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PECULIARITIES OF MANGLA RESERVOIR: BIODIVERSITY WITH SUSTAINABLE USE OPTIONS

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ABSTRACT

Mangla Dam is located in the district of Mirpur, Azad Jammu and Kashmir and downstream to district of Jhelum Punjab, Pakistan. A large water storage reservoir constructed in 1967 on the Jhelum River in the Pir Panjal range of upper Siwaliks. It cover an area of 26,500 ha, and is an important staging and wintering area for grebes, geese, ducks, gulls, cormorants, coots and waders. It regularly supports over 30,000 waterbirds including *Aythya ferina, Fulica atra, Phalacrocorax niger, Anas acuta, Aythya fuligula, Anas platyrhynchos, Anas clypeata, Phalacrocorax carbo, Anas strepera and Larus ridibundus.* The wetland also holds an appreciable number of *Anser indicus*. During this study (winter 2006) bird data is collected in five pocket of Mangla reservoir by walking across the shore line, by boat and on vehicle in surrounding buffer zone of 2 kilometer. Field observers recorded all birds seen or heard on the site. The survey found significant populations of waterfowl, including huge flock (1,073) of Bar-headed Geese, Ruddy Shelduck, Northern Pintail and Ferruginous duck (total bird count was 31,920 of 141 species). The reservoir is an important spawning ground and source of food for fish. It contains a variety of fish species, which increase in abundance during periods of high water levels. One of the most important freshwater game fish *Tor putitora* also breeds in the Mangla Dam. The mammalian fauna of the area resemble to that of Salt range, Pothowar plateau of the Punjab province of the Pakistan and mainly of Oriental origin. The habitat is generally of Sup-tropical thorn forest type; but as thickly populated, the forest around the Mangla dam is over exploited by livestock grazing, fire-wood cutting and encroachment etc. Which results in the depletion of suitable habitat for wildlife, coupled with the indiscriminate killing of the animals. The reservoir is not protected since this water body has a great biodiversity value. There are plans to intensify management of the site, partly through greater regulation/restriction of commercial fishing, particularly in light of the dam's reduced water level. Reforestation measures have been proposed in the water catchment area to mitigate the effects of erosion and to sustain stream flow throughout the year. This study concludes that the area should be identified as Ramsar site, under its specific criteria based on waterbirds.

Key words*:* Biodiversity, Conservation, Mangla Dam, Sustainable use.

INTRODUCTION

Mangla Dam (33.12 N, 73.39 E) is located in the district of Mirpur, Azad Jammu and Kashmir and downstream to district of Jhelum Punjab, Pakistan with maximum elevation of 630 metres. A large water storage reservoir constructed in 1967 on the Jhelum River in the Pir Panjal range of upper Siwaliks. It covers an area of 26,500 ha, and is a potential candidate to be designated as Ramsar site.

Mangla dam was constructed in 1967 on river Jhelum and is the 12th largest dam in the world. The dam was planned first and foremost to increase the amount of water that could be used for irrigation from the flow of the river Jhelum and its tributaries. Its secondary purpose was to generate electrical power from the irrigation releases at artificial head of the reservoir. The dam was not designed as a flood controls structure, although some benefit in this respect also arises from its use for irrigation and water supply. As the Mangla dam has excellent wintering and residing habitat conditions for a variety of waterfowl species and fish. And due to number of factors the wetland habitat is being deteriorated by human over exploitation, causing threats to the existing biodiversity of this very important wetland site of Pakistan. Mangla reservoir is a wetland of international importance which is clearly depicted in present survey studying ornitho-fauna of the site.

Mangla dam wetland has come into view as a major resort for migratory birds in the famous Indus Flyway route as also an attraction for bird watchers. The wetland has rich biodiversity with meager forests round the dam having some plant species which serve as edible fruits for the migratory birds. The water body occupies an area of at least 18,000 hectares and extends up to 26,500 hectares at the peak monsoon. An area of 55,100 hectares within the radius of 2 km should be notified as the buffer zone.

The commercial fishing in the wetland was initiated soon after the emergence of wetland. It provides direct employment to about 1,000 fishermen. Important development activities like soil conservation works, and habitat improvements works should be carried out in the catchments.

