

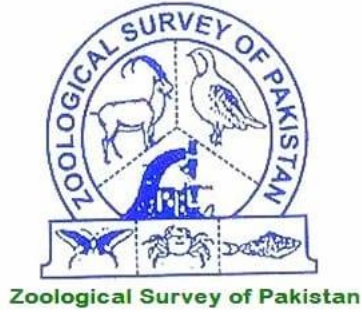
Volume: 24 2018

RECORDS

Zoological Survey of Pakistan



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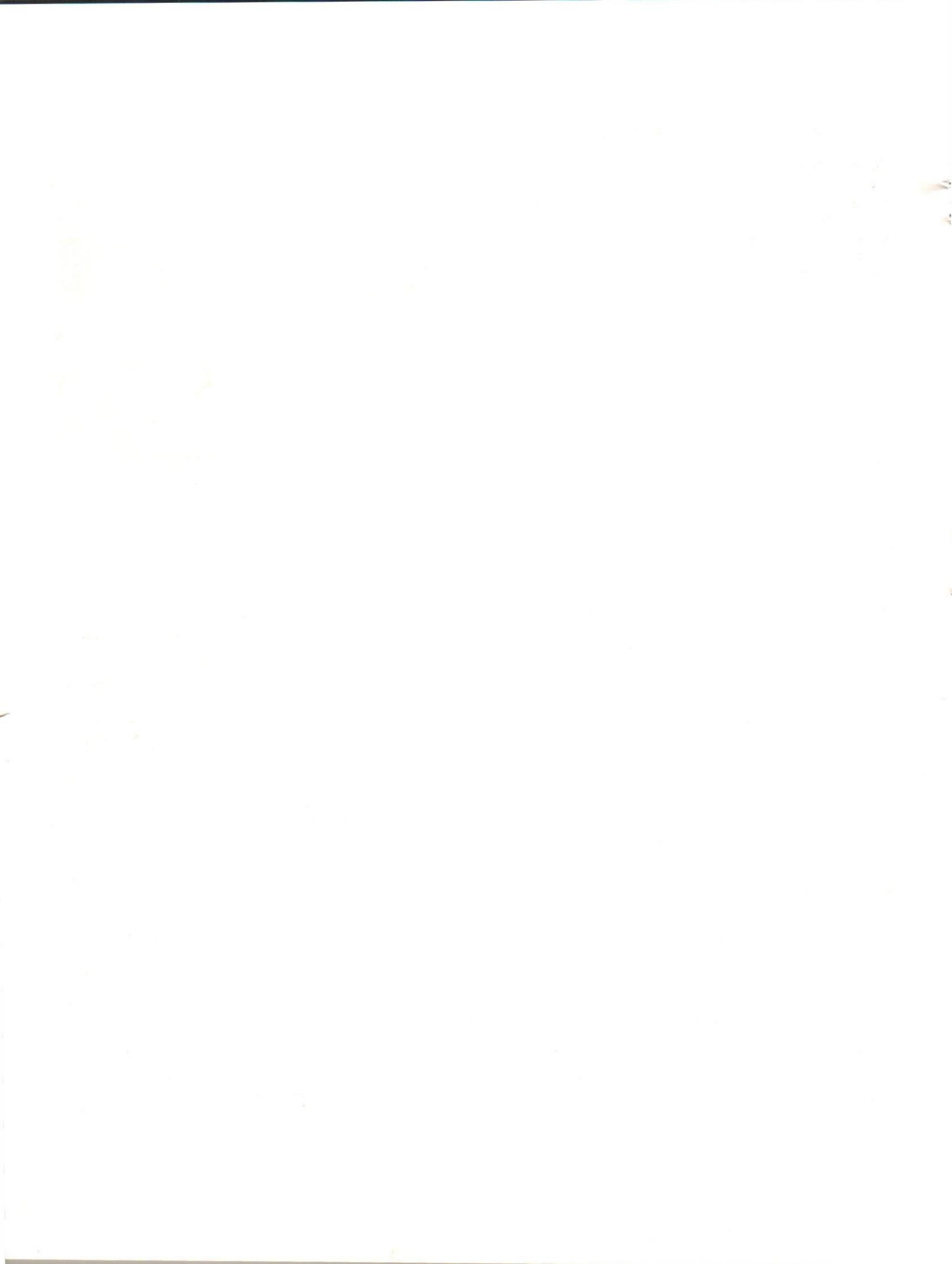
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Egyptian vulture (Neophron percnopterus)
Photo Credit: Khurram Saeed (Research Officer)



Additions to Echinoderm Fauna of Pakistan

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KEYWORDS

Luidia avicularia,
Pentacaster regulus,
Tripneustes gratilla,
Toxopneustes pileolus,
Asteroidea, Echinoidea,

ABSTRACT

Luidia avicularia Fisher (1913) and *Pentacaster regulus* Muller and Troschel (1842) belonging to Class Asteroidea (starfishes) and *Tripneustes gratilla* Linnaeus (1758) and *Toxopneustes pileolus* Lamarck (1816) belonging to Class Echinoidea (sea urchins) are recorded for the first time from Pakistan. These starfishes were collected through fishing operations along Pakistan coast whereas the sea urchins were photographed during underwater excursions at Churna Island (Balochistan Coast). Both the sea urchins are capable of delivering extremely painful and medically significant stings when touched.

Introduction

The echinoderms of Pakistan are known through the work of Kazmi *et al.*, 2019; Munir and Almas 2005. Tahera and Kazmi 2005, 1995; Tahera, 1996; Haque, 1969. Haque 1969 reported 24 species whereas Tahera (1992) listed 26 species from Pakistan. Tahira and Kazmi (2005) in their review reported 36 species (Asteroidea -8; Ophiuroidea-9; Crinoidea-2; Echinoidea-5 and Holothuroidea-12) from Pakistan. Munir and Almas (2005) listed 16 species that were housed in the collection of the Natural History Museum, Zoological Survey Department, Pakistan. Gul (2017) listed echinoids of Pakistan. Ahmed and Ali (2018) provided a list of holothurian from Karachi coast. Recently Kazmi *et al.*, (2019) provided a list of echinoderms of Pakistan. They reported 83 species (Asteroidea-12; Ophiuroidea-19; Crinoidea-7; Echinoidea-18 and Holothuroidea-27). Review of literature on echinoderms of Pakistan is given in (Tahera and Kazmi 2005; Kazmi *et al.*, 2019).

There are numerous gaps regarding data of echinoderms of Pakistan. As new records are regularly been added to the known species of echinoderms the data gaps are filled gradually. Present paper adds four new records of echinoderms from Pakistan based on the collection made from coastal and offshore waters of Pakistan.

Materials and Methods

Samples of echinoderms were collected during commercial trawling and gillnetting operations along the coast of Pakistan during 2017 and 2018. The echinoderm samples were photographed prior to preservation in 5 % formalin. The samples are housed in the Museum of Marine Fisheries Department, Karachi. In addition, photographic evidences of some echinoderms were collected from snorkeling and diving at Churna Island which yielded some new records of echinoderms.

Results

During present study four new records have been made from Pakistan. Two of these species were obtained during commercial trawling and gillnetting operations along the coast of Pakistan during 2017 and 2018 whereas two species *Tripneustes gratilla* and *Toxopneustes pileolus* were photographed during Scuba diving at Churna Island located along Balochistan coast.

Species Account:

1. *Luidia avicularia* (Fisher, 1913) Fig. 1-2

Specimen Examined

- 2 specimens collected from commercial trawler “Safina-e- Zhoab” on 10 November 2015 at 24° 11.221' N; 66° 24.121'E., 82 km southwest of Karachi (MFD/INV/HOL/032-033).
- 2 specimens collected from commercial trawler “Al Sultan” on 19 November 2016 at 24° 31.411' N; 66° 24.102'E, 56 km southwest of Karachi (MFD/INV/HOL/046-047).

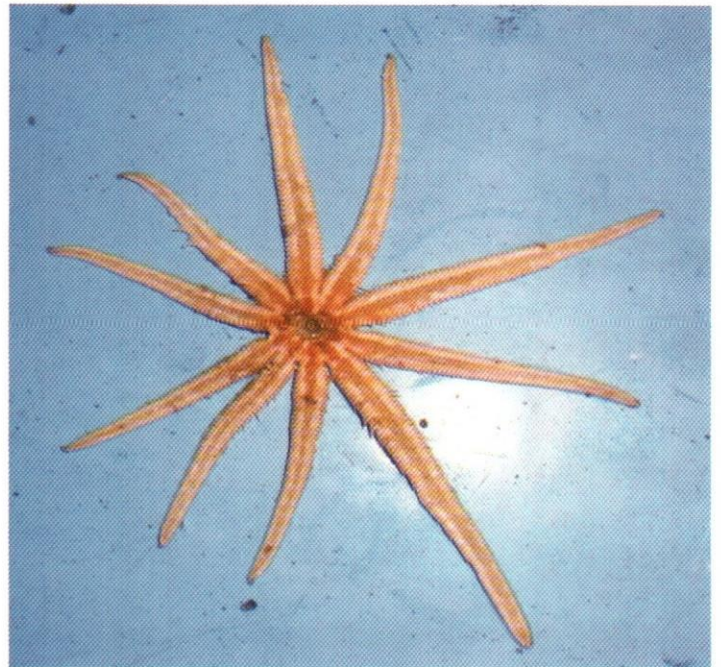
Description: Rays 10. R= 189 mm, r=17.5 mm (second specimen R=179 mm, r 17.2 mm). Disc small; body comprised almost completely of rays which gradually tapering, blunt, abactinal surface slightly convex. Paxillae in disc centre and midline of arms smaller than lateral ones. Dorso-lateral arm plates larger, quadrangular, forming three longitudinal and transverse series. Outermost row of lateral arm plates with a central spine, 6-12 small spines and 30-40 peripheral spinelets; 2nd row of lateral arm plates without central spine but with 5-6 short spines and 25-30 peripheral spinelets; 3rd row of lateral arm plates with fewer central short spines and peripheral spinelets. The specimens from Pakistan come in confirmation with the description of the species given by (Chao, 2000) and original description of the species given by (Fisher, 1913).

Distribution: This species is widely distributed in Indo-West Pacific including southeast Arabia, East Indies, Philippines, China, South Japan and South Pacific Islands, Taiwan and Australia (Clark and Rowe, 1971; Rowe and Gates 1995; Chao, 2000). The benthic species is known to inhabit inshore as well as continental shelf between 6 and 308 m (Rowe and Gates, 1995).

Along the coast line of Pakistan, the species was caught during trawling ground located about 50 to 80 km southwest of Karachi. It has 10 brittle and easily broken arms. Two specimens each with 10 arms were collected from the area survived in the seawater (without aeration) for more than 36 hour. This species is included in the list of marine fauna of Pakistan (Kazmi *et al.*, 2019).

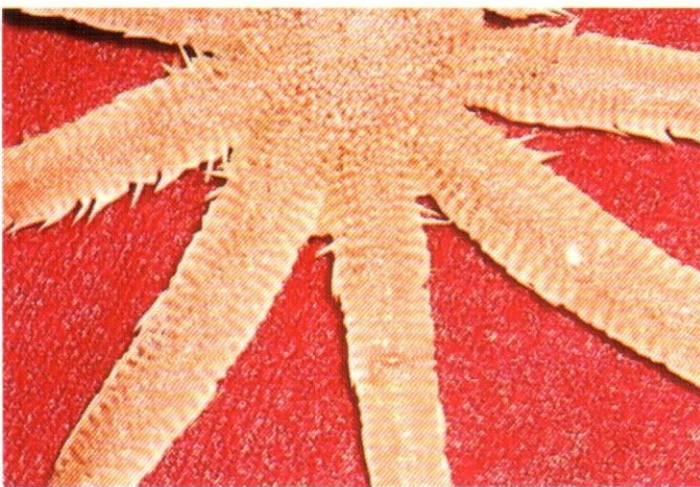


(a)

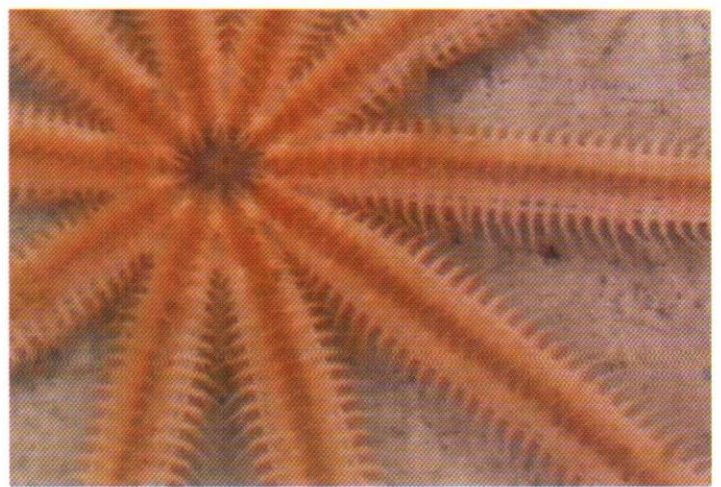


(b)

Fig. 1 *Luidia avicularia* (a) aboral view (b) oral view



(a)



(b)

Fig. 2. *Luidia avicularia* (a) aboral view showing paxillae (b) oral view showing mouth and marginal spines

2. *Pentaceraster regulus* (Muller and Troschel, 1842) Fig. 3

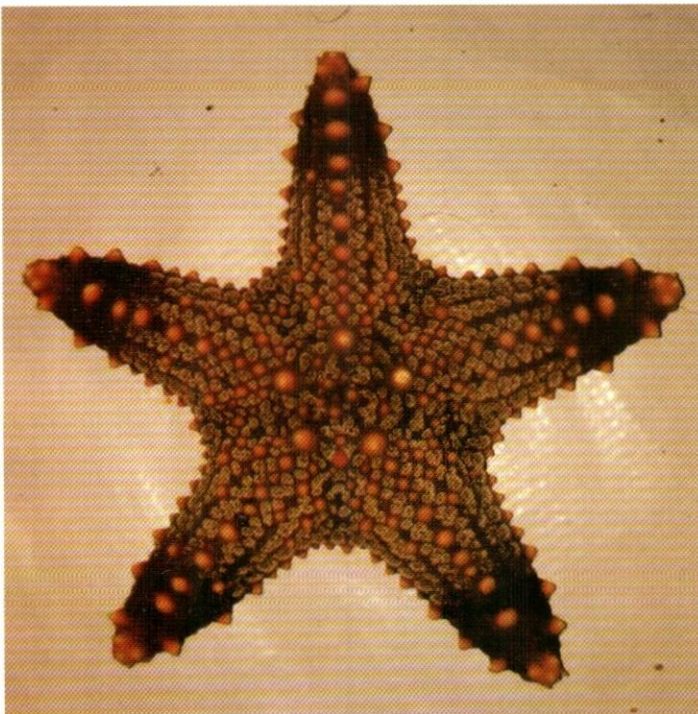
Specimen Examined

- 1 specimens collected from gillnetter "Al-Ishaq" on 24 April, 2017 at 24°54.000' N; 65° 24.000'E, 27 km south of KundMalir(MFD/INV/HOL/112)
- 2 specimens collected from gillnetter "Al Amal" on 22 may, 2018 at 24°56.000' N; 64° 46.000'E; 12 km south of Ormara (MFD/INV/HOL/161-162)

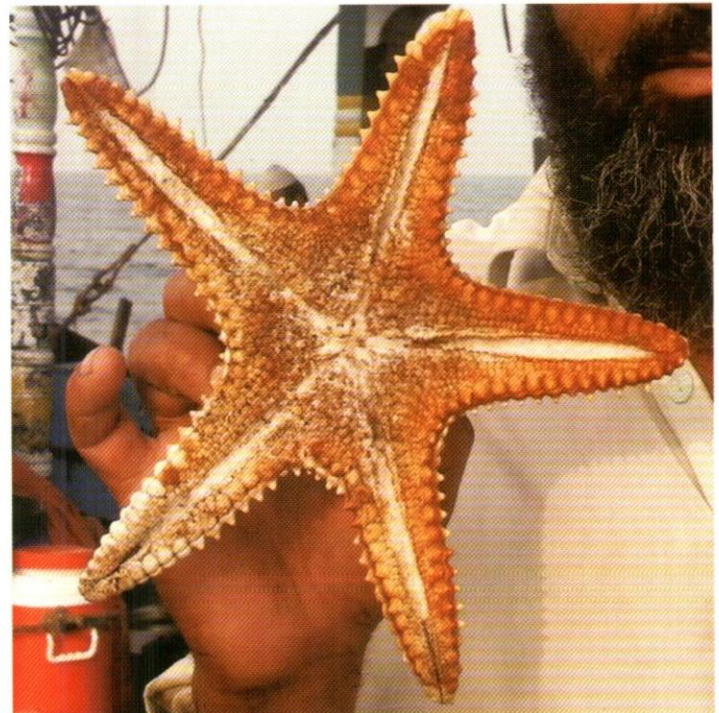
Description: R = 50-61 mm, r= 18-24 mm, Rs 2.5-2.5r. It has hard, thick and heavy body with flattened central side and convex dorsal side of disk and tapering arms. It has a regular pentagonal pattern consisting of five rounded knobs on the centre of disk. Arms five in number, bent upwards at tip and nearly triangular in cross section. Dorsal plates arranged in rows, parallel with lateral margins of arms, and covered with numerous fine granules, and each plate bear one or four valvate pedicellariae. In center of disk five large knobs of primary radial dorsal plates arranged in pentangular form. Smaller knobs on carinal plates form a distinct series towards tip of arm. Madreporite comparatively large conspicuous, more or less elliptical, and located near central pentagon form. Granules exactly like those of other plates, but become conspicuously dense toward to oral plates. Oral plates narrow and elongated, but indistinct on surface. Oral spines arranged in two rows. Inner row composed of 11-13 spines, of which four and five at oral end larger than rest. Outer row consists of seven or eight spines but

similar to large spines of inner row. Body colour was mainly dark brown, but two white stripes were on each arm in large specimens. Especially knobs forming pentangular shape on the disk were vermilion color, but this colour turned white towards tip of arm.

Distribution: Widely distributed in tropical, Indo-Pacific Korea, South Pacific, Bay of Bengal, East Indies, North Australia, Philippine, China, South Japan (Clark and Rowe, 1971); Lakshadweep (Sastry, 2007); and Australia (Rowe and Gates, 1995). Along the coast of Pakistan, these were collected from Ormara and KundMalir areas where bottom has some stones and rocky structures. These starfishes were dried and deposited in the Museum of Marine Fisheries Department. It is interesting that both the specimen got entangled in the gillnets deployed along the margin of subtidal rocky patches in KundMalir and Ormara area.



(a)



(b)

Fig. 3. *Pentaceraster regulus* (a) aboral view (b) oral view

3. *Tripneustes gratilla* (Linnaeus, 1758) Fig. 4

Specimen Examined

- 1 specimens photographed by Khizar Sharif at Churna Island on 24 xxx, 2018 at 24° 53' 56.4" N, 66° 36' 15.12" E, 27 km (MFD/INV/HOL-Photo/12)

Description: This is a round shaped sea urchin with different morphological characters. Its body surface has colourful short spine and tube feet which can move for defense and locomotion. Its test is divided into an aboral and oral surface. Surfaces are separated by the ambitus. Each surface is ended with a circular opening covered by flat structures. There are two major openings in the corona, namely the peristome and periproct. It is enclosed within a test like structure which consists of unified plates forming container where the species conduct its activities.

