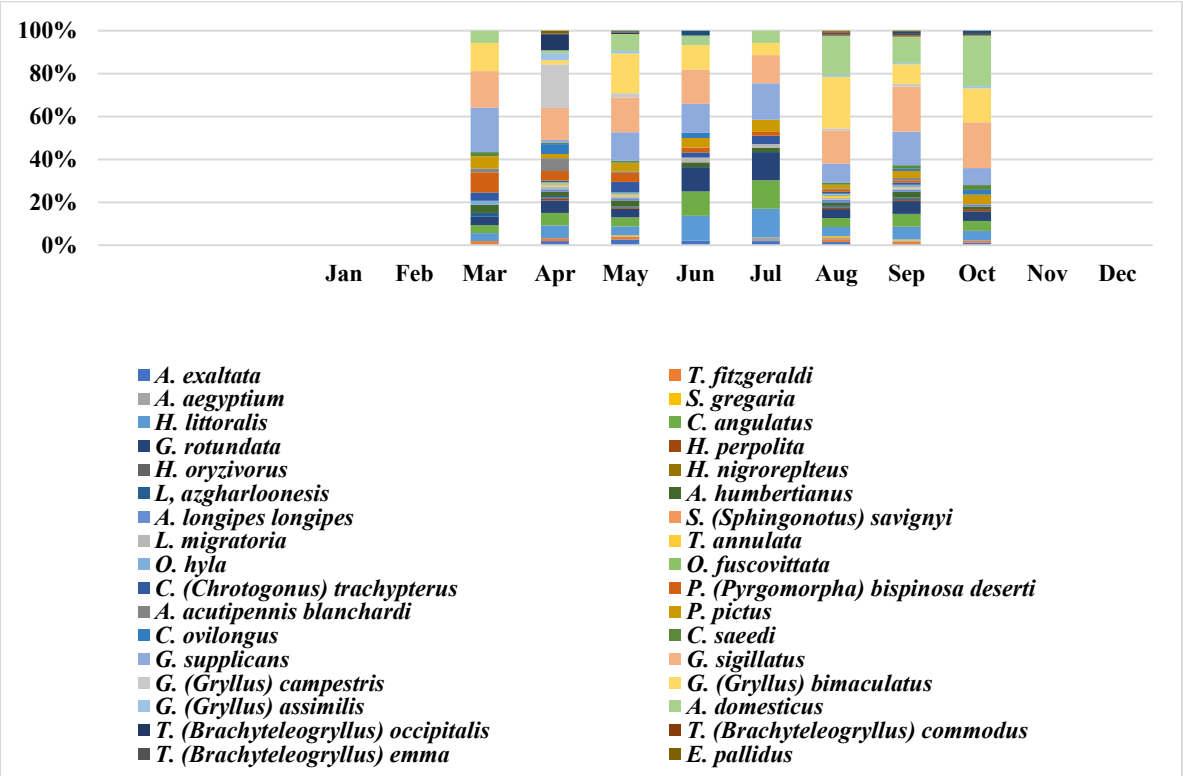

Figure 7. Distribution of Orthoptera Species from Nara desert during the year 2024

