Research Article

Diversity of grasshopper in the piedmont of mount Elum, Buner

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Abstract

A study from March 2019 to August 2019 was conducted to find out the diversity of Grasshopper in the piedmont of mount Elum, Buner. Its elevation is 2,800 meters. A total of 633 specimens were collected during the study period. A 22 species of grasshopper were identified under nineteen genera of three families. Members of family Acrididae (17) under 8 subfamilies were found the most abundant. Whereas, Tettigoniidae (3) has two subfamilies and Pyrgomorphidae (2) has only one subfamily. Statistical analysis indicated percentage of different species of family Acrididae is 84.2% while Tettigoniidae is 9.8% and Pyrgomorphidae is 6%. The most dominant species recorded was *Diabolocantops pinguis* (11%) whereas, *Euconocephalus incertus* (0.6%), indicated the lowest range. The diversity were found through analysis of different parameters like morphometric measurement such as body length, length of wings, length of femur, length of tabia, length of tarsi, length of antennae, length of pronotum with finely divider and a common scale ruler. The data were analyzed via MS Excel version 2010.

Keywords: Buner; Diversity; Elum; Exploration; Grasshopper

Introduction

Grasshoppers are large, slender, winged insects with strong hind legs and powerful mandibles, or mouth parts, suitable for chewing and biting. They have a front pair of rigid wings called tegmina and a hind pair, often bright color, large membranous wings. Their size ranges from 1–10 cm in length [1]. Grasshopper belongs to order Orthoptera which is the sixth largest order of insects [2], with more than 20,000 species worldwide [3]. In general, order orthoptera is classified into two sub-order such as short horned

grasshopper (Caelifera) and long horned grasshopper (Ensifera) [4]. Most of them are herbivores, but some are carnivores [5]. Most grasshoppers are polyphagous and consume vegetation from various plant sources. Some of them are omnivorous and consume animal tissue and faeces as well [6].

The distribution and abundance of grasshoppers was linked to a number of factors, including vegetation, temperature, precipitation and geographical area. Temperature and rainfall are important for plant growth [7], so grasshoppers, are also

affected by changes in plant conditions [8]. Grasshoppers are the main pests of many crops and grasslands and occupy almost all land habitats and climates are best known for their great potential to damage crops [9]. These species may be the most notable of all insect pests and are found abundant in dry grasslands and deserts [10]. Some species of grasshopper may change color, behavior and swarms at high population densities under certain environmental conditions [11].

Grasshoppers in Pakistan were found in arid and semi-arid areas. Pakistan's geographical conditions provide ideal breeding grounds for grasshoppers, which therefore pose serious threats to both irrigated and rainy crops and pastures [12].

Grasshoppers have a typical nervous system with a large set of external sensory organs. A pair of large compound eyes is on the side of the head that give a wide field of vision and can detect movement, shape, color and distance [13].

Like other insects, grasshoppers have an open circulatory system and their body cavities are filled with haemolymph. Haemolymph functions include wound healing, heat transfer and hydrostatic pressure supply. There is no gaseous exchange involving the circulatory system [14].

Grasshoppers are the utmost economic importance as they are major plant pests that can seriously damage crop growth [15], pastures, forests [16] their nutritional values and production rates. They are also beneficence to diversity, abundance and biomass [17-19].

Grasshoppers are considered to be the best source of protein food for several bird species [20]. Grasshoppers are important component of ecosystem [21]. For seasonal growth of grasses, adults as well as fourth and fifth instars of grasshopper are important because these stages are responsible for increased foliage consumption and destruction [22].

Materials and Methods

Study area

District Buner, of Khyber Pakhtunkhwa is located in the Northern part of Pakistan at geographical location of 34° - 9° and 34° - 43° N latitude and 72° - 10° and 72° - 47° E longitude. It shares the boundaries of Swat (north), Malakand (west), Mardan (south), and Indus River and Hazara Division (east). The region is surrounded by hills from all sides and is split from Swat by Elum Mountain. The population of the district is 897319 (2017). Its total area is 1,865 km² as shown in (Fig. 1 & 2).

Figure 1. Map of district Buner.

Figure 2. Mountain Elum

The well-known mountain of the district is Elum. Its elevation is 2,800 meters. Its peak covered with snow in winter. It is situated at

the west of Pir Baba. The recent research was conducted in the piedmont of this mountain (Elum).

Sampling

During March 2019 to August 2019, sample collections were made. In eleven different sites of the area, specimens were collected randomly, 4 times each month between 8 am to 3 pm. A Sweep net and hand picking Method was used for the collection of Baldi and Kisbenedek [23]. The collected insects were transferred to a bottle. Soaked cotton of ethyl acetate were added to kill the specimen. The specimen was removed from the bottle after being killed to prevent color change.