Distribution: *Tripneustes gratilla* is known to live in a range of tropical habitats, including coral reefs, sea grass meadows, macroalgae forests and on bare sediments. According to Toha *et al.*, (2017), *T. gratilla* a sea urchin species found extensively along the Indian Ocean, Pacific and Indo Pacific, Indo Malaya including Australia, Japan, Eastern Coast of Africa and Eastern part of Hawaii. Along the coast of Pakistan, this species was photographed at Churna Island.

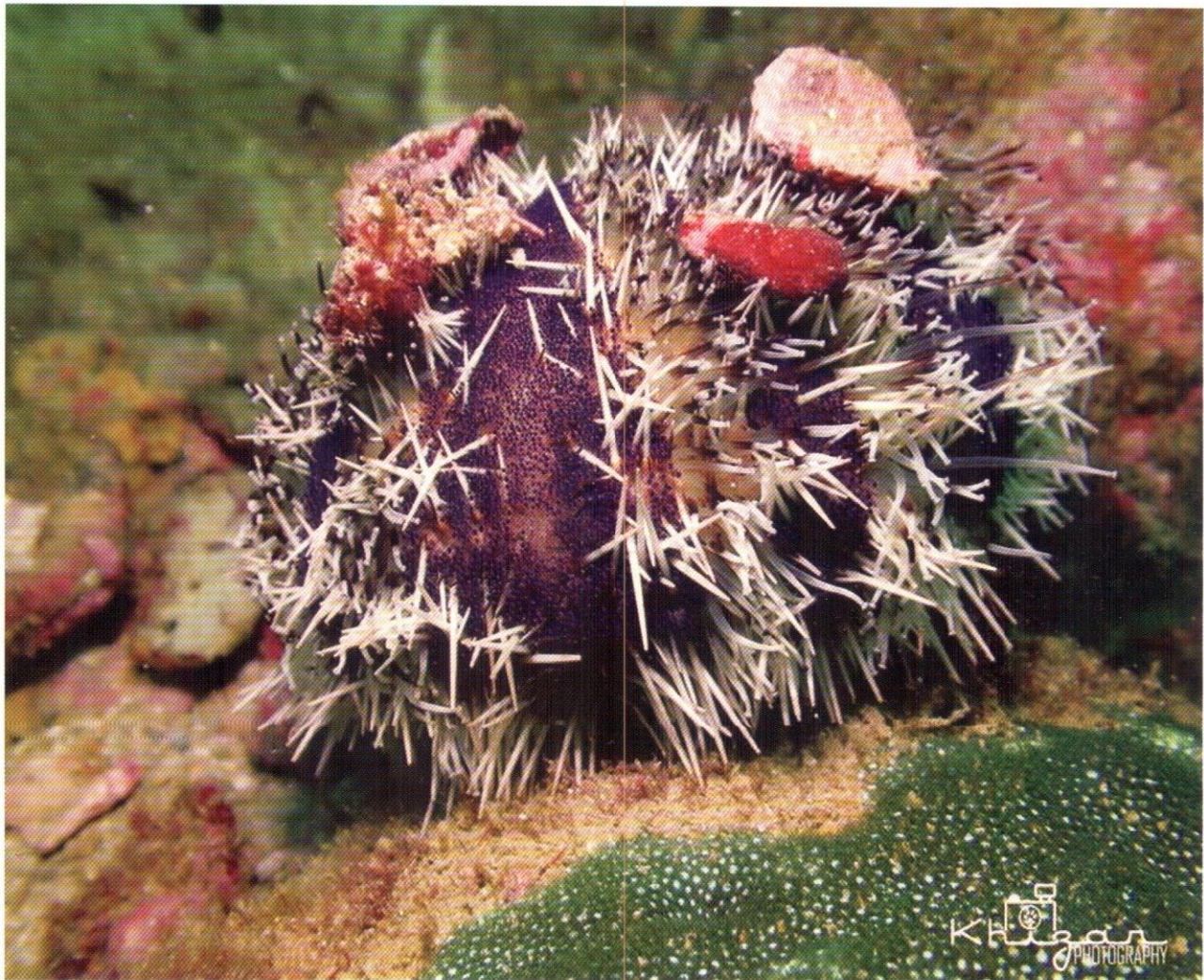


Fig. 4. *Tripneustes gratilla* Lateral view showing

4. *Toxopneustes pileolus* (Lamarck, 1816) Fig. 5

Specimen Examined

1 specimen photographed by Khizar Sharif at Churna Island on 24 xxx, 2018 at 24° 53' 56.4" N, 66° 36' 15.12" E 27 km (MFD/INV/HOL-Photo/13)



Fig 5. *Toxopneustes pileolus* (aboral view)

Description: Moderately large, hemispherical and sunken towards peristome with long three-jawed venomous, flower-shaped, pincer-like structures (pedicellariae), each with a red 'throat'. Spines short and inconspicuous. Spines of aboral side short with tip not sharply pointed. Globiferous pedicellariae very large and prominent, showing a flower-like appearance; skin between valves full of dumbbell-shaped spicules, forming a conspicuous white boarder along edge of valves. Tridentate pedicellariae scarce; valves rather slender, meeting only distally with edges irregularly serrated. Small forms of tridentate pedicellariae with simple, spoon-shaped valves sometimes occur on buccal membrane.

Colour: When the animal is alive, the test takes on the appearance of a flower garden because of the dense covering of large, bright reddish and white, three-jawed globiferous pedicellariae. Poriferous zones more or less yellowish-white. Oral side much lighter.

Distribution: Widely distributed over Indo-West Pacific Ocean, Tropical Indo-Pacific in Kalk (1958); from East Africa to Polynesia (Tortonese, 1980); Tropical, Indo-west-central Pacific Ocean, depth range 0-90 m. (Rowe and Gates, 1995). Also distributed in South East Arabia, Ceylon, Bay of Bengal, East Indies, Philippine, China, south Japan and South Pacific Island. (Clark and Rowe, 1971); Australia (Rowe and Gates, 1995).

Ecology: benthic, inshore, continental shelf (Rowe and Gates, 1995). Along the coast of Pakistan, this species was photographed at Churna Island. This species is included in the Marine Fauna of Pakistan (Kazmi *et al.*, 2019) through unpublished account of Yousuf Ali of Karachi Diver.

Discussion

Luidia avicularia can be distinguished from *L. maculata* (recorded from Pakistan by Haque, 1969) by having enlarged central spine or spinelets on the pixillae and by presence of bicuspid pedicellariae close to the adambulacrae spine (Chao, 2000). *Pentaceraster regulus* have recently been seen in an aquarium shop in Karachi which is said to be Pakistan origin but detailed interview revealed that it was actually caught in Kish Island and brought for sale in Karachi.

Pentaceraster regulus (Muller and Troschel, 1842) *Tripneustes gratilla* (Linnaeus, 1758) is commonly known as collector, cake or Parson's hat, halloween urchins, Hawaiian sea urchins, priest-hut urchins, pincushion, pin-cushion or hairy sea urchins. It has many different color morphs that vary throughout the visible color spectrum *T. gratilla* is venomous but doesn't inflict the severe stings.

Toxopneustes pileolus, commonly known as flower urchin, has typical flower-like appearance due to large globiferous pedicellariae. It is considered highly dangerous, as it is capable of delivering extremely painful and medically significant stings when touched. It does not deliver its venom through spines. Instead, the venom is administered through the flower-like globiferous pedicellariae. If undisturbed, the tips of the globiferous pedicellariae are usually expanded into round cup-like shapes. They possess tiny sensors on their inside surfaces which can detect threats by touch and chemical stimuli. When agitated or brushed against by a potential threat, the pedicellariae will immediately snap shut and inject venom. The claws of the pedicellariae may also break off from their stalks and adhere to the point of contact, retaining the ability to continually inject venom for several hours.

Acknowledgement

The authors are thankful to Mr. Khizar Sharif, an enthusiastic diver and naturalist for allowing to use his photographs of sea urchins. Thanks are also due to Prof. Quddosi B. Kazmi for her help in identification of *Luidia avicularia*.

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Genetic variation between two different strains GIFU and GIFT of Nile Tilapia, *Oreochromis niloticus* using allozyme marker

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KEYWORDS

Genetic variation,
Allozyme marker,
GIFT,
GIFU,
Oreochromis niloticus

ABSTRACT

Allozyme electrophoresis was accomplished to identify genetic variation in two different strains of Nile Tilapia, GIFU and GIFT. Two months aged experimental fish were collected from two different regions namely Noakhali and BFRI, Mymensingh. Five enzymes namely LDH, SOD, MDH, ODH and MDH (NADP+) were used in TC-1 buffer system to analyze the genetic variation. LDH and SOD provided clear resolution for muscle tissue. Two presumptive loci were identified where *Ldh-1** loci was found polymorphic in both populations. GIFT populations showed same mean proportion of polymorphic loci which was 50% whereas GIFU population showed highest mean number of alleles per locus which was 2.0. The highest mean number of effective alleles per locus was 1.47 and the mean proportion of heterozygous loci per individual was 24.31% which was found in GIFT population. Among two populations, observed heterozygosity (H_o) and expected heterozygosity (H_e) of GIFT population showed the highest values which was 0.333 and 0.254 respectively. The average observed heterozygosity (H_o) was 0.313 and expected heterozygosity (H_e) was 0.240 for GIFU populations. The average H_o/H_e value was 1.301 in *Oreochromis niloticus* population. The genetic differentiation (F_{st}) and the gene flow (N_m) over all two populations was 0.0239 and 10.1923, respectively. The genetic distance (D) between two populations was calculated and found to range from 0.0146 to 0.9855.

Introduction

Nile Tilapia, *Oreochromis niloticus* (Linnaeus, 1758), is one of the most important exotic species in Bangladesh which is fast grower, suitable for culture in native water, has high tolerances of wide range of water salinity, resistance to pesticides and other toxicants and favored by most of the people of Bangladesh. Genetically Improved Farmed Tilapia (GIFT), an improved strain of Nile Tilapia was introduced by BFRI from the Philippines in 1994. Growth performance of GIFT is now 40% higher than that of the founder stock (Rahman, 2005). BFRI is doing research on genetically stock improvement through selective breeding technique at every generation. However GIFU, the new strain of Nile Tilapia was recently introduced by the private hatchery owner at Noakhali district of Bangladesh. He claimed that GIFU is the 11th generation of GIFT which is superior (20% more growth) to the GIFT in terms of growth performance. The hatchery owner also mentioned that the superiority of GIFU through its higher filler ratio and attractive fillet color (light pink) than other strains. Tilapia, as aquaculture species, is now occupied highest position among all other aquaculture species

and contributing significantly towards the enhancement of total fish production in Bangladesh. So ensuring the more productive strain is of prime importance for the sustainability of aquaculture. Therefore the present study was conducted to identify the genetic variation between GIFU and GIFT through allozyme electrophoresis.

Materials and Methods

Fish samples:

Two months aged experimental fish were collected from different sources in Bangladesh namely GIFU from Noakhali and GIFT from Bangladesh Fisheries Research Institute (BFRI), Mymensingh. A small piece of muscle tissue was taken using scalpel and scissors maintaining cool condition. The scalpels and scissors were washed and soaked in ethanol and then dried with tissue paper (in time before cutting another individuals muscle tissue) to avoid protein contamination. Then the muscle tissues were stored in marked air tight small size plastic bag and this bags were transferred in a freezer (-18°C) immediately. This storage system continued until electrophoresis analysis.

Table 1. Sources, number of specimen and date of collection of *Oreochromis niloticus* population

Sr. No.	Strain	Source	No. of Individual
1.	GIFU	Private fish hatcher at Noakhali	30
2.	GIFT	BFRI, Mymensingh	30

Allozyme electrophoresis: Horizontal starch gel electrophoresis method using tris citrate (TC-1) buffer (pH 7)

(Shaw and Prasad, 1970) was used for allozyme work. The muscle sample was collected from each fish separately. The details of enzyme are shown in Table 2.

Table 2. Details of enzyme for electrophoresis of GIFU and GIFT.

Enzymes	Enzyme abbreviations	Enzyme patterns	*E.C. Number	Tissue
Lactate dehydrogenase	LDH	Tetramer	1.1.1.27	Muscle
Superoxide dismutase	DOD	Dimer	1.1.1.15	Muscle
Lactate dehydrogenase	LDH	Tetramer	1.1.1.27	Muscle
Malate dehydrogenase	MDH	Dimer	1.1.1.37	Muscle
Malate dehydrogenase (NADP+)	MDH (NADP+)	Dimer	1.1.1.40	Muscle

*E.C: Enzyme commission

After electrophoresis, enzyme staining recipes were followed by Whitmore (1990). Loci were numbered consecutively from the anodal to the cathodal side. Thus the most anodal locus was designated '1'. Gene nomenclature was followed by Shaklee *et al.*, (1990). The electrophoretic bands corresponding to multiple alleles at each locus were alphabetically named as *a, *b, *c etc. in order of detection.

Genetic analysis:

Allele frequencies were calculated directly from observed genotypes. Then observed genotypes were compared with the expected, calculated from the Hardy-weinberg equilibrium using

χ^2 test. When the most common allele existed in a frequency less than or equal to 0.95 at a given locus this locus was regarded as polymorphic. The mean proportion of heterozygous locus per individual, mean proportion of polymorphic loci per population, mean number of effective allele per locus were calculated so as to show the extent of genetic variability (Lewontin and hubby, 1966; and Lewontin, 1974), Expected (H_e) and observed (H_o) heterozygosity were also calculated (Nei, 1972). The co-efficient of gene differentiation (F_{ST}) and Gene flow (N_m) was calculated to estimate diversity. The analysis of allozyme data were performed using POPGENE (version 1.31) computer package program (Yeh *et al.*, 1999).

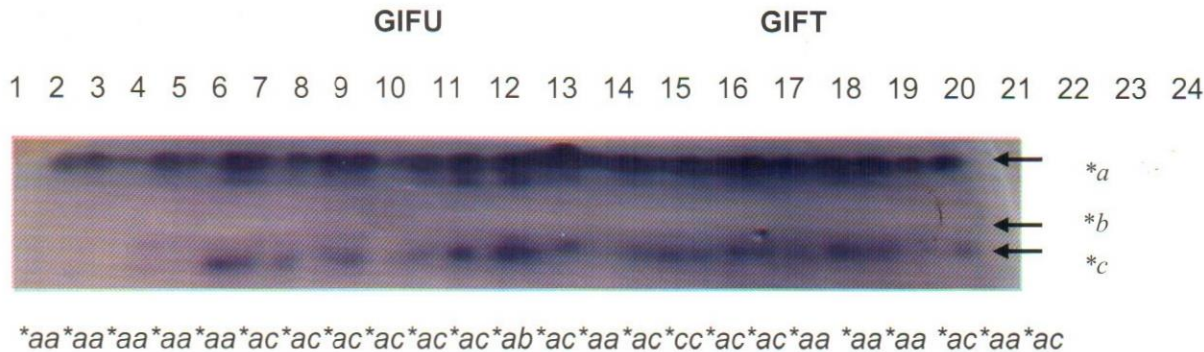


Fig 1: Electrophoregram of enzyme Lactate dehydrogenase (LDH) of *Ldh-1** locus between GIFU and GIFT populations. *a, *b, *c indicate the three different alleles in *Ldh-1** locus. The respective genotypes are shown below in each lane for a particular individual.

Results and Discussion

In the present study five enzymes LDH, SOD, MDH, ODH and MDH (NADP⁺) were used in TC-1 buffer system. Among them MDH, ODH and MDH (NADP⁺) did not show any resolution and LDH, SOD provided clear resolution for muscle tissue of the two strains of *Oreochromis niloticus*. According to Khan *et al.*, (1999) the allelic enzyme activity varies from buffer to buffer, species to species and also tissue specific.

Allele frequencies: The electrophoretic patterns of muscle samples showed that the genes at two presumptive loci controlled by the enzymes. The *Ldh-1** was produced

heterozygosity by the two alleles *a and *c with the frequency of 0.58 and 0.42 in the GIFT population and the GIFU population was produced heterozygosity by three alleles *a, *b and *c with the frequency of 0.70, 0.04 and 0.26. On the other hand, the *Sod** loci was monomorphic with the allelic frequency of *a=1.000 in two populations. In the present study, GIFU population showed three common alleles (*a, *b and *c) and GIFT population showed two common alleles *a and *c. The *Ldh-1** was showed four genotypes, *aa, *ab, *cc, *ac produced by three alleles, *a, *b, *c. The allele frequency of *a in *Ldh-1** was higher in all two populations. The allele frequency of *b in *Ldh-1** was present in the GIFU populations whereas it was completely disappeared in the GIFT population.

The amount of genetic variation in a population can be estimated only if one has information about the number of loci at which variation occurs (polymorphic loci) depicted by Lewontin,

1974. Electrophoretic data provided such information that could be successfully used to monitor levels of genetic variation in populations (Leary and Booke, 1990).

Table 3. Allele frequency at 2 presumptive loci of *Oreochromis niloticus* strains

Sr. No.	Locus	Allele	GIFU	GIFT
1.	<i>Ldh-1*</i>	*a	0.7	0.58
		*b	0.04	0
		*c	0.26	0.42
2.	<i>Sod*</i>	*a	1.0	1.0

The chi-square was made in all the cases of polymorphic loci between observed and expected genotypes, based on Hardy-Weinberg equilibrium. The test was not effective in the most cases in which the expected values were <5.

Genetic variability: The mean proportion of polymorphic loci per population was 50%. The mean proportion of heterozygous loci per individuals for all population ranging from 21.70% to 24.31% (Average 23.01%), which was higher in GIFT population and lower in GIFU population. The observed heterozygosity (H_o) and expected heterozygosity (H_e) obtained in the present study ranged from 0.2917 to 0.3333 (Average 0.3125) and 0.2264 to 0.2536 (Average 0.2400) respectively. The higher observed and expected heterozygosity ($H_o=0.3333$ and $H_e=0.2536$) exhibited by the GIFT population indicated that the gene pool of the GIFT population was maintained effectively. Between two *Tilapia* populations the H_o/H_e was higher in GIFT populations (1.31142) and lower in GIFU population (1.2884).

Sekino and Hara, (2000) found that H_o and H_e values in *Anabas testudineus* ranging from 0.54 to 0.090 and 0.056 to 0.106. The observed heterozygosity and expected heterozygosity was higher than Sekino and Hara (2000). Observed heterozygosity (0.3125) was higher with that obtained (0.059) by Barua *et al.*, (2004) and value (0.072) by Eunus (2004) for thai pangas, *P. Hypophthalmus*. Again Nevo (1978) reported that an average heterozygosity (H_o) value for bony fishes was 0.51. However, the H_e values obtained in the present study do not fall in the range of values ($H_e=0.22$ to 0.03) which are generally considered as the lower margin of the genetic variability for fishes (Nevo *et al.*, 1984; Kirpichnikov, 1992). The level of heterozygosity is related with the size of populations within a species. The practical interest of higher heterozygosity (H_o) value of a population can be aimed at genetic breeding programs. The average heterozygosity (H_o or H_e) is considered as a good indicator of the genetic variability throughout the genome of the population (Leary and Brooke, 1990; Allendorf and Ryman, 1986).