The site is an important staging and wintering area for migratory waterfowls and waders. It regularly supports over 30,000 waterbirds including *Aythya ferina, Fulica atra, Phalacrocorax niger, Anas acuta, Aythya fuligula, Anas platyrhynchos, Anas clypeata, Phalacrocorax carbo, Anas strepera and Larus ridibundus*. The wetland also holds an appreciable number of *Anser indicus*. Roberts (1991, 1992) has reported 347 species of birds from Mangla and its surroundings, that consists of 176 non passerines and 171 species of passerines. Grimmit *et al.,* (2001) reports 336 species of birds from which 153 were breeding residents, 115 were winter visitors, 15 were summer visitors, 39 passage visitors, and 14 were occasionally recorded species.

The reservoir is an important spawning ground and source of food for fish. It contains a variety of fish species, which increase in abundance during periods of high water levels. One of the most important freshwater game fish *Tor putitora* breeds in the Mangla Dam.

The mammalian fauna of the area resemble to that of Salt range, Pothowar plateau of the Punjab province of the Pakistan and mainly of Oriental origin. The main mammalian species found here are *Canis aureus, Canus lupus, Herpestes auropunctatus, Lepus capensis, Lutra prespcillata, Manus crassicaudata, Mus musculus, Pipistrellus spps, Rattus rattus, Rousettus leschnauln, Suncus murinus, Sus scrofa, Viverricula indica* and *Vulpes vulpes*.

However, there is abundant aquatic vegetation on the lake and mixed perennial and deciduous scrub forest on the hill sides girding up the lake to provide enough food and shelter respectively to the migratory birds. There are small patches of marsh with *Phragmites karka* and *Typha angustata* along the shoreline, and beds of *Chara* species *Hydrilla verticillata* and *Vallisneria* species in the reservoir. Adjacent land is mainly under cultivation of wheat. The natural vegetation of the region is dry subtropical broad-leaved forest dominated by species such as *Acacia modesta, Dodonea viscosa, Cenchrus ciliaris, Heteropogon controtus* and *Cymbopogon* species (Scott, 1989).

Forest in the immediate surroundings of the Mangla dam is dry sub tropical scrub type. These forests occur in lower reaches of Mirpur, Kotly and Bhimber districts and also extend upto Muzaffarabad along with the river Jhelum. Common species are *Olea ferruginea, Acacia modesta, Dalbergia sisso, Pistacia integerrima, Adhtoda vasica, Dodonea viscose, Maytenus royleanus* and *Carissa spinarum.*

The habitat is generally of Sup-tropical thorn forest type; but as thickly populated, the forest around the Mangla dam is over exploited by livestock grazing, fire-wood cutting and encroachment etc. Which results in the depletion of suitable habitat for wildlife, coupled with the indiscriminate killing of the animals as most of the local people in vicinities of Mangla Dam keep fighting and hunting dogs and hunts the animals mainly predator species like foxes, jackals and wolfs just for fun.

General location: It is a deep freshwater dam located in NNW of Punjab Province on the river Jhelum in foothills of the Pir Panjal (Figure 1). Following major towns of Azad Kashmir surround it:

Dudyal and Chakswari	North
Islam Garh	North East
Kakra Town	East
Mirpur City	South

Mangla dam is a property of government, while the adjacent areas are privately owned communal lands. The reservoir was declared protected as Game Reserve in 1972, yet no extensions was promoted in its protected status. No management plan has been prepared so far. AJK government is interested to have some plans to intensify management of the site, partly through greater regulation/restriction of commercial fishing, particularly in light of the dam's reduced water level. Reforestation measures have been proposed in the water catchment area to mitigate the effects of erosion and to sustain stream flow throughout the year.

The catchments of river Jhelum (317,000 ha) above Mangla, Poonch river (342,000 ha) and Neelum river (507,000 ha) which joins to flow into the Mangla reservoir. The fast flowing Jhelum, Poonch and Neelum rivers cut deep into the surrounding mountains and transfer tremendous quantities of sand, silt and gravel downstream.

The geological interest of the site is very high and is also responsible for the nature of present landscape. During excavation of Mangla dam fossils of elephants were discovered which are displayed in the Mangla Museum. As the site originally falls in Upper Siwalik region which are best known for their vertebrate fossil fauna in the subcontinent. There are very unique geological formations present in the Pir Panjal mountains.

