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Seasonal Variations in Scorpions (Arachnida: Scorpions) from Khyber Pakhtunkhwa, Pakistan

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Abstract

Scorpions are the members of phylum arthropods, Class arachnida and Order Scorpiones. Collection was made from March 2017 to October 2020. Scorpions were collected from diverse localities of Khyber Pakhtunkhwa Pakistan through Pitfall traps, Battery-operated portable ultraviolet lamps and Stone turning methods. The specimens which were collected belonging to three families Buthidae, Scorpiopidae and Scorpionidae. The collection of Scorpions was high in August and July and less in October and March. The populations *Hottentotta, Androctonus, Orthochirus,Fetilinia, Compsobuthus, Buthacus, Mesobuthus*and *Odontobuthus* of the family Buthidae were increases from March to August with increase in temperature and their numbers were decreases from September to October with decrease in temperature. The numbers of the specimens belonging to genus *Scorpiops*of the subfamily Scorpiopidae was high in August and less in October. The members of the genus *Deccanometrus* were increases up to August and then decreases from September to October with decrease in Temperature.

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Introduction

Arthropods represent most of the world's biodiversity, with the highest species richness totals found in tropical rain forests. Yet with less than 1.5 million species described out of the estimated 6 million insect species globally (Hamilton *et al.*, 2011; Basset *et al.*, 2012), we have hardly scratched the surface in our attempt to quantify arthropod diversity. Moreover, we have little idea how arthropod communities are structured across geographical and environmental gradients. In megadiverse tropical forests, an important component of plant diversity is the turnover of species composition across geographical regions and contrasting habitats (i.e. beta diversity (Condit *et al.*, 2002; Tuomisto*et al.*, 2003).

Variations in habitat structure and resource availability caused by such changes play an important role in determining the pattern of species diversity along bioclimatic gradients, since community processes are largely influenced by the capacities of species to adapt to environmental filtering and biogeographical processes (Lamarre*et al.*, 2016).

Scorpions are the members of phylum arthropods, Class arachnida and Order scorpiones. Out of 1988 species known from the world 113 belongs to India that are classified in 25 genera and 6 families (Nagaraj*et al.,* 2015). The order Scorpiones represents only 1.5 % of the known arachnids, comprising 16 families and 155 genera (Fet*et al.,* 2000). There are approximately 2587 described species of scorpions (Rein, 2021). Taxonomy of spiders mostly relies on morphology. Scorpions are not identified up to species level via studying genitalia morphology generally as other arachnids are identified on the basis of these characters. Identifications are made with carination, chaetotaxy, granulations etc. Scorpion's body is divided into Prosoma (also known as carapace) and Opisthosoma. Opisthosoma is divided to two regions Mesosoma and tail shaped Metasoma. Carapace consists of chelicerae, pedipalps and eight legs while antennae are absent (Hjelle, 1990). Their length range is approximately 13 to 220 mm. They can be easily identified from other groups due to their morphological structures (Ozkan*et al.*, 2006). They are ovoviviparous universally (Lourenco, 2000). Young born one by one after hatching and the brood carries on the mother back at least one moult. Young scorpions cannot survive without their mother. They depend on their mother for protection and for moisture (Benton, 1991).

In Pakistan, a variety of scorpion habitats (i.e., sandy, muddy, forested and hilly areas) are present but scorpion fauna of this region has not been explored in detail. Pocock (1900) was the first to initiated scorpion study in area now under Pakistan. Later on, some other arachnologists (Birula 1913-1928; Henderson 1913-1919; Khatoon 1999; Kovarik and Ahmed 2013 and Tahir*et al.,* 2014) added some new species to Pocock list. Available record on scorpions suggested that Pakistan has 5 families, 17 genera and 50 species of scorpions (Tahir*et al.*, 2014). Being a natural predator, scorpions play a vital role in the maintenance of prey populations in their habitat. But habitat destruction and the pet trade are the leading causes of their extinction (Prendini*et al.*, 2003). Scorpion fauna of Pakistan, except Islamabad and Karachi, is unknown (Tahir*et al.*, 2014). There are no comprehensive identification keys for scorpion identification. Studies on their ecology, spatial heterogeneity are very few. Pet trade is leading to the extinction of scorpion species (Prendini*et al.,* 2003).
The present study describes seasonal variations reported among the three families Buthidae, Scorpiopidae and Scorpionidae of the class arachnida at Khyber Pakhtunkhwa, Pakistan. The aims of the current study to find seasonal variations and distributional patterns of three families of theclass arachnida in Khyber Pakhtunkhwa, Pakistan.