Table 4. Genetic variabilities at two loci of *Oreochromis niloticus*

Population	Mean proportion of polymorphic loci (%)	Mean number of alleles (N_a) per locus	Mean number of effective alleles (N_e) Per locus	The mean proportion of heterozygous loci per individual (%)	Heterozygosity		
					H_o	H_e	H_o/H_e
GIFU	50	2.00	1.38	21.70	0.291	0.226	1.288
GIFT	50	1.50	1.47	24.31	0.333	0.254	1.314
Average	50	1.75	1.425	23.01	0.313	0.240	1.301

Genetic differentiation:

The co-efficient of gene differentiation (F_{ST}) in all two *Oreochromis niloticus* populations examined (Nei's 1972) for all loci was 0.0239, indicated the presence of population with a slight genetic differentiation and the number of individuals that migrate from one population to another is high ($N_m=10.1923$). The F_{ST} value (0.3667) was higher than obtained value for other fishes such as loach (0.774) (Khan and Arai, 2000) and freshwater Gobi (0.698) (Shimizu *et al.*, 1993). Yet, the present

F_{ST} value point towards the existence of slight genetic differentiation between the strains.

Acknowledgement:

The authors are grateful to the authority of BFRI for providing all over support to conduct the research work smoothly. We are also thankful to the Department of Fisheries and Marine Science of Noakhali Science and Technology University and the local hatchery owner for providing fish and logistic support.

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Baseline data of Vertebrate Fauna of Lal Sohanra National Park, (LNSP) Bahawalpur, Punjab, Pakistan

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KEYWORDS

Baseline Data,
Lal Sohanra National Park,
Patisar Lake,
Vegetation,
Ecosystem.

ABSTRACT

Lal Sohanra (District Bahawalpur, Punjab) was declared National Park (LNSP) in 1972 and is UNESCO recognized Biosphere Reserve. The National Park has diverse habitats including the desert to semi desert, irrigated forest land and wetland i.e. Patisar Lake. This diverse ecosystem is home to a variety of flora, terrestrial and aquatic fauna as well. Current study was initiated to develop a baseline of fauna of the National Park especially that of threatened species and to record the threats faced by ecosystem and fauna. Park enclosures house blackbuck, chinkara and Indian one horned rhinoceros but no wild population of these animals exist in National Park. There is small fragmented population of nilgai residing in the wilderness of the National Park. During the survey, three female Nilgai were observed in irrigated plantation near Quaid i Azam Solar Park and wandering animals are also present. Enclosure at Lion Safari also hosts four Nilgai. Jackal, small mongoose, porcupine, fox and Indian hare are very common in the National Park. Caracal and wolf are prosecuted to rarity. Wild cats including the jungle cat and Indian desert cats are also found in National Park. Striped hyena is also the park inhabitant but is very rare. Park is also home to Indian cobra, Russel's viper, four species of lizards and three species of freshwater turtles. A diversity of terrestrial and aquatic avifauna inhabits the National Park. Despite a diverse ecosystem and protected area, the Park ecosystem is threatened by habitat modification, degradation and intentional plantation of eucalyptus. Moreover, commercial timbering is also a major concern in the boundary of National Park. Illegal deforestation and poaching is threatening the flora and fauna of the Park. Certain non-muslim communities residing in the premises also consume the wild animals due to which many species have become rare in the National Park. Patisar Lake once a habitat for diverse flora and fauna is now drying up due to unavailability of water. It is need of hour to formulate a management plan for LNSP to check forest practices and over exploitation of the park resources. Managerial efforts are needed to restore the biological diversity and Patisar Lake. Livestock relocation and park zoning for grazing areas may also be considered along with proper boundary of LNSP along with provision of alternate livelihood options for the local communities.

Introduction

Biological diversity is globally threatened due to ever growing human population, its dependence on natural capital and over exploitation of natural resources (Lewton and May 1995; Whittaker *et al.*, 2005). The rate of species extinction has paced up and the mammals are most vulnerable group (Primack, 2002). Under the Convention on Biological Diversity, nations agreed that biodiversity conservation is a global concern and a fundamental portion of the developmental processes. However, achieving these goals in developing countries, particularly the South Asian nations are mostly challenging (Mishra, 2001).

The continued loss of biological diversity in response to habitat degradation, fragmentation and modification is of great concern in Pakistan. Furthermore, urbanization, pollution, poaching and our collective social apathy is taking the species on verge of extinction. It is resulting in the loss of species and genetic diversity. Many native flora and fauna is succumbed to decline (Government of Pakistan *et al.*, 2000).

By ratifying Convention on Biological Diversity (CBD), development of National Conservation Strategy (NCS) and Biodiversity Action Plan (BAP), Pakistan has given serious thought to biodiversity conservation and its sustainable use. Besides formulating national Climate Change and Forest policies, Pakistan has formalized the state level efforts for conservation of biodiversity. Moreover, provincial governments have their own legislations regarding wildlife conservation and

sustainable use; implemented by respective wildlife or forest departments (GOP, 1999)

To conserve the biological diversity in the region, Pakistan has established a system of protected areas with different categories including; wildlife sanctuaries, game reserves and National Parks (GOP, 2017). Currently there are 29 National Parks in Pakistan. The first national park, Lal Sohanra, was declared in Bahawalpur District of Punjab in 1972 (Khan, 2003). Lal Sohanra National Park (LNSP) is also a UNESCO recognized Biosphere Reserve and is a participating site in the Sustainable Management of Marginal Dry-lands project of MAB's Dry lands and Desertification programme (Hameed *et al.*, 2002). In spite the utmost importance of the eco-region, there are no systematic studies on fauna of LNSP. Therefore, current study was conducted to collect the baseline information of fauna of LNSP and assess the threats faced by the ecosystem.

Material and Methods

Study Area:

Lal Sohanra National Park (LNSP) spans over an area of 1, 62,567 acres and is IUCN Category V protected area. It is located in Bahawalpur District of Punjab Province. The National Park spreads on both sides of Desert Branch canal. The park's terrain is generally flat, interspersed with sand dunes measuring between 1 and 6 meters in height and occupying as many as thousands of acres apiece. The Biosphere Reserve is crossed by the dried-up bed of the Hakra River and comprises Patisar

Lake and irrigated land. The lake (1,935 hectares) was originally built as a water reservoir and used to be an important wetland as a wintering site of many waterfowls.

The climate of the area is of subtropical continental type, characterized by low and sporadic rainfall, high temperatures, low relative humidity, high rate of evaporation and strong summer winds. Temperature ranges from 50°C during summer to -2°C during winter and the hottest months are May and June. Annual rainfall varies between 90 to 200 mm and average relative humidity is about 60%. Wind direction in summer is south eastern and in winter it is north eastern. The soil in general is made up of alluvial deposits having clayey loam at "Dahars" (flat areas between dunes) with low sand dunes at scattered places. The size of sand dunes ranges from 0.01 to 0.50 km². Clayey loam deposits are about 1.5 to 5.0 m thick and pure sand starts below the hard clayey surface (Hameed *et al.*, 2002).

Survey Methodology:

Field survey was carried out during October 2018. Primary information regarding wildlife of LSNP was collected through field surveys, non-structured interviews and secondary data available with Punjab Wildlife Department and Hobuara Foundation International. Multiple survey techniques were employed during the census. Grid sampling was carried out in irrigated plantation and forest habitat was thoroughly searched for fauna. Transect method was applied in semi desert to desert habitat. Sampling was done either by walking or in vehicle. Transects of 2- 5km long were walked and observations were made. Transects by vehicle were observed by driving the vehicle at 5km/h and observations were made. Indirect evidences i.e. scat samples, foot prints etc. were also recorded in addition to direct sightings. Observations were made with the help of Nikon (10x 42) binocular. GPS coordinates of transects were recorded using Garmin map64 GPS Receiver and distance from animals was recorded with the help of Bushnell (20-0880) range finder.

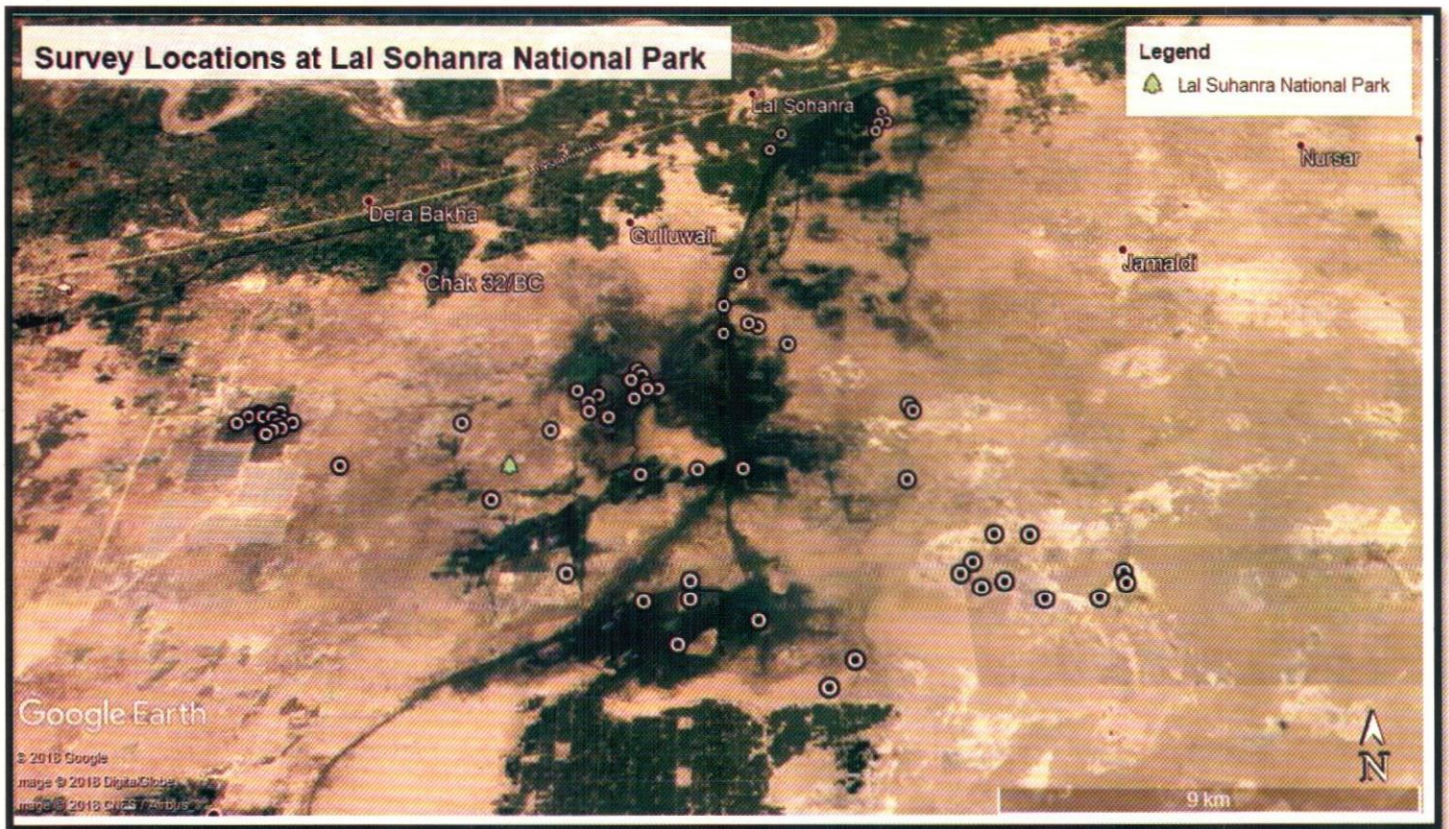


Figure 1: Map of Lal Sohanra National Park with study points

Results and discussion

Ecology and Habitat of Lal Sohanra National Park:

Lal Sohanra National Park is a common stake of Forest, Wildlife and Fisheries Department of Punjab Province with administrative control of Forest Department. The Forest Department is more concerned with irrigated plantation and commercial logging. The objective of declaring the area as National Park was to conserve the biodiversity of Cholistan Ecosystem especially the important species including the nilgai (Blue bull), chinkara and blackbuck and to ensure the sustainability in resource extraction and utilization.

Lal Sohanra National Park is diverse in terms of habitat availability i.e. semi desert to desert habitat, irrigated plantation and wetlands. The National Park spans over an area of 1,62,567 acres (51,368 hectares). Irrigated plantation is carried out on 20,974 acres (8,491 hectares) of park land. Semi desert/ desert habitat occupies 101,726 acres (40,942 hectares) while wetlands (Lake and Canals) spread over an area of 4,780 acres.

Each habitat type is unique in terms of its flora and fauna. *Euclyptus* and *acacia nilotica* (keekar) are main species in irrigated plantation stands while few stands of *dalbergia sissoo* (shesham) also exist. Irrigation is carried out by Desert Canal, an extension of Bahawal Canal. Extensive irrigation network is laid down in tree stands to meet the water needs.

Patisar Lake, a large water body situated in the centre of LSNP serves as important habitat for waterfowl. The wetland has characteristic floating, submerged and marshy vegetation. Dominant species include *Eichornia crassipes* (water hyacinth), *Typha domingensis* (cattail), *Nelumbo nucifera* (lotus), *Phragmites karka* (reed), *Hydrilla verticillata* (hydrilla), *Lemna minor* (duckweed) etc. Periphery of wetland habitat is surrounded by *Saccharum bengalense* (Sarkanda) and *Tamarix indica* (Tamarix).

Lal Sohanra Desert is the branch of Cholistan Desert, more specifically the Lesser Cholistan Desert. Area is dominated by shrubs and thorny vegetation. Clay flats and low sand dunes are present in this semi desert habitat. *Tamarix aphylla* (Tamarix), *Capparis deciduas* (Kair), *Calligonum polygonoides* (phog), *Calotropis procera* (rubber bush), *Prosopis cineraria* (Khejri Tree) and *Zizyphus Mauritania* (Jhand) are dominating desert plants in Lal Sohanra.

There is no permanent human settlement in the Lal Sohanra National Park but areas along the park boundaries are highly populated. People mostly rely on farming. Park resources play an important role in livelihood of local people. Fuel wood collection and grazing are common practices throughout the National Park. Local communities heavily rely on National Park for their timber needs and none of the Park area is left unexploited.

Fauna of Lal Sohanra National Park:

Faunal diversity is directly linked with the diversity in habitat availability. LSNP is home to desert and semi desert adapted species of reptiles, birds and mammals.

Mammalian Fauna of LSNP:

Blackbuck population is kept in two enclosures in LSNP. Enclosure at RD 65 has 70 blackbucks. These include 25 males, 29 females and 16 fawns while enclosure at RD 50 homes 336 blackbucks. These include 118 males, 141 females and 72 fawns. Breeding and reproduction is naturally occurring and surplus animals are moved to other areas or sold out. There is no proper veterinary hospital in LSNP or other trained staff to deal with sick animals. Chinkara is also kept in two enclosures in LSNP. Enclosure at Children Park has 150 chinkara while at Hobura Bustard Enclosure; there are 15-20 chinkara. No wild population of Blackbuck or chinkra is present in LSNP.

Nilgai (Blue bull) is present in wild habitat especially in irrigated plantation. Three females were observed from irrigated plantation near Quaid i Aazm Solar Park in LSNP. Moreover, wandering Blue bulls can also be found in the vast expanse of the Park but their population is very small and fragmented. Four blue bulls are also kept in enclosure at Lion Safari in LSNP.

Indian desert hare, porcupine, jackals and bengal fox are very common in LSNP as well the small mongoose. Caracal cat is also the resident of the Park but it is rarely encountered. Only recent sighting (2017) of caracal comes from Hobura Foundation International. Other wildcats include the Indian desert cat and jungle cat. Indian civet is also reported from LSNP. Wolf, once common in the National Park is prosecuted to rarity now. A large burrow surrounded with bones/ carcasses was also observed near the forest plantation of LSNP. The burrow structure and scattered bones indicate that it might be that of striped hyena.

Table 1: Inventory of mammalian fauna of LSNP

Common Name	Scientific Name	IUCN Red Data List Status
Long-eared Hedgehog	<i>Hemiechinus auritus</i>	LC ¹
Greater Mouse-Tailed Bat	<i>Rhinopoma microphyllum</i>	LC
Least Pipistrelle	<i>Pipistrellus tenuis</i>	LC
Kuhl's Pipistrelle	<i>Pipistrellus kuhlii</i>	LC

Greater Asiatic Yellow Bat	<i>Scotophilus heathii</i>	LC
Indian Wolf	<i>Canis lupus</i>	LC
Asiatic Jackal	<i>Canis aureus</i>	LC
Desert Fox	<i>Vulpes bengalensis</i>	LC
Small Indian Civet	<i>Viverricula indica</i>	LC
Indian Grey Mongoose	<i>Herpestes edwardsii</i>	LC
Striped Hyaena	<i>Hyaena hyaena</i>	NT ²
Indian Desert Cat	<i>Felis silvestris</i>	LC
Jungle Cat	<i>Felis chaus</i>	LC
Caracal Cat	<i>Caracal caracal</i>	LC
Indian Wild Boar	<i>Sus scrofa</i>	LC
Nilgai	<i>Boselaphus tragocamelus</i>	LC
Blackbuck	<i>Antilope cervicapra</i>	LC
Chinkara Gazelle	<i>Gazella bennettii</i>	LC
Indian Hare	<i>Lepus nigricollis</i>	LC
Northern Palm Squirrel	<i>Funambulus pennantii</i>	LC
Indian Desert Jird	<i>Meriones hurrianae</i>	LC
Indian Gerbil	<i>Tatera indica</i>	LC
Indian Hairy-Footed Gerbil	<i>Gerbillus gleadowi</i>	LC
Short-Tailed Bandicoot Rat	<i>Nesokia indica</i>	LC
Little Indian Field Mouse	<i>Mus booduga</i>	LC
House Mouse	<i>Mus musculus</i>	LC
Black Rat	<i>Rattus rattus</i>	LC
Indian Crested Porcupine	<i>Hystrix indica</i>	LC
1 Least Concern, 2 Near Threatened		

Reptiles observed at LSNP:

LSNP is also home to various reptilian species as well. Desert adapted snakes and lizards are common in LSNP. Moreover,

wetland ecosystem in LSNP is also home to freshwater turtle species.

