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Cover: Forest Dormouse (*Dryomys nitedula*) resting in the branches of Cedar (*Cedrus deodara*).

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Diet of Asiatic Jackal in the Salt Range, Punjab, Pakistan

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Abstract

Knowledge of the feeding habits of a taxon is considered the most significant tool in conservation and sustained persistence of a species. Understanding of food and feeding habits is also significant for managing other species especially subordinate populations. Considering the same, present study was undertaken with the aim to evaluate dietary requirements of Asiatic Jackal in the Salt Range, Pakistan. Food items are described based on analysis of 40 fresh and confirmed jackal scats collected from different parts of the study area between 2001 and 2005. Present study suggests almost equal contribution of animal and vegetable matter to meet the dietary requirements of the animal. Analysis of available stomach contents revealed subsistence on food items of anthropogenic origin. Discussion gives an insight into the possibility of the animal controlling the subordinate population of sympatric red fox and possibly Bengal fox.

Key Words: Asiatic Jackal, scat analysis, feeding ecology, Salt Range, subordinate population.

Introduction

Members of the order Carnivora having teeth modified for shearing flesh are considered resourceful animals adapted to feed on vertebrate prey, though many species have a good degree of subsistence on vegetable matter. For canids, pursuit remains the main strategy to capture the prey, sense of smell and hearing are well developed as compared with sight.

Asiatic jackal (*Canis aureus*) is a typical representative of the genus *Canis* (Clutton-Brock *et al.,* 1976) and is widely distributed throughout North and North-East Africa, Middle East, Central Asia to Far East (Sillero-Zubiri *et al.,* 2004). Subspecies *C. a. aureus* is widespread in Pakistan (Roberts, 1997) including the Salt Range. It is fairly common throughout the country and good populations exist in areas having abundant food supply and, especially in livestock rearing tracts where cattle carcasses, poultry, and other garbage are potential diet.

The Salt Range inhabits four sympatric canid species: Asiatic jackal *Canis aureus aureus*, Red fox *Vulpes vulpes pusilla*, Indian Wolf *Canis lupus pallipes* (Roberts, 1997) and Bengal fox *Vulpes bengalensis* (Irshad and Ahmad, 2008) having remarkably different ecological roles. The wolf as a high-ranking carnivore regulates the populations of herbivores and even those of lower carnivores (Palomares and Caro, 1999; Reynolds and Tapper, 1996), like jackals (Naaktgeboren, 1990). Asiatic jackal is an opportunistic omnivore (Macdonald, 1979; Prakash 1959) and scavenger (Sankar, 1988). Red fox, perhaps, lies somewhere between these two extremes, having a habit of hunting the small mammals (Blumstein, 1992B), insects (Skalski and Wierzbowska, 2008) and also the food items associated with human beings (Doncaster and Macdonald, 1997).

In Pakistan, relatively little work is available on feeding ecology of carnivores, especially on wild canids which are generally ignored in the past (Sheikh and Molur, 2005). Damage caused by jackal to agricultural crops, poultry and livestock in the central Punjab, Pakistan (Khan and Beg, 1986) and predation of lambs of Urial *Ovis vignei punjabiensis* in the Salt Range (Awan, 2004) have been indicated for different tracts of Pakistan indirectly suggesting an omnivorous nature of the species. The studies available from different parts of its distribution range suggest that the food of Asiatic jackal varies with area and season. According to Khan and Beg (1986), diet of Asiatic jackal consists of mammals and birds in the agriculture landscape of central Punjab (Pakistan), while invertebrates do not constitute a significant dietary part. Roberts (1997) gathered data on feeding habits of jackal through a variety of ways and the animal was regarded as omnivore with significant part of diet coming from rodents and invertebrates, like crabs, scorpions, beetles and insects. The plant part of the diet was derived from different fruits, including *Zizyphus jujuba, Z. nummularia, Syzygium cummi, Phoenix crassicaudata* and *Olea sp.*

In the Northern Rajasthan (India), about 50% of the diet of the contiguous jackal population is reported to be rodents and birds, about 37% grasses and vegetable matter, and some 13% carrion, insects and fish (Sankar, 1988). Quantitative analysis of 138 scats of Asiatic

Jackal in central India revealed that rodents (68%), vegetative matter (27%), reptiles (12%), birds (9%) and fish (8%) were consumed by this species as its food (Schaller, 1967). Mukherjee *et al.* (2004) employed scat analysis and suggested that rodents contributed an important part in diet of jackal in Rajasthan (India) and believed that a jackal consumed 5-6 rodents in a day and hence could potentially act as an important agent for the biological control of agricultural pests and disease harboring rodents.

In western extremity of the range of distribution of jackal, the presence of mammal hairs, parts of arthropod exoskeleton, plant seeds and vegetable matter is reported in the sample of jackal scats (Krofel, 2007). Similarly, scat analysis from sample collected from south-western Hungary revealed the presence of small quantity of vegetable matter while small mammals and hares contributed more than 55% of the biomass (Lanszki and Heltai, 2002). The organic waste is believed to be an important part in the jackal's diet in human dominated landscape in Europe (Giannatos, 2004; Macdonald, 1979) and Middle East (Yom-Tov *et al.*, 1995).

In Pakistan, mechanized agriculture and industrial development during the recent past to cope with the food requirements of increasing human population have grown very fast. The Salt Range, however, still has a promise to act as a refuge for biodiversity, at least, in Punjab and hence it is rightly considered as priority area for biodiversity conservation by conservation partners. The present work attempts to investigate some aspects of feeding ecology of Asiatic Jackal with the aim to suggest some measures for sustained persistence of the species in the area.

The study area

The study area is located in north central Punjab (Pakistan) falling in the civil districts of Jhelum, Chakwal, Mianwali and Khushab. The tract is bounded in the north-west by Rawalpindi and Attock districts, connected with Azad Jammu and Kashmir (AJK) in the north-east and on the south by Thal desert and in the west by Indus river and part of Mianwali district (Khan, 1991; Lindsay 1923). The Indus River constitutes a relatively strong western barrier, while the range is directly connected with the Potohar plateau, Kherimurat hills and Margalla hills in the north and hilly terrain of AJK (Fig. 1) which further extends upto Himachal Pradesh of India, for possible canids movements. The Salt Range (32° 41' - 33° 11' N and 71° 37' to 73° 38' E) is an east-west hill system extending as an irregular arc of about 200 km between river Jhelum in the east and river Indus in the west (GoP, 1999).

The altitude generally remains between 750 and 900m above sea level (asl) with valleys of different sizes distributed between the hills, and depression appear at many places to form natural lakes of different sizes. The lakes are generally saline and are considered as wetlands of international importance, attracting migratory birds and other animals. The Salt Range is rich in minerals like rock salt, gypsum, limestone, coal and oil (Khan, 1991) and relics of ancient civilizations.

The climate of the area is generally categorized sub-humid sub-tropical continental type with

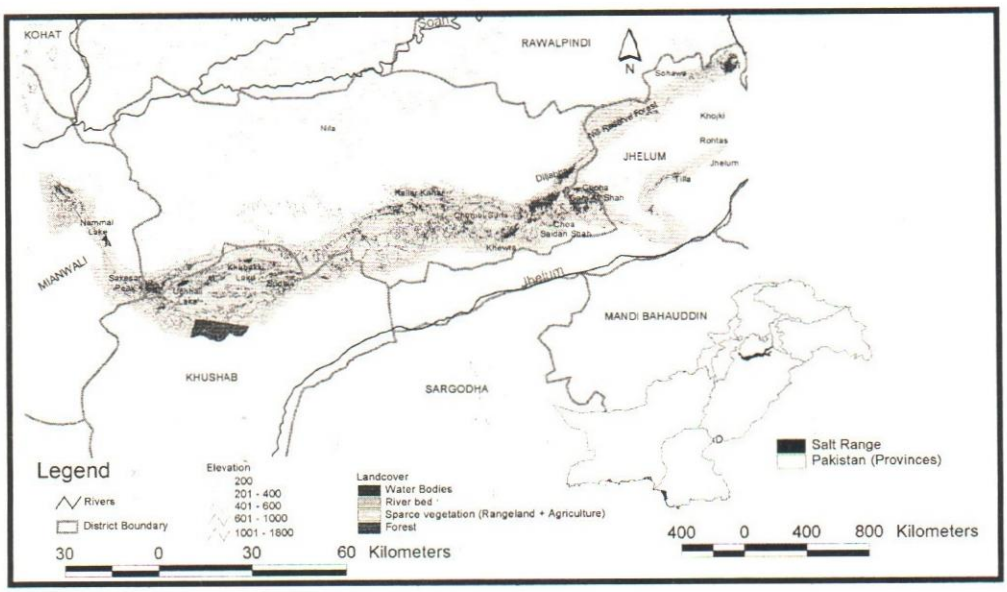

Fig. 1: Map of the Salt Range (Pakistan) showing the extant of sampling, administrative divisions and its adjoining areas.

intermediate monsoon influence (Roberts, 1997). Mean monthly temperature ranges from 5.9°C to 38.4°C, January being the coldest and June the hottest months of the year.

The Salt Range supports a varied spectrum of wildlife. Wolf, hyena, jackal and foxes, ungulates and game birds like partridges and quails used to be widely distributed in the area (Irshad and Ahmad, 2008; Khan and Mehmood, 2003; Roberts, 1991 and 1997). Hare is a significant natural prey species for wild carnivores in the area and is also hunted by local hunters.

The Provincial Government has established a protected areas system in the Salt Range which constitutes some 11% of the total area. Chumbi-Surla Wildlife Sanctuary, Dilgaba-Domelai Game Reserve, Jalalpur Wildlife Sanctuary, Sodhi Wildlife Sanctuary and Lehri Nature Park are significant protected areas. Forest Department has established a system of protected and reserved forests which are scattered all over the Salt Range (GoP, 1999).

Material and Methods

Variable strip transect sampling technique was used to explore the study site following Rudran *et al.* (1996) with certain modifications. A total of 163 transects (total transect length of 814 km) were randomly established in legally unprotected (n=77, transect length 388 km, average length=5.04 ± 0.31 km) and protected areas (n=86, transect length 427 km, average transect length 4.95 ± 0.30 km) exercising due care to include all microhabitat variations.

A total of 140 fresh and confirmed jackal scats were collected from different parts of the study area between 2001 and 2005. Each scat was probed for its contents in the field immediately after its collection. The identifiable parts of each scat were separated visually and identified to the lowest possible taxon using hand lens.

Photographs of doubtful pieces were taken and used for identification in the laboratory. The frequencies of different identifiable parts were recorded for each scat. Individual frequencies were pooled to workout the average frequencies of different food items in the total sample of the scats, which were then converted to relative frequencies.

The stomach contents of road killed jackals were also examined to collect some additional supportive data. For this purpose, 4 road killed jackals were dissected and the stomach contents examined macroscopically. The separable items were identified, photographed and recorded as field notes.

Results

The analyses of 140 randomly selected fresh and confirmed scats of jackal collected from different parts of the study area during different seasons of the study period revealed the presence of 10 broad food categories.

Table 1 shows that jackal in the Salt Range consumed both animal (52.4%) and plant (47.6%) matter. Pieces of polythene packing material and stones were also recovered from the scats. A closer examination of $7cm^2$ piece of polythene sheet, recovered from one of the scats, suggests that it was a part of commercial margarine wrapper. Other two scats contained small stones, which were probably engulfed along with the animal or vegetable matter of food. The contents of 47 scats with digested and homogenized material could not be identified to any taxonomic level.

Hair, skin and bones of mammals (28.3%) and eggs and feathers of birds (8.2%) could be identified in the animal part of the food of the scats. The mammals were largely represented by parts of small mammals and livestock, while bird part of the food was represented by egg shells and feathers. The major part of feathers was characteristically white in color, representing the farmed and domestic poultry. The invertebrates, including insects, millipedes and beetles also constituted an appreciable (7.1%) part of the diet. The plant part of the food was dominated by wild fruits and seeds (20.4%), mainly contributed by *Zizyphus sp.* (8.9%), ground nuts (6.7%) and *Olea cuspidata* (4.8%). Unidentified fibrous material, representing small twigs (25.7%), was present in the scats, 1.5% leaves (including leaves blades of cultivated wheat) and crop residues also appeared in the scats.

Table 1: Frequency of different food items identified from scats of jackals collected from the Salt Range.

Items	Frequency	
Animal matter:	**Number**	**%**
Mammals		
Hair and skin (Both livestock, small mammals)	76	28.3
Birds		
Eggs and feathers	22	8.2
Invertebrates		
Insects, millipedes and beetles	19	7.1
Unidentifiable residue metabolized protein	24	8.9
Total animal matter	141	52.4

Plant matter:	Frequency	
Seeds	**Number**	**%**
Zizyphus jujuba (Fruits and seeds)	24	8.9
Ground nuts	18	6.7
Olea cuspidata	13	4.8
Leaves and crop residues	4	1.5
Unidentified fibrous material including small twigs	69	25.7

Examination of the stomach contents of a road killed female jackal revealed that it was packed with large pieces of skin and cartilage of livestock although with appreciable quantities of pieces of newspapers. The stomach also contained some unidentified small molluscs (gastropods) and few unidentified small round seeds. Dissection of two other road killed jackals (a male and a female) revealed absolutely nothing in the stomach. The fourth specimen was a relatively smaller male with stomach tightly packed with skin and hair of livestock. Close examination revealed presence of maggots along with parts of skin, reflecting that the animal fed on a decaying carcass of a goat (Plate 1).

Discussion

Many studies have recommended use of a certain minimum number of scats for accurate determination of diet of predators (Mukherjee *et al.*, 2004; Henschel and Skinner, 1990). For black-backed jackal *Canis mesomelas* Kaunda and Skinner, (2003) recommended that analysis of minimum of 30 scats in each sampling unit is required for reliable determination of feeding preference. However, to ascertain the fact that the scats belong to target species, caution needs to be exercised. In a human dominated landscape like the Salt Range, human intervention into the wild is very common. Farmers, shepherd and other individuals visit the wilderness area for livestock grazing, fuel wood collection and grass cutting. Opportunistic poachers and trespassers visit the area along with their domestic dogs that leave behind the scats remarkably similar to those of wild canids. The study attempted to workout food preference of jackal with reference to management regimens as well as temporally but paucity of authentic data rendered the workers to restrict the scope of work.

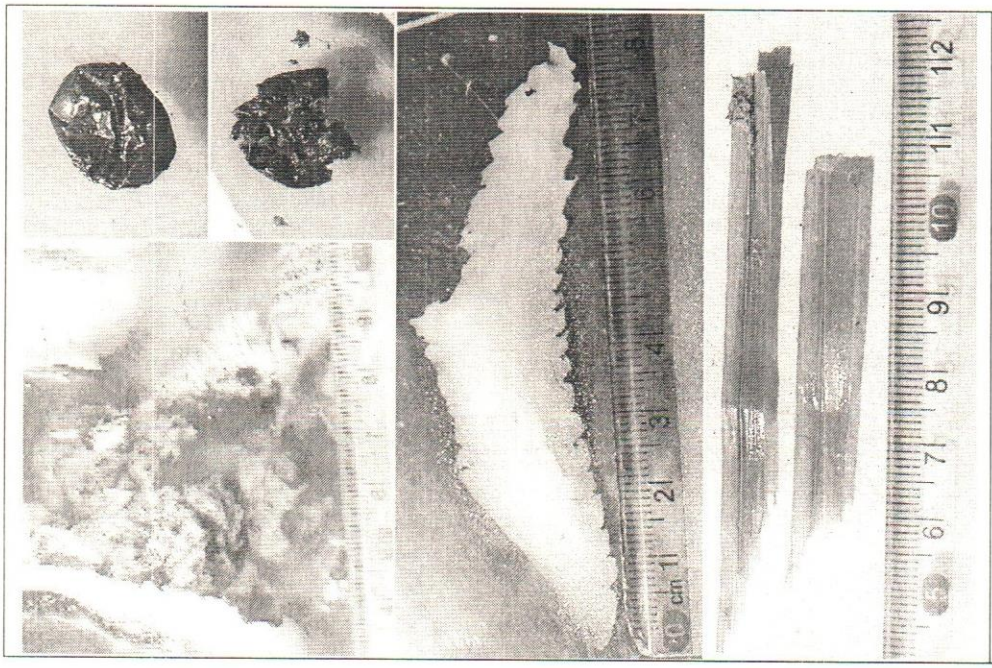

Plate 1.
Food items recovered from stomach of a road killed female jackal. A characteristic striation is visible on the margin of morsel of food (very likely an ear of slaughtered goat). Grass blades, pieces of newspaper and unidentified seeds are also noted.

The present study reveals that animal and vegetable matters contribute almost equally to the diet of Asiatic jackal. The food items belonging to mammalian origin constituted 28% of the total food. Very few small mammals were represented in the scats, while Invertebrates constituted 7.1% of the identifiable parts of the food in the scats. The analysis of stomach contents of 2 road killed jackals showed a heavy dependence of jackal on carcass of domestic goat that were most probably the remains of slaughtered livestock. Presence of pieces of newspapers and maggots support that jackal consumes decaying carrion found in human dominated landscape. Presence of a few gastropod mollusks did not reflect their direct

consumption to fulfill the dietary requirement of the animal, which might have been consumed along with the scavenged material. Such mode of food acquisition has been reported, when animals were found to consume human waste (Martina and Gallaratti, 1997). There were some reports of direct killing of the goats in the area, and other parts of the region (Jaeger *et al.*, 2007) suggesting that livestock depredation being attempted by the jackal needs further focused work.

Asiatic Jackal shares the area with red fox, Indian wolf and Bengal fox. Reports suggest a strong interspecific feeding competition of jackal with fox (Fedriani *et al.*, 1999). Studies based on scats analysis revealed that significant overlap of diet exists between jackal and red fox in Hungary (Lanszki *et al.*, 2006) and Israel (Scheinin *et al.*, 2006). Many other studies have focused on dietary overlap of sympatric canids (Skalski and Wierzbowska, 2008; Kamler, 2002) and positive effect of anthropogenic changes in natural environment towards increase in range of distribution, through provision of suitable habitat. In the Salt Range area, agriculture landscape and natural stands of thorn forests provide an excellent habitat where jackals presumably forage in human dominated rural and agricultural areas and remote natural forests provide resting and hiding places. Abandoned agricultural fields are also suitable dens.

It is established that Jackal and red fox are well adapted to human habitation (Macdonald and Reynolds, 2004; Roberts, 1997), and have learned to utilize anthropogenic waste as food source (Clutton-Brock *et al.*, 1976), the food might be limiting factor controlling the population size of red fox. On the Contrary, more dependence on vegetable diet, fox is expected to exhibit adaptation and resilience as compared with jackal (Kees Van Frankenhuyzen; pers. Comm., 2009). Fox density is likely to be controlled by interspecific interactions as experienced in case of fox-jackal interactions in Israel (Scheinin *et al.*, 2006) and coyotes-wolf in Yellowstone National Park (Smith *et al.*, 2003). Considering the work carried out in other areas of the range of distribution and species inhabiting the salt range, an elaborative study is indicated for working out the dietary overlap between sympatric carnivores and influence of food provision by man on population persistence of wild canids in the Salt Range.

Vultures, notably White-backed Vulture *Gyps bengalensis*, remained the principal scavengers, feeding on carcass of wild ungulates and livestock. The species was probably the most abundant large bird of prey in the world (Bird Life International, 2009). During the recent past, declining population of vultures (Lindsay *et al.*, 2004) very likely provide additional food items for consumption by wild canids especially Asiatic jackal, the later adapting to the new ecological niche. On the other hand, factors contributing towards decline of vultures might pose a threat to the mammalian scavengers. Only focused work can reveal the nature and intensity of the threat.

References

Awan, G.A. 2004. *An analysis of critical factors influencing the population persistence of Punjab Urial (Ovis vignei punjabiensis) in wild.* Ph.D. dissertation, Quaid-i-Azam University, Islamabad, Pakistan.

Bird Life International, 2009. *Gyps bengalensis*. In: *IUCN 2010. IUCN Red List of Threatened Species*. Version 2010.2. www.iucnredlist.org.

Blumstein, D.T. 1992B. Summer Diets of Tibetan Red Foxes in Khunjerab National Park, Pakistan. (submitted in Journ. of Mammalogy).

Clutton-Brock, J., Corbet, G. B. and Hills, M. 1976. A review of family Canidae, with a classification by numerical methods. *Bulletin of the British Museum (Natural History), Zoology* 29:79-199.

Doncaster, C.P. and Macdonald, D.W. 1997. Activity patterns and interactions in red fox in Oxford city. *Journal of Zoology, London.* 241:73-87.

Fedriani, J.M. Palomares, F. and Delibes, M. 1999. Niche relations among three sympatric Mediterranean carnivores. *European Journal of Wildlife Research* 50:53-58.

GoP. 1999. *Jhelum: District Census Report 1998.* Pakistan Census Organization, Government of Pakistan.

Henschel, J.R. and Skinner, J.D. 1990. The diet of the Spotted Hyena *Crocuta crocuta* in Kruger National Park. *African Journal of Ecology* 28:157-162.

Irshad R. and T. Ahmad. 2008. Bengal Fox in the Salt Range. *Rec. Zool. Sur. Pakistan* 18: 66-8.

Jaeger, M.M., Haque, E., Sultana, P. and Bruggers, R.L. 2007. Daytime cover, diet and space-use of golden jackals (*Canis aureus*) in agro-ecosystems of Bangladesh. *Mammalia* 1-10 DOI 10.1515/MAMM.2007.016.

Kamler, J.F. 2002. *Relationships of swift foxes and coyotes in northwest Texas.* Ph.D. thesis, Texas Tech University, Texas. 989-995pp.

Kaunda, S.K.K. and Skinner, J.D. 2003. Black-backed jackal diet at Mokolodi Nature Reserve: Botswana. *African Journal of Ecology* 41:39-46.

Khan, A.A. and Beg, M.A. 1986. Food of some mammalian predators in the cultivated areas of Punjab. *Pakistan Journal of Zoology* 18:71-79.

Khan, R.A. and Mehmood, R.T. 2003. Potential and prospects of mountain forests. 58-64 in S.A. Mufti, S.S. Hussain and A.M. Khan, eds. *Proceedings of International Symposium on Mountains of Pakistan: Protection, Potential and Prospects*. Global Change Impact Studies Center, Islamabad, Pakistan.

Lanszki, J., Heltai, M. and Szabó, L. 2006. Feeding habits and trophic niche overlap between sympatric golden jackal (*Canis aureus*) and red fox (*Vulpes vulpes*) in the Pannonian ecoregion (Hungary) *Canadian Journal of Zoology* 84:1647–1656.

Lindsay, J. Oaks, Martin Gilbert, Munir Z. Virani, Richard T. Watson, Carol U. Meteyer, Bruce A. Rideout, H. L. Shivaprasad, Shakeel Ahmed, Muhammad Jamshed Iqbal Chaudhry, Muhammad Arshad, Shahid Mahmood, Ahmad Ali and Aleem Ahmed Khan, 2004. Diclofenac residues as the cause of vulture population decline in Pakistan. *Nature* 427, 630-633 2004 | doi:10.1038/nature02317

Macdonald, D. W. and J. C. Reynolds. 2004. Red Fox (Vulpes vulpes) pp 129-136. In: in C. Sillero-Zubiri, M. Hoffmann, and D.W. Macdonald, eds. 2004, *Canids: Foxes, Wolves, Jackals and Dogs. Status Survey and Conservation Action Plan.* IUCN/SSC Canid Specialist Group Gland, Switzerland and Cambridge UK.

Macdonald, D.W. 1979. The flexible social system of the Asiatic jackal, *Canis aureus*. *Behavioral Ecology and Sociobiology* 5:17-38.

Martina, A. and Gallaratti, M. 1997. Use of a garbage dump by some mammal species in the Majella Masstf, Abruzzo, Italy. *Hystrix* 9:23-29.

Mukherjee, S., Goyal, S.P., Johnsingh, A.J. and Leite Pitman M.R.P. 2004. The importance of rodents in the diet of jungle cat (*Felis chaus*), caracal (*Felis caracal*) and golden jackal (*Canis aureus*) in Sariska Tiger Reserve, Rajasthan, India. *Journal of Zoology, London*. 262:405-411.

Naaktgeboren, C. 1990. Jackals. In: S.P. Parker, ed. *Grzimek's Encyclopedia of Mammals*. Vol. 4 McGraw Hill Publishing Co. New York. 104-105pp.

Palomares, F. and Caro, T.M. 1999. Interspecific killing among mammalian carnivores. *The American Naturalist* 135:492-508.

Prakash, I. 1959. Food of some Indian desert mammals. *Journal of Biological Sciences* 2:100-109.

Reynolds, J.C. and Tapper S.C. 1996. Control of mammalian predators in game management and conservation. *Mammal Review* 26:127-156.

Roberts, T.J. 1997. *Mammals of Pakistan*. Oxford University Press, Karachi revised edition. 525pp

Roberts, T.J., 1991. *The birds of Pakistan Vol. 1 Non-Passeriformes*, Oxford University Press, Karachi. pp. 26-32.

Rudran, R., Kunz, T.H., Southwell, C., Jarman, P. and Smith, A.P. 1996. Observational techniques for Nonvolant mammals. pp. 81-104. In: *Measuring and Monitoring Biological Diversity: Standard methods for mammals*, Smithsonian Institution Press.

Sankar, K. 1988. Some observations in food habits of Jackal in Keoladeo National Park, Bharatpur as shown by scat analysis. *Journal of Bombay Natural History Society* 85:185-86.

Scheinin, S., Yom-Tov, Y., Motro, U. and Geffen, E. 2006. Behavioural responses of red foxes to an increase in the presence of golden jackals: a field experiment. *Animal Behavior* 71:577-584.

Sheikh, K.M. and Molur, S. 2005. *Status and Red List of Pakistan's Mammals. Based on Pakistan's Conservation Assessment and Management Plan for Mammals.* IUCN, Pakistan 1-311.

Sillero-Zubiri, C. and Macdonald, D.W. 2004. Introduction pp. 2-7. In: C. Sillero-Zubiri, M. Hoffmann, and D.W. Macdonald, eds. 2004, *Canids: Foxes, Wolves, Jackals and Dogs. Status Survey and Conservation Action Plan.* IUCN/SSC Canid Specialist Group Gland, Switzerland and Cambridge UK.

Skalski, T. and Wierzbowska, I. 2008. Variation of insect assemblage in fox and marten faeces collected in southern Poland. *Annals Zoologica Fennici* 45:308-316.

Smith, D.W., Peterson, R.O. and Houston, D.B. 2003. Yellowstone after wolves. *Bioscience*. 53:330-340.

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Preliminary assessment of small mammals and their habitat relationships in Chitral Gol National Park (CGNP), Pakistan

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Abstract

The present study was conducted to assess the biodiversity of small mammals in Chitral Gol National Park (CGNP), an area of highlands of Hindukush-Himalayan range (Biogeographical Province – Himalayan Highlands). A total of 670 Shermans, 9 Tomahawks trap nights and 7 mist net hours to capture data on small mammals were expended in a survey from 8 to 26 June, 2004. In the course of the study, trapping produced 157 small mammals consisting of 11 different species. Out of the trapped animals 123 small mammals were registered with maximum ecological details while 34 small mammals of widespread species were released shortly after taking necessary details. The addition of 4 other mammal species is based on direct sighting which were not caught into the traps. Details of the species of small mammals in Chitral Gol National Park are discussed along with microhabitats and their niches. The paper gives recommendation, based on observation, to policy makers and managers of wildlife for conservation of larger mammals by conserving small mammals.

Key Words: Chitral Gol National Park (CGNP), Chitral, small mammals, management, conservation, predators, carnivores, prey.

Introduction

Chitral Gol National Park (CGNP) is a beautiful valley located in the Hindukush mountain range, nearly bordering with Afghanistan in the north-west at 35° 50′ 52N latitude and 71° 47′ 30E longitude (Fig. 3). Originally the Park was a private hunting reserve which included two hunting lodges at Merin and Kasavir Valleys established in 1880 by the Mehtars, the reigning family of the former state of Chitral. It continued as hunting reserve (Fig. 2) for a century until it became a wildlife sanctuary in 1971 and the National Park in 1984 (Akbar, 1974).

Mehtars of the state had huge flocks of livestock consisting of goats and cows. Continuous grazing and cutting of trees denuded some of the areas and changed them into open scrub valleys which were later on converted into crop fields. The most affected valleys are Gokhshal and Bironshal situated in the middle ranges of the Park at 2800m and 3200m respectively. Grazing is common even today in such areas as more than three hundred goats and about 40 cows were counted during the present visit to Gokhshal and Bironshal area. Farming was naturally suspended by the heavy flooding of some years back (pers. comm. Akbar and Akhtar, wildlife watchers) which eroded the fertile soils and turned the ground into a thick bed of rocks and rolling stones rendering the area unsuitable for raising crops. Nature rehabilitated the area with lost wildlife species (flora and fauna). The signs of deforestation still exists in the form of fire scars in stumps, snags and falling dead wood in the middle ranges of the Park. Records suggest that the Mehtars burned the forests perhaps to clear land for travel through or to drive game and/or keeping huge livestock and for growing crops.

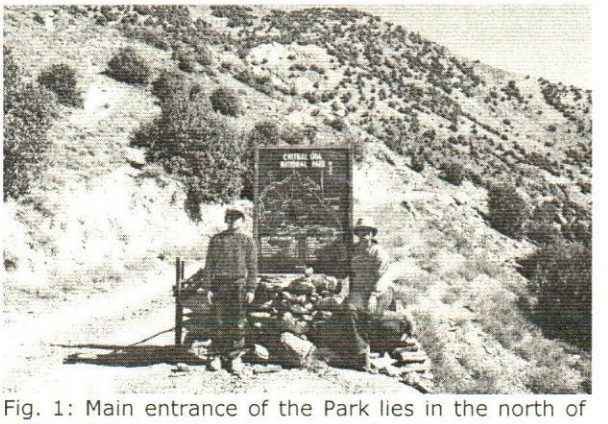


Fig. 1: Main entrance of the Park lies in the north of Chitral Town.

Chitral Gol (locally Gol means valley) is a deep gorge which first makes its way as a glacial stream from the north-west mountains of the Park and then a freshwater stream which runs down about 18 km in the south-east before falling in the Chitral River near Chitral town. Including its tributaries and adjoining mountainous areas declared as protected in 1984. The Chitral Gol National Park (CGNP) came into existence with the prime intent to protect the most important and threatened

wildlife (the flare-horned markhor *Capra falconeri cashmiriensis,* Siberian ibex *Capra ibex sibirica,* Ladakh urial *Ovis vignei vignei* and snow leopard, *Uncia uncia*) of the Hindukush-Himalayan region (Aleem, 1976).

The protected mountain terrain as a core-area of the Park spreads over 7,786 hectares situated in the north-west of Chitral town and further extends in the south as its buffer zone including some of the biologically rich habitats of Hindu Raj Mountains which cover an area of 12,145 hectares.

Fig. 2: The signs of Mehtar Shujjaa, marking his private hunting ground, carved in a stump at Kasavir Valley in CGNP. The inscription in English reads "THIS SHOOTING HOUSE BUILT IN SEPTEMBER 22, 1912".

There are more than 24 peaks in CGNP exceeding 3,000m height (IUCN, 1986). Most of the western parts of the park are situated above the tree line and have many high snow-capped mountain peaks. Many springs and streams are borne in this area and flow down to embrace the main river of the Park called Gokhshal Gol. Gokhshal Valley lies in the middle ranges and in the heart of the Park. Middle and lower ranges of the Park are fairly forested. The forest canopy consists of large and old trees of oaks *Quercus ilex*, cedar *Cedrus deodara,* chilghoza pine *Pinus gerardiana,* blue pine *Pinus wallichii,* Himalayan silver fir *Abies pindrow*, Himalayan spruce *Picea smithiana,* birch *Betula utilis* and junipers *Juniperus excelsa* and *Juniperus communis.*

The Park is well known for inhabiting most important and threatened wildlife species of the Hindukush mountain range which are unparalleled in the country for their variety and diversity. Among them mammals include flare-horned markhor *Capra falconeri cashmiriensis*, Siberian ibex *Capra ibex sibirica*, Ladakh urial *Ovis vignei vignei*, snow leopard *Uncia uncia*, black bear *Ursus thibetanus laniger*, Tibetan wolf *Canis lupus chanco*, Tibetan red fox *Vulpes vulpes montana*, golden marmot *Marmota caudate aurea*, Himalayan otter *Lutra lutra kutub*, Himalayan giant rhesus *Macaca mulatta mcmahoni*, alpine weasel *Mustella altaica* and gray flying squirrel *Eoglaucomys fimbriatus*. Significant bird species occurring in CGNP are known as Lammergier *Gypaetus barbatus*, Himalayan Griffon Vulture *Gyps himalayensis*, Golden Eagle *Aquila chrysaetos*, Peregrine Falcon *Falco peregrinus*, Demoiselle Crane *Anthropoides virgo* (passage migrant), Golden Oriole *Oriolus oriolus*, Himalayan Snowcock *Tetraogallus himalayensis*, Himalayan Monal *Lophophorus impejanus*, Snow and Rock Partridge, Snow Pigeon and Kestrels. They have been least studied, indeed least known for the remoteness of their habitats.

Usually mammals are categorized under two groups, the large and small mammals. Small mammals are a group separated from large mammals based upon various criteria including their weight, body mass and size and they are not included in either the big game or large mammals. Therefore, in the present study few small fur bearer carnivores and herbivores are also included.

The Park may be approached either by foot or by a 4x4 jeep through its door way (Fig. 1), some 2-3 km north-west of Chitral town. The narrow way initially traverses through a quite difficult terrain which is even more risky during the rainy days. The area is monsoon free and, therefore, the climate is dry-temperate with mean annual rainfall of only 462mm and mean annual temperature 16.8°C, ranging from a maximum of 43.3°C to a minimum of -12.2°C (Akbar, 1974). The area is fairly rugged and mountainous, soils are porous and fertile on gentle slopes and shale and lime on steep slopes.

Material and Methods

Flora of the Park is diverse in nature growing under the severe environmental conditions and

edaphic factors. Tree canopy is open allowing free sunlight and air to enter. Tree stands are distantly located on slopes and in depressions. Most of the soils are treeless, bare turning the vegetation more xerophytic. Topography and climatic conditions favor to grow a large number of aromatic species (*Artemisia sps.*) and thorny bushes (caragana, Rosa and Prunus). For the purpose of understanding the animal-plant relationship in different altitudinal zones, the Park area was divided on the basis of physiographic and ecologic factors into the following three major plant communities.

Oak-Pine Community

Valleys situated in this community at lower elevation (1,980m and 2,180m) such as Merin and Kasaveer are characterized by a different type of vegetation. Few families are still permanently settled at Merin who are involved with farming and agriculture on a small piece of land (probably 8 acres). They possess large herds of cows, sheep and goats.

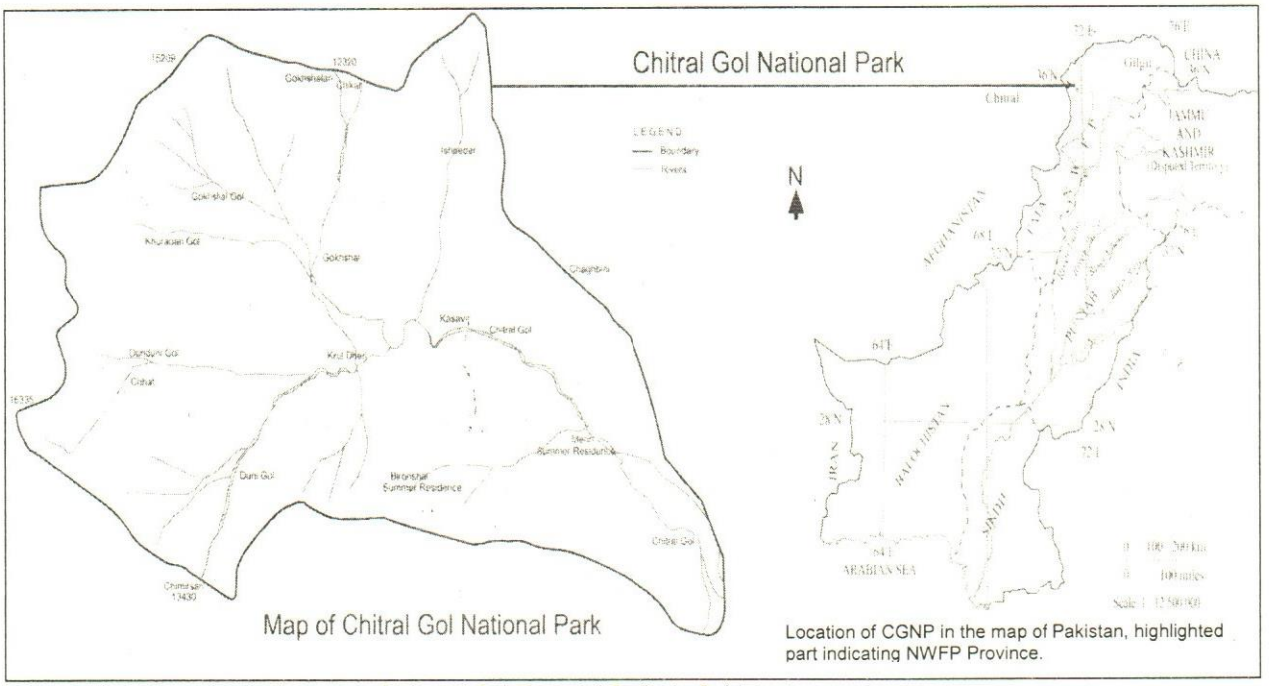


Fig. 3: Map showing the location of Chitral Gol National Park, in Pakista

A large number of fruit plants and shade trees grow in the old gardens of Mehtars at Merin and Kasaveer valleys of the Park. These include *Juglans regia*, *Pistacia khinjuk*, *Prunus amygdalus*, *Prunus armeniaca*, *Prunus padus*, *Prunus avium*, *Pyrus malus*, *Vitis vinifera*, *Morus alba* and *Ficus palmata*. Common and cultivated shade trees can be identified as Chinar *Platanus orientalis*, Willow tree *Salix spp*, *Celtis eriocarpa*, popler *Populus spp*, and *Elaeagnus angustifolia*. In addition, a well developed shrub stratum exists supporting to form rich plant communities which are represented by *Lonicera spp*, *Daphne oleoides*, *Fraxinus xanthoxyloides*, *Rosa moschata*, *Celtis australis*, *Sophora mollis*, *Sorbaria tomentosa*, *Cotoneaster spp*. *Rumex hastatus*, and *Poligonum spp*. Ground vegetation comprises mostly grasses (Poacae) and flowering herbs which are identified as *Andropogon spp*, *Cymbopogon spp*, *Stipa spp*, *chrysopogon spp*.

