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COMPARATIVE STUDY ON GRASSHOPPER DIVERSITY AND DESERT LOCUST IN WET AND DRY SOIL AREAS OF QUETTA DISTRICT (KUCHLAK) OF BALOCHISTAN

Amna Khalil[1], Nosheen Rafiq[1]*, Ayesha Khalil[1], Laraib Haider[1]

[1]**Department of Zoology,** Sardar Bahadur Khan Women University, Quetta, Pakistan

***Corresponding Author:** Nosheen Rafiq. E. mails: nosheenyasirzafar@gmail.com

Abstract

Populations of grasshoppers and desert locusts can rapidly expand to catastrophic levels, causing significant devastation in a short period. A study was conducted from July 2021 to June 2022 to assess the diversity of grasshoppers and desert locusts in wet and dry soil areas of Kuchlak, Quetta District in Balochistan. A total of 250 specimens were collected in this study. Fourteen species belonging to the order Orthoptera, distributed across two families (Pyrgomorphidae and Acrididae) and twelve genera, were observed; n=155 specimens were found in wet areas while n=95 were found in dry soil areas. Captured grasshopper species includes (Chrotogonus trachypterus, Sphingonotus rubsences rubsences, Poekilocerus pictus, Aiolopus thalassinus, Chrotogonus armatus, Heteracris littoralis, Anacridium aegyptium, Acrida cinerea, Pyrgomorpha conica, Aiolopus thalassinus tamulus, Diabolocatantops innotabilis, Acrotylus patruelis, Oxya hyla and desert locust (Schistocerca gregaria). In the present research, the Acrididae appeared as the richest family. The findings suggest that wet and dry soil areas support grasshopper and desert locust diversity

Keywords: *Catastrophic, Devastation, Kuchlak, Locust, Richest*

INTRODUCTION

The desert locusts, also known as the short-horned grasshopper, is a worldwide species that exists in both ancient and modern world (1). Grasshoppers and desert locusts are large, lean, flying insects with powerful hind legs and mandibles, and mouth-parts, designed for chewing. They range in length from 0.5 to 4 inches (1 to 10 cm). The thorax contains the locomotory organs, such as the legs and wings. In addition to housing many of the body's metabolic functions, the abdomen is in charge of reproduction and may contain appendages associated with this function (2).They have three sets of legs, and they use each pair to walk. Strong back legs are also used for jumping and taking off. Grasshoppers can leap up to 20 times their body length. Most species only allow males to sing or stridulate (3). Numerous variables, including vegetation, precipitation, and geographic location, have been connected to grasshopper and desert locusts dispersal and population. Rainfall is crucial for plant growth (4). The soil's moisture content is one of the most important factors influencing the onset and intensity of plague. Due to their ability to destroy both natural and cultivated vegetation, grasshoppers and desert locusts are considered major agricultural pests. The Acrididae family includes fifteen common species of grasshoppers, including the desert locusts (5). Desert locusts are the true locust (6). On top of that, a lot of species don't hurt leaves and have limited ecological possibilities and ranges of spread (7). Swarms of desert locusts have caused some of the most devastating natural disasters in recorded human history. The aim of study is to find the grasshoppers diversity and desert locusts in wet and dry areas of Kuchlak, Quetta District of Balochistan.

MATERIALS AND METHODS

STUDYAREA

Kuchlak, a small town in Balochistan, Pakistan, is part of the Quetta District. The climate in Kuchlak is continental and arid, with significant summer and winter temperature fluctuations. The main source of precipitation in Kuchlak is snowfall throughout the winter months; unlike most of Pakistan, it does not experience a monsoon with prolonged, heavy rainfall. In the present study, samples were collected from dry soil areas and wet soil areas of Kuchlak.

SAMPLE COLLECTION

Adult grasshoppers and desert locust were collected by hand from both agricultural and non-agricultural fields between July 2021 and June 2022. Specimens were captured early in the morning by hand and with nets during the warmer part of the day. The obtained specimens were placed in plastic containers. After the earth was dug up around 10 to 15 mm, a handful was taken, and the soil was squeezed together to determine if the soil was wet (W) or dry (D) (8).

KILLING AND PRESERVATION

Samples were killed and preserved using standard entomological methods; potassium cyanide was used in the laboratory. Specimens were stretched out for genital and other taxonomic components as well as morphological feature studies. A pin was inserted into the pronotum of specimens. The sample is put in wooden boxes and kept as permanent material for additional taxonomic and comparative research. The specimens were protected from ants and other dangerous insects by placing the naphthol inside the wood boxes (6).

