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VERTEBRATE BIODIVERSITY OF NARA GAME RESERVE, SINDH, PAKISTAN

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ABSTRACT

The Nara Game Reserve area having a number of wetlands and Nara Canal forms a Wetland Complex in the Nara Desert. More than 200 wetlands have been listed during the present study from 2007 – 2011. The area was surveyed particularly for the 22 important wetlands of the area to record their vertebrate biodiversity. 129 species of birds, 21 species of mammals, 20 species of reptiles, 02 species of amphibians and 37 species of fishes were recorded from the Nara Game Reserve area. The important wildlife species of the area are the Smooth-coated Otter (*Lutrogale perspicillata)*, Fishing Cat (*Prionailurus viverrina*), Hog Deer (*Axis porcinus)*, Black Partridge (*Francolinus francolinus*), Black Ibis (*Pseudibis papillosa*), Indian Darter (*Anhinga rufa*), Marbled Teal (*Marmaronetta angustirostris*), Ferruginous Duck (*Aythya nyroca*), Grey Partridge (*Francolinus pondicerianus*), Houbara Bustard (*Chlamydotis undulata*), Ruddy Shelduck (*Tadorna ferruginea*) and the Marsh Crocodile (*Crocodylus palustris*). It was found that more than 16 wetlands support marsh Crocodile. The threats to the biodiversity include developmental activities, disturbance, livestock grazing, and land reclamation for agriculture and human settlements. The wetlands of the area may be managed for their ecological significance for supporting important biodiversity, and the Reserve may be specially managed for Hog Deer, Fishing Cat, Smooth-coated Otter and Marbled Teal. Action may also be taken to develop ecotourism in the area due to its unique wetland ecosystem.

Keywords: Nara Game Reserve, Wetlands of Sindh, aquatic vertebrates, inventories, Nara Wetland Complex.

INTRODUCTION

Natural wetlands of Pakistan are fast disappearing because of provion of lands for housing, agriculture, irrigation and drainage. However, new marshes and lakes have been created near rivers, barrages and dams which provide excellent habitats for water birds.

The biodiversity of Sindh is quite unique due to presence of various ecosystems and diverse range of landscapes. The various ecosystems of Sindh include deserts, wetlands, riverine and mangrove forests, agricultural and coastal areas. Sindh is located on the Central Asian Flyway which provides many ideal habitats for several migratory species of water birds.

As regards to the environmental problems, there has been a severe water shortage in the lower Indus basin. Most of the important wetlands in Sindh are fed by the River Indus and because of reduced flows most of these are drying out or are being degraded. Due to water shortage in the Indus, several riverine forests have been badly affected and their environment and biodiversity is threatened (Khan, 2006).

The Indus receives huge amount of sewage, untreated industrial effluents and run off from the agriculture lands. This has caused the aquatic biodiversity to decline in numbers and diversity.

Scientists believe that salt water intrusion into the wetlands of Badin and Thatta Districts of Sindh is the outcome of decrease of water flow in the Indus. Sea water intrusion has affected fertile wetlands of the area resulting in economic disaster, as thousands of people from these areas have migrated to coastal areas of Karachi.

Nara Game Reserve having about 200 large, medium and small wetlands forms a Wetland Complex; most of these wetlands are permanent, while some are seasonal. The water of these wetlands is fresh to brackish to saline and these are stretching from the town of Januji in the north to Jamrao Head in the South. Nara Canal is largest canal of Sindh and these wetlands lie on both sides of Nara Canal which originates from Sukkur barrage along with Khairpur Feeder West and Rohri Canal. Woodlands, reed beds and vegetation present along these wetlands provide a very favourable habitat for fishes, amphibians, reptiles, avifauna and mammals. Ecologically the area has a great value as far as the biodiversity is concerned.

Nara Game Reserve was declared as a Protected Area in 1981 under the Sind Wildlife Protection Ordinance, 1972. It is located at 80 km East of Khairpur, 110 km away from Sukkur and 515 km from Karachi (Bhaagat, 2005).

The Nara Canal and associated wetlands form a complex of wetlands in the Nara desert region (Fig. 1) which extends over parts of Sukkur, Ghotki, Khairpur, and Sanghar districts. It is a part of Thar Desert extending further south in Tharparkar area. In the area, natural wetlands are of unique or rare type. Only Deh Akro II Wetland Complex is having this type of wetlands in the area.

The area supports several vulnerable species such as: Smooth-coated Otter (*Lutrogale perspicillata*), Marsh Crocodile (*Crocodylus palustris*) and Marbled Teal (*Marmaronetta anguistirostris*) and it also supports the near-

threatened species such as Hog Deer (*Axis porcinus*), Fishing Cat (*Prionalurus viverrina*), White-eyed Pochard (*Aythya nyroca*), Indian Darter (*Anhinga rufa*), Black Ibis (*Pseudibis papillosa*) Long-tailed Grass Warbler (*Prinia burnesii*), Houbara Buastard (*Chlamydotis undulata*) and Indian Softshell Turtle (*Aspederetes gangeticus*).

Although regular annual waterbird surveys have not been taken on these wetlands, but whatever data is available shows that these wetlands are very important for supporting quite good number of anatids and the waders during the migratory season (Scott, 1989).