Materials and methods

Study area

The present work was conducted in Khyber Pakhtunkhwa, Pakistan. The specimens were collected from different localities in Khyber Pakhtunkhwa, Pakistan. It is bounded by Afghanistan

to the West and North, Azad Kashmir and the Northern Areas (the Pakistani- administered area of the Kashmir region) to the East and Northeast, Punjab province to the Southeast, and Baluchistan province to the South west. On the Western boundary of Khyber Pakhtunkhwa, along the Afghan border, are the federally administered tribal areas, a series of semiautonomous areas that are ethnically homogeneous with the province but not politically connected to it. The terrain consists of mountain ranges, undulating sub mountain areas, rivers, forests, barren areas, and plains surrounded by hills (https://www.britannica.com/place/Khyber-Pakhtunkhwa).

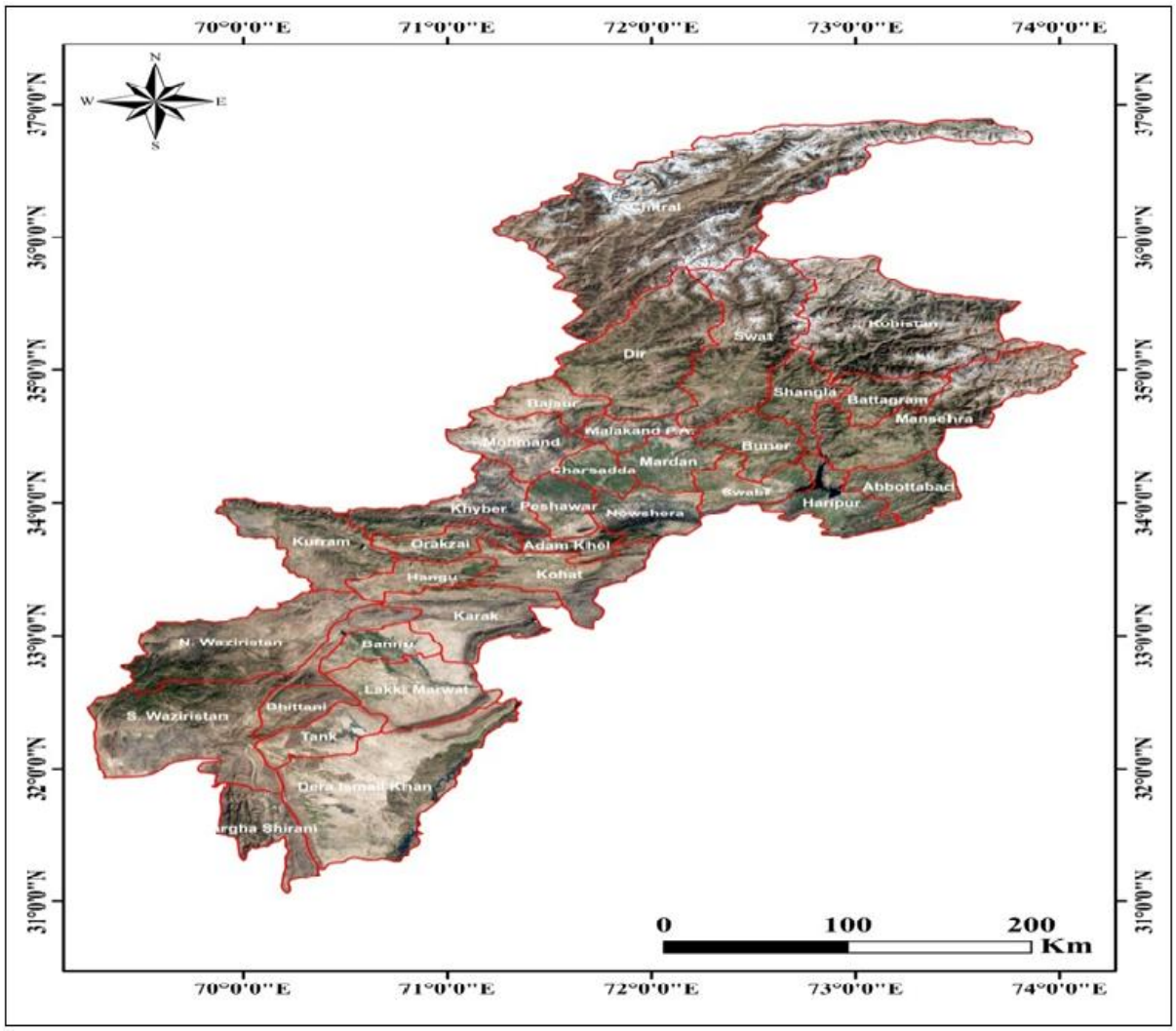

Fig. 1. Map of Khyber Pakhtunkhwa Pakistan.

Specimens' collection

Collection was made from March 2017 to October 2020. Pitfall traps, Battery-operated portable ultraviolet lamps and Stone turning methods were used for scorpion collections. Pitfall traps were used for collecting scorpions from open fields as well as from sandy and semi-sandy habitats. Glass jars (5 cm diameter and 10 cm length) were used as pitfall traps. Pitfall jars were buried in the soil up to their mouth while the rim of each jar will be ground level. Battery-operated portable ultraviolet lamps were used for detecting scorpion at night in all types of habitats.

When a scorpion was sighted, it was picked up with the help of a 12 inch long forceps, transferred to a plastic container. Stone turning method was used for specimens' collection at day time in rocky areas. Stones were turned over with the help of an iron rod and the scorpion under the stone was collected with the help of forceps.