The range is predominated by oak (*Quercus ilex*), forests mixed rarely with Pine species. Above 2,400m mixed forests of Chilghoza pine (*Pinus gerardiana*) and oak, still higher the latter is replaced by deodar *Cedrus deodara* and juniper *Juniperus excelsa*.

Juniper-Cedar-Pine community

This community is larger in the area than the Oak-pine and Juniper communities. It provides a greater abundance and diversity of food and shelter.

The valleys of Duni and Chhat, Gokhshal and Bironshal are located in the fairly forested area of intermediate ranges (2,750-3,200m) of the Park. Floral elements in these valleys comprise sprinkled trees of blue pine *Pinus wallichina*, spruce *Picea smithiana*, Himalayan silver fir *Abies pindrow* with the dominant character of chilghoza pine *Pinus gerardiana* and cedar *Cedrus deodara*. Some shade plants are found in the riparian zones which include *Salix*

tetrasperma, *Cotoneaster spp*, *Prunus spp.* Undergrowth is rich and differs with the reflection of *Ferula narthex*, *Cirsium falconeri*, *Chenopodium foliosum*, *Arenaria griffithii*, *Lychnis indica*, *Sisymbrium irio*, *Rosa webbiana*, *Malva neglecta*, *Astragallus spp*, *Artemisia spp*, *Hypericum perforatum*, *Eremostachys vicaryi*, *Heracleum spp*, *Sonchus asper* and *Leonurus cardiaca*.

Juniper-Betula Community

This community exists in the Park above the common tree line and the species which occur in this range are of great interest. Juniper *Juniperus excelsa* and Birch *Betula utilis* may be found dotted on the steep mountain ridges whereas *Juniperus communis* creeping on the gentle slopes of open valleys. Other forest species in this range consists of willow tree (*Salix oxycarpa* and *S. wallichiana*), Rhododendron and Ephedra. Important herbaceous species which dominate in this range are *Androsace baltistanica*, *Thymus serpylum*, *Bergenia Strecheyi*, *Astragalus alpinus*, *Artemisea species* and *Draba species.* There is a great deal of species segregation with the change of topographic conditions and facing aspects of mountain slopes. High pastures are present in this range which includes widespread genera of bush layer as *Aconitum*, *Lonicera* and *Artemisia*.

Work in the CGNP was carried out during the period from June 8 to 26, 2004. A total of 670 Shermans and 9 Tomahawks trap nights and 7 mist net hours of effort were expended. Traps and nets were set in selected areas in an effort to gain better understanding of specific habitat preferences of various species. Baits used to attract the animals are described with their relative traps. The scheme of methods for the collection of small mammals and further study followed, adapted by many authors in the past (Burton, 1915 and 1918; Anderson, 1965; Nagorson and Peterson, 1980). Small mammals were caught in live and snap traps. Detailed data such as sex, lengths, weights and other features were noted down for identification.

In the present study 157 small mammals belonging to 11 different species were captured. Among them 123 were dealt with detail for their body mass, sex, reproductive condition and some ecological features (Sollberger, 1943). In mammals, the body mass is the most important characteristic in taxonomic data (Silva and Downing, 1995) to ascertain the features of physiology, morphology, life history and to some extent the ecological role of the species (Peters, 1983; Lidicker, 1997). In addition to its importance as taxonomic data, Corbet and Hill (1992) while revising the mammalian species of the Indo-Malayan region, identified *Petaurista philippensis* as a distinct species on taxonomic basis which was earlier known as *P. petaurista philippensis* (a sub species).

Fig. 4: The stone marten *(Martes foina)* caught in a tomahawk trap.

Tomahawk live traps (National Trap Corp., P.O. Box 302, Tomahawk, Wisconsin, USA), were used for capturing the flying squirrels, martens, weasels (Fig. 4 and 5) and other animals of same size. These traps were baited with chicken pieces and sardine vegetable oil for carnivores and mixed fruits, vegetables, wild nuts, seeds and some buds and leaves for herbivores.

Fig. 5: The Grey Flying Squirrel *Eoglaucomys fimbriatus* caught in a tomahawk trap.

Longworth live traps (longworth Scientific Instrument Company Limited, Thames Street Abingdon, Berkshire, England) were used to capture rodents, shrews and other animals of the same size baited with rolled oats, peanut butter, porridge and some mixed grains. Shermans live traps (H. B. Sherman Company, Box 683, Deland, Florida, USA), which allow the unharmed release of specimens were mostly used to catch live small mammals (rodents and shrews). Baits were same as used in the Longworth live trap. To collect small rodents and shrews, the most successful special museum snaps traps (Victor Traps, Litiz. Pennsylvania, USA) were used which are

considered very effective. These traps were baited with a paste of peanut butter, rolled oats and porridge.

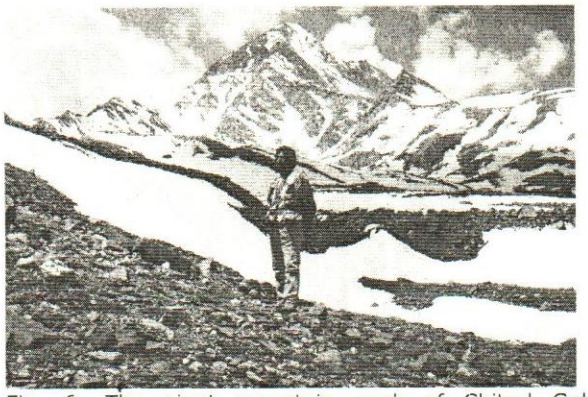


Fig. 6: The giant mountain peak of Chitral Gol National Park. The author is exploring the habitat of Golden Marmot *Marmota caudata aurea*, (4,200m asl).

Efforts were used to capture flying squirrels into mist nets (Bleitz Wildlife Foundation, Hollywood, California) fixed in the gaps between the tree boles assuming that they will be caught during the glide at night. Size of the net may vary from 2x6m to 2x12.5m. Mist nets are also helpful and successful to capture live bats. These nets were used in the caves and in the open valleys where bats were seen flying at night. Equipments used for flushing animals includes Cannon T-70 and Nikon F4E (Camera bodies), Nikon FD 35-200mm zoom lens, zoom lens FD 35-70mm (macro), Telephoto lens (Sigma) 500mm, and extender FD 2X, while Telescope 60mm 15x-60x, Nikon (Japan).

The whole area was surveyed on foot. The sighting of the animal was noted down and calculated to determine the population abundance particularly of those animals which were not caught through the traps. The presence of the animals was also detected by identifying their foot tracks.

Viewing the importance of taxonomy, captured individuals were weighed and measured with a spring scale (Pesola, Swiss) accurate to 1g and 1mm, respectively. Three main stages (immature, sub-adult, adult) of age were identified on the basis of body mass, measurements, morphological characters (Davis, 1963) and development of the sex organs. Reproductive condition was assessed on the basis of position of testis and development of mammae. Adult females were further distinguished as lactating, pregnant or in oestrus. Males were also designated in different categories. Tissues taken were preserved in 90% ethanol. The whole animals were preserved in 10% formaldehyde solution.

The field work of small mammals was conducted only in the core area of the Park which ranges from 1,500m at Hyrankot and 4,979m above Dunduni Gol at the giant mountain peak of the area (Fig. 6). The scheme of nomenclature and classification in the present study is adapted from Nowak (1991), Corbett and Hill (1992) and Roberts (1997).

Results and Discussion

Biodiversity of small mammals as a component particularly in CGNP has never been investigated, however, Roberts (1997) has given a comprehensive account of mammals of Pakistan. Florida State Museum, Gainesville, USA in collaboration with Pakistan Museum of Natural History (PMNH) and Zoological Survey Department (ZSD), Pakistan carried out an expedition of small mammals in Pakistan during 1991-1997, and conducted frequent surveys throughout the country. They did not work particularly in the core areas of the CGNP to evaluate its biodiversity of small mammals. They visited some of the areas of buffer zone of CGNP but their findings on small mammals as a whole are still awaited. Therefore, this study is the first published account of the ecological distribution of small mammals in Chitral Gol National Park.

Species Description

Asiatic White-toothed Shrew *Crocidura pullata,* Miller

Smallest existing mammal on the earth is an insectivorous shrew. Insectivores are usually small size mammals, which have long and narrow snouts (upper jaw) projecting longer than the lower jaw. Except for the arboreal tree shrews or semi-aquatic forms all others are nocturnal, adapted to terrestrial or fossorial life (Walker, 1964).

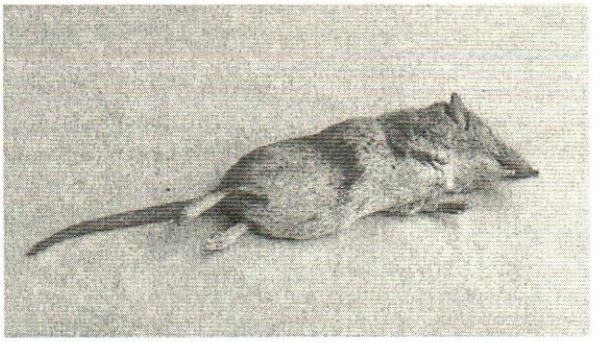


Fig. 7: Asiatic White-toothed Shrew *Crocidura pullata*

The Insectivores found In Pakistan are nocturnal in habit. During the field work, extensive areas were investigated by installing traps (Sherman live traps and Special Museum Snap Traps) at suitable places in different

ranges and zones. Only a single insectivore was trapped in Special Museum Snap Trap.

Shrew was caught in Gokshal area at 2,727m in the valley bottom along the base of a vertical cliff shaded with few cedar trees *Cedrus deodara* and chilghoza pine *Pinus gerardiana*, not more than 40 meters from the damp area of the stream (Chitral Gol). The lone catch of this shrew may either be due to its extreme rarity or its avoidance of entering the traps.

Study of this genus (*Crocidura*) in different geographical regions has created the taxonomic difficulties in separating the races on specific level. Blyth (1855) while working in Burma, described *Crocidura fuliginosa* from Schwegy near Pegu. Ellerman and Morrison-Scott (1951) examined specimens of this species in British Museum collection, the animals collected from Kumaon and Punjab were assigned to *Crocidura pullata*. Miller (1911) described *Crocidura pullata* which he caught from Kashmir and Miller (1913) recorded *Crocidura pergrisea* from Shigar, Skardu.

Table 1: Bioecological details of small mammals captured during June 08 - 26, 2004 in Chitral Gol National Park.

Species Name	Sex	Dimensions (mm)					WT (gm)	Major Habitat	Alt. (m)	Reproductive condition
		TL	HB	TA	HF	ER				
Chaghbini Ishpader- CGNP Alt. 2,946m = N 35 -54- 18.9 E071-44-44.3 Alt. 2,940-3,050m										
Dryomys nitedula	♀	177	90	88	17.5	23	23	*C. deo*	3050	perforate
Cricetulus migratorius	♀	137	98	39	20	19	25	*R. web A. sp*	3000	imperforate
Calomyscus bailwardi	♀	180	85	95	21.5	18	18	*C. deo P. ger*	3000	perforate
Calomyscus bailwardi	♀	170	81	89	22	18	17.5	*C. deo P. ger*	3000	imperforate
Calomyscus bailwardi	♂	154	87	67	22.5	18	21	*C. deo P. ger*	3000	descended
Apodemus rusiges	♀	194	99	95	22	17	18	*C. deo P. ger*	2950	imperforate
Apodemus rusiges	♂	194	99	95	23	17	22	*C. deo P. ger*	2950	descended
Apodemus rusiges	♀	189	100	89	24	16	25	*C. deo P. ger*	2940	perforate
Apodemus rusiges	♂	195	93	102	23	17	27	*C. deo P. ger*	2960	descended
Apodemus rusiges	♂	180	89	91	25	17	18.5	*C. deo P. ger*	2945	subadult-adult
Apodemus rusiges	♀	195	96	99	24	16	21	*C. deo P. ger*	2955	imperforate
Apodemus rusiges	♂	207	104	103	24	17	31	*C. deo P. ger*	2940	descended
Apodemus rusiges	♂	204	94	110	24	18	22	*C. deo P. ger*	2950	descended
Apodemus rusiges	♂	195	100	95	22	17	18.5	*C. deo P. ger*	2960	non-descended
Apodemus rusiges	♀	173	89	84	24	16	15	*C. deo P. ger*	2950	sub-adult
Apodemus rusiges	♂	200	96	104	23.5	17	29	*C. deo P. ger*	2950	descended
Apodemus rusiges	♀	155	76	79	21.5	15	13	*C. deo P. ger*	2940	immature
Dryomys nitedula	♂	182	90	92	22	18	24	*J. exc C. deo*	2940	breeding male
Calomyscus bailwardi	♀	172	83	89	21+	20	18	*P. ger*	2960	lactating
Calomyscus bailwardi	♂	160	72	88	21	19	15	*P. ger J. exc*	2960	non-descended
Calomyscus bailwardi	♂	172	90	82	23	20+	22	*P. ger J. exc*	2960	descended
Calomyscus bailwardi	♀	180	84	96	21+	19+	18	*P. ger J. exc*	2960	imperforate
Calomyscus bailwardi	♂	180	84	96	22	18	20	*C. deo P. ger*	2960	non-descended
Calomyscus bailwardi	♀	153	67	86	22	20	18	*C. deo P. ger*	3000	sub-adult
Calomyscus bailwardi	♂	174	83	91	21.5	19	15	*C. deo P. ger*	3000	sub-adult
Calomyscus bailwardi	♂	170	80	90	21	17	15	*C. deo P. ger*	3000	sub-adult
Calomyscus bailwardi	♀	170	76	94	21	18	17	*C. deo P. ger*	3000	sub-adult
Calomyscus bailwardi	♂	171	83	88	21	20	18	*C. deo P. ger*	3000	sub-adult
Calomyscus bailwardi	♀	172	79	93	21	18	19	*C. deo P. ger*	3000	imperforate
Apodemus rusiges	♂	200	95	105	23	18	22	*C. deo P. ger*	3000	descended
Apodemus rusiges	♀	201	95	106	23	18	19	*C. deo P. ger*	3000	descended
Apodemus rusiges	♀	180	85	95	24	15	16	*C. deo P. ger*	3000	imperforate
Apodemus rusiges	♀	190	90	100	22	18	22	*C. deo P. ger*	3000	perforate
Apodemus rusiges	♀	175	83	92	24	17	17	*C. deo P. ger*	3000	sub-adult
Apodemus rusiges	♀	188	92	96	22	17	16.5	*C. deo P. ger*	3000	imperforate
Apodemus rusiges	♀	180	108	72	24	20	24	*C. deo P. ger*	3000	imperforate

Apodemus rusiges	♀	171	81	90	23	18	18	*C. deo P. ger*	3000	sub-adult
Apodemus rusiges	♂	172	84	88	24	16	15	*C. deo P. ger*	3000	subadult-adult
Calomyscus bailwardi	♂	165	94	71	22	20+	19	*C. deo P. ger*	2984	descended
Calomyscus bailwardi	♂	172	81	91	21.5	18	18	*C. deo P. ger*	2984	non descended
Apodemus rusiges	♀	225	111	114	22	16	41	*Grasses rocks*	2950	pregnant
Apodemus rusiges	♀	192	99	93	23	17+	27	*Grasses rocks*	2950	pregnant
Apodemus rusiges	♂	194	102	92	24	16+	24	*Grasses*	2930	descended
Apodemus rusiges	♀	199	98	101	25	18	32	*P. ger grasses*	2975	pregnant
Apodemus rusiges	♀	195	95	100	21	17	22	*Pr. ebu*	2975	imperforate
Apodemus rusiges	♂	185	89	97	24	17	21	*P. ger grasses*	2975	non-descended
Apodemus rusiges	♂	203	94	109	25	18	23	*P. ger grasses*	2975	non-descended
Apodemus rusiges	♂	201	100	101	24	18	24	*P. ger grasses*	2975	non-descended
		Gokhshal-CGNP N35°-54´-06.2" E071°-41´-45.7" Alt. 2,700-2,870m								
Rattus turkestanicus	♂	340	160	180	35	25	130	*Sal. sp riparian*	2730	descended
Crocidura pullata	♀	111	70	41	12	8	4.5	*P. ger*	2727	imperforate
Alticola roylei	♂	161	111	50	22	17	30	*P. ger*	2750	non-descended
Alticola roylei	♂	160	115	45	22	18	26	*P. ger*	2800	descended
Alticola roylei	♂	162	111	51	21.5	18	32	*P. ger*	2770	non-descended
Apodemus rusiges	♂	172	82	90	22.5	16	15	*J. exc*	2790	non-descended
Apodemus rusiges	♀	190	91	99	22.5	19	18	*J. exc P. ger*	2780	imperforate
Apodemus rusiges	♂	188	93	95	22.5	15	18	*J. exc P. ger*	2760	non-descended
Apodemus rusiges	♂	196	96	100	24.5	19	25	*J. exc P. ger*	2750	descended
Apodemus rusiges	♂	185	92	93	22.5	18	21	*J. exc P. ger*	2770	non-descended
Apodemus rusiges	♂	195	104	91	23.5	17	17	*J. exc P. ger*	2800	non-descended
Apodemus rusiges	♀	200	104	96	23	18	31	*J. exc P. ger*	2790	pregnant
Apodemus rusiges	♂	175	89	86	22.5	16	16	*J. exc P. ger*	2750	sub-adult
Dryomys nitedula	♀	178	100	78	21	16+	27	*C. deo*	2770	imperforate
Dryomys nitedula	♂	178	94	84	22	16	25	*C. deo*	2760	descended
Dryomys nitedula	♀	176	90	86	21.5	14	25	*C. deo*	2800	perforate
Calomyscus bailwardi	♀	178	87	91	20	18	17	*Dry area, grasses*	2790	perforate
Martes foina	♂	630	390	240	85	39	1110	*Scree, C. deo*	2800	non-descended
Alticola roylei	♀	152	103	49	20+	17	35	*C. deo Rocks*	2840	perforate
Alticola roylei	♀	163	113	50	21+	16	45	*C. deo Rocks*	2830	pregnant
Apodemus rusiges	♂	162	94	68	24	16	29	*C. deo Rocks*	2830	descended
Apodemus rusiges	♀	191	94	97	23+	18	25	*C. deo*	2840	perforate
Apodemus rusiges	♂	180	89	91	23.5	18	20	*C. deo*	2840	non-descended
Apodemus rusiges	♀	190	90	100	22.5	17+	24	*C. deo*	2850	perforate
Apodemus rusiges	♂	170	76	94	24	16	18	*C. deo*	2870	non-descended
Apodemus rusiges	♀	160	78	82	21	16	14	*C. deo*	2860	sub-adult
Apodemus rusiges	♀	182	90	92	23.5	16+	18	*C. deo*	2860	imperforate
Dryomys nitedula	♀	170	81	89	22+	13	22	*C. deo Rocks*	2860	perforate
Alticola roylei	♀	171	115	56	21+	19	34	*C. deo P. ger*	2870	perforate
Alticola roylei	♂	135	109	26	22.5	15	37	*C. deo P. ger*	2850	non-descended
Alticola roylei	♀	172	120	52	22	19	41	*C. deo P. ger*	2850	perforate
Alticola roylei	♂	177	125	52	22	17	35	*C. deo P. ger*	2840	non-descended
Calomyscus bailwardi	♂	179	83	96	22	19	15	*C. deo P. ger*	2870	non-descended
Apodemus rusiges	♀	170	76	94	23.5+	18	15	*C. deo P. ger*	2870	sub-adult
Apodemus rusiges	♀	175	105	70	24	18+	25	*C. deo P. ger*	2860	perforate
Apodemus rusiges	♂	199	90	109	24	18	24	*C. deo P. ger*	2870	non-descended
Apodemus rusiges	♀	196	96	100	24	19	26	*C. deo P. ger*	2850	imperforate
Apodemus rusiges	♂	175	110	65	25	18	23	*C. deo P. ger*	2850	sub-adult

Apodemus rusiges	♂	176	82	94	24.5	16+	12	*C. deo P. ger*	2860	sub-adult
Khuraoan, Upper Dunduni CGNP Alt. 3,800m N 35°-54′-34.2" E071°-39′-31.5"										
Alticola roylei	♀	170	122	48	21	11	24+	*J. com B. util Grass*	3600	perforate
Alticola roylei	♀	165	124	41	22	18	22	*J. com B. util Grass*	3600	perforate
Alticola roylei	♂	120	94	26	20	10	11	*J. com B. util Grass*	3700	immature
Apodemus rusiges	♂	195	101	94	24	19	20	*J. com B. util Grass*	3650	adult
Apodemus rusiges	♂	182	92	90	22	17	16	*J. com B. util Grass*	3650	adult
Apodemus rusiges	♀	137	87	50	25	18	14	*J. com B. util Grass*	3700	immature
Apodemus rusiges	♂	185	87	98	25.5	18	20	*J. com B. util Grass*	3700	descended
Gokhshal-CGNP N35°-54′-06.1" E071°-41′-45.6" Alt. 2,700-2,870m										
Plecotus austriacus	♀	99	47	52	10+	42	5	*C. deo P. ger*	2745	imperforate
Duni, Chhat-CNGP Alt. 2,800-3,200m										
Alticola roylei	♂	156	115	41	21	13	24.5	*C. deo P. ger P. wal*	2840	non-descended
Apodemus rusiges	♀	156	102	54	22	19	32.5	*C. deo P. ger P. wal*	3100	pregnant
Apodemus rusiges	♂	201	98	103	24.5	17	26	*C. deo P. ger P. wal*	2930	descended
Apodemus rusiges	♂	161	91	70	24	18	25.5	*C. deo P. ger P. wal*	2870	descended
Apodemus rusiges	♂	202	106	96	24.5	17	26	*C. deo P. ger P. wal*	2860	descended
Apodemus rusiges	♀	190	99	91	24.5	16	16	*C. deo P. ger P. wal*	2900	perforate
Apodemus rusiges	♂	196	100	96	22	16	26	*C. deo P. ger P. wal*	3200	descended
Calomyscus bailwardi	♀	171	82	89	21	20	17	*C. deo P. ger P. wal*	2940	imperforate
Kasaveer, Ishpader Mountain-CGNP N35°-54′-25.2" E071°-42′-53.0" Alt. 2,626m at cave										
Plecotus austriacus	♂	101	50	51	8	40	4.25	*Cave, Rocks*	2626	non-descended
Plecotus austriacus	♂	100	48	53	8	39	6	*Cave, Rocks*	2626	non-descended
Plecotus austriacus	♂	95	44	51	8	38	3.5	*Cave, Rocks*	2626	non-descended
Plecotus austriacus	♀	109	54	55	9	45	5	*Cave, Rocks*	2626	perforate
Plecotus austriacus	♀	107	52	55	9	43+	5.25	*Cave, Rocks*	2626	perforate
Kasaveer Orchards-CGNP Alt. 2,352m N35°-54′-06.2" E071°-41′-45.7" Alt. 2,180-2,250m										
Apodemus rusiges	♀	192	93	99	24	17	20	*Orchards, riparian*	2200	imperforate
Apodemus rusiges	♀	185	83	102	23	18	18	*Orchards, riparian*	2180	imperforate
Apodemus rusiges	♀	184	95	89	22	17	10	*Orchards, riparian*	2180	imperforate
Apodemus rusiges	♂	200	103	97	23.5	18	19	*Orchards, riparian*	2250	non-descended
Rattus turkestanicus	♂	282	147	135	35	25+	70	*Orchards, riparian*	2180	non-descended
Rattus turkestanicus	♂	379	187	192	37.5	27+	..	*Orchards, riparian*	2180	descended
Bironshal-CGNP N 35°-52′-31.6" E071°-42′-53.9" Alt. 3,160m										
Apodemus rusiges	♀	175	98	77	23	17	33	*Rocks, Grassy*	3160	pregnant
Apodemus rusiges	♂	184	88	96	23.5	17	22	*Rocks, Grassy*	3160	descended
Apodemus rusiges	♂	182	83	99	24	18	19	*Rocks, Grassy*	3160	non-descended
Merin-CGNP N 35°-52′-47.1" E071°-45′-03.7" Alt. 2,030m										
Eoglaucomys fimbriatus	♀	630	280	350	70	45	500	*Prunus armeniaca.*	2030	imperforate
Apodemus rusiges	♂	183	87	97	25	16	20	*Stony, orchards*	2030	non-descended
Rattus turkestanicus	♂	251	120	131	31.5	25+	42	*Stony, orchards*	2030	non-descended
Apodemus rusiges	♀	182	90	92	25	17+	21	*Stony, orchards*	2030	imperforate
Eoglaucomys fimbriatus	♀	565	265	300	65	51	525	*Prunus armeniaca*	2030	breeding female
Mus musculus	♀	165	85	80	17	13	20	*Grassy, Rocky*	2030	Imperforate

Abbreviations: TL=total length, HB=head and body, TA=tail, HF=hind foot, ER=ear, WT=weight, Alt=altitude, *C. deo=Cedrus deodara, R. web=Rosa webbiana, A. sp=Artemisia sp, P. ger= Pinus gerardiana, J. exc= Juniperus excelsa, Pr. ebu= Prunus eburnea, B. util=Betula utilis, J. comm=Juniperus communis. Sal. Sp= Salix sp*

Table 2: Details of small mammals captured/observed and released through June 8-26, 2004 in Chitral Gol National Park.

Species Name	Sex	Major Habitat	Locality	Alt. (m)	Reproductive condition
Apodemus rusiges	♂	*Cedrus deodara, Pinus gerardiana*	Chaghbini	3050	adult
Apodemus rusiges	♀	*Cedrus deodara, Pinus gerardiana*	Chaghbini	3000	pregnant
Calomyscus bailwardi	♀	*Cedrus deodara, Pinus gerardiana*	Chaghbini	2950	imperforate
Calomyscus bailwardi	♀	*Cedrus deodara, Pinus gerardiana*	Chaghbini	2950	perforate
Apodemus rusiges	♀	*Cedrus deodara, Pinus gerardiana*	Junali Dhok	2930	pregnant
Apodemus rusiges	♀	*Juniperus excelsa, Pinus gerardiana*	Gokhshal	2800	immature
Alticola roylei	♀	*Pinus gerardiana*	Gokhshal	3100	immature
Alticola roylei	♂	*Pinus gerardiana*	Gokhshal	3150	sub-adult
Apodemus rusiges	♂	*Juniperus excelsa*	Gokhshal	3200	descended
Apodemus rusiges	♀	*Juniperus communis, Betula utilis*	Khuraoan	3700	imperforate
Apodemus rusiges	♂	*Juniperus communis, Betula utilis*	Khuraoan	4000	non-descended
Apodemus rusiges	♂	*Juniperus communis, Betula utilis*	Khuraoan	4000	descended
Apodemus rusiges	♀	*Juniperus communis, Betula utilis*	Khuraoan	4000	imperforate
Alticola roylei	♂	*Juniperus communis, Betula utilis*	Khuraoan	3800	non-descended
Alticola roylei	♀	*Juniperus communis, Betula utilis*	Khuraoan	4000	perforate
Alticola roylei	♂	*Juniperus communis, Betula utilis*	Khuraoan	4000	descended
Alticola roylei	♀	*Juniperus communis, Betula utilis*	Khuraoan	3800	imperforate
Apodemus rusiges	♂	*Juniperus communis, Betula utilis*	Upper Dunduni	3600	descended
Apodemus rusiges	♂	*Juniperus communis, Betula utilis*	Upper Dunduni	3700	non-descended
Alticola roylei	♀	*Juniperus communis, Betula utilis*	Upper Dunduni	3600	perforate
Apodemus rusiges	♂	*Juniperus communis, Betula utilis*	Upper Dunduni	3750	immature
Apodemus rusiges	♀	*Juniperus communis, Betula utilis*	Upper Dunduni	3750	immature
Rattus turkestanicus	♀	*Salix sp, riparian zone*	Gokhshal	2750	sub-adult
Apodemus rusiges	♀	*Pinus gerardiana, juniperus excelsa*	Gokhshal	2740	sub-adult
Alticola roylei	♀	*Pinus gerardiana*	Gokhshal	2750	sub-adult
Apodemus rusiges	♂	*Pinus wallichiana, C. deo, P. ger*	Duni Chhat	3200	descended
Apodemus rusiges	♂	*Orchards, riparian zone*	Kasavir	2400	imperforate
Apodemus rusiges	♂	*Orchards, riparian zone*	Kasavir	2300	imperforate
Apodemus rusiges	♀	*Orchards, riparian zone*	Kasavir	2350	descended
Apodemus rusiges	♀	*Orchards, riparian zone*	Kasavir	2310	non-descended
Rattus turkestanicus	♂	*Orchards, riparian zone*	Kasavir	2180	sub-adult
Rattus turkestanicus	♂	*Orchards, riparian zone*	Kasavir	2200	descended
Apodemus rusiges	♂	*Rocks, bush grass*	Bironshal	3200	descended
Rattus turkestanicus	♀	*Juglans regia, Riparian*	Merin	2000	imperforate

Populations occurring in the temperate mountains of Pakistan have been allocated as *Crocidura pullata* due to having comparatively longer fur when compared with the other forms of the genus. The present research, without any confusion, assigns the animal to *Crocidura pullata* (Fig. 7), which were previously caught during 1997-2002 in Murree hills and in Galliat forests by the author. The form which occurs in the CGNP is the first ever record in this area and appears to be as *Crocidura pullata* Miller (see dimensions and other features in Table 1).

The biodiversity and ecology of shrews particularly montane-forest-dwelling species have been little studied.

To determine the shrew species ecologically as belonging to particular vegetation zone is not possible. The available data on shrew is not sufficient to evaluate significant difference in habitat preference and niche partitioning; some tentative conclusions about such preferences are still possible. The shrew was caught near old logs at the base of mountain, sheltering in leaf litter or woody debris as well as rock crevices. It is a small predator of centipedes,

millipedes, larvae of insects and any carrion such as birds and mammals. The species does not hibernate in winter even when the ground is covered with snow (Roberts, 1997).

Grey Long-eared Bat *Plecotus austriacus* Fischer

Chiropterans are the only mammals which are capable of flying for long distances like birds. There is a great number of species in the world to form the second largest order after the Rodentia (Walker, 1964). Bats generally like to live in dark places like caves, holes in tree, cavities in rocks and old buildings (Prater, 1965). Because bats take rest and sleep during the day and are active at night, they are nocturnal. In Pakistan the order has a rich variety of bats consisting of forty-four species (Roberts, 1997) sharing 22% of the total number of mammal species. However, in the present study only six individuals of the grey long-eared bat *Plecotus austriacus* were collected (Fig. 8).

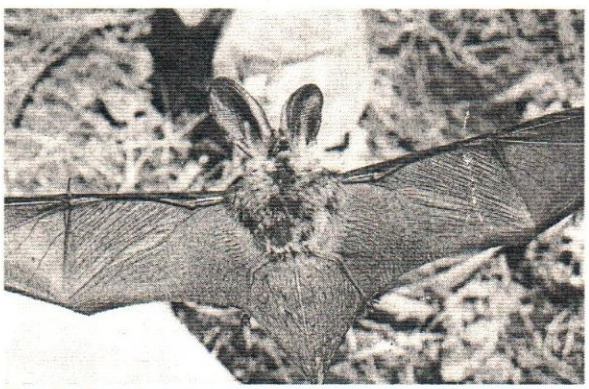


Fig. 8: Grey Long-eared Bat *Plecotus austriacus*

Out of the six long-eared bats collected in mist nets, one was caught near a stream at the mountain slope, a rugged and dry land dotted with cedar and pine trees at about 2,745m altitude and the other five were caught from the roosting site in a cave situated at 2,626m altitude. The cave is broad and long situated in a vertical mountain cliff facing south east sunshine. Many fresh signs (faecal pellets, urine and footmarks) of flare-horned markhor were observed inside the cave. It seemed a more protected place for the markhor being difficult orifice access. A big herd of 20 to 30 animals of markhor threatened by some predator (the snow leopard) can escape and hide inside the cave easily.

The bat is associated with deciduous and mixed coniferous forests of mountainous regions which provide it more sheltered and dark spaces deep in the caves and rocks for roosting and hibernation. The bat is insectivorous and the food is abundant. They emerge at dusk in search of food and pick insects near the trees and bushes. Many vertebrate predators of bats are present in the Park which hunt them at night as well as in the day at their roosting sites.

Stone Marten *Martes foina* Erxleben

The marten is a small carnivore adapted to terrestrial and arboreal life which enables it to adapt variable nature. This small carnivore was caught in Tomahawk trap at 2,800m altitude in the broken rocks along the mountain ridge at Gokhshal.

Fig. 9: Stone Marten *Martes foina*

This commonest carnivore is restricted to the dry-temperate and arid conditions spreading over the wide range of Balochistan, NWFP and Northern Areas of Pakistan (pers. obs.). Previously, it was caught and observed frequently in Chiltan-Hazarganji Mountains of Balochistan (Shafique, 2002). The stone marten (Fig. 9) avoids entering the fairly dense mixed forests where it is replaced by the endemic species, the yellow-throated marten *Martes flavigula* (Shafique, 2003).

Its food is abundantly available throughout its range as well as in the Park. It is a potential predator of arboreal mammals (flying squirrel) as well as birds and their eggs. Having great agility to climb up vertical mountain cliffs and trees it preys upon a variety of mammals and birds species. In the Park, cape hare, Royal's high mountain vole, Himalayan wood mouse and mouse-like hamster form its food.

Throughout its distribution, the habitat of stone marten overlaps with a number of other small carnivore predators; it does not overlap with the yellow-throated marten though occurring in the same range. It competes with the Altai weasel *Mustela altaica* and the stoat *M. erminea* in Gilgit-Baltistan and Indus Kohistan. In some parts of Balochistan, it occurs in the habitat close to marbled pole cat *Vormela peregusna.* It is a main competitor of red fox *Vulpes vulpes* throughout its range and shares the food resources except that found at the trees as the fox can not climb.

Tibetan Red Fox *Vulpes vulpes montana* Linnaeus

Common red fox *Vulpes vulpes* is a very commonest species in the country; thirty eight different subspecies have been recognized in the Palaearctic and Indian regions, and at least three subspecies in Pakistan (Ellerman and Morrison Scott, 1951). The species which occurs in this area is a subspecies of red fox, called Tibetan red fox. It is readily identifiable in having smaller size and longer bushy tail as compared to jackal and larger in size than the other foxes in the country (Fig. 10).

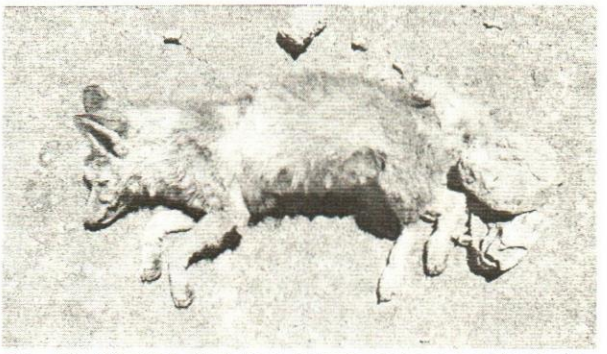


Fig. 10: Tibetan Red Fox *Vulpes vulpes montana* (A road killed female animal).

It was encountered commonly by its calls and direct sightings in the Park. Although, it is not social in its hunting habits (Roberts, 1997), the author came across four animals (perhaps the whole family) approaching the Chaghbini rest house in the evening right after the sunset. Probably, they had smelt the stored mutton and chicken or thrown away food. Nevertheless, they were common in most of the Park area as estimated by their calls, foot tracks and observations. In their hunting grounds, the prey was commonly found in the form of rodents and birds.

In case the food is limited in the form of prey they can rely on plant resources. The author has the definite record of sighting the animal feeding on the nuts of dwarf date palm *Nannorrhops ritchienna* during a survey of small mammals in district Panjgur, Balochistan. It was due to the shortage of food for the species in the area that generally comprised rodents. During a night trapping of small mammals in that particular area, the author found no result of any trapped animal which suggested the low occurrence of small mammals.

During the course of study on small mammals in the CGNP, some of the traps were found missing in the morning which were installed previous night. Presence of the flag and the disappearance of the trap was not a new story. The foot marks of the fox suggested that it took away the trap with the trapped prey. The frequency of food items consumed by the animal in order to their mass were found marmot remains followed by plant material and then domestic stock, followed by Royal's high mountain vole, *Alticola roylei* and then Himalayan wood mouse, *Apodemus rusiges* and less preferred birds and eggs (Roberts, 1997). All the above mentioned variety of its food is abundantly present in the Park.

Pallas' Cat *Felis manul* Pallas

The cat looks slightly heavier than the domestic cat and has comparatively shorter legs and broader forehead. It has thick and long body fur as compared to the other cats of this size. According to Roberts (1997) the status of the animal in Chitral district is unknown; however, in the present survey a single sighting in Duni area at 3,350m altitude suggested the occurrence of this small cat in CGNP. The cat is very rare and found in the higher mountainous ranges adjoining the eastern and northern borders of Afghanistan.

In CGNP, the prey is commonly present in its domain in the form of Himalayan wood mouse *Apodemus rusiges,* mouse-like hamster *Calomyscus bailwardi* and Royle's high mountain vole *Alticola roylei*. Mostly, small cats like to prey on birds. Species of birds in this range which occur includes many game birds species and are delicious food to many carnivore species (birds and mammals). The game birds known to occur in this range are Himalayan monal, Himalayan Snowcock, Snow and Rock Partridge and Snow Pigeon.

Cape Hare *Lepus Capensis* Linnaeus

Cape hare is one of the two species of family Leporidae which occupies broad latitude in Pakistan. The order Lagomorpha contains only two families distributed in Pakistan as well as the other regions of the world. All members of this group are terrestrial and are categorized as small mammals (Prater, 1965).

The cape hare is highly adaptable in variable environmental conditions ranging from the broad story deserts of southern Balochistan to the sub-alpine meadows of Hindukush-Himalaya and Karakoram through the arid and rugged mountain terrain of northern Balochistan and Khyber-Paktunkhwa (pers. obs). This ability to survive and continue in a wide range makes it a favourite game animal. Cape hare was commonly observed in the fairly forested canopy with dense undergrowth of many lower plants (shrubs, herbs, grasses). Being a consumer of grasses, the cape hare is one of the important foragers which influence the structure and function of grassland ecosystem.

The animal is a most wanted prey to all the carnivores present in the area.

