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Diversity of amphibians and reptiles in Daphar Forest Sanctuary, district Mandi Bahauddin, Pakistan

Saba Adil[1*], Shermeen Ijaz[1], Hira Aslam[1], Rimsha Kanwal[1] and Sehrish Afsheen[1]

1. Department of Zoology, University of Lahore, Sargodha campus, Sargodha, Pakistan

***Corresponding author e-mail:** sabaadil836@gmail.com

ABSTRACT

Total 195 of herpetofauna species are present in Pakistan, and have threats due to anthropogenic impacts on forests, deserts, wetlands, mountains and glaciers. Protected areas were developed for conservation of herpetofauna and other wildlife species i.e. Ramsar sites, wildlife sanctuaries, national parks, game reserves and zoos. The main objective of study was, to know the diversity and threats to herpetofauna in Daphar Forest Wildlife Sanctuary in Mandi Bahauddin, Pakistan. Study of herpetofauna diversity in Daphar Forest Wildlife Sanctuary was conducted during October 2017- November 2018. A total of 28 species were recorded from study area. Shannon-Wiener diversity Index was 1.325, Evenness was 0.9155 and Margalef index was 10.881. During current survey threats were also identified which were causing negative effects to herpetofauna. Due to human interruptions, many species were declined or extinct. Humans were killed herpetofauna in studied areas for different purposes i.e. superstition, narrative, tool, economic gain, entertainment, ornamental use, magical use, religious believe, food, and medicinal value.

Keywords: Herpetofauna, Sanctuary, Diversity, Distribution, Daphar

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INTRODUCTION

Pakistan has large varieties of wildlife (Bibi and Ali, 2013; Ali *et al.,* 2011), because this country has different types of habitats like forests, deserts, wetlands, mountains and glaciers. Wildlife of Pakistan has also threats due to anthropogenic impacts (Ali, 2005; Altaf *et al.,* 2013; Altaf, 2016). For the conservation of wildlife, protected areas were developed e.g. Ramsar sites, National Parks, Wildlife Sanctuaries, Game reserves and Zoos (Bibi and Ali, 2013; Ali *et al.,* 2011; Altaf *et al.,* 2014) and many scientists census the wildlife and suggested the conservation measures (Urbina, 2008; Shahrudin *et al*., 2011; Umair *et al.,* 2013; Prasad *et al*., 2018).

Wildlife Sanctuary are well defined source that provide rescue, lifelong care, breeding site and actual home in a boundary for the captured animals in super natural environment so they are kept in freedom to spend natural laws ruled life without any human interruption (Doyle, 2017). Herpetofauna provide a source of indicator of environmental conditions in a particular biome (Prasad *et al*., 2018). IUCN, 2004 red list of threatened and endangered species marks one in three of the world's amphibian species as threatened with extinction (Baillie *et al*., 2004). Worldwide, 32.5 percent and 22 percent of amphibian and reptile species, respectively, are listed as endangered (Canavero *et al*., 2010), and current trends suggest even more species could become threatened in the near future (Urbina, 2008).

Human activities are causing unlimited harmful effects to the biodiversity because of which most of species are getting endangered as well as extinct day by day. Attention is required to regulate the optimum number of animal species (Dwyer, 1983; McPhee, 1988; Rubin *et al.*, 1998; Li and Mundkur, 2003; Altaf, 2010). According to survey of 2008 nearly 6347 amphibians and 8863 reptiles' species are present in the world. Out of this calculation 32.5% of amphibians and 22% reptiles are endangered therefore 122 amphibians and 22 reptile species are extinct from wild (Urbina, 2008). In diversity count we find the richness (number of species in concerned area) and eveness (relative abundance of biomass availability between species) (Magurran, 2004; Iqbal *et al.,* 2017). On the base of biodiversity Pakistan has been divided into three main biogeographic regions which include Palearctic region, Oriental region and Ethopion region. Most of the country part is consist of mountainous region it is estimated that out of total 3 regions two parts consist of mountain. Because of sudden altitude changes within short ranged distance great change in diversity have been founded. Pakistan has 18 large geographical regions that make extensive range of terrestrial ecosystem (Roberts, 1997). The main objective of study to know the diversity and threats to herpetofauna in Daphar Forest Wildlife Sanctuary, district Mandi Bahauddin, Pakistan.

MATERIAL AND METHODS

STUDY AREA

Study was designed for herpetofauna in Daphar Forest Wildlife Sanctuary (Figure 1) during October, 2017 to November, 2018.