Storage

In storage boxes and cabinets, pinned specimens were kept with naphthalene balls to avoid decomposition. Wet specimens were stored in plastic vials in 70% ethyl alcohol.

Identification

Specimens were relaxed for the first time. Right wings were stretched putting a piece of paper on it (if necessary) and pinned it by inserting a pin on a stretching board on the rear right thorax and were left to become dry for 72 hours. The specimens were later identified up to species level through a key designed by Sultana and Wagan [1] in Hazara University using stereoscopic microscope in accessible literature and based on external morphological characters.

Morphometry and Photography

In the measurement phase: body length, length of wings, femur, tibia, tarsi, antennae and pronotum were measured with finely divider and a common scale ruler. A total of 22 different species were measured. After identification and measurement, the specimens were placed on the top of a blank white sheet of paper. And then the specimens were photographed with the help of mobile camera (Galaxy J2 Prime).

Results

A total of 633 specimens of grasshopper were collected. These samples were identified and yielded into 2 sub orders such as *Ensifera* and *Caelifera* with 3 Super families *Acridoidea*,

Tettigoniodea and *Pyrgomorphoidea*. Family *Acrididae* is subdivided into eight subfamilies,

(*Oxyinae*, *Oedipodinae*, *Acridinae*, *Calliptaminae*, *Hemiacridinae*, *Gomphocerinae*, *Eyprepocnemidinae*, and *Catantopinae*), 14 genera (*Oxya*, *Gesonula*, *Oedaleus*, *Trilophidia*, *Dociostaurus*, *Acrida*, *Acorypha*, *Spathosternum*, *Hieroglyphus*, *Gonista*, *Heteracris*, *Choroedocus*, *Diabolocatantops*, *Sphodromerus*) and 17 species (*Oxya velox*, *Oxya hyla hyla*, *Oxya japonica*, *Acrida ungarica*, *Acrida exaltata*, *Gesonula punctifrons*, *Oedaleus senegalensis*, *Trilophidia annulata*, *Dociostaurus desius*, *Spathosternum prasiniiferum*, *Hieroglyphus nigrarepletus*, *Gonista rotundata*, *Acorypha glaucopsis*, *Choroedocus illustris*, *Diabolocatantops pinguis*, *Sphodromerus undulates*, and *Heteracris pulcher*). Family *Tettigoniidae* contains two subfamilies (*Hexacentrinae* and *Conocephalinae*), three genera (*Conocephalus*, *Chrotogonus* and *Hexacentrus*) and three species (*Conocephalus maculatus*, *Chrotogonus trachypterus* and *Hexacentrus unicolor*). Whereas, family *pyrgomorphidae* has only one subfamily (*Pyrgomorphinae*), two genera (*Chrotogonus*, *Atractomorpha*), and two species (*Chrotogonus trachypterus* and *Atractomorpha crenulata*), as shown in (Table 1).

Morphometric measurement of different species

Morphometric measurement of 22 species in (mm) for seven different parameters BL, body length; AL, antenna length; FW, forewings length; FL, femur length; TL, tibia length; tL, tarsi length; PL, pronotum length were measured and as shown in (Table 2).

Month-wise abundance

The data showed increasing trend in the abundance of species from March to August as shows in (Fig. 3).

Table 1. Classification of collected species

Order	Family	Genus	Species
Orthoptera	Acrididae	<i>Oxya</i>	<i>hyla hyla</i>
		<i>Oxya</i>	<i>japonica</i>
		<i>Oxya</i>	<i>velox</i>
		<i>Acrida</i>	<i>exaltata</i>
		<i>Acrida</i>	<i>ungarica</i>
		<i>Gesonula</i>	<i>punctifrons</i>
		<i>Oedaleus</i>	<i>senegalensis</i>
		<i>Trilophidia</i>	<i>annulata</i>
		<i>Doclostaurus</i>	<i>desius</i>
		<i>Spathosternum</i>	<i>prasiniferum</i>
		<i>Hieroglyphus</i>	<i>nigrorepletus</i>
		<i>Gonista</i>	<i>rotundata</i>
		<i>Acorypha</i>	<i>glaucopsis</i>
		<i>Choroedocus</i>	<i>illustris</i>
		<i>Diabolocatanops</i>	<i>punguis</i>
		<i>Sphodromerus</i>	<i>undulates</i>
		<i>Heteracris</i>	<i>pulcher</i>
	Tettigoniidae	<i>Conocephalus</i>	<i>maculatus</i>
		<i>Hexacentrus</i>	<i>unicolor</i>
		<i>Euconocephalus</i>	<i>incertus</i>
	Pyrgomorphidae	<i>Chrotogonus</i>	<i>trachypterus</i>
		<i>Atractomorpha</i>	<i>crenulata</i>