Table 2: Inventory of reptilian fauna of LSNP

S. No.	Common Name	Scientific Name	IUCN Status
1	Oriental Garden Lizard	<i>Calotes versicolor</i>	NE ¹
2	Brilliant Agama	<i>Trapelus agilis pakistanensis</i>	NE
3	Afghan Ground Agama	<i>Trapelus megalonyx</i>	NE
4	Sind Sand Gecko	<i>Crossobamon orientalis</i>	NE
5	Tuberculate Ground Gecko	<i>Cyrtopodion scabrum</i>	LC ²
6	Brooke's House Gecko	<i>Hemidactylus brookii</i>	NE
7	Yellow-belly House Gecko	<i>Hemidactylus flaviviridis</i>	NE
8	Spotted Lacerta	<i>Mesalina watsonana</i>	NE
9	Common Mole Skink	<i>Eurylepis taeniolata</i>	NE
10	Three-Toed Snake Skink	<i>Ophiomorus tridactylus</i>	NE
11	Bengal monitor	<i>Varanus bengalensis</i>	LC
12	Desert monitor	<i>Varanus griseus koniecznyi</i>	NE
13	Slender Worm Snake	<i>Indotyphlops porrectus</i>	NE
14	Common Sand Boa	<i>Eryx johnii</i>	NE
15	Striped Keelback	<i>Amphiesma stolatum</i>	NE
16	Common Cat Snake	<i>Boiga trigonata</i>	LC
17	Northern Wolf Snake	<i>Lycodon striatus</i>	NE
18	Sindhi Awl-headed Sand Snake	<i>Lytorhynchus paradoxus</i>	NE
19	Banded Kukri Snake	<i>Oligodon arnensis</i>	LC
20	Streaked Kukri Snake	<i>Oligodon taeniolatus</i>	LC
21	Indian Sand Snake	<i>Psammophis condanarus</i>	LC
22	Pakistan Sand Racer	<i>Psammophis leithii</i>	NE
23	Schokari Sand Racer	<i>Psammophis schokari</i>	NE
24	Indian rat snake	<i>Ptyas mucosa</i>	NE
25	Diadem Snake	<i>Spalerosophis diadema</i>	NE
26	Red-Spotted Diadem Snake	<i>Spalerosophis arenarius</i>	NE
27	Checkered Keelback	<i>Xenochrophis piscator</i>	NE
28	Common Krait	<i>Bungarus caeruleus</i>	NE

S. No.	Common Name	Scientific Name	IUCN Status
29	Indian cobra	<i>Naja naja</i>	NE
30	Russell's viper	<i>Daboia russelii</i>	LC
31	Eastern Saw-Scaled Viper	<i>Echis carinatus sochureki</i>	NE
32	Indian Spiny-tailed Lizard	<i>Uromastyx hardwickii</i>	LC
33	Cholistan Skink Lizard	<i>Eumeces cholistanensis</i>	NE
34	Cholistan Lizard	<i>Eremius cholistanica</i>	NE
35	Brown Roofed Turtle	<i>Pangshura smithii</i>	NT ³
36	Spotted Pond Turtle	<i>Geoclemys hamiltonii</i>	EN ⁴
37	Ganges soft-shelled turtle	<i>Nilssonina gangetica</i>	VU ⁵

1 Not Evaluated, 2 Least Concern, 3 Near Threatened, 4 Endangered, 5 Vulnerable

Avifauna of LSNP:

LSNP is rich in terms of avifauna. Around 160 bird species were recorded from LSNP. Moreover, Patisar Lakes used to home

10,000 and 30,000 ducks during the mid- winter. An inventory of avifauna at LSNP is given below;

Table 3: Inventory of Avifauna at LSNP

Sr. No.	Common Name	Scientific Name	IUCN Status
1.	Common Quail	<i>Coturnix coturnix</i>	LC ¹
2.	Grey Francolin	<i>Francolinus pondicerianus</i>	LC
3.	Black Francolin	<i>Francolinus francolinus</i>	LC
4.	Red-vented Bulbul	<i>Pycnonotus cafer</i>	LC
5.	White-eared Bulbul	<i>Pycnonotus leucogenys</i>	LC
6.	Coppersmith Barbet	<i>Psilopogon haemacephalus</i>	LC
7.	Rufous-tailed Shrike	<i>Lanius isabellinus</i>	LC
8.	Bay-backed Shrike	<i>Lanius vittatus</i>	LC
9.	Long-tailed Shrike	<i>Lanius schach</i>	LC
10.	Southern Grey Shrike	<i>Lanius meridionalis</i>	LC
11.	Pied Cuckoo	<i>Clamator jacobinus</i>	LC
12.	Rufous Treepie	<i>Dendrocitta vagabunda</i>	LC
13.	House Crow	<i>Corvus splendens</i>	LC
14.	Common Raven	<i>Corvus corax</i>	LC

Sr. No.	Common Name	Scientific Name	IUCN Status
15.	Greater Coucal	<i>Centropus sinensis</i>	LC
16.	Common Hoopoe	<i>Upupa epops</i>	LC
17.	Indian Roller	<i>Coracias benghalensis</i>	LC
18.	European Roller	<i>Coracias garrulus</i>	LC
19.	Plain Martin	<i>Riparia paludicola</i>	LC
20.	Pale Martin	<i>Riparia diluta</i>	LC
21.	House Swift	<i>Apus nipalensis</i>	LC
22.	Blue-Cheeked Bee-Eater	<i>Merops persicus</i>	LC
23.	Green Bee-Eater	<i>Merops orientalis</i>	LC
24.	Alexandrine Parakeet	<i>Psittacula eupatria</i>	NT ²
25.	Rose-ringed Parakeet	<i>Psittacula krameri</i>	LC
26.	White-throated Kingfisher	<i>Halcyon smyrnensis</i>	LC
27.	Yellow-Crowned Woodpecker	<i>Leiopicus mahrattensis</i>	LC
28.	Sind Woodpecker	<i>Dendrocopos assimilis</i>	LC
29.	Black-Rumped Woodpecker	<i>Dinopium benghalense</i>	LC
30.	Macqueen's Bustard	<i>Chlamydotis macqueenii</i>	VU ³
31.	Indian Bustard	<i>Ardeotis nigriceps</i>	CE ⁴
32.	Pin-Tailed Sandgrouse	<i>Pterocles alchata</i>	LC
33.	Chestnut-Bellied Sandgrouse	<i>Pterocles exustus</i>	LC
34.	Spotted Sandgrouse	<i>Pterocles senegallus</i>	LC
35.	Black-Bellied Sandgrouse	<i>Pterocles orientalis</i>	LC
36.	Barn Swallow	<i>Hirundo rustica</i>	LC
37.	Collard Scops Owl	<i>Otus lettia</i>	LC
38.	Spotted Owlet	<i>Athena brama</i>	LC
39.	Eurasian Eagle Owl	<i>Bubo bubo</i>	LC
40.	Short-eared Owl	<i>Asio flammeus</i>	LC
41.	Eurasian Nightjar	<i>Caprimulgus europaeus</i>	LC
42.	Sykes's Nightjar	<i>Caprimulgus mahrattensis</i>	LC
43.	Rock Pigeon	<i>Columba livia</i>	LC

Sr. No.	Common Name	Scientific Name	IUCN Status
44.	Eurasian Collared Dove	<i>Streptopelia decaocto</i>	LC
45.	Laughing Dove	<i>Spilopelia senegalensis</i>	LC
46.	Red Collared Dove	<i>Streptopelia tranquebarica</i>	LC
47.	Indian Courser	<i>Cursorius coromandelicus</i>	LC
48.	Black-shouldered Kite	<i>Elanus axillaris</i>	LC
49.	Black Kite	<i>Milvus migrans</i>	LC
50.	Egyptian Vulture	<i>Neophron percnopterus</i>	EN ⁵
51.	Eurasian Griffon Vulture	<i>Gyps fulvus</i>	LC
52.	Cinereous Vulture	<i>Aegypius monachus</i>	NT
53.	Short-toed Snake Eagle	<i>Circaetus gallicus</i>	LC
54.	Eurasian Marsh Harrier	<i>Circus aeruginosus</i>	LC
55.	Pallied Harrier	<i>Circus macrourus</i>	NT
56.	Shikra	<i>Accipiter badius</i>	LC
57.	Eurasian Sparrowhawk	<i>Accipiter nisus</i>	LC
58.	Northern Goshawk	<i>Accipiter gentilis</i>	LC
59.	Oriental Honey Buzzard	<i>Pernis ptilorhynchus</i>	LC
60.	White-eyed Buzzard	<i>Butastur teesa</i>	LC
61.	Common Buzzard	<i>Buteo buteo</i>	LC
62.	Long-legged Buzzard	<i>Buteo rufinus</i>	LC
63.	Tawny Eagle	<i>Aquila rapax</i>	VU
64.	Greater Spotted Eagle	<i>Clanga clanga</i>	VU
65.	Steppe Eagle	<i>Aquila nipalensis</i>	EN
66.	Bonelli's Eagle	<i>Aquila fasciata</i>	LC
67.	Imperial Eagle	<i>Aquila heliaca</i>	VU
68.	Common Kestrel	<i>Falco tinnunculus</i>	LC
69.	Laggar Falcon	<i>Falco jugger</i>	NT
70.	Peregrine Falcon	<i>Falco peregrinus</i>	LC
71.	Golden Oriole	<i>Oriolus oriolus</i>	LC
72.	Black Drongo	<i>Dicrurus macrocercus</i>	LC

Sr. No.	Common Name	Scientific Name	IUCN Status
73.	Bluethroat	<i>Cyanecula svecica</i>	LC
74.	Indian Robin	<i>Saxicoloides fulicatus</i>	LC
75.	Common Stonechat	<i>Saxicola torquatus</i>	LC
76.	Pied Bushchat	<i>Saxicola caprata</i>	LC
77.	Red-Throated Flycatcher	<i>Ficedula albicilla</i>	LC
78.	Black Redstart	<i>Phoenicurus ochruros</i>	LC
79.	Variable Wheatear	<i>Oenanthe picata</i>	LC
80.	Desert Wheatear	<i>Oenanthe deserti</i>	LC
81.	Isabelline Wheatear	<i>Oenanthe isabellina</i>	LC
82.	Rufous-Tailed Wheatear	<i>Oenanthe xanthopyrna</i>	LC
83.	Rosy Starling	<i>Pastor roseus</i>	LC
84.	Common Myna	<i>Acridotheres tristis</i>	LC
85.	Bank Myna	<i>Acridotheres ginginianus</i>	LC
86.	Striated Prinia	<i>Prinia crinigera</i>	LC
87.	Rufous-fronted Prinia	<i>Prinia buchanani</i>	LC
88.	Ashy Prinia	<i>Prinia socialis</i>	LC
89.	Plain Prinia	<i>Prinia inornata</i>	LC
90.	Graceful Prinia	<i>Prinia gracilis</i>	LC
91.	Common Tailorbird	<i>Orthotomus sutorius</i>	LC
92.	Lesser Whitethroat	<i>Sylvia curruca</i>	LC
93.	Desert Warbler	<i>Sylvia nana</i>	LC
94.	Common Chiffchaff	<i>Phylloscopus collybita</i>	LC
95.	Common Babbler	<i>Argya caudata</i>	LC
96.	Jungle Babbler	<i>Turdoides striata</i>	LC
97.	Black-crowned Sparrow Lark	<i>Eremopterix nigriceps</i>	LC
98.	Ashy-crowned Sparrow Lark	<i>Eremopterix griseus</i>	LC
99.	Greater Hoopoe Lark	<i>Alaemon alaudipes</i>	LC
100.	Crested lark	<i>Galerida cristata</i>	LC
101.	Greater Short-toad lark	<i>Calandrella brachydactyla</i>	LC

Sr. No.	Common Name	Scientific Name	IUCN Status
102.	Oriental Skylark	<i>Alauda gulgula</i>	LC
103.	Purple Sunbird	<i>Cinnyris asiaticus</i>	LC
104.	House Sparrow	<i>Passer domesticus</i>	LC
105.	Spanish Sparrow	<i>Passer hispaniolensis</i>	LC
106.	Chestnut-Shouldered Petronia	<i>Gymnoris xanthocollis</i>	LC
107.	White Wagtail	<i>Motacilla alba</i>	LC
108.	Yellow Wagtail	<i>Motacilla tschutschensis</i>	LC
109.	Grey Wagtail	<i>Motacilla cinerea</i>	LC
110.	Paddyfield Pipit	<i>Anthus rufulus</i>	LC
111.	Tawny Pipit	<i>Anthus campestris</i>	LC
112.	Baya Weaver	<i>Ploceus philippinus</i>	LC
113.	Indian Silverbill	<i>Euodice malabarica</i>	LC
114.	Common Rosefinch	<i>Carpodacus erythrinus</i>	LC
115.	Rock Bunting	<i>Emberiza cia</i>	LC
116.	Red-Headed Bunting	<i>Emberiza bruniceps</i>	LC
117.	Common Shelduck	<i>Tadorna tadorna</i>	LC
118.	Ruddy Shelduck	<i>Tadorna ferruginea</i>	LC
119.	Gadwall	<i>Mareca strepera</i>	LC
120.	Eurasian Wigeon	<i>Mareca penelope</i>	LC
121.	Mallard	<i>Anas platyrhynchos</i>	LC
122.	Common Teal	<i>Anas crecca</i>	LC
123.	Garganey	<i>Spatula querquedula</i>	LC
124.	Northern Pintail	<i>Anas acuta</i>	LC
125.	Northern Shoveler	<i>Spatula clypeata</i>	LC
126.	Common Pochard	<i>Aythya ferina</i>	LC
127.	Little Grebe	<i>Tachybuptus ruficollis</i>	LC
128.	Great Cormorant	<i>Phalacrocorax carbo</i>	LC
129.	Little Egret	<i>Egretta garzetta</i>	LC
130.	Cattle Egret	<i>Bubulcus ibis</i>	LC

Sr. No.	Common Name	Scientific Name	IUCN Status
131.	Intermediate Egret	<i>Ardea intermedia</i>	LC
132.	Great Egret	<i>Ardea alba</i>	LC
133.	Grey Heron	<i>Ardea cinerea</i>	LC
134.	Purple Heron	<i>Ardea purpurea</i>	LC
135.	Indian Pond Heron	<i>Ardeola grayii</i>	LC
136.	Black-crowned Heron	<i>Nycticorax nycticorax</i>	LC
137.	Great Bittern	<i>Botaurus stellaris</i>	LC
138.	Cinnamon Bittern	<i>Ixobrychus cinnamomeus</i>	LC
139.	Demoiselle Crane	<i>Anthropoides virgo</i>	LC
140.	Purple Swampphen	<i>Porphyrio porphyrio</i>	LC
141.	Common Moorhen	<i>Gallinula chloropus</i>	LC
142.	Common coot	<i>Fulica atra</i>	LC
143.	Common Snipe	<i>Gallinago gallinago</i>	LC
144.	Jack Snipe	<i>Lymnocyptes minimus</i>	LC
145.	Common Greenshank	<i>Tringa nebularia</i>	LC
146.	Greater Painted Snipe	<i>Rostratula benghalensis</i>	LC
147.	Green Sandpiper	<i>Tringa ochropus</i>	LC
148.	Common Sandpiper	<i>Actitis hypoleucos</i>	LC
149.	Ruff	<i>Calidris pugnax</i>	LC
150.	Little Stint	<i>Calidris minuta</i>	LC
151.	Temminck's Stint	<i>Calidris temminckii</i>	LC
152.	Black-winged Stilt	<i>Himantopus himantopus</i>	LC
153.	Red-wattled Lapwing	<i>Vanellus indicus</i>	LC

1 Least Concern, 2 Near Threatened, 3 Vulnerable, 4 Critically Endangered, 5 Endangered

Annexure 1: Pictorial glimpse of field visit at Lal Sohanra National Park



Antelope cervicapra (Black Buck)



Canis aureus (Golden Jackal)



Gazella bennettii (Chinkara)



Felis silvestris (Indian Desert Cat) Picture Credit: Hobura Foundation



Felis chaus (Caracal Cat) Picture Credit: Hobura Foundation



Spatula querquedula (Garganey)



Coracias benghalensis (Indian Roller)



Buteo rufinus (Long-legged Buzzard)



Ceryle rudis (Pied Kingfisher)



Halcyon smyrnensis (White Throated Kingfisher)



Gallinula chloropus (Indian Moorhen)



Motacilla maderaspatensis (White Wagtail)



Dicrurus macrocercus (Black Drongo)



Chlamydotis macqueenii (Hobura Bustard)



Nilssonina gangetica (Indian Softshelled Turtle)



Pangshura smithii (Brown River Turtle)



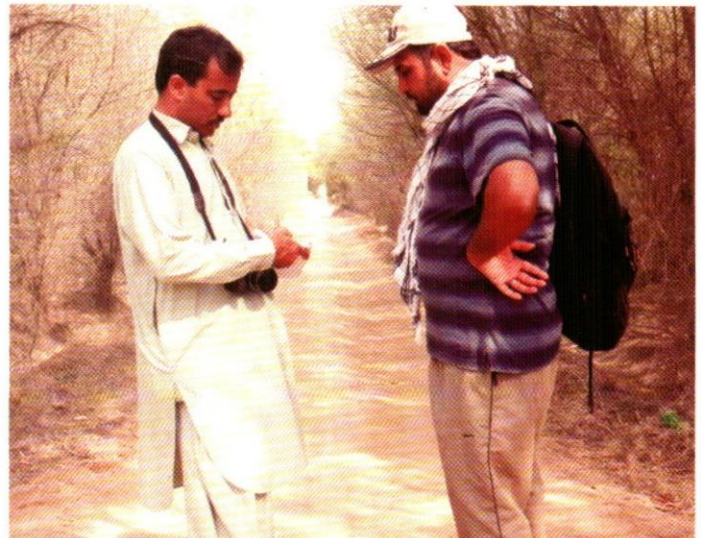
Geoclemys hamiltonii (Spotted Pond Turtle)



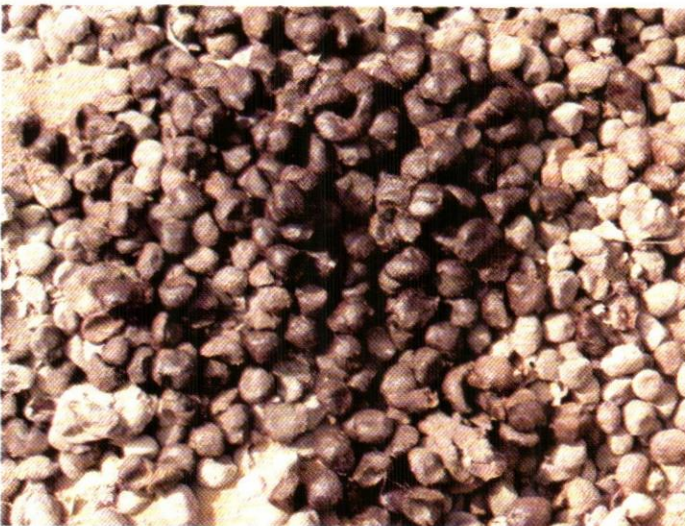
Calotes versicolor (Oriental Garden Lizard)



Varanus bengalensis (Monitor Lizard)



Field Data Collection



Scat sample of Nilgai



Foot prints of Indian desert Cat

Threats to Ecosystem and Fauna at LSNP:

LSNP is a case of serious concern. On one hand it is designated as National Parks which by definition prohibits any kind of anthropogenic activities but the things are contrary. National Park is under administrative control of Forest Department. Forest stands are planted and harvested for commercial timber while Wildlife Department is mostly concerned with animals in enclosures and fisheries department is concerned with Patisar Lake and Canals passing through LSNP. There is no synchronised conservation effort by these departments for protection of resources and biodiversity of LSNP. This has resulted in a variety of consequences for the ecosystem.