DAPHAR FOREST

The old name of the forest was 'Rakh' it was dry tropical forest. It was the second largest forest of Punjab in old books but now due to carelessness now it is not. Daphar wildlife forest sanctuary also called Daphar plantation reserved forest has 7812 acres area. Located at intersection of latitude 32-25'30"degree north and longitude 73-10'59.98" degree east in Tehsil of Malakwal district Mandi

Bahauddin nearly 9.6 km to south direction of Pakhowal Railway Station. Sub Division head quarters is located at 80 km distance from Sargodha district by route of Bhalwal. The soil of Daphar forest is affected from the river water. Therefore, forest soil has clay and sand in soil. In past years forest was irrigated by a canal that was linked to river Jhelum but now that canal is used for drainage purpose. Area is located in arid zone of semi-arid climate zone. Temperature is during the month of May and June it is nearly about 41 degree centigrade. The winter is in the month of January with lowest temperature. Rainy season is usually in the month of July and August. Plantation in forest includes mainly van, jand, karir, mallah, ber, chamror, rehru, lahura, frash and kangu, etc. Height of trees is different it ranges from 15 feet to 30 feet. Xerophytic plants are present which cover depressions like dhak, lasura, jangli-anar, phagwara etc. Other plantation includes eucalyptus, hybrid-poplar, semal, bakain and kiker and Bamboos (FWFD, 2014; Maan, 2001).

METHODOLOGY

Linear count method was used to calculate population of herpetofauna in the vicinity of Daphar Forest Sanctuary. For this purpose direct (i.e. total/physical count) and indirect (i.e. carcasses, molted skin and group questionnaire Survey) methods were used for the analysis of herpetofauna distribution and diversity in concerned area (Maan and Chaudhry, 2001).

STATISTICAL ANALYSIS

To assess the diversity and distribution of herpetofauna in different type of habitats Shannon-Weiner diversity index was used that tells about abundance of herpetofauna species in the vicinity of Daphar Forest Sanctuary. Calculation was done by Shannon-Weaver, 1963.

$$H' = - [\Sigma PI \ln PI]$$

Where, H' = i.e. amphibian and reptiles diversity index

Where, PI = i.e. proportion of the amphibian and reptiles species relative to the total number of species

In PI = i.e. Natural logarithm of PI

Specie richness (R), by using Margalef index 1951 number of species was estimated

$$\text{Species richness} = (S - 1)/\log n\ N$$

Where S = i.e. total amphibian and reptiles species number

N = Total individuals number included in sample

Specie evenness was designed according to the recommended formula (Pielou, 1966).