Table 2. Morphometric measurement of samples

Species	BL	FWL	FL	TL	tL	AL	PL
<i>Acorypha glaucopsis</i>	52	46	25	23	7	12	10
<i>Trilophidia annulata</i>	23	30	15	13	5	12	5
<i>Hexacentrus unicolor</i>	28	40	25	25	7	42	5
<i>Chrotogonus trachypterus</i>	13	15	13	12	3	10	4
<i>Gonista rotundata</i>	32	28	15	13	3	6	5
<i>Diabolocatanops pinguis</i>	35	30	26	14	6	8	7
<i>Oxya japonica</i>	15	15	13	10	4	7	3
<i>Oxya velox</i>	16	21	13	12	3	3	6
<i>Spathosternum prasiniferum</i>	14	15	11	8	3	3	4
<i>Acrida exaltata</i>	28	28	14	10	4	5	7
<i>Oxya hyla hyla</i>	36	34	14	11	4	8	4
<i>Conocephalus maculatus</i>	13	15	8	8	3	5	5
<i>Sphodromerus undulates</i>	28	18	18	17	5	10	8
<i>Hieroglyphus nigrorepletus</i>	32	10	17	14	7	15	7
<i>Gesonula punctifrons</i>	31	25	15	13	5	7	6
<i>Oedaleus senegalensis</i>	12	13	14	13	3	11	6

<i>Choroedocus illustris</i>	38	25	24	24	6	7	5
<i>Atractomorpha crenulata</i>	28	23	13	12	3	6	6
<i>Heteracris pulcher</i>	44	34	36	34	9	16	8
<i>Acrida ungarica</i>	50	40	38	25	4	13	8
<i>Euconocephalus incertus</i>	43	52	30	29	6	45	10
<i>Dociostaurus desius</i>	28	18	17	14	5	12	6

Figure 3. Month-wise abundance of grasshopper

Species diversity

Most abundant species was *Diabolocatantops pinguis*. Whereas, minimum value were recorded for *Euconocephalus incertus*. Acrididae was represented by 17 species, Tettigoniidae by 3 species and Pygromorphidae by 2 species. Species diversity of Di Species is shown in (Fig 4).

Sites of collection

The data collected from different sites showed variations in the population size of grasshoppers. Among the 633 collected samples, the highest number of specimens were recorded from Dokada (113) followed by Ghuanday (80) Ghowandakay (70) Jowar (56) and Balokhan (54) and as in (Fig. 5).

Discussion

In the current research 2 sub order (*Ensiera* and *Caelifera*) 3 Super family (*Acridoidea*, *Tettigonioidea* and *Pyrgomorphoidea*), 3 families (*Acrididae*, *Tettigonidae*, *Pyrgomorphidae*), 11 subfamilies, (*Acridinae*, *Oxyinae*, *Oedipodinae*, *Catantopinae*, *Hemiacridinae*, *Eyprepocnemidinae*, *Hexacentrinae*, *Conocephalinae*, *Gomphocerinae*, *Calliptaminae* and *Pyrgomorphinae*), 19 genera and 22 species were recorded. The most dominant species were *Diabolocatantops pinguis* (11%) whereas, *Euconocephalus incertus* was 0.6%, indicated the lowest value of the total sample size.

Figure 4. Species diversity of pecimens

Figure 5. For collection of grasshopper from different localities

Paulraj *et al.* [24]. Reported 33 species under four families, similarities shows in 3 families while members of the fourth (*Tetrigidae*) were found absent in recent research. *Acrididae* family was found the most abundant in both cases indicated similarities in this regard. This similarity was also found in study reports of Capinera *et al.* [25], Kandibane *et al.* [26], and Thakur *et al.* [27]. Six species (*A. exaltata*, *H. pulcher*, *O. hyla*

hyla, *S. prasineferum*, *Tannulata* and *A. crenulata*) were found similar while remaining were not reported.

Mukhtar *et al.* [28] reported 14 species belonged to six sub-families with twelve genera. Four subfamilies (*Acridinae*, *Gomphocerinae*, *Eypreponcnemidinae* and *Oedipodinae*) were found to be similar. *Oedipodinae* being a dominant subfamily with eight species whereas, in current

research sub family *Oxyinae* represents four species, found to be the abundant. Common Species found in both cases were *Acrida exaltata* and *Oedaleus senegalensis* while remaining were not reported in the present work.