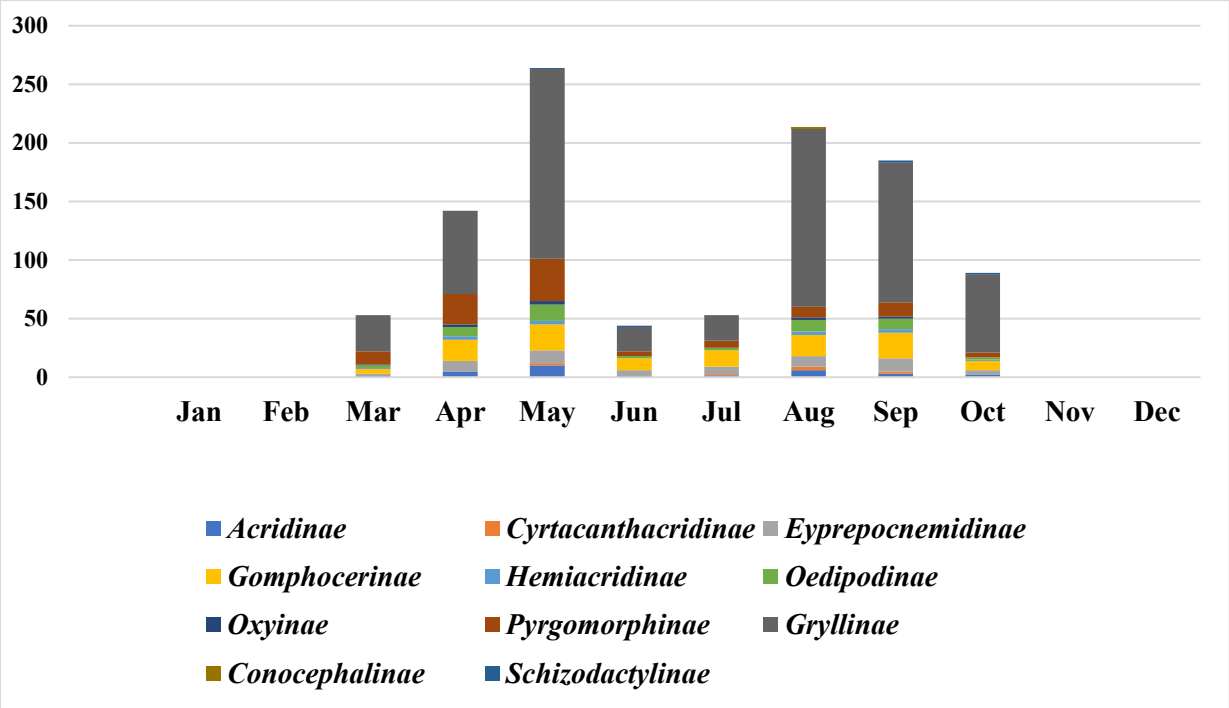

Figure 8. Distribution of Orthoptera Subfamily from Nara desert during the year 2024

