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Status of key faunal species in Koshi Tappu Wildlife Reserve after Koshi flood disaster 2008

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Abstract

Present survey was carried out from April 16th to December 15th of 2009 with a view to assess the key faunal species of Koshi Tappu Wildlife Reserve such as Birds, Gangetic Dolphin, Wild water buffalo, different species of fish and their habitats after Koshi flood disaster 2008. Several trips were made within the KTWR using boat for surveying dolphin census, to make checklist of birds and fishes and to study wild water buffalo status. Among 120 species of birds belonging to 44 families and 103 genera were sighted, 27 species were found as winter visitor, 4 species as summer visitor and 89 species as resident birds. The census of Gangetic Dolphin was conducted in the Koshi river course starting from Rajabas to Koshi Barrage (36 km) in November-December 2009. The census concluded with a sighting of 6 dolphins in the river section north of Koshi Barrage upto Rajabas and 5 dolphins in the downstream of Koshi Barrage. The status of wild water buffalo was also studied in different areas of KTWR. Regular collection of fish enlisted 64 species belonging to 15 families and 40 genera.

Key words: Key faunal species, Koshi Tappu Wildlife Reserve, flood disaster

Introduction

As a need was felt to conserve the endangered wild water buffaloes and their habitat, Koshi Tappu Wildlife Reserve (KTWR) was established in July 1976 over 6500 ha under the National Parks and Wildlife Conservation Act 1973 and extended in 1980 including the flood plains of the Koshi river. Koshi Tappu Wildlife Reserve lies in the flood plain area, formed as a result of braiding and meandering of the Saptakoshi river, one of the major tributaries of Ganges, originating from Tibetan plateau and the snow peaks in the Himalayas. It is high-ranked silt carrying river in the world (Sah, 1997). It drains a total area of 69,300 km^2 up to its confluence with the Ganges in India. Because of high siltation rate in the river, frequent changes of the river course takes place every year and sometimes shifts position from one side of the floodplain to the other. As silt is deposited, new sandy islands are formed each year. Before construction of the barrage and the embankment, the Koshi river had spread hundreds of kilometers east and west in Nepal as well as in India. After the construction of embankments and barrage, the river had been controlled till last the 18th August 2008, when the river showed its past behaviour again by devastating the embankment and changed its course. The Koshi river breached the nose of spur 12.90 and 12.10 on the eastern embankment, 12 km north of the barrage affecting six village development committees (VDC) of Sunsari district in Nepal and 14 districts in Bihar, India. The total number of affected people in Nepal is estimated to be 70,000. The flood has

damaged around 6000 hectares of agricultural land (ICIMOD, 2008). The devastating flood of Koshi not only displaced public from their homes but destroyed the habitats of wildlife too. The flood displaced people, made encroachments in many parts of Koshi Tappu Wildlife Reserve disturbing both plants and animal. Very few migratory birds might have visited. Local birds, mammals, reptiles and fishes might have been swept away by the devastating flood. Many folds of wetlands have turned into sandy land, considering the heavy loss of habitats of several species of animals and plants. The need of assessing the impact of Koshi flood disaster 2008 on biodiversity of KTWR, CEPF and WWF Nepal has funded a small grant for the present study.

Study area

Koshi Tappu Wildlife Reserve extends between 86°55'-87°05'E longitude and 26°34'-26°45'N latitudes covering an area of 17500 ha and buffer zone area covers 17300 ha. It includes part of Sunsari, Saptari and Udayapur districts of the eastern development region. Eastern and western embankments of 5-7 m high were constructed by the Koshi dam project to control flood. On the south of the reserve is a large expanse of open water, marshes and reed-beds, created by the construction of Koshi barrage between 1958 and 1964. Rectangular in shape, Koshi Tappu Wildlife Reserve is 16.3 km long and 9.3 km wide running along the Koshi river (Fig. 1). The area lies between 75 to 100 m altitudes above mean sea level. *Saccharum* and *Typha* are the dominant vegetation covering 80% of the KTWR area. Mixed forests of *Dalbergia*, *Bombax* and *Acacia* make up the remainder (Sah, 1997). The climatic condition of this area is tropical monsoonal type and experiences three distinct seasons summer (February to May), rainy (June-September) and winter (October-January). Koshi Tappu Wildlife Reserve lies in a low-lying area and its alluvial deposits are mainly composed of thin fine sand, silt and clay.

