



## RESEARCH PAPER

## OPEN ACCESS

## Vertebrate and Invertebrate fauna of Barghanati Dam FR Domel Bannu, Khyber Pakhtunkhwa, Pakistan

Muhammad Arsalan<sup>1</sup>, Arshad Abbas<sup>1</sup>, Shafi Ullah Gul<sup>1</sup>, Hameed Ur Rehman<sup>\*2</sup>, Haleema Sadia<sup>3</sup>, Nida Shah<sup>4</sup>, Taimur Khan<sup>5</sup>, Muhammad Waqas<sup>5</sup>, Khalid Usman<sup>5</sup>, Haider Ali<sup>6</sup>, Sahibzada Muhammad Jawad<sup>6,7</sup>, Bushra<sup>6</sup>, Sabreen<sup>6</sup>

<sup>1</sup>Department of Zoology, GPGC, Karak, KP, Pakistan

<sup>2</sup>Department of Chemistry, Kohat University of Science and Technology, KUST, Kohat, KP, Pakistan

<sup>3</sup>Department of Biotechnology, Balochistan University of Information Technology Engineering and Management Sciences, Quetta, Pakistan

<sup>4</sup>Department of Botany, Bacha Khan University, Charsada, KP, Pakistan

<sup>5</sup>Department of Zoology, Hazara University, Mansehra, Pakistan

<sup>6</sup>Department of Zoology, Qurtuba University of Science & Information Technology, Pakistan

<sup>7</sup>Department of Zoology, Islamia College University, Peshawar, Pakistan

Article published on July 30, 2018

**Key words:** Barghanati dam, FR Bannu, Fauna.

### Abstract

The present research work was conducted in Barghanati Dam FR Bannu, Khyber Pakhtunkhwa, Pakistan, to find out the vertebrate and invertebrate fauna of that dam, in a period from May-September 2017. Barghanati dam have a lot of vertebrate and invertebrate fauna. All type of vertebrates fauna are found in barghanati dam including Fishes, Amphibians, reptiles, Aves and Mammals. In invertebrate, insect are more common but other species of invertebrate are also present here. Fish fauna includes *H. molitrix*, *L. rohita*, *C. catla*, *C. carpio* and *O. pobda*. Amphibian fauna includes *R. tigrina* and *D. melanostictus*. Reptile includes *E. macmahonii*, *L. getula*, *X. vigilis*, *C. zeylanicus*, *C. mydas* and *A. gigantea*. Bird includes *C. splendens*, *A. tristis*, *G. grus*, *P. barbatus*, *B. moschata*, *C. coturnix*, *U. epops*, *P. domesticus*, *p. perdix*, *S. decaocto* and *H. smyrnensis*. Mammal includes *D. sibiricus*, *H. edwardsi*, *L. nigricollis*, *C. lupus*, *F. catus*, *C. Odustus*, *C. hircus*, *O. aries*, *E. asinus*, *H. auritus* and *V. cana*. Invertebrate includes *B. tentaculata*, *h. medicinalis*, *S. flaveolum*, *P. imperator*, *S. invicta*, *V. velutina*, *V. germanica*, *P. melanarius* and *M. bahiata*.

\*Corresponding Author: Hameed Ur Rehman ✉ 03449002451h@gmail.com

## Introduction

Barghanati dam was constructed in 2006 and are situated nearby the domel bazar, northern side of tribal area of domel FR Bannu. In the present research we will discuss about the biodiversity of vertebrate and invertebrate fauna of Barghanati dam. Biodiversity refers to the variety on earth surface and usually measure variation at genetic, specie and ecosystem level. It is the quantity, variety and distribution across the biological scale ranging through genetics and life form of population, species, community and ecosystem (Mace G *et al*, 2005).

Fishes are usually found nearly in all aquatic environments, from high mountain streams to the abyssal zone of the deepest oceans with 33,600 discovered species. Fishes have too much diversity than any other group of vertebrates (Moyle *et al*, 2003). Fishes have also too much diversity in their morphology, habitats that they occupy and in the life history. They live both in marine as well as in freshwater (Forese R and Paul D, 1998). In many countries fishes are constantly used in their food items and also play a very important role in the wealth of these countries (Essetchi PK *et al*, 2003).

