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Cover: Fledglings of Grey Shrike *Lanius Excubitor lahtora* in Galliat Forest Division, Abbotabad. A paper by Shafique et al. entitled "Birds of Ayubia National Park, District Abbotabad, NWFP – Pakistan.

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Some Observations on the Population Status of Punjab Urial (*Ovis vignei punjabiensis*) in District Chakwal, Punjab

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Abstract

Study on population status of Punjab urial *(Ovis vignei punjabiensis)* in Chumbi Surla Wildlife Sanctuary and Ara-Basharat area, Salt Range, district Chakwal was carried out in September, 2001. Population of Punjab urial in Chumbi Surla Wildlife Sanctuary was estimated to be 220 individuals. The actual observed animals were 45, which constituted 16 males, 20 females and 9 young ones. In Ara Basharat area, population of urial was estimated 152 animals whereas the observed population was 37 urials which consisted of 11 males, 20 females and 6 youngs.

Keywords: Punjab Urial, *Ovis vignei punjabiensis*, Population, Status.

Introduction:

The remarkable number of the world's ecological regions including variety of habitats in Pakistan supports a large number of unique species of fauna and flora (Roberts, 1997). Ungulates are among the most important game animals that are widely distributed and have the benefit of inhabiting in the broad ranges from the sea level to the world's highest mountain habitats of Hindukush, Karakorum and Himalayas. Due to high hunting pressure and habitat degradation some of the species of ungulates have become extinct in the past from their original distributional ranges of the country while some of them exterminated from their previous habitats whereas few of those are facing serious threat of extinction.

Punjab urial (*Ovis vignei punjabiensis)* is one of the important ungulates which is facing serious threats in some of the areas of Punjab. Various studies have documented the status and distribution (Ahmad and Ghalib 1975; Aleem, 1977; Chaudhari *et al.* 1997; and Mirza *et al.*, 1976), whereas others have examined some aspects of behaviour, ecology and biology (Roberts, 1997; Schaller, 1974, 1977 and Stockley 1922). Azam *et al.* (2006) have studied population status of Punjab urial in Jalalpur, Salt Range of district Jhelum in Punjab.

Better management and conservation needs wise maintenance and utilization of biological resources. Here the author's concern is a biological species – the Punjab urial presently included in the list of those species which have conservation status in the world's list of IUCN – 'Red Data Book'. In some of other parts of the country, the species conservation has been connected to the programme of trophy-hunting through local communities involvement. The occurrence of the species as a sub race in the Chumbi Surla Wildlife Sanctuary and Ara Basharat Area district Chakwal is a big concern towards its conservation. Preliminary initiatives towards conservation and management of a biological species demands its study to be conducted on distribution and status as a first step thus the present study for this purpose was conducted in preceding mentioned two areas of Salt Range.

Materials and Methods:

Chumbi Surla Wildlife Sanctuary is located 20 km southwest of Chakwal Town almost in the centre of Salt Range. Forests and 'shamilats' of this site covering an area of 55,987 ha which was declared a wildlife sanctuary in 1978 with the prime aim to conserve the largest known population of Punjab urial (*Ovis vignei punjabiensis*). The core zone, Surla and Bakshwala Reserve Forests cover an area of 5,342 ha and surroundings consisted of 49,912 ha of community forests which dominate on hill-slopes ranging from 460 to 1,050 m above the sea level. The area also includes agriculture lands in Kahoon which is a broad valley in the southern part of the sanctuary and the flat areas around Dhok Bann Ameer Khatoon, Tharpal, Bhadi, Karaila, Khokhazer and Shamsabad.

The forest comprises of four blocks Surla I, Surla II and Bakhshwala in the centre of the sanctuary area (4,932 ha), and Choa Saidan

Shah in the southeast (410 ha). The core area of the forest is surrounded by community lands of different villages. There are some areas under cultivation in the periphery of the Wildlife Sanctuary. There is no such village which is situated in or near the core zone of the forest. Vegetation of the area is dry-subtropical semi-evergreen scrub forest type dominated by *Acacia modesta* and *Olea ferruginea*. Other scrub species present in the area are *Justica adhatoda* and *Dodonaea viscosa* etc. and grass species are *Chrysopogon serrulatus, Heteropogon contortus, Digitaria sanguinalis, Dichanthium fovealatum and Dactyloctenium scindicum.*

Ara-Busharat is situated at southeast corner of district Chakwal which is known to be sustaining a sizeable population of urials. The area consists of hill-slopes and ravines besetting with typical vegetation of the Salt Range. *Olea ferruginea* was observed to be the dominant plant species followed by *Acacia modesta* and *Zizyphus spp.*

Population census of wild ungulates is difficult in the rugged mountains because they are well known to be adaptive from such steppic arid sub-tropical forests in the southern latitudes to the high mountain cliffs and alpine zone of Hindukush, Karakorum and Himalaya in the North-west. They are shy in nature and have ability to detect human smell from a great distance (Roberts, 1997). Although there are different methods that can be used in studying population of ungulates but transact and quadrate methods used by Azam *et al.* (2006) were followed during the present study.

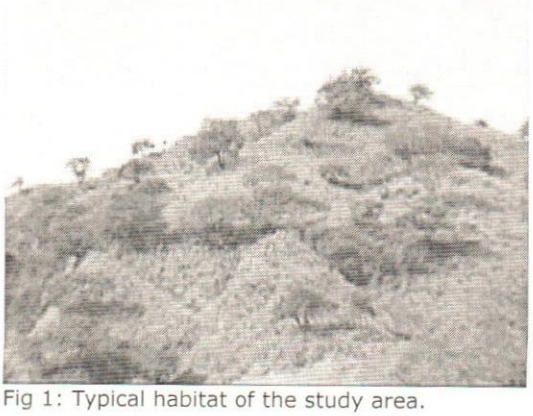

Fig 1: Typical habitat of the study area.

Results and Discussion:

The study revealed that Punjab urial (*Ovis vignei punjabiensis)* inhabits rugged terrain of the Salt Range including the two study areas; the Chumbi Surla and Ara Basharat. A sizeable population of urial was found in Chumbi Surla Wildlife Sanctuary. The actual counts were 45 animals consisting of 16 (35.56%) males, 20 (44.44%) females and 9 (20%) youngs (Table-I). Herd size varied from 4 to 16 (average 6.8). Almost whole of the population was found in the core zone particularly in the adjacent areas of Dhoke Sela. Small numbers of animals were seen between Dhoke Sela and Bann Ameer Khatoon. Extrapolating the observed data, the population of urial in the Chumbi Surla Wildlife Sanctuary was estimated to be 220 animals. Chaudhri *et al.* (1997) estimated population of urial in the sanctuary above 150 individuals. Present study revealed that the population of urial in the sanctuary is increasing after 1997.

In Ara-Busharat area population of urial was estimated to be 152 animals. However, only 37 urials were actually sighted; of these 11 (29.72%) were males, 20 (54.05%) were females and 6 (16.21%) young ones. Herd size was observed varying from 2 to 10 animals (average 5.2). Frequency of occurrence of urial in two areas was calculated 1.9 per urials/sq km which is almost same as observed in the area of Jalalpur, district Jhelum (Azam *et al.*, 2006). This may be because of similar habitat and juxtaposition of the two areas.

Table-1: Population of Punjab urial (*Ovis vignei punjabiensis)* in Chumbi Surla Wildlife Sanctuary and Ara-Busharat area.

Location	Male	Female	Young	Total
Chumbi Surla Wildlife Sanctuary	16	20	9	45
Ara-Busharat area	11	20	6	37
Total	**27**	**40**	**15**	**82**

Considerable variation in population size was noticed in the previous studies. According to Roberts (1997) urials had been totally exterminated from the Khair-i-murat Hills and a few were surviving around tracks north of

Jhelum as well as around Bhone and west of Chakri in the Salt Range area. Mountfort (1969) observed main concentration of the urials in northwest of Kala Chitta Hills and Mason Valley at Kalabagh. Schaller (1971) estimated population in the Salt Range to be 500 animals. Mirza *et al.* (1976) studied the population of urials in various parts of Salt Range and estimated 1,288 urials in Kalabagh Reserve district Mianwali, 213 in Kala Chitta hills (chak Jabbi area) and 588 animals in district Jhelum.

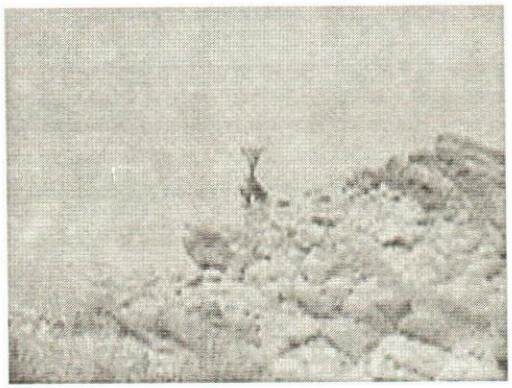

Fig 2: Punjab urial (*Ovis vignei punjabiensis)* observed in Chumbi-Surla Wildlife Sanctuary.

Present study figures proved that a sizeable population of urial exists in the Chumbi Surla Wildlife Sanctuary and Ara-Busharat areas both parts of Salt Range. However, considering the smaller size of the population (1.9 urials/sq km), there is a need to be taken vigil steps to improve the habitat of this majestic animal. Also, there is an urgent desire to take appropriate management measures including the total ban on its hunting, habitat conservation and control over human criminal activities.

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Studies on the Population Status of Water Birds in Major Wetlands of Upper Punjab

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Abstract

The study presents the counts of wintering population of birds at eight major water bodies of upper Punjab; the Chashma and Jinnah barrages, Shah Pur Dam and Kallar Kahar, Ucchali, Nammal, Khabbaki and Jhalar lakes. The field work conducted during the months of January and November 2007, and January 2008. Population counts represented that a large population of birds visited these water bodies in winter. The most common birds encountered were anatids while the common pochard (*Aythya ferina*) was found to be dominating at all the water bodies.

Keywords: waterfowl census, water bodies, census, Chashma and Jinnah barrages, Shah Pur Dam, Ucchali complex, Kallar Kahar, Nammal, common pochard, anatids.

Introduction:

Migratory birds are one of the important indicators for the ecological conditions and the productivity of the wetland ecosystem. For the better management and conservation, it is desirable to study and monitor migratory patterns, population dynamics and distribution status of migratory birds regularly. Pakistan is signatory of Convention on Migratory Species of fauna (1983), which is an intergovernmental treaty that aims to conserve the terrestrial, marine and avian species, especially water birds over whole range of their migratory route (Wetlands International, 2007). This convention requires the member states to take measures for the conservation of migratory water birds and to conduct census of birds regularly (Scott and Poole, 1989).

Midwinter Waterfowl Census initially progressed globally in 1970, however, the results of these censuses have been documenting regularly since 1987. These censuses are now carried out in collaboration with Wetlands International and it includes 535 wetland sites globally (Wetlands International, 2007).

Numerous studies have examined the population estimates of water birds at different wetlands of upper Punjab. Azam (1994) reported 86 water bird species from 5 different wetlands of the Salt Range, Punjab. Javed (2002) reported 34 species of water birds from Chashma Barrage. Chaudhry and Khan (1988) recorded 17 species of waterfowls from 13 different wetlands of Punjab. Ali and Akhtar (2005) reported 149 species, including 61 water bird species from 16 different wetlands of upper Punjab. Present paper is based on population census of waterfowls at some of the important wetlands of upper Punjab i.e. Chashma Barrage, Shah Pur Dam, Ucchali Complex (Ucchali lake, Jhalar lake and Khabbaki lake), Nammal lake and Kallar Kahar lake (Fig. 1). The present counts were produced as part of Midwinter Waterfowl Census conducted in November and January 2007 and in January 2008.

Study Area:

During the present study the water bird census was carried out at 8 lakes located in the upper Punjab, Pakistan. Few of these lakes are so large which can support a rich fauna and flora. Water of some lakes is slightly saline because of their situation in the salt range. Details of the study sites are given individually as follows.

Chashma Barrage:

Chashma barrage (32° 31'N, 71° 29' E) is located about 25 km southwest of Mianwali on Mianwali Dera Ismail Khan road. This wetland comprises of a large barrage on the river Indus with a series of embankments (flood-bunds) which divide the wetland into five lakes, each spreading over an area of about 250 sq km. Depth of these lakes vary from 0.2 m during the dry season and 8 m in the monsoon floods while the depth of the main river varies from 4.6 m to 8.8 m.

The aquatic vegetation consists of *Hydrilla verticillata, Nelumbium speciosum, Nymphaea lotus, Typha angustata, Pragmites karka, Potamogeton pectinus, Saccharum spontaneum,*

Vallisneria spiralis and Zannichellia palustris. Terrestrial vegetation around this lake system is a mixture of subtropical semi-evergreen scrub and tropical thorn forest which is dominated by *Olea ferruginea, Acacia modesta, A. nilotica, Adhatoda vasica, Dodonaea viscosa, Tamarix aphylla, T. dioica, Zizyphus mauritiana, Z. nummularia, Chrysopogon aucheri, Lasiurus hirsutus, Heteropogon contortus* and *Panicum antidotale.* Considering the importance of this wetland it was declared as wildlife sanctuary and categorized as a Ramsar Site.

Nammal Lake:
Nammal lake is situated (32° 41'N, 71° 48' E) about 29 km northeast of Mianwali. It is spread over an area of about 486 ha. It is a shallow water lake consisting of a small dam at one of its corners. Several small streams and a spring which flow from the hills of the Salt Range also feed it. Depth of the lake varies between 2 to 6 m with the average of 4.6 m. Water level fluctuates substantially due to its withdrawn for irrigation purpose. Water of this lake is slightly saline.

The aquatic vegetation consists of *Carex fedia, Hydrilla verticillata Juncus spp., Phragmites karka, Potamogeton crispus, Saccharum spontaneum. Typha angustifolia and Zannichellia palustris.* The terrestrial vegetation of the region is a mixture of subtropical semi-evergreen scrub and tropical thorn scrub dominated by *Acacia modesta, A. nilotica, Adhatoda vasica, Dodonaea viscose, Gymnosporia royleana, Olea ferruginea, Prosopis cineraria, Reptonia buxifolia, Salvadora oleoides, Tamarix aphylla, T. dioica, Zizyphus mauritiana, Z. nummularia, Chrysopogon aucheri, Lasiurus hirsutus, Heteropogon contortus* and *Panicun antidotale. Prosopis glandulosa* is introduced in the area. Most of the land adjacent to the lake has privately been utilized for agriculture. The wetland is declared as wildlife sanctuary.

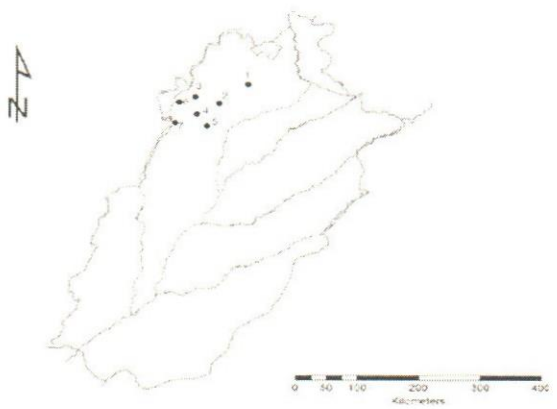
Ucchali Lake:
It is situated (32° 33'N, 72° 25' E) about 13 km west of Nowshehra town and 42 km northwest of Khushab. It is a saline lake with a little marshy vegetation and almost entirely surrounded by agricultural land. The lake is fed by a small spring which comes out of the adjacent agriculture lands. It used to be one of the largest lakes of the Punjab but due to previous long drought spell its area dwindled and turned into a small marsh. During the recent past the lake received adequate quantity of water and most of its area got inundated which revived more or less its previous status. Marshy vegetation is confined to a few small patches along the shore. The dominant aquatic plants are *Carex fedia, Hydrilla verticillata, Juncus spp., Phraagmites karka, Potamogeton crispus, Saccharum spontaneum, Typha angustifolia, Vallisneria spiralis and Zannichellia palustris.* The terrestrial vegetation around the lake is a mixture of subtropical semi-evergreen forest and tropical thorn forest dominated with *Acacia modesta, Adhatoda vasica, Dodonea viscose, Gymnosporia royleana, Olea ferruginea, Reptonia buxifolia, Tamarix aphylla, Withania coagulans* and *Zizyphus spp.* The natural vegetation of the lake in its surroundings has been cleared off to use the land for agricultural means. The lake is covered with very rich growth of phytoplankton.

Khabbaki Lake:
Khabbaki lake is situated (32° 37'N, 72° 13' E) about 10 km north of Nowshehra town and 38 km northwest of district Khushab. The lake covers an area of about 283 ha. Water level of the lake recorded maximum in 1985 and 1987 but the lake remained completely dried during the past many years. Due to long dehydration and dryness the lake was completely lacking of aquatic vegetation. Terrestrial vegetation around the lake was similar to the flora of Ucchali lake. Last year (2008), it received only a small quantity of water which just rejuvenated its posture.

Jhalar Lake:
Jhalar lake is located (32° 30'N, 72° 54' E) about 10 km southeast of Ucchali lake and 10 km southwest of Nowshehra, district Khushab. This small brackish lake has an area of 100 ha. General features and vegetation of this lake is similar to Ucchali and Khabbaki lakes. Water resource of the lake depends upon small channels which originate from the surrounding hills.

Kallar Kahar Lake:
The lake is sited (32° 46'N, 72° 42' E) some 25 km southwest of Chakwal in the vicinity of Kallar Kahar town. This small brackish lake covers an area of 220 ha. It has dense marginal vegetation along the lake dominated by *Typha angustifolia, Saccharum spp.* and *Pharagmites karka* and also it has sparse submerged

vegetation. There are a few orchards along the southern bank of the lake. Terrestrial vegetation around the lake is similar to the typical flora of the Salt Range.



1. Kallar Kahar lake, 2. Khabbaki lake, 3. Namal lake, 4. Ucchali lake, 5. Jhalar lake, 6. Jinnah barrage, 7. Chashma barrage.

Fig. 1 Map showing wetland areas of upper Punjab.

Shah Pur Dam:

Shah Pur Dam is a water reservoir situated (33° 35'N, 72°41'E) near Fath-e-Jhang city in district Attock. The dam was constructed for the purpose of irrigation. It is well known inhibiting a good population of water birds and provides the wintering grounds to the seasonal migratory birds during their passage. The wetland has light submerged vegetation and dense marginal vegetation which is dominantly represented by *Typha angustifolia*, *Saccharum spp.* and *Pharagmites Karka*. The wetland is facing a serious threat of degradation due to unwarranted fishing and other anthropogenic activities like poaching and hunting.

Jinnah Barrage:

Jinnah barrage is situated (32° 55'N, 71° 31'E) about 50Km Northwest of Mianwali city. It has a voluminous watershed in the main downstream (river Indus). Few small ponds are also located at the adjacent peripheries. The wetland has light submerged vegetation. The barrage is unique in having good concentration of anatids both at upstream and downstream of the barrage and also supports a variety of water birds.

Material and Methods:

The wetlands were surveyed in January and November 2007, and January 2008. Each wetland was visited three times during the study period and counts were made at five different selected points. The birds were directly observed, identified and counted with the help of binoculars (Olympus 8-16 X 40, DPS I) and spotting scopes (Nikon w/ 15-45 X). The GPS receiver (Magellan SporTrack) was also used to record the coordinate of the wetland. For identification of water birds, Sonobe and Usui (1993) were referred. The total population of the birds was determined by direct counts.

Results and Discussion:

During the present study 45 species of water birds belonging to 13 families and 7 orders were recorded at the wetlands of upper Punjab (Table-I-IV). Common coot (*Fulica atra*) was found to be the most dominant species in all the wetlands followed by common pochard (*Aythya ferina*) and shovler (*Anas clypeata*), respectively. Chashma barrage was observed to have a larger population of water birds as compared to other studied wetlands of upper Punjab (Fig. 2).

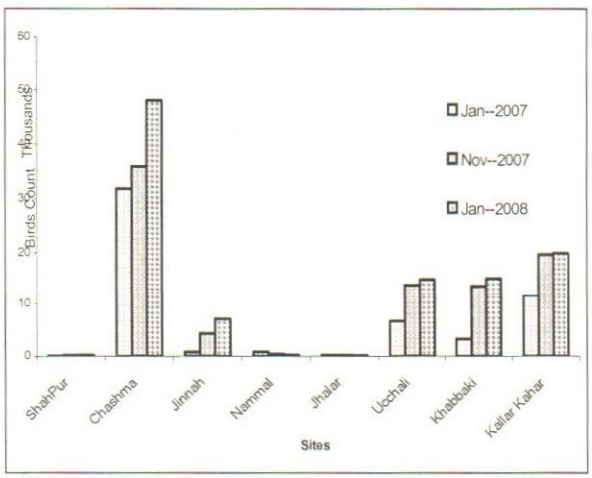


Fig 2: Temporal changes in the population of water birds at different wetlands.

The variation in the abundance of the water birds may be attributed to a number of factors. However, sparse distribution of birds in Khabbaki and Uchalli Lake may be due to little or no water in these lakes. The population of birds in these lakes increased substantially during January 2007 when water level got raised.

Table I: Number of water birds observed at Shah Pur Dam, Chashma barrage, Jinnah barrage and Nammal Lake.