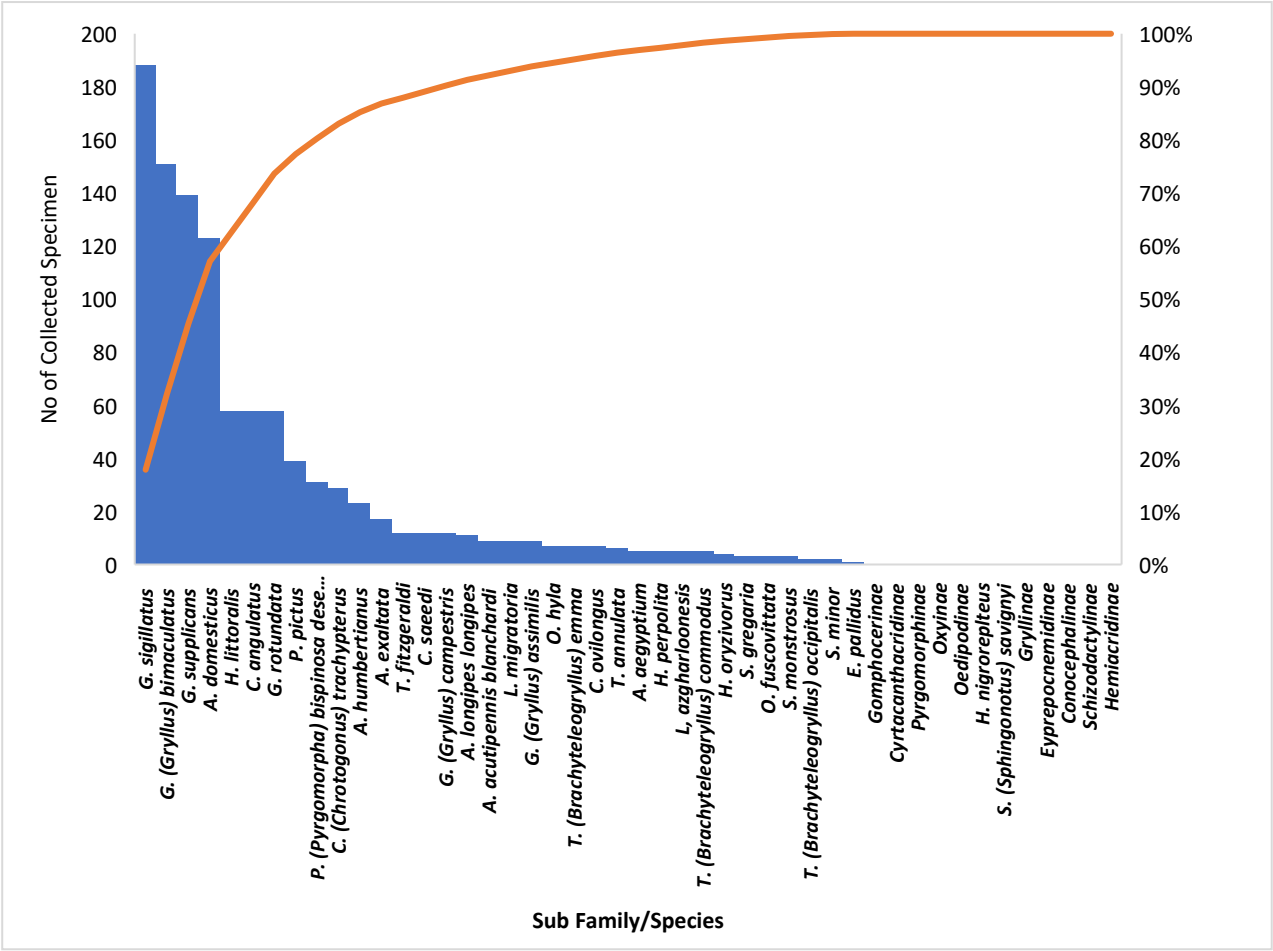

Figure 9. Distribution of Orthoptera Subfamily/Species from Nara desert during the year 2024

Table 6. Comparative analysis of Orthoptera from Nara desert during the year 2022, 2023 *and* 2024

Species	Eveness_e H/S			Shannon_H			Fisher_alpha			Dominance_D		
	2022	2023	2024	2022	2023	2024	2022	2023	2024	2022	2023	2024
Acrida exaltata	1	1	1	0	0	0	0.2185	0.1975	0.2322	1	1	1
Truxalis fitzgeraldi	1	1	1	0	0	0	0.2247	0.2045	0.2593	1	1	1
Anacridiuma egyptium	1	1	1	0	0	0	0.3426	0.3193	0.3759	1	1	1
Schistocerca gregaria	1	1	1	0	0	0	0.3426	0.2412	0.5252	1	1	1
Heteracris littoralis	1	1	1	0	0	0	0.1778	0.1502	0.1716	1	1	1
Chorthippus angulatus	1	1	1	0	0	0	0.2673	0.2525	0.1716	1	1	1
Gonistarotundata	1	1	1	0	0	0	0.2878	0.2673	0.1716	1	1	1
Hieroglyphusperpolita	1	1	1	0	0	0	0.3759	0.2878	0.3759	1	1	1
Hieroglyphusoryzivorus	1	1	1	0	0	0	0.3193	0.3193	0.4279	1	1	1
Hieroglyphusnigroreplteus	1	1	_	0	0	_	0.3017	0.2878	_	1	1	_
Leptacrisazgharloonesis	1	1	1	0	0	0	0.4279	0.3426	0.3759	1	1	1
Acrotylus humbertianus	1	1	1	0	0	0	0.2283	0.1817	0.2132	1	1	1
Acrotylus longipes longipes	1	1	1	0	0	0	0.2525	0.2132	0.2673	1	1	1
Sphingonotus (Sphingonotus) savignyi	1	1	_	0	0	_	0.4279	0.2878	_	1	1	_
Locusta migratoria	1	1	1	0	0	0	0.3017	0.2673	0.2878	1	1	1
Trilophidia annulata	1	1	1	0	0	0	0.2673	0.2322	0.3426	1	1	1
Oxya hyla	1	1	1	0	0	0	0.5252	0.2525	0.3193	1	1	1
Oxyafuscovittata	_	1	1	_	0	0	_	0.3426	0.5252	_	1	1
Chrotogonus (Chrotogonus) trachypterus	1	1	1	0	0	0	0.1639	0.1606	0.2008	1	1	1
Pyrgomorpha (Pyrgomorpha) bispinosa deserti	1	1	1	0	0	0	0.1906	0.1749	0.1975	1	1	1
Atractomorphaacutipennisblanchardi	1	1	1	0	0	0	0.3759	0.2364	0.2878	1	1	1
Poekilocerus pictus	1	1	1	0	0	0	0.2045	0.1723	0.1871	1	1	1
Callogryllusovilongus	1	1	1	0	0	0	0.5252	0.2673	0.3193	1	1	1
Callogryllussaeedi	1	1	1	0	0	0	0.2008	0.1778	0.2593	1	1	1
Gryllodessupplicans	1	1	1	0	0	0	0.1547	0.128	0.1457	1	1	1
Gryllodessigillatus	1	1	1	0	0	0	0.1405	0.1357	0.1386	1	1	1
Gryllus (*Gryllus*) *campestris*	1	1	1	0	0	0	0.2878	0.1975	0.2593	1	1	1
Gryllus (*Gryllus*) *bimaculatus*	1	1	1	0	0	0	0.1383	0.1237	0.1437	1	1	1
Gryllus (*Gryllus*) *assimilis*	1	1	1	0	0	0	0.2185	0.2085	0.2878	1	1	1