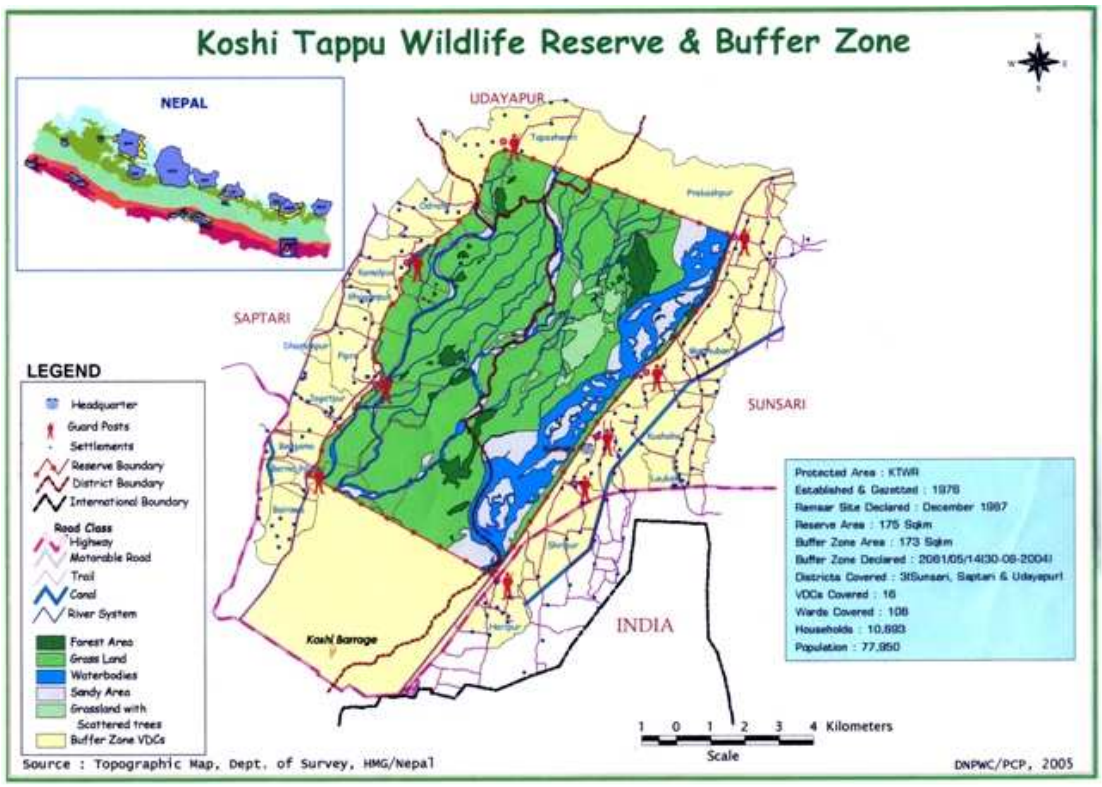

Figure 1. Map of Koshi Tappu Wildlife Reserve.

Methodology

Access of different places within the reserve for surveying was made by the use of boats. Photographs and video records of degraded habitat and key faunas were also captured.

Avifauna survey

Bird surveys was done in morning and evening. Five 500-metres transects were set across survey sites (Sites 1,2,3,4 & 5) as representatives of different habitats within Koshi Tappu Wildlife Reserve. The point count method was used at each transect (Table 1). At each of five points along the transects, all birds seen or heard within a 50 metre radius of the point, were recorded over ten minute intervals. Opportunistic sightings were recorded during the four days of the survey. The field books of Ali and Ripley (1986), Fleming *et al*. (2000) and Grimmett *et al*. (2000) were used in the field for bird identification. Avifaunal survey data was finally analyzed using Shannon-Wiener diversity index.

Table 1. Transect detail by survey site

Transect	Point co-ordinates					Survey site description
	I	II	III	IV	V	
1	26°31’17”N 86°57’06.8”E	26°31’16.7”N 86°57’02.5”E	26°31’16.4”N 86°56’58.1”E	26°31’16.1”N 86°56’53.9”E	26°31’15.8”N 86°56’50”E	East of Koshi barrage wetland area
2	26°37’25.6”N 87°01’46.2”E	26°37’28.4”N 87°01’48.2”E	26°37’31.2”N 87°01’50.4”E	26°37’34.4”N 87°01’52.7”E	26°37’37.6”N 87°01’55.1”E	West of Koshi river near Hattisar
3	26°38’51.9”N 87°03’03.9”E	26°38’54.6”N 87°03’02.3”E	26°38’56.8”N 87°03’01.8”E	26°38’59.4”N 87°03’01.9”E	26°38’02”N 87°03’03.7”E	West of Koshi river, North of Madhuvan
4	26°37’51.7”N 87°45’38.3”E	26°38’22.9”N 86°56’40.2”E	26°38’17”N 86°56’39.9”E	26°38’14.2”N 86°56’38.4”E	26°38’12”N 86°56’37.4”E	Pathari Army post grassland
5	26°32’51.3”N 86°53’47.4”E	26°32’47.8”N 86°53’50.9”E	26°32’45.6”N 86°53’54”E	26°32’42.9”N 86°53’58.3”E	26°32’40.8”N 86°54’01.4”E	North of Bardhaha Wetland

Dolphin survey

Qualitative information on the abundance and distribution of dolphin were obtained from key informants: reserve personnel, naturalist, local people and indigenous people by informal interviews. Field surveys were done on dolphin potential sites (Chaudhary, 2007) (a) Koshi barrage (b) Koshi river near reserve headquarter and (c) Rajbas by using boat and population survey was done following WWF Nepal Program (2006). The census was conducted in the co-ordination of expert team of Nature Conservation and Health Care Council, Biratnagar in collaboration with experts of KTWR office.

Wild buffalo survey

Observation on wild buffalo was made taking necessary assistance of experts in the field.

Monitoring of exotic fish through checklist

Monitoring of exotic fish species within KTWR area was carried out by making checklist of all the fish available. Fish collection with the help of local fishermen using different types of gears such as cast net, gill net, scoop net, hook etc. was done. Fishes were preserved in suitable percentage of formalin in fresh condition for taxonomic identification and database. Identification was done following standard taxonomic books: Shrestha (1981, 1994), Shrestha (1990), Talwar and Jhingran (1991) and Jayaram (1999).

Habitat survey

Different affected habitats like swampy area, marshy area of Koshi Tappu Wildlife Reserves due to Koshi flood were surveyed and observed.

Wetland destruction survey

An estimation of wetland destroyed by Koshi flood disaster 2008 within the reserve was done out by field survey method. Study of different wetlands area was made by collecting data of wetland damaged. GPS mapping method was used to prepare a map of wetland damaged.