Common and Scientific Names	Shah Pur Dam			Chashma Barrage			Jinnah barrage			Nammal lake		
	Jan 2007	Nov 2007	Jan 2008	Jan 2007	Nov 2007	Jan 2008	Jan 2007	Nov 2007	Jan 2008	Jan 2007	Nov 2007	Jan 2008
Little Grebe (*Tachybaptus ruficollis*)	5	50	53	575	465	230	25	8	5	45	4	5
Great Crested Grebe (*Podiceps cristatus*)	0	0	0	0	0	0	0	0	12	0	6	8
Black-necked Grebe (*Podiceps nigricollis*)	0	0	0	0	15	25	0	0	0	0	0	0
Large Cormorant (*Phalacrocorax carbo*)	0	0	0	138	150	562	30	300	325	0	0	0
Indian Cormorant (*Phalacrocorax fuscicollis*)	0	0	0	5	0	0	0	0	0	0	0	0
Little Cormorant (*Phalacrocorax niger*)	0	12	15	30	800	412	50	335	134	62	70	0
Darter or Snake Bird (*Anhinga melanogaster*)	0	0	0	4	0	0	0	0	0	0	0	0
Night Heron (*Nycticorax nycticorax*)	0	0	0	5	0	0	0	0	0	0	0	0
Indian Pond Heron (*Ardeola grayii*)	2	2	0	130	120	25	0	180	10	0	6	0
Cattle Egret (*Bubulcus ibis*)	0	0	0	22	0	17	0	0	0	0	0	0
Little Egret (*Egretta garzetta*)	5	0	10	73	315	335	45	264	35	63	215	12
Intermediate Egret (*Egretta intermedia*)	0	0	0	48	62	712	20	18	0	45	0	0
Large Egret (*Egretta alba*)	2	0	8	67	88	316	32	24	5	52	0	12
Gray Heron (*Ardea cineria*)	0	0	0	35	58	104	0	5	16	4	0	0
Purple Heron (*Ardea purpurea*)	0	0	0	5	0	0	0	0	0	3	0	0
Greater Flamingo (*Phoenicopterus ruber*)	0	0	0	0	0	0	0	0	0	0	0	0
Ruddy Shelduck (*Tadorna ferruginea*)	0	0	0	0	0	0	0	0	532	0	0	0
Common Shelduck (*Tadorna tadorna*)	0	0	0	0	0	0	0	0	0	0	0	0
Eurasian Wigeon (*Anas penelope*)	0	0	0	1,250	20	800	30	800	512	45	0	0
Gadwall (*Anas strepera*)	0	0	0	1680	1150	1200	45	1,600	200	0	0	25
Common Teal (*Anas crecca*)	0	0	0	580	700	850	120	15	1,225	0	0	0
Mallard (*Anas platyrhynchos*)	0	0	0	1,240	1,450	604	48	30	2,050	350	0	0

Northern Pintail (*Anas acuta*)	0	0	0	830	690	342	10	35	52	60	0	20
Shovler (*Anas clypeata*)	0	0	0	1,150	1,200	1,800	25	18	1,150	0	0	80
Red-crested Pochard (*Netta rufina*)	0	0	0	0	2	0	0	0	0	0	0	0
Common Pochard (*Aythya ferina*)	0	0	0	4,300	7,500	15,000	25	20	315	0	0	0
Tufted Duck (*Aythya fuligula*)	0	0	0	350	415	650	0	0	105	0	0	0
Indian Moorhen (*Gallinula chloropus*)	15	25	33	139	127	215	6	5	8	15	13	17
Purple Moorhen (*Porphyrio porphyrio*)	0	0	0	26	30	98	0	0	0	0	0	0
Common Coot (*Fulica atra linnaeus*)	12	50	68	18,200	19,000	21,000	225	200	316	15	15	30
Pheasant-tailed Jacana (*Hydrophasianus chirurgus*)	0	0	0	0	0	4	0	0	0	0	0	0
Black-winged Stilt (*Himantopus himantopus*)	5	6	4	380	432	680	0	114	25	12	16	20
Kentish Plover (*Charadrius alexandrinus*)	0	0	0	0	2	8	15	6	0	0	15	0
Red-Wattled Lapwing (*Holopterus indicus*)	4	3	5	35	25	34	8	30	21	0	2	0
Northern Lapwing (*Vanellus vanellus*)	0	0	0	0	0	0	0	0	0	0	0	0
Little Stint (*Calidris minuta*)	0	0	0	17	4	12	17	7	0	0	0	0
Common Snipe (*Gallinago gallinago*)	0	0	0	0	2	0	0	0	2	0	0	0
Spotted Redshank (*Tringa erythropus*)	0	0	0	7	0	0	7	0	0	4	0	0
Common Redshank (*Tringa totanus*)	0	0	0	22	0	0	17	25	6	9	0	0
Green shank (*Tringa nebularia*)	4	0	2	7	25	42	0	4	4	3	0	0
Green Sandpiper (*Tringa ochropus*)	0	0	0	12	17	0	19	5	0	10	0	0
Wood Sandpiper (*Tringa glareola*)	0	0	0	5	2	0	0	0	0	3	0	0
Common Sandpiper (*Actitis hypoleucos*)	0	0	0	3	0	4	0	0	0	0	0	0
Black-headed Gull (*Larus ridibundus*)	0	0	0	280	315	754	0	20	31	15	0	0
Gray River Tern (*Sterna aurantia*)	5	7	11	230	750	1246	0	275	56	0	0	0
Total number of birds	**59**	**155**	**209**	**31,880**	**35,931**	**48,081**	**819**	**4,343**	**7,152**	**815**	**362**	**229**
Total number of species	**10**	**8**	**10**	**35**	**31**	**31**	**24**	**26**	**26**	**19**	**10**	**10**

Table II: Number of water birds observed at Jhalar lake, Ucchali lake, Khabbaki lake and Kallar Kahar lake.

Common and Scientific Names	Jhalar lake			Ucchali lake			Khabbaki lake			Kallar Kahar lake		
	Jan 2007	Nov 2007	Jan 2008	Jan 2007	Nov 2007	Jan 2008	Jan 2007	Nov 2007	Jan 2008	Jan 2007	Nov 2007	Jan 2008
Little Grebe (*Tachybaptus ruficollis*)	22	18	15	28	35	120	78	200	78	135	150	165
Great Crested Grebe (*Podiceps cristatus*)	0	0	0	0	15	0	0	40	0	0	5	0
Black-necked Grebe (*Podiceps nigricollis*)	0	0	0	0	23	0	0	10	0	0	8	0
Large Cormorant (*Phalacrocorax carbo*)	0	0	0	0	0	0	0	0	0	114	120	135
Indian Cormorant (*Phalacrocorax fuscicollis*)	0	0	0	0	0	0	0	0	0	0	0	0
Little Cormorant (*Phalacrocorax niger*)	3	5	0	0	25	0	8	12	8	54	425	291
Darter or Snake Bird (*Anhinga melanogaster*)	0	0	0	0	0	0	0	0	0	0	0	0
Night Heron (*Nycticorax nycticorax*)	0	0	0	0	0	0	0	0	0	0	0	0
Indian Pond Heron (*Ardeola grayii*)	0	4	0	0	0	0	0	12	0	62	47	65
Cattle Egret (*Bubulcus ibis*)	0	0	0	0	0	0	0	0	0	18	0	0
Little Egret (*Egretta garzetta*)	15	12	0	0	180	86	13	20	13	48	65	95
Intermediate Egret (*Egretta intermedia*)	2	0	0	0	150	0	4	0	4	22	13	26
Large Egret (*Egretta alba*)	3	0	0	0	36	42	3	0	3	35	78	94
Gray Heron (*Ardea cineria*)	0	0	0	0	41	0	0	0	0	28	65	32
Purple Heron (*Ardea purpurea*)	0	0	0	0	0	0	0	0	0	0	0	0
Greater Flamingo (*Phoenicopterus ruber*)	0	0	0	31	36	27	0	0	0	0	0	0
Ruddy Shelduck (*Tadorna ferruginea*)	0	0	0	0	0	0	0	0	0	0	0	0
Common Shelduck (*Tadorna tadorna*)	0	0	0	0	0	8	0	0	0	0	0	0
Eurasian Wigeon (*Anas penelope*)	0	0	0	0	1200	335	250	35	250	1545	700	612
Gadwall (*Anas strepera*)	0	0	0	54	1700	80	0	96	0	1800	120	70
Common Teal (*Anas crecca*)	0	0	0	0	24	4200	0	0	0	500	32	87
Mallard (*Anas platyrhynchos*)	0	0	0	350	315	1350	0	0	0	800	780	615

Northern Pintail (*Anas acuta*)	40	0	0	28	2300	1500	0	18	0	1200	1350	950
Shovler (*Anas clypeata*)	0	0	15	42	1580	635	0	900	0	570	540	360
Red-crested Pochard (*Netta rufina*)	0	0	0	0	0	0	0	0	0	0	0	0
Common Pochard (*Aythya ferina*)	0	0	31	630	615	625	2,300	2,500	2,300	2050	2200	1800
Tufted Duck (*Aythya fuligula*)	0	18	0	0	115	55	0	220	0	9	185	70
Indian Moorhen (*Gallinula chloropus*)	16	16	12	0	2	0	0	4	0	150	150	69
Purple Moorhen (*Porphyrio porphyrio*)	0	0	0	0	0	0	0	0	0	325	534	570
Common Coot (*Fulica atra*)	48	118	70	5200	5400	5650	645	9,600	645	2000	12000	13700
Pheasant-tailed Jacana (*Hydrophasianus chirurgus*)	0	0	0	0	0	0	0	0	0	0	0	0
Black-winged Stilt (*Himantopus himantopus*)	12	16	18	180	7	15	38	45	38	48	56	67
Kentish Plover (*Charadrius alexandrinus*)	0	0	0	48	0	0	0	0	0	0	0	0
Red-Wattled Lapwing (*Holopterus indicus*)	12	6	5	25	2	4	3	4	3	6	5	4
Northern Lapwing (*Vanellus vanellus*)	0	0	0	0	3	0	0	0	0	0	0	0
Little Stint (*Calidris minuta*)	0	0	0	0	0	0	0	0	0	0	0	0
Common Snipe (*Gallinago gallinago*)	0	0	0	0	0	0	0	0	0	0	0	0
Spotted Redshank (*Tringa erythropus*)	0	0	0	0	0	0	0	0	0	8	0	0
Common Redshank (*Tringa totanus*)	0	0	0	0	0	8	0	0	0	0	0	0
Green shank (*Tringa nebularia*)	0	0	0	0	0	7	0	0	0	4	0	0
Green Sandpiper (*Tringa ochropus*)	15	0	0	35	0	4	5	0	5	3	0	0
Wood Sandpiper (*Tringa glareola*)	0	0	0	0	0	0	0	0	0	0	0	0
Common Sandpiper (*Actitis hypoleucos*)	0	0	0	0	0	0	0	0	0	0	0	0
Black-headed Gull (*Larus ridibundus*)	0	0	0	30	25	39	0	0	0	25	12	35
Gray River Tern (*Sterna aurantia*)	0	0	0	0	120	245	0	0	0	42	35	42
Total Number of birds	**188**	**213**	**166**	**6681**	**13949**	**15035**	**3,347**	**13,716**	**3,347**	**11,601**	**19,675**	**19,954**
Total Number of Species	**11**	**9**	**7**	**13**	**24**	**21**	**11**	**16**	**11**	**27**	**25**	**23**

On the contrary, Nammal lake recorded to support a very small number of birds in January 2008 (Table-I) when water level was very high which makes it impossible for dabbling anatids to feed on submerged vegetation.

Ucchali lake used to have dense population of aquatic birds in 1985 (Azam, 1994), however, present study reveals that the bird population significantly declined which may be attributed to low water level in the lake for the past few years. The population of water birds was observed to be increasing in January 2008, which may be attributed to high inflow of water in the lake (Table-II).

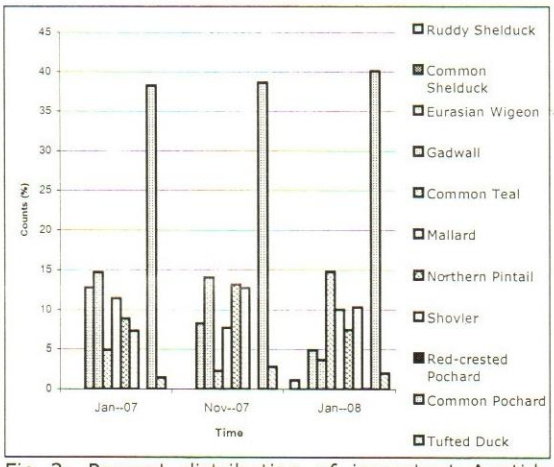


Fig 3: Percent distribution of important Anatids at lakes in upper Punjab (pooled data)

Among water birds, anatids seem to be the most common bird. Common pochard (*Aytha ferina*) was found to be dominant species especially at Chashma barrage (Fig. 3). Its contribution in total population during January 2007, November 2007 and January 2008 was 38.3 %, 38.7 % and 41.1 %, respectively. Ali and Akhtar (2005), Azam (1994), Roberts (1991; 1992) and Scot (1989) considered Ucchali, Khabbaki and Jhalar lakes were important wintering grounds of white-headed duck (*Oxyura leucocephala*) its amazing that during the present study, the species could not be recorded at any of the wetlands of upper Punjab. Similarly, greyleg goose (*Anser anser*) was considered to be a regular winter visitor to Nammal lake (Azam, 1994), however, it was not observed in these water bodies. Ruddy shelduck (*Tadorna ferruginea*) was reported from Jinnah Barrage (Ali and Akhtar, 2005; Chaudhry and Khan, 1998), however, its population was observed to be growing considerably higher than previous records. In comparison to previous studies, the population of water birds was observed to have decreased during the present study at Chashma barrage and at Nammal, Jhalar and Kallar Kahar lakes whereas sizeable increase in population was noted at Jinnah barrage, and at Ucchali and Khabbaki lakes (Table-I-II).

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Bird Records of Ayubia National Park, District Abbotabad, NWFP - Pakistan

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Abstract

We present bio-ecological investigation of bird fauna of Ayubia National Park covering the seasonal abundance and current status based on censuses carried out from 1997 to 2000. Study covers variable aspects such as population abundance, species richness, migrant and resident species and breeding records. We also report monthly counts which estimate the seasonal pattern of occurrence of species. The study recorded a total 154 bird species using this moist-temperate western Himalayan fairly dense forested landscape, including definitely a new record of Collared Flycatcher (*Ficedula albicollis*) for the country based on a single sighting during the summer season and the rediscovery with a pair of Green Shrike Babbler (*Pteruthias xanthochloris*) after a century back.

Key Words: Park, bird species, moist-temperate Himalayan, Ayubia National Park,

Introduction:

According to the WEMC/UNEP, there are now more than 44,000 protected areas, worldwide, covering about 10.1 percent of the world's terrestrial surface. Almost 42 percent (18,400 sites) are in the developing countries, including some of the most biologically rich habitats on the Earth. These protected areas are the cornerstone of biodiversity and species conservation (Kramer *et al.,* 1997; Bruner *et al.,* 2001). Ayubia National Park is one of the most important declared National Parks in NWFP - Pakistan (map) that falls in the IUCN-Category V. The Park is internationally known as a hot spot in the moist-temperate western-Himalayan mountainous range in the sense that many endemic, endangered or threatened species are inhabited in the Park.

The fairly-dense forested mountain landscapes serves as an international route used by the local and international migrant species. The Park is purely built to protect the beautiful landscape predominantly enriched with coniferous forest (*Abies pindrow, Cedrus deodara, Picea smithiana, Pinus wallichiana* and *Texus wallichiana*) mixed with broad-leaved evergreen plant species (*Quercus floribunda, Q. glauca, Q. incana,*) and deciduous broad-leave trees (*Acer caesium, Aesculus indica, Cornus macrophylla, Juglans regia, Populus cilliata, Prunus cornuta, Salix tetrasperma, Ulmus wallichiana*) in the moist-temperate environs of extreme western Himalayan range which inhabited a large faunal biodiversity together with some of the regional endemism including common leopard, *Panthera pardus* Himalayan rhesus, *Macaca mulatta villosa* Murree vole, *Hyperacrius wynnei* yellow-throated marten *Martes flavigula* Koklass Pheasant, *Pucrasia macrolopha biddulphi* Kalij Pheasant, *Lophura leucomelana hamiltonii* Oriental White-backed Vulture, *Gyps bengalensis* Hodgson's Hawk Eagle *Spizaetus nepalensis* Wedge-tailed Green Pigeon *Trenon sphenura* Himalayan Jungle Crow *Corvus, macrorhynchos intermedius* Himalayan Green Finch, *Carduelis spinoides* Orange Bullfinch *Pyrrhula aurantiaca* and Hawfinch *Coccothraustes coccothraustes.*

Material and Methods:

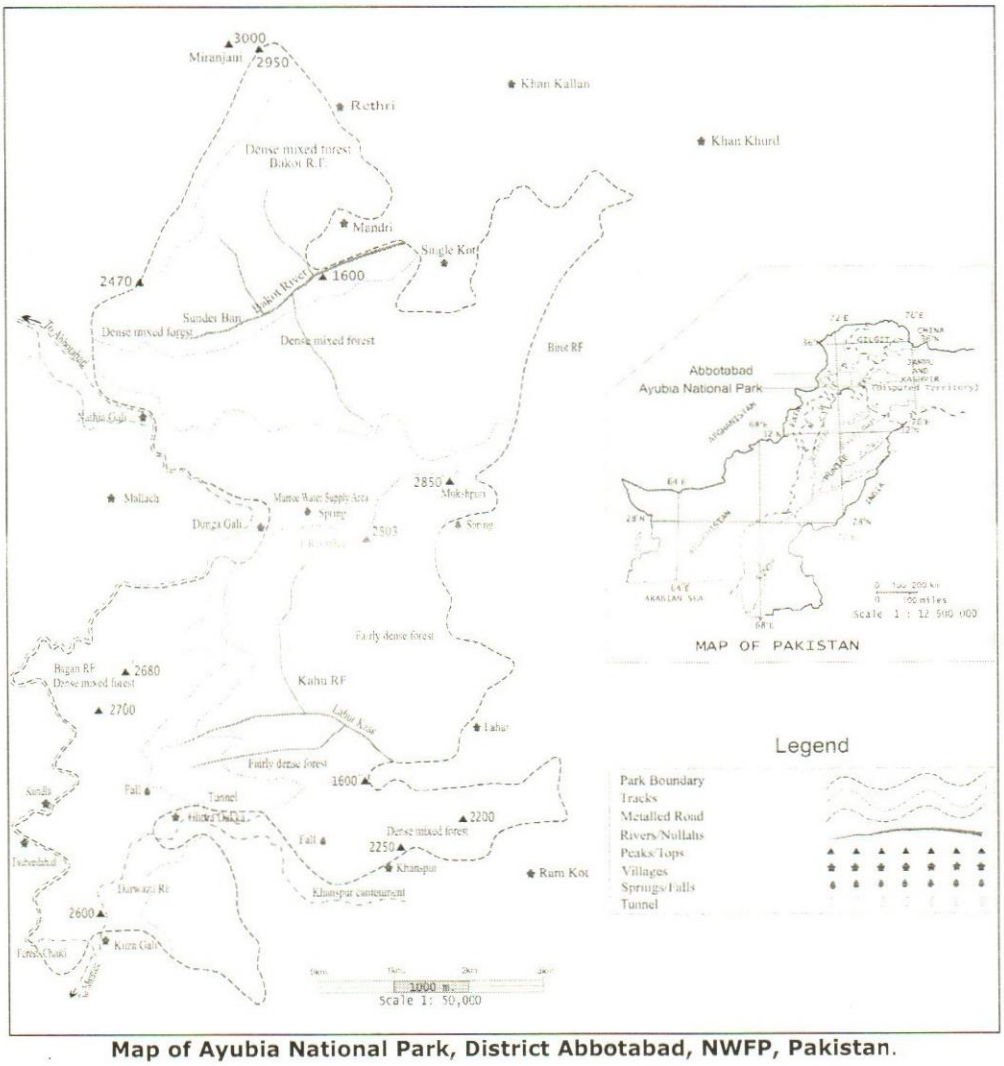
Since complete counting of birds is practically impossible as the present study area comprises of most difficult mountains of Himalayas ranges having altitudes upto approximately 3000 meters. It is for this reason, Anderson *et al.* (1976) strip census estimation method found to be the most suitable for bird count.

The strip census method was applied which entirely necessitates walking of predetermined track or line counting all the birds accrossed or observed in front or both left and right, and recording the distances at which they were seemed. The average of the flushing distance is determined and used to calculate the effective width of the strip covered. The average width is predetermined by trial and error method. The population of the entire area is considered to be the number of birds flushed, divided by the area of the strip and multiplied by the total area.

$$P = \frac{A\,Z}{2YX}$$

Where P = Population
A = total area of study
Z = number flushed
Y = average flushing distance
X = length of strip

During the visits, rapid bird biodiversity surveys were undertaken, partitioning the ranges of the area in all the habitats. Species diversity and species richness was encountered in every month of the study period.



Map of Ayubia National Park, District Abbotabad, NWFP, Pakistan.

Bird Identification:
Identification of birds was made following the literatures of Ali and Ripley (1982), King *et al.* (1986), Woodcock (1980), Heinzel *et al.* (1977). Certain small size birds which were difficult to identify at site, captured alive through the mist nets following the technique of Nagorsen and Peterson (1980). These birds were then identified and later released where they were caught. Many bird species were photographed which greatly assisted in identification without any confusion.

Tape Recordings:
Many species of birds were readily attracted to the tape-recorded calls of their own species. It was found to be most useful for population estimates. A comparative estimates of population density was obtained for these species by using a transect, and repeatedly playing suitable calls at intervals along their usual routes. Many birds of different species attracted to the calls, and then they were counted and assorted as they appeared or calls heard in response. This method was practically found to be much useful for shy skulking

species. Care had been taken to ensure that the volume at which the call was played remained constant through out the census.

Mist Netting:
Mist nets are made of fine nylon thread which trap birds unharmed when they fly into without seeing them, were used to assess changes in the abundance of a particular species in a locality. It has been observed that local birds especially used to avoid these nets, if the nets remained in the same site for several course entire days.

Random Nest Searching:
Fluctuations in breeding populations of some species of birds were obtained from the number of nests observed annually by random searching. During the study it was found that some birds may make more than one nest if their first effort was robbed by a predator, and also it was noted that some species of birds used their old nests in successive breeding seasons (constructed in the previous years) by renewing them to save their energy (thrush species). Birds which breed in large colonies were observed to occupy the same nesting area every year and such colonies were usually well known (martins and swallows). Some observations were most interesting as part of nesting. Species of wood peckers play an important role in the forest ecosystem, they benefit many other species of hole nesting. It was commonly observed that some hole nests of older colonies of Woodpeckers which were not in use were occupied by mynas as well as many other wildlife species of mammals (flying squirrels).

Small passerine birds have relatively short breeding cycle and nest more than once in a year as such counting nests all the time during the season had been done in order to be more accurate and precise.
Finding nests for some of territorial bird species is usually difficult for a population of more than 20 pairs instead it was to map the territorial system of the population, and this has the advantage that while nesting may be periodic, territories must remain fairly constant throughout the breeding season.

Results and Observations:
Prior to this work, little was known about the avian fauna of the Park. In the present study carried out by the scribes, a total of 154 bird species belonging to 42 families of 13 orders were recorded. Which embrace as 12.9% permanent resident, 12.3% were resident altitudinal migrant, 18.9% were passage migrant, 29.2% were summer migrant, 4.5% were winter migrant, 10.4% were occasional, 10.4% were vagrant and 2.6% passed through their aerial route (Fig 1). Earlier to the present study, only in a few instances estimates of particular localities of the country are available, however with subsequent gaps of species abundance and diversity (Roberts, 1991), therefore, the present accounts could be relatively a complete reference of ANP. Birds are unpredictable due to their high mobility with the seasonal changes. Roberts (1991 & 1992), Ali and Ripley (1968, 1974, 1982, 1983 &1987), Raja *et al.* (1997), Barker *et al.* (1996 & 1999) conducted ornithological surveys in the adjoining areas but none of them surveyed exclusively in the Park area. Therefore, the present accounts attempt to summarize the five main aspects including seasonal variation, relative abundance, breeding evidence, altitude and status of all bird species occurred in this protected area (ANP).

To record the avifauna of a particular area and their identification is a complicated job. The present study spans over a period of three years during which all the seasons were covered and avian census made at monthly frequency of occurrence. Table 1, shows the variation in abundance of birds during different seasons in three consecutive years: Spring (March to May); summer (June to August); autumn (September to November); and winter (December to February).

Research on the contemporary status of the avifauna exclusively of Ayubia National Park was lacking, however Roberts (1991 & 1992) compiled voluminous records of birds from Pakistan. Ali and Riplay in a series of papers (1968, 1974, 1982 & 1987) gave an overall picture of the birds of the India and Pakistan. Other workers conducted ornithological survey in the adjoining areas including Raja *et al.* (1997) Barker *et al.* (1996) and (1999), Whistler (1930a), Magrath (1908a,b), but none of them surveyed entirely the Park area.

Out of 154 species of birds, 20 bird species were resident and 19 species were found resident but locally altitudinal migrant, 16 species were occasional, 46 species were summer migrant and 7 species were winters migrant, 28 species were passage migrant, 16

species were found to be vagrant while one was new record in the country and one other found to be endemic rediscovered after a century back (Figure 2).

The present study spans over for a continuous period of 3 years (March 1997 - February 2000) covering all seasons and all areas of the Park. In respect of bioecological characteristics, many evidences collected interpreting their habits and behavioral activities in consideration with their seasonal movements. Appearance of birds in the field immediately recorded and identified by the existing literature in hand.

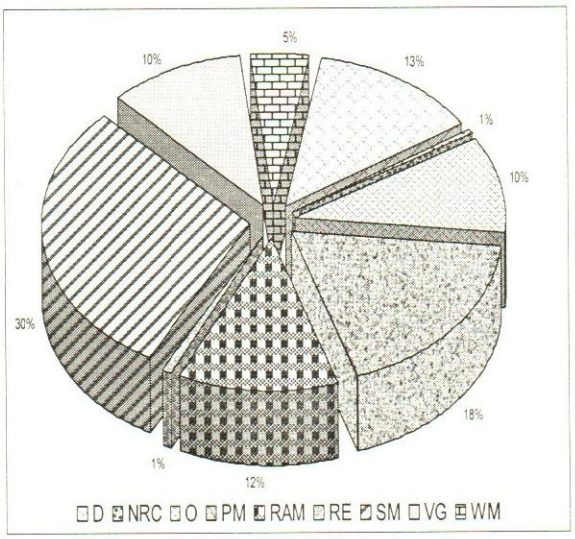


Fig 1: Graph showing the species abundance in percentage in different categories of status.