In Pakistan different research works were carried out to find the diversity of fishes in different areas (Mirza MR, 1975 and A.K. Pandian *et al.*, 2012). Amphibians are the cold-blooded vertebrates which passes their lifecycle both in water and on land. They use different organs in different time for respiration during their lifecycle, as they use gills after hatching, lungs when reach to adult stage and they also used their moist skin for the purpose of gaseous exchange (Duellman *et al*, 1994). Until now 7,044 species of amphibians were discovered which belong from three different orders namely *anura*, *caudata* and *gymnophiona* (Frost DR, 2013).

Amphibians exist everywhere in the world except Antarctica and occupy great variety of climatic and ecological zones (Hall RJ and Henry PFP, 1992). However, it is said that the population of amphibians decreases day by day in all over the world (Mc Callum, M.L., 2017), so conservation is therefore an

important concern. Reptiles are also cold-blooded vertebrates that required mostly land to complete their lifecycle except some. Reptiles were considered as the first truly land vertebrates.

They respire mostly through their lungs while in some cases they respire through their permeable skin (turtles) and some use modified Cloaca which increases the surface area for gaseous exchange (Orenstein and Ronald, 2001). There are more than 7,700 species of reptiles were discovered that includes Turtles, Tortoises, snakes, lizards, Crocodiles, Alligators and Tuataras. In Pakistan there are 179 species of reptiles are found consisting of turtles, tortoises, gavials, lizard, crocodile and snake (Rahman H and Iffat F, 1997).

Lizards are mostly common in Pakistan (Khan MS, 1980a). Reptiles give rise to birds, as because of some characters which are common in both i.e, egg of birds have amniotic membranes and also birds possess scales on their lower legs as retiles have. Modern birds do not have teeth. They play a very important role in cross pollination between flowers and also help in carrying the seed from one place to another. Birds are the most diverse group among vertebrates with 28 orders, 166 families and 8800 species (Nason I, 1992) (Neimi GJ, 1985).

There are some character which make them unique from other vertebrates such as they have feathers on their body surface, Wings (which help them in flight) and feathered Tail which helps in balancing and lifting (Wallace GJ and Mahan HD, 1975) (Pandian K and Chiappe LM, 1998). Usually, birds are found everywhere except someone which are confined to a particular region (Van Tyne J and Berger AJ, 1959).

There are some factors due to which the population of birds decreases day by day worldwide including Pollutions, Greenhouse effect, climatic changes and competition (BROTHERS NP, 1991) (Blackburn TP *et al*, 2004). Mammals are Endothermic vertebrates and show too much differences from some other vertebrates as due to the presence of Neocortex, Hairs on body surface, Mammary glands and middle Ear

bones which are absent in reptiles. Mammals show too many differences in their shape, size, habitat and behavior. The largest mammal is Blue Whale with a length of 30m and 15400kg in weight while the smallest one is Bumblebee Bat with a length of 30-40mm and 2g in weight (Jones KE, 2009).

Mammals are the diverse group of vertebrates having varieties of species. Due to the production of now individuals new variety of the same species comes along with new characters which lead to the extinction of those mammal species from which the evolved (Wilson DE and Reeder DM, 2005) (Reeder DM *et al*, 2007). There are 195 species of mammals in Pakistan belonging from 10 different orders (Roberts TJ, 2005a) (Roberts TJ, 2005b). Mammals also help in cross pollination of flowers by carrying pollen grains from on flower to another and also helps in controlling various diseases (Keesing F, 2010) (Kunz TH *et al*, 2011). Invertebrates are those animals which have no vertebral column. This includes all animals apart from the sub-phylum vertebrata e.g, insects, crabs, snails etc. One estimate puts the Fig. that there are 97% invertebrates (May and Robert M, 1988) and there are some Taxa of invertebrates which have a greater number and species than the entire sub-phylum of vertebrata (Richards O.W and Davies R.G, 1977). There are some invertebrates which are used by humans as a source of food in many ways e.g, honey bees, grasshoppers and shrimps (Kellert SR, 1993) (Carere C *et al*, 2011). Invertebrates also act as a powerful monitoring agent in case of environmental management (Rosenberg DM *et al*, 1986) (Mc Geoch MA, 1998). The aim of the current research work was to find out the Vertebrate and Invertebrate fauna of Barghanati Dam FR Domel Bannu, Khyber Pakhtunkhwa, Pakistan.