The site is predominantly made up of sandstone and mud and surrounded by mountain ranges formed by sand stone and clay. The wetland throughout the year show its extent depends on the climate/overall drought and water discharge. The extent increases due to good rains and following loss of rains areas is squeezed.

Average temperature range of the Mangla fluctuates round the year. During February to April; maximum 20° to 26° C and minimum 6° to 12 °C, during May to August, it ranges between maximum 35° to 48° C and minimum 22° to 26° C and during September to

November is between maximum 26° to 32° C and minimum 14° to 18° C, while during December to January ranges between maximum 12° to 16 C° and minimum 7° to 12° C. (Average of 1995 to 2000). While precipitation rate also fluctuates round the year and average is 1,000 mm per annum.

Under the Wetlands Survey Programme Section (WSPS) of the Pakistan Wetlands Project (PWP) the aim of the expedition was to increase the knowledge of sites and species of conservation importance in Pakistan and make this widely available to all those concerned with their conservation both in Pakistan and abroad.

The objectives of the survey were;

- to carry out a complete survey of wetland species in the Mangla Dam to provide baseline ornithological data to contribute to the conservation of this area especially concerning its status as Ramsar site.
- to publicise the results as widely as possible to raise the profile of the wetlands visited and provide a basis for further surveys to continue this process.

MATERIAL AND METHODS

Survey methods: Survey methods that were mainly consist of direct and indirect field observations. Direct observations include direct counts and specimen collection and indirect observations include information gathered from interviews and general discussions with the local community.

Direct field physical counts / point counts: In order to record mammals, birds and reptiles, direct physical count method was used. This was done by taking random points and recording species diversity and abundance directly from the field. The wide diversity of species was identified on the basis of identification guides, professional field experience and the animal's habitat and ecology. Two types of survey equipment: i.e., spotting scope binoculars and video camera were used for counting and identification of the wide range of biodiversity.

Boat survey: An extensive boat survey was conducted in five pockets of the Mangla Dam for counts and bird identification.

Informal meetings with the locals: The purpose of these informal meeting was to get some information about the status and the use regime of the aquatic wildlife and the natural resources of the area. Local fishermen and hunters were interviewed for the deliberate killing of the ducks.

RESULTS

Avi-fauna of Mangla Dam: Roberts (1991, 1992) has reported 347 species of birds from Mangla and its surroundings, that consists of 176 non passerines and 171 species of passerines. Grimmit *et al.,* (2001) reports 336 species of birds from which 153 were breeding residents, 115 were winter visitors, 15 were summer visitors, 39 passage visitors, and 14 were occasionally recorded species. The reservoir has emerged as a very important staging and wintering area for waterbirds, particularly Anatidae, Shorebirds and Piscivorous birds. Over 20,000 waterbirds were present in January 1986, 44,500 in January 1987 and 19,000 January 1988 and 31,920 during the present survey of 141 forms. The maximum counts have included Common Pochard (4,330), Coot (4,228), Pintail (2,727), Tufted Duck (2,150), Shoveler (1, 802,) Mallard (1,906), Gadwall (1,672), Black-headed Gull (1,182), Little Cormorant (3,706), Great Cormorant (1,801) and Bar headed Geese (1,073). (A complete list of the birds observed during the survey has been given in the Table 1).

Different Analysis of the results: For Census Index, surveyed area under was calculated using GIS techniques to calculate avi-fauna density.

MAJOR THREATS

Pollution

Agrochemical contamination: The farmers frequently make an indiscriminate use of pesticides and insecticides. There are a great number of insectivorous birds, which are greatly affected due to these insecticides.

Diesel pumps for the extraction of water lead to leakage of oil, which directly pollute the river water. The agriculture runoff is posing a threat to the aquatic fauna including fish aquatic birds. Agricultural practice at various places in the catchments is destroying the natural habitat for the wildlife.

Due to lack of awareness, the ecological damage and human dangers of chemical pollution is increasing manifold.