❖ There is no systematic census of fauna of the park and no authentic information is available on animal status and distribution which makes it really hard to formulate any management plan for the biodiversity conservation in LSNP.

- ❖ Area falls in Great Cholistan Desert with typical desert or semi desert ecosystem, but the habitat has been heavily modified by irrigated plantation. Desert has been turned into oasis. The thing which is of severe concern is the plantation of *Eucalyptus*. On one hand, there is acute water shortage in the area while on the other hand huge forest stands of *Eucalyptus* are maintained in LSNP by Forest Department and water is heavily exploited for irrigation of these stands.
- ❖ Patisar Lake is an important wetland in LSNP. It provided habitat to migrating waterfowl, freshwater turtles and fish stocks. Fishing contracts were provided earlier but now the lake is drying up resulting in decline of its productivity. Fish stocks have greatly reduced and fewer waterfowls are present in lake now. At certain points it is no more than a marsh now.

- ❖ LSNP is heavily exploited for grazing. None of the park area is free of livestock. It is resulting in severe disturbance of wilderness and retreating of wildlife from the park area.
- ❖ LSNP is also victim of extreme poaching. In some cases animals have been taken from enclosures. Moreover, waterfowl hunting is a common practice in the National Park.
- ❖ Local people heavily rely on Park resources for fuel wood. It is resulting in intensive logging practices which has severe consequences for flora and fauna of the National Park.
- ❖ In order to collect dry wood, forest stands are also set on fires intentionally by local communities residing along the protected area.
- ❖ All the areas in National Park are accessible as there is extensive unpaved motorcycle road network. It makes easier for people to poach and heavily exploit the resources and find a safe exit in case of legal action.
- ❖ Animals including the wolf and caracal cat have been prosecuted to extinction in the National Park in response to depredation on livestock foraging in the LSNP.
- ❖ A non-Muslim community, locally known as Bhgri, Gedhri or Boryia consume meat of the wild animals. There are four settlements (Chaks) of this community along the National Park with many temporary settlements. They utilize all the available animals and hunt exclusively in National Park. In an interview conducted, they revealed that they eat all kind of animals present in area. Wild cats, wild boar, jackal, porcupine, monitor lizards etc. are a part of their diet.

Recommendations for Management of LSNP

- Plantation of local flora and desert adapted species should be carried out instead of Eucalyptus. Shesham, keekar and Jhand are suitable trees for the region. It will minimize the irrigation water demand.
- Livestock needs to be relocated and proper zoning plan should be made. Grazing zones and core wildlife habitat zones should properly be declared and monitored. For this purpose, systemic faunal census should be carried out in LSNP.
- There should be provision of water supply to Patisar Lake so that its biodiversity could flourish again.

- There is dire need to check illegal logging activities in NP. Moreover, strict control on poaching is also need of hour. Alternate fuel resources needs to be supplied and biogas plants in this regard may be a suitable solution.
- Proper veterinary facility should also be a part of National Park to check on any disease in captive herds of Chinkara and Blackbucks.

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Population Dynamics of Migratory Ducks at the Wetlands of Salt Range, Punjab, Pakistan

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KEYWORDS

Migratory ducks,
Salt Range,
Lakes,
Anatidae,
Ramsar site.

ABSTRACT

Wetlands of Salt Range are important wintering sites for migratory waterfowl. Current study was a part of midwinter waterfowl census carried out in January each year from 2015 to 2019. During the study period, 14 species of migratory ducks belonging to family Anatidae were recorded. Climatic conditions, anthropogenic pressure, deteriorating and shrinking surface water supplies are possible factors resulting in degradation of waterfowl habitats. There is a dire need to address these issues to conserve the important wintering grounds of waterfowl in Salt Range.

Introduction

There are five wetlands in Salt Range. These are Uchhali, Jhalar, Khabikki (also known as Uchhali Wetland Complex due to ecological similarities), Kalar Kahar and Namal Lakes. Uchhali wetland complex is located in cup shaped Soan Valley while Namal and Kalar Kahar are located on the periphery of this Valley (PWP, 2002).

Uchhali Wetlands complex was designated Ramsar site in 1996. Surrounding hills of Salt Range act as watershed for this wetland complex. Another unique characteristic of this complex is its height from sea level i.e., approximately 800m. Lakes in Salt Range have brackish to saline water as salinity is highly dependent on rainfall and varies with rainfall patterns (300mm to 800mm average annual rainfall) and size of lakes also increase with high rainfall and vice versa. These wetlands are of utmost ecological importance as they host a significant number of migratory birds each year and are breeding grounds for some threatened and vulnerable waterfowl species, e.g., white-headed duck (Nawazish *et al.*, 2006), which breeds only in the Salt Range in Pakistan. As it provides habitat to rare species of duck Uchhali wetlands complex was given the status of wild life sanctuary. Uchhali Lake also owns the status of game reserve. This can be regarded as an effort for the conservation of ecologically important species in that area but still efforts are needed to conserve the habitat (Hameed *et al.*, 2008; Ashraf *et al.*, 2010).

Around 331 species of birds are reported from Salt range Wetland complex and its surroundings Roberts (1991, 1992). Grimmett *et al.*, (2001) also reported 346 species of birds from the area. The complex has emerged as an important wintering and staging ground for birds particularly for birds of family Anatidae and Shore birds. Over 20,000 water birds can be seen during mid-winter counts on every year (Ali *et al.*, 2011).

Pakistan is also signatory of Convention on the Conservation of Migratory Species (CMS), Asian Waterfowl Census (AWC) and is mandated to monitor waterfowl population yearly and revise the trends of their population at different wetlands in migratory season i.e. winter (non-breeding). The current data has been taken from annual mid-winter waterfowl census carried out to estimate the waterfowl population with special focus on migratory ducks species at wetlands of Salt Range Punjab.

Materials and Methods

1. Uchhali Lake

The Uchhali Lake (32° 33'N, 72° 01'E), located in Soon Valley is of global importance for supporting diversity of waterfowl and was designated as Ramsar site (under Ramsar Criterion 1b) in March 22, 1996 (Ali, 2005). It covers an area of 943 ha with depth ranging between 0.2 m and 6 m and altitude of 764 m above the sea level. It is a natural brackish to saline water body with pH > 8, mainly fed by rain and its runoff through natural hill torrents, while seepage and runoff from adjacent irrigated land and seasonal water springs around the lake also adds water in the lake. Climatically area falls under dry subtropics with hot summers and cool winters. Average annual rainfall varies from 300 mm to 800 mm and the relative humidity from 22% to 85%. Temperatures range from an average minimum of 0.5 °C in January to an average maximum of 36° C in June

Marsh vegetation is confined to a few small patches along the Lake banks, but there is a very rich growth of plankton in the Lake. The dominant aquatic plants are *Carex fedia*, *Hydrilla verticillata*, *Juncus sp*, *Phragmites karka*, *Potamogeton crispus*, *Saccharum spontaneum*, *Typha angustata*, *Vallisneria spiralis* and *Zannichellia palustris*. The natural vegetation of the region is a mixture of subtropical semi-evergreen forest and tropical thorn forest with species such as *Acacia modesta*, *Adhatoda vasica*, *Dodonea viscosa*, *Gymnosporia royleana*, *Olea ferruginea*, *Reptonia buxifolia*, *Tamarix aphylla*, *Withania coagulans* and *Zizyphus spp*. The natural vegetation around the Lake has been cleared for agricultural means.

2. Jhalar Lake

Jhalar Lake (32° 29'N 72° 07'E) is situated at approximately 10 km south east of Uchhali Lake and 10 km south west of Nowshehra, District Khushab. It has an area of 100 hectares. It is a small brackish Lake with little vegetation similar in general character to nearby Uchhali and Khabikki Lakes. The Lake is fed by seasonal streams from surrounding hills.

3. Khabikki Lake

Khabikki Lake (32° 37'N 72° 14'E) is situated at 10 km north of Nowshehra and 38 km north west of Khushab city. The Lake has an area of 283 hectares. Water level of the Lake increased excessively in the 1985-1987 but after wards it became completely dry in past few years and lost its aquatic vegetation. Since 2007, Lake has regained some water and now it is full of water. Natural vegetation in the surroundings is like that of Uchhali Lake.

4. Kalar Kahar Lake

The Lake (32° 46'N, 72° 42'E) is situated about 25 km southwest of District Chakwal at altitude of 554 meters above sea level. It is a game reserve and covers an area of 133.5 hectares. This small brackish Lake of salt range has dense marginal vegetation having *Typha angustifolia*, *Saccharum spp* and *phragmites karka*. The Lake has also light submerged vegetation and fruit orchards at southern banks of the Lake.

According to Ramsar Convention wetland types, Kalar kahar is an inland permanent saline/ brackish lake. It is fed by numerous minor and major three freshwater springs at the base of hills. Runoff from catchment area is also a source of water to the lake although spring water is fresh but salt is the bedrock of the lake turns it into moderate or brackish. Currently the sewage from the newly constructed hotels, restaurants and houses at the banks of the lake is discharged into the lake and that may deteriorate the fauna and flora of the lake.

5. Namal Lake

Namal Lake (32° 41'N, 71° 49'E) is situated 29 km Northeast of Mianwali, Punjab Province. The wetland was designated wildlife sanctuary with an area of 486 hectares in 1970 and has been re-notified many times. It is a shallow lake partly impounded by a dam at one corner and fed by a spring and several intermittent streams arising in the hills of salt range. Depth of the lake varies up to 6m with average of 4.6m. Water is slightly saline. The water level fluctuates widely and is particularly confronted by the removal of water for irrigation.

The aquatic vegetation consists of *Carex fedia*, *Hydrilla verticillata*, *Juncus spp*, *Phragmites karka*, *Potamogeton crispus*, *Saccharum spontaneum*, *Typha angustifolia* and *Zannichellia palustris*.

Methodology:

These wetlands were surveyed during the month of January each year from 2015 to 2019 for mid-winter waterfowl counts. Each wetland was visited at least three times during the survey period and counts were made at different points. Binoculars (Olympus 8-16 X 40, DPS I) and spotting scopes (Nikon w/ 15-45 X) were used for direct observation, identification and counting of birds. The coordinates of each wetland were recorded through GPS receiver (Magellan SporTrack). Field guide by Sonobe and Usui (1993) were referred for bird's identification. We paid great attention to the identification of each species of migratory waterfowl. Identifying as many species in each flock as possible, and then applying the observed ratios to unidentified members of the flocks to estimate total numbers of each species. The total number of the waterfowl species was determined by direct counts by selecting plots at each site of the wetlands and counting the number of species and birds in each plot and then multiplying each plot with total area of the wetland to determine the number of birds present at the total area of wetland. The data of the migratory ducks sorted out for each year is then computed to determine the population trend of each species of ducks on these wetlands.

Results and Discussion

Current study was the part of midwinter waterfowl census carried out in January every year. The data shown here is from

year 2015 to 2019. During the field surveys, 14 species of migratory ducks belonging to family Anatidae were recorded. These included *Tadorna ferruginea*, *Tadorna tadorna*, *Anas penelope*, *Anas streptera*, *Anas crecca*, *Anas querquedula*, *Anas platyrhynchos*, *Anas acuta*, *Anas clypeata*, *Netta rufina*, *Aythya ferina*, *Aythya nyroca*, *Aythya fuligula* and *Oxyurea leucocephala*. Site specific population abundance is given below;

Uchhali Lake: Highest abundance of migratory ducks at Uchhali Lake was recorded in 2017 (n=9,988) while lowest numbers were observed in 2015 (4,129 birds). 4,434 birds were recorded in 2016, 8,652 in 2018 and 6,157 in 2019 (Fig. 1).

Jhalar Lake: Maximum number of migratory ducks at Jhalar was observed in December 2015 (2105) while lowest number was recorded in 2019 (n=54). This difference in duck population is mainly due to habitat disturbance by overfishing and anthropogenic activities at the wetland. Similarly in other years, total number of Anatids in 2016 was 1763, 1983 in 2017 and 581 in 2018 (Fig. 2).

Khabikki Lake: Highest species abundance at Khabikki Lake was recorded in 2015 (n=1111) while minimum numbers were recorded in 2017 (n=59). Moreover, 450 ducks were recorded in 2016, 146 in 2018 and 184 in 2019 (Fig.3).

Kalar Kahar Lake: Kalar Kahar is an important wintering ground for thousands of migratory birds in Salt Range. During 2015, 1130 ducks belonging to 14 species visited the lake and it is the highest number recorded during the study period. Lower numbers were recorded in 2018 (276) while 716 ducks were recorded in 2016, 380 in 2017 and 633 year 2019 (fig.4).

Namal Lake: At Namal lake highest species abundance was recorded in the year 2015 i.e. 968 individuals, while lowest in 2017 (n= 226 birds). During 2016, 364 migratory ducks were recorded, 765 ducks in 2018 and 244 in 2019 (fig.5).

When we compare results of current study with previous census, a significant difference in species abundance is noticeable. Roberts (1991) reported 34 species from Order Anseriformes from Pakistan. Among these 17 species are winter visitors in Salt Range. Mirza (2007) reported 14 species of ducks from Salt Range and 32 species of Anseriforms throughout the wetlands of Punjab. Rais (in press) reported as many as 342 individuals of six species of ducks at Kalar Kahar Lake during 2008-2009.

Wetlands of Salt Range provide unique wintering habitat to migratory waterfowl. Their protection and conservation is important to sustain a healthy regulation of biodiversity. The socio-economic conditions in the Salt Range present a picture of excessive population pressure combined with intensive use of natural resources for livelihood. The use of the wetland vegetation affects the habitat hence destroying the wintering grounds of birds, hence lowering the bird diversity (Naugle *et al.*, 1999; Rittenhouse *et al.*, 2012). The results of present study reveal that migratory waterfowl diversity and abundance is declining with the passage of time in richness and abundance of ducks species at Salt range wetlands during five years (fig.6). This could be due to a number of ecological changes mainly induced by anthropogenic pressure, climatic condition, and shrinkage of surface area and deterioration of water quality in lakes.

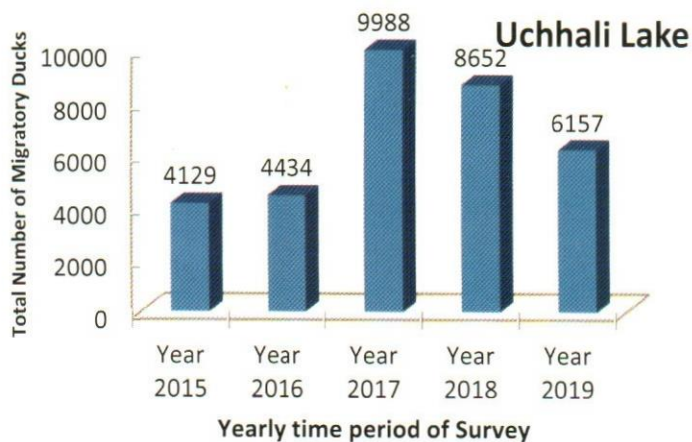


Fig: 1 Five years composition of Migratory Waterfowls at Uchhali Lake.

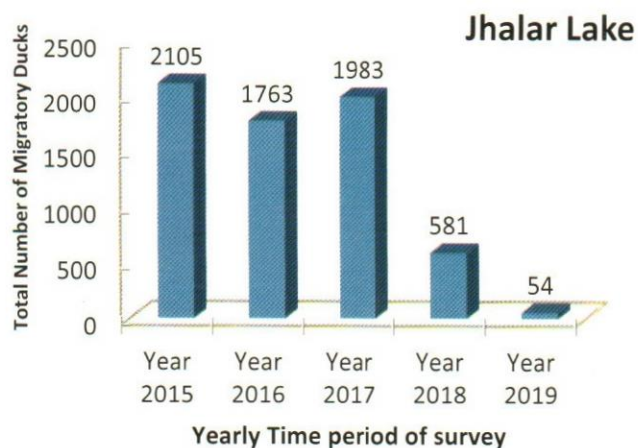


Fig: 2 Five years composition of Migratory Waterfowls at Jhalar Lake.

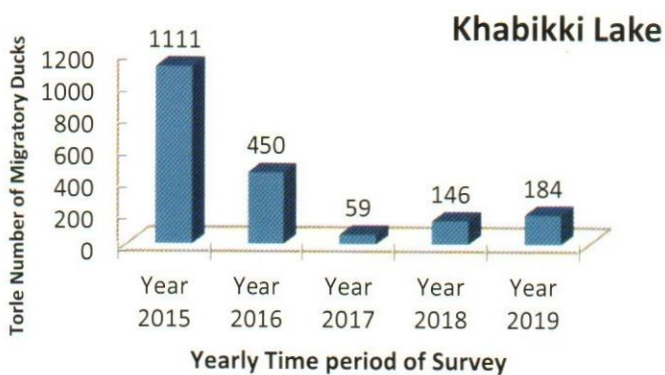


Fig: 3 Five years composition of Migratory Waterfowls at Khabikki Lake.

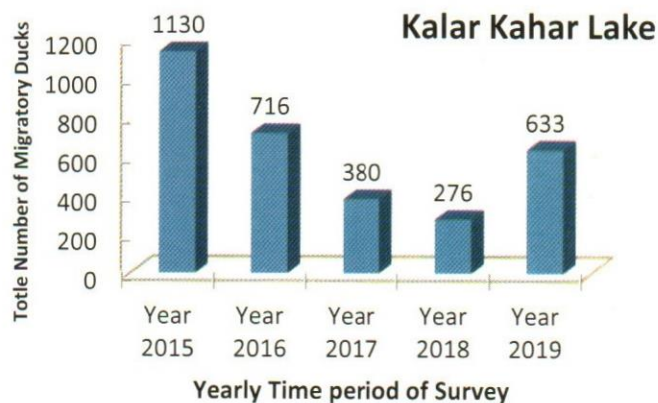


Fig: 4 Five years composition of Migratory Waterfowls at Kalar Kahar Lake.

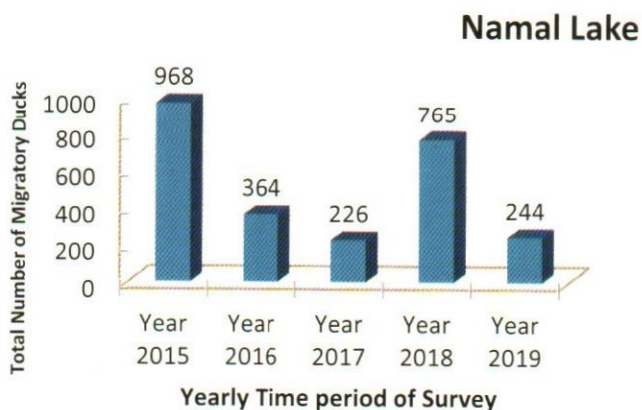


Fig: 5 Five years composition of Migratory Waterfowls at Namal Lake.