The largest occurrence of species richness and species diversity was calculated during the months of June and July and the lowest number occurred in March (Fig. 3). From March onward a substantial increase in the population of bird species is clearly indicating that the approach of summer or breeding season is the main factor inhabiting greater populations. This increase in numbering and species is continued till the month of July, then after, in the same pattern it may be observed from the graph (Fig. 3), it is decreasing gradually till December. In the winter, for a short span with some beautiful arrival of the new species looked interesting, as the migratory finches inhabitant of high altitudes which migrate from the Eastern Europe to wintering in the southern latitudes passes through the mountainous areas of Pakistan (Whistler 1930).

Studies on dynamics of species appear to have successional changes. The results (totals) for various species groups show that species turnover does occur, some species disappear and others added but the number of species often stays approximately constant. For instance, the total number of birds in a given month or season in different years were nearly same (Table 1). This actually is the maximum holding capacity of the area which showed the stability providing adequate shelter and space.

The highest species representation was that of the order Passeriformes with 90 species belonging to 26 families followed by the order Accipitriformes with 17 species belonging to only one family Accipitridae, while two species of Falconidae of order Falconiformes. Three species of Phasianidae represented by the order Galliformes and single species of family Gruidae of order Gruiformes. Some other records were those of three species represented by the family Columbidae of order Columbiformes, two species of family Psittacideae of order Psittacifroms and six species of family Cuculidae of order Cuculiformes. Five species diversified by the family Strigidae of order Strigiformes, and single species of Caprimulgidae of order Caprimulgiformes.

Some accounts were represented by the presence of five species of family Apodidae of order Apodiformes and three species of order Coraciformes belonging to the two families Coracidae and Upupidae. Study also recorded proceeding with the six species of the order Piciformes belonging to the two families of Capitonidae and Pisidae out of the 154 species of birds. About 52 species were found breeding in the Park area (Table 1).

The present survey recorded the presence of two green shrike babblers *Pteruthius xanthochloris* Gray of family Timalidae of the order Passeriformes which is rediscovered (Table 1). During the present expedition the species was sighted only in April-1998 at the altitude of 2300 m after a century back when a solitary bird was recorded by General Buchanan who took a clutch of 3 eggs near Changla Gali on 13 July 1900 at 2,400m altitude (Whistler, 1930).

The sighting of Collared Flycatcher *Ficedula albicolis* Temminck of family Muscicapidae of Passeriformes was surprising because it has not

been reported in Pakistan. Only single species was seen at the altitude of 2400 m in May 1999 perching on a tree of *Salix tetrasperma* at mid-day, thereafter, never sighted during the years of survey (Table 1).

Among the order Accipitriformes which comprises of 17 species belonging to a single family Accipitridae includes Crested Honey Buzzard, *Pernis ptilorhynchus* Indian Kite, *Milvus migrans govinda* Large Indian Kite, *M. m. lineatus* occasionally visited the area while Lammergeier or Bearded Vulture, *Gypaetus barbatus* Oriental White-backed Vulture, *Gyps bengalensis* Eurasian Griffon Vulture, *G. fulvus* Himalayan Griffon Vulture, *G. himalayensis* passed flying over through their aerial route during summer. Other raptors include in this order were reported occuring as Marsh Harrier, *Circus aeruginosus* Hen Harrier, *C. cyaneus* Northern Goshawk or Goshawk, *Accipiter gentilis* Eurasian Sparrow Hawk, *A. nisus* Shikra or Indian Sparrow Hawk, *A. badius* White-eyed Buzzard, *Butastur teesa* Black Eagle, *Ictinaetus malayensis* Steppe Eagle (photographed), *Aquilla rapax nipalensis* Booted Eagle, *Hieraaetus pennatus* and Hodgson's Hawk Eagle, *Spizaetus nipalensis.*

Crested Honey Buzzard, *Pernis ptilorhynchus* was occasionally seen at the site during winter and probably migrated from Northern Himalaya while White-eyed Buzzard was observed as vagrant species. Two species of kites; Indian kite, *Milvus migrans govinda* and Large Indian kite, *M. m. lineatus* (Photographed) occasionally visited the area. Lammergeir, *Gypaetus barbatus* always seen during winter migration, while three vulture species, Oriental white-backed vulture, *Gyps bengalensis;* Eurasian Griffon vulture, *G. fulvus* and Himalayan Griffon vulture, *G.himalayensis* seen only during their migration in summer, although these species were recorded breeding in this area some fifty years back (Roberts 1991) but now these birds never sighted even for a short stay, they passed in their fly route. Two species of Harrier, Marsh Harrier, *Circus aeruginosus* and Hen Harrier, *C. cyaneus* migrated to Indus Plains and Cholistan deserts of Pakistan during winter from Russian grounds observed rarely passing over site in winter. Among three species of Hawks includes Northern Goshawk, *Accipiter gentilis* Eurasian Sparrow Hawk, *A. nisus,* and Shikra, *A. badius* the Eurasian Sparrow Hawk, *A. nisus* now became the permanent resident of this area, few pairs always would stay round the year and bred during summer. Four species of Eagles include Black Eagle, *Ictinaetus malayensis* Steppe Eagle, *Aquilla rapax nipalensis* Booted Eagle, *Hieraaetus pennatus* and Hodgson's Hawk Eagle *Spizaetus nipalensis* were observed in the Park. Of which Steppe Eagle, *Aquilla rapax nipalensis* (Photographed) was a winter migrant and stayed whole of the winter in the Park. This species progressed entering in October and at the end of April it left the site to higher mountain range to the north and thus never seemed during summer in the Park.

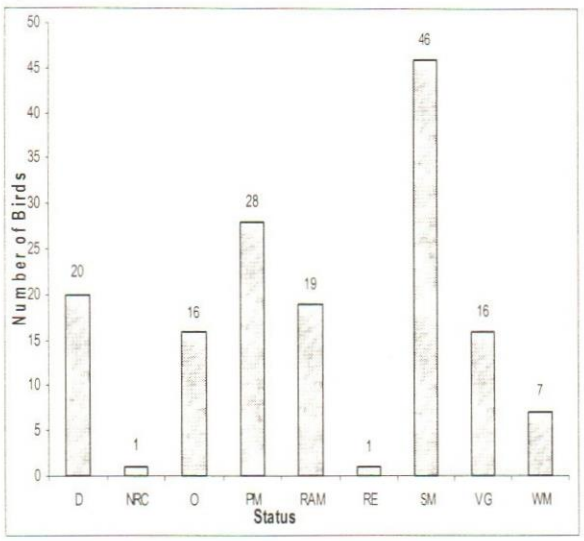


Fig 2: Graph representing the bird species frequency of occurrence in different categories of status.

Two species of Falcons include Eurasian kestrel, *Falco tinnunculus* and Northern Hobby *F. subbuteo* belonging to single family Falconidae of order Falconiformes were observed as locally migrant species from the higher northern mountains of Pakistan. Few birds of Eurasian kestrels, *Falco tinnunculus* were observed summering during the months of April to September.

Three species of pheasants of family phasianidae of order Galliformes include Chukar, *Alectoris chukar*, Koklass pheasant, *Pucrasia macrolopha biddulphi* (Photographed) and Kalij pheasant, *Lophura leucomelana hamiltonii* are the resident species of the Park areas. Chukar, *Alectoris chukar* is now becoming very rare although it was once abundantly occurring in the area but now it only seemed during summer. Koklas pheasant,

Pucrasia macrolopha biddulphi and Kalij pheasant, *Lophura leucomelana hamiltonii* which are now considered, threatened throughout Himalayas but the population of Koklas Pheasant, *Pucrasia macrolopha biddulphi* is the largest occurring as compared to any other areas of Pakistan. However, Kalij Pheasant has been declared endangered by IUCN and the present research encountered few pairs inhabiting in the lower altitudinal areas of the Park. Due to its preference to the drier places, never seemed during snow fall or in the moistest places of the forest probably it locally migrates to lower elevation.

A single flock of 39 Common Cranes, *Grus grus,* was observed in the month of October 1999 flying over the study site during their aerial pass towards the planes from the higher mountainous areas. While, another flock of 160 birds of European Bee-eaters *Merops apiaster* Linnaeus, was encountered crossing through Dunga Gali, Ayubia, the dense forest of the Park in the month of May 1998, utilizing the forest canopy and hunting thousands of insects in their way. Both the species used the oriental international migratory route over the Park.

Three species of Columbidae of order Columbiformes include Oriental Turtle Dove, *Streptopelia orientalis* which breeds in the Park (Photographed), nesting was observed in May 1998 on a bush *Sorbaria tomentosa*, Chinese Dove, *S. chinensis* and Wedge-tailed Green Pigeon, *Treron sphenura* were also occurred in the Park. Wedge-tailed Green Pigeon, *Treron sphenura* was once common in the Park but now it has become very rare and seemed occasionally in summer as a threatened species. The other two species were found throughout summering in the site where they breed but never observed during winter. Chinese Dove was also a rare bird species in the area.

Two species of parakeet, Blossom-headed parakeet, *Psittacula cyanocephala* and Slaty-headed Parakeet *P. himalayana* were observed in the Park. Former is an inhabitant of lower ranges while the latter species acquired higher altitudinal ranges and found to be occurring as a permanent resident of the Park which commonly bred (Photographed) in the summer and found to be absent from the scene for a short period. Broad leave trees species are the favourite one for resting and sheltering it in the site.

Himalayan Jungle Nightjar, *Caprimulgus indicus hazarae* of family Caprimulgidae of order Caprimulgiformes was the summer visitor of the Park. Sometimes we acrossed it during the summer nights survey resting on the ground. It did not occur commonly, it was a migrant species in this area, very restricted bird and in essence a bird of subtropical deciduous and evergreen forest.

Six species of Cuckoos include Pied Crested Cuckoo, *Clamator jacobinus* which occurred near the water channels, Indian Plaintive Cuckoo, *Cacomantis merulinus passerinus* comprise this zone but at lower altitudes, Indian or Short-winged Cuckoo, *Cuculus micropterus* occurred in the monsoon season, Common or Eurasian Cuckoo, *C. canorus* Oriental or Himalayan Cuckoo, *C. saturatus* and Little or Small Cuckoo, *C. poliocephalus* belonging to the family Cuculidae of order Cuculiformes were only seen after their long migration to reach this area in summer. They stayed for short periods just for resting during their journey. Of these Pied Crested Cuckoo, *Clamator jacobinus* and Indian Plaintive Cuckoo, *Cacomantis merulinus passerinus* were rare and occasional. The rest of the Cuckoo species particularly small Cuckoo's (Photograph) population was generally seemed to be very low. Many host species were recorded occurring in the area incubating the eggs of Cuckoo birds laid in their nests (Buchanan, 1903; Cock & Marshal, 1873).

Five species of Owls include Indian Scops Owl, *Otus bakkamoena* Mountain Scops Owl, *O. spilocephalus* Collard Pygmy Owl, *Glaucidium brodiei* Himalayan Barred Owlet, *G. cuculoides* and Himalayan Wood Owl, *Strix aluco himalayana* all belong to Strigidae of Strigiformes were recorded in the Park area.

A single bird of Himalayan Barred Owlet, *G. cuculoides,* was seen only once in June 1998. Himalayan Wood Owl, *Strix aluco himalayana* (photographed) were more commonly seen during night round the year and were found to be the permanent resident of the Park. Mountain Scops Owl, *O. spilocephalus* and Collard Pygmy Owl, *Glaucidium brodiei* (photographed) were not seen during peak snowy season. While Indian Scops Owl, *Otus bakkamoena* seemed summering in the Park.

Five species of swifts including White-throated Needle tail, *Hirundapus caudacutus* Swift or Eastern Swift, *Apus apus pekinensis* Pacific

Swift, *A. pacificus* Alpine Swift, *A. melba* and Indian House Swift, *A. affinis* (family Apodidae and order Apodiformes) were observed only summering in colonies or mixed species flocks. All swifts were seen affecting Park area in the months of April to July except Alpine Swift, *A. melba* which were late comer and visited the Park during August and September.

Two species of rollers including European Roller or Kashmir Roller, *Coracius garrulus* and Indian Roller or Blue Jay, *C. bengalensis* (family Coraciidae, order Coraciformes) was found to be now very rare but it was the first author's experience that it was very common in the Park some twenty years back. Another bird Hoopoe, *Upupa epops* (photographed, family Upupidae of order Coraciformes) were observed commonly visiting during summer, most of its preference was the area of Dunga Gali but avoiding thick forest.

Great Himalayan Barbet, *Megalaima virens* (photographed) belongs to family Capitonidae of order Piciformes is a common bird and permanent resident of the mixed coniferous and broad leave forest of the Park. These all are inhabitants as cavity nesting and bred successfully in the Park. Their populations seemed to prefer the dense forested areas. Five species of Woodpeckers belonging to the family Picidae of the same order include Black-naped Green Woodpecker, *Picus canus* Scaly-bellied Woodpecker, *P. squamatus* (photographed) Himalayan Pied Woodpecker, *Dendrocopos himalayensis* (photographed) Rufous-bellied Woodpecker or Rufous-bellied Sapsucker, *D. hyperythrus* and Brown-fronted Woodpecker, *D. auriceps* were observed in the Park. Black-naped Green Woodpecker, *Picus canus* (photographed) Rufous bellied Woodpecker, *D. hyperythrus* and Brown fronted Woodpecker, *D. auriceps,* were seen during summer but in winter they migrated to lower altitudes. However, others two were the hardy species; Scaly-bellied Green Woodpecker, *P. squamatus* and Himalayan Pied Woodpecker, *Dendrocopos himalayensis* (photographed). They were common and breeder, also permanent inhabitant of the Park. All the species belonging to this order play an animated and vigorous role likely as a carpenter, constructing shelters not only for themselves but also providing facilitation of cavities and holes to breed and inhabit a large variety of wild life species befitting not only the Park species but the world ecosystems in general.

Twenty seven families of order Passeriformes were recorded in the Park. Family Hirundinidae include two species of Martins; Northern Crag Martin, *Ptyonoprogne rupestris* (photographed) and Asian House Martin, *Delichon dasypus cashmeriensis* (photographed) flushed in the Park, of which latter species was very abundant and found commonly breeding in colonies using the residential barracks and huts present in the Park (photographed) but they migrated to the lower valleys during the winter. Red-rumped Swallow (photographed) was also a summer visitor and visited for breeding.

Three species of family Motacillidae were found occurring in the study site, of which single species of Tree Pipit or called Brown Pipit *Anthus trivialis,* was found using the double migratory passage through the Park. Two species of Wagtails; Grey Wagtail *Motacilla cinerea* and Siberian White Wagtail *M. alba dukhunensis* (photographed) were observed, of which the latter was found to be as vagrant due to a single sighting of three birds in May 1997.

A single species of each family representing of Long-tailed Minivet, *Pericrocotus ethologus* (photographed) Asiatic or Brown Dipper, *Cinclus pallasii* and Northern Wren, *Troglodytes troglodytes* were observed belonging to the families of Campephagidae, Cinclidae and Troglodytidae, respectively. The Long-tailed Minivet, *Pericrocotus ethologus* was found to be permanent summer inhabitant and breeder of the Park between 2000 to 2600 m altitude in the well-wooded mixed conifer and broad-leaved forest and seemed leaving the area in the winter to the lower valleys as altitudinal migrant. Few pairs of Brown or Asiatic Dipper *Cinclus pallasii* were regularly sighted reaching in summer and inhibited the fresh water nullahs of the Park, while Northern wren is a permanent resident and breeder bird which was encountered on the higher altitudes round the year. Local migration was noted when more birds reached and entered wintering to the Park from the higher northern mountains due to the heavy snowfall there. The species don't undergo long distance migration from their breeding grounds because of being a weak flyer and can't expose itself in large flocks vulnerable to a number of predators (pers. obs).

Three species of Bulbuls; White-checked Bulbul, *Pycnonotus leucogenys leucogenys* (photographed) Red-vented Bulbul, *P. cafer* and Black Bulbul, *Hypsipetes madagascariensis* belonging to the family Pycnonotidae were recorded. Of these the latter was a common permanent resident breeder and never observed above 2300 m altitude in the summits of the Park while White-checked Bulbul, *Pycnonotus leucogenys leucogenys* showed its affection in winter and the latter *P. cafer* in summer but rarely.

Four species of accenters; Black-throated Accenter, *Prunella atrogularis* Altai or Himalayan Accenter, *P. himalayana* Alpine Accenter, *P. collaris* and Rufous-breasted Accenter, *P. strophiata* include in the family Prunellidae were reported visiting in the more open wooded area during their altitudinal migration to the southern plains. Black-throated, *Prunella atrogularis* and Altai or Himalayan Accenter, *P. himalayana* were seen using double migratory passage while the Alpine Accenter, *P. collaris* was noted as a straggler and Rufous-breasted Accenter, *P. strophiata* was a locally altitudinal migrant to the Park. All the Accenters were found temporarily using the summits of the Park on their way to the breeding grounds of lower altitudinal ranges.

Family Turdidae was noted contributing a large number of species (21 species) in the Park. Four species of Redstarts occurred which include the Blue-capped Redstart, *Phoenicurus caeruleocephalus* (photographed) Kashmir Redstart, *P. ochruros phoenicuroides* Plumbeous Redstart, *Rhyacornis fuliginosus* (photographed) and White-capped Redstart or Water Redstart, *Chaimarrornis leucocephalus.* Six species of Chats/Robins showed their presence which represented by the inclusion of Indian Blue Robin, *Luscinia brunnea* Orange-flanked Bush Robin or Red-flanked Blue-tail, *Tarsiger cyanurus* (photographed) Golden Bush Robin, *T. chrysaeus* Common Stonechat or Indian Bush-chat, *Saxicola torquata* Pied Bush Chat, *S. caprata* (photographed) Grey Bush Chat or Dark-grey Bush Chat, *S. ferrea* (photographed). Other nine Turdids include recognizing as Thrushes; Blue-capped or Blue-headed Rock Thrush, *Monticola cinclorhyncha* Chestnut-bellied Rock Thrush, *M. rufiventris* Blue Rock Thrush, *M. solitarius* Blue Whistling Thrush or Himalayan Whistling Thrush, *Myiophoneus caeruleus* (photographed) Tickell's Thrush, *Turdus unicolor* Chestnut Thrush or Grey-headed Thrush, *T. rubrocanus* (photographed) Dark-throated Thrush or Black-throated Thrush, *T. ruficollis atrogularis* (photographed) Himalayan Mistle Thrush, *T. viscivorus bonapartei* which were reported ooccurring commonly (Table 1) with the exception of Golden Bush Robin which includes a single soaring sighting in May 1997. Two species of forktails known as Little Forktail, *Enicurus scouleri* and Spotted Forktail, *E. maculatus* (photographed), of the sub family Enicurinae were observed always during the summer along the water channels in the Park, possibly bred during their migratory passage. Of the twenty one species of family Turdidae, eight were noted to be using the Park as breeding haunts (Table - 1).

Eleven species of tiny birds called warblers of family Sylvidae were reported in the study area that include Pale Strong-footed Bush Warbler, *Cettia fortipes pallides* and Grey-sided or Rufous-capped Bush Warbler, *C. brunnifrons* Straited Prinia or Brown Hill Warbler, *Prinia criniger* Lesser White-throat, *Sylvia curraca* Grey-headed Warbler or Grey-headed Flycatcher Warbler, *Seicerus xanthoschistos* Western or Large Crowned Leaf Warbler, *Phylloscopus occipitalis* (photographed) Greenish Warbler or Dull Green Leaf Warbler, *P. trochiloides viridanus* (photographed) Pallas's or Yellow-rumped Leaf Warbler, *P. proregulus simlaensis* Hume's Leaf Warbler or Hume's Willow Warbler, *P. inornatus humei* Eurasian Chiffchaf or Brown Leaf Warbler, *P. collybita tristis* and Goldcrest, *Regulus regulus.* Of which four were found breeders. With the exception of grey-sided bush warbler and Brown hill warbler which were observed scarcely kept as occasional in the category of status, others which were found frequently in their particular visiting seasons (Table 1) were considered as common including the four breeders.

Seven species of Flycatchers which include in the family Muscicapidae made registered their presence mostly in summer in the study site. These were as Rufous-bellied or Beautiful Niltava, *Niltava sundara* Verditer Flycatcher, *Muscicapa thalassina* (photographed) Dark-sided or Sooty Flycatcher, *M. sibirica* Slaty-blue Flycatcher, *Ficedula tricolor* Ultramarine Flycatcher or White-browed Blue

Flycatcher, *F. superciliaris* Collard Flycatcher, *Ficedula albicollis* and Grey-headed Canary Flycatcher, *Culicicapa ceylonensis. A* single species of family Rhipiduridae, known as White-throated Fantail Flycatcher *Rhipidura albicolis* was also observed. Almost all of the Muscicapids made their regular appearance in consecutive seasons of the year. Conversely white-throated fantail flycatcher found to be a straggler presenting a single sighting of three birds in November 1998, *while Collard Flycatcher* (*Ficedula albicollis*) *is a new record for the country.*

Family Timalidae represented six species covering White-throated Laughing Thrush, *Gerrulax albogularis* Variegated Laughing Thrush, *G. variegatus similis* (photographed) Streaked or Himalyan Laughing Thrush, *G. Lineatus* (photographed) White-browed or Red-winged Greater Shrike Babbler, *Pteruthius flaviscapis* Green Shrike Babbler, *P. xanthochloris* and Black-capped or Black-headed Sibia, *Heterophasia capistrata*. White-throated Laughing Thrush was found to be as vagrant because of a single observation of two birds in June 1999 while Variegated Laughing Thrush, *G. variegatus similis* (Photographed) and Streaked or Himalyan Laughing Thrush, *G. Lineatus* (Photographed) were found to be the commonest permanent residents and breeders of the Park. *Green shrike babbler, a Sino-Himalayan species was rediscovered by a single sighting of two birds at 2300 m altitude in April 1998*, once it was a breeder of this area when Buchanan took a clutch of three eggs from the present study site (Changla-Gali) about a century ago (Whistler, 1930). Black-capped Sibia was also found to be a resident but altitudinal migrant to lower adjacent valleys during the winter days.

Eight species of beautiful small birds recognized as tits belonging to family Aegithalidae were occurring, of these two species as White-throated longtailed Tit, *Aegithalos niveogularis* and Red-headed Long-tailed Tit, *A. concinnus* (photographed) were very hardy species to be present during below zero degree temperatures, only during the months of January and February, while others (Paridae), Simla or Black Crested Tit, *Parus rufonuchalis* Spot-winged Black Tit or Crested Black Tit, *P. melanolophus* Great Tit or Grey Tit, *P. major* Green-backed Tit, *P. monticolus* (photographed) were the common members of the Park. The latter is a hardy species and permanent resident of the Park which was observed joining the incoming migratory species of tits in parties during winters. The Yellow-cheeked Tit was the only tit bird found to be a vagrant because of its single sighting in June 1998.

Of all the Tits, Grey Tit is a large-sized of its allied members encountered only during March to June on its way to the north to higher mountains, though its population was not so high but seemed breeding at the site. Green-backed Tit was the second commonest bird in this group and also found to be a permanent resident breeder as well as spot-winged black Tit. Fire-Capped Tit, *Cephalopyrus flammiceps* of the family Remizidae was found a summer visitor for a limited period only in May and June.

Two species of Nuthatches; White-Cheeked Nuthatch, *Sitta leucopsis* and Brooks or Kashmir Nuthatch, *S. europaea cashmirensis* of the family Sittidae were recorded of which the White-checked Nuthatch represented as a permanent resident and breeder of the site while Brooks or Kashmir Nuthatch was found a summer visitor but small flocks were observed during the winter migrating from the northern mountains while passing through the Park.