Specimens data

During each sampling trip, information regarding date and time of sampling, habitat type, temperature and humidity level was recorded.

Preservation of the specimens

The killed Specimens were washed with absolute alcohol in the laboratory to remove sand, soil particles and other impurities. The washed scorpions were store in special plastic bags containing absolute alcohol. After sealing the plastic bags, they were stored in a refrigerator at -40° C in the laboratory.

Specimens Identification

The collected Scorpions were observed and identified up to genus level with the help of taxonomic keys and catalogues (Kovarik and Ahmed, 2009; Tikader and Bastawade, 1983).

Results

The specimens which were collected belonging to three families Buthidae, Scorpiopidae and Scorpionidae. Among the collected specimens 2069 were Buthidae specimens, 412 were Scorpiopidae and 419 were Scorpionidae specimens. The collection of Scorpions was high in August 786 and July 595 and less in October 76 and March 117. The populations *Hottentotta, Androctonus, Orthochirus,Fetilinia, Compsobuthus, Buthacus, Mesobuthus*and *Odontobuthus*of the family Buthidae were increases from March to August with increase in temperature and their numbers were decreases from September to October with decrease in temperature.

The numbers of the specimens belonging to genus *Scorpiops*of the subfamily Scorpiopidae was high in August and less in October.

Table 1. Numbers of Specimens of different Specimens of the families Buthidae, Scorpiopidae and Scorpionidae collected from March 2017 to October 2020.