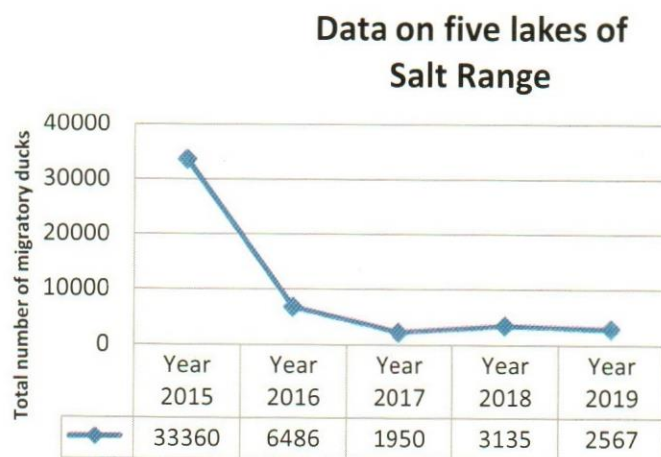


Fig 6: Population trends of fourteen species of migratory ducks through year 2015-2019 in five lakes of Salt range.

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Waterfowl Diversity at three important wetlands of Sindh i.e. Langh Lake, Drigh Lake and Hammal Lake

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KEYWORDS

Bird Diversity,
wetlands of Sindh,
Migratory birds,
population dynamics,
habitat

ABSTRACT

Pakistan attracts a large number of migratory birds across the globe. Nearly 70% of the migratory waterfowl that reaches Pakistan winters in Sindh alone. Sindh province has many important Ramsar Sites which provide a suitable habitat for resident and migratory water birds. The study was carried out at three important wetlands of Sindh i.e. Langh Lake, Drigh Lake and Hammal Lake. During the study period (2017-2019) total of 145619 birds belonging to 56 species were recorded. Common Teal (*Anas crecca*) was the most abundant species followed by Common Coot (*Fulica atra*) and Northern Shovler (*Anas clypeata*). During the study period large populations (88597) were observed at the Hammal Lake followed by Langh Lake (52999) and Drigh Lake (4023). Population shows decreasing trend at Hammal Lake and increasing trend at Langh Lake. Illegal land occupation, extensive fishing pressure, over grazing and diversion of water for irrigation purpose resulted in low water bird's diversity at Drigh Lake.

Introduction

Pakistan having primarily arid and semi-arid climatic conditions possesses a great variety of wetlands and these wetlands are attributable to the species diversity they support (PWP, 2002). Pakistan is blessed with more than 225 significant wetlands of diverse nature and environment; these wetlands are everlasting and seasonal, covering about 9.7% of land surface. Nineteen of these wetlands have been internationally recognized as Ramsar Sites (Baig *et al.*, 2017).

Total of 668 bird species belonging to 85 families with large number of winter visitors have been recorded within territorial limits of Pakistan (Roberts, 1991, 1992; Mirza and Wasiq, 2007). It has been reported that 85% of the migratory avian fauna of Pakistan consists of ducks and waders which is higher than resident and summer breeder population in Pakistan (Alfred *et al.*, 2001). Being occupying an ideal location between Asia's major Palearctic bird migration routes, Indus Flyway is one of the world's major migration routes, running from Siberia to various destinations in Pakistan over the Karakorum, Hindu Kush and Suleiman Mountain Ranges, along the Indus River and down to the delta. (Ali and Akhtar, 2006)

Sindh province has many important Ramsar Sites and is important wintering points along International migratory bird flyway Siberia -Kazakhstan- Indus migratory route. Nearly 70% of the migratory waterfowl that reaches Pakistan winters in Sindh alone. Wetlands of Sindh provide a suitable habitat for resident and migratory water birds. Moreover, percentage of other wintering water birds like herons, pelicans and waders was still higher in Sindh. About 365 bird species have been recorded from Sindh Province of Pakistan (Gabol *et al.*, 2005). Due to high significance of wetlands of Sindh, present study was carried out at Langh, Drigh and Hammal Lakes to determine the population status of migratory and resident birds at these sites.

Material and Methods

Study Sites:

1. **Langh Lake:** Langh Lake (68° 21' E, 27° 56' N) is a Ramsar Site located in district Larkana, Sindh. The lake was declared Wildlife Sanctuary in 1982. The lake spreads over an area of 3km². Continuous efforts by

Sindh Wildlife Department for habitat management and improvement have made the lake an ideal refuge for migratory waterfowl. Every year a large number of migratory waterfowl visits the lake. Habitat of the lake can be divided in three types; open water with *Typha* and *Juncus* on periphery, swampy area dominated by *Tamarix* and surrounding rice fields with predominant vegetation of *Juncus spp.*

2. **Drigh Lake:** Drigh Lake in District Qambar Shadadkot of Sindh Province is a small slightly brackish lake with extensive marshes. The sanctuary was listed wetland of international importance under the Ramsar Convention in 1976. The lake is fed by monsoon rains, several small streams entering along the western side and water from a small canal in the north. The size of the lake has decreased in recent years due to diversion of flood water for irrigation purposes and now completely overgrown with emergent vegetation, mainly *Tamarix* and *Typha*. The climate of the area is arid subtropical with an average annual rainfall of about 175 mm, mostly during summer monsoon. The summer are hot with maximum temperatures of 49 °C in the shade, the winters are cool with minimum temperature in January 1.7 °C.
3. **Hammal Lake:** Spread over an area of 50,000 hectares, the unprotected lake (27°26'54"N 67°39'10"E) is a complex of shallow freshwater lakes and marshes on the west bank of the Indus extending for almost 100 km from Kubo Said Khan to the region of Nasirabad Sindh. Aquatic vegetation of the wetland comprises of *Cyperus alternifolius*, *Hydrilla verticillata*, *Najas minor*, *Scripus littoralis*, *Impomoea aquatic*, *Juncus articulates*, *J. marilimus*, *Polamogelon peclinalus*, *Typha angusiata* and *Tamarix dioica*. Arid sub-tropical climate prevails with an average annual rainfall of about 150mm. The summers are hot, with maximum temperatures of 50°C. Winters are cool, with an average minimum temperature of 10°C. Irrigation, fishing and harvesting of weeds and bushes for local cottage industries, livestock grazing, forestry and agriculture in surrounding areas are major land use activities.

Methodology:

Field surveys for population dynamics of waterfowl on wetlands were conducted during winter season from 2017 to 2019. Direct count method was used and each wetland site was visited at least two times during the survey period. The birds were directly observed, identified and counted with the help of binoculars (Olympus 8-16 X 40, DPS I) and spotting scopes (Nikon w/ 15-45 X). The coordinates of each wetland were recorded through GPS receiver Magellan SporTrack. For the identification of water birds, Sonobe and Usui (1993) were referred. We paid great attention to species identification. Identifying as many species in each flock as possible, and then applying the observed ratios to unidentified members of the flocks to estimate total numbers of each species. The total number of the birds was determined by direct counts by selecting plots at each site of the wetlands and counting the number of species and birds in each plot and then multiplying each plot with total area of the wetland to determine the number of birds present at the total area of wetland. The data of three years were collected and then computed to find out the total estimated population of migratory water birds at each wetland.

Result and Discussion

Wetlands of Sindh attract a large number of migratory birds as compared to the other provinces due to habitat suitability. During

the study period (2017-2019), total of 145619 birds belonging to 56 species were recorded. Common Teal (*Anas crecca*) was the most abundant species followed by Common Coot (*Fulica atra*) and Northern Shovler (*Anas clypeata*) respectively. Tufted duck (*Aythya fuligula*) was recorded only ten in numbers.

During the study period large population (88597) were observed at the Hammal Lake followed by Langh Lake (52999) and Drigh Lake (4023).

Hammal Lake showed a decreasing population trend during the study period while Langh Lake had an increasing trend in population of migratory waterfowl. Hunting of migratory waterfowl at Hammal Lake is a major cause of population decline in aquatic avifauna. Langh Lake is well protected and provides a suitable habitat like the rice field on every sides of the lake provide feeding site resulting in increased visits of migratory birds.

Illegal land occupation, extensive fishing pressure, over grazing and diversion of water for irrigation purpose the number of birds counts at Drigh Lake were very low. Change in Drigh Lake, only two species of ducks i.e. common teal and common pochard were recorded in very few numbers. Marbled Teal and Common Pochard are vulnerable species (according to IUCN red list) recorded 273 and 771 in number respectively. Similarly white eyed pochard is near threatened.

Table# 1: Number of water birds at the three important wetlands of Sindh.

Scientific Name	Common Name	Langh lake			Drigh lake			Hammal lake		
		Jan 2017	Jan 2018	Jan 2019	Jan 2017	Jan 2018	Jan 2019	Jan 2017	Jan 2018	Jan 2019
<i>Podiceps nigricollis</i>	Black necked Grebe	0	0	0	0	0	10	0	0	4
<i>Tachybaptus ruficollis</i>	Little Grebe	36	12	59	17	29	21	138	112	92
<i>phalacrocorax fuscicollis</i>	Indian Shag	0	92	143	0	0	12	57	0	64
<i>Phalacrocorax carbo</i>	Large Cormorant	82	124	172	36	18	150	617	216	239
<i>Phalacrocorax niger</i>	Little Cormorant	215	96	69	230	32	227	939	824	612
<i>Nycticorax nycticorax</i>	Black crowned Night Heron	0	0	0	78	0	236	0	0	0
<i>Plegadis falcinellus</i>	Glossy ibis	0	0	6	7	0	0	0	0	22
<i>Ardeola grayii</i>	Indian Pond Heron	18	64	12	46	62	36	370	196	122
<i>Ixobrychus flarivollis</i>	Black Bittern	0	0	3	0	0	0	2	0	7
<i>Bubulcus ibis</i>	Cattle Egret	29	26	36	12	10	77	52	112	527
<i>Ciconia nigra</i>	Black Stork	0	0	17	0	0	0	0	0	0
<i>Egretta garzetta</i>	Little Egret	93	242	318	142	56	182	368	436	270
<i>Egretta intermedia</i>	Intermediate Egret	36	96	219	89	16	39	72	0	89
<i>Egretta alba</i>	Large Egret	32	124	87	13	0	12	26	72	182
<i>Ardea purperia</i>	Purple Heron	9	2	92	0	0	6	72	6	73
<i>Ardea cineria</i>	Grey Heron	36	0	154	5	2	2	280	110	147
<i>Platalea leucorodia</i>	White Spoon bill	0	0	0	0	0	0	8	0	69
<i>Anser anser</i>	Grey leg Goose	0		12	0	0	0	247	354	214
<i>Anas penelope</i>	Eurasian Wigeon	2	54	5	0	0	0	4610	216	176
<i>Anas streptera</i>	Gadwall	174	426	396	0	0	0	313	124	128

Scientific Name	Common Name	Langh lake			Drigh lake			Hammal lake		
		Jan 2017	Jan 2018	Jan 2019	Jan 2017	Jan 2018	Jan 2019	Jan 2017	Jan 2018	Jan 2019
<i>Anas crecca</i>	Common Teal	4739	12524	11967	0	2	12	9430	3423	2712
<i>Anas platyrhynchos</i>	Mallard	254	242	187	0	0	0	362	236	149
<i>Anas acuta</i>	Northern Pintail	425	365		0	0	0	864	52	0
<i>Anas clypeata</i>	Shovier	413	7460	5689	0	0	0	1410	0	315
<i>Aythya ferina</i>	Common Pochard	12	262	37	0	0	7	290	114	49
<i>Netta rufina</i>	Red-crested Pochard	0	0	2881	0	0	0	6	0	49
<i>Marmaronetta angustirostris</i>	Marbled Teal	0	126		0	0	0	112	0	35
<i>Aythya nyroca</i>	White-eyed Pochard	5	0	12	0	0	0	165	12	25
<i>Aythya fuligula</i>	Tufted Duck	0	0	6	0	0	0	0	0	4
<i>Amaurornis phoenicurus</i>	White-Breasted Water Hen	0	8	3	0	0	4	42	3	12
<i>Galinula chloropus</i>	Indian Moorhen	39	22	38	24	86	47	224	137	89
<i>Porphyrio porphyrio</i>	Purple Moorhen	0	0	28	0	0	4	12		17
<i>Fulica atra</i>	Common Coot	79	254	216	0	0	326	14712	18650	4312
<i>Hydrophasianus chirurgus</i>	Pheasant-Tailed Jacana	0	0		12	52	5	0	0	36
<i>Himantopus himantopus</i>	Black-winged Stilt	46	82	25	39	76	12	329	326	219
<i>Recurvirostra avosetta</i>	Pied Avocet	0	0	0	0	0	0	134	216	15
<i>Charadrius alexandrinus</i>	Kentish Plover	0	0	0	0	0	0	16	0	274
<i>Vanellus leucurus</i>	White-Tailed Plover	0	0	0	9	22	0	62	79	0
<i>Charadrius hiaticula</i>	Ringed Plover	0	0	0	0	0	25	0	0	72
<i>Holopterus indicus</i>	Red-wattled Lapwing	23	20	4	0	11	2	24	18	13
<i>Calidris minuta</i>	Little Stint	230	0	78	0	0	24	186	426	693
<i>Philomachus pugnax</i>	Ruff	0	0	0	0	0	0	417	5628	0
<i>Calidris temminckii</i>	Temminck's Stint	0	5	2	0	9	0	7	15	7
<i>Gallinago gallinago</i>	Common Snipe	0	12	0	4	7	0	12	51	0
<i>Tringa erythropus</i>	Spotted Redshank	0	0	0	0	29	0	0	12	0
<i>Tringa totanus</i>	Redshank	12	6	0	0	27	0	39	43	3742
<i>Tringa nebularia</i>	Common Greenshank	0	4	32	0	0	2	12	2	216
<i>Tringa ochronus</i>	Green Sandpiper	5	7	0	5	12	0	23	27	0
<i>Actitis hypoleucos</i>	Common Sandpiper	6	5	0	0	0	0	430	73	0
<i>Tringa glareola</i>	Wood Sandpiper	0	4	0	0	7	0	3	15	0
<i>Larus argentatus</i>	Herring Gull	0	0	12	0	5	0	29	42	68
<i>Larus ichthyaetus</i>	Great Black-Headed Gull	0	2	4	0	3	2	12	5	67
<i>Larus ridibundus</i>	Common Black-headed Gull	0	24	0	235	169	0	732	462	0
<i>Sterna aurantia</i>	Indian River Tern	48	28	6	137	113	23	190	233	68
<i>Sterna hirundo</i>	Common Tern	29	0	7	370	26	26	457	0	117
<i>Sterna albifrons</i>	Little Tern	0	16	2	89	12	0	68	120	5
Total no of birds		7127	22836	23036	1599	893	1531	38982	33198	16417
Total no of species		28	34	38	21	26	28	48	39	45

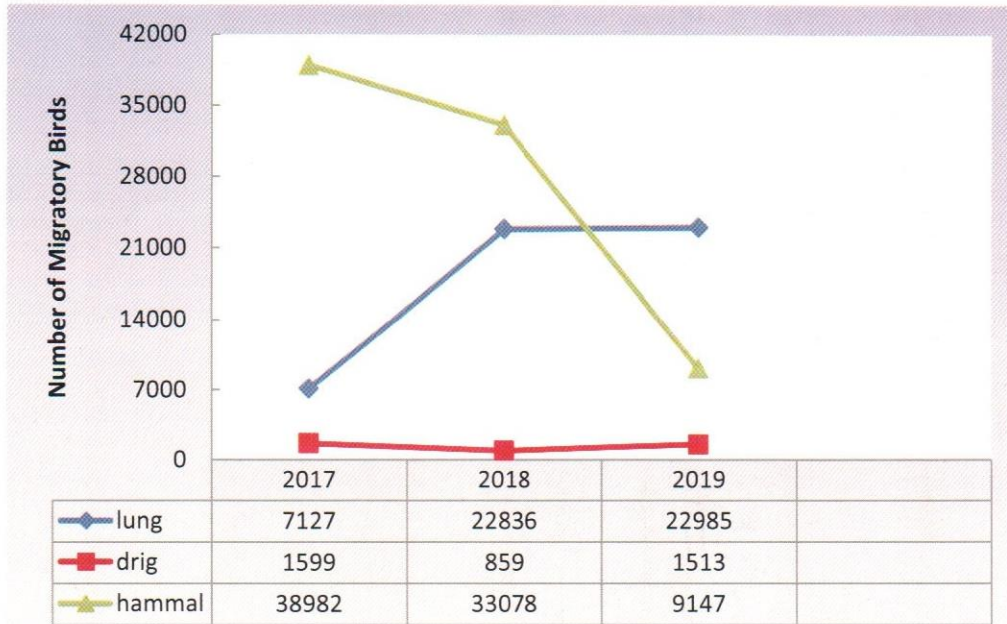


Fig. 1: Population trends of migratory birds at study sites during 2017-2019



Fig. 2: Greyleg Goose and Northern shoveler at Langh Lake



Fig. 3: Northern Pintail at Langh lake



Fig. 4: Common Teal at Langh Lake



Fig. 5: Pheasant tailed Jacana at Hammal Lake



Fig. 6: Common Teal and N.Shovler at Langh Lake

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Himalayan Brown Bear (*Arsus arctos*) in Deosai National Park, Gilgit Baltistan, Pakistan

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KEYWORDS

Brown Bear,
Deosai National Park,
Bara Pani,
Endangered Fauna,
Biodiversity

ABSTRACT

Deosai plateau represents the important alpine ecosystem in Pakistan. To protect the unique ecology of this ecosystem, Deosai National Park (DNP) was established in 1993 to conserve the Himalayan Brown Bear. Brown Bear population in DNP is highest in Asia. According to Gilgit Baltistan (GB) Wildlife Department, 70 to 75 bears are reported from the park. Population density tends to be 1 bear in every 35Km² of DNP. Survey team observed 4 brown bears at Bara Pani which is considered as the core bear habitat in DNP. There were also records of bear visit at tourist camp sites in search of food. Brown bear population in Pakistan and throughout its entire range has declined dramatically except Deosai National Park. Concrete conservation efforts are requisite to guarantee the enduring survival of Brown Bears by the state departments, non-governmental organizations (NGOs), research institutes, and local communities.

Introduction

Alpine pastures occur in higher regions of Gilgit, Baltistan, Ghizer, Diamer and Astore in Northern Areas of Pakistan. Much of the landscape in these areas is rock and ice with mountains extending above the tree line (Ehlers and Kreutzmann, 2000). Deosai plateau characterized by unpredictable and highly seasonal conditions is an important highlands alpine ecosystem in Pakistan (>3000m), (Mani and Giddings, 1980). With mean daily temperatures of -20°C to 12°C, annual precipitation of 510–750mm (mostly as snow), low atmospheric pressure (low oxygen and carbon dioxide levels), aridity rapid and high ultraviolet radiation, Deosai has harsh environmental conditions (HWF, 1999; Mani, 1990; Mani and Giddings, 1980).

To protect the unique ecology of the region and conserve the Brown Bears, Deosai was designated as National Park in 1993. The vast grazing alpine pastures of DNP are a vital resource for wildlife, specially the brown bears (Nawaz, 2007). The main objective of Deosai NP was to protect a highly threatened and dwindling population of Himalayan brown bear so the population size of the species was set as indicator of the park's success (HWF, 1999).