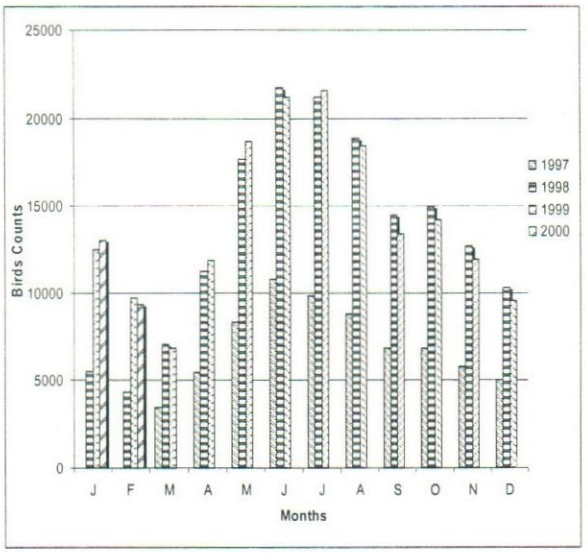


Fig: 3 Monthly variations in the number of birds of Ayubia national Park from March 1997 to February 2000.

A single species of creeper of the family Certhidae viz Himalayan Tree Creeper, *Certhia himalayana* (photographed) was encountered in

all the seasons and found to be as a commonest resident of the Park which breeds successfully and an increase in population noticed particularly during winter when more birds entered into the Park to pass down wintering in the lower valleys. The species has a variable adaptation because it has also recorded by the first author of this study, fairly occurring in the juniper forests of Balochistan.

Four families were represented by a single species each. These were Purple Sunbird, *Nactarinia asiatica* (Nectarinidae) Oriental White-eye *Zosterops palpebrosa* (Zosteropidae) Golden Oriole (photographed) *Oriolus oriolus* (Oriolidae) and Long-tailed Shrike or Rufous-backed Shrike *Lanius schach* (Lanidae). A single sunbird was sighted in June 1998 and considered to be a straggler or occasional. Oriental white Eye was observed at two occasions in July 1998 and in May 1999.

Table: 1. Seasonal variation in number of birds, relative abundance and related ecological information of Ayubia National Park from March 1997 to February 2000. (PM - Passage Migrant SM - Summer Migrant WM - Winter Migrant O - Occasional Sighting VG - Vagrant or Straggler RE - Rediscovered NRC - New Record for Country RAM - Resident-Altitudinal Migrant D - Permanent Resident AR - Aerial Route C - Confirmed)

Name of Species		Spring			Summer			Autumn			Winter							
Common / Scientific	Year	March	April	May	June	July	August	September	October	November	December	January	February	Total	Relative Abundance	Breeding Evidence	Altitude(m)	Status
Crested Honey Buzzard *Pernis ptilorhynchus*	1997-98												1	1	0.0012		2650	O
	1998-99	1												1	0.0006			
	1999-00																	
Indian Kite *Milvus migrans govinda*	1997-98			2										2	0.0025		1800	O
	1998-99		1											1	0.0006			
	1999-00																	
Large Indian Kite *M.m. lineatus*	1997-98																2500	O
	1998-99									1	2			3	0.0017			
	1999-00										1			1	0.0006			
Lammergeir *Gypaetus barbatus*	1997-98									1	2			3	0.0037		AR	WM
	1998-99											1		1	0.0006			
	1999-00										1			1	0.0006			
Oriental White-backed Vulture *Gyps bengalensis*	1997-98					1								1	0.0012		AR	SM
	1998-99				1	1								2	0.0012			
	1999-00					1								1	0.0006			
Eurasian Griffon Vulture *G. fulvus fulvescens*	1997-98				2	1								3	0.0037		AR	SM
	1998-99				1									1	0.0006			
	1999-00			1		2								3	0.0018			
Himalayan Griffon Vulture *G. himalayensis*	1997-98			3	6	1								10	0.0123		AR	SM
	1998-99		1	12	6	3								22	0.0128			
	1999-00		2	5	4	2								13	0.0077			
Marsh Harrier *Circus aeruginosus*	1997-98											1		1	0.0012		1700	PM
	1998-99		1											1	0.0006			
	1999-00		1								1			2	0.0012			

Hen Harrier *C. cyaneus*	1997-98					1									1	0.0012			
	1998-99		1									1	1		3	0.0017		2000	PM
	1999-00		1									2			3	0.0018			
Northern Goshawk *Accipiter gentilis*	1997-98																		
	1998-99			1											1	0.0006		2600	O
	1999-00									1					1	0.0006			
Eurasian Sparrow Hawk *A. nisus melachistos*	1997-98	3	2	3	6	8	3	6	3	5	3	4	3	49	0.0605				
	1998-99	3	6	5	5	8	4	2	4	3	4	6	3	53	0.0308	C	2400-2700	D	
	1999-00	5	6	5	7	6	4	3	5	2	3	4	3	53	0.0312				
Shikra *A. badius cenchroides*	1997-98		1											1	0.0012				
	1998-99																	2550	O
	1999-00			1										1	0.0006				
White-eyed Buzzard *Butastur teesa*	1997-98																		
	1998-99																	1900	VG
	1999-00				1									1	0.0006				
Black Eagle *Ictinaetus malayensis*	1997-98										1			1	0.0012				
	1998-99																	2400-2600	O
	1999-00								1	1				2	0.0012				
Steppe Eagle *Aquila rapax nepalensis*	1997-98	8	18							11	13	9	2	61	0.0753				
	1998-99	7	33							16	15	11	26	108	0.0627		2300-2600	WM	
	1999-00	6	22							12	9	10	17	76	0.0447				
Booted Eagle *Hieraaetus pennatus*	1997-98					1								1	0.0012				
	1998-99					2								2	0.0012			2500	SM
	1999-00				1									1	0.0006				
Hodgson's Hawk Eagle *Spizaetus nepalensis*	1997-98																		
	1998-99																	2450	VG
	1999-00				1									1	0.0006				
Eurasian Kestrel *Falco tinnunculus*	1997-98		1	4		2								7	0.0086				
	1998-99		2	3	6									11	0.0064		2500-2700	SM	
	1999-00		1	2	2			1						6	0.0035				
Nothern Hobby *F.subbuteo*	1997-98			8										8	0.0099				
	1998-99				2									2	0.0012			2550	PM
	1999-00				1									1	0.0006				
Chukar *Alectoris chukar*	1997-98				3									3	0.0037				
	1998-99				2									2	0.0012		1700-2000	SM	
	1999-00			4	7									11	0.0065				
Koklass Pheasant *Pucrasia macrolopha biddulphi*	1997-98	45	71	132	170	190	171	182	142	117	63	43	34	1360	1.6792				
	1998-99	108	195	271	298	306	317	333	263	182	159	107	88	2627	1.5242	C	1600-2750	D	
	1999-00	144	185	207	241	277	290	266	243	222	152	133	82	2442	1.4374				

Kalij Pheasant *Lophura leucomelana hamiltonii*	1997-98			2	4	6	3	5		6	3			29	0.0358	C	1600-2200	RAM
	1998-99			7	11	13	18	16	2	8	2			77	0.0447			
	1999-00		1	4	7	10	7	6		3	7			45	0.0265			
Common Crane *Grus grus*	1997-98																AR	PM
	1998-99																	
	1999-00								39					39	0.0230			
Oriental Turtle Dove *Streptopelia orientalis*	1997-98			9	19	9	3							40	0.0494	C	2200-2600	PM
	1998-99		7	35	40	25	8							115	0.0667			
	1999-00		3	22	43	20	7	1						96	0.0565			
Chinese Dove *S. chinensis*	1997-98				2									2	0.0025	C	2300-2550	PM
	1998-99			3	4									7	0.0041			
	1999-00			1	2	1								4	0.0024			
Wedge-tailed Green Pigeon *Trenon sphenura*	1997-98																2300	O
	1998-99				2									2	0.0012			
	1999-00							1						1	0.0006			
Blossom-headed Parakeet *Psittacula cyanocephala*	1997-98					13								13	0.0161		1600-1800	SM
	1998-99				5									5	0.0029			
	1999-00				4	18								22	0.0129			
Slatty-headed Parakeet *P. himalayana*	1997-98	55	103	156	212	271	103	35	114	93	77	84	40	1343	1.6582	C	2000-2700	D
	1998-99	237	273	356	305	316	226	57	43	135	219	124	105	2396	1.3902			
	1999-00	294	350	475	355	457	432	73	125	237	350	175	140	3463	2.0384			
Pied Crested Cuckoo *Clamator jacobinus*	1997-98					1								1	0.0012		2100	PM
	1998-99				3									3	0.0017			
	1999-00				8									8	0.0047			
Indian Plaintive Cuckoo *Cacomantis merulinus passerinus*	1997-98																1700	O
	1998-99					1								1	0.0006			
	1999-00			1										1	0.0006			
Indian Cuckoo *Cuculus micropterus*	1997-98					1								1	0.0012		2450	SM
	1998-99				2									2	0.0012			
	1999-00				1									1	0.0006			
Eurasian Cuckoo *C. canorus*	1997-98			1	8	14	5							28	0.0346		2200-2600	PM
	1998-99			7	24	21								52	0.0302			
	1999-00			3	19	39	13							74	0.0436			
Himalayan Cuckoo *C. saturatus*	1997-98				6	11								17	0.0210		1600-1900	SM
	1998-99			3	16	25								44	0.0255			
	1999-00				7	21								28	0.0165			
Small Cuckoo *C. poliocephalus*	1997-98				3	5	1							9	0.0111		1600-1900	PM
	1998-99			1	8	3								12	0.0070			
	1999-00			4	10	7								21	0.0124			

Indian Scops Owl *Ottus bakkamoena*	1997-98				14	10	6							30	0.0370	C	2100-2450	SM
	1998-99			4	36	66	30							136	0.0789			
	1999-00			22	84	74	24							204	0.1201			
Mountain Scops Owl *O. spilocephalus*	1997-98			11	18	23	5	9	9	11	2			88	0.1087	C	1800-2800	RAM
	1998-99		12	4	21	34	28	21	16	18	6			160	0.0928			
	1999-00		6	16	34	25	31	12	2	23	6			155	0.0912			
Collared Pygmy Owl *Glaucidium brodiei*	1997-98		2	13	16	26	23	17	11	8	2			118	0.1457	C	1800-2800	RAM
	1998-99	7	18	37	49	39	42	33	25	21	9			280	0.1625			
	1999-00	4	25	31	51	73	55	24	19	12	2			296	0.1742			
Himalayan Barred Owlet *G. cuculoides*	1997-98																	
	1998-99				1									1	0.0006		1900	VG
	1999-00																	
Himalayan Wood Owl *Strix aluco himalayana*	1997-98	15	18	17	5	3	6	7	6	9	8	8	18	120	0.1482		2300-2700	D
	1998-99	55	25	39	16	10	16	12	12	19	28	49	55	336	0.1949			
	1999-00	49	40	45	7	12	9	15	19	18	39	55	61	369	0.2172			
Himalayan Jungle Nightjar *Caprimulgus indicus hazarae*	1997-98				2									2	0.0025		1900-2300	SM
	1998-99			2	1	1								4	0.0023			
	1999-00			2	1									3	0.0018			
White-throated Needletail *Hyrundapus caudacutus*	1997-98				2	1								3	0.0037		2300-2700	PM
	1998-99			2	7	4								13	0.0075			
	1999-00			2	3	1								6	0.0035			
Eastern Swift *Apus apus pekinensis*	1997-98		5	3	4									12	0.0148		2300-2700	SM
	1998-99			7										7	0.0041			
	1999-00		2											2	0.0012			
Pacific Swift *A. pacificus*	1997-98			9	39									48	0.0593		2500-2800	SM
	1998-99				12									12	0.0070			
	1999-00			3	13									16	0.0094			
Alpine Swift *A. melba*	1997-98						44	35						79	0.0975		2600-2800	SM
	1998-99						56							56	0.0325			
	1999-00							136						136	0.0801			
Indian House Swift *A. affinis*	1997-98			2	6	1								9	0.0111	C	2200-2500	SM
	1998-99			13	28	13								54	0.0313			
	1999-00		12	18	25									55	0.0324			
European Bee-eater *Merops apiaster*	1997-98																2475	PM
	1998-99			160										160	0.0928			
	1999-00																	
Kashmir Roller *Coracius garrulus*	1997-98					2								2	0.0025		1800	VG
	1998-99																	
	1999-00																	
Indian Roller *C. bengalensis*	1997-98																1800	VG
	1998-99																	
	1999-00			1										1	0.0006			

Hoopoe *Upupa epops*	1997-98				11	4	1							16	0.0198		2300-2500	PM
	1998-99			7	39	27	4							77	0.0447			
	1999-00			3	19	11								33	0.0194			
Great Himalayan Barbet *Megalaima virens*	1997-98	55	72	81	108	130	140	145	135	115	112	40	23	1156	1.4273	C	2000-2600	D
	1998-99	82	105	208	249	305	344	264	342	334	295	184	37	2749	1.5950			
	1999-00	92	128	269	285	323	350	272	252	219	188	120	62	2560	1.5069			
Black-naped Green Woodpecker *Picus canus*	1997-98			6	11	7	3							27	0.0333	C	1650-2000	RAM
	1998-99			16	43	22	2							83	0.0482			
	1999-00			13	17	12	1							43	0.0253			
Scally-bellied Green Woodpecker *P. Squamatus*	1997-98	51	62	77	96	120	135	121	105	84	71	59	44	1025	1.2656	C	1800-2550	D
	1998-99	123	195	210	250	263	278	271	212	196	141	112	127	2378	1.3797			
	1999-00	107	183	220	272	312	287	260	230	210	121	88	102	2392	1.4080			
Himalayan Pied Woodpecker *Dendrocopus himalayensis*	1997-98	150	208	185	217	233	241	220	181	200	180	154	136	2305	2.8460	C	1900-2700	D
	1998-99	305	372	411	360	507	500	450	431	446	388	331	322	4823	2.7983			
	1999-00	87	396	437	462	496	522	473	432	383	347	316	382	4733	2.7859			
Rufous-bellied Pied Woodpecker *D. hyperythrus*	1997-98				9	7	2	5						23	0.0284		1700-2000	RAM
	1998-99			2	15	26	13	9						65	0.0377			
	1999-00			4	11	8	16	6	3					48	0.0283			
Brown-fronted Woodpecker *D. auriceps*	1997-98			1	23	8	15							47	0.0580		2250-2400	RAM
	1998-99			10	36	21	8							77	0.0447			
	1999-00			18	53	34	3							108	0.0636			
Northern Crag Martin *Ptyonoprogne rupestris*	1997-98																2200-2300	O
	1998-99				1									1	0.0006			
	1999-00			2										2	0.0012			
Red-rumped swallow *Hirundo daurica nipalensis*	1997-98				2	5								7	0.0086	C	2300-2500	SM
	1998-99				11	18	2							31	0.0180			
	1999-00				8	13								21	0.0124			
Asian House Martin *Delichon dasypus cashmeriensis*	1997-98	133	223	308	343	354	373	313	214	33				2294	2.8324	C	2200-2700	SM
	1998-99	317	411	446	649	744	754	699	628	243				4891	2.8378			
	1999-00	204	319	522	543	727	772	742	621	234				4684	2.7571			
Tree Pipit or Brown Pipit *Anthus trivialis*	1997-98		6					4						10	0.0123		2400-2600	PM
	1998-99		4						1					5	0.0029			
	1999-00		3					7	2					12	0.0071			
Grey Wagtail *Motacilla cinerea*	1997-98				6			2	1					9	0.0111		2400-2700	PM
	1998-99				6									6	0.0035			
	1999-00				27			10	4					41	0.0241			
Siberain White Wagtail *M. alba dukhunensis*	1997-98			3										3	0.0037		2650	VG
	1998-99																	
	1999-00																	

Long-tailed Minivet *Pericrocotus ethologus*	1997-98			23	33	41	53	27	24	3				204	0.2519	C	2000-2600	SM
	1998-99		3	28	43	73	94	71	58	4				374	0.2170			
	1999-00		9	23	59	84	108	62	70	14				429	0.2525			
White-Cheeked Bulbul *Pycnonotus leucogenys*	1997-98	1												1	0.0012		2100	WM
	1998-99	5												5	0.0029			
	1999-00	13												13	0.0077			
Red-vented Bulbul *P. cafer*	1997-98				1									1	0.0012		2000	O
	1998-99																	
	1999-00				2									2	0.0012			
Black Bulbul *Hypsipetes madagascariensis*	1997-98	175	213	258	308	329	372	364	290	251	241	191	161	3153	3.8930	C	1800-2300	D
	1998-99	346	476	466	535	543	646	532	418	340	385	286	121	5094	2.9556			
	1999-00	190	318	537	617	725	800	762	630	492	452	375	297	6195	3.6465			
Brown Dipper *Cinclus pallasii*	1997-98				1	3	1	1	3					9	0.0111	C	1800-2100	SM
	1998-99			1	1	4	9	4	2					21	0.0122			
	1999-00			1	4	16	12	7	1	1				42	0.0247			
Northern Wren *Troglodytes troglodytes*	1997-98	34	31	27	35	27	43	28	32	30	48	77	61	473	0.5840	C	2300-2800	D
	1998-99	79	55	100	93	76	87	45	54	88	97	132	126	1032	0.5988			
	1999-00	76	64	75	84	69	82	52	57	81	93	130	114	977	0.5751			
Black-throated Accenter *Prunella atrogularis*	1997-98		9								31	19		59	0.0728		2600-2800	PM
	1998-99		35								47	70		152	0.0882			
	1999-00		26							76				102	0.0600			
Himalayan Accenter *P. himalayana*	1997-98		3							2				5	0.0062		2500-2700	PM
	1998-99		13								7			20	0.0116			
	1999-00		17											17	0.0100			
Alpine Accenter *P. collaris*	1997-98											3		3	0.0037		2750	VG
	1998-99																	
	1999-00																	
Rufous-breasted Accenter *P. strophiata*	1997-98			14										14	0.0173		2500-2800	SM
	1998-99			45										45	0.0261			
	1999-00			16										16	0.0094			
Indian Blue Chat *Luscinia brunnea*	1997-98				58	65	73	70	52					318	0.3926	C	2300-2600	SM
	1998-99			57	121	146	178	150	103	8				763	0.4427			
	1999-00			13	146	142	145	124	110					680	0.4003			
Orange-flanked Bush Chat *Tarsiger cyanurus*	1997-98			22	25				48	40	19			154	0.1901		2300-2600	PM
	1998-99			58	31				66	48	27			230	0.1334			
	1999-00		3	65	14				72	60	32			246	0.1448			
Golden bush Robin *T. chrysaeus*	1997-98			1										1	0.0012		1800	VG
	1998-99																	
	1999-00																	
Blue-headed Redstart *Phoenicurus caeruleocephalus*	1997-98		103	114					158	171	206	235		987	1.2187		2000-2700	PM
	1998-99		223	264					310	408	405	511		2121	1.2306			
	1999-00		208	220					309	318	360	440		1855	1.0919			

Indian Redstart *P. Ochruros phoenicuroides*	1997-98			68					54	71				193	0.2383				
	1998-99		34	25					116	46				221	0.1282		2300-2700	PM	
	1999-00		17	43					36	82				178	0.1048				
Plumbeous Redstart *Rhyacornis fulinginosus*	1997-98			9	16				7	13	1			46	0.0568				
	1998-99		6	10	18				21	29				84	0.0487	C	1600-2400	SM	
	1999-00		5	17	24				44	15	4			109	0.0642				
Common Stone-Chat *Saxicola torquata*	1997-98		17	26	45	20	5							113	0.1395				
	1998-99		12	48	76	12	16	3						167	0.0969		2250-2700	SM	
	1999-00		62	52	44	16	1							175	0.1030				
Pied Bush Chat *Saxicola caprata*	1997-98			13	113	119	13							258	0.3186				
	1998-99				14	115	18		6					153	0.0888		2200-2500	SM	
	1999-00			16	114	122	13							265	0.1560				
Dark Grey Bush-Chat *S. ferrea*	1997-98		45	94	83	54								276	0.3408				
	1998-99			46	94	145	93							378	0.2193	C	2100-2600	SM	
	1999-00		79	57	163	204	142	69						714	0.4203				
White-capped Redstart *Chaimarrornis leucocephalus*	1997-98	8	11	17	19	22	15	12	18	20	8	5	3	158	0.1951				
	1998-99	18	35	26	31	40	24	25	33	28	22	25	20	329	0.1909	C	1700-2700	D	
	1999-00	13	18	32	41	48	29	36	46	39	14	11	6	333	0.1960				
Blue-headed Rock Thrush *Monticola cinclorhyncha*	1997-98			18	35	34	4							91	0.1124				
	1998-99		4	75	70	57	14							220	0.1276		2100-2600	SM	
	1999-00		11	58	78	61	24							232	0.1366				
Chestnut-bellied Rock Thrush *Monticola rufiventris*	1997-98			32	72	88	27	39	78	46				382	0.4717				
	1998-99			233	213	280	40	31	255	282	16			1350	0.7833	C	2200-2800	RAM	
	1999-00		45	175	198	261	70	54	228	169				1200	0.7063				
Blue Rock Thrush *Monticola solitarius*	1997-98				9	5								14	0.0173				
	1998-99				18	2								20	0.0116		1600-1800	SM	
	1999-00				3	10	2							15	0.0088				
Blue Whistling Thrush *Myophoneus caeruleus*	1997-98	9	35	54	64	81	70	58	98	72	69	27	20	657	0.8112				
	1998-99	70	83	115	158	180	127	120	173	160	103	38	29	1356	0.7868	C	2200-2600	D	
	1999-00	56	68	88	150	156	112	108	182	162	122	48	23	1275	0.7505				
Tickell's Thrush *Turdus unicolor*	1997-98		2	8	17	7								34	0.0420				
	1998-99		8	16	45	26	3							98	0.0569		1900-2500	SM	
	1999-00		8	26	40	18	7							99	0.0583				
Grey-winged Black-bird *T. boulboul*	1997-98				12	8			17					37	0.0457				
	1998-99			21	24	12	3							60	0.0348	C	1800-2200	SM	
	1999-00			9	25	4			46					84	0.0494				
Grey-headed Thrush *T. rubrocanus*	1997-98			19	94	121	88	63	57	33				475	0.5865				
	1998-99		30	147	324	357	303	225	178	138				1702	0.9875	C	2300-2600	RAM	
	1999-00		64	174	155	312	277	177	129	60				1348	0.7935				

Black-Throated Thrush *T. ruficollis atrogularis*	1997-98			272					506	482	312	1305	735	3612	4.4598				
	1998-99			385					700	1190	700	3272	1662	7909	4.5889		2000-2800	PM	
	1999-00			677					550	800	470	2350	1250	6097	3.5888				
Himalayan Mistle Thrush *T. viscivorous bonapartei*	1997-98	33	24						35	9				101	0.1247				
	1998-99	43	27						18	11				99	0.0574		2450-2700	PM	
	1999-00	38	17						57					112	0.0659				
Little Forktail *Enicurus scouleri*	1997-98									2	3	4	3	12	0.0148				
	1998-99										6	10	3	19	0.0110		1600-2200	PM	
	1999-00									3	13	6	7	29	0.0171				
Spotted Forktail *E. maculatus*	1997-98	5	7						6	3	2			23	0.0284				
	1998-99	13	15						7	13	6			54	0.0313		1600-2400	PM	
	1999-00	17	20						18	13	5			73	0.0430				
Strong-footed Bush Warbler *Cettia fortipes pallides*	1997-98		6	59	156	171	175	150	113	72				902	1.1137				
	1998-99		23	136	378	365	395	236	210	156				1899	1.1018	C	2200-2800	RAM	
	1999-00		32	112	348	342	376	234	152	116				1712	1.0077				
Grey-sided Bush Warbler *C. brunifrons*	1997-98	2												2	0.0025				
	1998-99																2350	O	
	1999-00											4		4	0.0024				
Brown Hill Warbler *Prinia criniger hodgsoni*	1997-98		1											1	0.0012				
	1998-99																2300	O	
	1999-00				2									2	0.0012				
Lesser White-throat *Sylvia curraca*	1997-98			9										9	0.0111				
	1998-99			11										11	0.0064		2000-2100	PM	
	1999-00			65	11									76	0.0447				
Grey-headed Fly-catcher Warbler *Seicercus xanthoschistos*	1997-98			167	91	79	24							361	0.4457				
	1998-99			176	136	282	56							650	0.3771		1900-2100	SM	
	1999-00			313	187	78	14							592	0.3485				
Western-Crowned Leaf Warbler *Phylloscopus occipitalis*	1997-98		412	635	788	867	473							3175	3.9202				
	1998-99		946	1468	1675	1822	1298							7209	4.1827	C	2100-2650	SM	
	1999-00		1164	1386	1488	1522	1138							6698	3.9426				
Greenish Warbler or Leaf Warbler *P. trochiloides viridanus*	1997-98			6										6	0.0074				
	1998-99		15	3										18	0.0104		2400	PM	
	1999-00		49	103										152	0.0695				
Pallas's Leaf Warbler *P. proregulus simlaensis*	1997-98			239	356	103			232	153	78	44		1205	1.4878				
	1998-99			414	628	181			683	387	277	133	36	2739	1.5892	C	2300-2800	RAM	
	1999-00			458	670	211			560	135	46	21		2101	1.2367				
Hume's Willow Warbler *P. inornatus humei*	1997-98			76	202	248			148	23	16			713	0.8803				
	1998-99			87	516	478	3		333	158	57			1632	0.9469	C	2300-2600	RAM	
	1999-00			174	442	519			415	236	127			1913	1.1260				