Municipal pollution: Municipal Pollution is increasing manifold generally due to the lack of proper management and it is disposed openly in heaps and was seen scattered along the surroundings of the dam. This waste not only provides an un-aesthetic look but is an excellent substratum for a variety of disease causing organism. A part of this waste is carried into the river body by winds thus leading to a high oxygen demand and depletion of oxygen levels with harmful effects on the aquatic life.

Heavy metal pollution: Pollution by heavy metals is increasing in Mangla Dam due to the weathering of rocks of Pir Panjal Range and catchments of River Jhelum. This is leading to detrimental effects on the biodiversity of the area particularly on the avi- fauna.

Sedimentation: Soil erosion by the natural process gives rise to sediments in water. Sediments represent extensive

pollutants of surface water and are the sources of organic and inorganic matter in water supply.

Sedimentation is a great problem in Mangla Dam. It is increasing due to the low water flow of the dam. Weathering of rocks is also causing this problem to a great extent.

Unsustainable Utilization of Wetlands Resources

Sport hunting: Sport hunting of waterfowl is on rise in this dam area. Hunting is done by gun shooting and by netting. The local people work under the power for the influential wealthy peoples of the area and kill the ducks ruthlessly. Due to lack of technical staff, training skills and resources the wildlife department has failed to enforce law in such areas.

Hunting for subsistence: Poverty and lack of alternative livelihood resources has led to a great increase in subsistence hunting amongst the local people. In recent years, large numbers of ducks have been poisoned by farmers and even hunters for allegedly causing damage to crops. The grazing ducks like Bar-headed Geese, Wigeon, and Ruddy Shelduck have been poisoned with pesticide granules (Basudine, Carbo-furan) mixed with soaked wheat grains, and then sold in local markets for human consumption. Many other ducks particularly diving ducks are killed in fishing nets.

Unsustainable fisheries practices: Over-fishing is commonly practiced in these areas and the fishermen catch fish even during the breeding season. Exotic fish such as the Chinese Carp is posing a major threat to the local fish. These drawbacks are due to the inadequate capacity of the selected departments for sustainable fisheries management.

Fishing is a major mainstay at Mangla Dam. River and ponds are used for catching fish. People work on the permit basis for the contractors and sell the fish either to a contractor or to a fish farm.

Over harvesting of shoreline vegetation: With the increase in human population around the dam area, over exploitation of the natural resources has become a common practice.

Lopping and uprooting of trees is frequently practiced in order to get timber and fuel wood, amongst which Kikar (*Acacia karoo*) is the most common. This continuous activity will lead to a restricted growth and reduced natural regeneration in this area.

Overgrazing is a serious threat in this area as majority of the local people are shepherds. Livestock is the main livelihood of majority of the people, so as a result this livestock has to graze in any available area for survival. Thus there is a heavy livestock grazing pressure on the natural vegetation and residue crops. Livestock grazing also leads to disturbance for migratory waterfowl.

Habitat destruction: People are encroaching wetlands for increasing agricultural lands consequently productivity. Areas in and around dam are extensively used for these purposes. Agriculture practices have also led to agrochemical pollution in wetlands. On account of the lack of awareness amongst decision-makers of the importance of sound ecological management, this malpractice is mounting.

THE WAY AHEAD

Mitigation Measures: This area is rich in biodiversity, facing severe environmental threats and habitat degradation. The major factors are weak law enforcement by the government and the lack of viable alternate livelihoods. In order to sustain this unique ecosystem, mitigation measures are essential primarily at the local level. The recommendations by the survey team have been broadly classified into two major groups: short-term (bridging) and the long-term measures.

Short-term Measures

- People should be provided with alternative sources of fuel instead of dam natural vegetation in catchments.
- Awareness should be created among the people to stop the heavy use of pesticides. Measures, which minimize the adverse effects of pesticides as living organisms, should be developed.
- Illegal hunting of waterbirds should be stopped.
- Solid waste pollution should be managed properly.
- Lopping and cutting of trees should be controlled in order to reduce deforestation.
- Over grazing should be controlled and sustainable grazing should be practiced.
- Local people should be given training about conservation strategies and the efficient use of the local fuels to minimize losses to the vegetation cover of the area.
- Exotic fish species can be introduced for aesthetic as well as commercial benefits but special attention is needed to avoid competition with local species.
- Fisheries Department should strictly enforce the regulations regarding over fishing and fishing during breeding season.
- Locally extinct species should be imported and reintroduced to promote indigenous fauna.
- Private land owners should be encouraged to introduce and propagate wildlife on their lands.