Small Kashmir Flying Squirrel *Eoglaucomys fimbriatus* Howell

Order Rodentia is the largest mammalian group in the world (Corbett and Hill, 1992). In Pakistan, it is the second largest following Chiropterans (Roberts, 1997). They are generally small in size except porcupine and marmots. The genus *Hylopetes* can easily be differentiated from the genus *Petaurista* by its smaller average size and relatively shorter but broader tail with hairs usually spreading laterally in a feather shape (Fig. 11).

Fig. 11: Small Kashmir Flying Squirrel *Eoglaucomys fimbriatus*

In the CGNP, the flying squirrel was observed inhabiting three different habitats. In Gokhshal and Duni it was confined to the mixed coniferous forest consisting of deodar, blue pine and chilghoza pine at 2,750m, in Chaghbini it preferred the combination of deodar and chilghoza pine at 3,000m and at Merin, it was associated with orchards consisting of walnut *Juglans regia* and apricot *Prunus armeniaca* at 2,030m altitude (asl), not far from the mixed forest of chilghoza pine and oak. The animal was observed feeding on the ripen nuts of apricot *Prunus armeniaca* and immature nuts of walnut *Juglans regia*. In Gokhshal, the species was observed feeding on immature cones of deodar *Cedrus deodara*. In its arboreal domain it is not beyond the approach of many predatory birds (eagles, owls, falcons) and mammals (martens).

Golden Marmot *Marmota caudata aurea* Blanford

In Pakistan Marmot is the second largest rodent after porcupine. Two species are distributed at high altitude in northern mountains, the golden marmot and Himalayan marmot.

In CGNP, the golden marmot *Marmota caudata aurea* was observed mostly confining to the Creeping Juniper *Juniperus communis* and sub alpine grasses, in Dunduni and Khuraoan ranging from 3,600m to 4,200m altitude (Fig. 12).

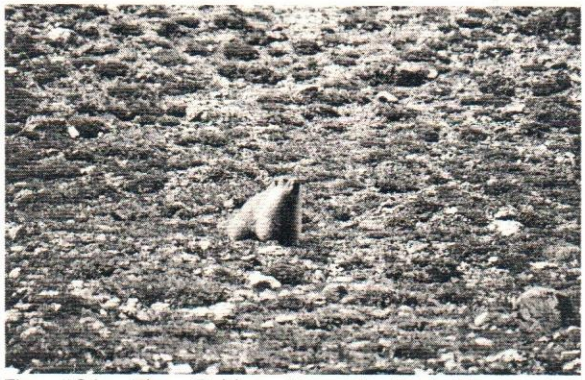


Fig. 12A: The Golden Marmot *Marmota caudata aurea*, in its natural habitat.

The observation showed that its population in CGNP was not as much as encountered in Khunjerab National Park. As excellent summer pastures, the habitat of this animal had been under tremendous pressure from livestock of the local people in the past. It might be one of the reasons limiting its population. Quantity and quality of food as a component of environment is an important factor which may influence an animal's chance to survive and multiply by modifying its fecundity, longevity or development (Kawamichi, 1997).

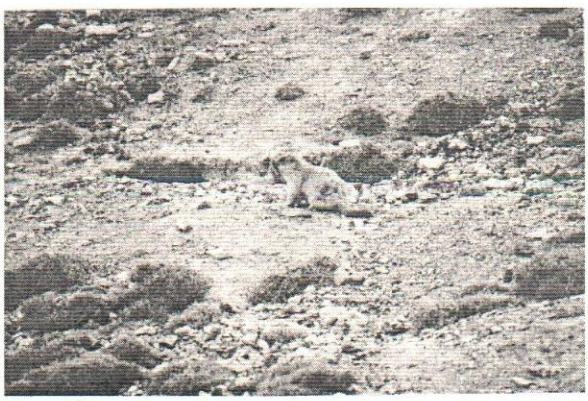


Fig. 12B: The Golden Marmot *Marmota caudata aurea*, (after threatening, approaching to his nest hole)

The animal though adapted to survive at high altitude is not out of the reach of its natural predators, the snow leopard, Himalayan lynx and red fox. Examination of the scats showed that 25% of the total diet of snow leopard and 19% of the red fox diet included marmots in Khunjerab National Park (Blumstein, 1992A).

Presence of both the predators in the present habitat of marmot was confirmed by their active foot tracks.

Forest Dormouse *Dryomys nitedula* Pallas

The forest dormouse *Dryomys nitedula* has interesting characteristics of ecological value which relate to flying squirrels with respect to its gliding and arboreal nature (Roberts, 1997) though it has no flanks (gliding membrane). At a glance it deceives to be a flying squirrel. It has a pinkish-grey thick fur on the dorsal, whitish on the ventral surface with a bushy tail. Eyes are large as flying squirrels or other nocturnal animals. The mouse is beautiful to look at (Fig. 13).

Fig. 13: The Forest Dormouse *Dryomys nitedula*, on Cedar *Cedrus deodara*.

The forest dormouse *Dryomys nitedula* inhabited the evergreen coniferous forest of Cedar *Cedrus deodara* (Fig. 13) and chilghoza pine *Pinus gerardiana* in association with many undergrowth components. It loves to remain in evergreen plants with shrubs and herbs forming the undergrowth. The undergrowth species include *Artemisea species*, *Rosa webbiana* and *Prunus eburnea*.

The forest dormouse is typically arboreal in nature. It jumps and leaps up to three feet between the adjacent branches of the trees. At night it comes on the ground for feeding where its movement is relatively slow as compared to its swiftness in its arboreal domain (Roberts, 1997). Occurrence of the forest dormouse in Pakistan was first recorded in upper Kurrum valley in 1906 (Whitehead, 1907). Previously the author collected it from Ziarat, Balochistan in 1997. In Chitral, it is the first ever record from the area of CGNP.

Turkestan Rat *Rattus turkestanicus* Satunin

The Turkistan rat *Rattus turkestanicus* is also known as House Rat, found as a commensal in human habitation as well as live in the wild. It is a big size rat (Fig. 14) with respect to its total length.

Prior to this, the author has collected it frequently from moist-temperate forest of Ayubia National Park as well as around human habitation. In the area of CGNP, the Turkestan rat was restricted to riparian vegetation or near the human settlements. It was caught as high as 2,740m altitude in Gokhshal Valley in association with willow tree *salix macrophylla* and cedar *Cedrus deodara*, at 2,200m in Merin Valley confined to the purely orchards (cultivated species) and as low as 1,980m in Kasaveer Valley in the mixed plantation of orchards and as well as in the wild habitat. They depend on large variety of food comprised of vegetables, fruits, seeds, grains and insects. Being of bold nature in the field, it is preyed by many vertebrate predators (Birds; the eagle owl, and carnivore mammals; martens).

Fig. 14: Turkestan Rat *Rattus turkestanicus*

The Turkestan rat is a common rat of moist-temperate and dry temperate mountain steppe in Pakistan. It is commonly found in Murree Hills, Abbotabad, Dir, Swat Kohistan, Chitral, Gilgit and Baltistan. During winters it migrates to the nearby human settlements and lives as a commensal of man for some period and returns to the field before the approach of summers. The rat is restricted only to the mountainous region vegetated with mixed coniferous forests; it has never been reported in the plains or as low as 1700m.

House Mouse *Mus musculus* Linnaeus

A commonest mouse in Pakistan has a wide range of its distribution. The author has collected it from Chiltan Hazarganji National Park, at 2,000m and Ayubia National Park at 2,450m in the wild plantation. In the present site it was not collected in the wild, it was trapped at 1500m in the north of Chitral town near the human settlement (Fig. 15).

The mouse is found throughout the country including plains and mountainous areas. Typically, it is associated with the human habitations but may occur in the nearby fields.

In domestic association, it attacks the stored grains and food stuff in the kitchen.

Fig. 15: House Mouse *Mus musculus*

Mouse-like Hamster *Calomyscus bailwardi* Thomas

It is a small mouse-like rodent known to occur in dry mountain steppe within the range from 600m to 3,100m elevation (Roberts, 1997). Previously the author collected the mouse-like hamster *Calomyscus bailward* (Fig. 16) abundantly around the drier rocky hill sides of Kirthar range in Sindh and along the rugged dry mountain steppe of Ziarat, Kalat and Quetta in Balochistan. It has never been reported from Khyber-Pakhtunkhwa with the exception of Kurram Agency (Roberts, 1997).

Fig. 16: A sub-adult of Mouse-like Hamster *Calomyscus bailwardi*

During the present investigation of CGNP, the hamster was caught in the plant communities of *Pinus gerardiana* mixed with *Juniperus excelsa* and sparsely dotted with *Cedrus deodara* at 2,900-3,000m. The mouse-like hamster was not collected further uplands and in the lowland valleys in Kasavir and Merin or elsewhere in the riparian zone.

Gray Hamster *Cricetulus migratorius* Pallas

Its presence in the CGNP is based on a single record (Fig. 17) caught at treeless mountain ridge vegetated with some bush and grass cover (*Rosa webbiana*, *Artemisea species* and other grasses).

Fig. 17: Grey Hamster *Cricetulus migratorius*

It was not found elsewhere in the Park though extensive trapping system was employed to capture animals. The author collected it in a dissimilar environment of Balochistan where it was associated commonly with dwarf juniper *Juniperus excelsa* and *Artemisia maritima* in Herboi hills district Kalat, and around Ziarat. It was also collected in orchards around villages of Ziarat and Kalat and found sympatric with mouse-like hamster in some of the high altitude areas of Balochistan. It also occurs in the mountainous region of Gilgit-Baltistan. Being its bold nature it frequently enters into human habitations and may adapt as commensal of man for short periods. They may often be preyed by carnivores while foraging at night.

Himalayan Wood Mouse *Apodemus rusiges* Miller

This mouse (Fig. 18) is widely distributed both in dry and moist conditions. Adaptation of the mouse is variable having extensive range in the country. Plants have little effect on the presence or absence of the mouse.

Fig. 18: A habitat of Himalayan Wood Mouse at Bironshal. No other small mammal was caught in this area.

In certain plant assemblages associated with clefts and ledges at moist temperate hill sides of Galliat forests of Abbotabad, the mouse was found commonly (Shafique, 2003). It was found less commonly in the open sandy and rocky hillsides of Ziarat where it was caught along the orchards in the bush and grass layer not much far from the wild.

Fig. 19: Himalayan Wood Mouse *Apodemus rusges*

The wood mouse is much common in the present study site associated with the plant communities as well as in the open scrub dotted with bushes and grasses. It was collected as low as 2,000m in the riparian vegetation consisting of *Salix macrophylla* and *Capparis spinosa* as well as at 2,180m in Kasavir valley in the same environment.

The mouse was collected from many parts of the Park. It was also found in juniper communities with *Juniperus excelsa* above 3,000m and with creeping juniper *Juniperus communis* above 3,500m to 4,000m along the snow line without giving any impression of plant community dependence. In the absence of suitable dwelling sites and food resources, the species (Fig. 19) appears to have wide altitudinal ranges particularly in the present study site.

Royle's High Mountain Vole *Alticola roylei* Gray

The vole is confined to the high altitudes of mountain areas usually above 3,000m (Roberts, 1997). In the present survey it was caught as low as 2,750m. The vole is small sized and mouse-like in appearance. The tail is shorter and measures half of the head and body length. The fur on the dorsal side is silvery grey, thick and long. Underparts are paler brown. The ears are small, concealed almost half in the body fur. The head is rounded, muzzle blunt, eyes large and body cylindrical (Fig. 20). It was found commonly in the Park ranging from 2,750m to 4,000m confined to bush and grass ground or in glades of rocks and talus.

The vole is diurnal as well as nocturnal in activity. Wherever it is found it occurs commonly in that area. It particularly burrows under the rocks vegetated with *Thymus serpyllum* and *Astragallus alpinum*. Royle's high mountain vole does not hibernate in winter and being a bold diurnal and nocturnal animal, it is frequently preyed by many vertebrate predators.

Fig. 20: Royle's High Mountain Vole *Alticola roylei*

Conclusion

Captured and observed small mammals were identified to species level and to some extent their ecological preferences and relationships between the species and habitat were studied. A total of fifteen species of small mammals including one species each of insectivores, chiropterans and lagomorphs, three species of carnivores and nine species of rodents were encountered during the present investigation (Table 3).

Table 3: Number of small mammal species captured and/or sighted during June 8-26, 2004 in Chitral Gol National Park.

Name of Species	Captured	Sighted	Abundance (%)
Crocidura pullata	1	0	0.53
Plecotus austriacus	6	5	5.79
Vulpes vulpes montana	0	6	3.16
Martes foina	1	3	2.1
Felis manul	0	1	0.53
Lepus capensis	0	4	2.1
Eoglaucomys fimbriatus	2	6	4.21
Marmota caudata aurea	0	8	4.21
Dryomys nitedula	6	0	3.16
Apodemus rusiges	89	0	46.84
Rattus turkestanicus	8	0	4.21
Mus musculus	1	0	0.53
Calomyscus bailwardi	21	0	11.05
Cricetulus migratorius	1	0	0.53
Alticola roylei	21	0	11.05

A single species of the smallest mammal of the Park, the Asiatic white-toothed shrew *Crocidura pullata* was trapped from the study area. The size of the animal and its intelligence may result in underestimation of its population. In Chiroptera, the long-eared bat *Plecotus austriacus* was observed commonly as forest species, a predator to control insect population. Insect-eating mammals, bats and shrews (nocturnal) eat and control insects.

Population of cape hare *Lepus capensis* was estimated in good numbers and was widespread in the Park. The cape hares influence the structure and function of the ground flora as consumer of plants and as the primary prey of raptors and carnivorous mammals. Three species of small carnivores mainly predators of rodents were recorded i.e. the Tibetan red fox *Vulpes vulpes montana,* stone marten *Martes foina* and Pallas' cat *Felis manul*. Some other carnivores also occur in this area which could not be observed during the present survey. Of those, the snow leopard *Uncia uncia* was identified by its fresh pug marks on the snow. Carnivores prey and control the rodent population and maintain the stability and balance of the ecosystem. Nine species of rodents i.e. small Kashmir flying squirrel, golden marmot, forest dormouse, Turkestan rat, house mouse, mouse-like hamster, gray hamster, Himalayan wood mouse and Royal's high mountain vole were recorded inhabiting diverse habitats.

Two species of rodents i.e. the small Kashmir flying squirrel and forest dormouse were found adapted to arboreal life and two species, the Turkestan rat and Himalayan wood mouse, were spotlighted partly arboreal and attacking ripen nuts of *Prunus armeniaca*. The other five rodent species recorded were the golden marmot, house mouse, grey hamster, mouse-like hamster and Royle's high mountain vole seemed to have adapted to fossorial way of life.

Since the area has been declared protected, many wildlife species have staged come back. Now many wildlife species may be observed particularly in the Gokhshal area such as long-eared bat, flare-horned markhor, stone marten, Tibetan red fox, Turkestan rat and small Kashmir flying squirrel, Himalayan wood mouse, Royle's high mountain vole and mouse-like hamster. The important flora of this site is dominated by *Cedrus deodara* and *Pinus gerardiana* on valley slopes, and *Salix illiensis*, *Sorbaria tomentosa* along the stream flanks, and *Rosa webbiana* both in open valleys and in dilating beds of riparian zone.

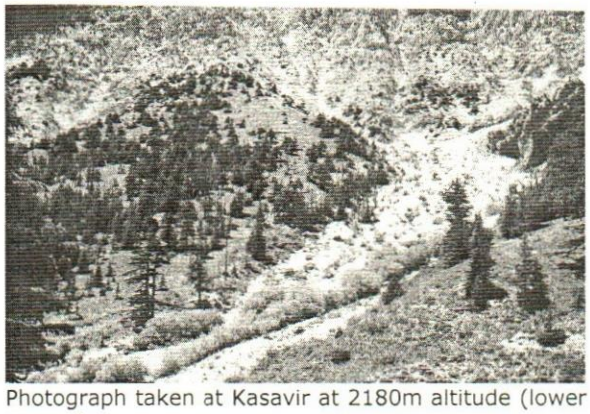
The arid and dry aspects of the Ishpeder Mountain between 2,800 and 3,500 meters altitude provide most suitable opportunities to grow *Juniperus excelsa* and *Artemisea species*. The community structure of animal species occurring in this area consisted of low number; however, the area attracted the Himalayan wood mouse and mouse-like hamster. They were seen occupying extensive ranges of the dry aspects and diverse habitats but the former seems to have played an important role. It was associated with the mouse-like hamster in the dry steppe upto 3,200m and further upwards it was sympatric with Royle's high mountain vole upto 4,000m. The vole was adapted to the cold and little mesic conditions throughout its range.

Cedar *Cedrus deodara*, in the intermediate ranges of the Park.

The fittest animal to the middle ranges of the Park at an altitude of 2,740m was stone marten because its prey species like the Himalayan wood mouse, Royle's high mountain vole and mouse-like hamster were abundantly available. It also feeds on small Kashmir flying squirrel, which occurs in the conifer forest dominated by deodar *Cedrus deodara*. Some other mammals such as flare-horned markhor *Capra falconeri cashmiriensis*, cape hare *Lepus capensis* and

Tibetan red fox *Vulpes vulpes montana* were also observed in this area.

Most of the small mammals occurring in CGNP have both Palaearctic and oriental affinities by their origin. The data on captured and observed animals provide distributional trends, abundance of the species, diversity in the Park and the occurrence of small mammal communities (Table 1 and 2). To understand the ecology and habitat preferences of animal species, the area of the Park was divided into three major plant community zones.



Photograph taken at Kasavir at 2180m altitude (lower ranges).

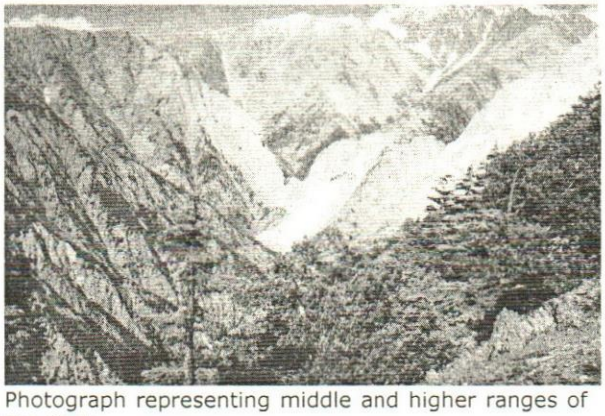
The mammalian fauna of each of the biotic communities has certain distinctive features which are summarized in Table 1 and Table 2. The pure oak forests (*Quercus ilex*) occur below 1,800m and mixed with blue pine at 2,000m. Two species of rodents, the house mouse, *Mus musculus* and Turkestan rat *Rattus turkestanicus* are restricted to the low lands and riparian vegetation of the Park which commonly occur at 1,500m and 2,200m altitudes, respectively. This fact may be partially due to the scarcity of diversified cover and food suitable for the species. Previously the author had collected these species sharing the same niche at 2,500m in a different environment - moist-temperate with mixed coniferous and broad-leaved plantation of Galliats forest of western Himalayan region. Therefore, they may occur above the present situation in suitable habitat.

The small Kashmir flying squirrel *Eoglaucomys fimbriatus* is an arboreal rodent species which frequently occurs in Oak-pine community but the range is not limited. Other mammals such as Asiatic jackal, Tibetan red fox and cape hare are encouraged to occur in this community. It was observed that Asiatic jackal remains restricted to this community whereas the other two animals crossed the range of oak-pine communities.

Topography and the existing vegetation along with favourable climate make it an ideal environment hosting diverse species of mammals. These include giant rhesus *Macaca mulatta mcmahoni,* Asiatic jackal *Canis aureus,* Tibetan red fox *Vulpes vulpes montana,* small Kashmir flying squirrel *Eoglaucomys fimbriatus,* Turkestan rat *Rattus turkestanicus*, House mouse *Mus musculus*, cape hare *Lepus capensis* and long-eared bat *Plecotus austriacus*.

The Cedar-juniper community in the middle ranges of the Park is notable in having a more diversified mammalian fauna than any other area in the Park.

Animals like mouse-like hamster *Calomyscus bailwardi* and Royle's high mountain vole *Alticola roylei* reach its greatest abundance here after following Himalayan wood mouse *Apodemus rusiges*, which seems to have competing with its greater population with all the other rodents or all the small mammals based on data of the captured animals. Two species are found to be restricted in this range, the migratory hamster *Cricetulus migratorius* and Asiatic white-toothed shrew *Crocidura pullata*. Some species which occur here reflect the influence and mixture of fauna more characteristics of both higher and lower elevations. These are Himalayan wood mouse, *Apodemus rusiges* Tibetan red fox, *Vulpes vulpes montana* cape hare, *Lepus capensis* stone marten *Martes foina* and flare-horned markhor *Capra falconeri cashmiriensis*.



Photograph representing middle and higher ranges of the Park.

Diversity of animal species was rich in Juniper-Cedar-Pine community which consists of flare-horned markhor *Capra falconeri cashmiriensis*, Tibetan red fox *Vulpes vulpes montana*, Pallas's cat *Felis manul*, small Kashmir flying squirrel *Eoglaucomys fimbriatus,* migratory hamster *Cricetulus migratorius,* Himalayan wood mouse *Apodemus rusiges*, Royle's high mountain vole *Alticola roylei,* mouse-like hamster *Calomyscus*

bailwardi and Asiatic white-toothed shrew *Crocidura pullata*.

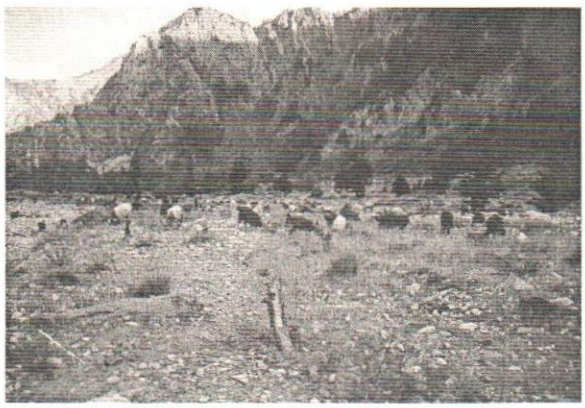
Three species of rodents, the Himalayan wood mouse *Apodemus rusiges,* Royle's high mountain vole *Alticola roylei* and golden marmot *Marmota caudate aurea* are found common in juniper-betula community but the Himalayan wood mouse *Apodemus rusiges* and Royle's high mountain vole *Alticola roylei* reach a greater abundance in the Juniper-Cedar-Pine community whereas golden marmot is restricted in juniper-betula community which was not found elsewhere in the lower communities because of its adaptation to high altitude around 4,000m. In winter, juniper-betula community is completely covered with heavy snow and golden marmot remains in hibernation for long period (Blumstein, 1992A and B). Other mammals which occur in this range are mostly furry or large mammals which include snow leopard *Uncia uncia*, Himalayan lynx *Felix lynx,* Tibetan wolf *Canis lupus chanco*, Tibetan red fox *Vulpes vulpes montana,* Himalayan black bear *Ursus thibetanus laniger* and flare-horned markhor *Capra falconeri cashmiriensis.* Himalayan black bear and Tibetan wolf harbor the Park area occasionally (Malik, 1985).

Importance and Limiting Factors

Small mammals covered in this paper are taxonomically very diverse. They are an important group of animals pertaining to conservation because most of these have short life spans and respond rapidly to environmental changes. Subsequently, monitoring small mammal populations is an important tool in developing management and conservation strategies. Small mammals are considered most important animals of many terrestrial ecosystems. They are major consumers of primary productivity and influence insect population as well as being an important food base for many vertebrate predators (mammals, birds and reptiles). Small mammals affect the abundance and diversity of the species throughout the food chain. Occurrence of carnivores in an area depends upon the availability of its food. Snow leopard and wolf cannot subsist only on few small rodents and shrews. They need larger animals to feed on, which can fulfill their dietary requirements. Small mammals may be a reserve resource in difficult times when the attempts of larger carnivores fail to prey on big herbivores. Small mammals can be preyed easily at night, which are nocturnal in habits. Those, which are diurnal in their habits such as marmot and cape-hare, are preyed upon in the day time. Being an important food resource, these two diurnal mammals release the predation pressure from the protected animal, the flare-horned markhor (threatened species).

The presence of cape-hare and golden marmot in the CGNP is a vital factor in reducing the predation pressure on flare-homed markhor. Both herbivore cape-hare and golden marmot are present in good numbers. If the managers of the Park intend to improve the status of the snow leopard and flare-homed markhor they have to provide conditions that help the cape hare and golden marmot populations to flourish in the Park. This will ultimately help in increasing and stabilizing snow leopard population and releasing predation pressure from flare-horned markhor. This is only possible if complete restriction on grazing of domestic animals in the pastures is strictly enforced. The more verdant the pastures will guaranty an increase in the population of herbivores that forms the food chain in maintaining the ecosystem of the Park.

Forest fragmentation and poaching caused by man is considered a major threat to this ecosystem. This process influences natural communities, causing changes in species abundance and sometimes leading to species extinction. Additionally, the disturbance in the environmental system caused by man usually results in a decrease of the system's stability. The small mammal fauna of the Park has suffered from intensive disturbances of habitat modifications such as grazing, movement of livestock or deforestation and human settlements.



Livestock grazing at Gokhshal Valley

The population of any forest species may be threatened due to the continuous loss of the forest. Removal of the trees for firewood can be detrimental because dead trees (snags and stumps) and old trees having cavities are often used by many wildlife species as nests.

Natural and woodpeckers constructed tree cavities are used for nesting and resting sites by many terrestrial vertebrate species as well as some small arboreal mammals e.g., stone marten, flying squirrel, giant rhesus and forest dormouse etc. About 20% of the total vertebrate species were estimated to depend on these cavities (Shafique, 2003). Small mammals which lived in the cavities were more secure than those lived outside cavities and roosted in the open probably created more risk for them from predation and severe weather conditions (Shafique, 2004).

In Pakistan, with the exception of Ziarat, Chitral Gol National Park is an incomparable terrestrial ecosystem and with the existing small mammal species diversity can be compared to any terrestrial mountain ecosystem of the world.

The biodiversity of the small mammals of CGNP is mostly affiliated to Palaearctic origin whereas some have Oriental origin such as Himalayan otter, *Lutra lutra* and few like Asiatic white-toothed shrew, gray long-eared bat and giant rhesus have Indo-Malayan affinities.

Suggestions

By controlling the little remaining poaching, grazing and wood cutting, the management and conservation tools would be much affective for future subsistence of wildlife species.

Few more seasonal surveys may be conducted to assess the occurrence of other species. It is strongly felt, based on the field survey conducted that Ermine weasel or Alpine weasel (carnivores), and Royle's pika and Indian porcupine may inhabit the area.

Longer-term studies are needed to better understand the influence of predators on the small mammals, population sizes, and key ecological interactions because of their conservation importance, and because natural populations of the region have suffered historic declines.

Zahler (1997) during the investigation of woolly flying squirrel in northern Pakistan has given the probability of existence of this animal in the mountain cliffs near Gokhshal in CGNP. According to local people there is a rock in the area, which produces Salajeet and in the past some local people have collected it from there. Woolly flying squirrel is strictly confined to the Salajeet producing rock cliffs. Salajeet contains urine and faecal pellets of woolly flying squirrel found in Gilgit, Pakistan (Zahler, 1997). This information suggests the presence of woolly flying squirrel in this area.

The species was rediscovered in Gilgit by Zahler (1997) in 1996 after a lapse of seventy two years. Due to its presence in few numbers in Giligt areas, it is endemic to Pakistan and is considered endangered (IUCN).

Acknowledgements

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References

Akber, A. 1974. Chitral Gol Sanctuary for markhor. Pakistan Journal of Forestry, 24(3): 209-212.

Aleem, A. 1976. Markhor in Chitral. Pakistan Journal of Forestry, 26:117-128.

Anderson, R.M. 1965. Methods of Collecting and Preserving Vertebrate Animals 4th ed. (rev.) National Museum of Canada, Bulletin No. 69, Ottawa.

Blumstein, D.T. 1992A. The Behavioral Ecology of Golden Marmot and Community Ecology of Dhee Sar (Khunjerab National Park). A progress report, November 1991, Department of Zoology, University of California, Davis.

Blumstein, D.T. 1992B. Summer Diets of Tibetan Red Foxes in Khunjerab National Park, Pakistan. (submitted in Journ. of Mammalogy).

Blyth, E. 1855. *Sorex fuliginosa*, J. Asiat. Soc. Bengal. 24: 362.

Burton, Lieut. Col. R.W. 1915. Weights and Measurements of Game Animals. JBNHS, Vol. 24, No.1, Misc. Notes, p 186.

Burton, Lieut. Col. R.W. 1918. Notes from the Oriental Sporting Magazine-New Series 1869-1879. Weights of Animals. JBNHS, Vol. 25, No.4, pp. 740-1.

Corbet, G.B. and Hill, J.E. 1992. The Mammals of the Indomalayan Region, a systematic review. Natural History Museum Publications, Oxford University Prsss, Oxford. United Kingdom. 481pp.

Davis, D.E. 1963. Estimating the numbers of game populations, pp. 89-118. In: Wild-life

investigational techniques (Ed. H. W. Mosby) The Wildlife Society, 2nd Ed. Washington D.C.

Ellerman, J.R. and Morrisson-Scott, T.C.S. 1951. Checklist of Palaearctic and Indian Mammals 1758-1946. British Museum (Natural History) London. 810 pp.

IUCN 1986. Directory of Indomalayan Protected Areas Pakistan, IUCN conservation monitoring centre Cambridge. 51pp.

Kawamichi, T. 1997. The age of sexual maturity in Japanese giant flying squirrels, *Petaurista Leucogenys*. Mammal Study, 22:81-87.

Lidicker, W.Z. Jr. 1997. Reviews on Handbook of mammalian body masses, M. Silva and J. A. Downing. J. Mammalogy. 78:987-988.

Miller, G.S. 1911. *Crocidura pullata species*. Proc. Biol. Soc. Washington, 24: 241.

Miller, G.S. 1913. *Crocidura pergrisea species*. Proc. Biol. Soc. Washington, 26: 113.

Malik, M.M. 1985. Management of Chitral Gol National Park, Pakistan. In McNeely, J.A., Thorsell, J.W. and Chalise, S.R. (Eds), People and protected areas in the Hindu Kush-Himalaya. King Mahendra Trust for Nature Conservation and International Centre for Integrated Mountain Development, Kathmandu. pp103-106.

Nagorsen, D.W. and Peterson, R.I. 1980. Mammal Collectors Manual. Life Sciences Miscellaneous Publications, Royal Ontario Museum. 79pp.

Nowak, R.M. 1991. Walkers Mammals of the World 5th edition. John Hopkins University Press, Baltimore, Maryland. 1:1-642.

Peters, R.H. 1983. The ecological implications of body size. Cambridge University Press, Cambridge. 329pp.

Prater, S.H. 1965. The Book of Indian Animals. (2nd ed). Bombay Natural History Society, Bombay. 324pp.

Roberts, T.J. 1997. The Mammals of Pakistan (Revised Ed.). Oxford University Press, New York. 525pp.

Shafique, C.M., Hassan, A. and Arain, Q.N. 2002. Wildlife of Chiltan Hazarganji National Park, Balochistan. Rec. Zool. Surv. Pakistan. 14:55-9.

Shafique, C.M. 2003. Some Aspects of Bio-ecology of Ayubia National Park, NWFP-Pakistan. (PhD Thesis) University of Karachi, Pakistan. 438pp.

Shafique, C.M. 2004. Ecology of Flying Squirrels of Ayubia National Park. Report submitted to WWF-Pakistan. 71pp.

Silva, M. and Downing, J.A. 1995. Handbook of mammalian body masses. CRC Press, Boca Raton. 359pp.

Sollberger, D.E. 1943. Notes on the breeding habits of the eastern flying squirrel *Glaucomys volans*. Ibis, 24:163-173.

Walker, E.P. 1964. Assisted by Florence Warrick, Kenneth I. Lange, Howard E. Uible, Sybil E. Hamlet, Mary A. Davis and Patricia F. Wright, Mammals of the World, 3 Vols. John Hopkins Press, Baltimore. 5th Edit. Nowak, Ronald, M. (1991) 2 Vols., John Hopkins.

Whitehead, C.H.T. 1907. "An Indian Dormouse", JBNHS, Vol. 18, Misc. Notes No. 12, p193.

Zahler, P. and Woods, C. A. 1997. The Status of Wooly Flying Squirrel *Eupetaurus cinereus* in Northern Pakistan. pp. 495-514. In: Biodiversity of Pakistan, Ed. S.A Mufti, C.A. Woods, S.A. Hasan. Florida Mus. Nat. Hist. Gainesville, USA.

Small mammals of Khunjerab National Park, Gilgit-Baltistan, Pakistan

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Abstract

Research about small mammals of Pakistan is mainly confined to those species considered as agricultural pests. The small mammal species which share boarder areas of Afghanistan and China with Holarctic and Central Asian affinities are not much known. A comprehensive survey of small mammals of Khunjerab National Park was, therefore, conducted to fill these lacunae. Seven species of small mammals are reported from the Park and its buffer zone in Northern Pakistan. Taxonomy, habitat and distribution of the species found are discussed. Habits of some of the mammals observed are also documented.

Key Words: Distribution, taxonomy, small mammals, National Parks

Introduction

Khunjerab National Park was established in 1974 and formally declared in 1975 to protect the Marco Polo Sheep and, possibly, a remnant population of the rare Tibetan wild ass (*Equus hemionus kiang*). The Park covers an area of about 2,270 square kilometers and consists of three different valleys: Khunjerab (through which the Karakoram Highway passes), Ghujerab and the remote Shimshal valley. With its snow-capped mountains, glaciers, alpine pastures and gorges, the park is home to endangered species like Marco Polo Sheep, Blue Sheep, Himalayan Brown Bear, Snow Leopard, Wolf and Fox. The Khunjerab National Park is surrounded by China in the North and north-east, by the proposed Central Karakoram National Park (CKNP) in the east, Mantika Pass, Kilik Pass and Misghar valley in the west and the upper Hunza in the south. Khunjerab valley is the core zone of the park and is drained by the Khunjerab river, Barkhun stream and the Karchanai Nullah in addition to other small streams. These streams and their headwater areas have sufficient vegetation to meet the requirements of shelter and food for small mammal species.

The large mammals are conspicuous, agile, diurnal and hence easy to locate and document. On the other hand small mammals are usually nocturnal, frequently fossorial, and always difficult to observe and, therefore, their importance and even their existence in the national parks remains obscure for an ordinary person in spite of the fact that they are most important and essential component of the ecosystem of a national park. The mainstream knowledge about the small mammals of Pakistan is mainly restricted to the species considered as agricultural pests. These species are mostly West Asian or Oriental in origin. The small mammal species found in areas of the country near the frontiers with Afghanistan and China with Holarctic and Central Asian affinities are not better known as compared to Arabian or Indian Subcontinent forms. A comprehensive survey of small mammals was, therefore, imperative to document the presence of different small mammals species in Khunjerab National Park.

Small mammals are well represented in Pakistan having 118 species making nearly 65% of the total mammalian fauna of the country. Being non-game wildlife, the small mammals have received very little attention in Pakistan. They, however, form an indispensable component of the fauna of any ecosystem. They play an important role in determining the holding capacity and maintaining the number of animals in the higher trophic level of an ecosystem. Rodents, insectivores, bats, mongooses, and pikas not only maintain ecological balance in the interlocking system of nature but also play a specific role in a self-sustained ecosystem. These small animals have a variety of feeding habits and depend upon plant origin like submerged roots, fallen seeds, rhizomes and bulbs, and animals like insects, snakes, scorpions, spiders and beetles for their food. These rodents are in turn eaten up by foxes, Jackals, cats, owls, wolves, lizards, snakes, alpine weasels, the stoats, and stone martens and bring the population of these animals to a sustainable level. Unless better data on the small mammals are available, it is not possible to determine the status of the carnivores in an ecosystem.

Material and Methods

Several standard methods for the study of small mammals are being used in the world (Wilson *et al.*, 1996; Sutherland, 1996). Based on information, the following method for the study of small mammals was adopted.

Sherman traps were used for the present studies to collect the live specimens. Different food grains mixed with fragrant seeds were used as bait in Sherman Traps for the attraction of small mammals. Wheat and rice were used as food grains while peanut butter, coriander, oats and onions were used for fragrance. One hundred traps were set at a specific area in a grid of 10X10m. The traps were checked on the next day. The trapped animals were carefully transferred, one after the other, into an already weighed transparent polythene bag. Utmost care was exercised to avoid direct handling and harassing of the specimens. Sex, weight, breeding status, habitat and other necessary data of the specimen were noted. The specimens were then released at the site of collection.

A voluminous literature on the small mammals of Pakistan has been published over the years (Beg and Hussain, 1990; Ellerman, 1961; Roberts, 1977, 1997 and 2006). Most of this work is concentrated on small mammals of agricultural importance or the species found in southern areas having affinities with west Asia or south Asia. Very little information is available on the small mammals of Himalayas or Karakoram ranges. Some work has been published exclusively on individual species (Zahler and Woods, 1997; Holden, 1996; Zahler, 1996; Arshad, 1991; Rossolimo, 1989; Phillips, 1969).

The species presented here depend on the active collections made in the area but information on distribution have also been collected from published information in Roberts, (1997 and 1977), Mirza (1969) and Siddiqi (1961). Many changes in nomenclature and the classification of small mammals have occurred in the past decades. Such changes were reviewed and adopted from Wilson and Reeder (2005 and 1993), Hoffmann (1996), and Corbet and Hill (1992).

Results and Discussion

Seven species of small mammal i.e. *Ochotona roylei*, *Marmota caudata*, *Alticola roylei*, *Hyperacrius fertilis*, *Cricetulus migratorius*, *Otonycteris hemprichi*, *Mustela altaica* were found within the boundaries of Khunjerab National Park while *Crocidura pullata*, *Apodemus pallipes* and *Sicista concolor* were found in the buffer zone.

Description of the Species Found in KNP

Ochotona roylei **Royle's Pika**

A tailless animal measures 150-200mm from nose to rump. Hind foot is 30-35mm and ears are 22-30mm long. The fur is long, dense, soft and fine, and generally gray brown to reddish brown along the head, shoulders and fore part of the body in the summer. The remainder of the dorsal surface is dark greyish rufous. Ventrally, the colour ranges from white to greyish-white to dark grey. The winter coat is similar but may show only traces of rufous coloration.

In Pakistan *Ochotona roylei* is distributed in Haji Pir Pass, Leepa valley, Machiara National Park, Neelum valley, Daukhun area (Azad Kashmir), Kaghan and Naran Valleys, Astor, Parashing valley, Deosai Plateau, Nanga parbat base camp area, Hunza, Khaplu, Hushe valley, Palas valley, and Chitral Gol area. Outside Pakistan, it is mainly found in Nepal; Tibet, Szechuan and Yunnan provinces in western China, and northern Myanmar.