Eurasian Chiff Chaff *P. collybita tristis*	1997-98		327	185					81	23				616	0.7606		2600-2800	RAM
	1998-99		714	418					88	9				1229	0.7131			
	1999-00		824	294					137	46				1301	0.7658			
Goldcrest *Regulus regulus*	1997-98	30	28	17	11	3	3				4	23	38	157	0.1938		2400-2700	PM
	1998-99	55	33	18	13						16	54	67	256	0.1485			
	1999-00	47	14	20	19	15					28	113	92	348	0.2048			
Beautiful Niltava *Niltava sundara*	1997-98		1	1	4	1				3				10	0.0123		2400-2500	SM
	1998-99			2	11	8			3	3				27	0.0157			
	1999-00	1	3	1					2	1				8	0.0047			
Verditer Flycathcher *Muscicapa thalassina*	1997-98		11	15	30	34	48	37	27	17	12			231	0.2852	C	2100-2800	RAM
	1998-99		33	43	76	63	90	81	60	39	27			512	0.2971			
	1999-00		31	27	51	45	72	57	40	33	24			380	0.2237			
Dark-sided Flycatcher *M. sibirica*	1997-98			57	78	33	37	27	48	116	38			434	0.5359	C	2400-2800	RAM
	1998-99			105	180	90	42	25	112	168	49			771	0.4473			
	1999-00			126	168	52	64	42	90	204	111			857	0.5044			
Slaty-blue Flycatcher *Ficedula tricolor*	1997-98			4	6	8								18	0.0222		2300-2700	SM
	1998-99			2	22	25	4							53	0.0308			
	1999-00			6	19	42	10							77	0.0453			
Ultramarine Flycatcher *F. superciliaris*	1997-98			25	60	30	16							131	0.1617	C	2200-2600	SM
	1998-99			45	135	79	48							307	0.1781			
	1999-00			34	112	54	24							224	0.1319			
Collared Flycatcher *F. albicollis*	1997-98																2400	NRC
	1998-99																	
	1999-00			1										1	0.0006			
Grey-headed Flycatcher *Culicicapa ceylonensis*	1997-98			83	94	13								190	0.2346		1750-2000	SM
	1998-99			130	172	87								389	0.2257			
	1999-00			138	132	91								361	0.2125			
White-throated Fantail Flycatcher *Rhipidura albicollis*	1997-98																2200	VG
	1998-99									3				3	0.0017			
	1999-00																	
White-throated Laughing Thrush *Garrulax albogularis*	1997-98																2300	VG
	1998-99																	
	1999-00				2									2	0.0012			
Variegated Laughing Thrush *G. variegatus similis*	1997-98	122	144	222	303	318	347	337	281	234	191	146	102	2747	3.3917	C	2050-2700	D
	1998-99	264	350	515	644	660	700	674	612	513	427	300	218	5877	3.4099			
	1999-00	247	370	532	644	650	678	713	706	626	489	290	138	6083	3.5806			
Streaked Laughing Thrush *G. lineatus*	1997-98	659	682	758	824	83	935	893	808	817	775	759	640	8633	10.6592	C	2000-2700	D
	1998-99	1380	1407	1566	1724	1821	1900	1934	1748	1800	1686	1467	1272	19705	11.4330			
	1999-00	1343	1437	1624	1788	1947	1922	1954	1876	1868	1813	1836	1322	20730	12.2021			

White-browed Shrike Babler *Pteruthius flaviscapis*	1997-98		2	9										11	0.0136			
	1998-99		14	11										25	0.0145		1600-2100	PM
	1999-00		13	26										39	0.0230			
Green Shrike Babbler *Pteruthius xanthochloris*	1997-98																	
	1998-99		2											2	0.0012		2300	RE
	1999-00																	
Black-capped Sibia *Heterophasia capistrata*	1997-98	32	37	77	81	101	130	52	28	21				559	0.6902			
	1998-99	58	88	164	194	236	277	117	79	61	17			1291	0.7490	C	2000-2750	RAM
	1999-00	76	117	145	178	217	268	93	48	31	7			1180	0.6946			
White-throated Long tailed Tit *Aegithalos niveogularis*	1997-98											3	6	9	0.0111			
	1998-99											16	33	49	0.0284		2400-2500	WM
	1999-00											13	26	39	0.0230			
Red-headed Long tailed Tit *A. concinnus*	1997-98											13	21	34	0.0420			
	1998-99											51	71	122	0.0708		2400	WM
	1999-00											36	88	124	0.0730			
Simla or Black Crested Tit *Parus rufonuchalis*	1997-98			372	1144	856	694	415	184					3665	4.5252			
	1998-99			1074	2125	1378	1214	917	564					7272	4.2193	C	2000-2600	RAM
	1999-00			1382	2020	1627	1678	1065	364					8136	4.7890			
Crested Black Tit *P. melanolophus*	1997-98	244	603	916	1354	1468	1235	833	421	88	83	85	156	7486	9.2430			
	1998-99	614	1345	2471	3211	3325	3166	2315	1288	230	174	119	262	18520	10.7455	C	2250-2750	D
	1999-00	917	1656	2630	2995	3646	2541	1381	960	147	368	634	438	18313	10.7794			
Great Tit or Grey Tit *P. major*	1997-98	14	13	32	7									66	0.0815			
	1998-99	27	8	11	2									48	0.0278	C	2400-2600	SM
	1999-00	36	13	15	6									70	0.0412			
Green-backed Tit *P. monticolus*	1997-98	638	657	744	972	1109	1049	1040	918	853	812	419	341	9552	11.7939			
	1998-99	985	1220	1506	1762	1891	2023	1947	1906	1833	1500	1155	1100	18828	10.9242	C	2300-2600	D
	1999-00	1128	1268	1394	1558	1690	1728	1612	1592	1566	972	926	817	16251	9.5657			
Yellow-cheeked Tit *P. xanthogenys*	1997-98																	
	1998-99				1									1	0.0006		2100	VG
	1999-00																	
White-Cheeked Nuthatch *Sitta. leucopsis*	1997-98	40	48	56	52	44	36	45	51	58	68	90	78	666	0.8223			
	1998-99	68	75	80	65	60	57	43	49	40	56	87	66	746	0.4328	C	2450-2850	D
	1999-00	117	128	143	123	104	88	111	138	156	166	189	153	1616	0.9512			
Brooks or Kashmir Nuthatch *S. europaea cashmirensis*	1997-98			1	33	16					7	16		73	0.0901			
	1998-99			21	12	3					56	14		106	0.0615		2350-2550	SM
	1999-00			13	3						23	152		191	0.1124			
Himalayan Tree Creeper *Certhia himalayana*	1997-98	575	585	576	486	453	421	427	526	730	692	937	976	7584	9.3640			
	1998-99	1272	1088	854	816	800	770	608	702	1154	1693	1910	2683	14350	8.3260	C	2000-2700	D
	1999-00	870	926	1050	868	802	721	665	1100	1341	1090	2350	2172	13955	8.2142			

Fire-capped Tit *Cephalopyrus flammiceps*	1997-98			6	23									29	0.0358		2000-2500	SM
	1998-99			36	93									129	0.0748			
	1999-00			7	68									75	0.0441			
Purple Sunbird *Nectarinia asiatica*	1997-98																1900	VG
	1998-99				1									1	0.0006			
	1999-00																	
Oriental White-eye *Zosterops palpebrosa*	1997-98																2200	O
	1998-99					1								1	0.0006			
	1999-00			1										1	0.0006			
Golden Oriole *Oriolus oriolus*	1997-98				3									3	0.0037		2550	PM
	1998-99				2									2	0.0012			
	1999-00				2									2	0.0012			
Long-tailed Shrike *Lanius schach*	1997-98				6	11								17	0.0210	C	2100-2400	SM
	1998-99				26	41								67	0.0389			
	1999-00				15	31								46	0.0271			
Black Drongo or King Crow *Dicrurus macrocercus*	1997-98			1										1	0.0012		2400	O
	1998-99				2									2	0.0012			
	1999-00																	
Ashy or Grey Dorngo *D. leucophaeus*	1997-98			5	29	8								42	0.0519	C	1850-2550	SM
	1998-99			27	79	15								121	0.0702			
	1999-00			21	87	25								133	0.0783			
Himalayan Red-crowned Jay *Garrulus glandarius bispecularis*	1997-98		5	20	35	43	24	2						129	0.1593	C	2200-2600	RAM
	1998-99		6	60	93	117	52	19						347	0.2013			
	1999-00		16	49	61	60	39							225	0.1324			
Black-throated Jay *G. lanceolatus*	1997-98		120	147	281	210	71	41						870	1.0742	C	2200-2600	RAM
	1998-99		152	190	392	349	169	69						1321	0.7665			
	1999-00		57	144	289	222	103	27						842	0.4956			
Yellow-billed Blue Magpie *Urocissa flavirostris*	1997-98	37	40	75	80	136	111	101	74	82	78	43	33	890	1.0989	C	1600-2650	D
	1998-99	68	77	154	216	238	245	250	237	205	187	85	63	2025	1.1749			
	1999-00	62	88	162	196	240	264	258	204	176	165	58	48	1921	1.1307			
Indian Tree-pie *Dendrocitta vagabunda*	1997-98																2100	O
	1998-99								1					1	0.0006			
	1999-00								3					3	0.0018			
Nutcracker *Nucifraga caryocatactes*	1997-98			3	1	2	9	2						17	0.0210	C	2300-2650	SM
	1998-99				6	2	4	6						18	0.0104			
	1999-00			4	1	4	3	1						13	0.0077			
Indian House Crow *Corvus splendens*	1997-98																2100	VG
	1998-99																	
	1999-00		1											1	0.0006			
Himalayan Jungle Crow *C. macrorhynchos intermedius*	1997-98	267	394	488	574	676	734	543	453	435	381	357	301	5603	6.9181	C	1600-2900	D
	1998-99	423	717	970	1232	1418	1638	1650	1563	1163	937	888	670	13269	7.6988			
	1999-00	570	800	1020	1340	1570	1546	1145	1078	976	712	823	782	12362	7.2765			

Common Myna or Indian Myna *Acridotheres tristis*	1997-98	13	15	36	74	101	104	47	38	30	17	11	10	496	0.6124				
	1998-99	29	64	106	200	231	255	114	85	70	51	38	25	1268	0.7357	C	1900-2650	D	
	1999-00	16	38	84	186	226	270	78	70	57	46	18	10	1099	0.6469				
Cinnamon Tree Sparrow *Passer rutilans*	1997-98		6	66	124	104	94	51				85	109	639	0.7890				
	1998-99		118	193	312	271	167	125				245	162	1593	0.9243	C	1900-2600	RAM	
	1999-00		36	172	380	312	262	148			195	277	265	2047	1.2049				
Common Chaffinch *Fringilla coelebs*	1997-98									1				1	0.0012				
	1998-99																2500	VG	
	1999-00																		
Brambling *F. montifringilla*	1997-98											6	13	19	0.0235				
	1998-99											33		33	0.0191		2250-2700	WM	
	1999-00										30	86	13	129	0.0759				
Himalayan Green Finch *Carduelis spinoides*	1997-98			11	17				24	82				134	0.1655				
	1998-99			112	23				112	252				499	0.2895		2400-2650	SM	
	1999-00			38	52				66	217				373	0.2196				
Plain Mountain Finch *Leucosticte nemoricola*	1997-98										109	185	208	502	0.6198				
	1998-99											558	254	812	0.4711		2300-2700	WM	
	1999-00										351	878	412	1641	0.9659				
Pink-browed Rosefinch *Carpodacus rhodochrous*	1997-98								3					3	0.0037				
	1998-99																2450-2550	SM	
	1999-00			16	36									52	0.0306				
Orange Bullfinch *Pyrrhula aurantiaca*	1997-98		8											8	0.0099				
	1998-99		17											17	0.0099		2600-2800	SM	
	1999-00		3										5	8	0.0047				
Black and Yellow Grosbeak *Mycerobas icterioides*	1997-98		3	7										10	0.0123				
	1998-99		3	18								3		24	0.0139		2400-2650	SM	
	1999-00		28	17								4	13	62	0.0365				
Spotted-winged Grosbeak *M. melanozanthos*	1997-98							1						1	0.0012				
	1998-99																2500	O	
	1999-00				2									2	0.0012				
Hawfinch *Coccothraustes coccothraustes*	1997-98																		
	1998-99																2450	VG	
	1999-00											7		7	0.0041				
White-capped Bunting *Emberiza stewarti*	1997-98					3								3	0.0037				
	1998-99																2300	VG	
	1999-00																		
Rock Bunting *Emberiza. cia*	1997-98			11	24									35	0.0432				
	1998-99			31	86									117	0.0679		2100	SM	
	1999-00			14	40									54	0.0318				
Total	**1997-98**	**3453**	**5440**	**8342**	**10817**	**9825**	**8817**	**6812**	**6862**	**5779**	**5038**	**5490**	**4316**	**80991**					
	1998-99	**7062**	**11236**	**17678**	**21743**	**21229**	**18878**	**14503**	**14932**	**12659**	**10299**	**12426**	**9707**	**172352**					
	1999-00	**6825**	**11857**	**18698**	**21186**	**21574**	**18456**	**13343**	**14183**	**11894**	**9555**	**12978**	**9340**	**169889**					

Golden Oriole a passage migrant observed in every June in successive years from 1997 to 1999, while Long-tailed Shrike or Rufous-backed Shrike *Lanius schach* (photographed) was found to be summering in the lower summits and a breeder of the Park (cover photograph taken by the first author of this study, fledglings of the species) .

Two species of Drongos i.e., Black Drongo or King Crow, *Dicrurus macrocercus* and Ashy or Grey Drongo, *D. leucophaeus* (photographed) of the family Dicruridae were found entering in the Park only in the summer. The latter was seen nesting in June 1998 on Blue Pine, *Pinus wallichiana,* while Black Drongo ascended from the south (warm climate) in summer but occasionally.

Seven species belonging to the family Corvidae were enlisted in this complex of bird site which represented as Himalayan or Red-crowned Jay, *Garrulus glandarius bispecularis* and Lanceolated Black-headed or Lanceolated Jay, *G. lanceolatus* Yellow-billed Blue Magpie, *Urocissa flavirostris* (photographed) Indian Tree-pie, *Dendrocitta vagabunda* Nutcracker, *Nucifraga caryocatactes* Indian House Crow, *Corvus Splendens* (photographed) and Himalayan Jungle Crow, *Corvus macrorhynchos intermedius* (photographed). Of these, Indian Tree-pie, *Dendrocitta vagabunda* was found to be an occasional summer visitor. Few pairs of Nutcrackers, *Nucifraga caryocatactes* were seen entering in the Park every summer.

Two species of crows were observed including the Indian House Crow, *Corvus Splendens* as a summer straggler and Himalayan Jungle Crow *Corvus macrorhynchos* as a permanent resident. House crow was seen only once as a single bird soaring on the lower summits of the Park while Himalayan Jungle Crow *Corvus macrorhynchos intermedius* was a common, permanent resident and breeder (Photographed) nesting was seen at Deodar Cedrus deodara in May. Common Myna or Indian Myna *Acridotheres tristis* belonging to the family Sturnidae was found fairly common round the year and a permanent resident breeder (Photographed). Cinnamon Tree Sparrow *Passer rutilans* (photographed) was also the only member of the family Passeridae which starts arriving in the Park from April as a regular summer visitor, breeding was also noted (photographed). At the approach of fall they started to leave the study site but again in the winter flocks were encountered coming from the northern high mountains to the lower valleys. They stayed for the resting purpose and then passed down wintering in the lower valley or plains.

Two species including Common Chaffinch, *Fringilla coelebs* and Brambling, *F. montifringilla* grouped under the family Estrildidae were recorded. Common chaffinch was found to be a straggler because only once a single bird was observed soaring on Himalayan dogwood *Cornus macrophylla* however, Brambling was found to be a regular winter visitor.

Seven species of beautiful small passerines called finches belonging to sub family Carduelinae were documented in the study site. They are known as Yellow-breasted Greenfinch or Himalyan Greenfinch, *Carduelis spinoides* (Photographed) Plain Mountain Finch or Hodgson's Mountain Finch, *Leucosticte nemoricola* (photographed) Pink-browed Rosefinch, *Carpodacus rhodochrous* (photographed) Orange Bullfinch, *Pyrrhula aurantiaca* Black-and-Yellow Grosbeak, *Mycerobas icterioides* Spotted-winged Grosbeak, *M. melanozanthos* (photographed) and Hawfinch, *Coccothraustes coccothraustes*. All the species of finches were found to be long distance migrant visiting the Park temporarily during their migratory routes. Two species of buntings of the sub family Emberizinae were recorded of which White-capped Bunting, *Emberiza stewarti* (photographed) found to be a straggler because of the single sighting during the three years investigation while Rock Bunting or Meadow Bunting, *E. cia* (photographed) was observed using the migratory route regularly in summer.

Discussion:

Species of birds regional conservation concern were rerecorded inhabiting in the areas of Dunga Gali, Changla Gali (Magrath 1908a, 1909a and 1909b). These species include Egyptian Vulture, *Neophron pernopterus* Crested Serpent Eagle *spilornis cheela* Himalayan Snow Cock *Tetrogularis himalayensis* Red Jungle Fowl, Gallus gallus Cheer Pheasant, *Catreus wallichi* Himalayan Monal *Lophophorus impejanus*. These areas are presently included in the Ayubia National Park. Similarly Rattray (1906) also reported the Crested Serpent Eagle *Spilornis cheela* and Himalayan Snow Cock

Tetragularis himalayensis occurring in the Galliat Forest and in the areas presently included in the study site. Cock and Marshal (1873) reported breeding of the Egyptian Vulture in the southern adjoining hills of the park (Murree). The present first author of this study during his last 16 years association with these areas has never been accrossed these birds nor did Roberts (1991, 1992) during his many visits of 26 years in this area. However, the study has recorded many new bird species for the area (Table 1) and a new record of Collared Flycatcher *Ficedula albicollis* Temmink for the country while the rediscovery of Green Shrike Babbler, *Pteruthias xanthochloris* after a century back is a great finding. Earlier, the species has a definite ancient breeding record in the present study area.

Some earlier ornithologists have conducted surveys around or in some of the areas presently included in the Ayubia National Park; they enlisted their findings with the first record of 70 species of birds breeding in the southern adjoining hills (Cock and marshal 1873) of the present study site. Rattray (1906) reported 109 species of birds nesting in Murree Hills (located in the southern hills of the Park) including Dunga Gali, Changla Gali, Kuza Gali and Nathia Gali which presently are the part of Park (ANP). Magrath (1908a, 1909a and 1909b) visited these temperate mountains and enjoyed recording some useful records of bird including those species which are declared endangered (IUCN 1996), he recorded 91 and 67 breeding species in 1908 and 1909 respectively. Corfield (1983) recorded 263 species occurring in Islamabad and 89 species from the Murree Hills during the spring and summer seasons. The latest published figures were those given by Thomas (1998) who prepared a list of 109 species of birds conducting a few days survey of ANP. These were mainly based on Roberts (1991, 1992) observations. The present investigation recorded a total of 154 bird species consisting of all categories (resident, migrant and breeding) in an area of 33 sq. km. of ANP. Therefore, this may be categorized as a rich biodiversity area compared to any other Protected Areas and National Parks in the country.

Barua and Sharma (1999) compiled the bird records from Kaziranga National Park India figuring 478 species from 430 sq. km. area. Drijvers *et al.* (1999) gave a list of 144 bird species in an area of 250 sq. km. from Punjab and NWFP. Raja *et al.* (1999) recorded bird species in an area or 1413 sq km from Palas, NWFP. A bird list of 161 species from the records of Kalesar Wildlife Sanctuary Haryana, India was presented in response to studying from 1993-1995 (Kalsi,1998) at an area of 133 sq km. Shafique *et al.* (2002) working on bird fauna of Chiltan-Hazarganji National Park, Balochistan, recorded 74 bird species from an area of 155 sq km.

The records of birds from Ayubia National Park during the present study indicate comparatively highest ratio of terrestrial ecosystems. Globally endangered declared species were still present in the park including Oriental White-backed Vulture, *Gyps bengalensis* Orange Bullfinch, *Pyrrhula aurantiaca* White-throated Tit, *Aegithalos niveogularis* and regionally and nationally threatened species such as Koklass pheasant, *pucrasia macrolopha biddulphi* Kalij Pheasant,*Lophura Leucomelana hamiltonii* Wedge-tailed Green pigeon, *Treron sphenura* and pink-browed Rosefinch, *Carpodacus rhodochrous*. Habitat shrinkage has led these species in deep trouble for their future subsistence. Many key species were found including common crane, *Grus grus* now globally declared as endangered and European Bee-eater, *Merops apiaster* were the first ever record in the area seen during their migratory way. Common Crane migrant species in the Great Rann of Kutch and Saurashtra in Indian territory (Roberts, 1991), the first author of this study noted wintering of these birds at coastal marsh areas of Jabho and Sandho Lakes in district Badin, Sindh - Pakistan (photographed). European Bee-eater which migrates from southern Europe and winters in the Southern and Central Africa (Roberts, 1991). On return through Pakistan they were observed routing the ANP and breeding in central Balochistan (Shafique *et al*, 2002), and through the NWFP, Chitral northwards to lower Swat and Indus Kohistan (Roberts, 1991, 1992), routing through Ayubia National Park, a moist-temperate region is the first ever record during the present study.

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Ecology of Birds of Kuppi Plantation, Faisalabad, Pakistan II. Diversity of Bird

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Abstract

The study deals with the bird diversity in the Kuppi Plantation located in district Faisalabad. The study indicates that in spring and summer population of the birds in the plantation increases substantially. Birds of the Order Passeriformes seem to be most dominating group. The next dominating order was observed to be Falconiformes followed by birds of other groups. The study revealed that bird population in the plantation is dependant on the availability of food and habitat.

Keywords: Kuppi Plantation, birds, Passeriformes, Falconiformes, seasonal abundance.

Introduction:

Present paper is second on the series of studies on the avifauna of Kuppi Plantation located in district Faisalabad, Punjab. Study of the phyto-sociology of this plantation indicates a well-diversified flora and available habitat for bird species (Javed *et al.,* 2006). This relatively undisturbed plantation with adequate tree cover provide ideal habitat for a number of wildlife species including birds. Present study was designed to survey Kuppi and Chakku Irrigated Forest Plantations of central Punjab with special reference to avian species diversity. The study also encompasses seasonal abundance and variation in the population of bird species in the areas as well as to determine the relationship of vegetation with distribution of bird species in the selected plantations.

Bird fauna of Kuppi plantation has never been described separately, however, Ali and Ripley (1974) and Roberts (1991, 1992) have covered birds that are found in the surrounding area. Donald (1918; 1919a; 1919b; 1920a; 1920b; 1920c; 1921) worked on birds of prey of the Punjab. Whistler (1914, 1922a, 1922b) observed the birds of Jhelum and Jhang districts. Waite (1948) worked on the birds of Salt Range, district. Chaudhry *et al.* (1997a, 1997b) described the bird fauna of Salt Range and Cholistan.