IDENTIFICATION AND PHOTOGRAPHS

Specimens were photographed using a stereoscopic dissecting binocular microscope and identified by comparing their characteristics with published taxonomic keys and descriptions (6).

SPECIES DIVERSITY INDEX

The number of each species, its proportion of all individuals, and the sum of its proportion times its natural log for each species are used to compute the Shannon-Weiner Species Diversity Index.
The equations for Shannon-Weiner Species Diversity Index

$$\text{Shannon Index} \quad H = -\sum_{i=1}^{s} pi \ \text{In} pi$$

In the Shannon index, p is the proportion (n/N) of individuals of one particular species found (n) divided by the total number of individuals found (N), ln is the natural log, Σ is the sum of the calculations, and s is the number of species (9).

RESULTS

During the study period, 250 individuals of grasshoppers and desert locusts (Insecta: Orthoptera) were recorded from both wet and dry soil areas. These individuals belonged to 14 species across two families. Twelve genera and two families, Pyrgomorphidae and Acrididae, were found. Acrididae was the most abundant family, with 10 species, followed by Pyrgomorphidae with four species.

Table I illustrates the captured grasshopper species includes *Chrotogonus trachypterus*, *Sphingonotus rubsences rubsences*, *Poekilocerus pictus*, *Aiolopus thalassinus*, *Chrotogonus armatus*, *Heteracris littoralis*, *Anacridium aegyptium*, *Acrida cinerea*, *Pyrgomorpha conica Aiolopus thalassinus tamulus*, *Diabolocatantops innotabilis*, *Acrotylus patruelis*, *Oxya hyla, Schistocerca gregaria* (desert locust). Acrididae was the most dominant family with 10 species followed by Pyrgomorphidae with 4 species as presented.

Table II demonstrate the randomly selected grasshopper species and desert locusts from a wet soil location in Quetta district (Kuchlak) were measured using the Shannon-Weiner Species Diversity Index. A total 155 number of individuals the sum ∑ of (Pi In Pi) = -2.46469 and the diversity index of relative value were H = 2.464693 higher grasshopper species including desert locust (*Schistocerca gregaria)* diversity index were calculated at wet soil area.

Table I. Classification of collected specimens

Order	Family	Genus	Species
Orthoptera	Pyrgomorphidae	Chrotogonus	*trachypterus*
		Poekilocerus	*pictus*
		Chrotogonus	*armatus*
		Pyrgomorpha	*conica*
	Acrididae	Sphingonotus	*rubsences rubsences*
		Aiolopus	*thalassinus*
		Heteracris	*littoralis*
		Anacridium	*aegyptium*
		Acrida	*cinerea*
		Aiolopus	*thalassinus tamulus*
		Diabolocatantops	*innotabilis*
		Schistocerca	*gregaria*
		Acrotylus	*patruelis*
		Oxya	*hyla*

Table II. Calculated the Shannon-Weiner Species Diversity Index of collected specimen at wet soil area

Species	Number of individuals in wet soil area	*Pi*	In *Pi*	*Pi* In *Pi*
Chrotogonus trachypterus (Blanchard,1836)	11	0.070968	-2.64553	-0.18775
Sphingonotus rubsences rubsences (Walker.1870)	8	0.051613	-2.96398	-0.15298
Poekilocerus pictus (Fabricius, 1775)	32	0.206452	-1.57769	-0.32572
Aiolopus thalassinus (Fabricius, 1781)	20	0.129032	-2.04769	-0.26422
Heteracris littoralis (Rambur, 1838)	6	0.03871	-3.25167	-0.12587
Chrotogonus armatus (Steinmann, 1965)	4	0.025806	-3.65713	-0.09438
Anacridium aegyptium (Linnaeus, 1764)	7	0.045161	-3.09751	-0.13989
Pyrgomorpha conica (Olivier, 1791)	12	0.077419	-2.55852	-0.19808
Acrida cinerea (Thunberg, 1815)	14	0.090323	-2.40437	-0.21717
Aiolopus thalassinus tamulus (Fabricius, 1798)	13	0.083871	-2.47848	-0.20787
Diabolocatantops innotabilis (Walker, 1870)	9	0.058065	-2.8462	-0.16526
Schistocerca gregaria (Forsskal, 1775)	9	0.058065	-2.8462	-0.16526
Acrotylus patruelis (Herrich-Schäffer, 1838)	6	0.03871	-3.25167	-0.12587
Oxya hyla (Serville, 1831)	4	0.025806	-3.65713	-0.09438
Sum	155	1		-2.464
H				2.464

Table III describe the Shannon-Weiner Species Diversity Index of Grasshopper species randomly collected at Kuchlak, Balochistan, in a dry soil environment. A total 95 number of individuals the sum ∑ of (Pi In Pi) = -1.55295 and the diversity index of relative value were H = 1.552953 lower grasshopper species diversity index were noted at dry soil area. No desert locusts observed at dry soil area.