Results

Bird survey

During observations of birds from 16th April, 2009 to 15th December, 2009 inside and in the periphery of Koshi Tappu Wildlife Reserve on regular basis, 120 species of birds belonging to 44 families and 103 genera were sighted. We observed 27 species as winter visitor, 4 species as summer visitor and 89 species as resident birds (Table 2). We calculated Shannon-Wiener Index value ($\overline{H}$) to be 5.256.

Table 2. Checklist of birds based on several observations from 16th April, 2009 to 15th December, 2009

SN	Common name	Scientific name	Family	Status
1	Crested Serpent Eagle	*Spilornis cheela*	Accipitridae	Resident
2	Osprey	*Pandion haliaetus*	Accipitridae	Winter visitor
3	Pallas's Fish Eagle	*Haliaeetus albicilla*	Accipitridae	Winter visitor
4	Shikra	*Accipiter badius*	Accipitridae	Resident
5	White-rumped Vulture	*Gyps bengalensis*	Accipitridae	Resident
6	Oriental Skylark	*Alauda gulgula*	Alaudidae	Resident
7	Short-toed Lark	*Calandrella cinerea*	Alaudidae	Resident
8	Bar-headed Goose	*Anser indicus*	Anatidae	Winter visitor
9	Common Merganser	*Mergus merganser*	Anatidae	Winter visitor
10	Common Pochard	*Aythya ferina*	Anatidae	Winter visitor
11	Cotton Teal	*Nettapus coromandelianus*	Anatidae	Winter visitor
12	Mallard	*Anad platyrhynchos*	Anatidae	Winter visitor
13	Ruddy Shelduck	*Tadorna ferruginea*	Anatidae	Winter visitor
14	Darter	*Anhinga melanogaster*	Anhingidae	Resident
15	Cattle Egret	*Bubulcus ibis*	Ardeidae	Resident
16	Black Bittern	*Dupetor flavicollis*	Ardeidae	Rare resident
17	Grey Heron	*Ardea cinerea*	Ardeidae	Resident
18	Intermediate Egret	*Mesophoyx intermedia*	Ardeidae	Resident
19	Little Heron	*Butorides striatus*	Ardeidae	Resident
20	Pond Heron	*Adreola grayii*	Ardeidae	Resident
21	Purple Heron	*Ardea purpurea*	Ardeidae	Resident
22	Yellow Bittern	*Ixobrychus cinnamomeus*	Ardeidae	Summer visitor
23	Crow Pheasant	*Centropus sinensis*	Centropodidae	Resident
24	Small Pied Kingfisher	*Ceryle rudis*	Cerylidae	Resident
25	Eurasian Curlew	*Numenius arquata*	Charadriidae	Winter visitor
26	Little-ringed Plover	*Charadrius dubius*	Charadriidae	Resident
27	Northern Lapwing	*Vanellus vanellus*	Charadriidae	Winter visitor
28	Red-wattled Lapwing	*Vanellus indicus*	Charadriidae	Resident
29	Yellow-wattled Lapwing	*Vanellus malabaricus*	Charadriidae	Winter visitor
30	Lesser Adjutant Stork	*Leptoptilos javanicus*	Ciconiidae	Resident
31	Black Stork	*Ciconia nigra*	Ciconiidae	Winter visitor
32	Black-necked Stork	*Ephippiorhynchus asiaticus*	Ciconiidae	Winter visitor
33	Asian Openbill	*Anastomus oscitans*	Ciconiidae	Resident
34	Plain Prinia	*Prinia inornata*	Cisticolidae	Resident
35	Eurasian Collared Dove	*Streptopelia decaocta*	Columbidae	Resident
36	Yellow-footed Green Pigeon	*Treron phoenicoptera*	Columbidae	Resident