Pikas are very common in the big rocks on the slopes above Khunjerab Pass. They live down in the rocks, and feed on grass. Fecal pellets are common in the same area as those of Long-tailed Marmots. Alpine Weasels were observed in same rocks, which probably feed on Pikas.

Marmota caudata **Long-tailed Marmot**

Marmots are solid and box-shaped, with the legs apart. The hind legs are shorter than the forelegs. All four feet have five digits with sturdy, blunt claws. Pads on the digits are very well developed. The fifth digit is reduced while other digits are long, flexible, and capable of holding thin plant stems. Red marmots weigh 8 to 9kg. The head of red marmots is flattened and the neck is short. The large eyes are close to the top of the head. Ears are small and barely extend beyond the fur. Long whiskers are located on cheeks, lower jaw, around the nose and eyes.

In Pakistan, *Marmota caudata* has been recorded from Upper Kaghan valley, Palas valley, Shah Sadeem Area, Azad Kashmir, Babusar Top, Nanga Parbat Base Camp1, Deosai Plateau, Khunjerab National Park. Out side Pakistan, this species is found in high alpine meadows of the Hindu Kush, Karakoram, and Tien Shan mountains of Central Asia.

This large rodent is common in areas from Goshgil (3,910m) to well above Khunjerab Pass.

We observed many in the rocky areas above Khunjerab top. During the course of our work we found few "road-kills", indicating that the species is vulnerable to vehicle accident. This is because when a marmot becomes alarmed (such as when it sees a jeep), it often will make a direct line to its burrow. If the road is between where the animal becomes alarmed marmot will often try to run across the road in front of the vehicle in order to escape to its burrow for safety, occasionally with disastrous results.

Alticola roylei **Royle's High Mountain Vole**
The head and body length ranges from 95-125mm. Body fur is dense and greyish in colour. The feet are whitish and belly colour is paler grey. Tail is bi-coloured, well furrowed, long (45-60mm) and ranging from thirty percent to half of the head and body length. Ears are comparatively long and covered with hairs on both surfaces. Upper incisors are yellow and their distal portion is grooved.

It is widely distributed in high mountain areas of Northern Pakistan. It has been found in upper Kaghan valley, Neelum valley (Azad Kashmir), Palas valley, Nanga Parbat base camp area, Fairy Meadows, Parashing and Tarashing valleys, Khanbury valley, Tangir and Darel valleys, Bonar Das valley, Rama lake area, Gondogoro (Masherbrum Mountain Area), Rutiz goa (Khaplu), Siato (Hushe), Gupis, Phandar, Shandur Pass, Kilik Pass, Baroghil Pass, Diran Peak area, Hoppar, Naltar, Deosai Plateau, Shah Sadeem (Dadkhshan border), Bamburet valley, Lowari Pass, Upper Swat (Mahodand Area). Outside Pakistan it is reported from Northern parts of Afghanistan, Tajikistan and Xinjiang (Tien Shan) province of China and Himachal Paradesh and Utterparadesh in India.

High Mountain Voles live in burrows among large rocks. The entrances to its burrows are often at the base of a rock, or in rock crevices. The High Mountain Vole is widely distributed in Pakistan and is capable of living in high mountains up to areas with perpetual snow. It is one of the most important food sources for carnivores and raptors in high mountain areas. In Khunjerab National Park this vole occurs from Dih to well above Khunjerab top and is the most common small mammal of the park.

Hyperacrius fertilis **Burrowing Vole**
It is comparatively smaller in size than Murree vole. Dorsal fur is reddish brown. Tail is dark grey and bi-coloured. The ears are more conspicuous due to comparatively shorter fur and ranges from 8-12mm in length. The head and body length ranges 90-110mm while tail length varies from 24-[illegible]m.

This species is also endemic to Pakistan including Kashmir. It has been collected from Sari, Lake Saiful Maluk (Kaghan valley), Baroghil Pass, Shah Sadeem Pass, Dorah Pass, Kilik Pass, Lowari top, Khunjerab Pass, Deosai Plateau, Besal, Burawai, Palas Valley (Ledi Meadows, Bareen Bek), Parashing, Tarashing, Rama Lake, Bonar Das Valley and Chilam.

This species has never been reported from the far north of Pakistan, and its presence in Khunjerab National Park is very significant. This vole lives in colonies, and is almost totally fossorial. It feeds on herbaceous vegetation, which it piles at the openings to its burrows to dry. The small mounds of dirt that the voles excavate can identify these burrows. Many openings are usually observed in one area. Burrowing Voles are extremely difficult to study because individual animals rarely leave their burrows. However, in the Khunjerab National Park area they leave the confines of their burrows more frequently and frequent raceways can be observed linking different burrows. Burrowing Voles are preyed upon by Alpine Weasels. This is one of the most important small mammals of Khunjerab National Park even though it is very inconspicuous and obscure.

Cricetulus migratorius **Grey Hamster**
It has very short, thin and well-furred tail. The fur is short, soft and dense. It is grey in colour. Belly, cheeks and throat is pure white. Cheek pouches are present which are usually full of grains and berries. The incisors are un-grooved on their interior surface and are coated with pale yellow enamel.

In Northern areas of Pakistan, the species is found in Ishkoman valley, Phandar, Shandur Pass, Boret Lake, Khunjerab National Park, Gulmit, Hoppar, Minapin, Naltar, Chitral Gol National Park, Mastuj, Shah Sadeem pass, and Lake Mahudhand. It is also found in Jammu and Kashmir (Agarwal, 2000). Outside Pakistan, it is found in various countries of Europe, Russia, Kazakistan, Mongolia, Northern China, Turkey, Jordan, Iraq, Iran and Afghanistan.

This species is widespread in dry, high mountain areas of northern Pakistan. It is one of the most important food sources for carnivores in Khunjerab National Park because of its abundance and because of its wide range distribution. We did not observe any of these rodents on the top of the mountains near Khunjerab top, even though it was expected

that the species would be abundant there. Grey Hamsters are extraordinarily abundant at intermediate elevations, and especially in and around the settlement of Dih. They frequently enter houses, and are found in most of the houses at Dih.

Otonycteris hemprichi **Hemprich's Long-eared Bat**

The ears are very long and broad and pale in colour with 10 transverse ridges inside the conch. The tips of the ears are bluntly rounded. The tragus is elongated (20mm on the average) and roughly half of the ear length (Roberts, 1997). Wings are relatively broad with fifth digit longer than the fourth. The head and body range from 70-80mm, tail from 55-61mm, forearm 57-66mm, ears 38-40mm, and tragus 19-20mm.

This species has been recorded from Gilgit, Yasin valley, Phander, Sost and Khunjerab National Park. Outside Pakistan, it is found in Arabian Peninsula, Egypt, Libya, Tunisia, Algeria, Turkey, Northern Afghanistan, Tajikistan, Uzbekistan and Turkmenistan. Though, it has a wide distribution in Central Asia, Arabia and North Africa, but nowhere is it common.

The center of its distribution may be the high dry mountains of northern Pakistan. Many specimens were collected from Dih area of Khunjerab National Park.

Mustela altaica **Alpine Weasel**

Males exhibit head and body length of 22-29cm, with the tail adding 11-15cm. Females measure 22-25cm, with tails length of 9-12cm. This species undergoes spring and autumn molts. The winter coat is dark yellowish to ruddy brown on the back, with pale yellow to creamy white on throat and belly. The upper head between the muzzle and ears is usually darker grey-brown. The summer fur is grey to grey-brown with some light yellow. The lips are white, and the chin has greyish-brown to whitish vibrissae.

In Pakistan it is found in Khunjerab National Park, Lake Saiful Maluke, Gitidas and Besal. Outside Pakistan it is found in South western China, Kazakistan, Kyrgyzstan, Tajikstan, Mongolia, North Korea and Kashmir, Ladakh and Sikkim.

It was observed deep down in the large boulders that surround Khunjerab Top. Pikas and Royal's High Mountain Voles live in the same rock crevices. It is usually solitary, and specializes in hunting for Royle's High Mountain Voles, Burrowing voles, and Royle's Pikas.

Description of the Species Found in Buffer Zone

Crocidura pullata **Asiatic White-toothed Shrew**

Comparatively long furred shrew with head and body length 58-80mm. The tail is slim and ranges from 36-50mm. Body colour is grey brown to dark brown. The belly fur is pale and silvery grey and there is no sharp dividing line between the upper and lower fur colouration.

It is endemic to and has wide distribution in northern Pakistan and Kashmir. It has been recorded from Galiat, Azad Kashmir, Palas valley, Upper Swat, Kaghan, Naran, Babusar Pass Area, Bamburet valley of Chitral, Boret lake (Hunza), Hashopi (Shigar valley), Chilam (Deosai), Parashing and Tarashing valleys and Fairy Meadows around Nanga Parbat, Diran peak area around Rakaposhi, Darel Tangir, Khanbury and Ishkoman valleys.

This small shrew was observed in buffer zone of Khunjerab National Park in Sust, Boret lake, Hashopi (Shigar valley) and in Deosai Plateau. There is no doubt that it occurs at various locations in the river valleys of Khunjerab National Park.

Apodemus pallipes **Wood Mouse**

This species is smaller in body size than *A. rusiges*. Its dorsal coat ranges from pale buffy brown to brownish gray. Ventral fur is whitish grey or solid white. Tail (100-110mm) is equal to or slightly longer than head and body length.

This species is mostly distributed in dry Hindukush and Karakoram ranges in Pakistan. Its altitudinal range has been reported from 1,465-3,965m (Wilson and Reeder, 2005) but during the present studies it was collected from 4050m at Dalsangpa (Upper Hushe Valley). It has been recorded from Shah Sadeem Pass (Upper Garm Chashma valley), Upper Dir and Swat Valleys, Baroghil Pass area, Gulmit, Sust, Khaplu, Hushe, Dalsangpa, Gondogoro (Masherbrum Mountain Areas). Outside Pakistan, it is found in Tajikstan, Kirgyzstan, Northern Afghanistan, Kashmir Himalayas and Nepal.

Sicista concolor **Chinese Birch Mouse**

Mouse like species covered with dull grey white greyish fur. Tail is very long, semi-prehensile, covered with small hair and almost one and a half times the head and body length. Upper

incisors are covered with orange enamel and are un-grooved while lower incisors have white enamel. Hind leg is quite long and bears five toes with strong claws. The soles of the feet are naked.

In Pakistan, it has been collected from Deosai Plateau but Roberts (1997) has reported it from Gilgit, Hazara, Kaghan valley and Chilas area. It, however, can easily be confused with sub-adult wood mouse if not captured and properly studied. Outside Pakistan, it is found in Heilongjiang, Jilin, Xinjiang, Qinghai, Gansu, Shaanxi, Sichuan and Yunnan provinces of China. It is also found in Ladakh, Kashmir and Tien Shan and Altai mountain ranges.

References

Arshad, M. 1991. *Ecology of Murree Vole, Hyperscrius wynnei Blandford in Galliat, Hazara, Pakistan.* (Ph.D. Dissertation) University of Peshawar, 182 pp.

Beg M.A. and Hussain, I. 1990. Important rodent pests of Pakistan. Ecology and distribution. In: J. E. Brooks, E. Ahmed, I. Hussain, S. Munir and A. A. Khan (eds.). *Vertebrate Pest Management*. pp. 27-38. Pangraphics Islamabad.

Corbet G.B. and Hill, J.E. 1992. *The Mammals of the Indomalayan Region*. Oxford. 488 pp.

Ellerman, J.R. 1961. *The Fauna of India including Pakistan, Burma and Ceylon*, Vol. 3, Rodentia (in two parts). Part I, 482 pp.

Hoffmann, R.S. 1996. *Noteworthy shrews and voles from the Xizang-Qinghai Plateau. pp 155-168. In Contributions in Mammalogy*: A memorial volume honoring Dr. J. Knox Jones Jr. Museum of Texas Tech. University.

Holden, 1996. Description of a new species of *Dryomys* (Rodentia, Myoxidae) from Balochistan, Pakistan, including morphological comparisons with Dryomys laniger Felten and Storch, 1968, and *D.nitedula* (Pallas, 1778). Bonner Zoologische Beitrage, 46(1-4): 111-131.

Mirza, Z.B. 1969. *The small mammals of West Pakistan. Volume 1: Rodentia, Chiroptera, Insectivora, Lagomorpha, Primates and Pholidota.* Central Urdu Board, Lahore. 145 pp. (in Urdu).

Phillips, C.J. 1969. A review of Central Asian voles of the genus *Hyperacrius*, with comments on zoogeography, ecology and ectoparasites. *Journal of Mammalogy*, 60:457-474.

Roberts, T.J. 1977. *The Mammals of Pakistan*. Ernest Benn. London, 361 pp.

Roberts, T.J. 1997. *The Mammals of Pakistan*. Oxford University Press, Karachi, New York, Delhi, 525 pp.

Roberts, T.J. 2006. *Field Guide to the small mammals of Pakistan*. Oxford University Press, Karachi, New York, Delhi, 306 pp.

Rossolimo, O.L. 1989. Revision of Royal's high mountain vole *Alticola* (A.) *argentatus* (Mammalia: Cricetidae). *Zoologicheskii Zhurnal*, 68:104-114 (in Russian).

Siddiqi, M.S. 1961. Checklist of mammals of Pakistan with particular reference to the mammalian collection in the British Museum (Natural History)-London, Biologia, 7(1-2): 93-225.

Sutherland, W.J. 1996. Ecological Census Techniques: A Handbook. Cambridge University Press.

Wilson, D.E., Cole, F.R., Nichols, J.D., Rudran, R. and Foster, M.S. (eds) 1996. Measuring and Monitoring Biological Diversity. Standard Methods for Mammals. Washington, DC: Smithsonian Institution Press.

Wilson, D.E., and D.M. Reeder (eds). 1993. Mammal species of the world, a taxonomic and geographic reference, Second ed. Smithsonian Institution Press, Washington, D.C. xviii+1207pp.

Wilson, D.E., and D.M. Reeder (eds). 2005. Mammal species of the world, a taxonomic and geographic reference, Second ed. Smithsonian Institution Press, Washington, D.C. xviii+2142pp.

Zahler, P. 1996. Rediscovery of the Woolly Flying Squirrel (*Eupetaurus cinereus*). *Jouranal of Mammalogy*, 77(1): 54-57.

Zahler, P. and Woods, C.A. 1997. The status of the woolly flying squirrel (*Eupetaurus cinereus*) in Northern Pakistan. pp 495-514. In: *Biodiversity of Pakistan* (S.A. Mufti, C.A. Woods, and S.A. Hasan eds.). Pakistan Museum of Natural History, Islamabad.

Studies on the water bird population of Manchar Lake, Dadu Sindh

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Abstract

An account of population dynamics of water birds of Manchar Lake over a period of one year was followed in all the bird hotspots of the Lake. In all 59 species of both migratory and resident water birds were noted. There is a decreasing trend of population of most of the birds' species in the lake. The paper also describes effects of illegal hunting of migratory water birds at the Lake. Further more, species and habitat conservation measures are recommended.

Key Words: water birds, Manchar Lake, pochard, population dynamics, illegal hunting.

Introduction

Wetlands provide base to biodiversity, including many globally threatened migratory species of water birds. A wide variety of birds uses wetlands habitat for all or part of their life and form one of the major components of the wetlands ecosystem (Hosetti, 2005). This valuable resource is utilized economically in most parts of the world for food, sports and ecotourism. Pakistan has many wetlands of international importance which support a number of migratory and resident water birds and these wetlands are sources of livelihood for thousands of people. Manchar lake situated in Sindh province is the largest freshwater turned saline Lake of Pakistan (200 km^2) and even counted among the largest lakes of Asian sub-continent (PTDC, 2009). The lake was home to a large variety of water birds and millions of migratory water birds annually visited the lake (Ali, 1928). Due to lack of awareness among local communities and feeble implementation of wildlife laws, ruthless hunting of birds by the local communities has negatively impacted the avifauna of the lake. Further, scarcity of food and vegetation has led to the deterioration of the lake.

A few scientific studies on fauna, water chemistry and fish production of Manchar Lake have been conducted during the last few years. Mahar *et al.* (2000) studied the water chemistry and fish production of Manchar Lake and Mahar *et al.* (2005) studied the algal flora of MNV Drain entering Manchar Lake. Jafri *et al.* (2006) studied the fish yield production of Manchar Lake. No systematic studies on the avifauna of this lake indicating the status of different water birds are available in the last five decades except by Hasan (1964) who recorded 43 species of water birds. Historically this lake has invited the attention of conservationists and ornithologists. Hume (1873) in his contribution to the avifauna of Sindh recorded a number of birds from Manchar Lake. Becher (1886) also recorded 25 species of water birds and gave a brief account of game and few others birds at Manchar Lake. Twenty out of 25 of the birds were new to the Hume's list. Ali (1928) while describing other aspects of the lake also recorded 33 species of birds. Manchar Lake, being one of the biggest freshwater bodies in Asia deserves special conservation measures as it harbor a variety of birds in massive counts in the past (Ali 1928).

The enhanced public awareness and mandate of Zoological Survey Department of Pakistan to document the faunal components in different habitats invited the attention of authors to contribute to fill up the gaps in knowledge regarding the Manchar Lake.

The present study of the Manchar Lake is aimed at making an inventory, determining status and distribution and identifying threats to avifauna.

Material and Methods

Study Area

Manchar Lake (longitude 67°-34' E to 67°-43' E and latitude 26°-23' to 26°-28' N) is one of the largest fresh water lakes of Asian sub-continent (http://www.tourism.gov.pk/manchar_lake_sindh.htm). It is located at a distance of about 18 km from Sehwan town of district Jamshoro, Sindh. The lake covers an area of approximately 200 km^2 though spreading up to 300 km^2 during monsoon season (July to September). The maximum depth of the lake at the central part is 2.5 to 3.5m (Jafri *et al.*, 2006). Manchar Lake receives water from three main sources i.e. River Indus through Aral and Danistar Wah,

Main Nara Valley Drain (MNV) and Hill torrents originating from Kirthar range i.e., Nai Gaj, Nai Baran and Nai Angai. When the Lake fills its banks the surplus water is drained through Morlak outlet back into River Indus. The surrounding area of the lake is classified as arid subtropical, with very hot summers and cold winters (Scoot and Poole, 1989). The rainfall in the region is largely from the North-east Monsoon (July-September). Very little rainfall occurs during winter season (December-February).

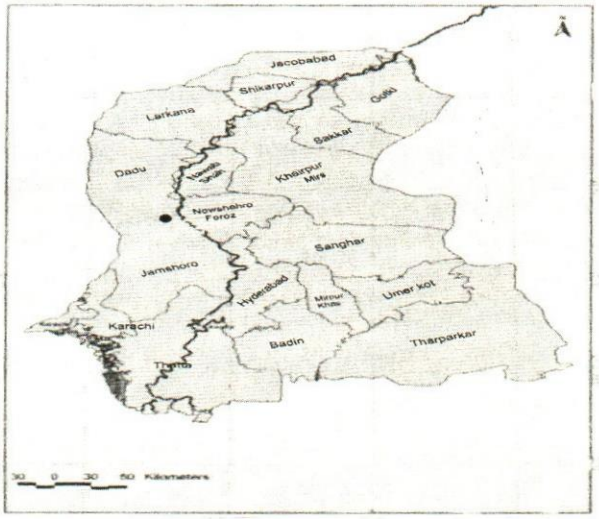

Fig1: Map of the Sindh Province showing the study area.

Survey Methodology

The series of surveys were carried out in 2008 (January, March, June, September, October and December), with a total sampling efforts of 30 days. Initially five bird hotspots were selected, which include: 1- Bhajara East (Rakh Ghulam Ali Shah), 2- Shah Hassan, 3- Garkano, 4- Danistar Wah and 5- Chandan Wah. Besides this, adjoining waterlogged areas of the Lake were also scanned in order to observe more water bird species. Each site was visited from 10:00 AM to 3:00 PM (at this time birds were found preening their wings and could be easily identified), spending five hours daily. The present study used the methodology of Azam *et al.* (2008) with slight modification considering the habitat topography of the lake.

For the identification and estimation of population of birds, direct sighting and counting were carried out with the help of binocular (Olympus 8-16X40, DPS I) and spotting scope (Nikon w/15-45X). The birds which were difficult to identify while flying were identified and estimated after their settlement on water with the help of identification guides (Sonobe and Usui, 1993; Ali, 2002). Boats were also used for thorough survey of the Lake at the speed of 9-12 Km/hr for five days during the study period. The local fishermen were interviewed for presence of rare bird species observed during the current and previous years. The birds were classified as winter visitors, resident, straggler, migratory and occasional. The common names of birds are also given with the zoological names in the checklist.

Results and Discussion

According to present surveys, 59 species of water birds were recorded from different sites of Manchar Lake, belonging to 7 orders and 18 families and sub-families (Table 1). Family Ardeidae, which includes Herons and Egrets, was found as the most dominant throughout the year, whereas family anatidae which includes Ducks and Gees was found most abundantly in winter season. The Herring Gull (*Larus ridibundus)* and Common Black-headed Gull (*Larus ichthyaetus*) were found as the most dominant species of water birds at Manchar Lake throughout the year.

Details of the protected birds observed during the current survey are given as follows.

White Spoonbill *Platalea leucorodia*

During the study period in the month of December, a flock of 34 birds was recorded at Bhajara East site of the lake. In Pakistan this is a winter visitor and is found on the wetlands of Sindh (Hassan, 1994; Hassan *et al.,* 2005), while in Punjab only 12 individuals of the bird were recorded from three different wetlands i.e., Chashma Barrage, Head Qadirabad and Rangpur Marsh Area (Ali and Akhtar, 2005). But there are no recent records of this bird in the wetlands of Upper Punjab (Azam *et al.,* 2008).

White Spoonbill belongs to family Threskiornithidae. It is a white bird standing up to 600mm high and almost similar to large Egret with longer neck and legs, but differs due to its spoon like bill. Convention on Migratory Species (CMS) places this bird in appendix II of List, which requires the member countries for conservation of the species. It is also placed in second schedule of protected animals of Sindh Wildlife Ordinance 1972, which requires the protection of all the species of family Threskiornithidae (Shafiq, *2005*).

White Pelican *Pelicanus onocrotalus*

Seventeen birds were seen in the deep water at the site of Bhajara East in the months of January and October

The bird is a winter visitor and stays here for few days and migrates further towards the wetlands of Indus Delta in the South.

Table1: A list of water birds and their numbers recorded during different months.

Birds Species	Jan.	Mar.	Jun.	Sep.	Oct.	Dec.	Total	Status
Little Grebe *Tachybaptus*	25	13	0	0	10	20	68	W
Indian Cormorant *Phalacrocorax fuscicollis*	65	25	0	4	0	34	128	W
Large Cormorant *Phalacrocorax carbo*	124	88	0	23	45	234	514	W
Little Cormorant *Phalacrocorax niger*	130	214	65	45	56	167	677	W
White Pelican *Pelecanus onocrotalus*	15	0	0	0	0	2	17	W
Indian Pond Heron *Ardeola grayii*	25	9	6	13	8	12	73	R
Little Green Heron *Butorides striatus*	4	0	2	6	3	2	17	R
Cattle Egret *Bubulcus ibis*	16	25	8	3	7	8	67	R
Little Egret *Egretta garzetta*	112	87	131	25	45	123	523	R
Intermediate Egret *Egretta intermedia*	45	67	23	12	48	34	229	R
Large Egret *Egretta alba*	213	184	222	4	2	165	790	R
Black Bittern *Botaurus stellaris*	0	0	0	2	0	0	2	R
Grey Heron *Ardea cinerea*	5	0	0	3	6	4	18	R
White-Necked Stork *Ciconia episcopus*	5	0	0	0	0	0	5	S
Greater Adjutant Stork *Leptoptilos dubius*	3	0	0	0	0	0	3	S
White Spoon bill *Platalea leucorodia*	0	0	0	0	34	0	34	W
Greater Flamingo *Phoenicopterus rubber*	0	0	0	0	0	6	6	W
Common Shelduck *Tadorna tadorna*	40	0	0	0	0	0	40	W
Eurasian Widgeon *Anas penelope*	450	0	0	0	43	270	763	W
Gadwall *Anas strepera*	60	0		0	0	43	103	W
Common Teal *Anas crecca*	1700	432	0	67	890	2109	5198	W
Mallard Anas platyrhynchos	24	7	0	0	4	8	43	W
Northern Pintail *Anas acuta*	20	0	0	0	0	74	94	W
Shovler *Anas clypeata*	750	290	0	0	123	210	1373	W
Marbled Teal *Marmaronetta angustirostris*	0	0	0	0	0	12	12	W
Red-crested Pochard *Netta rufina*	0	0	0	0	0	45	45	W
White- eyed Pochard *Aythya nyroca*	50	100	50	0	0	0	200	W
Common Pochard *Aythya ferina*	1500	360	0	0	120	90	2070	W
Garganey *Anas querquedula*	145	23	0	0	12	89	269	W
Tufted Duck *Aythya fuligula*	10	0	0	0	0	15	25	W
Common Moorhen *Gallinula chloropus*	15	20	5	8	10	25	83	W
Purple Moorhen *Porphyrio porphyrio*	10	8	5	6	12	16	57	W
Common Coot *Fulica atra*	150	200	0	0	0	100	450	W
Demoiselle Crane *Anthropoides virgo*	0	0	0	0	19	0	19	P
Black-winged Stilt *Himantopus himantopus*	0	10	0	30	0	0	40	R
Pied Avocet *Recurvirostra avosetta*	0	0	0	0	0	6	6	W
Yellow-wattled Lapwing *Vanellus malabaricus*	4	3	0	0	2	2	11	R
White tailed Plover *Vanellus leucurus*	0	0	0	25	0	10	35	R
Red-wattled Lapwing *Vanellus indicus*	25	13	0	0	10	20	68	R
Sociable Plover Chettusia gregaria	0	0	0	0	34	0	34	R
Kentish Plover *Charadrius alexandrinus*	0	0	0	0	12	0	12	W
Collard Pratincole *Glareola pratincola*	0	0	3	0	0	0	3	R
Little Stint *Calidris minuta*	22	25	28	58	54	75	262	R

Birds Species	Jan.	Mar.	Jun.	Sep.	Oct.	Dec.	Total	Status
Sanderling *Calidris alba*	0	75	0	0	100	0	175	P
Common Snipe *Gallinago gallinago*	5	4	2	0	4	6	21	W
Tringa tetanus Common Redshank	8	5	0	7	5	0	25	W
Whimbrel *Numenius phaeopus*	0	5	2	1	4	0	12	W
Marsh Sandpiper *Tringa stagnatilis*	0	0	2680	0	2000	0	4680	W
Wood Sandpiper *Tringa glareola*	0	60	0	200	6	0	266	W
Common Greenshank *Tringa nebularia*	5	0	7	6	2	9	29	W
Spotted Redshank *Tringa erythropus*	25	15	11	19	29	4	103	W
Common Sandpiper *Actitis hypoleucos*	14	11	0	2	4	11	42	W
Herring Gull *Larus argentatus*	4300	3500	7000	6544	8054	12000	41398	R
Common Black-headed Gull *Larus ridibundus*	1800	1400	1200	5100	8500	4251	22251	R
Pallas Gull *Larus ichthyaetus*	400	720	1500	1311	1142	1354	6427	R
Grey River Tern *Sterna aurantia*	40	0	0	200	0	0	240	R
Black-Bellied Tern *Sterna albifrons*	2500	1000	1500	3000	1202	200	9402	R
Caspian Tern *Sterna caspia*	0	10	0	0	0	20	30	R
Whiskered Tern *Chlidonias hybridus*	25	12	14	25	30	28	134	W
Total	**14920**	**9053**	**14479**	**16755**	**22702**	**21925**	**99834**	
Number of Species	**44**	**36**	**23**	**30**	**40**	**43**	**59**	

Abbreviations: W=Winter visitor , R=Resident, M=Migratory, P=Passage Migrant, S=Straggler

It was very common at Manchar in 1980s, but ruthless killing for its oil (which is locally used as medicine for joint diseases) this bird has become rare at the Manchar Lake. A sufficient number of this bird still visits coastal wetlands of Sindh and Balochistan (Hassan, 1994; Hassan *et al.*, 2005). There are no records of occurrence of this bird at the wetlands of Punjab (Ali and Akhtar, 2005 and Azam *et al.*, 2008).

White Pelican belongs to family Pelicanidae. It is placed in the List of Convention on Migratory Species (CMS) in Appendix I and is also placed in second schedule of protected animals of Sindh Wildlife Ordinance 1972, which requires the protection of all the species of family Pelicanidae (Shafiq, 2005).

White-necked Stork *Ciconia episcopus*

Single sighting of five individuals was recorded at the site of Chandan wah in the shallow flood water in January 2008.

It is a very rare winter visitor bird species (Roberts, 1991). White-necked Stork belongs to family Ciconidae. It is placed in the List of Convention on Migratory Species (CMS) in Appendix I and is also placed in second schedule of protected animals of Sindh Wildlife Ordinance 1972, which requires the protection of all the species of family Ciconidae (Shafiq, 2005). In Pakistan this bird was recorded in the Indus Delta (Hassan, 1994) and in Namal Lake Punjab (Azam, 1994). Currently it is not observed in the Namal Lake since 2000 (Azam *et al.*, 2008) and there are no records of this bird at other wetlands of Punjab (Ali and Akhtar, 2005).

Greater Adjutant Stork *Leptoptilos dubius*

A single sighting of two birds was recorded from Gharkano North site in the shallow water. According to local fisherman this is also a very rare winter visitor at Manchar Lake.

The Greater Adjutant Stork belongs to family Ciconidae. This rare bird is listed as globally threatened species (IUCN Red Data List, 2003; Sharma, 2006) and also placed in second schedule of sub section 2 (1) of protected animals of Sindh Wildlife Ordinance 1972, which requires the protection of all the species of family *Ciconidae* (Shafiq, 2005).

According to Roberts (1991) it breeds in Assam, India. They are vagrant to Pakistan and occur rarely. According to Roberts (1991), Ticehurt (1919) recorded a specimen and exhibited in Karachi Zoo during World War 1. There are no current records about the distribution of this species on the other wetlands of Pakistan (Roberts, 1991).

Greater Flamingo *Phoenicopterus rubber*

During the study period a single sighting of six individuals of Greater Flamingo were observed at the site of Bhajara East of the lake in the shallow water. It is a winter visitor and stays at this Lake for few days.

Greater Flamingo belongs to family Phoenicopteridae. According to list of Convention on Migratory Species (CMS) it is placed in Appendix II and second schedule of protected animals of Sindh Wildlife Ordinance 1972, which requires the protection of all the species of family Phoenicopteridae (Shafiq, 2005). In Pakistan this bird is a winter visitor but can be found in the wetlands of Indus Delta (Hassan *et al.,* 2005) and at Mekran Coast Balochistan (Hassan and Khan, 2005). In the province of Punjab it is found at the wetlands of Uchali Complex (Ali and Akhtar, 2005, Azam *et al.,* 2008)

White-eyed Pochard *Aythya nyroca*

White-eyed Pochard is a regular winter visitor at the Manchar Lake and was recorded twice in the months of January and December during the study period at the site of Shah Hassan and Bhajara East.

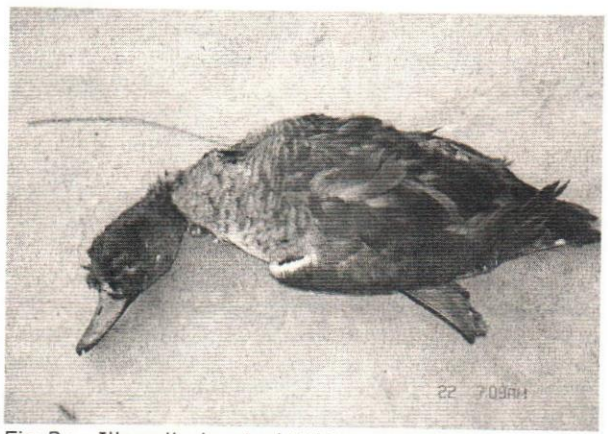

Fig 2: Illegally hunted White-eyed Pochard *Aythya nyroca*

White-eyed Pochard *(Aythya nyroca)* belongs to family Anatidae. This is also a very rare water bird species and according to the list of Convention on Migratory Species (CMS) it is globally threatened species and placed in Appendix I. According to Roberts (1991) the White-eyed Pochard was recorded from the wetlands of Sindh, especially in lower Sindh. In Punjab this species was recorded from Namal Lake, wetlands of the Salt range and Rawal Lake (Roberts, 1991). Ali and Akhtar (2005) have also reported this bird from almost all the wetlands of Punjab. But there are no current records of this species from the wetlands of Upper Punjab *(Azam et al.,* 2008*)*. It also breeds in the Zangi Nawar Lake of south-eastern Balochistan (Roberts, 1991).

Marbled Teal *Marmaronetta angustirostris*

Contrary to Roberts (1991) the survey team sighted twelve Marbled Teal at the site of Bhajara East of the lake and the local fishermen also sighted this bird from the Lake.

Marbled Teal (*Marmaronetta angustirostris*) belongs to family *Anatidae*. This water bird species is also globally threatened.

The Marbled Teal is also placed in second schedule of protected animals of Sindh Wildlife Ordinance 1972, which requires the protection of the species (Shafiq, 2005). According to Roberts, (1991), Ticehurt (1919) considered this bird pretty common at the wetlands of Sindh particularly Manchar, Larkana lakes (Drigh and Lungh lakes) and Pithoro Jheel East Nara Canal. This bird migrates to Pakistan from South India, Iran, and Afghanistan as a winter visitor (Roberts, 1991; Bhaagat, 2006). Marbled teals were reported to breed only on Zangi Nawar and Khushdal Khan Lakes of Balochistan. But after these places dried up during the late 1980s, the bird began to inhibit the wetlands of Sindh (Deh Akro-II Wetlands) and according to Bhaagat (2006) about 50 pairs of Marbled teal still breed in the Deh Akro Wetland.

Discussion

The Manchar Lake is one of the largest fresh water lakes of Asian sub-continent and is home for millions of water birds including migratory waterfowl (Ali, 1928). In the present survey, 59 species of water birds were recorded from five selected sites of Manchar Lake i.e. Bhajara East (Rakh Ghulam Ali Shah); Shah Hassan; Garkano; Danistar Wah and Chandan Wah. The number of water birds, especially migratory waterfowl used to visit the wetland in thousands a few years ago, has significantly declined. This is due to loss of habitat caused by the saline water of Main Nara Valley Drain (MNV Drain) and ruthless hunting of migratory waterfowl specially ducks and coots. The wetland has become a transient site for some species of ducks and waterfowls during their migratory route (Indus Fly way).

According to Hume (1873) Common Coot (*Fulica atra)* was very common species; no part of the world had seen such incredible multitudes of coots as were met within Sindh in Manchar Lake. During the current studies not more than two thousand Coots were observed in small flocks consisting of 30 to 40 birds. Although Common Coot (*Fulica atra)* is still very common at the wetlands of Upper Punjab especially Chashma Barrage, Khabbaki, Uchalli and Kallar Kahar lakes (Azam *et al.,* 2008), but its number is decreasing year by year at Manchar Lake due to habitat loss and ruthless hunting for commercial purpose. Only gulls and terns have dominated the avifauna of the Manchar Lake.

The authors did not observe Pheasant-tailed Jackana (*Hydrophasianus chirurgus*), Black-tailed Godwit (*Limosa limosa*), Ruff (*Philomachus pugnax*), Jack Snipe (*Lymnocryptes minima*), Glossy Ibis (*Plegadis falcinellus*) and Great-crested Grebe (*Podiceps cristatus*) from the Manchar Lake as earlier reported by Hassan (1964).

Many species of Goose used to visit the lake in the migratory season (winter). Ali (1928) has also reported huge flocks of Grey leg Goose (*Anser anser)* and Bar-headed Goose (*Anser indicus*). Roberts (1991) states that Dr. Ticehurt shot two specimens of Goose on Manchar Lake between 1917 and 1919, which he identified as White-fronted Goose (*Anser albifrons*). In the current study, none of the Goose species were observed but according to local fisherman one to three individuals of Grey leg goose (*Anser anser*) still visit the lake. Ali and Akhtar (2005) have also recorded this bird from Chashma Barrage of Punjab, but there is no recent record of this bird at Chashma Barrage (Azam *et al.*, 2008).

There are many factors for the declining trend of the migratory anatids and other water birds at the Manchar Lake but some remarkable ones are given below.

- Adequate food is basic need of any organism; the peripheries of the Manchar Lake on the North east (Miani and Abad) areas were famous for paddy crops till late 1970s and were ideal feeding grounds for water birds especially granivorous ducks and geese. But for the last few decades, due to scarcity of irrigation water, paddy crops could not be grown in the area. This may have caused decline in the number of birds.
- Adequate protection is required for the birds in the habitat but in the case of Manchar Lake there is no protection to the birds and illegal hunting of bird's especially migratory water birds is a business for the people who are dependant on the lake for their livelihood. Due to ruthless hunting the number of migratory birds has declined at the lake.
- Although all the species of family Anatidae (Ducks and Geese) have been placed in the first or second schedule of protected animals of Sindh Wildlife Ordinance (1972), which requires the protection of migratory Anatidae, but due to lack of awareness and negligence of rules illegal hunting is regularly practiced by local community.

Recommendations

- Studies on important avian species and their habitat requirements should be carried out in and around the lake.
- Regular studies on water quality and vegetation as well as changes in the community structure and population dynamics of the key species of birds and plants may be carried out.
- Sindh Wildlife Department should take more measures to minimize hunting pressure of migratory birds like coots and ducks.
- Pakistan Wetland Programme may initiate awareness raising among the local fishermen communities for wise use of wetland resources especially in context of water birds through community managed concept of natural resources.
- The Manchar Lake has potential for bird watching, fish angling and water sports. Ecotourism as an alternate source of income for the local communities can be developed to protect the fauna and flora of the lake.
- The lake also fulfils the requirements of a wetland of International importance. For its better management and conservation of its flora and fauna, NCCW should make efforts to declare it as a Ramsar Site.

References

Ali S. 1928. A Sind Lake. JBNHS, 32 (3): 460-471.

Ali S. 2002. The Book of Indian Birds. Oxford University Press, Bombay.

Ali, Z. and Akhtar, M. 2005. Bird surveys at wetlands in Punjab, Pakistan with special reference to the present status of white-headed duck (*Oxyura leucocephala*). Forktail. 21: 43–50.