## Materials and methods

### *Collection of Fishes*

Fishes were collected from different sites of Barghanati dam, from May-September 2017 with the help of local fishermen through various types of catching nets like hand nets and cast nets but mostly hooks were used

for fish catching. Immediately after capturing, the fishes were directly preserved in 70% alcohol or 10% formalin solution; larger fishes were given injection of formalin in different parts of the fish body to avoid bacterial contamination. After preservation fishes were properly identified in research laboratory by using keys of identification Mirza (Mirza MR, 1990), Mirza and Sandhu (Mirza MR and Sandu AA, 2007), Jayaram (Jayaram KC, 1999), talwar and Jhingran (Talwar P.K and Jhingran A.G, 1991) and Nelson (Nelson J.S, 2006).

### *Amphibians and Reptiles Observation*

Most fauna of Amphibians and Reptiles were observed during day time when they are active while some are also observed during night time. Both of these were than recognized and identified by using identification keys of Khan (Khan MS, 2004) (Khan MS, 2006).

### *Birds and Mammals Observation*

Birds of that areas were seen usually during day time when they comes for the purpose to drink water. Some of them were also observed near the sides of that dam where they search for food and also some of them were also observed in trees during summer session where they gather to avoid heat.

When we face some sort of difficulties in identification of birds species, then we take helps directly from the experts otherwise we follow the slander literature of community (Ali S and Ripley SD, 1987) (Grimmett R *et al* 1999) (Ali S and Repley SD, 1983) (Grimmett R *et al*, 1998). Besides these there are some birds were also observed in mountains which cover the whole dam while some are also observed in those fields to which water supplies from that dam e.g Quails etc. Usually we use Telescope for the observation of Mammals to see them in the mountains when they walking for the search of pray and also when they comes to drink water from the sides of dam. Shells of snails were also collected from the all sides of barghanati dam during the collection of fish sample. Other invertebrates were also found around the sides areas of barghanati dam which were putted on the list.



Fig. 1. Site view of Barghanati Dam.

**Results**

Different vertebrate and invertebrate fauna were collected randomly from Barghanati dam and

identified upto species level and were presented in table 1-6.

**Table 1.** Fish fauna of Barghanati Dam.

S. No	Class	Order	Family	Genus	Specie
01	Actinopterygii	Cypriniforme	Cyprinidae	<i>Hypophthalmichthys</i>	<i>H. molitrix</i>
02	Actinopterygii	Cypriniforme	Cyprinidae	<i>Labeo</i>	<i>L. rohita</i>
03	Actinopterygii	Cypriniforme	Cyprinidae	<i>Catla</i>	<i>C. catla</i>
04	Actinopterygii	Cypriniforme	Cyprinidae	<i>Cypinus</i>	<i>C. carpio</i>
05	Actinopterygii	Siluriformes	Siluridae	<i>Ompok</i>	<i>O. pobda</i>

**Table 2.** Amphibian fauna of Barghanati Dam.

S.No	Local name	Class	order	Family	Genus	Specie
01	Frog	Amphibia	Anura	Dicroglossidae	<i>Rana</i>	<i>Rana tigrina</i>
02	Common toad	Amphibia	Anura	Bufoidea	<i>Duttaphrynus</i>	<i>D. melanostictus</i>

**Table 3.** Reptiles fauna of Barghanati Dam.

S. No	Local name	Class	Order	Family	Genus	Specie
01	McMahon's viper	Reptilia	Squamata	Viperidae	<i>Eristicophis</i>	<i>E. macmahonii</i>
02	Desert king snake	Reptilia	Squamata	Colubridae	<i>Lampropeltis</i>	<i>L. getula</i>
03	Lizard	Reptilia	Squamata	Xantusiidae	<i>Xantusia</i>	<i>X. vigilis</i>
04	Chameleon	Reptilia	Squamata	Chamaeleonidae	<i>Chameleo</i>	<i>C. zeylanicus</i>
05	Turtle	Reptilia	Testudines	Cheloniidae	<i>Chelonia</i>	<i>C. mydas</i>
06	Tortoise	Reptilia	Testudines	Testudinidae	<i>Aldabrachelys</i>	<i>A. gigantea</i>