37	Spotted Dove	*Streptopelia chinensis*	Columbidae	Resident
38	Wedge-tailed Green Pigeon	*Treron sphenura*	Columbidae	Resident
39	Indian Roller	*Coracias benghalensis*	Coraciidae	Resident
40	House Crow	*Corvus splendens*	Corvidae	Resident
41	Indian Tree Pie	*Dendrocitta vagabunda*	Corvidae	Resident
42	Jungle Crow	*Corvus macrorhynchos*	Corvidae	Resident
43	Large Cuckooshrike	*Coracina macei*	Corvidae	Resident
44	Common Hawk Cuckoo	*Cuculus varius*	Cuculidae	Resident
45	Indian Cuckoo	*Cuculus micropterus*	Cuculidae	Resident
46	Koel Cuckoo	*Eudynamys scolopacea*	Cuculidae	Resident
47	Pied Cuckoo	*Clamator jacobinus*	Cuculidae	Summer visitor
48	Lesser Whistling-duck	*Dendrocygna javanica*	Dendrocygnidae	Resident
49	Ashy Drongo	*Dicrurus leucophaeus*	Dicruridae	Resident
50	Black Drongo	*Dicrurus adsimilis*	Dicruridae	Resident
51	Stork-billed Kingfisher	*Pelargopsis capensis*	Halcyonidae	Resident
52	White-breasted Kingfisher	*Halcyon smyrnensis*	Halcyonidae	Resident
53	Plain Martin	*Riparia paludicola*	Hirundinidae	Resident
54	Common Iora	*Aegithina tiphia*	Irenidae	Resident
55	Bronze-winged Jacana	*Metopidius indicus*	Jacanidae	Resident
56	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	Jacanidae	Summer visitor
57	Brown Shrike	*Lanius cristatus*	Laniidae	Winter visitor
58	Grey-backed Shrike	*Lanius tephronotus*	Laniidae	Resident
59	Long-tailed Shrike	*Lanius schach*	Laniidae	Resident
60	Black-headed Gull	*Larus ridibundus*	Laridae	Winter visitor
61	Caspian Tern	*Sterna caspia*	Laridae	Winter visitor
62	Black-bellied Tern	*Sterna acuticauda*	Laridae	Resident
63	Blue-throated Barbet	*Megalaima asiatica*	Megalaimidae	Resident
64	Crimson-breasted Barbet	*Megalaima haemacephala*	Megalaimidae	Resident
65	Blue-tailed Bee-eater	*Merops philippinus*	Meropidae	Resident
66	Green Bee-eater	*Merops orientalis*	Meropidae	Resident
67	Asian Paradise-flycatcher	*Terpsiphone paradisi*	Muscicapidae	Summer visitor
68	Collared Bush Chat	*Saxicola torquata*	Muscicapidae	Resident
69	Dusky Warbler	*Phylloscopus fuscatus*	Muscicapidae	Winter visitor
70	Grey-headed Canary Flycatcher	*Culicicapa ceylonensis*	Muscicapidae	Winter visitor
71	Oriental Magpie Robin	*Copychus saularis*	Muscicapidae	Resident
72	Pied Bush Chat	*Saxicola caprata*	Muscicapidae	Resident
73	Red-throated Flycatcher	*Ficedula albicilla*	Muscicapidae	Resident
74	Verditer Flycatcher	*Eumyias thalassina*	Muscicapidae	Winter visitor
75	White-breasted Fantail Flycatcher	*Rhipidura aureola*	Muscicapidae	Resident
76	White-throated Fantail Flycatcher	*Rhipidura albicollis*	Muscicapidae	Resident
77	Purple Sunbird	*Nectarinia asiatica*	Nectariniidae	Resident
78	Black-hooded Oriole	*Oriolus xanthornus*	Oriolidae	Resident
79	Black-napped Oriole	*Oriolus chinensis*	Oriolidae	Resident
80	Golden Oriole	*Oriolus oriolus*	Oriolidae	Resident
81	Citrine Wagtail	*Motacilla citreola*	Passeridae	Winter visitor
82	House Sparrow	*Passer domesticus*	Passeridae	Resident
83	Paddyfield Pipit	*Anthus novaeseelandiae*	Passeridae	Resident
84	Pied Wagtail	*Motacilla alba*	Passeridae	Resident
85	White-browned Wagtail	*Motacilla maderaspatensis*	Passeridae	Resident
86	Yellow Wagtail	*Motacilla flava*	Passeridae	Winter visitor
87	Large Cormorant	*Phalacrocorax carbo*	Phalacrocoracidae	Resident
88	Little Cormorant	*Phalacrocorax niger*	Phalacrocoracidae	Resident
89	Swamp Francolin	*Francolinus gularis*	Phasianidae	Resident
90	Fulvous-breasted Woodpecker	*Dendrocopos macei*	Picidae	Resident
91	Lesser Golden-backed Woodpecker	*Dinopium benghalense*	Picidae	Resident
92	Streak-throated Woodpecker	*Picus xanthopygaeus*	Picidae	Resident
93	Scaly-breasted Munia	*Lonchura punctulata*	Ploceidae	Resident
94	Little Grebe	*Tachybaptus ruficollis*	Podicipedidae	Winter visitor
95	Great Crested Grebe	*Podiceps cristatus*	Podicipedidae	Winter visitor
96	Rose-ringed Parakeet	*Psittacula krameri*	Psittacidae	Resident
97	Red-vented Bulbul	*Pyconotus cafer*	Pycnonotidae	Resident
98	Red-whiskered Bulbul	*Pycnonotus jocosus*	Pycnonotidae	Resident
99	Common Coot	*Fulica atra*	Rallidae	Winter visitor
100	Common Moorhen	*Galinula chloropus*	Rallidae	Resident
101	Purple Swamphen	*Porphyrio porphyrio*	Rallidae	Resident
102	White-breasted Waterhen	*Amaurornis phoenicurus*	Rallidae	Resident

103	Common Sandpiper	*Actitis hypoleucos*	Scolopacidae	Winter visitor
104	Marsh Sandpiper	*Tringa stagnatilis*	Scolopacidae	Winter visitor
105	Spotted Owlet	*Athene brama*	Strigidae	Resident
106	Common Myna	*Acridotheres tristis*	Sturnidae	Resident
107	Grey-headed Myna	*Sturnus malabaricus*	Sturnidae	Resident
108	Jungle Myna	*Acridotheres fuscus*	Sturnidae	Resident
109	Pied Myna	*Sturnus contra*	Sturnidae	Resident
110	Clamorous Reed Warbler	*Acrocephalus strenoreus*	Sylviidae	Winter visitor
111	Dusky Warbler	*Phylloscopus fuscatus*	Sylviidae	Winter visitor
112	Jungle Babbler	*Turdoides striatus*	Sylviidae	Resident
113	Rusty-cheeked Scimitar Babbler	*Pomatorhinus erythrogenys*	Sylviidae	Resident
114	Striated Babbler	*Turdoides earlei*	Sylviidae	Resident
115	Tailor Bird	*Orthotomus sutorius*	Sylviidae	Resident
116	Black Ibis	*Pseudibis papillosa*	Threskiornithidae	Resident
117	White Ibis	*Threskiornis melanocephalus*	Threskiornithidae	Winter visitor
118	Spotted Owlet	*Athene brama*	Tytonidae	Resident
119	Hoopoe	*Upupo epops*	Upupidae	Resident
120	Oriental White-eye	*Zosterops palpebrosus*	Zosteropidae	Resident

Dolphin survey

A direct sighting survey of dolphin conducted from Rajabas to Koshi barrage in November and December of 2009 made a total count of 11 dolphins (Fig. 2). The team observed 6 dolphins in the river section upstream of Koshi barrage to Rajabas (Fig. 3) and 5 dolphins on downstream of Koshi barrage (Table 3). But indirect sighting of 3 dolphins in the coffer dam area made by local people has not been included in total count.