In Jharkhand (India), Nayeem and Usmani [29] worked on taxonomy and field observations of grasshopper and locust fauna (*orthoptera: acridoidea*) and collected 421 specimens under 41 species, 28 genera of 10 subfamilies, and 3 families. Subfamilies *Oxyinae*, *Hemicridinae*, *Oedipodinae*, *Catantopinae*, *Eyprepocnemidinae* and *Acridinae* were reported mutual in both cases. *O. japonica*, *O. hyla hyla*, *O. velox*, *H. nigrorepletus*, *S. prasiniferum*, *D. pinguis*, *A. exaltata* and *T.annulata* were found to be Similar, while other species were absent.

Akhtar *et al.* [30] observed 26 species of 14 genera belonging to 2 families, and 8 sub families. Both families (*Acrididae* and *pyrgomorphidae*) were found in the present work. *Acrididae* family was found to be the most abundant in both explorations which indicated similarities. All sub family was found to be similar except sub family *Spathosterninae* which was not found in recent study. Eleven species (*O. senegalensis*, *O. japonica*, *O. hyla hyla*, *O.velox*, *C. trachypterus*, *A. crenulata*, *G. punctifrons*, *H. nigrorepletus*, *S. prasiniferum*, *A. exaltata* and *T. annulata*) were found to be similarly while other 15 species were not recorded in recent study.

Abusarhan *et al.* [31] collected 340 samples, under four families, ten subfamilies, and forty species. Mutually reported families are *Acrididae* and *Pyrgomorphidae* while *Dericorythidae* and *Pamphagidae* were absent. In the work of both studies estimated that family *Acrididae* was found to be abundant. *Acridinae*, *Calliptaminae*, *Oedipodinae*, *Eyprepocnemidinae*, *Gomphocerinae* and *Pyrgomorphinae* were found common subfamilies in both

researches, while other four subfamilies were not found in recent work. Only one specie *O.senegalensis* were present similarly and all other species were found absent in present research.

Hussain *et al.* [32], stated 18 species representing 14 generas, 10 subfamilies and 3 families. All the families, (*Acrididae*, *Tettigoniidae* and *Pyrgomorphidae*) were reported similarly indicated agreement in research work.

Acrididae family was found the richest in both cases specified similarities in this respect. Comparable subfamilies were *Acridinae*, *Oxyinae*, *Oedipodinae*, *Hemiacridinae*, *Gomphocerinae*, *Conocephalinae*, and *Pyrgomorphinae* while other 3 sub families (*Melanoplinae*, *Cyrthacanthacrinae* and *Phaneropterinae*) were found to be absent. Hussain *et al.* [32], repoted *O.hyla hyla* the most abundant specie while in current research *D.pinguis* were found to be dominant. Six species (*A. exaltata*, *A. ungarica*, *O.hyla hyla*, *Ojaponica*, *T. annulata* and *A crenulata*) were recorded related in both explores.

Kandibane *et al.* [26] sampled 21 species of grasshoppers from three families. All the three families (*Acrididae*, *Tettigoniidae* and *Pyrgomorphidae*) show likenesses in both researches. Five species (*A.exaltata*, *D.pinguis*, *Acrenulata*, *Eincertus* and *C.maculatus*) were reported to be same while other shows dissimilarity in current exploration. *Oxya nititula* was reported to be common and dominant specie while *Diabolocatantops pinguis* was the abundant specie in present study.

The distribution of several grasshopper families documented in this study were similar to that of Andersen *et al.* [33] who also confirmed that Acridid grasshoppers were the largest group followed by *Tettigoniidae* and *Pyrgomorphidae* in Kakadu National Park, Australia. During his study, 56 species, 46 genera were recorded,

spread among 5 families where 3 families (*Acrididae*, *Pyrgomorphidae*, and *Tettigoniidae*) were shows similarities but 2 families (*Eumastacidae* and *Tetrigidae*) were absent in present investigation. The fact was that there were no similar species found in both cases.

Conclusion and Recommendations

It is concluded that a total of 22 species belonging to three families, were recorded from the piedmont of mountain Elum, Pirbaba, Buner. It is the first pioneer work ever conducted. In the current research work 19 Genera has been identified and explored. The abundant family was *Acrididae* whereas the most abundant specie was *D. pinguis*. It is recommended to save and support the life of Grasshoppers because of its importance to diversity, abundance and biomass. It is recommended to conduct different surveys at various localities to create awareness in publics about the key role of grasshoppers in keeping blance of ecosystem. For further investigation and accuracy molecular characterization should be done to achieve the need of modern world.

Authors' contributions

Conceived and designed the experiments: Z Khan, Performed the experiments: Z Ikhtiar, A Sadiq & SA Mehmood, Analyzed the data: W Rahman, H Rahman & F Khan, Contributed materials/ analysis/ tools: Z Khan & Z Ikhtiar, Wrote the paper: Z Khan & Z Ikhtiar.

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