$$\text{Evenness (E)} = H'/ \text{Logn } S$$

Where S = i.e. total number of amphibian and reptiles species

H' = i.e. Shannon-Wiener diversity index

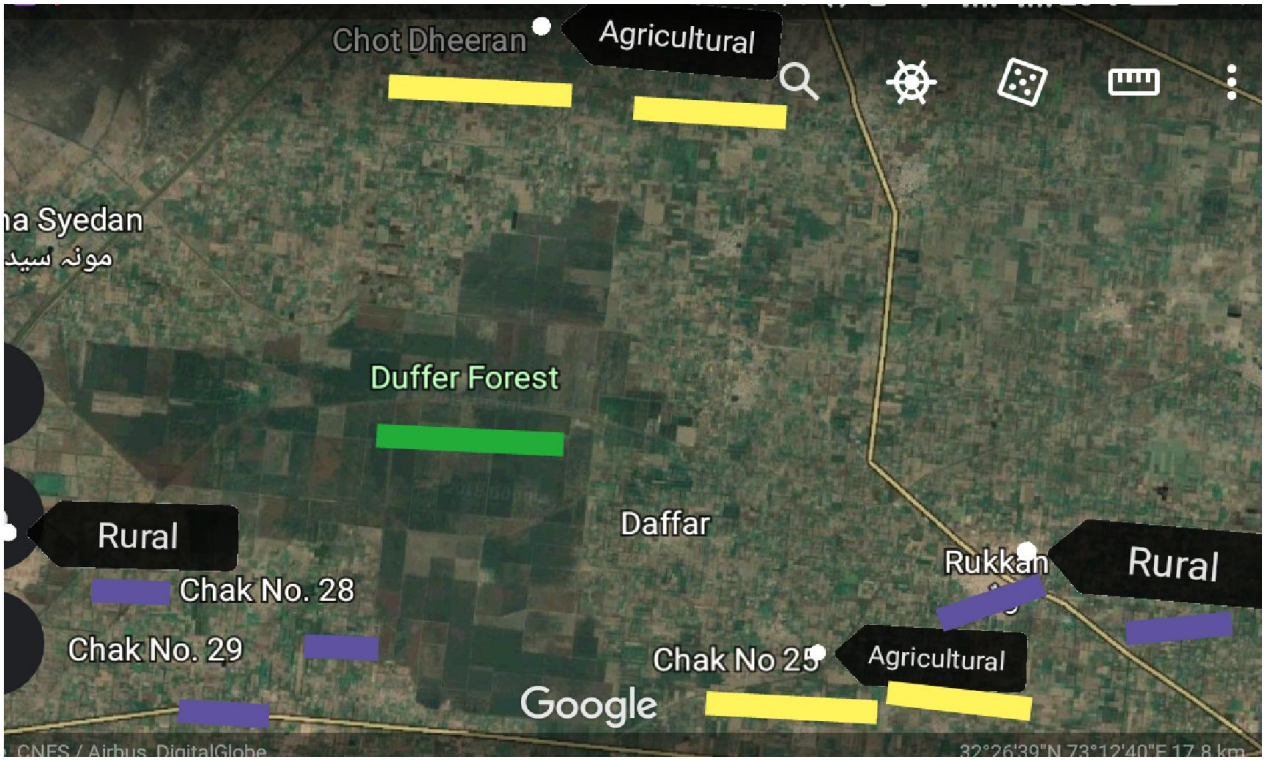

Figure 1: Map of study area.

RESULTS AND DISCUSSION

In study area, total 28 species were documented during this survey. Herpetofauna belonging to 03 order i.e. (05) Testudines, (02) Anura and (21) Squamata and 14 families i.e. Trionychidae, Geoemydidae, Bufonidae, Dicroglossidae, Varianidae, Agamidae, Gekkonidae, Scincidae, Lacertidae, Typhlopidae, Colubridae, Lamprophiidae, Elapidae, Viperidae were found to be studied. Shannon-Wiener diversity Index for herpetofauna species in vicinity of Daphar Forest Sanctuary was as 1.3248. Noted specie richness was 10.887 and Evenness Index value calculated in the concerned area was as 0.9155 (Table 2).

During present study, yellow belly common gecko (*Hemidactylus flaviviridis*) was found as the most abundant species of the study area with relative abundance of 0.1353135 in Daphar Forest Sanctuary (Table 1). The species was one of the abundant reptile species of whole Pakistan (Khan, 2006; Masroor, 2011; Manzoor *et al.,* 2013; Rais *et al.*, 2015; Ali *et al.,* 2016).

Indus valley toad (*Bufo stomaticus*), common mole skink (*Eurylepis taeniolatus*), barhminy blind snake (*Ramphotyphlops braminus*), common krait (*Bungarus caeruleus*), brown cobra (*Naja oxiana*) and black cobra (*Naja naja*) are recorded from the study area (Table 1) and these species also previously recorded from whole Pakistan (Khan, 2006; Masroor, 2011; Rais *et al*., 2015; Sarwar *et al*., 2016;Khan, 2017).

Present census revealed that Indian flap-shelled turtle (*Lissemys punctata andersoni*) was reported from the study area with relative abundance was as 0.049505 (Table 1), this species previously documented from Punjab, Margalla Hill National Park, Islamabad (Rais *et al.,* 1997; Akbar and Mushtaq-ul-Hassan, 2006; Khan, 2006; Masroor, 2011; Rais *et al*., 2015).

Indian narrow headed soft-shelled turtle (*Chitra indica*) only recorded (relative abundance, 0.009901) from Daphar Forest Sanctuary duringpresent survey, this species was reported from Chenab and district Kasur, Punjab (Khan, 2006; Akbar and Mushtaq-ul-Hassan, 2006; *Ali et al.*, 2016, 2018).

Indian soft shell turtle (*Nilssonia gangeticus*) was observed (relative abundance, 0.029703) from study area during present study. The species is common Punjab, throughout the Indo-Pakistan region, Margala Hill National Park, Islamabad (Rais *et al.,* 1997; Akbar, M., and Mushtaq-ul-Hassan, 2006; Masroor, 2011; Rais *et al*., 2015).