Table 3. Number of dolphin sighted in survey trip

SN	Name of site	GPS co-ordinates	No. of dolphin sited
	Direct sighting		
1.	Rajabans	26°43’10.9” N; 87°05’48.4” E	1
2.	Prakaspur	26°41’41.1” N; 87°03’51.8” E	2
3.	Near Vulture nest area	26°39’25.1” N; 87°02’35.7” E	1
4.	Katan area	26°36’17.8” N; 87°00’59.7” E	1
5.	Trijuga Dobhan	26°34’18.6” N; 86°57’7.5” E	1
6.	Koshi Barrage	26°31’26.3” N; 86°55’49.8” E	5
		Total	11
	Indirect sighting		
7.	Coffer dam	26°38’51.9” N; 87°03’03.9” E	3
		Total	3

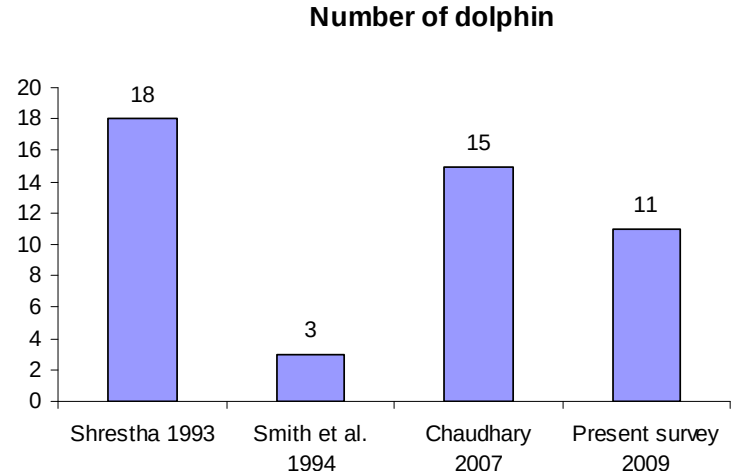

Figure 2. Population of dolphin in Koshi river from 1993 to 2009 carried out by different researchers

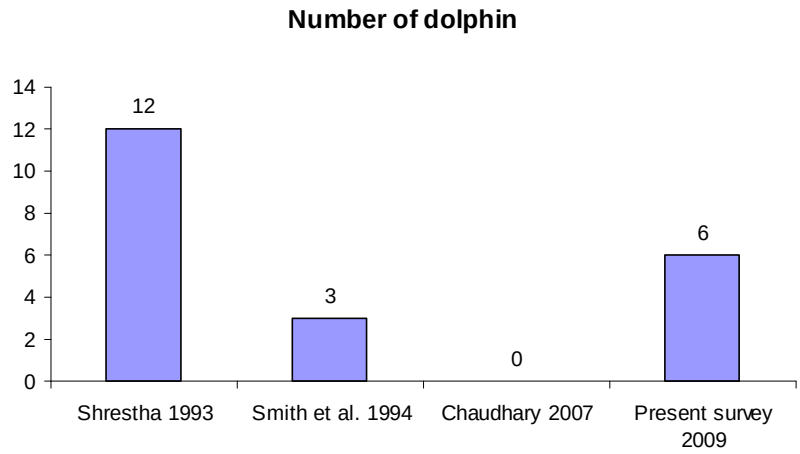

Figure 3. Population of dolphin in river section north of Koshi Barrage

Wild water buffalo survey

Regarding the census of wild water buffalo, Nilamber Mishra, Conservation Officer of KTWR suggested that it would be futile to re-census the wild water buffalo within short period as it was already done by joint venture of KTWR office and Conservation and sustainable use of wetland resources in Nepal (CSUWN). 219 wild water buffalo were counted on 3 days by KTWR office and CSUWN (Tables 4 & 5). The population structure of wild water buffalo in KTWR in 1976 (Dahmer, 1978), 1987, 1988 (Heinen, 2001) and 2009 (KTWR office, 2009) was shown in Table 6. We observed large herd of wild water buffalo many times in the west of KTWR office across the Koshi river in grassland areas.

Table 4. Population status of wild water buffalo

Adult male	Adult female	Sub adult	2nd year calves	1st year calves	Back crossed	Total
34	101	39	22	23	74	219

Source**:** KTWR office

Table 5. Blockwise population status of Wild water buffalo

West of Koshi river		East of Koshi river		Total
Block A	Block B	Block C	Block D	
South to Pathari post	North to Pathari post	South to Hawa mahal	North to Hawa mahal	
24	9	99	87	219

Source: KTWR office

Table 6. Population structure of wild water buffalo in KTWR

Year	Adults		Sub adult	2nd year	1st year	Total
	Male	Female				
1976 (Dahmer, 1978)	12	18	-	22	11	63
1987 (Heinen, 1993)	32	29	-	14	16	91
1988 (Heinen, 1993)	37	33	-	8	15	93
2000 (Heinen, 2000)	56	53	-	17	19	145
2009 (KTWR office)	34	101	39	22	23	219

Fish survey

Our regular collection of fish could enlist 64 species of fishes belonging to 15 families and 40 genera (Table 7). It included 44 common fishes, 6 fairly common, 2 less common, 3 most common, 9 uncommon fishes. 17 species of previously available fishes were not found during fish survey (Table 8).