SPECIES DIVERSITY

In areas with dry soil, *Chrotogonus trachypterus* was the most prevalent species. *Oxya hyla*, on the other hand, had the lowest value in the wet soil site, as indicated by the different grasshopper species and desert locusts richness and evenness in both locations.

DISCUSSION

The study identified five species of grasshoppers and locusts belonging to the genera Anacridium and Schistocerca (subfamily Cyrtacanthacridinae) and Sphingonotus and Aiolopus (subfamily

Oedipodinae). *Locusta migratoria* was not detected in the fruit and vegetable orchards of Kuchlak, Balochistan, where *Schistocerca gregaria, Anacridium aegyptium, Sphingonotus rubsences, Aiolopus thalassinus,* and *Aiolopus thalassinus tamulus* were present.

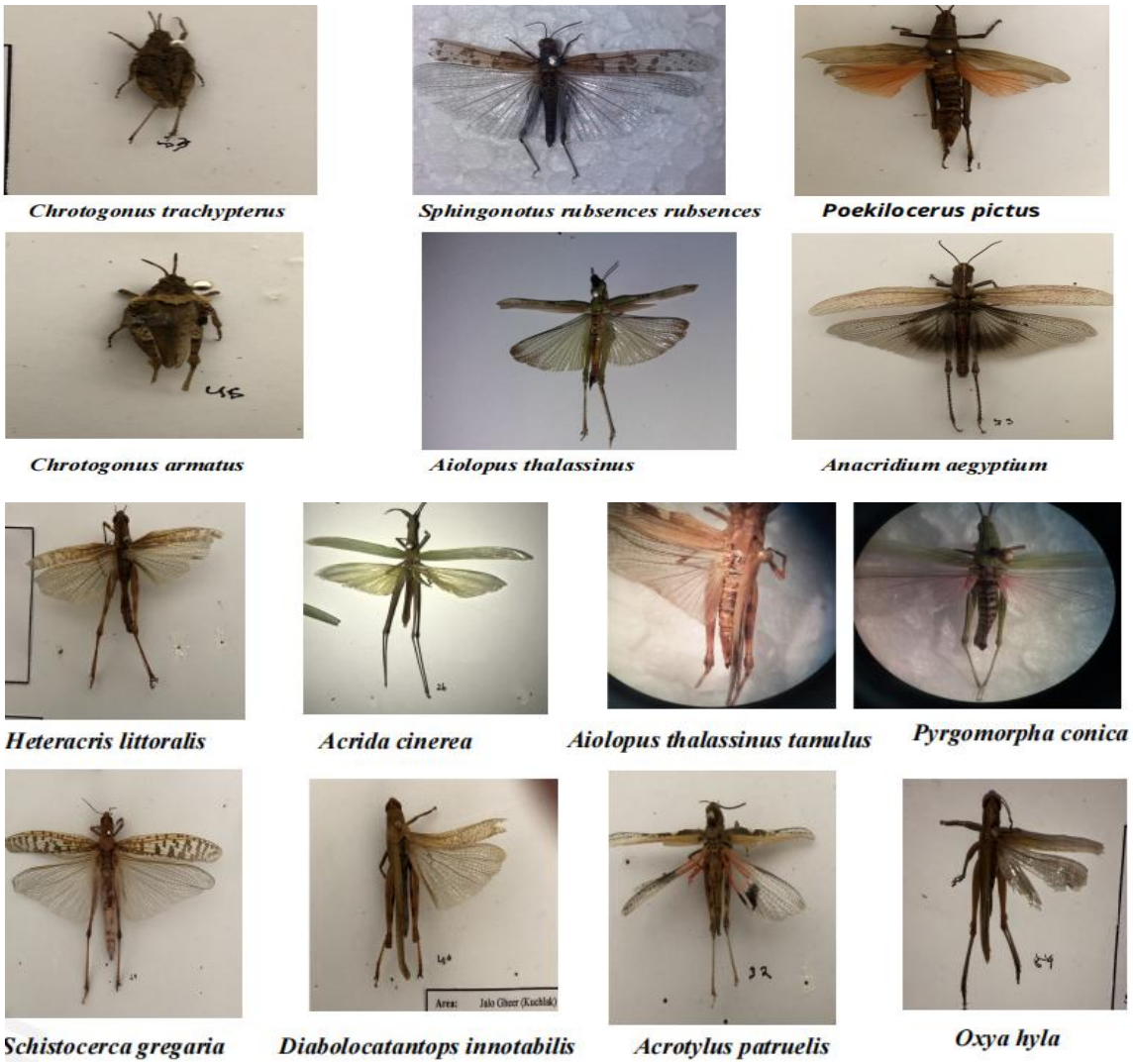

Fig.1(a). *Chrotogonus trachypterus*, **(b)** *Sphingonotus rubsences rubsence*,,**(c)** *Poekilocerus pictus*, **(d)** *Chrotogonus armatus*, **(e)** *Aiolopus thalassinus*,,**(f)** *Anacridium aegyptium*,**(g)** *Heteracris littoralis*,**(h)** *Acrida cinerea*, **(i**) *Aiolopus thalassinus tamulus*,**(j)** *Pyrgomorpha conica* , **(k)** *Schistocerca gregaria*,**(l)** *Diabolocatantops innotabilis*,**(m)** *Acrotylus patruelis*,**(n)** *Oxya hyla*

Four locusts species have been found in the Thar Desert, according to Samejo and Sultana (2016). They are members of the genus Locusta of the subfamily Oedipodinae, family Acrididae, and the genera Anacridium, Cyrtacanthacris, and Schistocerca of the subfamily Cyrtacanthacridinae (6). These specimens were collected from both naturally existing vegetation and farmed fields. *Schistocerca gregaria* and *Locusta migratoria* stand out among these four locusts species as being particularly bothersome. Two families, nine subfamilies, and fourteen species from twelve genera were reported in the current findings. The Pyrgomorphidae family was the least abundant, while the Acrididae family was the most prosperous. Khan *et al.* (2022) found that there are 22 species of grasshopper, divided into 19 genera and 3 families. Six hundred thirty-three specimens of the majority of the Acrididae were found (4).

Hussain *et al.,* (2017) discovered that there were 14 genera, 3 families, 10 subfamilies, and 18 species. There have been reports of the Pyrgomorphidae, Tettigoniidae, and Acrididae families. Noting similarities, the Acrididae family was the greatest (10). The current study supports the findings of Hussain *et al.,* (2017) and Khan *et al.,* (2022), who also discovered that the Acrididae family was the most prosperous of the other families.

Ten species from the Acrididae family and four from the Pyrgomorphidae family were found in the current study. These results correspond with those of Sultana *et al.,* (2013), who noted four species in the Pyrgomorphidae family. Nonetheless, 29 species from the Acrididae family were identified (11). Recent studies have emphasized the ecological importance and diversity patterns of orthopteran insects,