Azam, M.M. 1994. The Birds of the Salt Range. Rec. Zoo. Sur. Pak. 12: 63-97.

Azam, M.M., Brohi, M.A and Ahmed, W. 2008. Studies on the Population Status of Water Birds in Major Wetlands of Upper Punjab. Rec. Zoo. Sur. Pak. 18: 1-11.

Bhaagat, H.B. 2006. Biodiversity Richness and Rare and Endangered Species in Deh Akro-II Wildlife Sanctuary (Nawabshah) Sindh Pakistan. Tiger Paper. Bangkok, Thailand. xxxiii: No.4: 1-08.

Becher, E.F. 1886. A Sind Lake. JBNHS, 1(5): 91-96.

Hassan, S.A. 1964. Birds of Manchar Lake. Agriculture Pakistan. 15(3): 259-283.

Hassan, S.A. 1994. Birds of Sindh Mangroves. Rec. Zoo. Sur. Pak., 12: 98-105.

Hassan, A., Khan, S.A. and Ahmed S.I. 2005. Fish and Birds in Keti Bundar and other parts of the Indus Delta. Rec. Zoo. Sur. Pak., 16:33-39.

Hassan, A. and Khan, S.A. 2005. Some observations on the vertebrate fauna of Jiwani wetland complex. Rec. Zool. Sur. Pak., 16:12-25.

Hosetti, B.B. 2005. Management of wetland birds. In: Concepts in Wildlife Management (ed. Hosetti, B. B.). Daya Publishing House, Delhi, India. pp 162-191.

Hume, A.O. 1873. Contribution to the Ornithology of India, Sind No.2, pp.91-289; 1878a: Asio butleri, sp.nov. Stray Feathers, vol.7 pp.316-8. Recited from Becher EF 1886. A Sind Lake. JBNHS, 1(5): 91-96.

Jafri, S.I.H., Mahar, M.A., Baloch, W.A. and Narejo, N.T. 2006. Trophic State Index, Morphoedaphic index and fish yield prediction in a sub-tropical Lake, Manchar (Sindh), Pakistan. Bangladesh J. Fish Res., 10 (2):131-137.

Mahar, M.A., Jafari, S.I.H., Leghari, S.M. and Khuhawar, M.Y. 2000. Studies on Water Chemistry and Fish Production of Manchar Lake, Dadu. Sindh. Pak. Journal of Biological Sciences, 3 (12):2151-2153.

Mahar, M.A., Jafari, S.I.H., Leghari, S.M. and Khuhawar, M.Y. 2005. Studies on the Physico-Chemical Parameters and Pollution Indicator Algal Flora of Main Nara Valley Drain Water Entering Manchar Lake. Sind Uni. Res. Jour. (Sci. Ser.) 37(2): 1-8.

PTDC, 2009. Manchar Lake (www.tourism.gov.pk/manchar_lake_sindh.htm).

Roberts, T.J. 1991. The Birds of Pakistan. Oxford University Press. Pakistan.

Scoot, D.A. and Poole, C.M. 1989. A Status Overview of Asian Wetlands. AWB, Kuala Lumpur, Malaysia no.53

Shafiq, M. 2005. Wildlife Acts and Rules of Pakistan. Pakistan Forest Institute Peshawar.

Sharma, S. 2006. Population Status and Distribution of Lesser Adjutant (*Leptoptilos javanicus*) in Far-Western Lowland Nepal. Tiger Paper. Bangkok, Thailand. 33(4): 9-11.

Sonobe, K. and Usui S. 1993. A Field Guide to the Water Birds of Asia. Wild Birds Society of Japan, Tokyo.

Seasonal changes in waterfowl community of Hawkesbay, Karachi Coast, based on guild structure

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Abstract

The present study deals with the seasonal changes in migratory pattern and aspects of population dynamics of 53 species of waterbirds from Hawkesbay, Karachi, northern Arabian Sea, from 1993 to 1996. The birds were categorized on the basis of Guild structure. Relative abundance of birds of six guilds is discussed in relation to availability of food and selection of foraging habits. Maximum number of birds (63,386) were observed in 1993 that gradually reduced to 18,276 (28.8 %) in 1996. Decline in number of birds is indicative of habitat deterioration and disturbance by visitors and fishermen.

Keywords: Waterfowl, Guild Structure, Population dynamics, relative abundance, habitat deterioration

Introduction

The concept of functional species groups or "Guilds" proposed by Root (1967) is used in the present study. Study on foraging guild has not so far undertaken about birds of Pakistan. Information on diet, degree of social foraging, diurnal habits and habitat characteristics are projected on the guild structure to describe the waterfowl community along the Karachi coast. Considerable work has been done on various aspects of the birds of Karachi and other regions of Sindh. Most of the literature has been summarized by Ghalib and Hasnain (1992), Ghalib *et al.* (1985, 1993, 1999, 2000), Hasnain and Ghalib (1997), Khanum *et al.* (1980, 1994), Roberts (1991) and Root (1997a, b). The data collected through Asian Waterfowl census were analyzed by Perennou *et al.* (1999). Waterfowl species of mangrove areas were documented by Ahmed *et al.* (1985, 1986, 1987 and 1988) and Root (1997c).

Four representative sites on the Karachi coast viz. Hawkesbay, Cape Monze, Clifton and Korangi Creek were selected on the basis of different ecological characteristics. The present communication, first of a series, deals with the migratory pattern and the seasonal changes in population structure of 53 species of waterfowls at Hawkesbay for a period of four years from 1993 to 1996.

Material and Methods

Four sandy beaches along the Karachi coast, namely, Hawkesbay, Clifton, Korangi Creek and Cape Monze were visited from 1993 to 1996. Soil from the study sites were analyzed using Soil Texture Unit. Salinity and temperature was measured using YSI model 30 SCT meter. Nikon binocular with specification of 10x21 CF and Nikon Spotting Scope (model ED 78 A) were used to watch and count the birds. Birds were counted early in the morning in areas of fewer disturbances. Behaviour of various guilds was studied in evening.

Although a number of methods for bird counting were employed, the Block method (Howes, 1987) proved reliable. In "Block Method" the bird flock was divided into groups from right to left or from left to right with individual counting undertaken for each group. Observations were also taken on styles of feeding i.e. searching, hunting or catching the prey.

Samples of sediments from shallow (less than 10cm) and deeper (10-30cm) layers were obtained following the method of Swennen and Marteijn (1985). Sediments were sieved through 1.0mm mesh size net to examine the food items.

During the present study 53 species of birds were selected out of 93 reported from Karachi coast (Ghalib *et al.*, 1993).

Results

Study Site

Hawkesbay (24°47'-24°52' N, 66°50'-66°59' E) is located on the south west of Karachi city. There is a gently sloping sand beach on the eastern and rocky ledge on the western side. Backwaters support extensive intertidal mudflats with pockets of mangrove swamps at places. The long sandbank protects the coastal belt from the open surf action. The beach consists of fine to medium grained sand which is susceptible to wind.

The vegetation noted on the beach, adjoining creeks, backwaters and surroundings include *Ipomoea pescaprae, Atriplex griffithii, Suaeda mudiflora, Arthrocnemum indicum, Crotolaria burhia, Aerua pseudomentosa, Astragalus*

fatmensis, Tamarix spp., Aerua pseudotomentosa, Aeluropus insignis, Cressa cretica, Indigofera oblongifolia, Prosopis cineraria, Accacia senegal, Prosopis juliflora and *Calatropis procera*. The mangrove swamps are dominated by *Avicennia marina*. The main beach is a recreational resort. Excavation of hard strata at Hawksbay reveals that this stratum (layer no.3) is made up of oyster dead bed.

The concept of "Guild" given by Root (1967) is used in the present study. The "Guild" is defined on the basis of diet, degree of soil foraging, habit and habitat characteristics. The birds were divided into groups; each group with its own feeding style. To structure our information on the foraging habits, diurnal rhythms and diets of 53 waterfowl species of Hawkesbay, 6 guilds have been identified: (1) herbivorous; (2) stalking; (3) fishing; (4) visual surface foraging; (5) tactile surface foraging and (6) pelagic foraging.

The Hawkesbay beach provides the best feeding and roosting ground for birds of all types of guilds. This site is, however, severely affected by the beach visitors coming here for recreation. Moreover, the mangrove occupied backwaters and their adjacent muddy grounds are under the control of fishing communities that are fishing without employing camouflaged boats and traps disturbing the population of the waterfowls.

Information about the number of birds belonging to 53 species and 6 guilds from Hawkesbay during the present study period is given in Table 1 and Figures 2-7. A total of 163,404 birds were counted; the number of birds per year ranged from 63,386 (1993) to 18,276 (1996).

The population of the colonial birds, specially the stalking birds was found gradually shifted from the backwaters of Hawkesbay to the mangrove areas of the north east side which are under control of the Pakistan Navy. Population of the little, median and large egrets (*Egretta garzetta, E. intermedia* and *E. alba*), purple and grey herons (*Ardea purpurea* and *Ardea cinerea*) decreased (Table 1 & Fig. 3). The population of visiting spoonbill (*Platalea leucorodia*) was also very small (Table 1).

Mud flats of backwaters are also under constant pressure of human interference. The number of greater flamingo (*Phoenicopterus rubber*) gradually declined from 348 (1994) to 162 (1996). Black winged stilt (*Himantopus himantopus*) also reduced from 3,470 (1995) to 520 (1996). The decline in their number at Hawkesbay may be due to continuous disturbance by visitors and direct interference of the shrimp and crab catchers.

Populations of six species of Plovers also declined (Fig. 5). Yellow-wattled lapwing (*Vanellus malabaricus*) was seen only once in 1996, which shows that the habitat of Hawksbay was not suitable for the species. Population of red-wattled lapwing (*Vanellus indicus*) declined from 1,010 (1994) to 316 (1996). Population of this species can not be assessed solely on the basis of marine or coastal grounds as it also prefers to live around the inland fresh/brackish water masses.

White-tailed lapwing (*Chettusia leucura*) is not a common species in coastal areas and prefers to live away from the sea water and was observed only in the backwaters. Their reduction in number is also an indicator of degradation of the wetland's habitat of Hawksbay. Sanderlings (*Calidris alba*) which prefer to live along the shoreline with highly oxygenated sea water also showed a marked decline in their numbers from 8,220 in 1993 to 110 in 1996. Similarly population of dunlin (*Calidris alpine*), temminck's stint (*C. temminckii*) and little stint (*C. minuta*) were counted as 10,060, 815 and 2,930, respectively in 1993, which declined to 786, 250 and 565, respectively in 1996 (Table 1).

Included among the 53 species of waterfowls studied, 7 are terns (*Sterna* spp.) and 7 gulls (Table 1). Surprisingly population of terns showed an increase (52 to 620 in gull-billed tern *Gelochelidon nilotica*), whereas gulls either remained stable from 1993 to 1996, such as, great black-headed gull (*Larus ichthyaetus*) and black-headed gull (*L. ridibundus*) showed a minor increase, for instance, from 10 to 70 in sooty gull (*L. hemprichii*), 6 to 87 in brown-headed gull (*L. brunnicephalus*), 274 to 575 in herring gull (*Larus argentatus*), 150 to 255 in lesser black-backed gull (*L. fuscus*). But the population of slender billed gull (*L. genei*) showed a little decrease (Table 1). These birds are not conscious about the presence of humans around; they usually remain on the ground at the time of roosting, whereas a sharp change in numbers was observed in case of waders, for e.g. whimbrels (*Numenius phaeopus*), which declined from 260 in 1993 to 22 individuals in 1996.

Collectively, the whole community of birds population of Hawkesbay exhibit a continuous decline from 63,386 birds (1993) to 52,396 (1994), 29,346 (1995) and 18,276 (1996).

The status of the five members of Guild-1 - common teal (*Anas crecca*), pintail (*A. acuta*), shoveller (*A. clypeata*), mallard (*A. platyrhynchos*) and common coot (*Fulica atra*), is uncertain and irregular (Table 1 & Fig. 2).

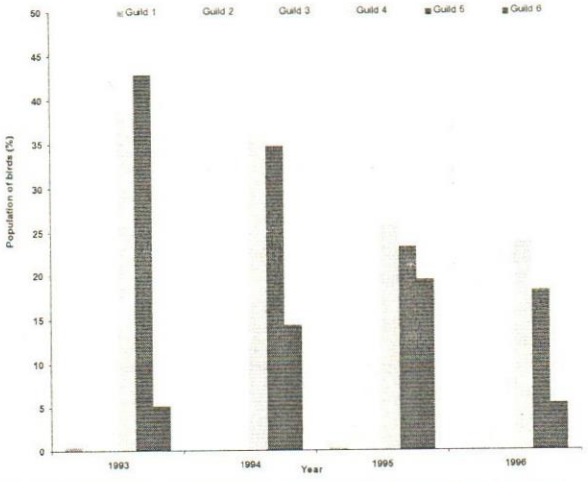

Fig 1: Seasonal changes in number of birds belonging to six guilds at Hawkesbay during the period 1993-1996.

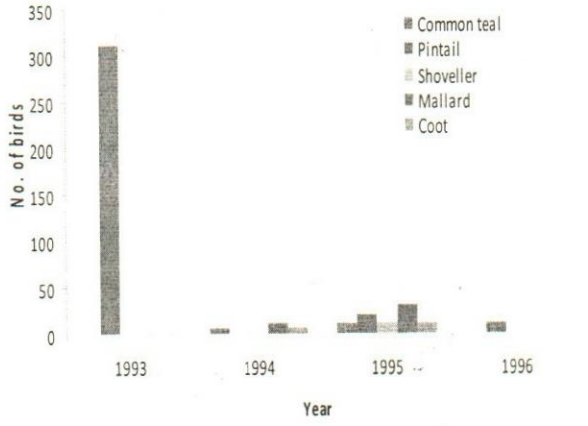

Fig 2: Changes in composition of birds of guild 1 during the study period (1993-1996) from Hawkesbay, Karachi.

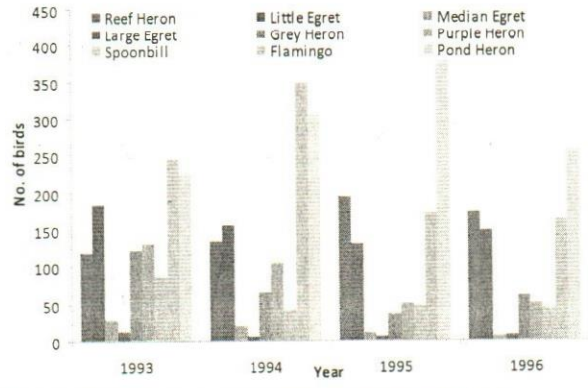

Fig 3: Changes in composition of birds of guild 2 during the study period (1993-1996) from Hawkesbay, Karachi

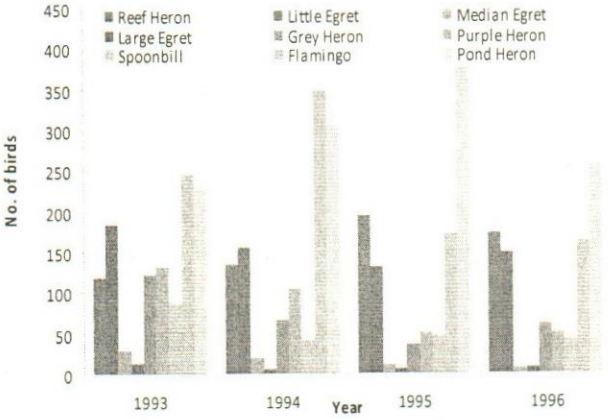

Fig 4: Changes in composition of birds of guild 3 during the study period (1993-1996) from Hawkesbay, Karachi.

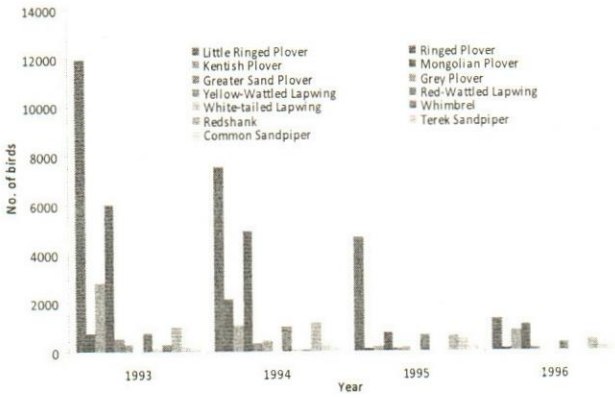

Fig 5: Changes in composition of birds of guild 4 during the study period (1993-1996) from Hawkesbay, Karachi.

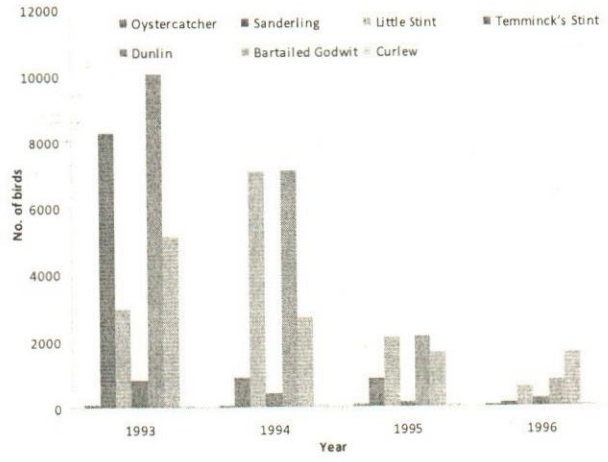

Fig 6: Changes in composition of birds of guild 5 during the study period (1993-1996) from Hawkesbay, Karachi

Their extremely low population indicates that they irregularly visit the site of Hawkesbay for roosting only. It is also evident that all these herbivore birds, which are listed above are freshwater dwellers and the habitat of the Hawkesbay does not fulfill their food requirement.

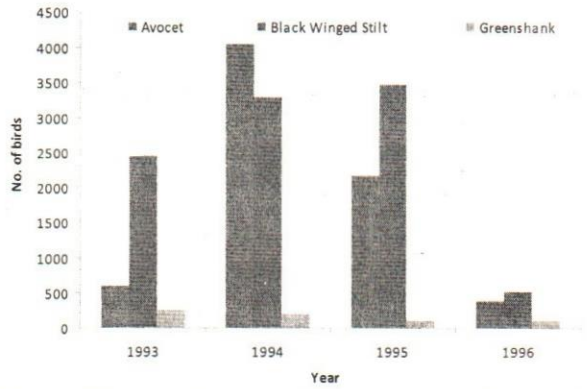

Fig 7: Changes in composition of birds of guild 6 during the study period (1993-1996) from Hawkesbay, Karachi

The eroded elevated rocky areas of backwater are made up of dead oyster-beds which perished mainly due to pollution, high salinity and lack of freshwater input from Layari River. The oystercatcher (*Haematopus haematopus*), another important seabird, is disappearing slowly and gradually from the Hawkesbay site, there is no other place where it can find its food (mussels, oysters, and clams). This has resulted in the reduction of numbers of oystercatchers from 63 in 1993 to 22 in 1996.

The number of Avocets (*Recurvirostra avosetta*) was 588 in 1993 which increased to 4,060 in 1994 but showed a sharp decline in 1995 to 2,170, and to 380 in 1996. Avocets take their food from submerged muddy soil (benthos) or pelagic animals (invertebrates). The pelagic fauna is slowly and gradually disappearing from the muddy, muddy-cum-sandy areas due to increasing pollution, as also mentioned by Barkati (1991), and others. This might have affected the avocet's population at Hawkesbay.

Comparative Analysis

Comparative analysis of birds' populations of Hawkesbay shows that coastal habitats are probably unsuitable for the herbivore birds (Guild-1) because of the absence of proper feeding grounds. These birds are, therefore, represented by just 0.04 to 0.48% of the total population (Fig. 1). Birds of Guild-1 comprising of common teal (*Anas crecca*), pintail (*A. acuta*), shoveller (*A. clypeata*), mallard (*A. platyrhynchos*) and coot (*Fulica atra*) stay on the coast for a brief period while passing through it (Fig. 2).

The population of Guild-2 also constitutes a small proportion of the total birds, ranging from 1% in 1993 to 4% in 1996. Flamingo (*Phoenicopterus rubber*) - a representative of Guild-2, exhibited its maximum population in 1993 and 1994, but declined in 1995 from 348 to 162 individuals in 1996. The strength of Guild-2 in 1993 was only 1.8% of the total population which slightly increased in 1994 (2.2%), remained unchanged in 1995 but increased in 1996 to 4.9% of the total population.

Guild-3 was the dominant group of birds at Hawkesbay in terms of number of birds (Fig. 1). Birds of this guild displayed their liking towards fish as food. Whiskered tern, however, is an exception which is quite different from other terns which were once fish eating but gradually changed their likeness for other animals such as crustaceans and decapods. Black-headed gull (*Larus ridibundus*) displayed stable position over the period of four years. Sandwitch terns (*Sterna sandvicensis*) also followed the same pattern. Population of birds of Guild-3 was 10.9% in 1993 which increased gradually to reach 47.2% of the total population in 1996 (Fig. 1). It seems that decrease in population of guild-4 birds over the study period, from 38.7% to 24.0% was compensated by simultaneous increase in Guild 3 bird's population.

There was a general decline in the number of birds of Guild-4 from 38.7% in 1993 to 24.0% of the total birds in 1996. Relatively more pronounced decrease in the number of birds of Guild 5 was noticed during the study period i.e. from 42.9% in 1993 to 18.2 % in 1996.

Discussion

Gradual decline in the number of birds of the six guilds studied at Hawkesbay from a maximum in 1993 to minimum in 1996 (Table 1) is quite obvious. The same is true for the total number of birds that showed a reduction in number from 63,386 in 1993 to 18,276 in 1996. Selection of site and fluctuation in population of different species of birds may be attributed to availability or otherwise of food for a particular species in the area.

Food availability has been considered as one of the main important determinants of abundance and distribution of migratory birds (Hockey *et al.*, 1992; Davidson *et al.*, 1992; O'Riley and Wingfield, 1995).

Table 1: Changes in number of birds in six guilds during the period 1993 -1996 from Hawkesbay, Karachi.

S.#	Species	Common name	1993	1994	1995	1996	Total
1	*Anas crecca*	Common teal	0	6	10	0	16
2	*Anas acuta*	Pintail	310	0	20	10	340
3	*Anas clypeata*	Shoveller	0	0	10	0	10
4	*Anas platyrhynchos*	Mallard	0	10	30	0	40
5	*Fulica atra*	Coot	0	5	10	0	15
	Guild 1 total		310	21	80	10	421
6	*Egretta gularis*	Reef heron	118	135	195	173	621
7	*Egretta garzetta*	Little egret	183	155	131	149	618
8	*Egretta intermedia*	Median egret	28	20	10	5	63
9	*Egretta alba*	Large egret	12	5	6	7	30
10	*Ardea cinerea*	Grey heron	122	66	36	60	284
11	*Ardea purpurea*	Purple heron	131	104	50	49	334
12	*Platalea leucorodia*	Spoonbill	87	40	46	43	216
13	*Phoenicopterus rubber*	Flamingo	246	348	172	162	928
14	*Ardeola grayii*	Pond heron	226	305	377	256	1164
	Guild 2 total		1153	1178	1023	904	4258
15	*Phalacrocrax carbo*	Great cormorant	690	955	658	658	2961
16	*Phalacrocrax niger*	Little cormorant	125	107	87	115	434
17	*Larus hemprichii*	Sooty gull	10	16	35	70	131
18	*Larus ichthyaetus*	Great black-headed gull	59	11	74	65	209
19	*Larus ridibundus*	Black-headed gull	1680	2035	1650	1645	7010
20	*Larus brunnicephalus*	Brown-headed gull	6	52	65	87	210
21	*Larus genei*	Slender-billed gull	1535	380	1575	1145	4635
22	*Larus argentatus*	Herring gull	274	1032	450	575	2331
23	*Larus fuscus*	Lesser black-backed gull	150	232	155	255	792
24	*Gelochelidon nilotica*	Gull-billed tern	152	146	260	620	1178
25	*Hydroprogne caspia*	Caspian tern	73	73	165	210	521
26	*Sterna sandvicensis*	Sandwitch tern	1320	1102	1810	1615	5847
27	*Sterna hirundo*	Common tern	165	100	185	340	790
28	*Sterna albifrons*	Little tern	543	193	785	1035	2556
29	*Sterna saundersi*	Black-shafted tern	115	115	55	145	430
30	*Childonias hybrida*	Whiskered tern	12	12	30	55	109
	Guild 3 total		6909	6561	8039	8635	30144
31	*Charadrius dubius*	Little-ringed plover	11924	7535	4610	1265	9180
32	*Charadrius hiaticula*	Ringed plover	730	2090	100	100	3020
33	*Charadrius*	Kentish plover	2796	1050	162	833	4841
34	*Charadrius mongolus*	Mongolian plover	5972	4882	745	1060	12659
35	*Charadrius lesheaultii*	Greater-sand plover	510	327	80	105	1022
36	*Pluvialis squatarola*	Grey plover	293	405	130	0	828
37	*Vanellus malabaricus*	Yellow-wattled lapwing	0	0	0	16	16
38	*Vanellus indicus*	Red-wattled lapwing	724	1010	618	316	2668
39	*Chettusia leucura*	White-tailed lapwing	78	50	0	0	128
40	*Numenius phaeopus*	Whimbrel	260	34	14	22	330
41	*Tringa totanus*	Redshank	987	1125	574	395	3081
42	*Xenus cinereus*	Terek sandpiper	139	275	448	149	1011
43	*Actitis hypoleucos*	Common sandpiper	109	115	160	124	508
	Guild 4 total		24522	18898	7641	4385	30112
44	*Haematopus*	Oystercatcher	63	50	52	22	187
45	*Calidris alba*	Sanderling	8220	885	830	110	10045
46	*Calidris minuta*	Little stint	2930	7050	2060	565	12605
47	*Calidris temminckii*	Temminck's stint	815	415	132	250	1612
48	*Calidris alpine*	Dunlin	10060	7075	2105	786	20026
49	*Limosa lapponica*	Bartailed godwit	5075	2675	1625	1585	10960
50	*Numenius arquata*	Curlew	35	41	24	24	124
	Guild 5 total		27198	18191	6828	3342	55559
51	*Recurvirostra avosetta*	Avocet	588	4060	2170	380	7198
52	*Himantopus*	Black-winged stilt	2454	3290	3470	520	9734
53	*Tringa nebularia*	Greenshank	252	197	95	100	644
	Guild 6 total		3294	7547	5735	1000	17576
	Grand Total		**63386**	**52396**	**29346**	**18276**	**163404**

It was also argued that birds, in general, and shorebirds, in particular, have evolved traits in response to the long migrations between breeding and non-breeding quarters (Preisma and Baker, 1990).

Long migrations often require shorebirds to make several rapid refueling stops which further require abundant and readily available food at stop over sites. A relationship between shorebird density and productivity proposed for South America by Morrison and Ross (1989) was confirmed for Panama by Butler *et al.* (1998a, 1998b).

Moreover, seasonal changes in the abundance of birds have been related to the presence of roosting areas, availability of food and weather conditions (Bibby and Green, 1980). Foraging behaviour was also studied by a number of other workers, for instance, Bibby and Green (1980) worked on foraging behavior of migrant pied fly catcher (*Ficedula hypoleuca*) and it restricted his work to temporary territories of the birds.

Salinity of the coastal waters was also considered as controlling factor in the distribution and abundance of shorebirds. Salinity values were on the higher side both at the beginning and at the end of the year. It was also seen that salinity values in almost all months of 1996 were significantly higher than in the previous three years of the study i.e. 1993-1995. Rise in salinity is instrumental in the decline of coastal fauna and flora. The total number of birds at Hawkesbay declined sharply from 29,346 in 1993 to 18,276 in 1995 (Table 1). Moreover, human interference has drastically reduced the mangrove forests resulting in the elimination of benthos as well as planktons. Furthermore, high salinity had a negative impact on the oxygen content of the coastal water. This has also affected the ability of teleost fish population to regulate the intake of oxygen as a result of which it remains on the water surface. The reclamation of land and polluted water of the drainage system might be another main factor due to which Hawkesbay is losing its fertility. Developmental activities, for instance, construction of fish harbour at Korangi, construction of sea wall at Clifton and land reclamation in Defense and Hawkesbay areas, have destroyed a vast habitat of waders and stalking birds.

There are no reserved or protected areas for birds along the Karachi coast. These important sites lack proper management. The Karachi Development Authority has developed a five year recreational plan consisting of proposals which would not only disturb the environment, but also destroy the ecology of the entire area. Another habitat disturbing factor is the increase in fishing activities by using un-prescribed small mesh nets in the channels and backwaters by non-locals.

The results of the present study show that the bird population is shifting slightly towards the south eastern areas of the coast with every passing year. Pakistan's coastal areas are facing population pressure due to increase in the number of coastal dwellers as well as coast visitors. This is causing considerable disturbance and also polluting the bird habitat. Increase in fishing activities is another factor affecting bird populations, particularly birds of Guild 2 and 3. As a result of environmental deterioration due to the pollution and interaction of the human activity, the gastropods and bivalves are fast disappearing and the population of shorebirds dependent on these like oystercatcher (*Haematopus ostralegus*), is also affected.

References

Ahmed, M.F., Ghalib, S.A. and Niazi, M.S. 1985. Vertebrate Fauna of Mangroves of Pakistan. Ist Ann. Res. Rep., PARC, Islamabad. Zool. Surv. Deptt, Karachi, Pakistan. Unpublished report, 44 pp.

Ahmed, M.F., Ghalib, S.A. and Niazi, M.S. 1986. Vertebrate Fauna of Mangroves of Pakistan. IInd Ann. Res. Rep., PARC, Islamabad. Zool. Surv. Deptt, Karachi, Pakistan. Unpublished report, 35 pp.

Ahmed, M.F., Ghalib, S.A. and Niazi, M.S. 1987. Vertebrate Fauna of Mangroves of Pakistan. IIIrd Ann. Res. Rep., PARC, Islamabad. Zool. Surv. Deptt., Karachi, Pakistan. Unpublished report, 80 pp.

Ahmed, M.F., Ghalib, S.A. and Niazi, M.S. 1988. Vertebrate Fauna of Mangroves of Pakistan. IVth Ann. Rep., PARC, Islamabad. Zool. Surv. Deptt., Karachi, Pakistan. Unpublished report, 68 pp.

Barkati, S. 1991. Mangrove borers. The Environment (special issue): 41-42.

Bibby, C.J. and Green, R.E. 1980. Foraging behaviour of migrant pied flycatchers (*Ficedula hypoleuca*) on temporary territories. J. Anim. Ecol., 49: 507-521.

Butler, R.W., Morrison, R.I.G. Delgado, F.L. and Ross, R.K. 1998a. Habitat association of coastal birds in Panama. Colonial Waterbirds, 20: 518-524.

Butler, R.W., Morrison, R.I.G., Delgado, F.L. and Ross, R.K. 1998b. Distribution of Shorebirds, Coastal Seas Birds and Wading Birds in relation to Oceanic upwelling along the Pacific Coast of Panama. pp. 90-93. In: Atlas of Nearctic shorebirds and other Waterbirds on Coast of Panama (R.I.G. Morrison, R.W. Butler, F.S. Delgardo and R.K. Ross, Eds.). Canadian Wildlife Service Special Publication, Ottawa.

Davidson, N.C., Stroud, D.A., Rothwell, P.I. and Pienkowski, M.W. 1992. Towards a flyway conservation strategy for waders. International Wader Studies, 10: 24-44.

Ghalib, S.A. and Hasnain, S.A. 1992. The Waterfowl of Makran coast. Proceedings of National Conference on problems and resources of Makran coast and plan of action for its development. pp. 113-123.

Ghalib, S.A., Hasnain, S.A. and Ahmad, M.F. 1993. The Waterfowl of Karachi coast. Rec. Zool. Surv. Pakistan. Vol. XII: 39-62.

Ghalib, S.A., Hasnain, S.A. and Khan, A.R. 1999. Observations on the avifauna of tidal link, Badin, Sindh. pp. 37-46. In: Proceedings of the seminar on Aquatic Biodiversity of Pakistan (eds., Kazmi, Q.B. & Kazmi, M.A.). MRC & Zool. Deptt., Univ. of Karachi.

Ghalib, S.A., Hasnain, S.A. and Khursheed, S.N. 2000. Observations on the avi-fauna of Hab Dam. Pakistan J. Zool., 32: 27-32.

Ghalib, S.A., Perveen, S. and Hasnain, S.A. 1985. Notes on Waite's collection of birds eggs in the Zoological Survey Department. Rec. Zool. Surv. Pakistan. Vol. X: 25-56.

Hasnain, S.A. and Ghalib, S.A. 1997. The Waders of Karachi coast. pp. 107-110. In: Marine Sciences of Arabian Sea (eds. Thompson, F. & Tirmizi, N.M.). American Institute of Biological Sciences, Washington, D.C.

Hockey, P.A.R., Navarro, R.A., Kalejta, B. and Velasquez, C.R. 1992. The riddle of the Sand: why are shorebirds densities so high in southern estuaries? American Naturalist, 140: 961-979.

Howes, J.R. 1987. Rapid assessment techniques for coastal wetland evaluation. Interwader Publ. No. 24, Kuala Lumpur.

Khanum, Z., Ahmad, M. and Ahmad, M.F. 1994. A revised checklist of birds of Pakistan. Ibid, Vol. XII: 144-200.

Khanum, Z., Ahmed, M. and Ahmad, M.F. 1980. A checklist of birds of Pakistan with illustrated keys to their identification. Rec. Zool. Surv., Pakistan, Vol. 9(1&2): 138 pp.

Morrison, R.I.G. and Ross, K. 1989. Atlas of Neartic shorebirds on the coast of South America. Vol. 1. Canadian Wildlife Service Special Publication, Ottawa.

O'Riley, K.M. and Wingfield, J.C. 1995. Spring and autumn migration in arctic shorebirds: same distance different strategies. American Zoologist, 35: 222-233.

Perennou, C., Mundkur, T. and Scott, D.A. 1999. Asian Waterfowl Census 1987-91: Distribution and status of Asian Waterfowl. AWB, Kuala Lumpur, pp.372.

Preisma, T. and Baker, A.J. 1990. Life history characteristics and the conservation of migratory shorebirds. pp. 105-124. In: Behaviour and conservation (eds. Gosling, L.M. & Sutherland, W.J.). Cambridge University Press.

Roberts, T.J. 1991. The birds of Pakistan, Vol. 1, Regional studies and non-passeriformes. Oxford University Press, Oxford, New York, Karachi. 598 pp.

Root, R.B. 1967. The niche exploitation of the blue-gray gnatcatcher. Ecol. Monogr., 37: 317-50.

Root, R.B. 1997a. Observations on the waterfowl of Clifton beach, Karachi. Rec. Zool. Surv., Pakistan, Vol. 13: 23-30.

Root, R.B. 1997b. Observations on the birds of Cape Monze (mouth of Hab River & Sonehri area), Karachi. Pakistan J. Zool., 29: 287-291.

Root, R.B. 1997c. Avifauna of the mangroves of Baluchistan coast. pp. 423-428. In: Biodiversity of Pakistan (eds., S.A. Mufti; C.A. Woods & S.A. Hasnain). Pakistan Mus. Nat. Hist., Islamabad, and Florida Mus. Nat. Hist., Florida.

Swennen, C. and Marteijn, E.C.L. 1985. Water feeding ecology studies in the Malay peninsula (ed. D.R. Daud Wells). Interwader Ann. Rep., 1984. Interwader Kuala Lumpur.

Observation on the avifauna of Soon Valley, District Khushab, Punjab, Pakistan

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Abstract

During the present study 143 species belonging to 95 genera, 39 families, and 18 orders were recorded. Out of these 10 species were abundant, 69 common, 57 rare and 7 species were scarce. Among the birds reported, 82 species were resident, 52 winter visitor, 4 summer visitor and 5 passage migrant. One of the globally threatened species of birds, white-headed stiftailed duck has been reported to occur on the wetlands.

Keywords: stiftailed duck, avifauna, Soon Valley.

Introduction

Soon Valley is one of the most important areas for study of avian diversity and occurrence of globally threatened species of avifauna. The study area supports a variety of avifauna in different habitat types i.e. wetlands, scrub forest, agricultural fields and human habitation. Wetlands of the Salt Range have supported high concentration of water birds in the past. White headed stiftailed duck (*Oxyura leucocephala*) is one of the globally threatened species of Anatids and has been wintering only at wetlands of Soon Valley in the sub-continent for a long period.

The Valley is located in the Salt Range, district Khushab. It is stretched approximately 40 km in the east-west and about 30 km in the north-west direction. It is surrounded by a series of hills extending from east to west. Its elevation generally ranges upto 3,000ft except Sakesar peak which is 4,992 ft high. Average rainfall ranges from 450-750mm.

Vegetation is dry subtropical semi-evergreen with Olea-Acacia and Dodonea scrub forest. Important plant species are *Acacia modesta*, *A. nilotica*, *Olea ferruginea*, *Justacea adhatoda*, *Prosopis cineraria*, *Reptonia buxifolia*, *Ziziphus nummularia*, *Dodonea viscosa*, *Salvadora oleoides* and *Tamarix spp*.

Nowshehra is a large town in the center of the Valley while a number of large and small villages are also present. Of these, Sodi, Uchali, Ugali, Khabbaki and Khoora are significant to mention.

A number of workers have contributed to the studies on Avifauna of the region. Waite (1951) studied "The Birds of the Salt Range" and described 248 species. Ali and Riplay (1989) described "Birds of the Indian Sub-Continent" including this area. Van (1987 and 1988), Scott and Rose (1989), and Perennou et al. (1991 and 1992) documented the Midwinter Waterfowl Counts of Asia including wetlands of the Soon Valley. Scott (1989) compiled "A Directory of Asian Wetlands" including the Wetlands of Soon Valley. Roberts (1991 and 1992) has published "Birds of Pakistan" in two volumes which include the avifauna of Soon Valley. Azam (1994) and Azam *et al.* (2008) has also documented the birds of the Valley. Ali and Akhtar (2005) published a paper entitled Birds Surveys at Wetlands in Punjab, Pakistan with special reference to the present status of white headed duck (*Oxyura leucocephala*).

Habitat types

The Salt Range has following important habitat types.

1. Wetlands

There are three important lakes in the Valley – Ucchali, Khabaki and Jahalar lakes. The light aquatic vegetation of these lakes consists of *Potamogeton crispus*, *Hydrilla verticillata*, *Carex fedia*, *Vallisneria spiralis*, *Zannichellia palustris*, *Saccharum spontaneum*, *Typha angustata* and *Phragmites karka*, which primarily provide shelter to a large number of waterfowl species.