Awan (1992) studied bird of Changa Manga plantation which is an oldest irrigated forest plantation of Pakistan, in district Kasur, Punjab. He recorded 81 bird species belonging to 60 genera in different habitats i.e. dense plantation of sheesham and mulberry, avenue tree plantations, amenity plantation in recreational park, farmlands and wetlands created as a result of irrigating vast areas. Beg and Qureshi (1972) have listed birds found in Faisalabad and its vicinity. Beg *et al.* (1987) worked on food preference of house sparrow in the cultivated area of Faisalabad. Present study is aimed to study the seasonal abundance and variation in the population of bird species in Irrigated Forest Plantation of Kuppi with especial reference to vegetation pattern of the area.

Materials and Methods:

For the management purpose Kuppi plantation is divided into 41 compartments (Javed *et al.*, 2006). Five transects were selected in the plantation keeping in view the plant species and their age in different compartments. The selected transects were sampled by walking at a slow and uniform pace to record the species of the birds present with the number of birds within 50 meter wide belt on either side of the survey line during the fixed hours of the day i.e. two and a half hour in the morning since sunrise and two and half hour in the evening till sunset. Salient features of the studied transects in Kuppi Forest Plantation are given in Table-I.

Results and Discussions:

Kuppi Plantation was observed to be rich in bird diversity (Table-II to V). In summer, a total of 12 orders of the birds consisting of 55 species were recorded from this Plantation (Table-II). Passeriformes was the largest represented order having 30 species. Out of 6,231 birds recorded, 3200 birds belong to 30 species of order Passeriformes. The next dominating order was Falconiformes, which was represented by 280 birds belonging to 5 species. The order Coraciiformes was represented by 4 species with the total 420 birds. The order Columbiformes was

also found to be rich with respect to the number of birds (1,366) but with respect to the number of species it was represented by only 3 species. The orders Ciconiformes and Piciformes were represented by 2 species, whereas Psittaciformes, Cuculiformes, Strigiformes, Galliformes, Charadriiformes and Caprimulgiformes were represented by single species. The overall density of birds per hectare was calculated to be 95.86. Transect wise diversity of species and abundance of birds show that transect 2, 3 and 5 are the most diversified with 41 species each. On the basis of their abundance; 23 species categorized as very common, 7 species as common, 11 species as less common, 12 species as not common species and 4 species as rare species.

In autumn, total of 3,008 birds were recorded (Table-III). It is apparent that the order Passeriformes was most dominating group with a total of 1,499 birds belonging to 29 species. Order Falconiformes was represented by 138 birds belonging to 4 species whereas order Columbiformes and Ciconiformes were represented by 3 species each. Order Piciformes was represented by 2 species whereas orders Psittaciformes, Charadriiformes, Cuculiformes, and Strigiformes were represented by one species each. Density of birds per hectare during autumn was calculated to be 46.28. Maximum number of birds are recorded in transect 2; whereas least number of birds are recorded in transect 5. In autumn, 10 species can be categorized to be very common, 3 species common, 14 species as not common, 16 species as less common and 7 species as rare.

In winter a total of 2,297 birds belonging to only 9 orders and 43 species were recorded (Table-IV). Passeriformes was observed to be the most diversified group represented by 26 species. Five species of order Falconiformes were recorded in winter. Orders Columbiformes and Coraciiformes were represented by 3 species each whereas Piciformes was represented by two species and orders Pstrigiformes, Cuculiformes and Charadriiformes were represented by one species each. Overall density of birds per hectare in the plantation during winter was 35.34. Maximum number of birds were recorded in transect 3 whereas minimum number was recorded in transect number 5. In winter, 6 species can be categorized as very common, 2 species as common, 9 species as less common, 18 species as not common and 8 species as rare species.

In spring, a total of 5,207 birds were recorded dominated by order Passeriformes that was represented by 33 species (Table-V). Order Falconiformes was represented by 5 species and 266 birds. Orders Coraciiformes and Cuculiformes were represented by 4 species each, whereas order Culumbiformes was represented by 3 species and order Piciformes by two species. Order Psittaciformes, Galliformes, Charadriiformes and Strigiformes by one species each. Study on the density of bird in winter revealed that transect 5 have a well diversified bird fauna with 49 species recorded in spring. Based on their abundance in spring, 11 species can be categorized as very common, 16 species as common, 16 species as less common, 8 species as not common and 5 species as rare species.

Table I: Features of transects in Kuppi Forest Plantation.

Transect #	Area (ha.)	Description
Transect 1	12	Consisted of five compartments in a row that is compartment No. 3, to compartment No. 7. Main tree species of this transect was Sheesham planted in 1955. The second important tree species was Kikar planted in 1978-80.
Transect 2	10	Consisted of three compartments on the eastern edge of the plantation. It consisted of pure Kikar planted in 1965.
Transect 3	14	Consisted of compartment 15 to 23. Young plantation of Kikar and natural tropical thorn forest species like *Tamarix kari* were dominating. Mesquite was also invaded in this transect.
Transect 4	15	This transect consisted of a compartment of 4 acres with six years old *Eucalyptus nianiation*. Besides, Sheesham and Kikar planted in 1978 to 1980. *Tamarix kari* is naturally grown shrubs. The Sheesham and Kikar were not well established due to shortage of water and soil salinity. Trees usually were thin, less in diameter with respect to their age, short in size and had poor canopy cover.
Transect 5	14	The soil was hard and saline. Major species are Sheesham and Kikar, which were planted in 1979-1981. Due to unfavourable conditions the plantation is not well established.

Table-II Density/hectare of birds in Kuppi Plantation during summer.

Bird Species	Transect					Total	Density (No./ha)	Status
	1	2	3	4	5			
Ciconiiformes								
Ardeidae								
Pond heron (*Ardeola grayii*)	2	12	0	0	1	15	0.23	NC
Cattle egret (*Bubulcus ibis*)	28	52	14	36	10	140	2.15	VC
Little egret (*Egretta garzetta*)	18	30	46	17	0	111	1.71	VC
Accipitriformes								
Accipitridae								
Black-winged kite (*Elanus caeruleus*)	2	3	1	0	0	6	0.09	NC
Black kite (*Milvus migrans*)	50	7	11	13	2	83	1.28	C
Egyptian vulture (*Neophron percnopterus*)	2	1	0	0	0	3	0.05	R
White-backed vulture (*Gyps bengalensis*)	132	51	0	0	0	183	2.82	VC
Indian sparrow hawk (*Accipiter badius*)	2	3	0	0	0	5	0.08	R
Galliformes								
Phasianidae								
Grey partridge (*Francolinus pondicerianus*)	0	0	9	0	0	9	0.14	NC
Charadriiformes								
Charadriidae								
Red-wattled lapwing (*Vanellus indicus*)	16	51	27	45	51	190	2.92	VC
Columbiformes								
Columbidae								
Indian ring dove (*Streptopelia decaocto*)	98	222	179	313	136	948	14.58	VC
Red collard dove (*Streptopelia tranquebarica*)	32	137	67	33	49	318	4.89	VC
Little brown dove (*Streptopelia senegalensis*)	0	35	34	25	6	100	1.54	C
Psittaciformes								
Psittacidae								
Rose ringed parakeet (*Psittacula krameri*)	42	80	83	132	45	382	5.88	VC
Cuculiformes								
Cuculidae								
Pied crested cuckoo (*Clamator jacobinus*)	3	1	0	4	0	8	0.12	NC
Koel (Common) (*Eudynamys scolopacea*)	6	4	0	0	2	12	0.18	NC
Common hawk cuckoo (*Cuculus varius*)	5	0	0	2	0	7	0.11	NC
Strigiformes								
Strigidae								
Spotted owlet (*Athene brama*)	0	9	0	0	0	9	0.14	NC

Caprimulgiformes								
Caprimulgidae								
Grey nightjar (*Caprimulgus indicus*)	0	0	0	1	0	1	0.02	R
Coraciiformes								
Alcedinidae								
White breasted kingfisher (*Halcyon smyrnensis*)	0	0	2	0	4	6	0.09	NC
Meropidae								
Green small bee-eater (*Merops orientalis*)	48	25	35	37	53	198	3.05	VC
Coraciidae								
Indian roller (*Coracias bengalensis*)	44	26	19	34	15	138	2.12	VC
Upupidae								
Hoopoe (*Upupa epops*)	17	41	9	8	3	78	1.20	C
Piciformes								
Picidae								
Golden backed woodpecker (*Dinopium bengalense*)	10	12	18	27	8	75	1.15	C
Maharatta woodpecker (*Dendrocopos mahrattensis*)	0	0	2	0	4	6	0.09	NC
Passeriformes								
Alaudidae								
Crested lark (*Galerida cristata*)	0	0	11	5	8	24	0.37	LC
Oriental skylark (*Alauda gulgula*)	0	0	19	15	6	40	0.62	LC
Campephagidae								
Common wood shrike (*Tephrodornis pondecerianus*)	6	12	10	14	15	57	0.88	C
Motacillidae								
Large pied wagtail (*Motacilla maderasespatensis*)	2	0	0	6	4	12	0.18	NC
Pycnonotidae								
Red vented bulbul (*Pycnonotus cafer*)	6	12	34	43	24	119	1.83	VC
Turdidae								
Magpie robin (*Copsychus saularis*)	0	0	0	0	2	2	0.03	R
Pied bush chat (*Saxicola caprata*)	0	3	7	5	1	16	0.25	NC
Indian robin (*Saxicoloides fulicata*)	3	0	13	23	14	53	0.82	C
Sylviidae								
Eurasian chiffchaff (*Phylloscopus collibyta*)	0	7	0	5	14	26	0.40	LC
Black redstart (*Phoenicurus ochruros*)	0	0	10	5	15	30	0.46	LC
Ashy wren warbler (*Prinia socialis*)	12	4	0	8	0	24	0.37	LC
Muscicapidae								
Red-throated flycatcher (*Ficedula parva*)	0	2	3	10	20	35	0.54	LC

Green warbler (*Phylloscopus nitidus*)	7	9	0	11	0	27	0.42	LC
Jungle Prinia (*Prinia sylvatica*)	15	8	0	5	4	32	0.49	LC
Rhipiduridae								
White-browed fantail (*Rhipidura aureola*)	4	0	3	4	7	18	0.28	NC
White throated fantail (*Rhipidura albicollis*)	4	3	0	8	6	21	0.32	LC
Timalidae								
Common babbler (*Turdoides caudatus*)	25	40	20	34	45	164	2.52	VC
Jungle babbler (*Turdoides striatus*)	44	54	52	35	34	219	3.37	VC
Nectariniidae								
Purple sunbird (*Nectarinia asiatica*)	20	0	23	45	34	122	1.88	VC
Oriolidae								
Golden oriole (*Oriolus oriolus*)	8	11	0	10	3	32	0.49	LC
Dicruridae								
Black drongo (*Dicrurus macrocercus*)	23	47	61	35	32	198	3.05	VC
Laniidae								
Rufous backed shrike (*Lanius schach*)	10	33	19	18	17	97	1.49	C
Bay-backed shrike (*Lanius vittatus*)	15	32	23	24	29	123	1.89	VC
Corvidae								
Indian tree pie (*Dendrocilta vagabunda*)	7	4	6	2	0	19	0.29	NC
House crow (*Corvus splendens*)	112	176	152	156	105	701	10.78	VC
Sturnidae								
Common myna (*Acridotheris tristis*)	77	97	32	68	151	425	6.54	VC
Bank myna (*Acridotheris ginginianus*)	40	84	15	15	14	168	2.58	VC
Common starling (*Sturnus vulgaris*)	29	113	15	0	0	157	2.42	VC
Passeridae								
House sparrow (*Passer domesticus*)	45	74	60	0	22	201	3.09	VC
Tree sparrow (*Passer montanus*)	7	0	11	0	20	38	0.58	LC
Area surveyed (ha)	**12**	**10**	**14**	**15**	**14**	**65**		
Total No. of species	**41**	**41**	**38**	**39**	**41**			
No. of birds in each habitat	**1078**	**1627**	**1155**	**1336**	**1035**	**6231**		
Density of birds/ha	**89.83**	**162.70**	**82.50**	**89.07**	**73.93**	**95.86**	**95.86**	

Table-III Density/hectare of birds in Kuppi Plantation during Autumn.

BIRD SPECIES	TRANSECT					TOTAL	DENSITY (NO./HA)	STATUS
	1	2	3	4	5			
Accipitriformes								
Accipitridae								
Black-winged kite (*Elanus caeruleus*)	12	7	11	9	2	41	0.63	LC
Black kite (*Milvus migrans*)	38	27	24	12	29	130	2.00	VC
Egyptian vulture (*Neophron percnopterus*)	21	5	12	10	0	48	0.74	LC
White-backed vulture (*Gyps bengalensis*)	0	4	0	2	1	7	0.11	NC
Falconidae								
Kestrel (*Falco tinnunculus*)	12	9	0	0	3	24	0.37	LC
Charadriiformes								
Charadriidae								
Red-wattled lapwing (*Venallus indicus*)	31	55	0	0	20	106	1.63	VC
Columbiformes								
Columbidae								
Indian ring dove (*Streptopelia decaocto*)	0	0	1	0	0	1	0.02	R
Red collard dove (*Streptopelia tranquebarica*)	1	0	1	0	0	2	0.03	R
Little brown dove (*Streptopelia senegalensis*)	11	20	15	16	21	83	1.28	C
Psittaciformes								
Psittacidae								
Rose ringed parakeet (*Psittacula krameri*)	18	41	86	66	47	258	3.97	VC
Cuculiformes								
Cuculidae								
Crow pheasant (*Centropus sinensis*)	17	20	16	30	22	105	1.62	VC
Strigiformes								
Strigidae								
Spotted owlet (*Athene brama*)	4	6	8	8	13	39	0.60	LC
Coraciiformes								
Alcedinidae								
White breasted kingfisher (*Halcyon smyrnensis*)	80	86	51	173	67	457	7.03	VC

Coraciidae								
Indian roller (*Coracias benghalensis*)	2	0	0	1	2	5	0.08	R
Upupidae								
Hoopoe (*Upupa epops*)	0	7	0	0	0	7	0.11	NC
Piciformes								
Picidae								
Golden backed woodpecker (*Dinopium benghalense*)	3	6	3	3	3	18	0.28	NC
Maharatta woodpecker (*Dendrocopos mahrattensis*)	23	8	14	12	16	73	1.12	C
Passeriformes								
Alaudidae								
Crested lark (*Galerida cristata*)	4	10	18	2	16	50	0.77	LC
Oriental skylark (*Alauda gulgula*)	10	0	3	2	11	26	0.40	LC
Hirundinidae								
Collard sand martin (*Riparia riparia*)	3	2	3	14	2	24	0.37	LC
Common house martin (*Delichon urbica*)	0	3	0	1	1	5	0.08	R
Motacillidae								
Yellow wagtail (*Motacilla flava*)	3	0	5	4	0	12	0.18	NC
White wagtail (*Motacilla alba*)	0	0	0	0	8	8	0.12	NC
Large pied wagtail (*Motacilla maderaspatensis*)	20	39	60	15	15	149	2.29	VC
Pycnonotidae								
Red vented bulbul (*Pycnonotus cafer*)	12	5	13	7	11	48	0.74	LC
Turdidae								
Pied bush chat (*Saxicola caprata*)	6	0	12	2	0	20	0.31	NC
Indian robin (*Saxicoloides fulicata*)	8	4	0	8	0	20	0.31	NC
Sylviidae								
Eurasian chiffchaff (*Phylloscopus collibyta*)	8	10	12	16	13	59	0.91	C
Black redstart (*Phoenicurus ochruros*)	2	0	3	6	0	11	0.17	NC
Ashy wren warbler (*Prinia socialis*)	0	2	3	9	2	16	0.25	NC
Muscicapidae								
Red- throated flycatcher (*Ficedula parva*)	0	0	10	5	6	21	0.32	LC

Jungle wren warbler (*Prinia sylvatica*)	6	4	6	0	0	16	0.25	NC
Rhipiduridae								
White-browed fantail (*Rhipidura aureola*)	4	5	10	8	7	34	0.52	LC
Timalidae								
Common babbler (*Turdoides caudatus*)	2	0	5	4	4	15	0.23	NC
Jungle babbler (*Turdoides striatus*)	9	7	0	13	0	29	0.45	LC
Dicruridae								
Black drongo (*Dicrurus macrocercus*)	5	8	0	10	0	23	0.35	LC
Laniidae								
Bay-backed shrike (*Lanius vittatus*)	10	6	0	14	0	30	0.46	LC
Corvidae								
Indian tree pie (*Dendrocitta vagabunda*)	0	0	0	5	2	7	0.11	NC
House crow (*Corvus splendens*)	0	0	8	0	3	11	0.17	NC
Sturnidae								
Common myna (*Acridotheris tristis*)	16	39	40	18	21	134	2.06	VC
Common starling (*Sturnus vulgaris*)	6	24	42	31	30	133	2.05	VC
Ploceidae								
House sparrow (*Passer domesticus*)	0	0	0	3	0	3	0.05	R
Tree sparrow (*Passer montanus*)	0	0	0	0	1	1	0.02	R
Area surveyed (ha)	**12**	**10**	**14**	**15**	**14**	**65**		
Total No. of species	**26**	**29**	**31**	**30**	**27**			
No. of birds in each habitat	**505**	**457**	**571**	**452**	**312**	**2297**		
Density of birds/ha	**42.08**	**45.70**	**40.79**	**30.13**	**22.29**	**35.34**	**35.34**	

Table-IV Density/hectare of birds in Kuppi Plantation during winter.

BIRD SPECIES	TRANSECT					TOTAL	DENSITY (NO./HA)	STATUS
	1	2	3	4	5			
Accipitriformes								
Black-winged kite (*Elanus caeruleus*)	9	1	3	2	2	17	0.26	NC
Black kite (*Milvus migrans*)	5	0	7	6	7	25	0.38	LC
Egyptian vulture (*Neophron percnopterus*)	0	0	0	2	0	2	0.03	R
White-backed vulture (*Gyps bengalensis*)	141	43	38	27	17	266	4.09	VC
Falconidae								
Kestrel (Common) (*Falco tinnunculus*)	0	0	0	1	0	1	0.02	R
Charadriiformes								
Charadriidae								
Red-wattled lapwing (*Vanellus indicus*)	0	3	8	0	15	26	0.40	LC
Columbiformes								
Columbidae								
Indian ring dove (*Streptopelia decaocto*)	33	69	60	24	20	206	3.17	VC
Red collard dove (*Streptopelia tranquebarica*)	0	0	0	15	0	15	0.23	NC
Little brown dove (*Streptopelia senegalensis*)	6	0	2	0	6	14	0.22	NC
Psittaciformes								
Psittacidae								
Rose ringed parakeet (*Psittacula krameri*)	59	61	71	90	42	323	4.97	VC
Cuculiformes								
Cuculidae								
Crow pheasant (*Centropus sinensis*)	0	2	0	0	0	2	0.03	R
Strigiformes								
Strigidae								
Spotted owlet (*Athene brama*)	1	2	0	0	0	3	0.05	R
Coraciiformes								
Alcedinidae								
White breasted kingfisher	0	1	1	0	1	3	0.05	R

(*Halcyon smyrnensis*)								
Coraciidae								
Indian roller (*Coracias bengalensis*)	2	7	7	1	0	17	0.26	NC
Upupidae								
Hoopoe (*Upupa epops*)	7	9	9	6	5	36	0.55	LC
Piciformes								
Picidae								
Golden backed woodpecker (*Dinopium bengalense*)	2	18	5	0	6	31	0.48	LC
Maharatta woodpecker (*Dendrocopos mahrattensis*)	1	1	0	0	0	2	0.03	R
Passeriformes								
Alaudidae								
Crested lark (*Galerida cristata*)	0	0	10	3	0	13	0.20	NC
Oriental skylark (*Alauda gulgula*)	0	0	14	10	6	30	0.46	LC
Hirundinidae								
Collard sand martin (*Riparia riparia*)	0	0	30	0	0	30	0.46	LC
Common house martin (*Delichon urbica*)	20	0	0	0	0	20	0.31	NC
Motacillidae								
Yellow wagtail (*Motacilla flava*)	2	3	7	2	4	18	0.28	NC
White wagtail (*Motacilla alba*)	4	3	7	2	4	20	0.31	NC
Large pied wagtail (*Motacilla maderaspatensis*)	0	2	1	3	0	6	0.09	NC
Pycnonotidae								
Red vented bulbul (*Pycnonotus cafer*)	0	2	7	3	4	16	0.25	NC
Muscicapidae								
Pied bush chat (*Saxicola caprata*)	4	1	7	4	3	19	0.29	NC
Indian robin (*Saxicoloides fulicata*)	4	2	7	6	12	31	0.48	LC
Eurasian chiffchaff (*Phylloscopus collibyta*)	5	0	0	0	0	5	0.08	R

Black redstart (*Phoenicurus ochruros*)	0	0	4	5	8	17	0.26	NC
Red-breasted flycatcher (*Ficedula parva*)	2	0	6	5	7	20	0.31	NC
Ashy wren warbler (*Prinia socialis*)	5	7	0	4	0	16	0.25	NC
Jungle wren warbler (*Prinia sylvatica*)	8	4	0	7	0	19	0.29	NC
Rhipiduridae								
White-browed fantail (*Rhipidura aureola*)	0	0	5	7	0	12	0.18	NC
Timalidae								
Common babbler (*Turdoides caudatus*)	5	24	23	24	11	87	1.34	C
Jungle babbler (*Turdoides striatus*)	45	49	51	46	49	240	3.69	VC
Dicruridae								
Black drongo (*Dicrurus macrocercus*)	12	10	107	15	7	151	2.32	VC
Laniidae								
Bay-backed shrike (*Lanius vittatus*)	0	2	0	2	1	5	0.08	R
Corvidae								
Indian tree pie (*Dendrocitta vagabunda*)	1	4	1	2	3	11	0.17	NC
House crow (*Corvus splendens*)	114	54	43	119	47	377	5.80	VC
Sturnidae								
Common myna (*Acridotheris tristis*)	30	148	31	22	20	251	3.86	VC
Common starling (*Sturnus vulgaris*)	8	18	0	0	5	31	0.48	LC
Ploceidae								
House sparrow (*Passer domesticus*)	0	19	12	9	15	55	0.85	C
Tree sparrow (*Passer montanus*)	0	0	10	0	0	10	0.15	NC
Area surveyed (ha)	**12**	**10**	**14**	**15**	**14**	**65**		
Total No. of species	**26**	**29**	**31**	**30**	**27**			
No. of birds in each habitat	**505**	**457**	**571**	**452**	**312**	**2297**		
Density of birds/ha	**42.08**	**45.70**	**40.79**	**30.13**	**22.29**	**35.34**	**35.34**	

Table-IV Density/hectare of birds in Kuppi Plantation during spring.