Table 7. Checklist of fish

SN	Zoological name	Family	Status
1	*Colisa fasciatus*	Anabantidae	Common
2	*Anabas testudineus*	Anabantidae	Common
3	*Anguilla bengalensis*	Anguillidae	Uncommon
4	*Mystus aor*	Bagridae	Common
5	*M. cavasius*	Bagridae	Common
6	*M. tengra*	Bagridae	Common
7	*M. bheekerie*	Bagridae	Less common
8	*M. vittatus*	Bagridae	Less common
9	*Bagarius bagarius*	Bagridae	Common
10	*Batasio batasio*	Bagridae	Uncommon
11	*Xenentodon cancila*	Belonidae	Common
12	*Chanda nama*	Centropomidae	Common
13	*C. ranga*	Centropomidae	Common
14	*C. gachua*	Channidae	Common
15	*C. punctatus*	Channidae	Common
16	*C. striatus*	Channidae	Common
17	*C.morulius*	Channidae	Uncommon
18	*Clarias batrachus*	Clariidae	Common
19	*Semiplotus gongota*	Cobitidae	Common
20	*Botia lohachata*	Cobitidae	Fairly common
21	*B. dario*	Cobitidae	Common
22	*Lepidocephalichthys guntea*	Cobitidae	Common
23	*Nemacheilus botia*	Cobitidae	Common
24	*Somileptes gongata*	Cobitidae	Common
25	*Amblyphoryngodon mola*	Cyprinidae	Common
26	*Aspidoparia jaya*	Cyprinidae	Most common
27	*A. morar*	Cyprinidae	Most common
28	*Barilius bola*	Cyprinidae	Uncommon
29	*B. barana*	Cyprinidae	Fairly common
30	*B. bendelisis*	Cyprinidae	Common
31	*Chagunius chagunius*	Cyprinidae	Fairly common
32	*Chela laubuca*	Cyprinidae	Common
33	*Cirrhinus mrigala*	Cyprinidae	Fairly common
34	*C. reba*	Cyprinidae	Fairly common
35	*Danio devario*	Cyprinidae	Common
36	*D. rerio*	Cyprinidae	Common
37	*Esomuns dandricus*	Cyprinidae	Common
38	*Garra lamta*	Cyprinidae	Common
39	*Labeo rohita*	Cyprinidae	Common
40	*Labeo calbasu*	Cyprinidae	Common
41	*Puntius sophore*	Cyprinidae	Most common
42	*P. sarana*	Cyprinidae	Common
43	*P. ticto*	Cyprinidae	Uncommon
44	*P. conchonius*	Cyprinidae	Uncommon
45	*Tor putitora*	Cyprinidae	Uncommon
46	*Crossocheilus latius*	Cyprinidae	Common
47	*Glossogobius giuris*	Gobiidae	Common
48	*Macrognathus aculeatus*	Mastacembelidae	Common
49	*Mastacembelus armatus*	Mastacembelidae	Common
50	*Heteropneustes fossilis*	Saccobranchidae	common
51	*Ailia coila*	Schilbeidae	Common
52	*Clupisoma garua*	Schilbeidae	Common

53	*Eutropiichthys vacha*	Schilbeidae	Common
54	*Pseudeutropius atherinoides*	Schilbeidae	Common
55	*P. murius batarensis*	Schilbeidae	Common
56	*Ompok bimaculatus*	Siluridae	Common
57	*Wallago attu*	Siluridae	Common
58	*Bagarius bagarius*	Sisoridae	Uncommon
59	*Gagata cenia*	Sisoridae	Common
60	*G. viridescens*	Sisoridae	Common
61	*Glyptothorax cavia*	Sisoridae	Common
62	*G. pectinopterus*	Sisoridae	Common
63	*G. telchitta*	Sisoridae	Uncommon
64	*G. trilineatus*	Sisoridae	Fairly common

Table 8. Unavailable fishes during collection

SN	Zoological name	Family
1	*Amblycep mongois*	Amblycipitidae
2	*Rita rita*	Bagridae
3	*Chaca chaca*	Chacidae
4	*Gadusia godanahiai*	Clupeidae
5	*G. chapra*	Clupeidae
6	*Achanthocephala pangia*	Cobitidae
7	*Puntius phutunis*	Cyprinidae
8	*P. chola*	Cyprinidae
9	*P. gelius*	Cyprinidae
10	*Oxygaster bacaila*	Cyprinidae
11	*Barilius jalkapoorie*	Cyprinidae
12	*Septipina phasa*	Engraulidae
13	*Nandus nandus*	Nandidae
14	*Notopterus chitala*	Notopteridae
15	*Erethistes pussilus*	Sisoridae
16	*Siror rhabdophorus*	Sitoridae
17	*Tetradon cutcutia*	Tetradontidae

Habitat and wetland destruction

Important resting areas of residential and migratory birds like Titirgachi Daha has dried due to Koshi flood. More than 75% Swamp Partridge habitat in the eastern dam site was found to have lost due to dam and spur construction activities and flood displaced people. We estimated 113 ha area (Fig. 4) in eastern embankment of KTWR as most disturbed area due to construction activities for making spur, large number of heavy vehicles transportation and use of steamer in the Koshi river.