Long-term Measures

Effluent Treatment Plant: There is a need to install municipal effluent treatment plant at Mirpur to throw municipal and sewage directly into the river.

Integrated Pest Management: Argro-chemical pollution is increasing at an alarming rate in the wetlands area. So,

integrated pest management should be adopted in order to reduce pesticidal pollution.

Watershed and forestry management: Catchment area of River Jhelum has great potential for reforestation and of sustainable management of existing of forest resources.

Public Awareness: Popular media including video, posters, comic books, radio, television, etc. should be used to be published the conservation needs and values of endangered birds/mammals, especially targeting communities within and near Mangla Dam.

Research

a) The richness of biodiversity in Mangla Dam reflects different and interconnected ecological processes that remain largely a mystery. Scientifically, credible research can greatly help the development of effective conservation strategies.
b) Closed coordination should be maintained among research organisations and scientists involved in research and conservation activities
c) Information is particularly needed on the distribution, abundance and habitat micro and mega-fauna species. Biodiversity indices are particularly valuable for monitoring the abundance of animals for evaluating the effect of human disturbance.

Protected areas as Wildlife Sanctuary/Ramsar Site: A managed resource approach that ensures long term protection and maintenance of biological diversity, while providing a sustainable flow of natural products and services to meet community needs may be appropriate for areas already inhibited by people. This type of protected area will probably be more readily supported by local people and therefore more viable, if adequate protection can be assured.

Legislation and enforcement: Legislation that addresses endangered animals/birds such as directed killing, fisheries regulations to reduce accidental killings, discharge of harmful pollutants, and environmental impact of development projects can be useful tool for conservation.

Ecotourism: Tourism must be managed to ensure that it does not contribute to environmental degradation or cultural disintegration. A portion of all profits should be invested in local conservation and social development. Programmes that use participating tourist to accomplish research and conservation goal should be encouraged.

Birdwatching and Hunter's Club: Mangla dam is an excellent place to watch birds. It is famous for the large numbers of bar headed geese, ruddy shelduck, pintail and waders that occur on passage, and the territory regularly attracts other species that are major rarities in Pakistan. To facilitate and encourage the study of birds in Mangla dam there should be a birdwatching club or hunter's association to assist in the enforcement of the law relating to the protection of birds in the area and to provide information and assistance to all, whether visitors to Mangla Dam or residents, who are interested in birds and also to promote the conservation of birds and their habitats in Mangla dam.