2. Scrub Forest

Semi-mountainous area of salt range has a chain of hills ranging upto 5,000 feet above sea level. These hills fall in dry sub-tropical region growing semi-evergreen scrub forest of Olea spp., *Acacia modesta* and *Dodonaea spp*. The habitat provides ideal environment for urial *Ovis orientalis*, see-see patridge *Ammoperdix griseogularis* and grey partridge *Francolinus pondicerianus*.

Sodi Wildlife Sanctuary is an important area for game birds encompassing 5,817.48ha of land and is situated 6 km south-east of Nowshehra Town. Major area of the sanctuary consists of hills with typical vegetation of the Salt Range. This Wildlife sanctuary is also important both for conservation of mammalian and avian species. This sanctuary is one of the areas having the

highest density of grey partridge (*Francolinus pondicerianus*) in the country.

3. Orchards

Orchards play an important role in any eco-system offering a variety of fruits to many frugivorous species. In this area, the orchards comprise of many fruit plants species which are largely cultivated at Kahetti near Khubbaki. The most important species of these orchards commonly known as guava, pomegranate, pear, loukat, apricot, mango and mulberry are paradise to harbour many species of birds. During the present visit parakeets, bulbuls and babblers were observed in this habitat but the parakeets were encountered most commonly flocking in good numbers.

4. Agriculture fields

There are large extents of agricultural fields cultivated with annual crops and vegetables in the surroundings of human settlements. These lands are always vital for those birds which feed on the ground, primarily the granivorous like doves, sparrows and finches. Around the agricultural fields, farmers grow a few plant species to demark the boundary of their land ownership which commonly include *Acacia* and *Dalbergia spp*. These plants provide space for resting and nesting requirements of many bird species.

5. Human habitation

Some of the birds i.e. sparrows, mynas and crows are found more commonly in towns and villages than other habitat types. Plants of *Ziziphus jujuba*, *Acacia nil*otica and *Melia azadirachta* are common in the human habitation.

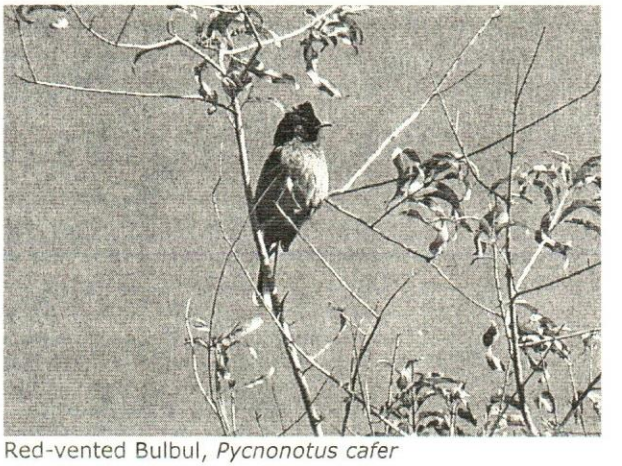
Material and Methods

The present study was conducted in Soon Valley from 2005 till 2009. The birds were directly observed, identified and counted by using binoculars 10x50, 8x40 and spotting scope. GPS was also used to demark the wetlands. Field guides were referred to identify the bird species. The total population of the birds was counted directly in the field at the wetland and the data then computed to find out the total population. Transact Count was used for studying the relative abundance of terrestrial species.

Results and Discussion

During the study 143 species of birds of 95 genera in 39 families and 18 orders were recorded. Of the recorded species, 43 of the order Passeriformes, 27 of Charadriiformes, 14 of Anseriformes, 11 of Accipitriformes, 10 of Coraciformes, 4 of Cuculiformes, 3 each of Podicipitiformes, Pelecaniiformes, Galliformes and Piciformes, 2 Psittaciformes, and 1 each of Ciconiiformes Strigiformes, Phoenicopterformes, Falconiformes, and Apodiformes were classified. Among the observed birds, 10 (6.99%) species were found abundant, 69 (48.25%) common, 57 (39.86%) rare and 7 (4.90%) species were scarce. Classification of birds on the basis of visit to the area shows that 82 (57.34%) species were resident, 52 (36.36%) as winter visitor, 4 (2.80%) as summer visitor and 5 (3.50%) as passage migrant.

The most important species found in Soon Valley is white-headed stiftailed duck (*Oxyura leucocephala*) which is one of the globally threatened Anatids and was reported by locals during the course of the present study, only on Ucchali Complex in winter 2009. Roberts (1991) has also reported that in the sub-continent almost the whole migrant population of the species winters only at one or two lakes of the Punjab Salt Range. Therefore, Pakistan has a special international obligation for the conservation of white-headed stiftailed duck. Ali and Akhtar (2005) presented the data of occurrence of white headed duck at different wetlands of Punjab for the past many years which indicate that highest concentration has been found at the Ucchali Complex. In the past three years the species has not been observed during midwinter waterfowl census.



Red-vented Bulbul, *Pycnonotus cafer*

Over 100,000 water fowl largely *Fulica atra* were reported in January 1986 at Ucchali Lake (Scot, 1989). As the area of the wetlands has been decreased, therefore, smaller populations of water birds are observed.

Table 1: Number of water birds observed at Jhalar, Ucchali, and Khabbaki Lakes.

Common Names	Scientific Names	Jhalar Lake		Ucchali Lake		Khabbaki Lake	
		Jan-08	Jan-09	Jan-08	Jan-09	Jan-08	Jan-09
Little Grebe	*Tachybaptus ruficollis*	15	35	120	125	78	0
Great Crested Grebe	*Podiceps cristatus*	0	10	0	0	0	0
Black-necked Grebe	*Podiceps nigricollis*	0	25	0	0	0	0
Large Cormorant	*Phalacrocorax carbo*	0	0	0	0	0	0
Indian Cormorant	*Phalacrocorax fuscicollis*	0	0	0	0	0	0
Little Cormorant	*Phalacrocorax niger*	0	25	0	0	8	18
Darter or Snake Bird	*Anhinga melanogaster*	0	15	0	0	0	0
Night Heron	*Nycticorax nycticorax*	0	38	0	0	0	0
Indian Pond Heron	*Ardeola grayii*	0	21	0	0	0	22
Cattle Egret	*Bubulcus ibis*	0	13	0	0	0	26
Little Egret	*Egretta garzetta*	0	0	86	0	13	36
Intermediate Egret	*Egretta intermedia*	0	0	0	0	4	25
Large Egret	*Egretta alba*	0	0	42	0	3	12
Gray Heron	*Ardea cineria*	0	0	0	0	0	8
Purple Heron	*Ardea purpurea*	0	0	0	0	0	3
Greater Flamingo	*Phoenicopterus rubber*	0	0	27	0	0	0
Ruddy Shelduck	*Tadorna ferruginea*	0	0	0	5	0	0
Common Shelduck	*Tadorna tadorna*	0	0	8	0	0	0
Eurasian Wigeon	*Anas Penelope*	0	0	335	350	250	270
Gadwall	*Anas strepera*	0	570	80	170	0	75
Common Teal	*Anas crecca*	0	0	4200	640	0	1800
Mallard	*Anas platyrhynchos*	0	0	1350	30	0	150
Northern Pintail	*Anas acuta*	0	1750	1500	570	0	15
Shovler	*Anas clypeata*	15	0	635	780	0	900
Red-crested Pochard	*Netta rufina*	0	50	0	0	0	0
Common Pochard	*Aythya ferina*	31	24	625	3000	2,300	5000
Tufted Duck	*Aythya fuligula*	0	47	55	0	0	0
Indian Moorhen	*Gallinula chloropus*	12	0	0	0	0	0
Purple Moorhen	*Porphyrio porphyrio*	0	32	0	0	0	0
Common Coot	*Fulica atra*	70	0	5650	4000	645	4000
Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	0	22	0	0	0	0
Black-winged Stilt	*Himantopus himantopus*	18	0	15	0	38	0
Kentish Plover	*Charadrius alexandrinus*	0	0	0	0	0	0
Red-Wattled Lapwing	*Holopterus indicus*	5	0	4	52	3	28
Northern Lapwing	*Vanellus vanellus*	0	0	0	0	0	5
Kentish plover	*Charadrrrus alexandrinus*	0	18	0	0	0	0
Little Stint	*Calidris minuta*	0	12	0	0	0	12
Common Snipe	*Gallinago gallinago*	0	7	0	0	0	0
Spotted Redshank	*Tringa erythropus*	0	13	0	0	0	0
Common Redshank	*Tringa tetanus*	0	5	8	0	0	0
Green shank	*Tringa nebularia*	0	5	7	0	0	0
Green Sandpiper	*Tringa ochropus*	0	0	4	18	5	0
Wood Sandpiper	*Tringa glareola*	0	0	0	0	0	0
Common Sandpiper	*Actitis hypoleucos*	0	0	0	0	0	0
Little Stant	*Calidris minaties*	0	0	0	15	0	0
Black-headed Gull	*Larus ridibundus*	0	0	39	0	0	100
Gray River Tern	*Sterna aurantia*	0	0	245	0	0	8
Total Number of birds		166	2737	15035	9750	3347	12513

In the last few years 6,681 birds were found in January 2007, 13,949 in November 2007 and 15,035 in January 2008 (Azam *et al.*, 2008). Important Anatid species recorded at the complex include Common Shellduck (*Tadorna tadorna*), Ruddy Shellduck (*T. ferrugenia)* and Red crested Pochard (*Netta rufina*). Common Pochard (*Aythya ferina*) is relatively most abundant anatid species. Other commonly found anatids include Mallard (*Anas platyrhynchos*), Wigeon (*Anas penelope*), Shoveller (*Anas clypeata*), Pintail (*Anas acuta*) and Common Teal (*Anas crecca*). A small resident population of Flamingo (*Phoenicopterus ruber*) was also found at Uchali Lake.

Table 2: Types of occurrence of the species.

Status of Species	N	Frequency
Abundant	10	6.99
Common	69	48.25
Rare	57	39.86
Scarce	7	4.90
Total	143	100

Egrets are commonly seen on the Khabaki Lake and Jhalar Lake. These are not usually seen at Ucchali lake as there is no fish in it. Among the waders commonly found species include Black-winged Stilt (*Himantopus himantopus*), Kentish Plover (*Charadrius alexandrinus*), Red-wattled Lapwing (*Holopterus indicus*), Little Stint (*Calidris minuta*), Common Red Shank (*Tringa totanus*), Green Shank (*Tringa nebularia*), Wood Sandpiper (*Tringa glareola*) and Common Sandpiper (*Actitis hypoleucos*). Sociable Lapwing *(Vanellus gregarious)* is one of the rarest species of the waders which was recorded in January 2009 at khabaki lake.

Indian Robin, *Saxicoloides fulicata*

Terrestrial species in Sodi Game Reserve has one of the highest densities of Grey Partridge *(Francolinus pondicerianus)* in the country. However, with increasing human settlements, number of the partridges is on decline. Ring Dove *(Streptopelia decoacta)* is another abundant terrestrial species. Bulbuls, Mynas, Babblers etc. are also abundant. Presence of a small resident population of Common Kestrel in the valley was also noted.

Most of the terrsitial species are resident, however, some of these are winter visitors which include Long-legged Buzzard (*Buteo rufinus),* Hen Harrier (*Circus cyaneus cyaneus),* Pallid Harrier (*C. macrourus),* Marsh Harrier (*C. aeruginosus aeruginosus),* Osprey *(Pandion haliaetus haliaetus),* Bengal Green Pigeon *(Treron phoeonicoptera),* Black Redstart (*Phoenicurus ochruros),* Pied Chat (*Oenanthe picata),* Grey-headed Yellow Wagtail (*Motacilla flava),* Grey Wagtail (*M. caspica caspica)* and Yellow-headed Wagtail (*M. citreola citreola).* Summer visitors include Pied Crested Cuckoo (*Clamator jacobinus serratus),* Indian Koel (*Eudynamys scolopacea scolopacea),* Common Swallow (*Hirundo rustica rustica),* Indian Wire-tailed Swallow (*H. smithii filifera)* and Striated Swallow (*H. daurica).*

Table 3: Status of species in the area.

Types of Occurrence	N	Frequency
Resident	82	57.34
Winter Visitor	52	36.36
Passage Migrant	5	3.50
Summer Visitor	4	2.80
Total	143	100

The wetlands and associated fauna are facing a number of ecological problems. The tube wells around Uchali Lake may have a negative impact on the quantity of water in the lake because of drop of water table. The mettaled road on the watershed side of the Jhalar Lake hinders water flow to the lake, reducing water quantity.

References

Ali, S. and Ripley, S.D. 1989. Hand book of the birds of India and Pakistan, 10 volumes. Oxford University Press, Bombay.

Ali, Z. and Akhtar, M. 2005. Birds surveys at wetlands in Punjab, Pakistan with special reference to the present status of white-headed duck (*Oxyura leucocephala*). Forktail. 21: 43-50

Azam, M.M. 1994. The Birds of Salt Range. Rec. Zool. Surv. Pakistan, 12: 63-97.

Azam M.M., M.A. Brohi and W. Ahmed 2008. Studies on the Population Status of Water Birds

in Major Wetlands of Upper Punjab. Rec. Zool. Surv. Pakistan, 18: 4-11.

Perennou, C., Rose, P. and Poole, C. 1991. Asian Waterfowl Census, 1990. International Waterfowl and Wetlands Research Bureau, Slimbridge, England.

Perennou, C. and Mundkhur, T. 1992. Asian Waterfowl Census, 1991. International Waterfowl and Wetlands Research Bureau, Slimbridge, England.

Roberts, T.J. 1991. The Birds of Pakistan. Volume, 1 (Non Passeriformes), Oxford University Press, Karachi.

Roberts, T.J. 1992. The Birds of Pakistan, Volume, 2 (Passeriformes), Oxford University Press, Karachi.

Scott, D.A. and Rose, P.M. 1989. Asian Waterfowl Census, 1989. International Waterfowl and Wetlands Research Bureau, Slimbridge, England.

Scott D.A., 1989. A Directory of Asian Wetlands (ed.) Gland, Switzerland, International Union for Conservation of Nature and Natural Resources Cambridge, UK.

Van, J. Van der 1987. Asian Waterfowl, 1987. International Waterfowl and Wetlands Research Bureau, Slimbridge, England.

Van. J. Van der 1988. Asian Waterfowl, 1988. International Waterfowl and wetlands Research Bureau, Slimbridge, England.

Waite, H.W. 1951. The Birds of the Punjab Salt Range (Pakistan). Journal of the Bombay Natural History Society, Vol. 48, 1 and 2, pp 93-117.

Annexure I: Systematic list and details of birds observed in Soon Valley.

Scientific Name	Common Name	Status	Occurrence
ORDER: PODICIPITIFORMES			
FAMILY: PODICIPITIDAE			
Podiceps cristatus cristatus	Great Crested Grebe	Rare	Winter Visitor
P. nigricollis nigricollis	Blacknecked Grebe	Rare	Winter Visitor
Tachybaptus ruficllis ruficollis	Little Grebe	Common	Resident
ORDER: PELECANIFORMES			
FAMILY: PHALACROCORACIDAE			
Phalacrocorax carbo sinensis	Large Cormorant	Rare	Resident
Halietor niger	Little Cormorant	Common	Resident
FAMILY: ANHINGIDAE			
Anhinga melanogaster	Darter	Rare	Resident
ORDER: CICONIIFORMES			
FAMILY: ARDEIDAE			
Ardea cinerea	Grey Heron	Common	Winter Visitor
A. Purpurea	Purple Heron	Rare	Winter Visitor
Bubulcus ibis	Cattle Egret	Common	Resident
Ardeola grayii grayii	Pond Heron	Common	Resident
Egretta alba	Large Egret	Common	Resident
E. garzetta garzetta	Little Egret	Common	Resident
Nycticorax nycticorax	Night Heron	Rare	Resident
Ixobrychus minutus minutus	Little Bittern	Rare	Resident
I. cinnamomeus		Rare	Resident
ORDER: PHOENICOPTERIFORMES			
FAMILY: PHOENICOPTERIDAE			
Pnoeicopterus rubber	Flamingo	Rare	Resident
ORDER: ANSERIFORMES			
FAMILY: ANATIDAE			
Tadorna tadorna	Common Shelduck	Scarce	Winter Visitor
T. ferruginea	Ruddy Shelduck	Scarce	Winter Visitor
Anas acuta	Pintail	Common	Winter Visitor
A. crecca	Common Teal	Abundant	Winter Visitor
A. platyrhychos	Mallard	Common	Winter Visitor
A. strepera	Gadwal	Common	Winter Visitor
A. Penelope	Wigeon	Common	Winter Visitor
A. querquedula	Gargany	Rare	Passage Migrate
A.clypeata	Shoveller	Rare	Winter Visitor
Netta rufina	Rdcrested Pochard	Scarce	Winter Visitor
Aythya ferina	Common Pochard	Abundance	Winter Visitor
A. nyroca	White eyed Pochard	Scarce	Winter Visitor
A. fuligula	Tufted Duck	Rare	Winter Visitor
Oxyura leucocephala	Whiteheaded Stifftailed Duck	Rare	Winter Visitor
ORDER: ACCIPITRIFROMES			
FAMILY: ACCIPITRIDAE			
Milvus migrans	Black Kite	Common	Resident
Elanus caeruleus	Black Winged Kite	Rare	Resident
Accipiter badius	Shikra	Rare	Resident
A. nisus	Sparrow Hawk	Rare	Resident
Buteo rufinus	Longlegged Buzzard	Scarce	Winter Visitor
Aquila rapax	Tawny Eagle	Common	Resident
Neophrone percnopterus	Egyptian Valture	Rare	Resident
Circus cyaneus cyaneus	Hen Harrier	Rare	Winter Visitor
C. macrourus	Pallid Harrier	Rare	Winter Visitor
C. aeruginosus aeruginosus	Marsh Harrier	Rare	Winter Visitor
Pandion haliaetus haliaetus	Osprey	Rare	Winter Visitor
ORDER FALIONUFORMES			
FAMILY: FALCONIDAE			
Falco tinnunculus	European Kestrel	Common	Resident
ORDER: GALLIFORMES			
FAMILY: PHASIANIDAE			
Ammoperdix griseogularis	Seesee Partridge	Rare	Resident
Francolinus pondicerianus	Grey Partridge	Abundance	Resident
Coturnix coturnix	Grey Quail	Common	Resident

ORDER: GRUIFORMES			
FAMILY: TURNICIDAE			
Turnix tanki tanki	Indian Button Quail	Common	Resident
FAMILY: RALLIDAE			
Porzana parva	Little Crake	Rare	Resident
Porphyrio porphyrio	Purple Moorhen	Common	Resident
Gallinula chloropus	Indian Moorhen	Common	Resident
Fulica atra	Coot	Common	Resident
FAMILY: CHARADRIIDAE			
SUB-FAMILY: CHARADRIINAE			
Vanellus leucurus	White-tailed Lapwing	Rare	Winter Visitor
V. vanellus	Lapwing	Common	Winter Visitor
V. gregarious	Sociable Lapwing	Scarce	Resident
V. indicus	Redwattled Lapwing	Common	Resident
Charadrius dubius	Little Ringed Plover	Rare	Winter Visitor
C. alexandrinus	Kentish Plover	Rare	Winter Visitor
FAMILY: SCOLOPACIDAE			
Numenius arquata	Curlew	Rare	Winter Visitor
Limosa limosa	Blacktailed Godwit	Rare	Winter Visitor
Tringa erythropus	Spotted Redshank	Rare	Winter Visitor
T. tetanus	Common Redshank	Common	Winter Visitor
T. nebularia	Green Shank	Common	Winter Visitor
T. ochropus	Green Sandpiper	Common	Winter Visitor
T. glareola	Wood Sandipiper	Common	Winter Visitor
Actitis hypoleucos	Common Sandpiper	Common	Winter Visitor
SUB-FAMILY: GALLINAGONINIAE			
Gallinago gallinago gallinago	Common Snipe	Common	Winter Visitor
SUB-FAMILY:CALIDRIDINAE			
Calidris minutus	Little Stint	Common	Winter Visitor
C. temminkii	Temmincks Stint	Rare	Winter Visitor
C. Alpinus alpinus	Dunlin	Rare	Winter Visitor
C. ferruginea	Curlew Sandpiper	Rare	Winter Visitor
FAMILY: ROSTRATULIDAE			
Rostratula benghalensis	Panited Snipe	Rare	Resident
Recurvirostra avocetta	Avocet	Scarce	Winter Visitor
Himantopus himantopus	Blackwinged Stilt	Common	Resident
FAMILY: GLAREOLIDAE			
Glareola lacteal	Small Indian Pratincole	Common	Summer Visitor
FAMILY: LARIDAE			
Larus ridibundus	Blackheaded Gull	Common	Winter Visitor
L. brunnicephalus	Brown Headed Gull	Common	Winter Visitor
Sterna aurantia	Indian River Tern	Common	Resident
S. acuticauda	Blackbellied Tern	Rare	Resident
ORDER COLUMBIFORMER			
FAMILY: COLUMBIDAE			
Treron phoeonicoptera	Bangal Green Pigeon	Rare	Winter Visitor
Columba livia	Blue Rock Pigeon	Common	Resident
Streptopelia decaocta	Ring Dove	Abundant	Resident
S. tranquebarica tranquebarica	Red Turtle Dove	Rare	Summer Visitor
S. senegalensis	Little Brown Dove	Common	Resident
ORDER: PSITTACIFORMES			
FAMILY: PSITTACIDAE			
Psittacula eupatria nipalensis	Large Indina Parakeet	Rare	Resident
P. krameri borealis	Rose-finged Parakeet	Rare	Resident
ORDER: CUCLIFORMES			
FAMILY: CUCLIDAE			
SUB-FAMILY: CUCULINAE			
Clamator jacobinus serratus	Pied Crested Cuckoo	Rare	Summer Visitor
Eudynamys scolopacea scolopacea	Indian Koel	Rare	Summer Visitor
Cuculus canourus canorus	Cuckoo	Rare	Resident
Centropus sinensis sinensis	Crow Pheasant	Common	Resident
ORDER: STRIGIFORMES			
FAMILY: STRIGIDAE			

SUB-FAMILY: STRIGINAE			
Athene brama indica	Northern Spotted Owl	Rare	Resident
ORDER: APODIFORMES			
FAMILY: APODIDAE			
Apus affinis	House Swift	Common	Resident
ORDER: CORACIIFORMES			
FAMILY: ALCEDINIDAE			
Ceryle rudis leucomelanura	Indian Pied Kingfisher	Common	Resident
Alcedo atthis	Small Blue Kingfisher	Common	Resident
Halcyon smyrnensis	Whitebreasted Kingfisher	Common	Resident
FAMILY: MEROPIDAE			
Mereps superciliosus persicus	Bluecheeked Bee-eater	Rare	Winter Visitor
M. orientalis beludschicus	Sind Small Green Bee-eater	Common	Resident
FAMILY: CORACIIDAE			
Corracias bangalensis	Blue Jay	Common	Resident
FAMILY: UPAPIDAE			
Upapa epops	European Hoopoe	Common	Resident
FAMILY: PICIDAE			
SUB-FAMILY: PICINAE			
Picus squamatus squamatus		Rare	Resident
Dinopium benghalense dilutum	Golden-backed Woodpecker	Rare	Resident
Picoides assimilis	Sind Pied Woodpecker	Rare	Resident
ORDER: PASSERIFORMES			
FAMILY: ALAUDIDAE			
Gelerida cristata chendoola	Indian Crested Lark	Common	Resident
Alauda gulgula	Skylark	Common	Resident
FAMILY: HIRUNDINIDAE			
Riparia riparia diluta	Siberian Collared Sand Martin	Rare	Winter Visitor
Hirundo rustica rustica	Common Swallow	Common	Summer Visitor
H. smithii filifera	Indian Wiretailed Swallow	Common	Summer Visitor
H. daurica	Striated Swallow	Common	Summer Visitor
FAMILY: LANIIDAE			
Lanius excubitor lahtora	Indian Grey Shrike	Common	Resident
L. vittatus vittatus	Indian Baybacked Shrike	Common	Resident
L. schach erythronotus	Rufous-backed Shrike	Common	Resident
FAMILY: ORIOLIDAE			
Oriolus oriolus kundoo	Indian Golden Oriole	Rare	Summer Visitor
FAMILY: DICRURIDAE			
Dicrurus adsimilis albirictus	North Indian Black Drongo	Common	Resident
FAMILY: STURNIDAE			
Sturnes roseus	Rosy Starling	Rare	Passing Migrate
S. vulgaris	Common Starling	Common	Resident
Acridotheres tristis	Indian Myna	Abundant	Resident
A. ginginianus	Bank Myna	Abundant	Resident
FAMILY: CORVIDAE			
Dendrocitta vagabunda	Tree Pie	Common	Resident
Corvus splendens	Sind House Crow	Common	Resident
C. corax subcorax	Punjab Raven	Rare	Resident
FAMILY: PYCNONOTIDAE			
Pycnonotus leucogenys	Whitecheeked Bulbul	Abundant	Resident
P. cafer	Redvented Bulbul	Common	Resident
FAMILY: MUSCICIAPIDAE			
SUB-FAMILY: TIMALIINAE			
Turdoides caudatus	Common Babbler	Abundant	Resident

T. striatus	Sind Jungle Babber	Abundant	Resident
SUB-FAMILY: SYLVIINAE			
Cisticola juncidis	Streaked Fantail Warbler	Common	Resident
Prinia buchanani	Rufousfronted Wren Warbler	Common	Resident
Prinia gracilis	Indian Wren Warbler	Rare	Resident
Orthotomus sutorius	Indian Tailor Bird	Common	Resident
	Indian Great Reed Warbler	Common	Resident
SUB-FAMILY: TURDINAE			
Copsychus saularis	Indian Magpie Robin	Common	Resident
Phoenicurus ochruros	Black Redstart	Rare	Winter Visitor
Sexicola torquata	Indian Collared Bush Chat	Common	Resident
S. carjpata	Northern Pied Bush Chat	Common	Resident
Oenanthe picata	Pied Chat	Rare	Winter
Saxicoloides fulicata	Brownbacked Indian Robin	Rare	Resident Visitor
Anthus campestris	Tawny Pipit	Rare	Winter Visitor
Motacilla flava	Greyheaded Yellow Wagtail	Common	Winter Visitor
M. maderaspatensis	Large Pied Wagtail	Common	Resident
M. caspica caspica	Grey Wagtail	Common	Winter Visitor
M. alba	Indian White Wagtail	Common	Resident
M. citreola citreola	Yellowheaded Wagtail	Common	Winter Visitor
FAMILY: NECTARINIIDAE			
Nectarinia asiatica brevirostris	Sind Purple Sunbird	Rare	Resident
FAMILY: PLOCEIDAE			
SUB-FAMILY: PASSERINAE			
Passer domesticus indicus	Indian House Sparrow	Abundant	Resident
SUB-FAMILY: ESTRILDINAE			
Lonchura malabarica	White-throated Munia	Common	Resident
FAMILY: FRINGILLIDAE			
SUB-FAMILY: FRINGILLINAE			
FAMILY: EMBERIZIDAE			
Embregea. cia par	Rock Bunting	Rare	Resident

Hatching and rearing of two species of marine turtles from Karachi, Pakistan

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Abstract

Captive hatching and rearing of two species of marine turtles (*Chelonia mydas* and *Lepidochelys olivacea*) from Karachi coast were conducted on experimental basis. The study aimed to investigate growth rate, feeding behavior and rate of survival of hatchlings. Hatchlings of green turtle were relatively hard and sturdy in tolerating the controlled condition. Eighteen green and two olive ridley hatchlings survived in controlled environmental conditions for a period from 27 to 1272 days with increase in weight from 30 to 3500gm and body size from 6.5x5.6cm to 35x30cm (CCLxCCB).

Key words: captive, hatching, growth, marine turtles

Introduction

Almost all species of marine turtles are presently categorized as endangered (Groombridge, 1982) mainly due to overexploitation and destruction of their nesting habitat. They are listed as "threatened" in the "Red Data Book" (IUCN, 1996). Firdous (2001) has reviewed literature dealing with conservation measures taken round the world to save the turtle populations from depletion.

In early 1970's the turtles along the coast of Sindh were slaughtered and their meat and other products were sold in the local market of Karachi. As a result of overexploitation, the sea turtles were given the status of endangered species in Pakistan.

On the recommendation of a team of Worldwide Fund for Nature (WWF), the Government of Sindh decided to take necessary steps for the protection of sea turtles in Pakistan. The present study was initiated under the patronage of Government of Sindh in collaboration with IUCN and WWF Pakistan. A comprehensive project was launched with main emphasis on egg laying, hatching, rearing and growth in order to collect baseline information about the bioecology of threatened species of marine turtles.

Notable publications on captive rearing of marine turtles include those of Minton (1966), Suwelo (1973), Balazs and Ross (1973), Stickney (1979), Ponnuswamy and Rehman (1985), Eckert *et al.* (1994), Donnelly (1994), Caillouet *et al.* (1995), Heppell and Crowder (1996), and Shaver (1996). Knowledge about conservation of turtles of Pakistan is nonexistent. Very few publications contain preliminary observation required for preservation and propagation of marine turtles (Ghalib and Zaidi, 1976; Rajagopalan, 1984). The present communication is in continuation of a series of publications on nesting, egg laying, tagging and captive rearing of marine turtles (*Chelonia mydas* and *Lepidochelys olivacea*) from Pakistan (Firdous *et al.*, in press).

Material and Methods

Raising hatchlings in captivity was carried out to ensure the safe return of hatchlings to the sea and to protect them from natural predators for conservation of the species.

Fiberglass tanks measuring 6´x3´ in size were used to keep the hatchlings. The hatchlings were kept in seawater for the first few days. Later, pieces of fresh shrimps and fish, dry fish, crab meat and seaweeds were added to the seawater. Fresh Seaweeds were collected from the rocky shores of Buleji, Paradise Point and Cape Monz. Changes in different body parameters of hatchlings were recorded at regular intervals.

In another series of experiments, 20 hatchlings were kept in bathtubs of same measurement and were given different types of diet at different stages of growth. Measurements were taken usually after ten days. The water of the tanks was normally changed twice a day and sometimes thrice a day depending on the nature of suspended material.

The length as CCL (Curved carapace length) and breadth as CCB (Curved carapace breadth) of shells of adults and hatchlings of green and olive ridley turtles were measured and records were properly maintained. A vernier caliper was used to measure the flat surface dimensions, whereas the curved surface measurements were taken using a flexible tape. The following dimensions were taken: length (maximum distance between the anterio-posterior axis of the carapace), breadth (maximum distance along the lateral

axis, mostly between the second and third coastal scutes).

Results

Hatching process

The hatchlings emerged after 40-60 days of incubation period from a depth of 2-3ft of the sand. Rise to the surface occurred by sporadic outbursts usually triggered by one hatchling and quickly spreading throughout the clutch. The sand sank down in a circular area where hatchlings strived to emerge on the surface. As soon as the hatchlings were out of the nest they started moving towards the sea.

During the present study (1979 to 1997), a total of 1,453,966 eggs of green turtles and 78,014 eggs of olive ridley were transplanted in protected enclosures at Sandspit and Hawkesbay. Out of these 370,414 (25%) and 21,142 (27%) hatchlings of green and olive ridley turtles hatched respectively and were released to the sea during a period of 19 years.

Hatching rate in terms of number of clutches hatched during the present study period varied from 47-85% and 50-100% for green and olive ridley turtles, respectively.

Carapace length and breadth of green turtle hatchlings varied from 4.5-6.5cm and 4.0-5.6cm (N=170) at Sandspit while from 4.5-5.8cm and 4.0-5.3cm (N=149) at Hawkesbay, respectively. Their weights varied from 17.0 to 32.0gm at Sandspit and from 22.0 to 31.5gm at Hawkesbay. On the other hand carapace length and breadth of olive ridley hatchlings from Sandspit ranged from 3.6-5.2cm (average 4.4cm, N=27) and from 3.2-4.9cm (average 4.2cm, N=27), respectively. At Hawkesbay, it varied from 3.0 to 5.1 (average 4.4cm, N=26) and from 3.9-5.0cm (average 4.3cm, N=26), respectively. The weight of olive ridley hatchlings at Sandspit and Hawkesbay recorded varied from 15.5 to 19.0gm (average 16.3gm, N=27) and from 15.5-19.0g (average 16.7gm, N=26), respectively.

Hatching Season

i. Green Turtle

Hatching in green turtles though occurred throughout the year, the average number of hatchlings produced per month ranged from 172 (July) to 5,981 (October) per month. Moreover, the year may be divided into two halves; the hatchlings produced in the first half (January to August) ranged from 924 (May) to 172 (July) whereas in the second half (September to December) they ranged from 5,986 (October) to 2,655 (December). The maximum percentage (29.10%) of hatching was observed during October and minimum (0.50 %) in July.

ii. Olive Ridley

The average number of hatchlings produced ranged from 56 (December) to 669 (September) per month. Hatchings of olive ridleys were observed exclusively during the period of August to December with a peak in October (42.1%). The average number of hatchlings produced ranged from 56 (December) to 669 (September). The minimum hatching was recorded during the month of December (1.10%) and maximum in September (44.30%).

Hatching Frequency (Juveniles Released)

i. Green Turtle

A total of 371,414 hatchlings were hatched and released during 205 months out of a total of 218 months of study period (November 1979 to December 1997). The number of hatchlings produced per month ranged from 2,065 (July) to 107,749 (October). Highest values of coefficient of variation (265.1%) in July and lowest (68%) in May and October are indicative of the minimum and maximum consistency, respectively.

ii. Olive Ridley

A total of 21,142 hatchlings were produced at Karachi coast during the study period. The number of hatchlings produced ranged from 222 (December) to 9,363 (September). The highest values of coefficient of variation (132.8%) in October and lowest (52.2%) in August are indicative of minimum and maximum consistency, respectively.

During the whole study period of 218 months (November 1979 to December 1997), hatchlings were hatched and released in only 51 months during the period August to December. These were not available for release not only from January to July in the whole study period but also during August to December in many years of the study period.

High number of hatchlings during September to November and relatively low number of hatchlings in August and December are reflected in relatively low values of C.V. (52.4-93.4%) in August and December and high values (114.3-132.8%) during September to November.

Captive Rearing

Captive rearing or head starting is a method of raising hatchlings in captivity until they are large enough to be less vulnerable to predation. A total of 18 green and 2 olive ridley hatchlings were kept and grown in experimental tanks between 1989 and 1994. Out of 18 green turtle hatchlings, 12 were kept in captivity in 1989, 4 in 1990 and 2 in 1992. Only two hatchlings of green turtle

survived for a period of over four years. Two olive ridley hatchlings were kept for rearing in captivity during 1989.

The weight of green turtle hatchlings ranged from 20-32gm. (Av. 26.28gm, SD 3.18), whereas that of olive ridley hatchlings ranged from 18-20gm (Av. 19, SD 1.41). The CCL and CCB of green turtle hatchlings averaged 6.0 and 5.19cm, respectively whereas CCL and CCB of olive ridley hatchlings averaged 5.15 and 4.6cm, respectively. The weight of green turtle hatchlings increased from 20-7,000gm during a period from 27 to 1,772 days.

Initially only fresh sea water was given for at least 29 days (Sample Nos. 1-12). Chopped fresh tissues of small shrimps were also added to sea water for further 10 days. Dry chopped fish was then given to the hatchlings for the remaining days in captivity.

Overall growth of olive ridley hatchlings in captivity was recorded as 0.008 and 0.012cm per day in CCL and CCB, respectively.

Overall growth of green turtle hatchlings in experimental tanks was recorded ranging from 0.0028-0.230cm per day and 0.0009-0.0340cm per day in CCL and CCB, respectively.

Most of the green turtle hatchlings survived for a period of 176 days except for two (sample numbers 9 and 18) that survived up to 1,772 and 1,342 days, respectively. Seaweeds and crabs (*Ocypod* sp., *Naptunus* sp.) were also given to these two samples in addition to the above-mentioned diet. Details of S-9 and S-18 are given below.

S-9 Hatchling

This was reared in tanks at Sandspit from October 1989 to August 1994. The hatchling was kept in sea water without any additional food for initial 29 days, fresh small shrimps and crabs for next 11 days, dry small shrimps for further 11 days, fresh small fish, crabs and sea-weeds up to the age of 1,772 days.

Changes in CCL

The rate of increase in CCL was at its maximum from April to September 1990 (6 months). The rate of growth decreased considerably during the rest of the study period. No increase was observed between January and March 1993 followed by a minimal increase of 0.5 cm. No increase was noticed in the last six months of the experiment.

Changes in CCB

The changes in CCB followed the pattern similar to that of CCL. The CCB shows an increase of 1.0cm during the first three months, i.e. from October to December 1989. The rate of increase then dropped down considerably and proceeded at a slow pace till December 1993 when the experiment was terminated.

Changes in Weight

The rate of change in weight of hatchling varied considerably. It increased very slowly during the first six months (ranging from 13-20gm per three months) compared to rest of the experiment period. The rate of increase in weight ranged from 115 to 326gm per 3 months from April 1990 to September 1992 (30 months). An extraordinary increase in weight of 1300gm in three months was observed during October to December 1992. More strangely the period of maximum increase was followed by a period of no increase and then a drastic drop in weight of the hatchling of 1,200gm was noted. The weight remained stable during the last six months of the experiment.

The hatchling weighed 3500gm with a size 35x30cm (CCLxCCB) when it was released to the sea after being tagged. Its growth was calculated as 0.016x0.0137cm (CCLxCCB) per day.

S-18 hatchling

Second longest survival of green turtle hatchling (S-18) weighing 28gm and measuring 6.1x5.2cm (CCLxCCB) was reared in captivity at Sandspit from April 1990 to December 1993. The hatchling was kept in sea water without any additional food for initial 10 days, was given crabs (*Ocypod sps.* and *Naptunus sps.*) for next 11 days, chopped fish for 102 days and lastly fish and sea-weeds for 52 days until it died on 28th December 1993 after 1342 days. The changes in size and weight were compiled for every month and the data was used to calculate the changes after every three months.

Changes in CCL

During the initial three months in captivity (April-June 1990) an increase of 3.6cm was observed in CCL. Growth rate of CCL accelerated in the next three months. During the rest of the study period, the growth rate decreased considerably reaching to its minimum during October to December 1992. No increase was observed during the last one year of the experiment (January-December 1993).

Changes in CCB

An increase of 3.9cm in CCB was seen during the initial three months (April-June 1990). It then dropped down to 3.7cm in the next three months from July to September 1990. The rate of growth in CCB during the rest of the study period (39 months) fluctuated considerably, varying from

0.5-2.4cm. No change was noticed in the last six months.