**Table 4.** Birds fauna of Barghanati Dam.

S.No	Local name	Class	Order	Family	Genus	Specie
01	House Crow	Aves	Passeriformes	Corvidae	<i>Corvus</i>	<i>C. splendens</i>
02	Mina	Aves	Passeriformes	Sturnidae	<i>Acridotheres</i>	<i>A. tristis</i>
03	Karkara(zorye)	Aves	Galliformes	Gruidae	<i>Grus</i>	<i>G. grus</i>
04	Bulbul	Aves	Passeriformes	Pycnonotidae	<i>Pycnonotus</i>	<i>P. barbatus</i>
05	Duck	Aves	Anseriformes	Anatidae	<i>Cairina</i>	<i>B. moschata</i>
06	Batair(quail)	Aves	Galliformes	Phasianidae	<i>Coturnix</i>	<i>C. coturnix</i>
07	Hudhud	Aves	Bucerotiformes	Upupidea	<i>Upupa</i>	<i>U. epops</i>
08	Charchnra	Aves	Passeriformes	Passeridae	<i>Passer</i>	<i>P. domesticus</i>
09	Teetar	Aves	Galliformes	Phasianidae	<i>Perdix</i>	<i>P. perdix</i>
10	Fahta	Aves	Columbiformes	Columbidae	<i>Streptopelia</i>	<i>S. decaocto</i>
11	Kingfisher	Aves	Coraciiformes	Halcyoninae	<i>Halcon</i>	<i>H. smyrnensis</i>

**Table 5.** Mammal fauna of Barghanati dam.

S.No	Local name	Class	Order	Family	Genus	specie
01	Palipash	Mammalia	Rodentia	Sciuridae	<i>Eutamias</i>	<i>D. sibiricus</i>
02	sarbonak	Mammalia	Carnivora	Herpestidae	<i>Herpestes</i>	<i>H. edwardsi</i>
03	Hargosh	Mammalia	Lagomorpha	Leporidae	<i>Lepus</i>	<i>L. nigricollis</i>
04	Dog	Mammalia	Carnivora	Canidae	<i>Canis</i>	<i>C. lupus</i>
05	Cat	Mammalia	Carnivora	Felidae	<i>Felis</i>	<i>F. catus</i>
06	Jackal	Mammalia	Carnivora	Canidae	<i>Canis</i>	<i>C. adustus</i>
07	Goat	Mammalia	Artiodactyla	Bovidae	<i>Capra</i>	<i>C. hircus</i>
08	Sheep	Mammalia	Artiodactyla	Bovidae	<i>Ovis</i>	<i>O. aries</i>
09	Donkey	Mammalia	Perissodactyla	Equidae	<i>Equus</i>	<i>D. asinus</i>
10	Hedgehog	Mammalia	Eulipotyphla	Erinaceidae	<i>Hemiechinus</i>	<i>H. auritus</i>
11	Fox	Mammalia	Carnivora	Canidae	<i>Vulpes</i>	<i>V. cana</i>

**Table 6.** Invertebrate fauna of Barghanati Dam.

S.No.	Common name	Class	Order	Family	Genus	Species
01	Snail	Gastropoda	Caenogastropoda	Bithyniidae	<i>Bithynia</i>	<i>B. tentaculata</i>
02	Leech	Clitellata	Arynchobdellida	Hirudidae	<i>Hirudo</i>	<i>H. medicinalis</i>
03	Dragonfly	Insecta	Odonata	Petaluridae	<i>Sympetrum</i>	<i>S. flaveolum</i>
04	Scorpion	Arachnida	Scorpiones	Scorpionidae	<i>Pandinus</i>	<i>P. imperator</i>
05	Ants	Insecta	Hymenoptera	Formicidae	<i>Solonopsis</i>	<i>S. invicta</i>
06	Wasps	Insecta	Hymenoptera	Vespidae	<i>Vespa</i>	<i>V. velutina</i>
07	Wasps	Insecta	Hymenoptera	Formicidae	<i>Vespula</i>	<i>V. germanica</i>
08	Beetle	Insecta	Coleopteran	Carabidae	<i>Pterostichus</i>	<i>P. melanarius</i>
09	Butterfly	Insecta	Lepidoptera	Hedlidae	<i>Macrosoma</i>	<i>M. bahiata</i>