Families	Genus	March	April	May	June	July	August	September	October	Total
Buthidae	*Hottentotta*	20	24	47	60	86	110	56	10	413
	Androctonus	5	8	15	20	30	45	13	2	138
	Orthochirus	2	5	9	14	25	31	11	1	98
	Fetilinia	4	7	8	12	21	34	11	3	100
	Compsobuthus	12	19	32	47	64	93	31	9	307
	Buthacus	8	17	41	63	74	91	73	13	380
	Mesobuthus	15	20	36	53	68	86	62	9	349
	Odontobuthus	19	23	29	49	57	71	34	2	284
	Total	85	123	217	318	425	561	291	49	2069
Scorpiopidae	*Scorpiops*	17	21	53	74	86	125	21	15	412
Scorpionidae	*Deccanometrus*	15	26	37	58	84	100	87	12	419
Total		117	170	264	450	595	786	399	76	2900

The members of the genus *Deccanometrus*were increases up to August and then decreases from September to October with decrease in Temperature (Table 1).

Discussion

In the present study scorpions specimens were collected from diverse localities of Khyber Pakhtunkhwa, Pakistan through Pitfall traps, Battery-operated portable ultraviolet lamps and Stone turning methods. The collected specimens were belonging to 10 genera *Hottentotta, Androctonus, Orthochirus, Fetilinia, Compsobuthus, Buthacus, Mesobuthus, Odontobuthus, Scorpiops and Deccanometrus* of the three families Buthidae, Scorpiopidae and Scorpionidae. All the collected specimens were first time reported from Khyber Pakhtunkhwa, Pakistan. It was found that the populations of Scorpions belonging to 10 genera and three families show Seasonal Variations in their numbers. Among the collected specimens 2069 were Buthidae specimens, 412 were Scorpiopidae and 419 were Scorpionidae specimens. The collection of Scorpions was high in August and July and less in October and March.

Table 2. Month wise mean temperature and rainfall of Khyber Pakhtunkhwa, Pakistan (2017-2020).

Months	Mean Temperature Centigrade		Rainfall/ Precipitation mm
	Maximum	Minimum	
January	12.73754	0.36754	83.49375
February	16.18022	3.007813	90.525
March	20.30585	6.906452	103.325
April	26.57908	11.73958	110.1625
May	31.36149	15.13044	54.60625
June	32.84396	18.85167	39.84375
July	35.43931	21.61169	67.48125
August	34.46593	20.99395	63.8875
September	26.90307	14.18458	21.50625
October	20.84839	7.700605	22.76875
November	15.4544	3.963125	43.2375
December	12.47198	0.89496	13.70625

Pakistan Meteorological Department, Regional Meteorological Center Khyber Road Peshawar.

The populations *Hottentotta, Androctonus, Orthochirus,Fetilinia, Compsobuthus, Buthacus, Mesobuthus*and *Odontobuthus*of the family Buthidae were increases from March to August with increase in temperature and their numbers were decreases from September to October with decrease in temperature. The numbers of the specimens belonging to genus *Scorpiops*of the subfamily Scorpiopidae was high in August and less in October. The members of the genus *Deccanometrus*were increases up to August and then decreases from September to October with decrease in Temperature.

Fig. 2. Habitat.

The study which was done in Northeastern Brazil founded that total number of scorpions captured was correlated with climatic variables and prey abundance. Scorpions were captured monthly using pitfall traps; their potential prey was captured using malaise, beating trays and pitfalls. The abundance of scorpions captured was significantly correlated with precipitation, real evapotranspiration, and abundance of invertebrates (Araujo*et al.*, 2010).

Conclusion

The current work was the first study on the Scorpions of Khyber Pakhutunkhwa, Pakistan. Collection of Scorpions was high in August and July and less in October and March. The members ofthe *Hottentotta, Androctonus, Orthochirus,Fetilinia, Compsobuthus, Buthacus, Mesobuthus*and *Odontobuthus*were increases from March to August with increase in temperature and then their numbers were decreases from September. The numbers of the specimens belonging to genus *Scorpiops* was high in August and less in October. The members of the genus *Deccanometrus* were increases up to August and then decreases from September to October with decrease in Temperature.

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