Discussion

We observed 120 species, 42 genera of 25 families of birds. Bird species availability in the present environment of the reserve and its surroundings depicts that there is every possibility of rehabilitation of bird diversity in the future through proper management. Both migratory and resident birds were impacted greatly by the flood. In 2008 few migratory birds such as Ruddy Shelduck, Common Pochard turned out for short time then left the place for another safe area. It might happen so because of disturbance and unavailability of food. A few representatives of some migratory birds such as Ruddy Shelduck, Bar-headed Goose, Mallard, Black Stork and Great Crested Grebe were observed. They were sighted along with resident birds such as Large

Cormorant, Darter, Cattle Egret, Intermediate Egret and Pond Heron. So far the published Checklists of birds (Baral, 2000; Grimmett *et al.*, 2000; Baral & Inskipp, 2001; 2004; Baral, 2005; Bird Conservation Nepal, 2006; Thapa Chhetry, 2008) prepared in different months make it clear that some birds such as Eurasian Kingfisher, White-necked Stork, Collared Pygmy Owlet, either they have little scattered population so they didn't appear or they have left the area for the time being because of disturbances or food scarcity. Among the birds mentioned above, migratory ones are regular visitors of KTWR in the past. They were sighted in the month of November every year in the past. Among the migratory birds sighted in the month of November and upto the second week of December 2009, the number of Ruddy Shelduck was praiseworthy among aquatic water fowls. Its population was remarkably the highest. Common Pochard, Mallard, Bar-headed Goose, Black Stork, Common Merganser and Great crested Grebe had a few number of representatives. No doubt the population of every bird species is declining but at what ratio, it has to be estimated globally then only right status of each species of bird can be estimated. Annual Waterbird Counts highlighted the decline of winter visitor since 1999 in KTWR. A total of nearly 9800 birds were counted in February 2003 at the site in one day when more than 50000 birds were estimated in the past years (Choudhary, 2003). We counted not more than 2000 in the present survey. The population of globally threatened Lesser Adjutant has been declining every year in and around Koshi Tappu Wildlife Reserve (Baral, 2005). Pokharel (1998) recorded 65 individuals in Koshi Tappu during his study in 1994-1995. We observed not more than 20 individuals and no nest in and around Koshi Tappu Wildlife Reserve. Hunting and alteration of its habitat in Koshi Tappu area reduced its feeding area (Shakya, 1995; Giri, 1997; Petersson, 1998). Loss of *Bombax ceiba* is recognized as a major threat in Chitwan even inside a protected area (Gyawali, 2003) for large bird species. We observed White-rumped Vulture nests inside the reserve area in *Bombax ceiba*. At the same time, many trees of *Bombax ceiba* were found to be illegally felled near the area of vulture nest. KTWR holds the largest population of globally threatened Swamp Francolin in Nepal (Baral, 1998). Grasslands in the eastern embankments and spurs from reserve office to Madhuvan are the major habitat of Swamp Francolin in KTWR. These areas are disturbed by dam and spurs construction activities after Koshi Flood disaster. Grasslands turned into the barren land as for storage of stones and other equipments they were used. From the above observation it can be concluded that the migratory birds left the feeding ground of Koshi river within a week or so because of either disturbance created by fishing activities or lack of food. As a good number of fisherman belonging to flood displaced community have been given permission, so almost all places in the river, fishermen were seen fishing using gillnet, cast net and large net. Purple Gallinules are unsafe in the south, so they also have migrated towards north. Black-necked Stork, White-necked Stork, Painted Stork also were sighted in winter as well as in other seasons also in the past but they didn't turn out in our survey of 36 km from Rajbas to Koshi Barrage on boat. Resident birds such as Eurasian Kingfisher, Purple Swamphen and White-breasted Kingfisher were seen to have been disturbed by human activities because of flood disaster. The flood disaster has left a chronic problem for the Koshi Tappu Wildlife Reserve in addition to its number of unsolved problems. Shannon-Wiener diversity Index ($\overline{H}$) represents the uncertainty or information of a community. The more variable its composition, the more variable each sample of it would be. It varies from 0, for a community of one species only, to values of 7 or more in rich biodiversity regions (Barbour *et al.*, 1980). The higher the diversity index the greater the number of species and evenness of their populations

(Bibby *et al*., 2000). Bird Shannon –Wiener diversity index in KTWR was calculated as 5.256 in the present survey which indicates KTWR still holds a good abundance of bird diversity even after flood. No other previous literature regarding the diversity index of Bird diversity in KTWR was found to compare the results.