## Discussion

The present research work was conducted in Barghanati Dam FR Bannu, Khyber Pakhtunkhwa, Pakistan, to find out the vertebrate and invertebrate fauna of that dam, in a period from May-September 2017. During this time we find 05 species of fishes were found which are preserved in 70% alcohol and are then identified up to their species level. Out of these 05 species of fishes, 04 species *Hypophthalmichthys molitrix*, *Labeo rohita*, *Catla catla* and *Cyprinus carpio* belongs to 01 order Cypriniformes and 01 family Cyprinidae, and the remaining one species of fish *Ompok pabda* belongs to order Siluriformes and family Siluridae but the one thing is that all of these 05 species of fishes belongs to one class Actinopterygii. So we can say that the environmental condition of Barghanati dam is suitable for those fishes which belong from family Cyprinidae like most of the Kpk dams. According to the list of IUCN, *Cyprinus carpio* was marked as endangered species (Rafique M and N.U.H. Khan, 2012). According to Lachner and Jenkins environmental condition such as drought may also effect the distribution of family Cyprinidae (Lachner E.A and Jenkins, 1971). However much better research is being done on the other district of Province, Hasan *et al* worked on the fishes collected from the different streams of Bajaur Agency and reported sixteen (16) fish species (Hasan Khan *et al*, 2014). Butt reported 94 species of fishes from the whole province of K.P.K (Butt J.A, 1986). Similarly Mirza *et al* identified 13 species of fishes from river Kurram (Mirza M.R *et al*, 1993). Nisar study on the fishes of Tanda Dam Kohat and collect 23 species among which 2 species, *Cyprinus carpio*, *Labeo rohita* were the part of the present research (Nisar M, 1998). At the same time 02 species of amphibians *Rana tigrina* and *Duttaphrynus melanostictus* were also observed in Barghanati dam. Both of them belong to one order Anura and two different families Dicroglossidae and Bufonidae. In 2016 Saqib *et al*, reported 03 species of amphibians (*R. tigrin*, *E. cyanophlyctis* and *D. melanostictus*) from two different dam, one is Khuram dam and 2<sup>nd</sup> one is Muhabbat khel dam (Saqib Y *et al*, 2016).

During same time 06 species of reptiles were observed in Barghanati dam and are classified up to their species level, out of which 04 species belong from 01 order Squamata and the remaining 02 belongs from order Testudine as shown in detail in Table 3. Khan (Khan MS, 1986) reported one species of toad, three frogs and nine species of lizards and snakes each from the District of Mianwali which is located 164 km from Chakwal District, North-western Punjab. 11 species of birds were also observed in area of Barghanati dam and are identified up to their species level, 04 species of birds belong to 01 order Passeriformes, 03 species from order Galliformes and the remaining 04 species belong from different orders i.e Anseriformes, Bucerotiformes, Columbiformes and Coraciiformes, one from each as shown in detail in Table 4. Previous work on birds was done by Awan *et al*, 2004 in Muzaffarabad, Kashmir and Pakistan who recognized 59 species of birds. 24 were resident, 14 were visiting in winter and 11 were visiting in summer (Awan MN *et al*, 2004). From June 2014 to July 2015 Hameed *et al* worked on the birds fauna of District Karak Khyber Pakhtunkhwa Pakistan and they studied 32 bird species belonging to 26 families and 11 orders from different areas of district Karak (Hameed UR *et al*, 2016). 11 mammal species were also observed in surrounding areas of Barghanati dam, mostly in hills. Usually, these mammals' drink water from the sides of Barghanati dam where there is shallow water and usually they choose such side for drinking of water where there is no human involvement. Out of these 11 species of mammal, 05 species belong from Order Carnivora, 02 from Artiodactyla, and the remaining 04 belongs from different order namely, Rodentia, Lagomorph, Perissodactyla and Eulipotyphla as shown in detail in Table 5. Roberts (1997) recorded 23 mammalian species (15 small and 8 large mammalian species) from river Chenab belonging to 20 genera, 11 families, and 6 orders (Roberts TJ, 1997). Beside these, 09 species of invertebrates were also collected from Barghanati dam and are identified up to their species level by using taxonomic keys. Out of these 09 species of invertebrates, 06 species belong from Class Insecta, and the remaining 03 species belong from 03

different Classes i. e one from Gastrophoda (*B. tentaculata*), one from Clitellata (*H. medicinalis*), and one from Arachnida (*P. imperator*). 03 species in the identified invertebrates belong from same Order Hymenoptera and the 06 belong from different order and all of them belonged from different families as shown in detail in Table No 6.