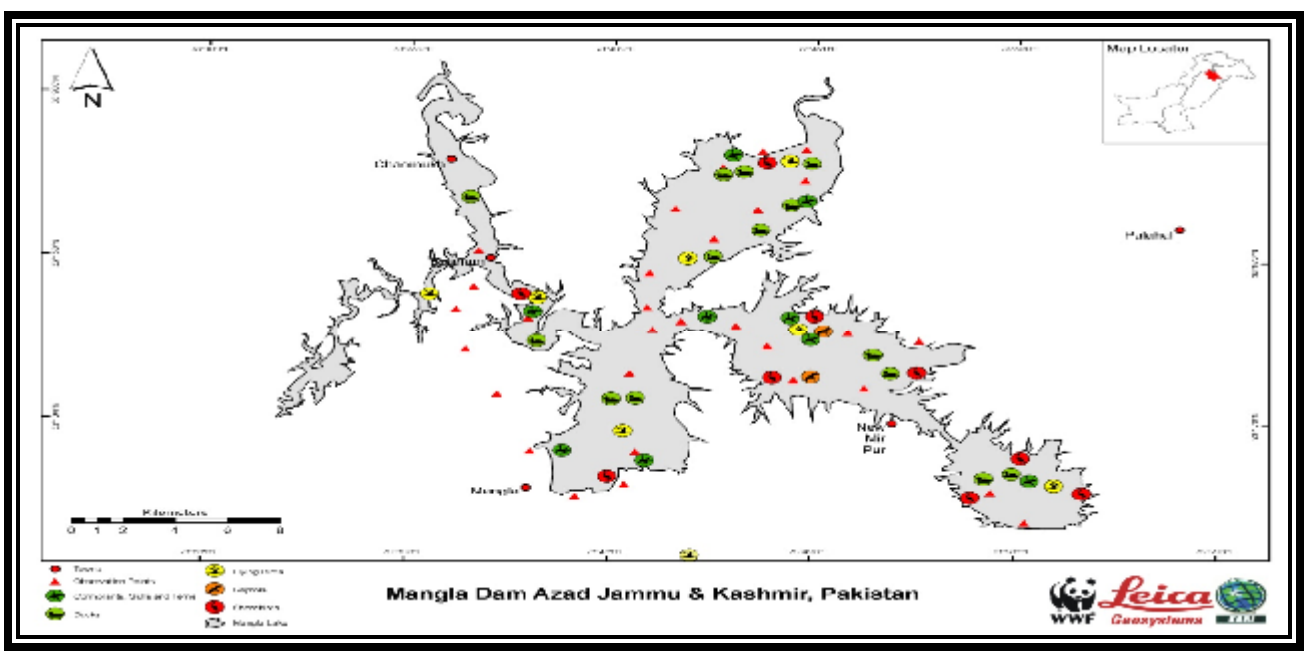

Figure: 1 Map of Mangla Dam.

Table: 1Avian Fauna observed during this survey at Mangla Dam

	Sr. No.	Common Name	Count
1	*Tachybaputus ruficollis*	Little Grebe	117
2	*Podiceps cristatus*	Great Crested Grebe	34
3	*Podiceps nigricollis*	Black-necked Grebe	25
4	*Phalacrocorax carbo*	Great Cormorant	1801
5	*Phalacrocorax fusciollis*	Indian (shag) Cormorant	45
6	*Phalacrocorax niger*	Little Cormorant	3706
7	*Anhinga melanogaster*	Darter or Snakebird	9
8	*Botaurus stellaris*	Great or Eurasian Bittern	2
9	*Nycticorax nycticorax*	Night Heron	17
10	*Ardeola grayii*	Indian Pond Heron	11
11	*Bubulus ibis*	Cattle Egret	4
12	*Egretta garzetta*	Little Egret	112
13	*Egretta intermedia*	Intermediate Egret	66
14	*Egretta alba*	Great Egret or Large Egret	17
15	*Ardea cinerea*	Grey Heron	8
16	*Ardea purpurea*	Purple Heron	4
17	*Platalea leucorodia*	White Spoonbill	21
18	*Anser indicus*	Bar-headed Goose	1073
19	*Tadorna ferruginea*	Ruddy Shelduck	444
20	*Tadorna tadorna*	Common Shelduck	86
21	*Anas Penelope*	Eurasian Wigeon	697
22	*Anas falcate*	Falcated (Teal) Duck	7
23	*Anas strepera*	Gadwall	1672
24	*Anas crecca*	Common Teal	45
25	*Anas platyrhynchos*	Mallard	1906
26	*Anas poecilorhyncha*	Spot-billed Duck	4
27	*Anas acuta*	Northern Pintail	2727
28	*Anas querquedula*	Garganey	6
29	*Anas clypeata*	Northern Shoveler	1802
30	*Netta rufina*	Red-crested Pochard	33
31	*Aythya ferina*	Common Pochard	4330
32	*Athya nyroca*	Ferruginous Duck	288
33	*Aythya fuligula*	Tufted Duck	2150
34	*Elanus caeruleus*	Black-shouldered Kite	2
35	*Milvus migrans*	Black Kite	132
36	*Haliastur Indus*	Brahminy Kite	1
37	*Circaetus gallicus*	Short-toed or Snake Eagle	2
38	*Circus aeruginosus*	Marsh Harrier	2
39	*Circus macrourus*	Pallid Harrier	1
40	*Pandion haliaetus*	Osprey or Fish Hawk	2
41	*Falco tinnunculus*	Common or Eurasian Kestrel	2
42	*Francolinus francolinus*	Black Francolin or Partridge	7
43	*Francolinus pondicerianus*	Grey Francolin or Partridge	12
44	*Turnix tanki*	Yellow-legged Buttonquail	3
45	*Porzana porzana*	Spotted Crake	2
46	*Porzana fusca*	Ruddy-breasted Crake	5
47	*Fulica atra*	Black or Eurasian Coot	4228
48	*Himantopus himantopus*	Black-winged Stilt	274
49	*Recurvirostra avosetta*	Pied Avocet	2
50	*Charadrius dubius*	Little Ringed Plover	47
51	*Charadrius alexandrinus*	Kentish or Snowy Plover	34
52	*Hoplopterus indicus*	Red-wattled Lapwing	325
53	*Calidris minuta*	Little Stint	26
54	*Calidris temminckii*	Temminck's Stint	41
55	*Lymnocryptes minimus*	Jack Snipe	51
56	*Gallinago gallinago*	Common Snipe or Fantail Snipe	28