Change in Weight

The rate of increase in weight of hatchling during the first three months was very slow (69.3gm). It accelerated in the next 30 months. Rate of increase in weight ranged from 147 to 1,050gm per three months during the period from July, 1990 to December, 1992. The period of maximum increase (October-December 1992) showing an increase of 1,050gm was followed by a period (January to March 1993) of no change in weight. However, a reduction of 1,100gm in weight was observed during April to June 1993. The hatchling again showed an increase of 1,000gm during the last three months of the experiment period (October to December 1993).

The hatchling weighed 7,000gm and had 38x36cm (CCLxCCB) carapace size when it died. Growth was calculated as 0.0241x0.0229cm (CCLxCCB) per day.

Discussion

Investigations on marine turtles since last 30-40 years are mainly focused on developing and strengthening the conservation strategies. Areas of prime importance in this regard are captive hatching and rearing of marine turtles in order to save them from extinction. Results of studies on diet of turtle hatchlings in captivity are still inconclusive. According to Biswas (1981) a change in the behavior of turtles occurs from carnivorous to herbivorous diet after one year of age. Kar (1982) and Hughes (1983) considered the turtles as carnivorous. Murthy and Menon (1976) categorized them as omnivorous.

A variety of food items and their combinations were, therefore, tried as food (Table 1). Meat (crab, shrimp, fish), grass (sea grass, manatee grass), garden vegetables in solitary or mixed forms were used. In Sunderban olive ridley hatchlings preferred to feed on crab rather than fish and prawn (Banerjee, 1985). In the present study, S-18 hatchling was fed chopped fish and crab meat whereas S-9 hatchling was given the meat of shrimps and crabs. The growth rate of turtle shell (CCLxCCB) of S-18 hatchling was found higher (0.024x0.022 cm/day) than that of sample 9 (0.016x0.013 cm/day). Similarly, weight of S-18 hatchling increased from 28 to 7,000gm compared to S-9 hatchling which increased from 30 to 3,500gm. It shows that the diet consisting of chopped fish and crabs is more suitable for better growth rates of green turtle hatchlings.

The hatching rates of green and olive ridley at Karachi coast (25 and 27%, respectively) were much lower than reported from other parts of the world: Florida, 61% (Witham and Futch, 1977); Gulf of Aden, 60% (Hirth and Carr, 1970); Tortuguero, Costa Rica, 50.7% (Carr and Hirth, 1962); Sri Lanka, 90-94% (A.G.R.W., 1968), Nancite, Costa Rica, 33.9 and 21.4% (Cornelius and Robinson, 1984).

Minimum rates in the present study were recorded in June and July which may be related to the monsoon season and prolonged wet weather as also mentioned by Hendrickson (1958) and Bustard (1972).

Table 1: Diet composition of marine turtles.

Diet	Locality	References
Olive Ridley		
Prawn, fish, crab, weed, grass	Sunderban	Banerjee (1985)
Hen's eggs, sea grass, prawns, sepia, fish	Tamil Nadu	Ponnuswamy and Rehman (1985)
Green Turtle		
Garden vegetable, mixed fish.	Gulf Stream	Zwinnenberg (1975)
Cooked crab offal (as supplement garden vegetables), Manatee grass + sea purslane	House of Refuge, Florida, Gulf Stream	Witham and Futch (1977)
Trout fish food, ground fish, frozen crab	Skidway	Stickney *et al.* (1973)
Shrimps, fish, sea weed, crab	Sandspit + Hawkesbay (Pakistan)	Present study

Shell dimensions of green and olive ridley turtles from Karachi match favourably with the figures reported for these species from other countries (Table 2). Unavailability of complete information in the literature regarding details of ranges and averages of shell dimensions and body weights, made it difficult to draw comparative conclusion. Nevertheless, a comparison of the present results with the fragmentary knowledge available in the literature (Table 2) shows that hatchling of green turtle grew faster and attained more body weight. Included in Table 2 are also the values of dimensions (length and breadth) and weights of 6 and 22 months old hatchlings from India (Rajagopalan, 1984; Whitakar, 1979). It may be seen that hatchlings of the same age from Karachi gained more weights than those from India.

Table 2: Shell dimension and body weight of marine turtles just after hatching. Average numbers are given in parentheses.

Shell size (CCL× CCB; mm)	Body weight (gm)	Locality	Reference
Green Turtle			
50 × 35	29	Hawaii	Balazs and Ross (1973)
51 × 40	-	Surinam	Schulz (1975)
50 × -	2.5 lb after 1 year	Australia	Rebel (1974)
45 - 65 × 40 × 56	20.0 -32.0	Pakistan (Sandspit)	Present Study
45 – 58 × 40-53	22.0 -31.5	Pakistan (Hawkesbay)	Present Study
177 × 162 (6 months old)	585	Pakistan (Hawkesbay)	Present Study
322 × 295 (22 months old)	3835	Pakistan (Hawkesbay)	Present Study
385 × 360 (44 months old)	7000	Pakistan (Hawkesbay)	Present Study
Olive Ridley			
36 – 52 (44) × 32-49 (42)	15.5 – 19.0	Pakistan (Sandspit)	Present Study
30 – 51 (44) × 39-50 (43)	15.5 – 19.0	Pakistan (Hawkesbay)	Present Study
41.5 × 32.39	-	Pakistan	Minton (1966)
42 – 46 × -	-	Australia	Frauca (1970)
47 - 50 × -	-	India	Valliappan and Whitaker (1974)
83- 95 (89.0) × - (6 months old)	100-175 (6 months old)	India	Whitaker (1979)
102.4 - 119.2 × - (6 months old)	280 (6 months old)	India	Rajagopalan (1984)
	3300 (22 months old)	India	Rajagopalan (1984)
27.8 × 25.26	2.795 kg (395 days)	Sunderban	Banerjee (1985)
74 (6 months old)	76 (6 months old)	Ceylon	Deraniyagala (1939)

Abbreviations: CCL= Curved Carapace Length, CCB= Curved Carapace Breadth

References

A.G.R.W. 1968. Olive-backed loggerhead turtles. Loris XI (4): 203-204.

Balazs, G.H. and Ross, E. 1973. Reared in captivity. Int. Turtle and Tortoise. Soc. J., 7 (1): 6-9.

Banerjee, R. 1985. The marine turtle *Lepidochelys olivacea* Eschscholtz, its occurrence and captive rearing in Sundarbans. Symposium on endangered marine animals and marine parks. Mar. Biol. Asso. of India, Cochin. 2: (26): 1-14.

Biswas, S. 1981. A report on olive ridely, *Lepidochelys olivacea* (Eschscholtz) (Testudines: Chelonidae) of Bay of Bengal. Rec. Zool. Surv. India. 79: 275-302.

Bustard, H.R. 1972. Sea turtles, their natural history and conservation. Collins, London-Sydney. 220pp.

Caillouet, C.W., Fontaine, C.T., Manzella-Tirpak, S.A. and Williams, T.D. 1995. Growth of headstarted Kemp's ridley sea turtles (*Lepidochelys kempi*) following release, *Chelonian*. Conserv. Biol., 1(3): 231 (cited in: Chaloupka and Musick, 1997).

Cornelius, S.E. and Robinson, D.C. 1984. Abundance, distribution and movements of olive ridley sea turtles in Costa Rica, IV. U.S. Fish and Wildlife Service. Office of Endangered Species Albuquerque, New Mexico. 1-43.

Carr, A.F. and Hirth, H. 1962. The ecology and migration of sea turtles. 5. Comparative features of isolated turtle colonies. Am. Mus. Novit., 2091: 42.

Deraniyagala, P.E.P. 1939. The tetrapod reptiles of Ceylon, Ceylon J. Sci., Colombo Mus. Nat. His. Ser., 1: 1-242.

Donnelly, M. 1994. Sea Turtle Mariculture: A Review of Relevant Information for Conservation and Commerce. The Centre for Marine Conservation Washington D.C. 113pp.

Eckert, S.A., Eckert, K.L. and Richardson, T.H. 1994. Compilers, Proc. 9th. Ann. Workshop on sea turtle biology and conservation, NOAA Tech. Memo. NMFS-SEFC, 232pp., Miami, Florida.

Firdous, F. 2001. Some aspects of bioecological studies of green turtle (*Chelonia mydas*) and olive ridley turtle (*Lepidochelys olivacea*) from Karachi coast. Ph.D. thesis, Department of Zoology, University of Karachi, Karachi-Pakistan: 452pp.

Firdous, F., Barkati, S. and Rahman, S. (In press). Studies on nesting and tagging of two species of marine turtles of Karachi coast. Pakistan J. Oceanography.

Frauca, H. 1970. The marine turtle of Australia. News and Inf. Bur. Bull. E 709: 1-4.

Ghalib, S.A. and Zaidi, S.S.H. 1976. Observations on the survey and breeding of marine turtles of Karachi coast, Pakistan. Agriculture Pakistan. Vol. XXVII, No. 1: 87-96.

Groombridge, B. 1982. The IUCN Amphibia-Reptilia Red Data Book, Part I: Testudines, Crocodylia, Rhynchocephalia. IUCN. Gland, Switzerland. 426pp.

Hendrickson, J.R. 1958. The green sea turtle *Chelonia mydas* (Linn.), in Malay and Sarawak. Proc. Zool. Soc. London. 130(4): 455-535.

Heppell, S.S. and Crowder, L.B. 1996. Models to evaluate headstarting as a management tool for long-lived turtles. Ecological Applications, 6: 556-56.

Hughes, G.R. 1983. Sea Turtles. ISBN 0949939196: 23pp.

Hirth, H.F. and Carr, A. 1970. The green turtle in the Gulf of Aden and the Seychelles Islands.Verh. K. Ned. Akad. Wet. Afd. Nat. Tweeda Sect., 58: 1-44.

IUCN. 1996. Red list of threatened animals (Compiled and edited by J. Ballie and B. Groombridge), Gland, Switzerland. 368pp.

Kar, C.S. 1982. Discovery of second mass nesting ground of the Pacific olive ridley sea turtles *Lepidochelys olivacea* in Orissa, India. Tiger Paper, 9(1): 6-7.

Minton, S.A. 1966. A contribution to the Herpetology of West Pakistan. Bull. Am. Mus. Nat. Hist., 134: 27-184.

Murthy, T.S.N. and Menon, A.G.K. 1976. The turtle resources of India. Seafood Export Journal, 8 (1): 1-12.

Ponnuswamy, P. K. and Rahman, A.A. 1985. Captive rearing of hatchlings of olive ridley *Lepidochelys olivacea* at Point Calimere, Tamil Nadu. Symp. Endangered Marine Animals and Marine Parks. Cochin, India. J. Mar. Biol. Assoc., India. 29(2): 1-4.

Rehman, A.A., Ponnuswamy, P.K. and Rajendran, K. 1985. Recovery plan for olive ridley *Lepidochelys olivacea* at Point Calimere, Tamil Nado. pp. 1-10. Symposium on endangered marine animals and marine parks. Mar. Bio. Asso.Cochin, India.

Rajagopalan, M. 1984. Studies on the growth of Olive ridley *Lepidochelys olivacea* in captivity. Bull. Cent. Mar. Fish. Res. Inst., 35: 49-54.

Rebel, T.P. 1974. Sea Turtles and the turtle industry of the West Indies, Florida, and Gulf of Mexico. Coral Cables Florida, Uni. Miami Press, 250pp.

Schulz, J.P. 1975. Sea turtles nesting in Surinam. Surinam Forest Service Nederlandsche Commissie voor International Natuurbescherming Mededelingen 23. Stitching Natuurbehoud Surinam (Stinasu). Verhandeling. 3: 143pp.

Shaver, D.J. 1996. Head-started Kemp's ridley turtles nest in Texas. Marine Turtle Newsletter, 74: 5-6.

Stickney, R.R. 1979. Principles of warm water Aquaculture. John Wiley and Sons, New York, 375pp.

Stickney, R.R., White, D. B. and Perlmutter, D. 1973. Growth of green turtle and loggerhead sea turtles in Georgia on natural and artificial diets. Bull. Georgia Acad. Sci., 31: 37-44.

Suwelo, I.S. 1973. Notes on turtle ranching at Tidung Island. Universitas Nasional, Jakarta. Manuscript, 3pp.

Valliappan, S. and Whitaker, R. 1974. Olive Ridleys on the Coromendel Coast, Madras Snake Park, Guindy Deer Park, Madras, India. (cited in: CMFRI Bull. 35, 1984).

Whitaker, R. 1979. Captive rearing of marine turtles. J. Bombay Nat. Hist. Soc., 76 (1): 163-166.

Witham, R. and Futch, C.R. 1977. Early growth and oceanic survival of pen-reared sea turtles. Herpetologica, 33(4): 404-409.

Zwinenberg, A.J. 1975. The Green Turtle (*Chelonia mydas*), one of the reptiles most consumed by man, needs immediate protection. Bull. Maryland. Herp. Soc., 11(2): 45-63.

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Fish fauna of Haleji Lake, Sindh, Pakistan

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Abstract

A total of 49 fish species were recorded from the Haleji Lake. The fish fauna of the Haleji Lake is similar to that of the Kinjher Lake in composition. Twenty one species (43%) represented family Cyprinidae while twenty-eight species (64%) were from the rest of the 14 families. Among the latter, four species represented family Bagridae and three species each represented families Mastacembelidae, Chandidae and Schilbeidae. One or two species represented the remaining families. Among the 49 species found in the Haleji Lake, 10 species have very high commercial value. In addition to these species, 4 have high and 6 have fairly high commercial value while eleven species have significance as they can be exploited in hitherto untapped aquarium business in Pakistan. Among the varied factors contributing to the deterioration of the lake the top most is the lack of coordination among the three main stakeholder departments of the Government of Sindh.

Key Words: Fish fauna, Haleji Lake, Cyprinidae, Pakistan, lack of coordination

Introduction

Haleji Lake is situated in district Thatta, about 15 km in the west of Thatta town. It is located 70 km north of Karachi at about 5 km off the Thatta-Karachi road from the village of Gujjo. Originally the Haleji Lake was a small salt-water lake formed by seasonal water collecting in a depression. During World War II, thousands of American and British Troops were stationed in Karachi and the then British Government of Sind decided to increase the capacity of this lake by having a feeder canal from River Indus. Salt water was drained out and an embankment was constructed around the lake which was fed by fresh water through a canal. The whole lake work was completed within 24 months. Resultantly, Haleji became one of the major sources of water supply to the increasing population of Karachi as well as an exquisite refuge for waterfowl.

Haleji lake has a square shape structure, each side having a length of about 5 km. The main water reservoir covers an area of 14.5 km^2 and the maximum depth being 5m. Shady trees surround it along the embankment. Phragmites, typha, hydrilla and lotus cover parts of the lake. Along the banks there are a series of brackish lagoons formed as pits reminding the depressions created as a result of mass scale excavation and soil transfer when the banks were formed.

The Government of Sindh has provided legal cover to preserve ecology of the area and Haleji was declared Wildlife Sanctuary and later on as Ramsar Wetland Site in 1977. With the passage of time Haleji has lost its initial status and presently faces a number of problems. Water was first collected in the Kinjher lake and from there diverted to Haleji lake and thence supplied to Karachi city. Presently a canal has been constructed which directly supplies water to Karachi bypassing the Haleji Lake. Water in the Haleji Lake is now only provided when it is surplus or it is plenty during flood season. Stagnant water conditions and extra vegetation growth has choked the lake and eutrophication process has changed the physico-chemical characteristics of the lake water making it unfit for a number of animal species.

Diverse studies have been conducted on many aspects of fish and fisheries of the lakes of lower Sindh. The major part of literature is on the biodiversity of various parts of the coastal areas. The significant works in this regards are that of Jafri *et al.* (2000), Leghari *et al.* (1999), Iqbal *et al.* (1999), Mirza (1986), Ahmed *et al.* (1976), Niazi (1976), Siddiqui *et al.* (1973), and Qureshi (1965). Some work on the commercial fishes has been conducted by Khan (1999), Ahmed and Niazi (1988), and Bianchi (1985). The limnological aspects of various water bodies have been covered by Dewani *et al.* (2002), Mahar *et al.* (2000), Monawar *et al.* (1999), Nazneen (1995), Baig and Khan (1976), and Baqai *et al.* (1974 a, b) while aquaculture aspect is only documented by Yaqoob (1994).

Material and Methods

There are five techniques for fish surveys: Bank side counts, trapping, cast netting, gill netting and electro-fishing. Bank side counts are recommended only for clear and shallow streams; trapping is done by using specific baits for specific species; Gill nets are used for commercial fishes while electro-fishing is a

technique for wadable streams with limited width. The cast netting is, therefore, the most appropriate technique for study of fish diversity of large rivers and reservoirs.

A general survey of the reservoir area was conducted to identify different habitats in the study area. Field stations were selected covering all the representative habitats of the lake. Fish were collected using cast nets of two different mesh sizes (small one having mesh size of 1cmx1cm and having a circumference of 5m, and the large one with mesh size of 2.5cmx2.5cm and a circumference of 10m) so that fishes of all sizes could be collected. Ten nets of each mesh size were cast in each station along a line transect of about 500 meters. The fishes were identified in the field and number of specimens of each species collected from each station was counted. The required specimens were preserved in 10% formaldehyde for reference.

Results

A total of 49 fish species were recorded from the Haleji Lake during the present study (Table 1). The fish fauna of the Haleji lake is similar to that of the Kinjhar Lake except a few species because of their proximity to each other and their connection with each other by a canal. Moreover, the water supply to both of these lakes is from the Kotari Barrage constructed on the river Indus. A large number of species have been found in the lagoons formed on all sides of the lake. Presently, the lake is facing a real threat of eutrophication, water quality deterioration, illegal fishing, over growth of vegetation, water shortage, change of water regime from lentic to lotic, invasion by golden apple snail, human intrusion for multiple use of the lake especially for fishing and cutting of vegetation.

Twenty-one species (43%) represented family Cyprinidae while twenty-eight species (64%) were from the rest of the 14 families. Among the latter, four species represented family Bagridae and three species each represented families Mastacembelidae, Chandidae and Schilbeidae. One or two species represented the remaining families (Fig. 1).

Among the 49 species found in the Haleji Lake, 10 species viz., *Cirrhinus mrigala*, *Gibelion catla*, *Labeo rohita*, *Cyprinus carpio*, *Sperata sarwari*, *Bagarius bagarius*, *Wallago attu*, *Clupisoma garua*, *Clupisoma naziri*, and *Channa marulius* have very high commercial value. In addition to these species, 4 have high and 6 have fairly high commercial value while eleven species have significance as they can be exploited in hitherto untapped aquarium business in Pakistan (Fig 2).

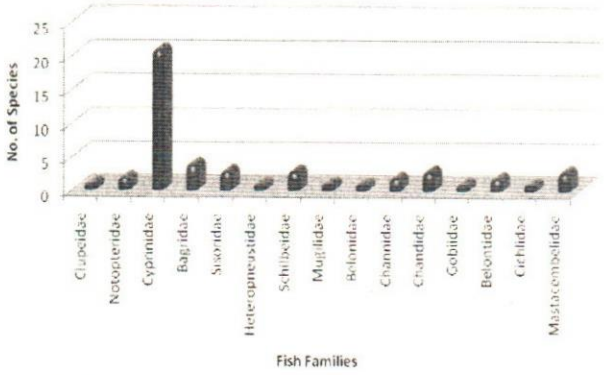

Fig. 1: Number of fish species represented in each of the fifteen fish families found in Haleji Lake, Sindh, Pakistan.

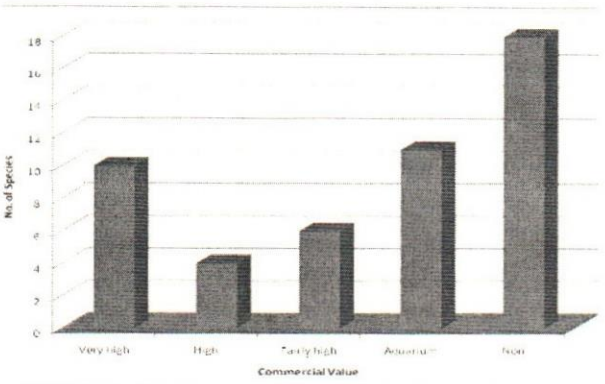

Fig. 2: Commercial values of different fish species of Haleji lake, Sindh, Pakistan.

Discussion

Haleji lake has always remained an important Ramsar Site having a rich biodiversity in the form of birds and fishes. Presently, however, it is on the verge of dying due to a number of reasons. The Right Bank Outfall Drain (RBOD) being dug out in close proximity to the lake poses direct threat to it. The RBOD is hardly 15 to 35m away from the lake and 7 to 10m below the level of the wetland areas. The construction of the unlined drain is a violation of the wildlife Sanctuary and Ramsar Site bylaws. The outfall drains had already destroyed a number of wetlands of Sindh. Most lakes in District Badin have dried up while many in other districts, for instance, Larkana and Sanghar, are being wiped off.

Table 1: Fish fauna recorded from Haleji Lake, Sindh, Pakistan.

S#	Species	Common Name	English name	Family	Max. size (cm)	Commercial value
1	*Gudusia chapra*	Palli	Indian river Shad	Clupeidae	20	None
2	*Chitala chitala*	Chital pari	Humped featherback	Notopteridae	120	High
3	*Notopterus notopterus*	But Pari	Grey featherback	Notopteridae	25	Low
4	*Chela cachius*	Bidda	Silver hatchet chela	Cyprinidae	6	None
5	*Salmophasia bacaila*	Chal	Large razorbelly minnow	Cyprinidae	15	None
6	*Securicula gora*	Bari Chal	Gora-chela	Cyprinidae	22	None
7	*Amblypharyngodon mola*	Chilwa	Pale carplet	Cyprinidae	20	None
8	*Aspidoparia morar*	Chilwa	Aspidoparia	Cyprinidae	17	None
9	*Barilius vagra*	Chal	Vagra baril	Cyprinidae	12	None
10	*Esomus danricus*	Soomara	Flying barb	Cyprinidae	9	None
11	*Rasbora daniconius*	Chali	Scissortail Rasbora	Cyprinidae	15	None
12	*Cirrhinus mrigala*	Mori	Mrigal	Cyprinidae	100	Very high
13	*Cirrhinus reba*	Sunni	Reba carp	Cyprinidae	30	Fairly high
14	*Gibelion catla*	Thaila	Catla	Cyprinidae	180	Very high
15	*Labeo calbasu*	Calbans	Kalbansu	Cyprinidae	90	High
16	*Labeo dero (Hamilton)*	Chali	Kalbans	Cyprinidae	60	Fairly High
17	*Labeo dyocheilus pakistanicus*	Torki	Pakistani Labeo	Cyprinidae	90	Fairly High
18	*Labeo gonius*	Sareha		Cyprinidae	150	Fairly high
19	*Labeo rohita*	Rohu	Rohu	Cyprinidae	200	Very high
20	*Osteobrama cotio*	Palero	Cotio	Cyprinidae	15	Non
21	*Puntius chola*	Popra	Swamp Barb	Cyprinidae	15	Aquarium
22	*Puntius sophore*	Popra	Spotfin Swamp Barb	Cyprinidae	17	Aquarium
23	*Puntius ticto*	Popra	Two spt Barb	Cyprinidae	10	Aquarium
24	*Cyprinus carpio*	Carp	Common carp	Cyprinidae	120	Very high
25	*Sperata sarwari*	Singhari	Giant river cat fish	Bagridae	150	Very high
26	*Mystus bleekri*	Kingar	Days' Mystus	Bagridae	15	None
27	*Mystus cavasius*	Kingar	Gangetic mystus	Bagridae	40	None
28	*Mystus vittatus*	Kingar	Striped Dwarf cat fish	Bagridae	21	None
29	*Bagarius bagarius*	Fauji Khagga	Gangetic goonch	Sisoridae	250	Very high
30	*Ompok bimaculatus*	Palu	Butter catfish	Siluridae	45	None
31	*Wallago attu*	Mulli	Boal	Siluridae	240	Very high
32	*Heteropneustes fossilis*	Nalai	Stinging catfish	Heteropneustidae	30	Non
33	*Clupisoma garua*	Jhalli	Garua bachcha	Schilbeidae	60	Very high
34	*Clupisoma naziri*	Jhalli	Indus garua	Schilbeidae	24	Very high
35	*Eutropiichthys vacha*	Bachwa	Batchwa vacha	Schilbeidae	40	High
36	*Sicamugil cascasia*	---	Yellow tail mullet	Mugilidae	14	Non
37	*Xenentodon cancila*	Kanj	Freshwater garfish	Belonidae	40	Non
38	*Channa marulias*	Saul	Giant snakehead	Channidae	180	Very high
39	*Channa punctata*	Daula	Spotted snakehead	Channidae	30	Fairly high
40	*Chanda nama*	Shesha	Elongate glass-perchlet	Chandidae	10	Aquarium
41	*Parambasis baculis*	Shesha	Himalayan glassy perchlet	Chandidae	5	Aquarium
42	*Parambasis ranga*	Shesha	Indian glassy fish	Chandidae	8	Aquarium
43	*Glossogobius giuris*	Guloo	Tank goby	Gobiidae	35	Aquarium
44	*Colisa fasciata*	Kanghi	Stripled Gourami	Belontidae	12	Aquarium
45	*Colisa lalia*	Kanghi	Dwarf Gourami	Belontidae	9	Aquarium
46	*Oreochromis mossambicus*	Tilapia	Tilapia	Cichlidae	39	High
47	*Mastacembelus armatus*	Groje	Tire-track spiny eel	Mastacembelidae	90	Fairly high
48	*Macrognathus aral*	Groje	One-stripe spiny eel	Mastacembelidae	35	Aquarium
49	*Macrognathus pancalus*	Groje	Striped spiny eel	Mastacembelidae	20	Aquarium

The larger portions of the lake are choked with aquatic grass and weeds. The lake is full of typha, lotus, phragmitis etc. and there is no plan to cut or eradicate the vegetation. Local people regularly visit the lake and cut trees and Typha from the lake and its surrounding area. Vegetation overgrowth is not only destroying the morphology of the lake but also deteriorating the water quality.

The irrigation department does not release enough water into the lake, which has resulted in the deterioration of the Ramsar Site. The ongoing digging for the Left Bank Outfall Drain (LBOD) has accelerated the process of degradation caused by reduced supplies of fresh water and high rate of evaporation. The water level is hardly 3m now and what little water is being supplied is often pilfered by landlords.

An exotic species of snail, the apple snail, has somehow invaded the lake (Fig. 3). This snail is so common in the lake that clusters of its eggs are seen everywhere on the leaves of typha vegetation. The snail has completely dominated the lake and is the most common species of the lake. It is likely that the snail may invade other lakes of the Indus River System and become ecological threat to the freshwater ecosystem in Pakistan.

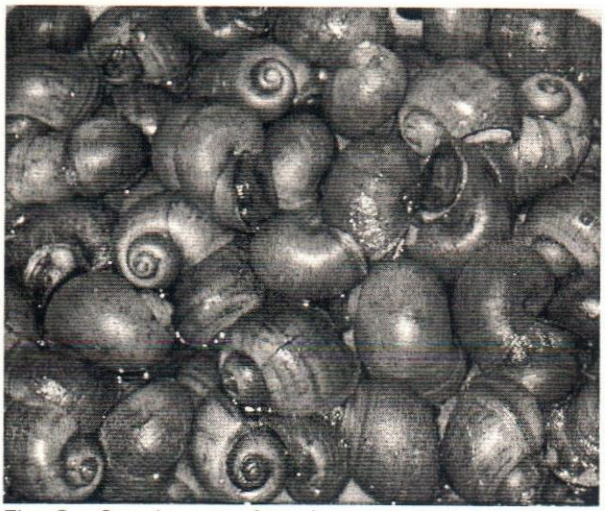

Fig. 3: Specimens of apple snails found in the Haleji Lake.

The lake area is quite large and is surrounded by 20 to 25 villages having a total population of around 8,000. There is also pressure from visitors. To protect the Sanctuary only eight people are posted at the lake. The number of staff needs an increase and facilitation to protect the Wildlife Sanctuary. Angling is allowed on the lake being a Wildlife Sanctuary, but despite of ban on fishing intensive fishing practices are going on in and around the lake area. It is violation of the laws laid down for the protection of Wildlife Sanctuaries and Ramsar Sites leading to destroying the natural balance of the species in and around the lake.

The lake is shared by three departments, the Sindh Wildlife Department, the Irrigation Department and Karachi Water and Sewerage Board (KWSB). Each of these departments have their own objectives, priorities and frame of work which do not tally with each other, resulting in mismanagement and negative impact on the environment of the lake.

References

Ahmed, F. and Niazi, M.S. 1988. Important edible fishes of Pakistan. Zool. Surv. Deptt. Govt. of Pakistan 31p.

Ahmed, M.F., Khan, S.A. and Mirza, M.R. 1976. A check list of fresh water fishes of Indus plain, Pakistan. Biologia, 22: 229 295.

Baig, N.A. and Khan, M.Y. 1976. Biological and Chemical Conditions of Manchar lake (Distt: Dadu). Pak. J. Sci., 28: 33 40.

Baqai, I.U., Zuberi, V.A. and Iqbal, M. 1974a. Limnological studies of Kalri lake. Agriculture Pakistan. 25(2): 119 135.

Baqai, I.U., Zuberi, V.A. and Iqbal, M. 1974b. Limnological studies of Haleji lake. Agricutlure Pakistan. 25(4):321 344.

Bianchi, G. 1985. Field guide to the commercial marine and brackish water species of Pakistan. FAO, Rome, Italy. 200 p.

Dewani, V.K.; Ansari, I.A. and Khuhawar, M.Y. 2002. Determination and transport of metal ions in river Indus at Kotri barrage. J. Chem. Soc. Pak. 24(3): 190 194.

Iqbal, M.S., Shoukat, S. and Kazmi, M.A. 1999. Diversity of Fish Communities in Pakistan's coastal waters, northern Arabian Sea. proc. Sin. Aq. Biol. Pakistan. (Kazmi, and Kazmi B. eds) MARCRC, Dept. of Zool. Univ. of Karachi, pp. 55 62.

Jafri, S.I.H., Ali, S.S., Mahar, M.A., Hussain, S.M. and Khatoon, Z. 2000. Fisheries potential of Tidal link lakes (distt: Badin) of Sindh coast (N. Arabian Sea). Pak. J. Zool. 32(4): 301 306.

Khan, M.A. 1999. The mud crab *Scylla sirrata,* A potential commercial species for culture and export from Karachi. Proc. Workshop. Coast. Aqucult. (Q.B. Kazmi ed) MRCRC, Univ. of Karachi. pp. 65-80.

Leghari, S.M., Jafri, S.I.H., Mahar, M.A. Lashari, K.H., Khuhawar, M.Y. and Jehangri, T.M. 1999. Biodiversity of Chotiari reservoir (Distt: Sanghar), Sindh Pakistan. Proc. Sem. Aq. Biodev. Pakistan. (Kazmi, Q.B. and M.A. Kazmi, eds.) MRCRC, Dept. of Zoology, Univ. of Karachi. pp. 139-156.

Mahar, M.A., Jafri, S.I.H., Leghari, S.M. and Khuhawar, M.Y. 2000. Studies on Water Chemistry and fish production of Manchar Lake, Dadu, Sindh, Pakistan. Pak. J. Biol. Sci., 3(12): 2151-2153.

Mirza, F.B. 1986. Epibenthic fauna of Indus deltic region and adjoining creeks. Nat. Sem. Fish. Policy and Planning, MFD, Karachi.

Nazneen, S. 1995. State of Limnology in Pakistan. In: Limnology in Developing countries (Gopal, B. and Witzel, R.G. eds.) Intrn. Assoc. Limnology, India pp. 191-229.

Niazi, M.S. 1976. Fishes of Sindh Creeks Order, Clupeiformes Rec. Zool. Surv. Pakistan. Vol. 111(1): 116.

Qureshi, M.R. 1965. Common fresh water fishes of Pakistan. Agricult. Res. Coun. Govt. of Pakistan. 61 p.

Siddiqui, PA., Baqai, I.U. and Iqbal, M. 1973. Checklist of fishes from Kinjhar Kalri lake with notes on environmental codnitions and fisheries potential. Agriculture, Pakistan, 24: 201-220.

Yaqoob, M. 1994. Pond Culture of fresh water prawn, *Macrobrachium malcomsoni* (Edwards, 1844) in Pakistan. Pak. J. Zool. 26 (3): 243-247.

Distribution of Gastropods (Mollusca) at different tidal heights on the rocky beach of Buleji Karachi Coast

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Abstract

In order to study the gastropods at different tidal heights in the inter-tidal zone of Buleji rocky beach, the area was divided arbitrarily into 3 zones. Ten families were observed each from zone I and zone III while 20 families from zone II, with species crossing over boundaries of the zones. Some species were restricted to only one zone. The distribution of 53 species belonging to 25 families of gastropods has been listed in the upper, mid and low inter-tidal heights.

Keywords: Buleji, rocky beach, inter tidal area, tidal height, gastropods.

Introduction

Gastropod studies on Pakistan coast have been carried out by quite a few workers, but there is dearth of information on the distribution pattern of gastropods with regard to tidal heights. Khan and Dastagir (1971) published Gastropod Fauna of Pakistan based on marine, freshwater and land forms. Tirmizi and Zehra (1983, 1984) updated the classification and described 69 species, giving synonyms and examined maximum sizes of shells. Iffat (2004, 2005 and 2005) recorded growth stages of *Cypraea turdus* and described marine gastropods of rocky beaches of Karachi. Iffat (2005) listed 62 species of gastropods from the reserved collection of Zoological Survey Department (ZSD).

The classification adopted in the present work is based mainly on Tirmizi and Zehra (1984) and Rao (2003). Buleji Rocky Beach is located between Hawkesbay and Paradise point at 24^0 54′ N and 66^0 48′ E at a distance of about 20km from Karachi. It is triangular horizontally spread wave beaten rocky shore with uneven profile protruding out in the open Arabian Sea. The tidal height of Karachi shore ranges from 0-3.3 meters and thus considered as an average type of shore (Saifullah, 1975). The middle and lower tidal areas of the ledge are made up of continuous rocks with depressions here and there. When the tidal water recedes, the depressions turn into rock pools and the animal communities offer a beautiful look under the transparent water.

The rocky part of Buleji is open to direct wave action of the sea and may be classified as "Exposed rocky shore" (Lewis, 1964). The period of exposure of shore between low and high tide varies with the season. The biota remains uncovered for relatively longer period of time in winter than in summer (Barkati, 1995).

Availability and abundance of gastropods is related to the exposure time of the inter-tidal area. The upper area is formed of rocks having medium and large boulders with sandy patches in between. Exposed and semi-exposed conditions occur on the entire rocky area of Buleji. The distribution of gastropod species mainly depends on the degree of exposure. Buleji rocky beach displays a wide variety of habitats which change over a small distance. There are rocky pools of various sizes, boulders, exposed and sheltered rocks, crevices, rough and smooth surfaces etc.

A view of rocky shore of Buleji

Material and Methods

Samples of gastropods were collected form the inter-tidal zone of Buleji at different tidal heights on monthly basis from July 2006 to June 2008. The collections/observations were made in a manner to start from the lowest tidal level moving towards high tidal mark. The pattern of distribution and abundance of inter-tidal species

was noted at various tidal heights. The entire inter-tidal area measuring about 800m in length and two Km in breadth was arbitrarily divided into 3 zones as under:

Zone I: Upper inter-tidal area ranging from 2 meters and above tidal height

Zone II: Mid inter-tidal area ranging from 1 to 2 meters tidal height

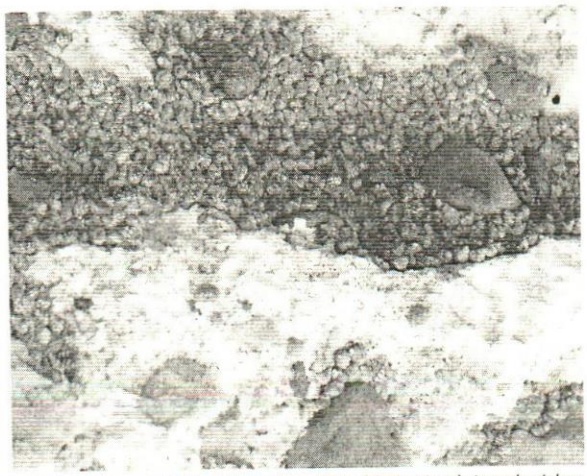
Zone III: Low inter-tidal area ranging from 0 to 1 meter tidal height

Results and Discussion

According to the criterion of inter-tidal heights, the samplings have been divided into 3 groups. The lower and upper tidal height species are, of course, conspicuously different in their characteristics because of their peculiar ecological factors, but on the contrary, there is much similarity of characters in the mid-tidal species. Several mid- tidal species have a wide range of distribution and overlap in their limits on both sides. The mid inter-tidal area corresponding to tidal height between 1 to 2 meters is the most productive area in terms of number of species.