### Conclusion

From the present research work we concluded that the fish fauna of that dam does not increases from a particular size after reaching to its adult size, so we recommend that someone done an experimental research to find the main cause of such dam that why fishes of barghanati dam does not grow in size after reaching to its adult stage. There are some factors which lead to the declining of fish fauna in Barghanati dam, so we recommend another research project who display the main cause of declining. Otherwise the environmental condition is suitable for both Vertebrates and invertebrates fauna of Barghanati dam.

### References

**Ali S, Ripley SD.** 1983. A pectoral guide to the birds of the Indian subcontinent, Bom.Nat. Hist. Soc, Bombay 177.

**Ali S, Ripley SD.** 1987. Compact handbook of the birds of Indian and Pakistan together with those of Bangladesh, Nepal, Bhutan and Sri Lanka. Oxford University Press, Delhi.

**Awan MN, Awan MS, Ahmed KB, Khan AA, Dar NI.** 2004. A Preliminary Study on Distribution of Avian Fauna of Muzaffarabad–Azad Jammu and Kashmir, Pakistan. IJAB. **06(2)**, 300-302.

**Blackburn TP, Cassey R, Duncan, Evans K, Gaston K.** 1958. Avian Extinction and Mammalian Introductions on Oceanic Islands. Science. 22004; **305**, 1955.

**Brothrs NP.** 1991. Albatross mortality and associated bait loss in the Japanese longline fishery in the southern ocean. Biol. Conservation. **55**, 255-268.

**Butt JA.** 1986. Fish and Fisheries of (NWFP) Pakistan, Biologia Pak- Special Supplement 21-34.

**Carere C, Woods JB, Mather J.** 2011. species differences in captivity: where are the invertebrates? Trends EcolEvo. **26(5)**, 211. DOI:10.1016/j.tree.2011.01.003.

**Duellman, William E, Linda Trueb.** 1994. Biology of amphibians. Johns Hopkins University Press. ISBN 978-0-8018-4780-6.

**Essetchi PK, Guy GT, Valentin ND, Gouliand GBI, Tidiani K.** 2003. fish diversity and interrelationships with environment variables in a west African basin. Hydrology **505**, 139-146.

**Forese R, Paul D. fish Base 98.** 1998. Concepts, Design and Data sources, Manila. ICLARM. 66-94.

**FROST DR.** 2013. Amphibian species of the world: An online Reference. Version 5.6 Electronic Database accessible at American Museum of Natural History, New York, USA.

**Grimmet R, Inskipp C, IN skip T.** 1998. Birds of the Indian subcontinent, Christopher Helm an imprint of A and C Black (publisher) Ltd, 35 Bedford Row, London WC1R 4 JH **888**.

**Grimmett R, Inskipp C, In skip T.** 1999. Pocket guide to the birds of Indian subcontinent, Oxford University Press, Delhi.

**Hall RJ, Henry PFP.** 1992. assessing effects of pesticides on amphibians and reptiles: status and needs. Herpetol. J. **2(3)**, 65-71.

**Hameed UR, Jamil UR, Shahzeb S, Abdul W, Kinza Z.** 2016. Ornithological survey of District Karak, KPK, Pakistan, Journal of Entomology and Zoology Studies. **4(2)**, 326-328.