As the Wildlife Preservation Act (1975) of Gilgit Baltistan doesn't permit resource exploitation/extraction from protected areas, concerned communities didn't accept the new legal status of the area. Himalayan Wildlife Foundation (HWF) was contributory in designating the Deosai as National Park and they took the case of DNP as opportunity to test the emerging approach of ecological sustainable rural development in line with the conservation of biological diversity (Mishra *et al.*, 1989). Conservation plan of DNP was built on three main rules; (i) community rights recognition and zoning of NP, (ii) biodiversity protection via strong law enforcement and community involvement in biodiversity conservation, (iii) employment of community staff for conservation as alternate livelihood option, ecotourism development and revenue sharing with communities (HWF, 1999).

Zoning plan became instrumental to allow grazing rights in DNP but not in the core bear habitats. It resulted in reduced pressure on bear habitat and human/livestock-wildlife encounters and

conflicts. As per census in 2004, about 9000 livestock especially goats and sheep, grazed within the National Park. Zoning plan allowed the *Bakarwals/Gujjars* to utilize the alpine grasslands in park except south eastern half which was designated as the core habitat area for brown bears (HWF, 1999).

Deosai Plateau lies between two world's major highlands, the Karakoram and Himalayas and biota are representative of Karakoram, Himalaya and Indus Valley origin. The Deosai Plains are also home to snow leopard (*Panthera uncia*), Tibetan wolf (*Canis lupus chanco*), Himalayan ibex (*Capra ibex sibirica*), Tibetan red fox (*Vulpus vulpus montana*), golden marmot (*Marmota caudata*) and 17 other small mammal species (Nawaz *et al.*, 2006). Alpine meadows of DNP are also important habitat for over 124 resident and migratory birds. Birds in the park include the golden eagle, lammergeyer, griffon vulture, laggar falcon, peregrine falcon, Eurasian kestrel, Eurasian sparrow hawk, Himalayan snow cock, snow pigeon and many other Passeriformes (Virk *et al.*, 2003).

Keeping in view the importance of this ecosystem and flagship species; the Himalayan brown bear, current survey was carried out to gather information regarding the population status of Himalayan brown bear and assess threats to the ecosystem.

Materials and Methods

Study Area: Located in alpine ecological zone, Deosai plateau encompasses an area about 20,000 km². The plateau is situated about 30km south of Skardu with an elevation range from 3500-5200m. About 60% area of DNP lies among 4000 - 4500m. During winter (November to May), Deosai is covered by snow, and life window is confined to five months. Deosai National Park has an area of 3000 km² of the alpine plateau in Western Himalayas and administratively area lies under the jurisdictions of Gilgit-Baltistan Forest and Wildlife Department.

Field Survey Methods: Information was collected through galloping survey technique. Field observations were made at Sheosar Lake, Kala Pani and Bara Pani Areas aided by Nikon (10x 42) binocular. Unstructured interviews were conducted from locals and *bakarwals* for the population status of brown bears and other fauna in the area. Indirect evidences i.e. fecal

samples; foot prints etc. were also recorded. Field staff of GB wildlife and forest departments were consulted during the field and comprehensively interviewed regarding wildlife of DNP and conservation efforts.

Results and Discussion

Biological diversity is under threat worldwide due to ever growing population, its dependence on natural capital and over exploitation of natural resources (Lewton and May 1995; Whittaker *et al.*, 2005). The rate of species extinction has greatly increased in current times, and the mammals are most vulnerable group (Primack, 2002). As per by the Convention on Biological Diversity, nations agree that the conservation of biodiversity is a global concern and a fundamental portion of the developmental processes. However, achieving these goals in developed countries, particularly the South Asian nations is mostly challenging due to high population growth and their dependence on natural resources. In Himalayas of South Asia, rangelands and livestock are major sources of sustenance and also the major cause of resource rights conflicts (Mishra, 2001).

The DNP, a part of Conservation International Himalayan Biodiversity Hotspot contains a variety of species. The main water channels of DNP are home to the local snow trout. DNP also lies within the Bird Life International's Western Himalaya Endemic Bird Area and is important as a resting place and breeding ground of residential and migratory birds. Current results on population status of Himalayan brown bear (*Ursus arctos*) are given under.

Himalayan Brown Bear (*Arsus arctos*): Himalayan brown bear is critically endangered and the flagship species of Deosai National Park. Brown bear population is fragmented and smaller in Pakistan and they are typically slow reproducing. Habitat degradation, fragmentation and loss, bear baiting and poaching are already playing havoc to their dwindling population. Though legally protected in Pakistan, they are recently included in critically endangered (CE) group of animals on IUCN's Red data List of Mammals. There are seven brown bear populations in

Himalaya, Karakoram, and Hindu Kush and the only meta-population at Deosai Plateau is stable.

Due to severely fragmented habitats and anthropogenic pressure, population size in these ranges is not exceeding more than 20 individuals. Deosai is an exception, where with concrete conservation measures, population is stable and on increasing trends. Currently 70 to 75 brown bears are reported in DNP (Personal Communication). Distribution range of brown bear in Pakistan falls under three jurisdictions including Gilgit Baltistan, Azad Jammu and Kashmir and Khyber Pakhtunkhwa and according to Provincial Wildlife Acts of these administrative units, brown bears are protected animals.

During current field visit to DNP, 5 days were spent in field trekking for brown bear. Brown bear visit was recorded at Sheosar Lake for two consecutive nights. Bear visit from Kala Pani and Bara Pani were also recorded. Brown bear are feeding on grasses in the area with occasional catch of other animals. As current year is dry in the area due to low rainfall, food resources are scarce and bears are forced to visit camp sites in DNP in search of food. The situation is alarming and also depicts the vulnerability of this eco-region to global climate change.

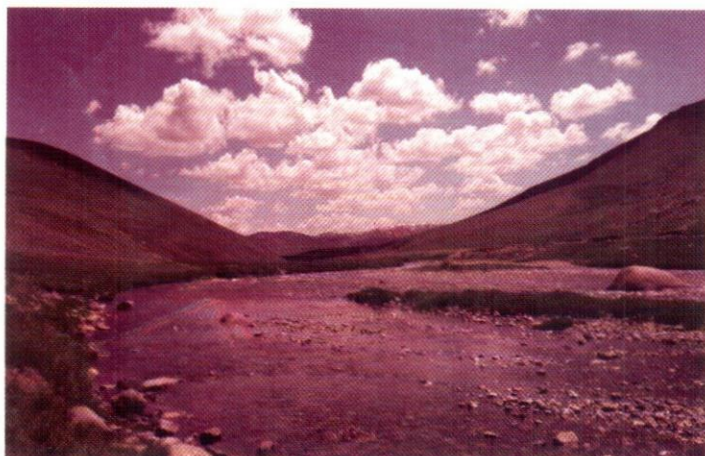
According to officials of GB Wildlife Department, there are 70 to 75 Brown Bears in the DNP. The number indicates a steady population increase as a result of good management practices. Data reveals a population density of 1 bear in every 35km² of the DNP. Previously, data record shows 43 bears in 2007 (Nawaz *et al.*, 2007) and a population of 52 in 2013 (Hameed *et al.*, 2013). During field efforts, 4 bears were directly sighted by the survey team in the vicinity of Bara Pani. The area is regarded as the core bear habitat in DNP. 2 females with cubs were observed at two different points in DNP. Moreover, fecal samples of brown bear were also observed from various locations in Bara Pani. Interviews revealed that brown bear population in DNP is higher as compared to other fauna as bear encounter rates by *bakarwals* and other respondents were higher.



(a) Brown Bear at DNP



(b) Brown Bear at DNP



(c) Kala Pani River at DNP



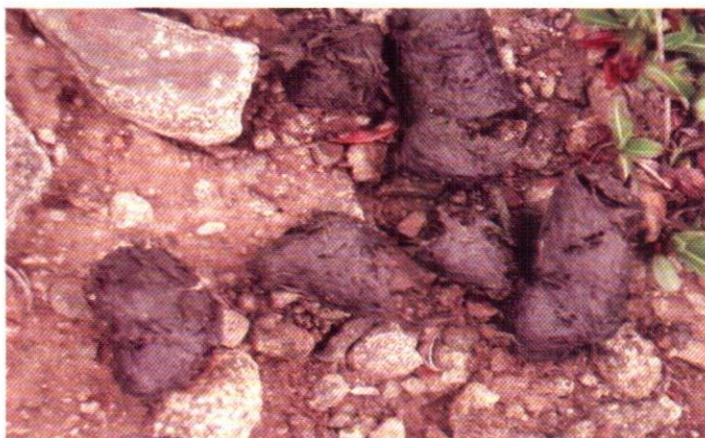
(d) Camp site at Kala Pani



(e) Brown Bear and Cub at Bara Pani



(f) Brown Bear at DNP



(g) Scat sample of Brown Bear



(h) Scat sample of Brown Bear

Management of DNP: In spite of conservation efforts by GB Wildlife Department, anthropogenic pressure in core bear habitat in DNP is a realistic thing as livelihood of local nomads and peripheral communities is linked with Deosai. However, zoning plan is working favorably in conservation of brown bears and population growth indicates the success of this protected area.

The key factors behind the success of the park are control on human-caused wildlife mortalities and community participation. A vigilant monitoring system is established with the support of local communities and cooperation between military, police and forest departments. The main entry points of the park are guarded by the staff of the police and the forest department, and all people entering or leaving the park are checked carefully. It evades any kind of risk to the Wildlife of the NP. Eco-tourism in the NP helped providing alternate livelihood to the locals and reduced dependence of communities on natural resources of the Park. Frequent patrolling throughout the park helped identify any illegal human presence within the park and surrounding valleys.

Recommendations: Since the Deosai is hosting the highest population of brown bears in Asia, as proposed by Nawaz *et al.*, (2006), the area should remain the conservation focus as the future of the species will depend on the stability of the eco-region. Population monitoring needs to be carried out and maintained, use of radio collars for bear trekking should also be introduced. Moreover, capacity building of wildlife staff in DNP should also be carried out to conduct surveys for other fauna in the area. More technological sound instruments and proper living space for wildlife personals is also required in DNP to overcome the harsh environment of the region.

Brown bear populations are fragmented and habitats are degrading, regional connectivity should be in focus in order to maintain gene flow and avoid any meta-populations. Moreover, level of protection should be extended to adjoining areas and forested lands in Deosai. Regional connectivity and corridors will also help the movement of other important wildlife species in the area including the snow leopard (*Panthera uncia*), Asiatic black bear (*Ursus thibetanus*), Himalayan ibex (*Capra ibex*), common leopard (*Panthera pardus*) and Marco Polo sheep (*Ovis ammon polii*).

Since the local communities claim their grazing rights in DNP, zoning plan should effectively managed as the number of livestock herds is increasing in DNP and is also observed in the core bear habitats. Eco-tourism in DNP needs more managerial efforts. Development of resorts at entrance points of Deosai may also boost the tourism in the area. Awareness on the part of public is required as visitors throw garbage in the DNP Proper awareness campaigns should be started to raise awareness among public regarding the ethics while visiting the protected areas.

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Population status of Punjab Urial (*Ovis vignei punjabiensis*) at Lehri Nature Reserve, Chumbi Surla and Jalalpur Wildlife Sanctuaries, Punjab, Pakistan

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KEYWORDS

Punjab Urial,
Population density,
Threats,
Endemic,
Wildlife sanctuary

ABSTRACT

The Punjab urial (*Ovis vignei punjabiensis*) is endemic to northern Punjab, Pakistan and is declared endangered due to magnitude of threats faced by the species. Current study was conducted at Lehri Nature Reserve, Chumbi Surla and Jalalpur Sharif Wildlife Sanctuaries to estimate the population trends of Punjab urial and document the threats to the species and its habitat using the standard ecological methods. At Lehri Nature Reserve, 69 animals (39 female, 24 fawns and 6 males) were recorded. Estimated population at Lehri Nature Reserve tends to be 147 head with population density (animals/km²) 2.12. At Chumbi Surla Wildlife Sanctuary, total of 27 urial were recorded. These included 17 females, 9 adult males and 1 fawn. Population estimates of Punjab urial at Chumbi Surla Wildlife Sanctuary are 175 heads with population density 1.40. In Jalalpur Wildlife Sanctuary, 97 animals (47 female, 31 fawns and 19 males) were recorded; population estimates tend to be 113 head with population density of 5.10. Urial habitat is critically threatened by anthropogenic pressure. Developments in natural habitats, deforestation, and ever increasing need for fuel-wood is forcing people to collect resource from protected areas; competition with livestock for food is having worst impacts on Punjab urial population. Illegal hunting for meat, trophies and poaching of lambs for keeping as pet is also threatening the species survival. There is need for strict law enforcement to protect these populations. Capacity building and training of field staff is also needed to ensure maximum protection. Community involvement and education regarding biodiversity conservation will be effective tool to protect the natural capital.

Introduction

In Pakistan, there are three sub-species of urial (*Ovis vignei*). i.e. Baluchistan urial (*Ovis vignei blanfordi*) found in Balochistan and Sindh, Ladakh urial (*Ovis vignei vignei*) found in Gilgit-Baltistan and Chitral and Punjab urial (*Ovis vignei punjabiensis*) found in Salt and Kala Chitta Ranges in the Punjab Province (Aleem, 1977; Roberts, 1997).

Punjab urial is endemic species to Northern Punjab, Pakistan and principal mammalian game species of the scrub forest in Salt Range and Kala Chitta Range of the Punjab Province (Chaudhry *et al.*, 1991). It is listed as Endangered by Red List of Mammals of Pakistan (Sheikh and Molur, 2005), and Vulnerable by IUCN Red List of Threatened Species (IUCN, 2013). The species is protected under the Punjab Wildlife (Protection, Preservation, Conservation and Management) Act, 1974 (Punjab Wildlife & Parks Department, 2010).

Punjab urial is actually dispersed between the Indus and Jhelum Rivers from an altitude of 250 to 1500m primarily in the Kala Chitta and Salt Ranges (Schaller and Mirza, 1974). Habitat in such areas is dry sub-tropical semi-evergreen scrub forest (Roberts, 1997). Schaller (1977) suggested that the animal must have immigrated from the west, a herd perhaps crossing the Indus at a time when landslides temporarily dammed the river in the mountains. It formerly was distributed throughout these mountains, but it underwent a substantial decline in the twentieth century. By the early 2000's, the greatest concentration occurred within the Salt Range, mainly at Kalabagh in the western extremity near the River Indus.

There is no way to know precisely the historic population size. Reports from expeditions, naturalists, and hunters to the region in the early 1900's (Lydekker, 1913; Burton 1920; Stockley, 1922; Mounfort, 1969) suggest that urials were once plentiful in

the mountains of Northern Punjab, but no figure has ever been given. Punjab urial prefers to form outsized crowds in winter than in other seasons and favors more open habitats and forms cohesive groups that certify equal safety to all (Hoover and Bailey, 1985; Chundawat and Qureshi, 1999).

To determine the status of Punjab urial, Mirza *et al.*, (1980) surveyed the Kalabagh 'Game Reserve' in April 1976, Jhelum District in March, May & June 1976 and Kala Chitta Range in November & December 1976 and estimated result was a population comprising about 2157 individuals. In another report, it is stated that 47 animals were estimated in Chak Jabbi in 1977 which is a small part of the Kala Chitta Range (Aleem, 1977). Chaudhry (1992) estimated a minimum total population of 1,550 throughout its whole range and then Chaudhry *et al.*, (1988) reported a momentous decline in urial numbers in Punjab in only one year; from a great figure of 733 in 1986 to a remarkable decline of 528 in 1987. In the Chumbi Surla Wildlife Sanctuary, the estimated population of urial was only 60 head (IUCN, 1997). Aleem (1977) and Mirza *et al.*, (1980) reported that in Salt and Kala Chitta Ranges, there are high poaching rates for urial. Aleem (1977) has reported that poaching of young ones for keeping urial as pets is also observed. Wolves, leopards and caracal cats have been found preying on urial (Stockley, 1936; cf. Roberts, 1977).

Major threats to Punjab urial is severe hunting and poaching pressure and hence striving for its survival (Awan *et al.*, 2006). Animal collectors traditionally prize it as a pet, apart from its trophy value in sport hunting. Some communities in Pakistan consider the ownership of this pet (urial) as status symbol (Awan, 2001). Some other major threats to this species include habitat degradation due to construction of roads, dams, towns, cutting of trees for fuel wood and conversion of range lands into agricultural lands. Access of poachers to the habitat of urial becomes easy by such supportive activities (Awan *et al.*, 2006).

The recent study has estimated the distribution and population status of Punjab urial and potential threats to the species in Chumbi Surla Wildlife Sanctuary (District Chakwal), Jalalpur Sharif Wildlife Sanctuary (District Jhelum) and Lehri Nature Reserve, an extension of Salt Range, barriered by G.T. Road and about 10km from Dina.

Material and Methods

Study Area

Chumbi Surla Wildlife Sanctuary: Chumbi Surla Wildlife sanctuary (32.50°N, 72.46°E) was notified as sanctuary in 1978 for the protection of Punjab urial. It is named after village Chumbi and Surla Reserved Forests forming main bulk of the sanctuary. It comprises of an area of 55,943 hectares and located in Chakwal District of Punjab. It has Karst topography and is mainly underlain by dolomite. The core area mainly consists of hill slopes ranging in elevation from 460 m to 1050 m above sea level.

The area around the core zone mainly constitutes of agricultural, grazing land and community forest. Core area provides shelter for urial and many other vertebrate species as there is good vegetation cover with open canopy. However, the community forests are being cleared for agriculture, brushwood cutting and livestock grazing. The main vegetation of area consists of phulai (*Acacia modesta*) but on higher altitudes wild olive (*Olea ferruginea*) and sanatha (*Daytona viscosa*) also exist. Other important shrub species are bhekar (*Justiciar adhatoda*) pataki (*Maytenus rawlins*) and malla (*Zizyphus nummularia*). Important grass species include *Chrysopogon serrulatus*, *Hetropogon contortus*, *Digitaria sanguinalis*, *Dichanthium foveolatum* and *Dactyloctenium scindicum*.

The local community consists of 25 villages, either located on the periphery or within the area. Local communities are dependent on the sanctuary forest for firewood and livestock grazing. On south-eastern side of the sanctuary, there are scattered small coals mining operations.

Jalalpur Wildlife Sanctuary: Rakh Jalalpur (32.41°N, 72.32°E) wildlife sanctuary was notified in 1991. It covers an estimated area of 2263 hectares. It is located in the Jhelum District and has almost similar vegetation and range conditions as prevailing in Chumbi Surla. However in this sanctuary *Acacia modesta* often in association with *Salvadora oleioides* is speckled in patches along streambeds and on slope.