Acheta domesticus	1	1	1	0	0	0	0.1395	0.1257	0.1488	1	1	1
Teleogryllus (*Brachyteleogryllus*) *occipitalis*	1	1	1	0	0	0	0.3193	0.2878	0.7959	1	1	1
Teleogryllus (*Brachyteleogryllus*) *commodus*	1	1	1	0	0	0	0	0.2673	0.3759	1	1	1
Teleogryllus (*Brachyteleogryllus*) *emma*	1	1	1	0	0	0	0.3759	0.2878	0.3193	1	1	1
Euconocephalus pallidus	1	1	1	0	0	0	0.2878	0.2525	0	1	1	1
S. monstrosus	1	1	1	0	0	0	0.5252	0.3759	0.5252	1	1	1
Schizodactylus minor	1	1	1	0	0	0	0.7959	0.2322	0.7959	1	1	1

Conclusions

During the present study, a total of 36 species belonging to 25 genera and 11 subfamilies were collected from various localities in the Nara Desert region. The study highlights clear seasonal and inter-annual trends in Orthoptera assemblages in terms of species richness, abundance, and distribution. Peak activity occurred during the warmer months, particularly from May to August, indicating the thermophilic nature of most species. While 2023 emerged as a highly productive year likely due to favorable ecological conditions, a noticeable decline in 2024 suggests environmental stress, resource limitations, or other ecological disturbances. The consistently low diversity indices and high dominance values point to an unbalanced community structure, dominated by a few generalist species. Furthermore, the localized distribution of several species underscores the importance of microhabitat specificity. These findings stress the need for targeted habitat management and conservation strategies to maintain ecological balance and prevent further loss of Orthopteran biodiversity in the region.

Conflict of interest

Authors declared that there is no conflict of interest.

References

Barkat, I. A., Shome, A. R., Sultana R and Rabb, M. F.(2024). First confirmed record of *Schizodactylusmonstrosus* (Orthoptera: Schizodactylidae) based on its nymph from Bangladesh. *Journal of Bangladesh Academy of Sciences*, *48*(2), 161-163.

Baron, J. S., Gunderson, L., Allen, C. D., Fleishman, E., McKenzie, D., Meyerson, L. A. and Stephenson, N. (2009). Options for national parks and reserves for adapting to climate change. *Environmental management*, *44*, 1033-1042.

Belovsky, G. E., and Slade, J. B. (2018). Grasshoppers affect grassland ecosystem functioning: Spatial and temporal variation. *Basic and Applied Ecology*, *26*, 24-34.

Bidau, C. J. (2014). Patterns in Orthoptera biodiversity. I. Adaptations in ecological and evolutionary contexts. *Journal of Insect Biodiversity*, *2*(20), 1- 39.

Bhanger, N., Sultana, R., Baloch, N., and Kumar, S. (2024). Taxonomic insights and geographic distribution of Gryllidae (Gryllinae: Orthoptera) in Sindh, Pakistan.

Journal of Wildlife and Biodiversity, *8*(2), 1–15.

Byerly, A. R., Firneno Jr, T. J., Beard, R., and Larson, E. L. (2023). The role of community science in orthopteran research. *Journal of Orthoptera Research*, *32*(2), 109-114.

Chahil, G. S., Gill, H. K., and Goyal, G. (2018). Food Chains and Webs: Interaction with Ecosystem. *Advances in Crop Environment Interaction*, 405- 424.

Dight, I. J., and Scherl, L. M. (1997). The International Coral Reef Initiative (ICRI): Global priorities for the conservation and management of coral reefs and the need for partnerships. *Coral Reefs*, *16*, 139-147.

Fartmann, T., Krämer, B., Stelzner, F., and Poniatowski, D. (2012). Orthoptera as ecological indicators for succession in steppe grassland. *Ecological Indicators*, *20*, 337-344.

Fumy, F., Löffler, F., Samways, M. J., and Fartmann, T. (2020). Response of Orthoptera assemblages to environmental change in a low-mountain range differs among grassland types. *Journal of Environmental Management*, *256*, 109919.

Gomez-Morales, D. A., and Acevedo-Charry, O. (2022). Satellite remote sensing of environmental variables can predict acoustic activity of an orthopteran assemblage. *PeerJ*, *10*, e13969.

Hintz, W. D., and Garvey, J. E. (2012). Considering a species-loss domino- effect before endangered species legislation and protected area implementation. *Biodiversity and Conservation*, *21*, 2017-2027.