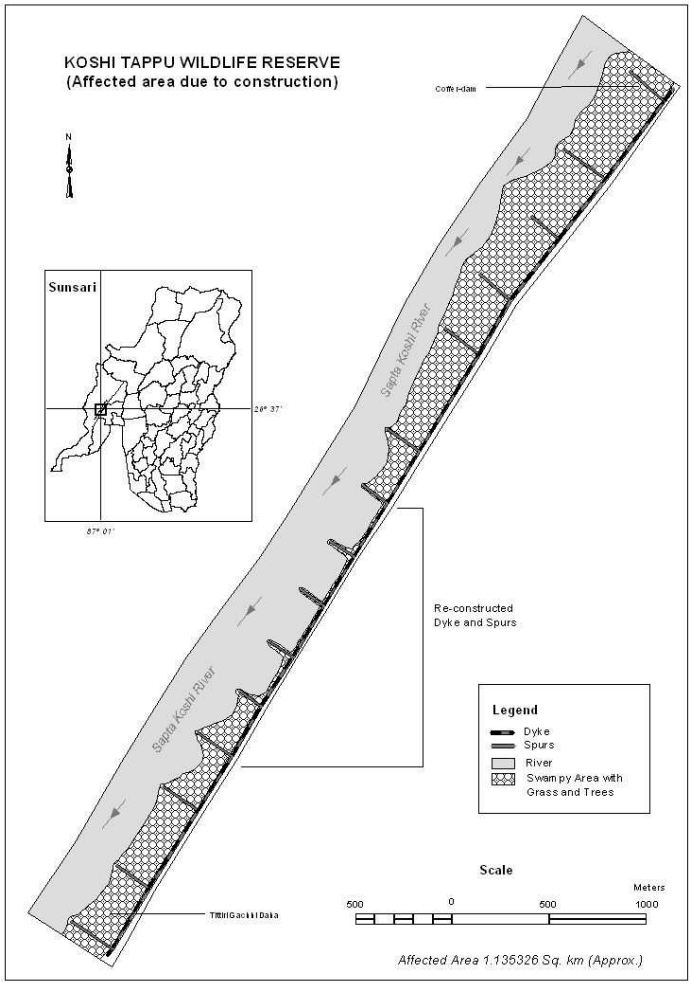

Figure 4. **Affected area due to flood and construction activities within KTWR**

Perhaps Dolphin census in the Koshi river course, starting from Rajabas to Koshi Barrage might be the first step of its kind. Gangetic Dolphin is the only big aquatic mammal found in rivers such as Koshi, Karnali and Narayani (Smith *et al*., 1994). Shrestha (1993) observed 3 individuals near Barahachhetra and Chatara, 6 individuals near Chatara, 3 individuals in Kusaha and 6 individuals in Koshi Barrage area and estimated the total population of 18 individuals in the Koshi river. Smith *et al*. (1994) surveyed the area between the confluence of the Arun and Sun Koshi rivers; and the Koshi Barrage and found only 3 dolphins. In the southern section of the barrage, Chaudhary (2007) estimated a population of 15 individuals distributed within the range of 2 km in the river section south of Koshi Barrage but no dolphins were sighted by Chaudhary (2007) in the river section north of Koshi Barrage. In our survey, the first census concluded with the sightings of 9 dolphins. Our survey estimated a total of 6 individuals in the river section north of Koshi Barrage upto Rajabas and 5 individuals in the downstream of Koshi Barrage. All these data indicated that no dolphins were observed north of Koshi Barrage upto Barahachhetra since 1994 to 2007. The Koshi Barrage blocked the migration of fish and aquatic animals causing shortage of food for dolphin in the river section north of Koshi

Barrage (Shrestha, 1993). During high water periods, there is a chance of dolphins to move downstream through the Koshi Barrage but the high current might have prevented them from swimming upstream through the barrage. The effects of subdividing a single population into non-interacting insular units increase their vulnerability to environmental, demographic and genetic (Haque *et al.*, 1998). Reappearance of dolphin in north of Koshi Barrage upto Rajabas in the present survey indicates that Koshi Flood disaster 2008 might be the reason of dolphin to move north of Koshi river as the river did not flow through the Koshi Barrage during flood period. But the use of Steamer after Koshi flood in the Koshi river was harmful for dolphins. Heavy boat traffic and overfishing were the causes of extinction of Dolphin Baiji in China.

The wild water buffalo in KTWR is highly endangered; with the few remaining populations already affected or likely to be affected by hybridization with domestic buffalo (Flamand *et al.*, 2003). Population estimation of wild water buffalo in KTWR was initiated by Dahmer (1978) with a count of 63 individuals in 1976. Heinen (1993) observed total of 91 individuals in 1987 and 93 in 1988. In total, 145 wild water buffalo were censused in 2000 by Heinen (2001). Recent count of wild water buffalo by joint venture of KTWR office and CSUWN (2009) estimated a total count of 219. All these data show a population growth of wild water buffalo in KTWR is satisfactory. But 2 of the predefined as wild buffalo and 7 of the predefined as domestic buffalo showed evidence of mixed ancestry in the genetic analysis of wild water buffalo examined (Flamand *et al.*, 2003). Habitat of wild water buffalo was also studied in our survey. All the locations where wild water buffalo live were visited taking the help of Ranger, Game scout and cowherd. The number has increased remarkably. In fact, the number of wild water buffalo was seen praiseworthy but whether they were of purebred wild or hybrid could not be ascertained. Ideally, in all cases, detailed genetic studies are further needed to identify the purebred wild. Inside the reserve, the habitat was seen not drastically altered; however, heavy grazing of grasslands shows that they shared food and other space with feral cattle. The uncontrolled illegal entry of domesticated cows and buffaloes may be one of the main reasons of declining number of wild water buffalo in the time to come.

A small population of Gangetic Dolphin found in Koshi river indicates that the status of fishes in the river is not so bad. Altogether 92 species of fishes was identified by Thapa Chhetry (2008) during the course of 3 years period. But we recorded 64 species in 8 months out of 117 species in KTWR (IUCN, 1998). Altogether 17 species of commonly available fish species of KTWR area could not be collected instead of regular collection. During fish collection, population was also estimated and was found the highest population of *Aspidoparia morar* and *A. jaya*. In the collection there was least number of representatives of the following fish species: *Tor putitora*, *Bagarius bagarius*, *Barillius bola, Notopterus notopterus*, *Anguilla bengalensis*. None of the cultivated exotic fish species was found in the collection. This trend of fish species availability in the Koshi river depicts that either Koshi flood disaster has impacted on the fish population which inhabit mainly in swamp land. In regard of *Puntius* species, it was found that only *Puntius sophore* has become dominated species. Some other species which were also found in KTWR showed least number of representatives.

In addition to flood impacts on habitat destruction, from all sides, herd of cattle and group of herd-men enter the reserve freely, this kind of activities are making the

reserve totally public right property rather than a protected reserve semi-public right property.

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