Peacock soft shell turtle (*Nilssonia hurum*) was sighted at Daphar Forest Sanctuary (relative abundance, 0.009901) during present study.Previously it was distributed in Punjab, throughout the Indo-Pakistan region, Margala Hill National Park, Islamabad (Rais *et al.,* 1997; Akbar, M., and Mushtaq-ul-Hassan, 2006; Masroor, 2011; Rais *et al*., 2015).

Spotted pond turtle (*Geoclemys hamiltonii*) was noted (relative abundance, 0.019802) from the Daphar Forest Sanctuary and previously documented from Tropical thorn forests, Pakistan (Akbar and Mushtaq-ul-Hassan, 2006; Khan, 2006; Ali *et al*., 2016).

Indian burrowing frog (*Sphaerotheca breviceps*), spiny-head rock agama (*Agama agama*) and brilliant ground agama (*Trapelus agilis pakistanensis*) observed from the study area with relative abundance was as 0.0429043 and Indian burrowing frog was previously documented from Chakwal and Mianwali districts, Plains of Punjab, Margalla Hills National Park, Islamabad (Khan, 2006; Masroor, 2011; Rais *et al.,* 2015; Ali *et al*., 2017; Khan,2017), spiny-head rock agama documented from Balochistan to southwestern Sindh extending on to the Waziristan hills (Khan, 2002; Khan, 2006) while brilliant ground agama previously reported from Mianwali district and Plains of Punjab and Sindh, Balochistan and southern KPK (Khan, 2002; Khan, 2006; Ali *et al.,* 2017).

Indus valley spiny-tail ground lizard (*Saara hardwickii*) was sighted at Daphar Forest Sanctuary (relative abundance, 0.0462046) during present study.Previously it was distributed throughout the Indus Valley and extends into

Las Bela southern Balochistan, Margala Hill National Park (Khan, 2004; Khan, 2006; Masroor, 2011; Rais *et al.,* 2015; Balouch *et al.*, 2016).

Present census revealed that agror agama (*Laudakia agrorensis*) was reported from the study area with relative abundance was as 0.029703, this species previously documented from Mansehra, Abbottabad, Chitral in KPK, Islamabad, Azad Jammu and Kashmir (Khan, 2006; Masroor, 2011; Mansoor *et al*., 2013).

Blue tailed sand lizard (*Acanthodactylus cantoris*) was found as the lowest abundant species of the study area with relative abundance of 0.0033003 in Daphar Forest Sanctuary. The species was noted from Western Balochistan and along the Makran coast, Margala Hill National Park and Chakwal, Punjab (Khan, 2002; Masroor, 2011; Rais *et al.,* 2015).

Different snake species were recorded from the study area i.e. barhminy blind snake (*Ramphotyphlops braminus*), white spotted wolf snake (*Lycodon aulicus*), streaked kukri snake (*Oligodon taeniolatus*), Indo burmese snake (*Psammophis condanarus*), steppe ribbon snake (*Psammophis leithii*), saharo-Sindian ribbon snake (*Psammophis schokari*), common krait (*Bungarus caeruleus*), black cobra (*Naja naja*), brown cobra (Brown Cobra), Russell's chain viper (*Daboia russelii*) and rat snake (*Ptyas mucosus mucosus*) and previously these species also reported from the different parts of Pakistan (Khan, 2002; Khan, 2006; Masroor, 2011; Khan *et al.,* 2012; Rais *et al*., 2015; Ali *et al.,* 2016; Farooq *et al*., 2018; Balouch *et al.,* 2016).

THREATS

During current survey few of threats were identified which were causing negative effects to herpetofauna. Human interruption was noted too much causing decline in the diversity, distribution of herpetofauna and in their ecology. People use to kill herpetofauna located in studied areas for different purposes like expected harm, superstition, narrative, their use as tool, for economic gain, for entertainment, ornamental use, use in magical, religious believe, for food and medicinal value etc because of which the overall diversity, distribution of herpetofauna has decreased. People who visit these areas placed garbage especially in water sources of concerned areas which is another largest anthropogenic effect causing decrease in diversity, because of water deficiency not just plants are getting effected but as well as herpetofauna survival and especially their reproductive sites. Animals get feared and try to escape but in mostly cases they are killed as targeted animal in surrounding areas. Previously available water sources are depleting in concerned area.