57	*Tringa tetanus*	Common Redshank	51
58	*Tringa nebularia*	Common Greenshank	31
59	*Tringa ochropus*	Green Sandpiper	6
60	*Tringa glareola*	Wood Sandpiper	2
61	*Actitis hypoleucos*	Common Sandpiper	5
62	*Larus ridibundus*	Common Black-headed Gull	1182
63	*Larus brunnicephalus*	Brown-headed Gull	562
64	*Larus cachinnans*	Yellow -legged Gull	11
65	*Gelochelidon nilotica*	Gull-billed Tern	4
66	*Sterna aurantia*	River Tern	52
67	*Sterna acuticauda*	Black-bellied Tern	4
68	*Chlidonias hybridus*	Whiskered Tern	6
69	*Columba livia*	Rock Pigeon or Dove	143
70	*Streptopelia decaocto*	Eurasian Collared Dove	42
71	*Streptopelia tranquebarica*	Red collared or Turtle Dove	3
72	*Streptopelia orientalis*	Eastern rufous or Oriental Turtle Dove	5
73	*Streptopelia senegalensis*	Laughing Dove	4
74	*Treron phoenicoptera*	Yellow-footed Green Pigeon	6
75	*Psittacula eupatria*	Alexandrine or Large Indian Parakeet	6
76	*Psittacula krameri*	Rose-ringed Parakeet	12
77	*Psittacula cyanocephala*	Plum-headed Parakeet	2
78	*Clamator jacobinus*	Pied or Jacobin Cuckoo	2
79	*Cuculus canorus*	Common Cuckoo	2
80	*Eudynamys scolopacea*	Common Koel	1
81	*Caprimulugus affinis*	Savanna or Franklin's Nightjar	2
82	*Apus affinis*	Little Swift or House Swift	132
83	*Halcyon smyrnensis*	White-throated or Smyrna Kingfisher	17
84	*Alcedo atthis*	Common or Small Blue Kingfisher	2
85	*Ceryle rudis*	Pied Kingfisher	67
86	*Ceryle lugubris*	Crested Kingfisher	1
87	*Merops orientalis*	Little Green or Small Green Bee-eater	45
88	*Merops prientalis*	Blue-Cheeked Bee-eater	5
89	*Coracias garrulous*	European Roller or Kashmir Roller	2
90	*Coracias benghalensis*	Indian Roller or Blue-jay	14
91	*Upupa epops*	Hoopoe	10
92	*Megalaima haemacephala*	Coppersmith or Crimson Breasted Barbet	2
93	*Dinopium benghalense*	Lesser Golden-backed Woodpecker	2
94	*Mirafra cantillans*	Singing Bushlark	2
95	*Melanocorypha bimaculata*	Bimaculated Eastern Calandra Lark	2
96	*Galerida cristata*	Crested Lark	25
97	*Alauda gulgula*	Oriental Skylark	2
98	*Riparia Paludicola*	Brown-throated or Plain Martin	4
99	*Riparia riparia*	Sand Martin	4
100	*Hirundo rustica*	Barn Swallow	12
101	*Delichon urbica*	Common House Martin	32
102	*Anthus sylvanus*	Upland Pipit	3
103	*Anthus spinoletta*	Water Pipit	2
104	*Motacilla flava*	Yellow Wagtail	6
105	*Motacilla cinerea*	Grey Wagtail	2
106	*Motacilla alba*	White or Pied Wagtail	5
107	*Pycnonotus leucogenys*	White-cheeked Bulbul	2
108	*Pycnonotus cafer*	Red-vented Bulbul	12
109	*Cinclus pallasii*	Brown or Asiatic Dipper	2
110	*Luscinia svecica*	Blue Throat	2
111	*Luscinia brunnea*	Indian Blue Robin or Indian Blue Chat	2
112	*Phoenicurus caeruleocephalus*	Blue-headed or Blue-capped Redstart	2
113	*Phoenicurus ochruros*	Black or Indian Redstart	17
114	*Phoenicurus fuliginosus*	Plumbeous or Slaty-blue Redstart	3
115	*Saxicola torquata*	Common Stone Chat	6