Kvassay, G. (2014). The complete cricket breeding manual: revolutionary new cricket breeding systems. Zega Enterprises.

Muluneh, M. G. (2021). Impact of climate change on biodiversity and food security: a global perspective review article. *Agriculture and Food Security*, *10*(1), 1-25.

Nagendra, H., Lucas, R., Honrado, J. P., Jongman, R. H., Tarantino, C., Adamo, M., and Mairota, P. (2013). Remote sensing for conservation monitoring: Assessing protected areas, habitat extent, habitat condition, species diversity, and threats. *Ecological Indicators*, *33*, 45-59.

Rajak, P., Roy, S., Ganguly, A., Mandi, M., Dutta, A., Das, K., and Biswas, G. (2023). Agricultural pesticides–Friends or foes to biosphere. *Journal of Hazardous Materials Advances*, *10*, 100264.

Schwartz, M. K., Luikart, G., and Waples, R. S. (2007). Genetic monitoring is a promising tool for conservation and management. *Trends in Ecology* and *Evolution*, *22*(1), 25-33.

Samejo, A.A, Sultana R, Kumar S., and Samiullah S. (2021). Could Entomophagy Be an Effective Mitigation Measure in Desert Locust Management. *Agronomy, 11*, 455.

Samiullah, S, and Sultana R. (2023). Taxonomic and morphological studies on the genus *Chrotogonus* Serville, 1838 (Pyrgomorphidae: Orthoptera) from Pakistan, with reference to their habitats. *Baghdad Science Journal, 20*(6), 2155-2167.

Sultana, R. (2019). A new genus *Schizocomicus* (Schizodactyloidea: Ensifera) from Sindh Pakistan" *Pakistan Journal of Zoology*, 51(5): 1693-1697.

Sultana, R. and Lecoq M. (2020a). *Encyclopedia of Plant Pests for world* published by China, (Contributed 2 chapters from Pakistan). ISBN: 978-7-5655-2232-1.

Sultana, R. and Lecoq M. (2020b). *Encyclopedia of Plant Pests for world*. published by China, (Contributed 2 chapters from Pakistan). ISBN: 978-7-5655-2232-1.

Sultana **R** and SONG H. 2024. Annotated catalogue of Pakistani Acrididae (Orthoptera: Caelifera: Acridoidea). Zootaxa 5486 (1): 001–047. https: //doi.org/10.11646/zootaxa.5486.1.1

Sultana, R., Soomro, N and Wagan, M.S. (2020c). Description of new species with comparison to close allies (Oxyinae: Acrididae: Orthoptera). *Pakistan Journal of Zoology*, pp 1-6.

Sultana, R, Surriya S., Kumar, S., Sheik M. R. and Fakhra S. (2021). A review of Gryllidae (Grylloidea) with the description of one new species and four new distribution records from the Sindh Province, Pakistan. *ZooKeys 1078*, 1-33

Sultana, R, Kumar, S., Samejo, A.A, Soomro, S. Lecoq, M. (2021). The 2019–2020 upsurge of the desert locust and its impact in Pakistan. *Journal of Orthoptera Research*, 30(2): 145-154.

Sultana, R., Soomro, S. and Ma, C. (2021). Molecular Identification of *Chrotogonus*spp. (Pyrgomorphidae: Caelifera: Orthoptera) *Pakistan Journal of Zoology*,*54*(4), 1931-1934.

Sultana, R, Lal, M, Samiullah S., Kumar, S. and Samejo, A.A. (2024). Biodiversity and Systematic Status of band-winged grasshoppers, Oedipodinae Walker, 1871 (Orthoptera: Acrididae) from Thar Desert, Pakistan. *Pakistan Journal of Zoology*, *56*(1), 307-321.

Tallis, H, Kareiva, P., Marvier, M. and Chang, A. (2008). An ecosystem services framework to support both practical conservation and economic development. *Proceedings of the National Academy of Sciences*, *105*(28), 9457-9464.

Van-Klink, R., August, T., Bas, Y., Bodesheim, P., Bonn, A., Fossøy, F. and Bowler, D. E. (2022). Emerging technologies revolution in insect ecology and monitoring. *Trends in Ecology and Evolution,* 37(10), 872-885

Willis, K. J Araujo, M. B., Bennett, K. D., Figueroa-Rangel, B., Froyd, C. A. and Myers, N. (2007). How can a knowledge of the past help to conserve the future? Biodiversity conservation and the relevance of long-term ecological studies. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *362*(1478), 175-187.