Lehri Nature Reserve: It comprises an area of about 17000 acres (69 km²) of a bit steep and rugged mountains ranging from 250 to 1025 m in altitude above mean sea level and forms the most eastern extension of the Salt Range. The reserve is centered on 33° 09 .012 N and 73° 35. 931 E. about 10 Km from Dina town, in the Jhelum District of Punjab. Grand Trunk (GT)

Road from Lahore to Islamabad serves as a boundary of the reserve in the south. The Northern edge is at Mangla Reservoir, while East and West boundaries are close to the Mangla cantonment and Lehri village respectively.

Climatically, area is sub-humid sub-tropical continental type with mean monthly temperature range 5- 39 °C. January is the coldest and June the hottest month of the year. There are two distinct rainy seasons; monsoon rains start by about mid-July and last until the mid of September. Most of the precipitation is received during July and August. The winter rains begin in January and persist up to beginning of March.

This chunk of land belongs to the Lehri and Jindi Reserve Forests. Dominant plant species of the area are *Acacia modesta*, *Olea ferrugenia*, *Salvadora alights*, *Zizyphus nummularia*, *Dodonea viscosa*, *Prosopis glandulosa*, *Adhatoda zeylanica*, *Calotropis procera* and some more similar species, while the shrubs are sparse with scattered *Zizyphus nummularia* except in some ravines and on the high ridges where *Dodonea viscosa* is prominent and grasses like *Cymbopogon jwarancusa*, *Eleusine compressa*, *Heteropogon contortus*, *Aristida adscensionis*, *Cynodon dactylon* and *Saccharum spp* are found (Roberts, 1997).

Field Survey Methodology: Line transects method was employed during the current study. According to the topography of region, transects of variable lengths were selected and explored. While walking through these transects, the animals were observed with the help of Nikon (10x 42) binocular and data was recorded.

Certain observation points, with higher probability of finding the animals were selected. The whole place was searched by using binoculars. Transect lines on mountain ranges were drawn in such a way that they either run across the crest from base of the range on one side to the base of the range on the other side, or from the base to the crest of the range, then down again by another route to avoid biasing. The routes taken on mountain were climbed at oblique angle to maximize the distance covered and minimizing the sternness of the climb and return to the lowlands was also in the same fashion.

To avoid being detected by animals through scent, walking along survey transect was done in the direction of prevailing wind. GPS coordinates were marked at the start and finish point of each transect as well as at the points of observation. GPS coordinates of transects were recorded using Germin map64 GPS Receiver. As urial is crepuscular in nature, most of the survey was conducted at the time of dawn and dusk. It was ensured that none of the individual or group was repeated. Indirect evidences i.e., fecal pellets, foot prints etc. were also recorded in addition to direct sightings. Horn length, horn curl and neck ruff size (Schaller and Mirza, 1974) were used to

classify adult rams into four age classes: Class I (2-years old), Class II (3 years), Class III (4 to 6 years) and Class IV (>6 years old).

Population density was calculated by using the following equation and total population of Punjab urial was calculated by multiplying its population density with total area (Bumham *et al.*, 1980).

1. $Density = \Sigma n / L \times 2W$

Where

L = Total length of Transect

n = Number of objects detected.

W = Width of transect.

2. Total Population = Density x Total Area of Reserve (Km²)

Results and Discussion

Field survey at Lehri Nature Reserve was carried out in May 2018, while at Chumbi Surla Wildlife Sanctuary and Jalalpur Wildlife Sanctuary study was undertaken in November 2018. Population density and estimates at survey sites are given below;

Lehri Nature Reserve: During field survey, 6 transects of 7 km each were surveyed. A total 69 urials (Details in table 1) were recorded. These included 39 females (60.9%), 6 adult males (8.69%) and 24 lambs (34.78%). Urial population structure was highly dynamic. Population structure differs with respect to breeding and non-breeding season. During current census, number of adult males was low. Males are more prominent and aggressive during the breeding season. Punjab urial are said to mate in September and October (Prater, 1965). Currently, female and lamb population is abundant in the study area.

Overall population density of Punjab urial during current study was 2.12 animals / km² with population estimates of 147 animals in approximately 69 km² area of Lehri Nature Reserve. Herds of Punjab urial were distributed in fragments in the study area mainly based on condition of their natural habitat.

Chumbi Surla Wildlife Sanctuary: 4 transects of 7km each were surveyed in areas of Dhoke Sehla, Chappar Meraan Wala,

Chumbi Village, Khae Mouri, Kokhar Zair and Surla Dam. Footprints and fecal material was found at various places in the study area along with direct sighting. A total of 27 urial (Details in table 1) comprising of 17 females (58.6%), 9 adult males (33.3%) and 1 lamb (3.70%) were recorded. During current census, number of fawns was low as compared to male and female urial population. Population density of Punjab urial during current study is 1.40 animals / km². Overall population was estimated to be 175 animals in approximately 125 km² area of Chumbi Surla Wildlife Sanctuary. Herds of Punjab urial were distributed in fragments in the study area and mostly were found on undulating ground, deeply intersected with narrow gullies and ravines, sharp edges /ridges of red marl, against which their foxy red coats were highly camouflaged.

Jalalpur Wildlife Sanctuary: During the survey, 3 parallel transects of 6 km each were randomly selected in areas of Andar Galli, Kala Bachha, Shah Mir Village and Landay Wala Kass and surveyed for Punjab urial. Total of 97 animals were observed in the field (Details in table 1). Among these, there were 19 adult males (19.58%), 47 adult females (48.45%) and 31 yearlings (31.98%). This is the actual number of animals present in the area. Population density of Punjab urial at Jalalpur Wildlife Sanctuary was 5.1 with estimated population of 113 heads.

Since the population estimation formula gives population estimates based on assumption that animals are evenly distributed but in reality distribution is patchy. Animals are more or less distributed in small pockets providing food and shelter. Estimated populations through this formula here tends to be exaggerated and numbers are on higher side.

Higher population density of urial was reported in other sections of Salt Range i.e. 11-13 animals/km² at Kalabagh Game Reserve (Schaller, 1977), 4.89 animals/km² at Jalalpur Wildlife Sanctuary (Azam *et al.*, 2006), and 2.68 animals/km² at Diljappa-Domeli Game Reserve (Habiba *et al.*, 2015). Azam *et al.*, (2006) surveyed the Jalalpur Wildlife Sanctuary for Punjab urial in December 2005 and reported a total population of 130 individuals. Shafique and Brohi (2016) estimated a total population of 180 during the survey of Chumbi Surla Wildlife Sanctuary (District Chakwal). Current estimates for Punjab urial are higher in Jalalpur while lower for Chumbi Surla Wildlife Sanctuary.

Table 1: Population Dynamics, Density and Estimates for Punjab Urial at study sites

Location	Population Dynamics							Population Density (animals/km ²)	Estimated Population
	Male				Female	Yearlings	Total		
	Class I	Class II	Class III	Class IV					
Lehri Nature Reserve	4	2	-	-	39	24	69	2.12	147
Chumbi Surla WS	2	1	4	2	17	1	27	1.4	175
Jalalpur WS	4	5	7	3	47	31	97	5.1	113

Threats to Punjab Urial:

- Major threats to the Punjab urial population in study area are the loss and degradation of habitat due to livestock grazing, fuel wood collection and expanding agricultural practices.
- Developments like roads network, dams and agricultural lands expansion etc. in range lands have increased the threats to wildlife species especially by easy human access to the intact urial habitats. This has consequently made the species more vulnerable to poaching.
- Many hunting parties from different areas approach the urial habitat and hunt the animal. The urial is protected in Punjab i.e. its hunting is banned and only a few trophies are offered annually for legal hunting by the Punjab Wildlife & Parks Department. But due to illegal hunting practices a large number of animals are hunted illegally each year. This situation is posing a serious threat to the urial population.
- Limited water availability particularly during summer months forces the animals sometimes to move outside the game reserve which increases the chances of road kill and hunting.

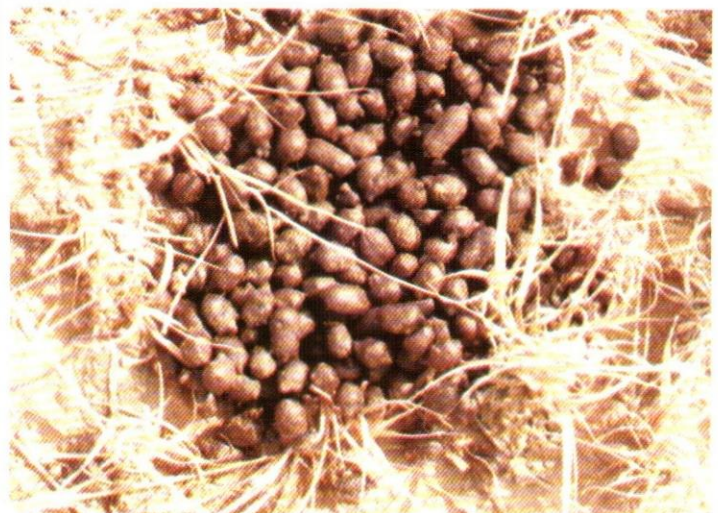
- Trophies and poaching of lambs for keeping as pet and illegal hunting for meat are the other reasons for decline in urial population in the area.
- Areas with high anthropogenic disturbance have lower population of Punjab urial. Practices such as grazing and fuel-wood collection have resulted in degradation of not only habitat but also created competition for foraging sites. It has resulted in decline and shifting of urial population to relatively less disturbed areas.

Recommendations: For releasing pressure on natural vegetation in urial habitat, it is suggested to provide alternative energy resources to human population living close to the reserves and establish specific grazing areas for livestock. Mining and queering activities in wildlife sanctuaries also need monitoring. Strict law enforcement is required to check illegal hunting and pet trade. Capacity building in terms of infrastructure and technology of officials of wildlife department involved in law enforcement needs to be improved. Moreover, local communities and NGOs should be involved regarding awareness rising about significance of species and conservation campaign of the Punjab urial.

ANNEXURE: Glimpse of Field Survey and Observations at Lehri Nature Reserve, Chumbi Surla Wildlife Sanctuary and Jalalpur Wildlife Sanctuary



1. Footprint of Punjab Urial at Chumbi Surla WLS



2. Fecal Material of Punjab Urial at Chumbi Surla



3. Male Urial at Chumbi Surla WLS



4. Male Urial at Chumbi Surla WLS



5. Male and Female Urial at Chumbi Surla WLS



6. Terrain of Chumbi Surla WLS



7. Female Urial at Jalalpur WLS



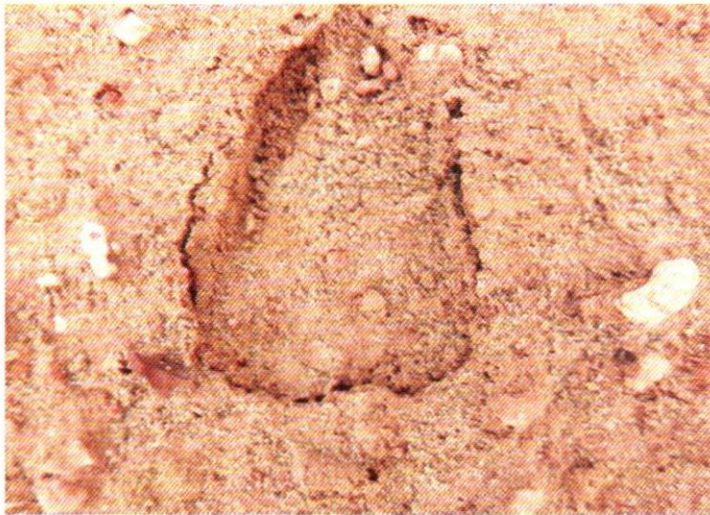
8. Male Urial at Jalalpur WLS



9. Female Urial and sub adult male at Jalalpur WLS



10. Terrain of Jalalpur WLS



11. Footprints of Punjab Urial



12. Footprints of Punjab Urial

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Vultures at Poonch River Mahasheer National Park, Kotli (AJK)

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Introduction

Eight species of vultures viz White-rumped Vulture (*Gyps bengalensis*), Long-billed Vulture (*Gyps indicus*), Himalayan Griffon Vulture (*Gyps himalayensis*), Eurasian Griffon Vulture (*Gyps fulvus*), Red-headed Vulture (*Sarcogyps calvus*), Egyptian Vulture (*Neophron percnopterus*), Cinereous Vulture (*Aegypius monachus*), and Bearded (Lammergeier) Vulture (*Gypaetus barbatus*) are found in Pakistan (IUCN 2016).

Vultures play essential ecological function by scavenging the carcasses and other organic wastes, performing the role as the most successful scavengers. Hence, providing highly effective free of cost sanitation services (Pain *et al.*, 2003; Prakash *et al.*, 2003). However, their vital ecological functions are now threatened due to abrupt decline of more than 90% of their population throughout the Indian subcontinent (Prakash *et al.*, 2003).

In early 1990s, a catastrophic population crash occurred in *Gyps* vultures and once numbering tens of millions throughout India and Pakistan, their population declined by over 99 % and currently number less than 10,000. In Punjab (Pakistan), 50% per annum decline of Oriental White-backed vultures was recorded in years 2003-2004 (Gilbert *et al.*, 2004, 2006; Green *et al.*, 2004) while a population decline in the Long-billed vulture was also recorded at an annual rate of 25% per year in Sindh Province of Pakistan (Gilbert *et al.*, 2004). Population of Himalayan Griffon Vulture (*Gyps himalayensis*) is also declining in Pakistan (Roberts, 1991; Samant *et al.*, 1995; Awan *et al.*, 2004; Qamar *et al.*, 2008).

In 2003, the Diclofenac, a non-steroidal anti-inflammatory drug (used to reduce the pain, fever and inflammation in livestock) was declared as the exclusive agent responsible for the rapid decline of Oriental White-backed vulture population in Punjab, Pakistan (Oaks *et al.*, 2004). Vultures can die of kidney failure within a few days of their exposure to diclofenac during feeding on carcasses of livestock dozed with the drug soon before death (Swan *et al.*, 2006). Not only diclofenac but some other non-steroidal anti-inflammatory drugs (NSAIDs) are also harmful to other vulture species and scavenging birds (Cuthbert *et al.*, 2006; Acharya *et al.*, 2009).

Major threats to vultures are poisoning, habitat loss, disturbance, lack of awareness and declining food resources. Among these threats, food is the ultimate limiting factor for the vulture population (Armstrong, 1993). Diclofenac proved to be the main threat in subsequent years. Development of modern agricultural methods and intensive use of pesticides; significant decrease in food sources due to the reduction in the number of sheep and cattle, wildlife hunting, low reproductive potential, habitat loss, infectious diseases, environmental pollution and damage to the natural environment are some other reasons for the vultures'

decline (Leshem, 1985; Pain *et al.*, 2003; Prakash *et al.*, 2003; Green *et al.*, 2004).

A colony of vultures was identified at entrance of Kotli City (AJK) at Poonch River Mahasheer National Park and observations were made to record the vultures species in the specific colony.

Material and Methods

Study Area: The observations were carried out at Poonch River Mahseer National Park just at entrance of Kotli City (AJK). The area is situated at 707m asl with sub-tropical climate with annual precipitation of 976mm.

Data Collection: Field observation for species record of vultures was conducted in December 2018; the breeding season of vultures. The site was thoroughly surveyed. Bird diversity belonging to different species was confirmed by direct sightings. Vultures were observed from the ground with the help of binoculars. To ensure the correct identification of bird, its position relative to sun was considered (Gilbert *et al.*, 2007). Keys by Roberts (1991) and Grimmett *et al.*, (2008) were followed to identify different species of vultures.

Results and Discussion

Results of present study reveal presence of 4 vulture species at surveyed area. These include Oriental white backed vulture; (*Gyps bengalensis*), Himalayan Griffon vulture; (*Gyps himalayensis*), Eurasian griffon vulture; (*Gyps fulvus*) and Egyptian vulture; (*Neophron percnopterus*). The colony is situated near a slaughter house just above the Poonch River. The area also serves as the garbage/ waste dumping site for Kotli City. Hence availability of food appears to be the main driver for presence of high abundance of vultures at the specific site.

Recommendations: Vultures are generally considered ghostly and unpopular in the subcontinent region. This is the major factor hindering their conservation. Thus it is crucial to launch awareness campaigns and provide enough understanding of their current declining status to the public. To protect the colony at Poonch River Mahasheer National Park, Kotli City, there is need to declare the vulture safe zone around the breeding colony. Deforestation and stone quarrying in the Safe Zone should be banned and disturbance should also be reduced. Local staff should be trained to develop capacity for vulture conservation aiming to reduce vulture mortality in the wild. It is assumed that increased human interference in the breeding colony may reduce the breeding success, so there is need to create awareness among locals about the importance of the species.

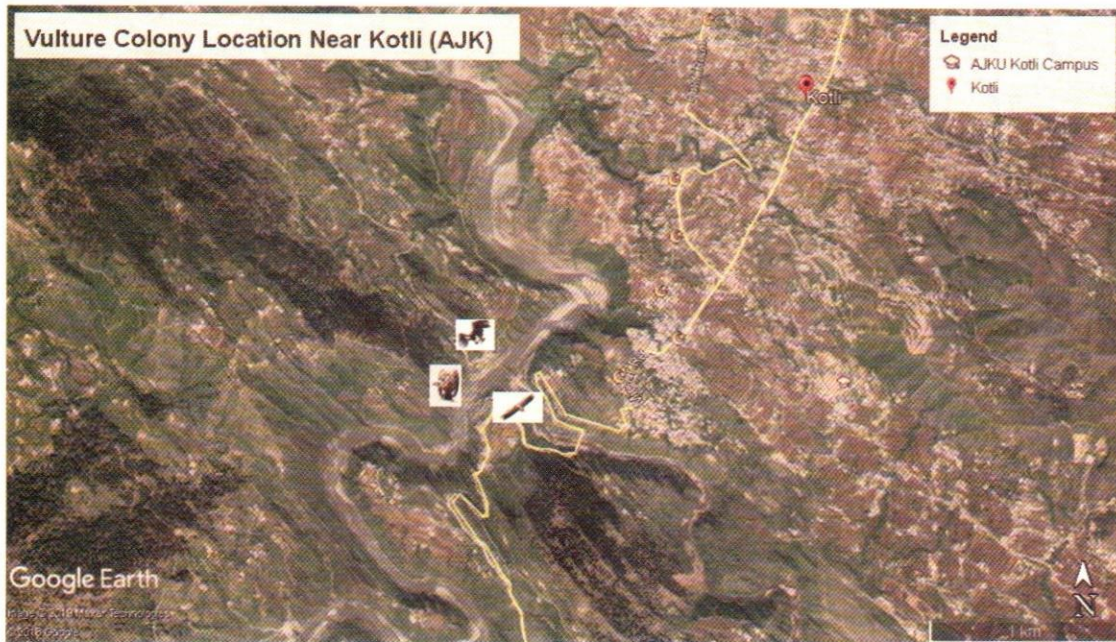


Figure 1: Vulture Colony Location at Kotli City (AJK) – Poonch River Mahasheer National Park



Figure 2: Egyptian Vultures at Poonch River Mahasheer National Park – Kotli AJK



Figure 3: Oriental White Rump Vulture at Poonch River Mahasheer National Park – Kotli AJK



Figure 4: Himalayan Griffon Vulture at Poonch River Mahasheer National Park – Kotli AJK

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