BIRD SPECIES	TRANSECT					TOTAL	DENSITY (NO./HA)	STATUS
	1	2	3	4	5			
Cicniiformes								
Ardiidae								
Pond heron (*Ardeola grayii*)	0	0	39	0	15	54	0.83	C
Falconiformes								
Accipitridae								
Honey buzzard (*Pernis ptilorhynchus*)	4	2	3	2	1	12	0.18	NC
Black-shoulder kite (*Elanus caeruleus*)	15	4	0	1	5	25	0.38	LC
Black kite (*Milvus migrans*)	19	20	3	14	8	64	0.98	C
White-backed vulture (*Gyps bengalensis*)	71	75	5	2	0	153	2.35	VC
Falconidae								
Shikra (*Accipiter badius*)	0	3	4	4	1	12	0.18	NC
Galliformes								
Phasianidae								
Grey partridge (*Francolinus pondicerianus*)	0	0	2	0	2	4	0.06	R
Charadriiformes								
Charadriidae								
Red-wattled lapwing (*Vanellus indicus*)	19	8	9	5	10	51	0.78	LC
Columbiformes								
Columbidae								
Indian ring dove (*Streptopelia decaocta*)	22	64	40	211	134	471	7.25	VC
Red collard dove (*Streptopelia tranquebarica*)	63	21	19	71	128	302	4.65	VC
Little brown dove (*Streptopelia senegalensis*)	22	19	13	23	14	91	1.40	C
Psittaciformes								
Psittacidae								
Rose ringed parakeet (*Psittacula krameri*)	46	56	37	52	72	263	4.05	VC

Cuculiformes								
Cuculidae								
	0	2	0	5	2	9	0.14	NC
Pied crested cuckoo (*Clamator jacobinus*)								
Common Koel (*Eudynamys scolopacea*)	6	3	6	4	2	21	0.32	LC
Crow pheasant (*Centropus sinensis*)	0	20	0	0	6	26	0.40	LC
Brain fever bird (*Cuculus varius*)	5	3	0	0	4	12	0.18	NC
Strigiformes								
Strigidae								
Spotted owlet (*Athene brama*)	0	12	0	0	0	12	0.18	NC
Coraciiformes								
Alcedinidae								
	0	0	0	0	2	2	0.03	R
White breasted kingfisher (*Halcyon smyrnensis*)								
Meropidae								
Small green bee-eater (*Merops orientalis*)	25	60	45	43	64	237	3.65	VC
Coraciidae								
Indian roller (*Coracias benghalensis*)	18	16	5	9	14	62	0.95	C
Upupidae								
Hoopoe (*Upupa epops*)	15	9	0	0	10	34	0.52	LC
Piciformes								
Picidae								
	21	11	25	16	8	81	1.25	C
Golden backed woodpecker (*Dinopium benghalense*)								
Maharatta woodpecker (*Dendrocopos mahrattensis*)	0	0	4	0	2	6	0.09	R
Passeriformes								
Alaudidae								
	0	0	19	11	2	32	0.49	LC
Crested lark (*Galerida cristata*)								
Oriental skylark (*Alauda gulgula*)	0	0	7	5	2	14	0.22	NC
Hirundinidae								
Collard sand martin (*Riparia riparia*)	0	0	0	8	3	11	0.17	NC

Common swallow (*Hirundo rustica*)	0	0	27	0	0	27	0.42	LC
Campephagidae								
Common wood shrike (*Tephrodornis pondicerianus*)	11	11	12	10	7	51	0.78	LC
Motacillidae								
Tree pipit (*Anthus trivialis*)	0	4	0	0	0	4	0.06	R
Yellow wagtail (*Motacilla flava*)	8	0	12	14	3	37	0.57	LC
White wagtail (*Motacilla alba*)	0	0	16	15	3	34	0.52	LC
Large pied wagtail (*Motacilla maderaspatensis*)	0	0	0	9	10	19	0.29	NC
Pycnonotidae								
Red -vented bulbul (*Pycnonotus cafer*)	0	5	20	25	21	71	1.09	C
Turdidae								
Pied bush chat (*Saxicola caprata*)	0	0	12	16	5	33	0.51	LC
Indian robin (*Saxicoloides fulicata*)	0	0	7	14	2	23	0.35	LC
Sylviidae								
Eurasian chiffchaff (*Phylloscopus collibyta*)	5	0	12	13	8	38	0.58	LC
Turdidae								
Black redstart (*Phoenicurus ochruros*)	7	12	12	16	6	53	0.82	C
Muscicapidae								
Red-throated flycatcher (*Ficedula parva*)	0	13	11	7	18	49	0.75	LC
Sylviidae								
Ashy wren warbler (*Prinia socialis*)	17	17	14	17	21	86	1.32	C
Green warbler (*Phylloscopus nitidus*)	11	15	7	15	14	62	0.95	C
Jungle wren prinia (*Prinia sylvatica*)	14	10	24	19	17	84	1.29	C
Monarchidae								
Paradise flycatcher (*Terpsiphone paradisi*)	0	0	0	2	0	2	0.03	R

Rhipiduridae								
White-browed fantail flycatcher (*Rhipidura aureola*)	0	3	10	10	5	28	0.43	LC
White spotted fantail flycatcher (*Rhipidura albicollis*)	2	3	4	8	7	24	0.37	LC
Timalidae								
Common babbler (*Turdoides caudatus*)	17	49	27	42	27	162	2.49	VC
Jungle babbler (*Turdoides striatus*)	8	26	18	30	25	107	1.65	VC
Nectariniidae								
Purple sunbird (*Nectarinia asiatica*)	7	21	18	19	15	80	1.23	C
Oriolidae								
Golden oriole (*Oriolus oriolus*)	4	2	14	13	6	39	0.60	LC
Dicruridae								
Black drongo (*Dicrurus macrocrcercus*)	9	35	45	34	33	156	2.40	VC
Laniidae								
Rufous backed shrike (*Lanius schach*)	0	12	32	16	20	80	1.23	C
Bay-backed shrike (*Lanius vittatus*)	10	8	50	12	19	99	1.52	C
Corvidae								
Indian tree pie (*Dendrocita vagabunda*)	9	14	0	0	0	23	0.35	LC
House crow (*Corvus splendens*)	77	48	244	446	459	1274	19.60	VC
Sturnidae								
Common myna (*Acridotheris tristis*)	22	39	61	37	66	225	3.46	VC
Bank myna (*Acridotheris ginginianus*)	0	24	21	30	0	75	1.15	C
Passeridae								
House sparrow (*Passer domesticus*)	35	0	25	16	25	101	1.55	VC
Area surveyed (ha)	**12**	**10**	**14**	**15**	**14**	**65**		
Total No. of species	**33**	**40**	**43**	**45**	**49**			
No. of birds in each habitat	**644**	**779**	**1040**	**1391**	**1353**	**5207**		
Density of birds/ha	**53.67**	**77.90**	**74.29**	**92.73**	**96.64**	**80.11**	**80.11**	

Seasonal fluctuation in the number of species recorded within plantation may be attributed to the in and out movements of birds from the plantation and seasonal rotation of crops in the surrounding agricultural land. In late summer and early autumn mostly rice is cultivated in surrounding agricultural fields whereas in late autumn and early winter wheat and sugar cane is mostly cultivated on the surrounding agricultural fields.

The study revealed that with the onset of spring, arrival of summer migrant and summer breeders start, thus resulting the increase in number of species in the plantations. Since Kuppi plantation is open type of woodland with two major tree species Sheesham and kiker whereas some patches of natural tropical thorn forest dominated by Tamarix, Jund and wan still exist. The harvesting of wheat in the nearby fields also helps in attracting different species of Columbiformes, which are predominantly graminivores. Order Ciconiformes is not well represented in spring. The species of this order are considered to have affinity with water. In late summer and early autumn water availability improves in the Plantation, which results in increase in the numbers of birds of Order Ciconiformes. Order Passeriformes also became much diversified in spring and summer season with the arrival of golden oriole, purple sunbird and shrikes. This order is well represented both in terms of number of species and their abundance.

With the onset of winter season, the number and abundance of the birds were observed to start decreasing. Orders Ciconiformes and Galliformes were observed to be totally absent during winter in the Plantation. Because of overall shortage of water during winter season especially due to closure of canal for desilting and change of crop pattern from paddy to wheat and sugarcane made habitat unattractive for Ciconiformes and was not recorded in winter.

Chaudhry *et al.* (1997a) studied biodiversity of birds in a sub-mountainous protected area of Chumbi Surla Wildlife Sanctuary in Salt Range and reported 113 plant species belonging to 35 families. The largest family was Poacae represented by 41 species. Among the birds 71 species belonging to 57 genera from 34 families representing 14 orders were recorded from the sanctuary area. Chaudhry *et al.* (1997b) studied biodiversity of Cholistan desert in Punjab. Vegetation was studied at 26 different sites and 23 distinct plant communities were recognized on the basis of importance value of the plant species. Among birds 58 species were recorded representing 42 genera, 26 families and 12 orders.

In comparison to Chumbi-Surla and Cholistan, Kuppi Forest plantation is less diversified from vegetation point of view (Chaudhry *et al.*, 1997a, b). Only the sheesham and the kiker are the major planted species in the plantation, while other plants that can provide food and shelter to bird species are also present in the plantation. In addition shrubs and other undergrowth vegetation are also very poor in the area. The Plantation is also known for scarcity of water resulting in death of some plants. The above mentioned factors lead to a limited diversity of birds in this plantation.

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Study of environmental variables in the moist-temperate environs of western Himalayan mountain range, Pakistan.

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Abstract

In order to study the effect of environmental variables on the distribution of flora and fauna in a moist-temperate mountain environment; the temperature, humidity and rain-fall (precipitation) were recorded from February 1997 to February 2000 at two distinctive places at the height of 2130m and 2500m altitude from the sea level at Ayubia National Park located in the Galliat Forest Division, Abbotabad district, NWFP – Province. The present study is of its own kind which at the same time represents variable features of the environment at two distinct places, located distantly straight through the hill-ridges approximating 7 km. To record the environs data, the higher station (2500m) was located north-west at the steep hill-range, whereas the lower in the south-east on dilating and gentle slopes in the opposite direction.

Keywords: temperature, humidity, moisture, altitude - 2130m, 2500, Ayubia National Park.

Introduction:

The present study was carried out in a protected area called Ayubia National Park at the turn of the 20th century. The Park is situated in the Galliat Forest Division of Abbotabad district, province NWFP (Northwest Frontier Province), Pakistan between 34°-1/ to 34°-3.8/ N latitude and 73° 22.8/ to 73°-27.1/ E longitude. Originally it spreaded over an area of 1684 hectares which was notified under Section-18 of NWFP-Wildlife Act 1975, declared as National Park in 1984. Exercising on the initial area, the Government of NWFP, and the Provincial Departments of Fisheries, Forests and Wildlife agreed to extend the original area to over an area of 3312 hectares in 1998.

The present investigation studied the environmental variables at an altitude of 2130m and 2500m where daily temperature, precipitation (rainfall) humidity during morning (0800 hrs.) and evening (1700 hrs.) were noted; the average daily precipitation was also observed during the study period. The work started in March 1997 and lasted for 3 consecutive years, ending in February 2000.

Materials and Methods:

Precipitation (Rainfall): Any open container that has a consistent cross section through the cane may be used as a rain gauge. Various types of sophisticated rain gauges are used to measure small and large amounts of rain fall - Pakistan Meteorology Department (PMD). A rain gauge having a diameter of about 5 inches at the top was used to collect the dropping rain (locally manufactured in the workshop of Pakistan Meteorology Department, - PMD) in the container. Once the drops are caught, a funnel passes the water through a narrow opening into a cylindrical measuring tube that had a cross-sectional diameter one-tenth of the receiver (standard), readings were taken to the nearest 0.1mm as given on the scale of measuring cylinder. The instrument is designed to avoid the effect of evaporation. Precautions were taken to install the instrument at a suitable place in the field to minimize the wind and turbulence effect. For this purpose a wind screen was placed above the instrument so that the rain falls into the gauge and not carried across it, instead of collecting a representative quantity of rain.

Humidity (Moisture): The term is used generally to describe the amount of water vapours in the air. Presently many kinds of devices and methods are used to determine the amount of vapours (humidity) and to quantitatively express humidity which is denoted as absolute humidity, specific humidity and relative humidity (PMD).

In the present study, the moisture content of air i.e. the relative humidity was determined twice a day at 800 and 1700 hrs. The measurements were taken with the help of two identical thermometers fixed in the "Enclosure Screen" which is locally made in the workshop of PMD - Karachi, one was with wet bulb and the other

with a dry bulb. The thermometer with wet bulb, has a thin muslin strip wrapped around the bulb at the base and its other end is dipped into the water (in a fixed water bottle below the wet bulb). A continuous current of air is passed over the strip of cloth, as a result of which water evaporates from the strip and the temperature of the wet bulb lowers the thermometer reading. The amount of cooling is directly proportional to dryness of the air; the drier the air, the more is the cooling. Therefore, the larger the difference between the readings of the two thermometers, the lower is the relative humidity and vice versa. If the moisture increases and the air is saturated, no evaporation will occur. In this case, the two thermometers will have identical readings and the relative humidity in the air will be 100 percent.

Tables (standard) were devised for calculating the relative humidity. Readings of wet and dry bulb thermometers were used to determine the relative humidity with the help of standard table.

Temperature: Both maximum and minimum temperatures were obtained. The thermometers are designated as the maximum and minimum thermometers (Casella, UK). Mercury is used in case of "maximum thermometer". A narrow passage called constriction is present in the bore of the glass tube just above the bulb. As the temperature rises, the mercury expands and forced through the narrow opening whereas when the temperature falls the constriction prevents the return of mercury. As a result, the top of the mercury column remains at the highest point. The instrument is reset by shaking after taking the reading. Once the thermometer is set, it indicates the current air temperature.

Conversely, the thermometer used to record minimum temperature contains a liquid of low density such as alcohol. Temperature measurements were taken accurate to 0.1mm. The accurate determination of air temperature depends not only on the care with which the thermometer is constructed but also on its proper exposure. To obtain a meaningful temperature reading, thermometers must be shaded from direct sunlight and be shielded from radiating surfaces such as buildings and the ground. Radiation should be prevented from reaching the instruments because thermometers are much more efficient absorbers than the air. It is the air temperature that is desired not the temperature of the thermometer after absorbing radiation. In addition, good ventilation is essential. Thermometers sheltered from freely moving air can not indicate the true air temperature. In order to take precise and correct readings free of various environmental factors, thermometers were hanged in the "Enclosure Screen". The Enclosure Screen is a white box having louvered sides permitting the free movement of air through it while shielding the instruments from sunshine and precipitation. The screen was placed over a grassy ground and was mounted on a stand about 2 meters above the ground.

Observations and Discussion:

Since the present study site is located along a main ridge running North-South at an altitude ranging from 1600 – 3000 meters from the sea level, as such it can be placed in moist-temperate climate (Champion and Seth, 1966) which is heavily influenced by the monsoonic rainfalls (Roberts, 1997). The summers of the Park are quite moderate but winters are quite covered with heavy snowfall.

Temperature:

During the study a little variation in temperature was observed at two different study stations located at 2130m and 2500m. The minimum lowest temperatures occurred in the months of January and February (Figures 1 and 2) at both the altitudes (stations) where daily minimum average temperatures were below the freezing point and the daily maximum average were below 11°C. While in May, June and July daily minimum average temperatures were calculated above 13 °C and daily maximum temperatures averaged below 27 °C devised from the standard tables which contained the daily entries of minimum and maximum temperatures at both the stations at 2130m and 2500m altitude. The temperature graphs (Fig. 1 and 2) are showing values of daily minimum and maximum averaged of the two dissimilar altitudes abstracted from the daily recorded values. Daily recorded values typically may vary from the monthly averaged calculates.

Variation in average daily temperatures as shown in the figures 1 and 2 clearly indicates a momentous rise from the month of February to June during all the years and then a gradual fall (return) to the month of January.

Due to differences in the temperature at two different altitudes, the forest habitat also predominantly differed. At 2500m fairly mixed forests of coniferous dominates the Himalayan

Silver Fir, *Abies pindrow* Spruce, *Picea smithiana* Blue Pine, *Pinus wallichiana* yew, *Taxus wallichiana* and broad-leave and evergreen plant species represent admixture of Holly Oak, *Quercus floribunda* Oak, *Quercus glauca* Himalayan Bird Cherry, *Prunus Cornuta*

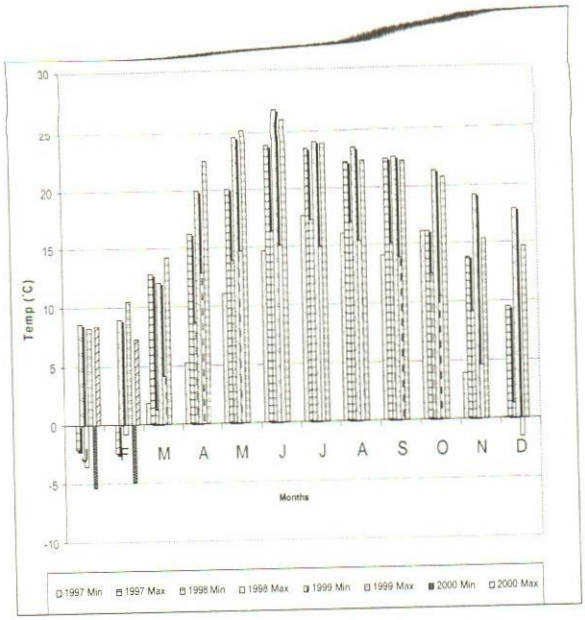

Fig 1: Seasonal variation in values of daily average temperature (maximum and minimum °C) at 2130m altitude (station -1) Ayubia National Park during the study period from 1997-2000.

Himalayan Popler, *Populus cilliata* Large-leaved Elm, *Ulmus wallichiana* Maple, *Acer caesium* and Horse Chestnut *Aesculus indica.* At 2130m altitude where only Blue Pine *Pinus wallichiana* and Deodar *Cedrus deodara* sparcely spread, the other species of broad leave also intersperse with bare patches, these include as White Oak, *Quercus incana* Walnut, *Juglans regia* and many other wild fruit species. The bush layer is dominant in this range with the large ground coverage of herbaceous flora. This clearly indicates that temperature greatly influenced the wild life which inhabit at the different ranges of the area, and due to concentration of forests at high altitude, the condensation of wild life also occurred.

There is a wide variation in daily or monthly average (minimum and maximum) temperature at a given altitude during the same month. This variation is more marked during colder seasons i.e. from December to March. Variation gradually decreased during spring and warmer months of June, July and August. From September onwards this range of temperature begins dropping (decreasing) till February.

The same pattern of variation in average (minimum and maximum) temperature was also derived from the daily taken readings at higher altitude (2500m). A maximum variation of at least 11°C represented during the cold months which decreased to 5 - 6 °C in warmer seasons.

The maximum difference between temperature of warmest month (e.g. June) and coldest months (e.g. January & February) was more than 20°C at a given altitude.

It is well known that, animals of one sort or another can thrive high on mountains or at high altitudes and in the heart of equatorial continental deserts. Not only the average temperature but also its variability will be reflected by the particular animal or plant. Those that live in cold places have a favourable range lower than that for animals and plants that occur in warmer zones.

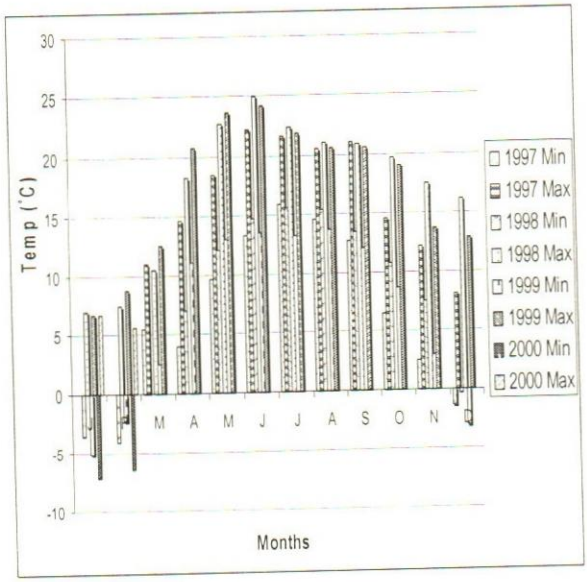

Fig 2: Seasonal variation in values of daily average temperature (maximum and minimum °C) at 2500m altitude (station – 2) at Ayubia National Park during the study period from 1997-2000.

If an animal is introduced (exposed) to a temperature higher or lower than its normal range, it may either could not survive or if continue to live its growth and ability to reproduce will badly suffer.

Moisture (Humidity): The present study may be regarded as the one which has taken observations regarding humidity, temperature, precipitation etc. at Ayubia National Park. Daily two readings were noted, one in the morning at 0800 hrs. and the other in the evening at 1700 hrs. The observations were made at two different altitudes; at 2130m altitude (Figures 3 and 5) and 2500m altitude (Figures 5 & 6).

The average humidity markedly increased during the heavy rainy seasons (monsoon) at both the altitudes. In general the humidity increased during the evening at both the altitudes while it rarely increased in the morning as compared to the evening. The values of humidity may differ ranging from 6 to 17% the same day in the morning and evening and with the increase or decrease in the altitude. While comparing the humidity in the same month from 1997 to 2000,

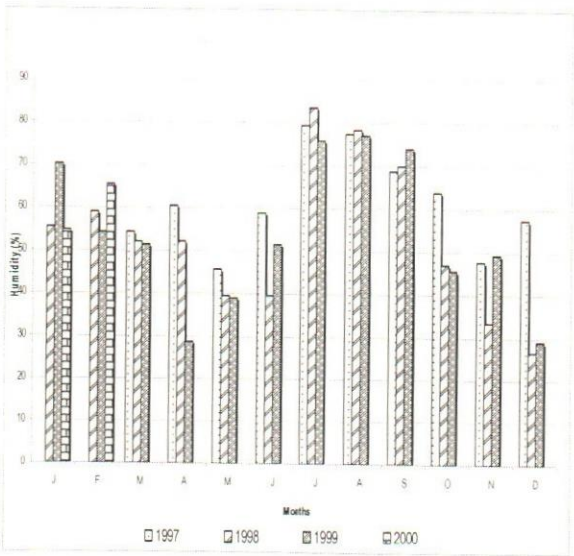

Fig 3: Seasonal changes in values of daily average humidity (%) (station-1) at 2130m altitude of Auybia National Park during the study period from 1997-2000 based on observations taken daily at 0800 hours.

it was observed that during a given period of the year the relative humidity was almost constant with the exception of a very minor variation which may have a negligible effect as a whole. The same observation is made at the higher altitude starting from March to February.

A gradual decrease in values of humidity was recorded from January to June and thence a sharp increase in July occurred reaching to as high as 93.32% in the evening and 88.9% in the morning at 2500m altitude in 1998. This was the maximum average of the monthly humidity noted during the three years of study. A gradual and continue decline in the values of daily average humidity was seen commencing from September to December. The minimum average humidity was noted in the month of December when the ground was everywhere covering snow. The only variation in this observation was recorded during the year 1997 when the daily average humidity was recorded 57.52% in the morning at 2130m altitude and 69.52% in the evening as compared to the altitude of 2500m where it was markedly high as 63.68% in the morning and 74.58% in the evening.

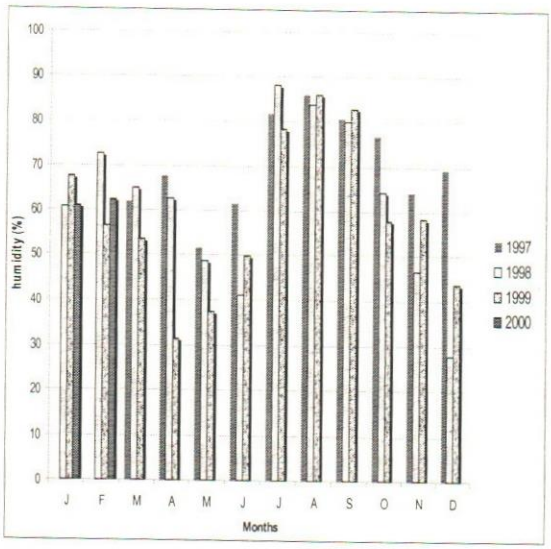

Fig 5: Seasonal changes in values of daily average humidity (%) (station-1) at 2130m altitude of Auybia National Park during the study period from 1997-2000 based on observations taken daily at 1700 hours.

This was quite a humid atmosphere as compared to the readings noted during the following years in 1998 and 1999 when in the same month the humidity was low as 26.74% and 29.26% in the morning and 28.0% and 43.74% in the evening in respective years at 2130m altitude. At 2500m altitude these values were 32.42% and 34.61% in the morning and 34.13% and 49.48% in the evening respectively. As a result, it was the lowest noted atmospheric moisture during the study period in these moist-temperate environs of western Himalayan range.

In short, the humidity was noted at its maximum during rainy periods and minimum during snowy seasons. It was observed that most animals need to keep the proportion of water in their bodies' within rather narrow limits. The tendency, which can be readily observed in some animals, to move in a definite direction along a gradient of

humidity until they come to rest in some particular part if it may some times be recognized as an adaptation which helps the animals to avoid extremes of wetness or dryness and bring it forward the places where moisture is more favourable. The distribution of many animals is restricted by extensive wetness or excessive dryness.