116	*Saxicoloides fulicata*	Indian Robin or Indian Chat	1
117	*Prinia gracilis*	Graceful Stripe-backed Prinia	1
118	*Orthotomus sutorius*	Common Tailorbird	12
119	*Phylloscopus affinis*	Tickell's or Chinese Leaf Warbler	2
120	*Cyornis rubeculoides*	Blue-throated Flycatcher	1
121	*Muscicapa thalassina*	Verditer Flycatcher	2
122	*Ficedula parva*	Red-breasted Flycatcher	2
123	*Ficedula subrubra*	Kashmir Flycatcher	2
124	*Rhipidura albicollis*	White-throated Fantail	2
125	*Chrysomma (Moupinia) sinense*	Yellow-eyed Babbler	5
126	*Turdoides caudatus*	Common Babbler	3
127	*Turdoides earlei*	Striated Babbler	6
128	*Sitta leucopsis*	White-cheeked Nuthatch	4
129	*Sitta europaea*	Eurasian or Kashmir Nuthatch	2
130	*Tichodroma muraria*	Wallcreeper	2
131	*Nectarinia asiatica*	Purple Sunbird	4
132	*Zosterops palpebrosa*	Oriental White-eye	6
133	*Laniius excubitor*	Great Grey or Northern Shrike	4
134	*Dicrurus macrocercus*	Black Drongo or King Crow	12
135	*Corvus splendens*	House Crow	279
136	*Sturnus pagodaaarum*	Brahminy Starling or Myna	23
137	*Sturnus vulgaris*	Common Starling	12
138	*Passer domesticus*	House Sparrow	425
139	*Ploceus philippinus*	Baya Weaver or Indian Baya	12
140	*Euodice malabarica*	Indian Silverbill	2
141	*Carpodacusrhodochlamys*	Red-mantled Rose Finch	2
		Total	31920

Table: 2: Results of different analysis at Mangla Dam.

Analysis	Total
Area Surveyed (Km ²)	26500 ha
Total Population	31,920
Number of Species	141 out of total 736 from Pakistan.
Number of Families	52 out of total 92 from Pakistan.
Number of Orders	17 out of total 22 from Pakistan.
Dominant Species	Common Pochard (13.565)
Sub-Dominant Species	Coot (13.246)
Shannon-Wiener Index	2.750
Census Index	120/km²

Table: 3 Dominant and Sun-Dominant Index of the Birds observed at Mangla Dam.

Sr. No.	Scientific Name	Common Name	Total	Relative Abundance	Density (birds/Km²)
1	*Aythya ferina*	Common Pochard	4330	13.565	16.340
2	*Fulica atra*	Black or Eurasian Coot	4228	13.246	15.955
3	*Phalacrocorax niger*	Little Cormorant	3706	11.610	13.985
4	*Anas acuta*	Northern Pintail	2727	8.543	10.291
5	*Aythya fuligula*	Tufted Duck	2150	6.736	8.113
6	*Anas platyrhynchos*	Mallard	1906	5.971	7.192
7	*Anas clypeata*	Northern Shoveler	1802	5.645	6.800
8	*Phalacrocorax carbo*	Great Cormorant	1801	5.642	6.796
9	*Anas strepera*	Gadwall	1672	5.238	6.309
10	*Larus ridibundus*	Common Black-headed Gull	1182	3.703	4.460
11	*Anser indicus*	Bar-headed Goose	1073	3.362	4.049
12		Other Birds	5343	16.739	20.162
	Total		31920	100	120.453

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