Moreover, Increase in toxic chemicals level in water and soil, air pollutants and non degradable wastage in urban, agricultural and rural areas are intensively affecting the forest plantation, water supply to forest and herpetofauna diversity which include not just species number but also the number of individuals of each species. Human herpetofauna conflict is much higher as compared to

other animals because these are the most disliked and harmful animals usually. They are thought as danger. Summarily thought and believed by humans about herptile is see and kill them but infect the killing of herpetofauna is indirect death of human themselves.

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Table 1: Diversity of herpetofauna of District Mandi Bahauddin, Punjab

Sr.	Scientific Name (Specie authority) Common name Order Family	Relative abundance/ Pi	Reported Area	Reference
1	*Lissemys punctata andersoni* (Webb, 1980) Indian Flap-shelled Turtle Testudines Trionychidae	0.049505	Punjab, Margalla Hill National Park, Islamabad	Rais *et al.,* 1997; Akbar and Mushtaq-ul-Hassan, 2006; Khan, 2006; Masroor, 2011; Rais *et al.*, 2015
2	*Chitra indica* (Gray, 1831) Indian Narrow Headed Soft-shelled Turtle Testudines Trionychidae	0.009901	Chenab, district Kasur, Punjab	Khan, 2006; Akbar and Mushtaq-ul-Hassan, 2006; Ali *et al.*, 2016, 2018
3	*Nilssonia gangeticus* (Cuvier, 1825) Indian Soft Shell Turtle Testudines Trionychidae	0.029703	Punjab, throughout the Indo-Pakistan region, Margala Hill National Park, Islamabad	Rais *et al.,* 1997; Akbar, M., and Mushtaq-ul-Hassan, 2006; Masroor, 2011; Rais *et al*., 2015
4	*Nilssonia hurum* (Gray, 1831) Peacock soft shell Turtle Testudines Trionychidae	0.009901	Head Qadirabad Punjab, district Charsadda, Khyber Pakhtunkhwa (KPK)	Khan, 2006; Akbarand Mushtaq-ul-Hassan, 2006; Noureen *et al*., 2012; Safi and Khan, 2014
5	*Geoclemys hamiltonii* (Gray 1831*)* Spotted Pond Turtle Testudines Geoemydidae	0.019802	Tropical thorn forests, Pakistan	Akbarand Mushtaq-ul-Hassan, 2006;Khan, 2006;Ali *et al*., 2016
6	*Bufo stomaticus* (Lutkin, 1862) Indus Valley Toad Anura Bufonidae	0.0957096	Whole Pakistan	Khan, 2006; Masroor, 2011; Rais *et al*., 2015; Sarwar *et al*., 2016;Khan, 2017
7	*Sphaerotheca breviceps* (Schneider, 1799) Indian Burrowing Frog Anura Dicroglossidae	0.0429043	Chakwal and Mianwali districts, Plains of Punjab, Margalla Hills National Park, Islamabad	Khan, 2006; Masroor, 2011;Rais *et al*., 2015; Ali *et al*., 2017; Khan, 2017
8	*Varanus flavescens*(Hardwicke and Gray, 1827)	0.0132013	Salt Range, district Sialkot, northern Punjab, and Sindh	Khan, 2006; Khan, 2002; Rais *et al.,*