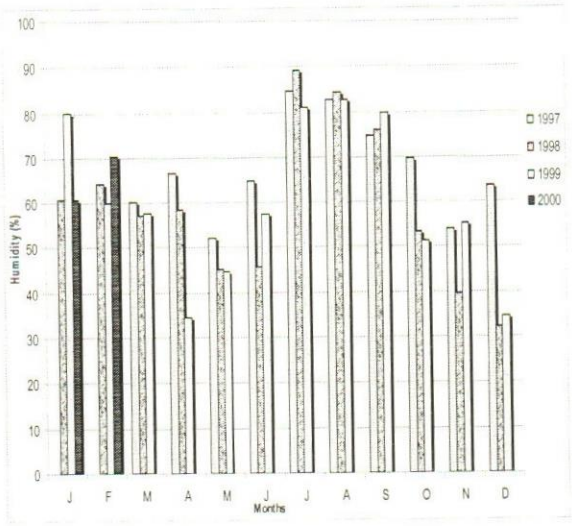

Fig 4: Seasonal changes in values of monthly average humidity (%) (station-2) at 25000m altitude of Auybia National Park during the study period from 1997-2000 based on observations taken daily at 0800 hours.

It was observed that animals may respond to moisture in a way which takes them to places where the moisture gives them a good chance to survive and multiply, for example yellow-throated marten, *Martes flavigula* Murree vole, *Hyperacrius wynnei* Himalayan giant flying squirrel, *Petaurista petaurista albiventer* Kashmir masked palm civet *Paguma larvata grayi* and Koklass Pheasant *Pucrasia macrolopha biddulphi* adapted and preferred high moisture conditions.

Some animals move away from moisture to dry places while others move from dryness to wetter places. But whether they are in dry or wet places, animals are still faced with the necessity for maintaining the water content of their bodies at a relatively constant level. When their water content falls below a certain minimal amount they dies, animals also die when their water content increase above "normal" as it may in very wet places (observations on many bird species).

Precipitation (Rainfall):

Except for the maximum snowy days which were observed during January and February, the rest of the calendar days were rainy days but there were very low rains in the months of November and December. It was very little (0.46mm) daily average in April, 1999 and too heavy (21.83 mm) in August, 1997. Soils being deep and porous absorbs a good amount of (water) precipitation which in case , many springs flow in the area which provides a pleasant environment for a number of riparian species which can not live far from the water, for example the forktails, redstarts and dippers.

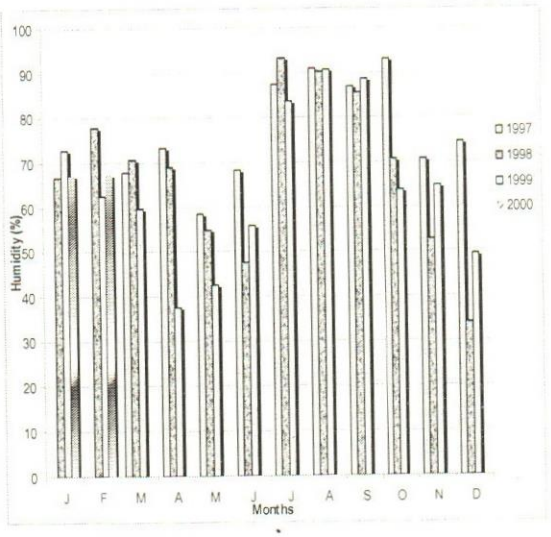

Fig 6: Seasonal changes in values of monthly average humidity (%) (station-2) at 2500m altitude of Auybia National Park during the study period from 1997-2000 based on observations taken daily at 1700 hours.

The area observed the dry season during the months of May and November. In the spring season there were good amounts of rains (February, March and April). After a short break, there was again a burst of heavy showers during the months of June, July and august. This burst was heavier due to monsoonic influence than the episode that occurs in the early months of the year. The same pattern was observed at both the altitudes at 2100m and 2500 m (Figure 7 and 8). The only difference is in the amount, the rains are higher at 2130m and lesser at 2500m altitude because heavier clouds seemed to occupy the lower height than 2500m altitude. Unusual split of rains was experienced in August 1997 when it was calculated as daily average above 20mm.

Light is mainly important in relation to behavior and as a stimulus for those mechanisms which

regulate life cycles and keep them in step with seasons. In the present case, generally the weather is cloudy and the forest has a thick canopy which prevents penetration of direct light at the floor. The moist-temperate forest is a paradise for those species which are low-light loving.

It is a common observation that many species of animals are not equally active throughout the day. Some are primarily nocturnal, others are diurnal and still others are referred to as "crepuscular" which are active mainly at dawn and dusk. A species may confine its activities of feeding, mating , and moving about from one place to another to there particular periods of the 24 hours light in the main environmental components which under go a daily fluctuations besides temperature and moisture.

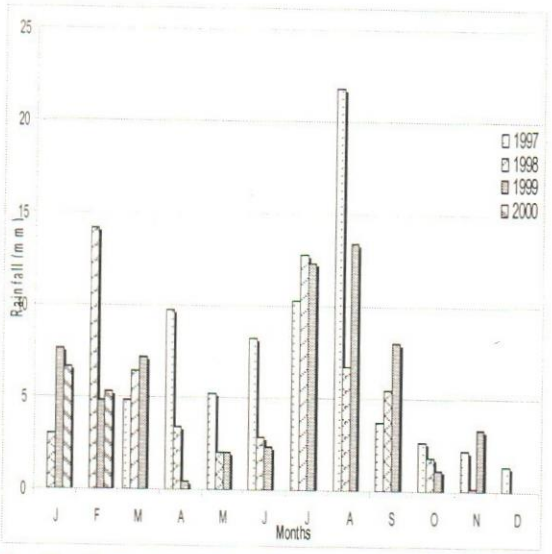

Fig 7: Seasonal variation in values of daily average rainfall (mm) (station - 1) at 2130m altitude of Ayubia National Park during the study period from 1997 - 2000.

Desert climates are characterized by annual rainfall of less than 250mm per annum with total highly unpredictable from year to year, and potential evaporation exceeding rainfall often by a considerable amount (Begon et. al. 1990). For instance Kirthar National Park (KNP) Sindh and Lal Sohanra National Park, Punjab (LNP) where soils are sand dunes and soft, heavily eroded by the winds (LNP) gravally-hilly, unconsolidated and skeletal (KNP) and therefore under arid climate conditions with low rates of activity by organisms may have a prominent aspect. Humidity is very low and the winds are dry. The vegetation is likely dominated by open communities of small trees and woody shrubs, most of which are winter deciduous.

Thus in case of Kirthar National Park, mean annual rainfall is 150-200mm falling mostly in July and August. Temperatures are often extreme, exceeding 38 °C during most of the summer. Humidity is lowest in summer and highest in winter (Holloway and Khan, 1973). Thus the plants which grow characterized by the species of Saharo-Sindhian biogeographic region (Roberts, 1995) with the distribution of many species and genera stretching from north-eastern Africa though to sindh and the Punjab. Common species of flora in KNP comprise mostly as bushy woods and plants as *Acasia nilotica*, *A. Senegal*, *Euphorbia caducifolia*, *Salvadora oleoides*, *Prosopis cineraria* and *Tamarix spp*. The tropical thorn low mountain range provide the major refuge for a number of rare and endangered mammal species including Sindh ibex (wild goat), urial (wild sheep), chinkara gazelle, striped hyaena, leopard and desert wolf, pangolin and jungle cats (Roberts, 1997).

While the desert sand dune environment of Lal Sohanra national Park, Biogeographical Province - Thar Desert are arid subtropical continental characterized by low sporadic rainfall, hot summer winds low relative humidity, high evaporation rates, and mild winters. Vegetation is dominated by *Acasia nilotica*, *Suaeda-Salsola* scrub and riverine *Tamarix* forest, *salvadora oleoides*, *Prosopis spicigera* and *P. glandulosa*. Important fauna includes; black buck became extinct in the Cholistan desert, reintroduced in the large enclosures together with chinkara, nilgai, hog deer, and Indian rhinoceros (Roberts 1975, Sheikh 1982). Other mammals include wolf, jackal, Bengal fox, ratel, common otter, Indian mongoose, caracal, jungle cat and wild boar (masud 1980).

Alpine environs of Khunjerab National Park - Biogeographical Province Himalayan Highlands are represented by the range from 3200m to over 6000m, half of the park is above 4000m (Wegge 1988), distinguished feature is Khunjerab pass, and the gateway to China Karakoram highway is at 4934m altitude. Climatic conditions vary considerably with altitude. The minimum temperature winter (December and January is -12 °C). July and August are the hottest months with a mean temperature of 14 °C. Most precipitation falls during the winter in the form of snow. Vegetation is sparse as *Salix spp.*,

Potentilla desertorum, *Mertensia tibetica* and a few grasses and sedges dominated by *Saxifraga sibirica*, *Primula macrophylla*, *Sedum spp.* and *Polygonum spp.*

Only fifteen species of mammals are recoded inhabiting in Khunjerab national Park, others are likely to be present (Wegge, 1988). Most important mammals adapted in this harsh environment comprised of Marcopolo sheep, blue sheep, snow leopard and Himalayan marmot (Schaller, 1974), and birds include Himalayan snow cock and chukar are common (Rasool, 1981).

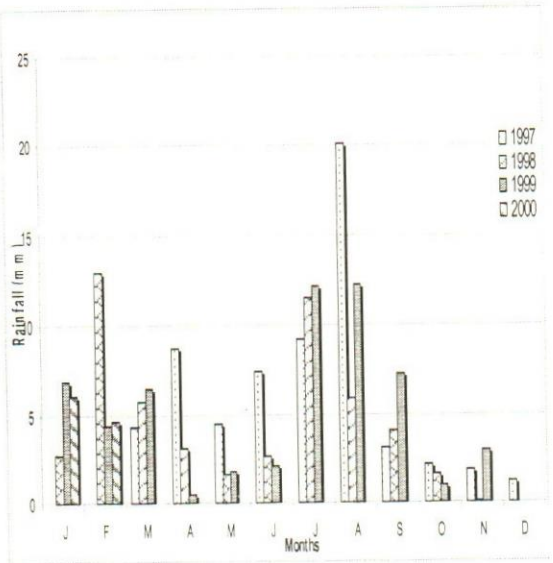

Fig 8: Seasonal variation in values of daily average rainfall (mm) (station - 2) at 2500m altitude of Ayubia National Park during the study period from 1997 - 2000.

Himalayan habitat in the alpine belt is characterized by glaciers and glacial deposits such as moraines, outwash etc. the vegetation is influenced by climatic factors such as rainfall, humidity, temperature and winter precipitation apart from topographical considerations like direction and precipitousness of slope. Exposed steep slopes in many situations don't permit the formation of matured soil as the mineral soil is easily washed down with the humus layer.

Rainfall in the alpine environment may be as low as 100 - 120mm while in the winter precipitation is heavy in the form of snow. At 4500m., it may exceed 10 meters. As regards temperature, it falls with the increasing altitude at the rate of 1 °C, for each 180 meter rise, daily fluctuation is possible (Meher and Puri, 1989)

In the present case, soils are porous, deep and fertile on the steep slopes, they have strong capacity of water holding and absorbing which in turn they grow a rich variety of plant life (421 species of flora), and support a large diversified fauna (22 mammal species, 154 species of birds and 8 species of herps). Rainfalls and atmospheric moisture content is high.

Thus the characteristics of the different environments are unique. Champion and Seth (1966) classified alpine vegetation as alpine forest and alpine scrub which grow above 3600 meters, and the temperate forests below 3600 meters and above 1700 meters altitude. Below this (1700 meters altitude), the range is occupied by the tropical and sub-tropical forests. It is for this reason that in each case the environment is greatly differentiated with the adaptation of fauna and flora. Life therefore is an active equilibrium between the living organisms and its surrounding, an equilibrium which can be maintained only if the environment suits the particular animal or plant which is then said to be adapted to that environment (Shafique, 2003).

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Study of the Carcass of Marine Animals Beached after "Tasman Spirit" Oil Spill at Karachi, Pakistan

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Abstract

"Tasman Spirit" oil spill occurred along the coast of Karachi, Pakistan in July 2003. An assessment of the immediate damage of fishes and other animals was made which revealed that a large number of fishes and other animals died immediately after the oil spill. The study further showed that distribution and abundance of marine animals were adversely affected along the beaches of Clifton, Sea View and adjoining areas which were directly affected by the oil spill. Analysis of the tissues of the dead animals revealed presence of high levels of polycyclic aromatic hydrocarbons.

Keyword: "Tasman Spirit" Oil Spill, carcass, polycyclic aromatic hydrocarbons, necropsy

Introduction:

Incident of grounding of oil tanker "Tasman Spirit" occurred in July 2003, which caused a major oil spill along Karachi coast. Following this spill, a large number of fishes and other marine animals were reported dead and beached at Clifton, Sea View and adjoining areas. Present paper describes the species composition, initial post mortem analysis and bioaccumulation of polycyclic aromatic hydrocarbon in the tissues of dead animals collected during and immediately after the oil spill.

About 235 species of fishes have been reported from the nearby mangrove areas on the eastern side of Clifton (Ahmed *et al.*, 1988). Hasan and Ahmed (2000) have estimated the percentage composition of different groups of shrimps and fishes in the area which reveals that shrimp contribute about 22% in the total catch whereas mullets contribute about 15%. Although marine turtles are not reported from Clifton beach but there are important nesting grounds of turtles at Hawkesbay and Sandspit western side of Clifton beach. Two species of marine turtles i.e. *Chelonia mydas* (green turtle) and *Lepidochelys olivacea* (olive Ridley turtle) are known from these beaches (Firdous, 1988). Among cetaceans, Indian humpback dolphin (*Sousa plumbea*) and black finless porpoise (*Neophocaena phocaenoides*) have been reported commonly from coastal waters of Karachi. Beaked sea snake (*Enhydrina schistosa*) is frequently found in the adjacent to Clifton (Hasan, 2004).

Materials and Methods:

Weekly surveys were conducted along the Clifton beach to determine the causes of mortality of fishes and other marine animals from August to November 2003. Two main sites were selected along the Clifton beach, between old Clifton and sea view and between Dodarya to further east affected by oil spill. The first site was heavily affected, while the second site was less affected by the oil. One kilometer inter-tidal zone was surveyed by four persons along the beach for collection of carcasses.

The dead animals were identified Munro, 1955; Bianchi, 1985; Hoda, 1988; Roberts 1997), weighed measured and wrapped in aluminum foil and frozen till further analysis.

Before analysis, samples were thawed and tissues of 34 specimens were removed with the help of scalpel and got analyzed at National Institute of Oceanography, Karachi for polycyclic aromatic hydrocarbons (PAHs) by high performance liquid chromatography (HPLC).

Results and Discussions:

Observations made during the major spill (August – October 2003) revealed high mortality of fishes and other animals either due to smearing of oil on the body especially gills or because of toxic effect of oil (Table-I). Out of 95 specimens of dead animals collected were comprised of 25 species of fishes and 5 species of crabs; of these 51 were studied in detailed for length, weight and necropsy. Local administration has carried out cleanup operation on the beach to remove oil, dead animals and affected sand, however, during this period a high mortality was observed. In one of such surveys carried out on 19th August, 2003 about 1,000 fishes were found to be dead in an area of 1 sq km. The study revealed that mullets

Liza tade and *L. vaigiensis* constitute the 50% of the dead animals. Sardinellas (*Sardinella spp.*) were observed to contribute 20% of collected speciemens. Sea catfishes (*Arius spp.*), croakers (*Johnius spp.),* scat (*Scatophagus argus*), eels (species could not be identified due to mutilation), long-spine tripod fish (*Pseudotriacanthus strigilifer*), scorpion fishes, rays and guitar fishes were other dominant groups.

Two specimens of dead Olive Ridley turtles were collected from Clifton beach on 15th and 21st August, 2003 whereas one live specimen was observed to be beached in the area. The live specimen was smeared with oil. Among marine mammals, one dead black finless porpoise (*Neophocaena* phocaenoides) was collected on 24th August, 2003. One decomposed beaked sea snake (*Enhydrina schistosa*) was also collected from Clifton beach.

After three months of the oil spill (October 2003 and onward), the number of dead animals decreased substantially. The major groups of fishes observed during this period were grey mullets, croakers, groupers, sardinellas, shads, terapons, ponyfishes, flounders, tripod fishes, soles, seabreams, scats, silver sillagos, queenfishes, flatheads, needle fishes, catfishes and pufferfishes. In addition, crabs (*Charybdis feriatus, Portunus sanguinolentus, P. pelagicus, Matuta planipes and Ocypoda votudula*) were also found among the dead fishes. Two dead specimens of olive ridley turtle (*Lepidochelys olivacea*) were collected from Clifton beach on 25th October, 2003 and 5th November, 2003, respectively. One specimen of dead bottlenose dolphin (*Tursiops truncates*) was also reported on 5th November, 2003.

Table I: Dead animals collected from Clifton beach and adjacent areas after "Tasman Spirit" Oil Spill and Concentration of Polycyclic Aromatic Hydrocarbons (PAHs) in selected animals.

Locality	Collection	Species	L (cm)	W (g)	Comments	PAHs (ppb)
Casino	7-10-2003	Small scaled terapon (*Terapon jarbua*)	16.8	60	One eye absent. Skin oily. Whole body cavity filled with black substance.	10.33
Clifton (Ship)	17-10-2003	Mullet	12	25	Gills, skin and body cavity filled with black substance.	4.515
"	06-11-2003	Karanteen Sea bream (*Crenidens crenidens*)	16	70	Gills covered with oil. No gross abnormality seen in internal organs.	19.31
Clifton	21-10-2003	Sardinella (*Sardinella sp*).	10	20	Gills and gut filled with black substance.	28.49
"	"	Sole	23	105	Eyes absent, Gills and skin covered with black substance. No abnormality seen in internal organs.	15.46
"	"	Big eyed scad (*Selar crumenophthalmus*)	20	80	Gills and skin black. Hemorrhage in gut.	15.41
"	"	Belanger's croaker (*Johnius belangerii*)	24	150	Gills and skin black. No gross abnormality seen in internal organs.	10.96
"	"	Blacked croaker (*Nibea maculata*)	15.9	52	Gills and skin covered with black substance. No abnormality seen in internal organs.	6.02
"	"	Small scaled terapon (*Terapon puta*)	13	45	Gills and skin filled with black substance. No abnormality seen in internal organs.	-

Locality	Collection	Species	L (cm)	W (g)	Comments	PAHs (ppb)
"	"	Mullets	13	45	Eyes absent. Gills black. Liver hemorrhagic.	6.08
"	"	Blue swimming crab (*Portunus sanguinolentus*)	11x 5.9	60	Carapace and internal organs filled with black substance.	20.75
"	"	Square-tail mullet (*Liza vaigensis*)	21.8	140	One eye absent, lesions on skin and whole body cavity filled with black substance.	-
"	"	Grouper (*Epinephelus sp.*)	22	100	Gills, skin, mouth black. Internal organs black.	-
"	22-10-2003	Spot-tail needlefish (*Strongyleura strongyleura*)	34	53	Gills clear, Gut black.	10.55
"	"	Puffer fish	18	85	Gut black	2.75
"	"	Short-nosed tripod fish (*Triacanthus biaculeatus*)	12.1	22	Black skin. No abnormality seen in internal organs.	5.59
"	"	Small scaled Terapon (*Terapon puta*) (live)	13	30	No abnormality seen in any part of the body.	11.62
"	25-10-2003	Crab (*Partunus sanguinolentus*)	2 x 1	14	No gross abnormality seen.	20
Casino	25-10-2003	Mullet	15.6	45	No abnormality seen in skin. Gills, liver, stomach filled with black substance.	11.65
"	25-10-2003	Splendid ponyfish (*Leiognathus splendens*)	11	25	Gills black. No abnormality seen in internal organs.	-
Marina Club	1-11-2003	Mullet	11	25	No gross abnormalities. Gills covered with black substance.	11.13
Clifton "	"	Bar tailed flathead (*Platycephalus indicus*)	9	15	Whole body blackened due to oil. No abnormalities seen in gills. Liver ulcerated. Injured tail.	20
Shireen Jinnah Colony	5-11-2003	Silver sillago (Sillago sihama)	16	40	Gills and stomach filled with black substance. No gross abnormality seen at skin and other organs.	7.96
"	"	Saddle grunt (*Pomadysis maculatum*)	18	80	Gills and skin have seen black. No gross abnormality seen in internal organs.	13.9
"	"	Mullet	16	50	Hemorrhagic gills, Eyes hemorrhagic. Skin covered with oil. Internal organs have also seen oily.	48.54
Marina Club (Ship)	6-11-2003	Long-spined tripod fish (*Pseudotriacanthus strigilifer*)	15	40	Gills filled with oil.	20.60
Clifton (Ship)	6-11-2003	Blue spotted flounder (*Crossorhombus azureus*)	18	64	No abnormality seen.	29.32
"	"	Elongate sole (*Solea elongate*)	10.2	17	No gross abnormality seen.	-
Clifton (Ship)	6-11-2003	Slender barred pony fish (*Scutor insidiator*) (live)	9	11	No gross abnormality seen	6.12
"	"	Crab (*Charybdis feriatus*) (live)	4x2	5	Black carapace, Internal tissues filled with black substances.	6.43
"	"	Small scaled terapon (*Terapon puta*)	8.5	11	No gross abnormality seen.	-

factors influencing the persistence of species in Salt Range, Pakistan.

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Echinoderms in the collection of the Natural History Museum, Zoological Survey Department, Pakistan

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Echinoderms are an important group of exclusively marine animals. For commercial and academic point of view a survey of local fauna is thus essential to explore commercial and potential commercial species. The echinoderm fauna of Pakistan remained neglected. Hoque (1969) reported 24 species whereas Tahera (1992) listed 26 species from Pakistan. Wood-Mason and Alcock (1891), Anderson (1894), Koehler (1899, 1914, 1927) Koehler and Vaney (1908), Clark (1931, 1932) and James (1966) have contributed to the echinoderms of India. Present paper describes the echinoderms housed in the Natural History Museum of the Zoological Survey Department, Pakistan.

Material and Methods

Present study was based on the material collected during 1949-1988 from various parts of the Pakistan coast and housed in the Museum of Zoological Survey Department. Additional samples collected from Keameri, Buleji, Native Jetty, Baba Island, Manora along Karachi coast, and Pasni from Balochistan coast between 1991 and 2008 were also examined. All the specimens are now housed in the Natural History Museum of the Zoological Survey Department, Pakistan. The samples were preserved in 70% alcohol.

Results and Discussions:

The study revealed a total of sixteen species where housed in the Natural History Museum of the Zoological Survey Department.

Asteroidea (star fishes)

1. *Astropecten indicus*
2. *Anthenea rudis*
3. *Asterina Lorioli* and
4. *Asterina burtonii*

Ophiuroidea (brittle stars)

1. *Ophioplocus imbricata* and
2. *Macrophiothrix aspidota*

Crinoidea (feather star)

1. *Comanthus samoanus*

Echinoidea (sea urchins)

1. *Echinometra mathaei*
2. *Echinostrephus molaris* and
3. *Stomopneustes variolaris*

Holothurioidea (sea cucumber)

1. *Stolus buccalis*
2. *Actinopyga mauritiana*
3. *Holothuria (Thymiosycia) arenicola*
4. *Synapta inhaerens*
5. *Staourothyone rosacea, and*
6. *Holothuria leucospilota*

The study revealed that echinoderm fauna of Pakistan is well diversed. And all major classes of Echinoderms are represented in Pakistan. It may, however, be noticed that some of the species reported by Haque (1969) from Pakistan are not represented in the present collection of Zoological Survey Department. These include Asteroidea (*Astropecten euryaxanthus* and *Luidia amculata*), Ohiuroidea (*Ophiopeza fallax*, *Ophionereis dubia* and *Amphiura tenuis*), Echinoidea (*Temnopleurus torenmaticus and Clypeaster rarispinus*) and Holothuroidea (Stereoderma forbesi).

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