particularly grasshoppers and locusts, in arid and semi-arid ecosystems. Variations in species richness between wet and dry soil habitats can be attributed to the differences in vegetation type, microclimate, and soil structure, which significantly influence oviposition, nymphal development, and adult survival (12). In Pakistan's desert regions, such as Cholistan and Thar, species such as *Schistocerca gregaria, Aiolopus thalassinus,* and *Sphingonotus rubescens* have been reported to exhibit habitat-specific preferences, with moisture gradients influencing their population density and distribution (13). Such patterns are consistent with the present findings in Kuchlak, where species assemblages varied between habitats, indicating the role of soil moisture as a key driver of orthopteran diversity.

In addition to their ecological roles, certain grasshopper species serve as agricultural pests and pose a significant threat to crop productivity. *Schistocerca gregaria*, the desert locust, is one of the most notorious pests worldwide and is capable of forming devastating swarms that can rapidly destroy vast areas of crops (14). Environmental conditions such as prolonged rainfall and green vegetation following dry periods create ideal breeding grounds for locust outbreaks, as seen in Pakistan during the 2019–2020 upsurges (15). Recent remote-sensing and GIS-based models have been used to predict the distribution and migration of these locusts, aiding in early warning systems and control strategies (16). The presence of *Schistocerca gregaria* and other economically relevant species in Kuchlak underscores the importance of continued monitoring and region-specific biodiversity assessments to manage potential locust outbreaks effectively.

CONCLUSION

The study revealed that grasshoppers and desert locusts are more prevalent in wet soil areas compared to dry ones, confirming that both habitats support Acrididae species. While these insects are globally distributed, they pose a significant threat to subsistence farming. In the event of severe infestations, the use of pesticides remains a crucial control strategy. Chemical insecticides, particularly those containing fipronil, have proven effective in managing grasshopper and locust populations and preventing rapid swarm expansion.

Conflict of interest:

There is no conflict of interest among authors regarding this review article.

Authors' contribution:

AK Conceptualization, data curation, writing and statistical analysis; NR Supervision, project administration; AK Formal analysis, investigation and editing & LH Methodology, writing.

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