	Yellow Monitor Lizard Squamata Varianidae		Delta	1997
9	*Agama agama* (Linnaeus, 1758) Spiny-head Rock Agama Squamata Agamadiae	0.0429043	Balochistan to southwestern Sindh extending on to the Waziristan hills	Khan, 2002; Khan, 2006
10	*Saara hardwickii* (Strauch, 1863) Indus Valley Spiny-tail Ground Lizard Squamata Agamadiae	0.0462046	Throughout the Indus Valley and extends into Las Bela southern Balochistan, Margala Hill National Park	Khan, 2004; Khan, 2006; Masroor, 2011; Rais *et al.,* 2015; Balouch *et al.*, 2016
11	*Trapelus agilis pakistanensis* (Rastegar-Pouyani, 1999) Brilliant Ground Agama Squamata Agamadiae	0.0429043	Mianwali district and Plains of Punjab and Sindh, Balochistan and southern KPK	Khan, 2002; Khan, 2006; Ali *et al*., 2017
12	*Laudakia agrorensis* (Stoliczka, 1872) Agror agama Squamata Agamadiae	0.029703	Mansehra, Abbottabad, Chitral in KPK, Islamabad, Azad Jammu and Kashmir	Khan, 2006; Masroor, 2011; Mansoor *et al*., 2013
13	*Hemidactylus flaviviridis* (Ruppell, 1835) Yellow belly common house gecko Squamata Gekkonidae	0.1353135	Whole Pakistan	Khan, 2006; Masroor, 2011; Manzoor *et al.,* 2013; Rais *et al.*, 2015; Ali *et al.,* 2016
14	*Eutropis macularia* (Blyth, 1853) Bronz Grass Skink Squamata Scincidae	0.019802	Plains and highland of the Salt Range, district Kasur in Punjab, Karachi and Las Bela	Khan, 2002; Ali *et al*., 2016
15	*Eurylepis taeniolatus* (Blyth, 1854) Common mole skink Squamata Scincidae	0.0066007	Whole Pakistan	Lamimia *et al.,* 2000; Khan, 2006; Masroor, 2011
16	*Brachysaura minor* (Hardwicke and Gray, 1827) Hardwicke's Short Tail Agama Squamata Agamadiae	0.0165017	Sindh and Punjab provinces	Khan, 2002; Khan, 2006;
17	*Acanthodactylus cantoris* (Linnaeus, 1758) Blue Tailed Sand Lizard Squamata Lacertidae	0.0033003	Western Balochistan and along the Makran coast, Margalla Hill National Park and Chakwal, Punjab	Khan, 2002; Masroor, 2011; Rais *et al.,* 2015
18	*Ramphotyphlops braminus*, (Daudin, 1803) Barhminy Blind Snake Squamata Typhlopidae	0.0594059	Whole Pakistan	Khan, 2002; Rais *et al.,* 2015;Balouch *et al.,* 2016
19	*Lycodon aulicus* (Linnaeus, 1758) White Spotted Wolf Snake Squamata Colubridae	0.049505	Sindh province, Lahore,Kasurand Rabwah and Jhang districts	Khan, 2002; Khan, 2006; Ali *et al.,* 2016

20	*Oligodon taeniolatus*, (Jerdon, 1853) Streaked kukri snake Squamata Colubridae	0.0561056	Throughout the plains from Rawalpindi to Las Bela	Khan, 2002; Khan, 2006; Rais *et al.,* 2015
21	*Psammophis condanarus,* (Merrem, 1820) Indo Burmese Snake Squamata Lamprophiidae	0.029703	Sindh and Punjab provinces	Khan, 2002; Khan, 2006;
22	*Psammophis leithii*, (Gunther, 1869) Steppe Ribbon Snake Squamata Colubridae	0.0066007	Southern Punjab, Pakistan	Farooq, 2018
23	*Psammophis schokari* (Forskail, 1775) Saharo-Sindian Ribbon Snake Squamata Lamprophiidae	0.0165017	Margala hill National Park, Islamabad, Cholistan and Thal deserts of Punjab, Pakistan	Khan, 2002; Khan, 2006;Rais *et al.,* 2015
24	*Bungarus caeruleus* (Schneider, 1801), Common krait Squamata Elapidae	0.0594059	Whole Pakistan	Khan, 2002; Khan, 2006;Masroor, 2011; Khan *et al.,* 2012; Rais et al., 2015; Ali *et al.,* 2016; Farooq *et al*., 2018; Balouch *et al.,* 2016
25	*Naja naja* (Linnaeus, 1768) Black Cobra Squamata Elapidae	0.0132013	Whole Pakistan	Khan, 2002;Khan, 2006;Rais *et al.,* 2015
26	*Naja oxiana* (Eichwald, 1831) Brown Cobra Squamata Elapidae	0.049505	Whole Pakistan	Khan, 2006; Masroor, 2011; Manzoor *et al.,* 2013
27	*Daboia russelii* (Shaw and Nodder, 1797) Russell's Chain Viper Squamata Viperidae	0.0132013	Margalla Hills National Park Islamabad, Punjab and Sindh Provinces	Khan, 2002; Khan, 2006;Rais *et al.,* 2015
28	*Ptyas mucosus mucosus* (Linnaeus, 1758) Rat snake Squamata Colubridae	0.0330033	Southern Punjab, Pakistan	Khan, 2006; Farooq *et al.,* 2018

Table 2: The diversity indices of the study area.

Diversity indices	**Values**
Shannon-wiener diversity Index	1.325
Species richness =(S – 1)/logn N	10.881

Eveness = H'/ Logn S	0.9155

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