**Jayaram KC.** 1999. The freshwater fishes of India region. Narendra Publication house, Delhi 110006 (India).

- Jones KE.** 2009. Pantheria: a specie-level database of life-history, ecology and geography of extant and recently extinct mammals. *Ecology* **2648**.
- Keesing F.** 2010. impact of biodiversity on the emergence and transmission of infectious diseases. *Nature* **468**, 647-652.
- Kellert SR.** 1993. Values and perceptions of invertebrates. *Conserve Biol.*
- Khan MS.** 1980a; A new species of gecko from northern Pakistan. *Pakistan J Zool., Lahore.* **12**, 11-16.
- Khan MS.** 1986. A noteworthy collection of amphibians and reptiles from North-western Punjab, Pakistan. *The Snake* **18**, 118-125.
- Khan MS.** 2004. Annotated checklist of amphibians and reptiles of Pakistan. *Asi Herpetol Res* **10**, 191-201.
- Khan MS.** 2006. Amphibians and reptiles of Pakistan. Krieger publication company, Malabar, Florida.
- Kunz TH, Braun de Torrez E, Bauer D, Lobova T, Fleming TH.** 2011. Ecosystem services provided by bats. *Ann. Ny Acad. Sci.* **1223**, 1-38.
- Lachner EA, Jenkins RE** 1971. Systematic, distribution and evolution of the *Nocomis biguttatus* species group 9 family Cyprinidae: Pisces) with a description of a new species from the Ozark Upland, *Smithsonian Contribution to Zoology* **91**, 1-27.
- Mace G, Masundire H, Baillie J, Ricketts T, Brooks T.** 2005, Biodiversity. In: Hassan, R., Ash, N. (Eds.), *Ecosystem and Human well- Being: Current State and Trends (Finding of the Condition ana Trend Working Groups)*. Island. 77-122.
- McCallum ML.** 2017. "Amphibian decline or extinction? Current declines dwarf background extinction rate". *Journal of Herpetology* **41(3)**, 438-491.
- McGeoch MA.** 1998. The selection, testing and application of terrestrial insects as bioindicators. *Biol. Rev.* **73**, 181-201.
- Mirza MR.** 1990. Pakistan ki Taazapaniki Machlia, (in Urdu) urdu science board. 31-35.
- Mirza MR.** 2012. freshwater fish's and A.K. Pandian, A. Pandey, V.K. Dubey and zoogeography of Pakistan. In: *Bijdragen tot de W.S. Lakra. Freshwater fish's biodiversity in the Dierknnde, 1975.* **45**, 143-180.
- Moyle, Peter B, Cech, Joseph J.** 2003). *Fishes, An Introduction to Ichthyology (5<sup>th</sup> ed.)*. Benjamin Cummings. ISBN 978-0-13-100847-2.
- Nelson JS.** 2006. *Fishes of the world, 4<sup>th</sup> edn.* Hoboken, NJ: Wiley and Sons, Niemi GJ. Pattern of morphological evolution in bird genera of New World and Old World peat lands. *Ecology.* 1985; **66**, 1215-1228.
- Orenstein, Ronald** 2001. *Turtles, Tortoises & Terrapins: Survivors in Armor.* Firefly Books. ISBN 978-1-55209-605-5.
- Padian k, Chiappe LM.** 1998. The origin and early evolution of Birds" *Biol. Rev.* **73**, 1-42.
- Rafique M, Khan NUH.** 2012. Distribution status of significant freshwater fishes. *Record Zoological Survey of Pakistan* **21**, 90-95.
- Rahman H, Iffat F.** 1997a. A revised checklist of Reptiles of Pakistan. *Rec. zool. Surv. Pakistan.* **13**, 1-17.
- Reeder DM, Helgen K, Wilson DE.** 2007. Glob trends and biases in new mammal species discoveries. *Occasional Paper, Museum of Texas Tech. Univ.* **269**, 1-36.
- Richards OW, Davies RG.** 1977. *Imms' General Textbook of Entomology: Volume 1: Structure, Physiology and Development. Volume 2: Classification and Biology.* Berlin: Springer. ISSB 0-412-61390-5.
- Roberts TJ.** 1997, *The Mammals of Pakistan*, Oxford University Press, New York. 525.



**Roberts TJ.** 2005a. Small mammals of Pakistan, Oxford University Press, Karachi, Roberts TJ < Large and medium-sized mammals of Pakistan, Oxford University Press, Karachi, 2005b.

**Rosenberg DM, Danks HV, Lehmkuhl DM.** 1986. Importance of insects in environmental impact assessment. *Environmental management*. **10**, 773-783.

**Saqib Y, Shafi UG, Hameed UR, Faisal J, Wali MA.** 2016. Zoological fauna of Khuram and Muhabbat khel dam of district Karak, KPK, Pakistan, *Journal of Entomology and Zoology Studies* **5(1)**, 380-387.

**Talwar PK, Jingran AG.** 1991. Inland fishes of India and adjacent countries, Oxford and IBH Publication Co. Pvt. Ltd. 1-2.

**Van Tyne J, Berger AJ.** 1959. *Fundamental of Ornithology*, 2<sup>nd</sup> ed., John Wiley and Sons, Inc., New York. 645.

**Wallace GJ, Mahan HD.** 1975. *An introduction to Ornithology*, 3<sup>rd</sup> ed. Macmillan Publishing Co. Inc., New York, 492.

**Wilson DE, Reeder DM.** 2005. *Mammal species of the world. Taxonomic and geographic reference*. Baltimore, MD: Johns Hopkins University Press.