The list of species of the 3 zones is given below:

Zone I - upper inter-tidal area



Buleji Colony of Nodilittorina *(Nodilittorina) trochoides* in spray zone of upper tidal area

Family Patellidae
Cellana radiate Born 1778

Family Fissurellidae
Diodora funiculata Reeve 1850

Family Turbinidae
Turbo (*Lunella*) *Coronatus* Gmelin 1790

Family Neritidae
Nerita (*Theliostyla*) *albicilla* Linnaeus 1758

Family Littorinidae
Nodilittorina (*Nodilittorina*) *trochoides* Gray 1839

Family Siphonariidae.
Siphonaria rosea Hubendick, 1943

Family Cerithidae
Clypeomorus variegatum Quoy & Gaimard 1834

Family Nassaridae
Nassarius abokiensis Jourseasume 1888

Family Thaididae
Marula granulata Duclos 1832
Morula (*Cronia*) *amygdala* Kiener 1835

Family Buccinidae
Canthurus undosus Linnaeus 1758

Zone II - mid inter-tidal area

Buleji *Cellana radiata* in rocky pool- mid inter- tidal area

Family Patellidae
Cellena radiata Born 1778

Family Fissurellidae
Diodora funiculata Reeve 1850

Family Trochidae
Trochus (*Belangeria*) *scabrosus* Philipi 1850
Trochus (*Belangeria*) *depictus* Deshayes 1883
Monodonta australis Lamarck 1822
Euchelus asperus Gmelin 1791

Family Stomatellidae
Stomatella elegans Gray 1847

Family Turbinidae
Turbo (*Lunella*) coronatus Gmelin 1790
Colonies also observed
Turbo (*Marmarostoma*) *intercostalis* Menke 1847
Colonies also observed
Astraea semicostata Kiener 1850

Family Nertidae
Nerita (*Theliostyla*) *albicilla* Linnaeus 1758
Nerita (*Theliostyla*) *textilis* Gmelin 1791
Nerita (*Nerita*) *undata* Linnaeus 1758
Nerita (*Ritena*) *costata* Gemlin 1791
Nerita (*Amphinerita*) *polita* Linnaeus 1758

Family Cerithidae
Clypeomorus variegatum Quoy & Gaimard 1834
Clypeomorus cearuleum Sowerby 1855
Rhinoclavis (*Rhinoclavis*) *sinensis* Gmelin 1791

Family Cypraeidae
Cypraea (*Mauritia*) *arabica* Linnaeus 1758
Cypraea (*Mauritia*) *moneta* Linnaeus 1758
Cypraea turdus Lamarck 1810

Family Naticidae
Natica tigrina Roeding, 1798
Natica (*Neverita*) *didyma* Roeding 1798
Natica vitellus Linnaeus 1758
Polinices (*P*) *mammilla* Linnaeus 1758

Family Epitonidae
Epitonium pyramidala Sowerby 1844

Family Cymatidae
Gyrenium natator Roeding 1798

Family Buccinidae
Babylonia spirata Linnaeus 1758
Cantharus spiralis Gray 1839
Cantharus undosus Linnaeus 1758

Family Columbellidae
Pyrene flava Bruguiere 1789

Family Nassaridae
Nassarius (*Plicarcularia*) *pullus* Linnaeus 1758
Nassarius abockiensis Jourseaume 1888
Colony observed
Alectrion sufflatus Gould 1860
Bullia persica Martens 1874

Family Mitridae
Mitra caeligena Reeve 1845

Family Olividae
Oliva bulbosa Roeding 1798

Family Thaididae
Thais lacera Born 1778
Thais (*Thais*) *bufo* Lamarck 1822
Morula granulata Duclos 1832
Morula (*Cronia*) *amygdala* Kiener 1835

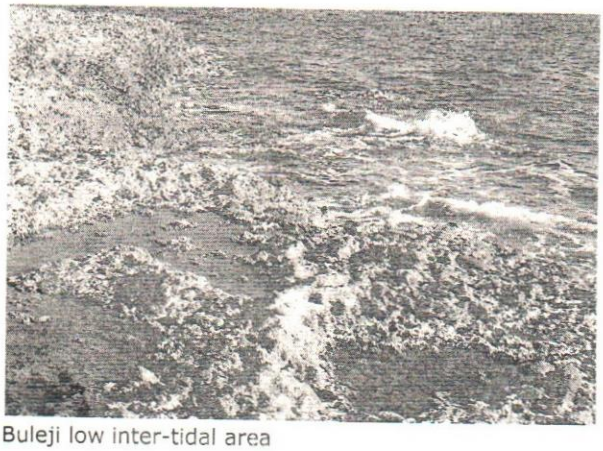
Family Conidae
Conus (*Pinoconus*) *magus* Linnaeus 1778

Family Turridae
Turricula javana Linnaeus 1767

Family Architectonida
Architectonica perspectiva Linnaeus 1758

Family Hydatinidae
Hydatina physis Linnaeus 1758
Hydatina velum Gmelin 1791

Zone III - low inter-tidal area



Buleji low inter-tidal area

Family Trochidae
Monodonta australis Lamarck 1822

Family Turbinidae
Turbo (*Lunella*) *coronatus* Gmelin, 1790
Turbo (*Marmarostoma*) *intercostalis* Menke 1847

Family Neritidae
Nerita (*Theliostyla*) *albicilla* Linnaeus 1758
Nerita (*Thelistyla*) *textilis* Gmelin 1791
Nerita (*Nerita*) *undulata* Linnaeus 1758

Family Cerithidae
Clypeomorus caeruleum Sowerby 1855
Clypeomorus variegatum Quoy & Gaimard 1834
Rhinoclavis (Rhinoclavis) sinensis Gmelin 1791

Family Cypraeidae
Cypraea (*Mauritia*) *arabica* Linnaeus 1758
Cypraea (*Mauritia*) *ocellata* Linnaeus 1758
Cypraea (*Mauritia*) *moneta* Linnaeus 1758
Colony observed
Cypraea (*Cypraea*) *tigris* Linnaeus 1758
Cypraea turdus Lamarck 1810
Colony observed

Family Cymatidae
Gyrinium natator Roeding 1798

Family Buccinidae
Canthurus undosus Linnaeus 1758

Family Columbellidae
Pyrene flava Bruguiere 1789

Family Nassaridae
Alectrion sufflatus Gould 1860
Nassarius abockiensis Jourseaume 1888

Family Thaididae
Thais lacera Born, 1778
Thais (*Stramonita*) *rudolphi* Chemnitz 1788

Thais hippocastanum Linnaeus 1758
Morula granulata Duclos 1832
Morula (*Cornia*) *amygdala* Kiener 1835
Colony observed

It is obvious that the species of upper tidal zone are hardy being capable of surviving without water for longer duration as compared to those occurring in mid and low tidal heights. The low water mark species are more sensitive in having narrow range of tolerance against salinity, temperature and exposure to direct sunlight. Thus the shell covering of the individuals belonging to families Fissurellidae, Patellidae, Siphonariidae and Littorinidae are hard enough to permit any desiccation of body moisture.

Cellana radiate and *Diodora funiculate* are common in zone I, but have wide range of distribution and seen in zone II (mid inter tidal) area also. *Turbo (lunella) coronatus, Nerita (Theliostyla) albicilla, Clypeomorus varigatum, Morula granulate Canthurus, undosus, Trochus scabrosus, Nassarius abokiensis* and *Morula amygdala* are commonly found in the mid inter-tidal zone, but occur in the adjoining area of upper inter-tidal zone as well. *Nodilittorina* (*Nodilittorina*) *trochoides* is exclusively found in spray zone of the upper most tidal range. (Ahmed, 1982).

Fifty three species of gastropods are listed from Buleji area out of which forty six species have been found occurring in the mid tidal area. Nine species of the mid tidal zone overlap in the upper tidal area. Similarly fourteen species were observed from the mid water area overlapping in the low tidal zone. Four species namely *Cypraea* (*Cypraea*) *tigris, Cypraea* (*Mauritia*) *ocellata, Thais rudolphi* and *Thais hippocastanum* were observed to occur commonly in lower tidal and sub-tidal areas. Colonies of *Cypraea turdus* and *C. moneta* were observed in low tidal area only. Similarly colonies of *Turbo Coronatus, Clypeomorus variegatum,* and *Nassarius abokiensis* were observed in mid tidal area.

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References

Ahmed, M. 1982. The distribution and abundance of inter-tidal organisms on some beaches of Makran coast in Pakistan (Northern Arabian Sea). 175-184.

Barkati, S. 1995. Benthic dynamics of a rocky beach macroinvertebrates. Cyclical changes in biomass at various tidal heights at Buleji Karachi. Marine Research vol. 4, (1) Centre of Excellence in Marine Biology, University of Karachi.

Iffat, F. 2004. Sea Shells of Pakistan (Brochure) Publ. Zoological Survey Department Govt. of Pakistan, Karachi.

Iffat, F. 2005. Some Marine gastropods of Rocky Beaches of Karachi, Pakistan. Jour. Nat. Hist. Wildlife, University of Karachi. vol. 4 (1) pp. 83-92.

Iffat, F. 2005. Marine gastropods of Karachi in the collection of Zoological Survey Department Rec. Zool. Sur. Vol. 16: PP 86-97.

Khan, M. And Dastagir, S.G. 1971. Gastropod fauna of Pakistan. Rec. Zool. Sur. Pak. II (I): 17-130.

Lewis, J.R. 1964. The ecology of rocky shores. Hodder & stoughten, London. 323 PP

Rao, S.N.V. 2003. Indian Sea shells (Part-1) Polyplacophora and Gastropoda Rec. Zool. Surv. India, Kolkata.

Saifullah, S.M. 1975. A preliminary survey of the standing crop of sea weeds from Karachi coast. Bot. Mar. 16: 139-144

Tirmizi, N.M. and Zehra, I. 1983. Study of the eggs of six common prosobranchs of the Pakistan coast Pak. J. Zool. 15 (1): 39-43.

Tirmizi, N.M. and Zehra, I. 1984. Marine fauna of Pakistan: 2. Mollusca: Gastropoda. University Grants Commission Islamabad, Pakistan.

Distribution and diversity of swallowtail butterflies (Lepidoptera:Papilionidae) in Karachi, Sindh, Pakistan

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Abstract

Butterflies of the family Papilionidae commonly known as swallowtail butterflies were sampled from different sites of Karachi, Sindh, Pakistan. The species were compared with the species reported previously. Three species i.e., Lemon Butterfly *Papilio demoleus*, Common Mormon *Papilio polytes* female forms *Papilio polytes f. cyrus*, *Papilio polytes f. stichius*, and *Papilio polytes f. romulus* and third species Common Rose *Pachliopta aristolochiae*, were recorded. Their present status and distribution showed less population as compared with the previous records due to habitat destruction and pollution.

Keywords: Distribution, Papilionidae, Karachi, habitat destruction.

Introduction

The natural environment provides many inspirational, aesthetic, recreational and educational needs of human beings. Biological diversity is an intrinsic part of the world. It has value in many parts of the world for tourism and recreational purposes such as film, photographs or literature based on or using wildlife, natural habitats and natural features, bird watching and ecological field study and other scientific pursuits (McNeely, 1988).

Presently changes in butterflies (Lepidoptera) distribution involve both expanding ranges and contraction ranges. Natural changes in distribution can be difficult to detect because they tend to be slower and more subtle than the dramatic changes caused by human beings. Unfortunately most expanding ranges involve introduced species and most contracting ranges relate to the destruction of natural habitats (Lafontaine, 1997). Pollution and over exploitation are serious threats to many species of plants and animal kingdom. The continuing loss of habitats is the major cause of species extinction. Consequently habitat conservation is the key to effective conservation of the world's biological diversity (Brady, 1988). At present thousands of insects are threatened with extinction by habitat loss. However, naturalists are developing technology for captive propagation of these organisms. For example, 49 butterfly houses exist in England, 4 in USA, 3 in Australia and 2 in Japan. This operation could attempt captive propagation of endangered species of insects mainly the butterflies (Bryant, 1998). About 500 live specimens of 80 species of butterflies from south and Central America, Philippines, Malaysia, Taiwan and other Asian countries have been placed in semi-natural conditions providing them natural environment (Boender and Farrel, 1988).

Since the dawn of civilization, butterflies have been regarded as the symbol of beauty and grace; their beautiful colors make this universe beautiful; shapes and graceful flight give great pleasure to everyone (Dal, 1978). Butterflies are found almost in every part of the world wherever their host and flowering plants are present. They inhabit even high altitudes, except the Arctic, Antarctic and mountains covered with heavy snow and glaciers (Hassan, 1994). Butterflies of the same species are usually alike but they may differ in size, color, physiology and behavior due to inherint or external climatic features (Dal, 1978).

Papilionidae is one of the most conspicuous families of butterflies. This family comprises the most ornate butterflies, which are comparatively larger than other butterflies. The family Papilionidae is represented most commonly by swallowtail butterflies which are cosmopolitan in distribution except in the extreme north and south and in the desert areas (Talbot, 1939; Hassan, 1994). They are the larger butterflies; some have magnificently beautiful colors (Morral, 1960; Dal, 1978). Bright color predominates with patterns of yellow, white, orange, red, black, blue and green (Hassan, 1994). They are strong and elegant gliders (Dal, 1978). Most of them possess tails at their hind wings (Hassan, 1994). In the Indo-Australian region wings of both sexes of species of Papilionidae are always thickly scaled. Almost all the species have at least a few metallic, gray, green and blue scales (Jordan, 1909).

The members of Papilionidae are also known as the black and yellow bodied swallow-tailed butterflies. Their host plants are chiefly citrus plants (Jordan, 1909). *Papilio demoleus*, *Papilio polytes* female forms host plants belongs to family Rutaceae including all varieties of citrus and curry leaf *Murraya koenigii* (Roberts, 2001; Suwarno *et al.*, 2007). *Papilio polytes* is found commonly throughout the Oriental region. It is well known that the female is polymorphic and has four forms, whereas the male is always monomorphic. The female forms are described as *F. cyrus*, *F. stichius*, *F. romulus* and *F. theseus.* Only one form of *F. cyrus* resembles the male (Uesugi, 1991). The *Pachliopta aristolocahiae* host plant is *Aristolochia spp.* (Malik, 1970). Several *Papilio spp.* have evidently moved from wild species of Rutaceae to cultivated citrus and their caterpillars are found mainly on citrus. Several other *Papilio spp.* (*Papilio dardamus* and *Papilio nireus*) have also moved to citrus (Owen, 1971). *Papilio demoleus* was for first time recorded in Jamaica (Homzaik and Homzaik, 2006) and also in Puerto Rico (Sherwood and Mayers, 2008).

The present research aims at studying endangered species of family Papilionidae in Karachi, Sindh. The study will help to form plans for protection of the species specifically for those which are economically and potentially useful to human beings.

Material and Methods

The present study was conducted during March-June 2001 and June-September 2009 at Karachi sindh, Pakistan. The selected sites were: Ghandhi Garden Karachi; Plant Nurseries, Korangi Agriculture Farms; University of Karachi Nursery; Memon Goth, Jam Goth, Dumba Goth, Ali Murad Goth, Pir Sirhandhi Goth and Sheedi Goth Malir. Agriculture field throughout a range of natural habitat types were also selected for extensive sampling to determine the distribution and diversity of swallowtail butterflies (Lepidoptera: Papilionidae).

These sites were selected on the basis of their natural position. Temperature and moisture gradients are quite independent of habitat types defined by vegetation; these often are of primary importance in determining the distribution and local abundance of many terrestrial plants and animals' taxa (Whittaker, 1952; Terborgh, 1970; Brussard, 1985). Several methods for sites categorization were considered (Elton and Miller, 1954; Southwood *et al.*, 1979; Bunce and Shaw, 1973). These sampling sites were selected on the basis of their distinct characteristics.

Papilionidae butterflies were censussed in each site by netting in one square Kilometer. Collected butterflies were kept in wooden cages. Each site was netted for 30 minutes. After noting the data, caged specimens were released, while only few specimens were preserved for identification. All specimens were kept in wooden insect boxes and properly preserved for each site sampled after fortnightly interval.

Results and Discussion

In the present research study it was observed that the three species belong to swallowtail butterflies of family Papilionidae which are; Lemon Butterfly *Papilio demoleus*, Common Mormon *Papilio polytes* female forms *Papilio polytes f. cyrus*, *Papilio polytes f. stichius* and third form *Papilio polytes f. romulus* and third species Common Rose *Pachliopta aristolochiae,* their distribution and status was noted on the basis of collected specimens. The results of this study were compared with earlier reported by Menesse (1950) and Malik (1970 and 1973). Though, the species are the same as reported earlier but the distribution and population of the species showed (Table 1) that the *Papilio demoleus* and *Papilio polytes* female forms *P. polytes f. cyrus*, *P. polytes f. stichius* and *P. polytes f. romulus* and third species *Pachliopta aristolochiae* were less common in Ghandhi Garden Karachi, Korangi Agriculture Farms, Memon Goth Malir, Dumba Goth Malir, Pir Sirhandhi Goth Malir and Sheedi Goth Malir. In some patches of Plants Nurseries, University of Karachi Nursery, Jam Goth Malir and Ali Murad Goth Malir, the populations were recorded little bit higher, while the *Pachliopta aristoloachiae* population was recorded higher only in the nursery of Karachi University. The present study validates the report of Rafi *et al.* (1999) about the decline of *Papilio* species due to pollution and natural habitat destruction. The population of species was slightly higher in the Plant Nurseries, University of Karachi Nursery, Jam Goth and Ali Murad Goth due to the availability of more host plants. The observation suggests that the number of the species is directly proportional to the number of host plants (Roberts, 2001).

Only *Papilio demoleus* population was recorded dominant to *Papilio polytes* forms *Papilio Polytes f. cyrus*, *Papilio polytes f. stichius* and *Papilio polytes f. romulus* and third species *Pachliopta aristoloachiae*. But the present population of *Papilio demoleus*, *Papilio polytes* forms *Papilio polytes f. cyrus*, *Papilio polytes f. stichius* and *Papilio polytes f. romulus* and third species *Pachiliopta aristolochiae* were not higher as recorded by Menesse (1950) and Malik (1970).

Table 1: Distribution of swallowtail butterflies (Lepidoptera:Papilionidae) in Karachi Sindh, Pakistan.

Locality	*P. demoleus*	*P. polytes f .cyrus*	*P. polytes f .stichius*	*P. polytes f .romulus*	*Pachliopta aristolochiae*
Ghandhi Garden	--	--	--	--	--
Plants Nurseries	**	**	**	**	--
Korangi Agriculture farms	--	--	--	--	--
University of Karachi Nursery	**	**	**	**	**
Memon Goth Malir	--	--	--	--	--
Gam Goth Malir	**	--	**	--	--
Dumba Goth Malir	--	--	--	--	--
Ali Murad Goth Malir	**	**	--	**	--
Pir Sirhandhi Goth Malir	--	--	--	--	--
Sheedi Goth Malir	--	--	--	--	--
DOMINANT =	** , **RARE**	=	--		

In the present finding *Papilio polytes* three female forms; *P. polytes f. cyrus*, *P. polytes f. stichius* and *P. polytes f. romulus* were recorded on the contrary to the findings of Uesugi (1991) who observed one female form to resemble the males. This may be due to change of environment. It was also noted that *Pachliopta aristolochiae* population was lower probably due to unfavorable environment, non-availability of host plants and land conversion and indiscriminate use of pesticides. In Karachi the dominant species recorded at Plants Nurseries, University of Karachi Nursery, Jam Goth Malir and Ali Murad Goth Malir due to the availability of large number of host plants and suitable environment. Recent changes showed contraction in distribution of *P. polytes* female forms and third species *Pachliopta aristolochiae*. Habitat conservation is the key to the effective conservation of *Papilio polytes* female forms *Papilio polytes f. cyrus, Papilio polytes f. stichius* and *Papilio polytes f. romulus* and third species *Pachliopta aristolochiae* in these areas. New technologies such as biotechnology and butterfly houses are necessary for the conservation point of view.

References

Boender, R. and Farrell, C.P. 1988. Butterflies of the world. http://www,butterflyworld.com/campaign.html

Brady, N. 1988. International Development and the protection of Biological Diversity, 409-427pp In: Biodiversity, (Wilson. E. O. and PETER, P. M. Eds.) National Academy Press Washington, DC. 521pp.

Brussard, R.F., 1985. Geographical pattern and environmental gradients: the central marginal model in Drosophila revisited. Ann. Rev. Ecol. Syst. 15:25-64.

Bryant, J. 1998. Biodiversity and Conservation. A hypertext book. School of Biological Sciences, University of California, Irvan. http://darwin .bio.uci.edu/sustain/bio 65/tital page htm.

Bunce, R.G.H. and Shaw, M.W. 1973. A standardized procedure for ecological survey. J. Environ. Manage. 1:239-285.

Dal, B. 1978. The Butterflies of Northern Europe. Croom. Helm, London. 128pp.

Elton, C.S. and Miller R.S. 1954. The ecological survey of animal communities with practical system of classifying habitats structural characteristics. J. Ecol. 42:460-496.

Hassan, S.A. 1994. Butterflies of Islamabad and the Murree Hills. Asian Study Group Islamabad Pakistan. 68pp.

Homzaik, M.T. and Homzaik, J. 2006. *Papilio demoleus* (Lepidoptera:Papilionidae). A new record for the United States. Commonwealth of Puerto Rico Florida Entomologist. 89:485-488.

Jordan, K. 1909. In Seitz, Macrolep. Fauna Indo-Australia. 9. pp17-109

Lafontaine, J.D. 1997. Assessment of species diversity in the mixed wood plains, Ecozone: Butterflies and Moths (Lepidoptera) http://www.cciw.ca/emantemp/rports/publications/mixedwood/lep/lep/mothz.htm

Malik, J.M. 1970. Notes on the Butterflies of Pakistan in the collection of Zoological Survey Department Karachi, Part I. Rec. Zool. Surv. Pakistan. 2(2):25-54.

Malik, J.M. 1973. Notes on the Butterflies of Pakistan in the collection of Zoological Survey Department Karachi. Part 11. Rec. Zool. Surv. Pakistan. 5(1-2):11-28.

Menesse, N.H., 1950. Butterflies of Sindh. J. Bombay Natural History Society. 49 (1):20-24.

McNeely, J.A. 1988. Economics and Biological Diversity IUCN, Gland, Switzerland. Gland, Switzerland. 57pp.

Morral, R. 1960. Common Malayan Butterflies, Malayan Nature Handbooks. Long Man Press. 64PP.

Owen, D.F. 1971. Tropical Butterflies Clarendon Press. Oxford. 214pp.

Rafi, M.A., Khan, M.R., Ilyas, M. and Safdar, M. 1999. Distribution and diversity of genus *Papilio* (Lepidoptera: Papilionidae) in Rawalpindi and Islamabad. Pak. J. Sci.1:(1-2).

Roberts, T.J. 2001. The Butterflies of Pakistan. Oxford University Press, Karachi.180pp.

Southwood, T.R., Brown, F.V.K. and Reader, R. M. 1979. The relationship of plants and insects diversity in succession. Biol. J. Linn. Soc.

Suwarno, M.R., Che Salmah. A. Abu Hassan and A. Norani. 2007. Effect of Different Host Plants on the life cycle of *Papilio polytes* cramer (Lepidoptera: Papilionidae) Common Mormon Butterfly. Jurnal Biosains, Malaysia. 18(1):35-44.

Sherwood, M., Myers, L. 2008. Lime Swallowtail *Papailio demoleus* (Lepidoptera:Papilionidae). Entomology Circular, Ministry of Agriculture Research and Development Division, Jamaica.

Talbot, G. 1939. Fauna of British India, Butterflies. Today and Tomorrow Printers and Publishers. Vol:1, 187pp.

Terborgh, J. 1970. Distribution on environmental gradients: theory and a preliminary interpretation of distributional patterns in the avifauna of the Cordillera Vilcamba, Peru. Ecology 52:24-40.

Uesugi, K. 1991. Temporal change in records of the mimetic butterfly *Papilio polytes* with establishment of its model *Pachliopta aristolochiae* in Ryukyu Island. Japan. Pap. J. Ento. 59(1):183-198.

Whittaker, R. F. 1952. A study of summer foliage insects communities in the Great Smoky Mountains. Ecol. Monogr. 22:1-44.

Short Communication:

Some observations on birds of Karachi west coast, Pakistan

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Abstract

The paper describes 41 species of birds recorded from Karachi west coast. After the heavy pollution from Lyari River, the site has lost its attractiveness for ducks. The site still supports pelicans, cormorants, herons, egrets, flamingos, spoonbills, terns, gulls and a large number of waders, which shows that after pollution abatement measures, the site may restore its attractiveness.

Key words: Karachi west coast, pollution, ducks, mangroves.

Introduction

Stretching from Sandspit through Yunus Abad Goth, Hawksbay, Buleji and Paradise Point to Cape Montz, the coastal area west of Karachi mainly consists of 20 km of sandy beaches with small rocky areas, cliffs and raised mud plateaus. The beaches of Sandspit and Hawksbay are mostly lined with beach huts built between the road and the top of the sand dunes. Both areas are significant as nesting places for the green turtles (*Chelonia mydas*).

The back waters extend at a couple of points into the area behind Sandspit beginning from Yunus Abad Goth and reaching to the Naval Officers Housing Society. A large area of backwaters supports a dense mangrove vegetation comprising *Avicennia marina.* Much of the mangroves are dwarf and stunted due to grazing, cutting and high salt concentration (41%) in the area. The mudflats are generally barren except for some very stunted bushes of mangroves.

The backwater contains a very rich and complex food web of algae and invertebrates living in the mud, such as worms, shrimps, crabs and juvenile fish. In this particular area the diversity of species may be curtailed by the extensive pollution which must have swept back by the tide from the sewage and industrial waste being discharged untreated from the Lyari River.

Due to rich food, many water birds are found in the area. The creek system is one of the most important areas for wintering, passage and summering shorebirds in Pakistan. Previous workers have also reported some ducks from this site (Scott, 1989; Galib and Hasnain, 1994). According to these workers, the species of *Tadorna tadorna* (common shelduck), *Anas acuta* (pintail), *Anas Penelope* (wigeon), *Anas cracca* (common teal), *Anas clypeata* (shoveller), *Anas platyrhynchos* (mallard) and *Aythya ferina* (Common Pochard) were commonly reported from Karachi west. Ghalib and Hasnain (1994) have given a comprehensive account of birds of Karachi coast. Their paper describes 93 species of birds of Karachi coast including Karachi west coast. Hasan (1994) has described 62 species of birds of mangrove areas of Sindh including Karachi coast. Hasan (1996) has given a comparative account of bird diversity of two areas of Sindh coast. Among the other most related studies are Hasan (2005), Hasan *et al.* (2004), Hasan and Ahmad (2006) and Ahmad *et al.* (1988).

Material and Methods

The survey of Karachi west coast was undertaken during March, 2009. The identification of the species was done with the help of binoculars and spotting scope. Only the areas with high bird population were surveyed for census. These were Hawkes Bay and Cape Montz (Fig. 1).

For the identification of birds, Mirza (2007) and Perrins and Attenborough (1987) were also consulted.

Results and Discussion

The survey of Karachi west coast was under taken during March 2009 and 41 species of birds were recorded. The site still have potential to support pelicans, cormorants, herons, egrets, flamingos, spoonbills, terns, gulls and a large number of waders (Table 1). The species of ducks which were reported by Scott (1989) and Ghalib and Hasnain (1994) are no more seen on the site, which shows that the site is no more suitable for migratory ducks mainly due to high salinity, sewage and industrial waste being discharged untreated into the site through the Lyari River.

Table 1: List of birds recorded from Karachi west coast (Hawkes Bay, and Cape Montz) during March 2009.

No.	Common Name	Scientific Name	Numbers	Status	Occurrence
1	Little Grebe	*Tachybaptes ruficollis*	20	C	WV
2	White Pelican	*Pelecanis oncrotalus*	12	LC	WV
3	Great Cormorant	*Phalacrocorax carbo*	50	C	WV
4	Pond Heron	*Ardeola grayii*	12	LC	R
5	Reef Heron	*Egretta gulari*	50	C	R
6	Little Egret	*Egretta garzetta*	15	C	R
7	Large Egret	*Egretta alba*	5	LC	R
8	Grey Heron	*Ardea cinerea*	15	LC	WV
8	White Spoonbill	*Platalea leucorodia*	12	LC	WV
10	Flamingo	*Phoenicopterus rubber*	102	C	R
11	Pariah Kite	*Milvus migrans govinda*	50	C	R
12	Brahminy Kite	*Haliaster indus*	5	C	R
13	Osprey	*Pandion haliaetus*	1	R	WV
14	Coot	*Fulica atra*	5	LC	WV
15	Oystercatcher	*Haematopus ostralegus*	15	LC	W
16	Avocet	*Recurvirostra avosetta*	600	C	WV
17	Black-winged Stilt	*Himantopus himantopus*	150	C	R
18	Little Ringed Plover	*Charadrius dubius*	150	C	WV
19	Ringed Plover	*Charadrius hiaticula*	3	R	WV
20	Kentish Plover	*Charadrius alexandrinus*	150	C	R
21	Mongolian Plover	*Charadrius mongolus*	25	C	WV
22	Red-wattled Lapwing	*Vanellus indicus*	5	LC	R
23	Sanderling	*Calidris alba*	2000	C	WV
24	Little Stint	*Calidris minuta*	52	C	WV
25	Curlew	*Numenius arquata*	5	LC	WV
26	Dunlin	*Calidris alpine*	4	R	WV
27	Bar-tailed Godwit	*Limosa lapponica*	2	R	WV
28	Red Shank	*Tringa tetanus*	25	C	WV
29	Common Sandpiper	*Actitis hypoleucos*	50	C	WV
30	Great Black-headed Gull	*Larus ichthyaetus*	2	R	WV
31	Black-headed Gull	*Larus ridibundus*	38	C	WV
32	Slender-billed Gull	*Larus genei*	25	C	WV
33	Herring Gull	*Larus argentatus*	10	LC	WV
34	Lesser Black-backed Gull	*Larus fuscus fuscus*	10	LC	WV
35	Brown-headed Gull	*Larus brunnicephalus*	8	LC	WV
36	Gull-billed Tern	*Gelochelidon nilotica*	500	C	WV
37	Caspian Tern	*Hydroprogeni caspia*	8	LC	WV
38	Sandwich Tern	*Thalassens sandvicenses*	50	C	WV
39	Common Tern	*Sterna hirundo*	20	C	WV
40	Little Tern	*Sterna albifrons*	500	C	WV
41	White-throated Kingfisher	*Halcyon smyrnensis*	2	R	R

Status:

R = Rare
LC = Less Common
C = Common

(Criteria: R: 1-4 LC: 5 –15 C: More than 15 for all birds except Brahminy Kite and Osprey).

WV = Winter Visitor (recorded from Karachi west coast during winter months)
R = Resident (recorded from Karachi west coast throughout the year).

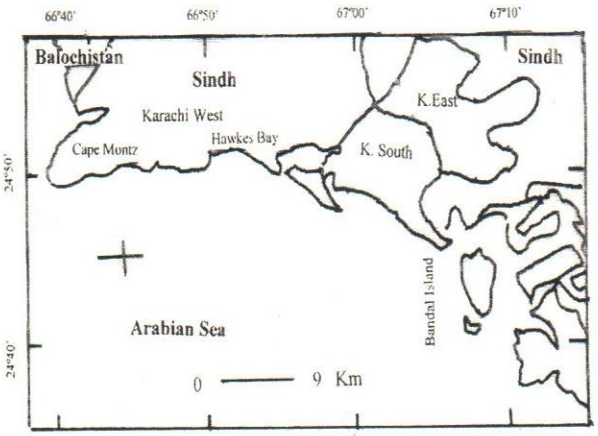

Fig 1: Map of Karachi west coast (study Area)

Another study by Hasan *et al.* (2004) after Tasman Sprit Oil Spill (TSOS) showed similar results.

Conclusion

The area of Karachi west coast was an excellent site for migratory birds. But due to organic pollution and hyper-saline conditions, the area has lost its importance as wintering, roosting and feeding grounds for migratory anatids. The pollution abatement measure can improve the site.

References

Ahmad, M.F., Ghalib, S.A., Niazi, M.S., Parveen, Z. and Hasan, A. 1988. *Vertebrate fauna of the Mangrove Swamps of Sindh Coast.* Zoological Survey Department, Karachi (unpublished Report).

Ghalib, S.A. and Hasnain, S.A. 1994. *The waterfowl of Karachi Coast.* Rec. Zool. Sur. Pakistan. 12: 39-62pp.

Hasan, A. 1994. *The birds of Sindh mangroves.* Records Zool. Sur. of Pak. Vol. XII: 98-105.

Hasan, A. 1996. *Biodiversity of bird fauna in mangrove areas of Sindh.* Proc. of the UNESCO workshop on coastal aquaculture: 21-26.

Hasan, A. 2005. *Seasonal avifauna diversity of Korangi- Phitti mangrove swamps, Indus delta, Pakistan.* Proceeding of the National Workshop on Biodiversity. Ministry of Environment, Islamabad. 62-67.

Hasan, A., Javed, H.I. and Ejaz, P. 2004. *Natural resource damage assessment study.* Zoological Survey Department, Karachi (Unpublished Report).

Hasan, A., Ahmad, S.I. 2006. *Some observations on birds and marine mammals of Karachi coast.* Rec. Zool. Surv. of Pakistan. XVII:15-20.

Mirza, Z.B. 2007. A field guide to birds of Pakistan. *Published by WWF (P) and Bookland Lahore.*

Perrins, C. and Attenborough, D. (1987). The Birds of Britain and Europe. *William Collins Sons and Co. London.*

Scott, D.A. 1989. *A Directory of Asian Wetlands.* IUCN Gland, Switzerland and Cambridge, U.K.

Short Communication:

A short note on massive stranding of spinner dolphin (*Stenella longirostris*) at Gadani, Balochistan coast, Pakistan

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Abstract

The present paper deals with a massive stranding of spinner dolphin (*Stenella longirostris)* at Gadani, Balochistan coast, where 200-250 spinner dolphins beached, possibly as a reaction to environmental pollution.

Keywords: spinner dolphins, Pollution, ship-breaking industry.

Introduction

According to Gore (2008) 12 species of marine dolphins, whales, porpoises and one species of freshwater dolphin (blind dolphin) are reported from waters of Pakistan. Out of 12 coastal species 4 species frequently visit coastal waters of Sindh, Pakistan. These species are bottlenose dolphin, (*Tursiops truncates*), humpback dolphin (*Sousa chinensis*), finless porpoise (*Neophcaena phocaenoides*) and humpback whale (*Megaptera novaeangliae*). Hasan and Ahmad (2006) reported three species of cetaceans found in the coastal waters of Sindh. Among the other studies which directly deal with marine mammals are Hasan *et al.* (2005) and Ahmad *et al.* (1988).

Among the most serious threats faced by cetaceans is the release of polluted water with traces of heavy metals into the sea. Layari and Malir rivers are sources of such threat to Karachi coast. Other threats to whales, dolphins and porpoises are non-availability of fish stocks, silting of rivers, degradation of mangroves, the growth of toxic algae and the presence of rubbish and plastic bags in the sea.

Material and Methods

The survey of Gadani (Balochistan coast) was conducted on 6 and 7 March, 2009 and a stranded specimen of dolphin was recorded. The different morphological characters like total length, teeth formation and their numbers, the colour of the body and body shape were also noted. The species was identified by personal experience and by consulting Evans (1987).

Observations of stranded specimen

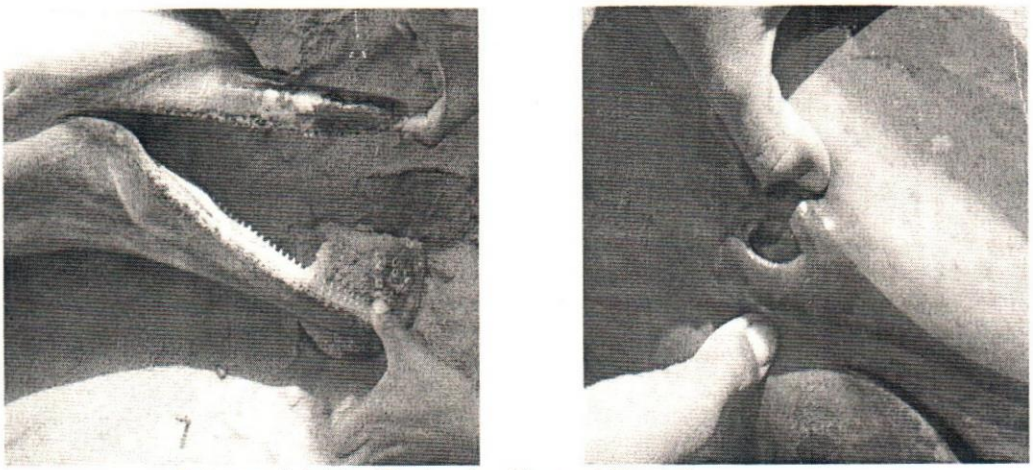
The body was streamlined with slender beak and the length of the body was 1.9m. The specimen was dark gray on the dorsal side and white ventrally. There was a grey strip on the side running from flippers to eyes and melon. About 68 sharp, closely spaced teeth were counted.

Results and Discussions

During the survey of Gadani, Balochistan, a stranded specimen of cetacean was recorded. The species was identified as spinner dolphin (*Stenella longirostris)*. The identification characteristics like the body length, colours and shape, shape and number of teeth confirmed the species as spinner dolphin (Evans 1987). About 250 spinner dolphins emerged at the coast of Gadani, Balochistan. Almost all of the animals (99%) returned successfully to the sea. Unfortunately, two of them stranded and died. The team observed only one specimen while the other one was taken away by someone. The emergence of spinner dolphins in such massive numbers on this part of the coastline was never recorded before. A similar incident occurred in the gulf of Oman during 2007 where 500-600 common dolphins came out from the sea at the coast of Iran (personal communication at Abu-Dhabi).

Experts of cetaceans believe that such type of episode takes place as a reaction to heavy metal pollution in the sea (http://current.com/news/89819805_200-to-300-dolphins-beaching-themselves-on-the shores-of-manila-bay.htm). High levels of toxins could cause damage to their nervous system and they become partially confused and disoriented and ultimately strand themselves. Pakistan's largest ship breaking industry is situated near the coast of Gadani and there is always a chance of discharge of heavy metals and chemicals into the sea water. Spinner dolphins have twice mass stranded in the Gulf of Mexico. One stranding of 36 animals (spinners) occurred on Dog Island, Florida, in 1961, and the other was near Sarasota, Florida, in 1976. The latter stranding involved 50-150 spinners that beached

themselves at several points during an extremely low tide. The dolphins came ashore with much "squealing and crying" but this later subsided and the animals were quite passive on the beach. Several of the animals were returned safely to the sea; however, others merely stranded again and at least 10 died (www.nsrl.ttu.edu/tmot1/stenlong.htm 2009).



Spinner dolphin (Photos by Abrar ul Hasan)

References

Ahmad, M.F., Ghalib, S.A., Niazi, M.S., Parveen, Z. and Hasan, A. 1988. *Vertebrate fauna of the Mangrove Swamps of Sindh Coast.* Zoological Survey Department, Karachi (unpublished Final Report).

Evans, P.G.H. 1987. The Natural History of Whales and Dolphins. Christopher Helm (Publishers) Ltd. Kent.

Gore, M. 2008. *12 species of whale, dolphin found in Pakistan waters.* Article by Faiza Ilyas, the daily Dawn. 5-1-2008.

Hasan, A., Javed, H.I. and Ejaz, P. 2005. *Natural resource damage assessment study.* Zoological survey Department, Karachi. (Unpublished report).

Hasan, A. and Ahmad S.I. 2006. *Some observations on birds and marine mammals of Karachi coast.* Rec. Zool. Surv. of Pakistan. 17:15-20pp.

Website. 2009. The mammals of Texas- on line edition www.nsrl.ttu.edu/tmot1/stenlong.htm

Website. 2009. 200–300 dolphins beaching themselves on the shores of Manila. http://current.com/news/89819805_200-_to-300-dolphins-beaching-themselves-on-the-shores-of-manila-bay.htm

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