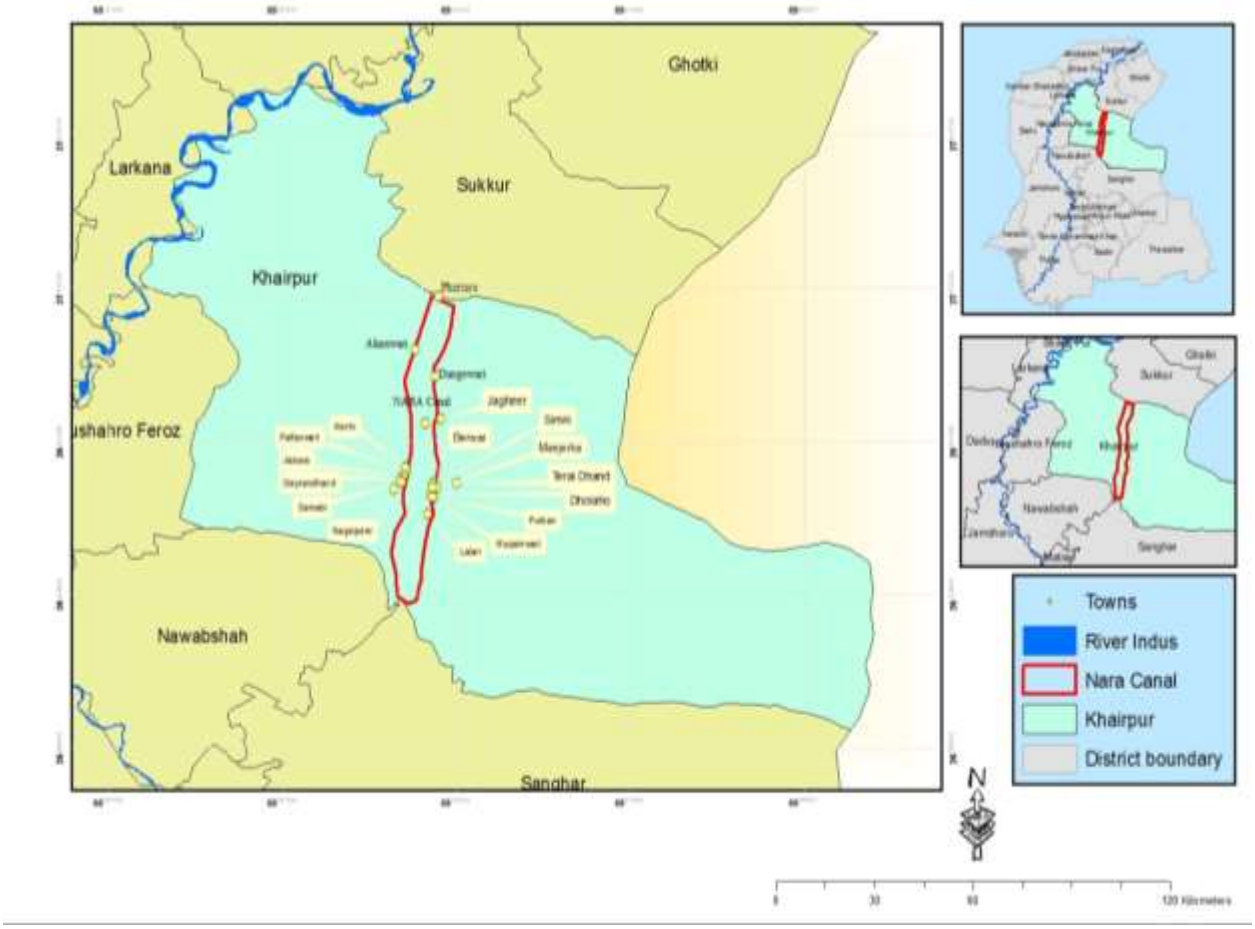

Fig. 1. Study Area Map of Nara Game Reserve.

MATERIALS AND METHODS

Study Areas

Based on baseline study, some of the key areas were selected for study, which are given in Table 1.

Survey of Mammals

Many vertebrates were inconspicuous or avoided detection in other ways for which different techniques were used to record their occurrence and distribution in the study area as follows:

Roadside Counts

In this method, motor vehicles are used along the road trails while the sighted number of individuals of the species being estimated is tallied and related to the number of kilometers traveled (Brower *et al.*, 1990). Roadside counting method is known not to disturb the animals and the animals are observed along the road / track from a few meters distance. Further, large areas can be covered in short time using only two persons and a vehicle.

Count of tracks, footprints, burrows etc

In this method, the tracks, footprints and burrows of animals were noted and recorded which confirmed the presence of animals which were nocturnal or secretive in their habits.

Table 1. Wlidlife Habitats and important Wetlands of Nara Game Reserve.

S. NO.	NAME OF STUDY AREA	CO-ORDINATES
1.	Akanwari Dhand	**27 04 40. 5 N; 68 55 57. 2 E**
		26 31 83. 4 N; 68 56 13. 1 E
2.	Akhero Dhand	**26 45 53. 5 N; 68 53 57. 2 E**
		26 45 88. 0 N; 68 53 95. 1 E
3.	Baboo Dhand	**27 13 73. 9 N; 69 00 93. 6 E**
4.	Berwari Dhand	**26 44 50. 9 N; 68 58 49. 2 E**
5.	Dangewari Dhand	**27 00 39. 0 N; 68 59 17. 5 E**
		27 00 53. 0 N; 68 58 54. 7 E
6.	Dayran Dhand	**26 44 78. 1 N; 68 53 24. 5 E**
7.	Dholaho Dhand	**26 43 02. 9 N; 68 58 27. 1 E**
8.	Jaari Dhand	**27 01 02. 0 N; 68 7 01. 9 E**
		27 00 36. 2 N; 68 58 12. 3 E
9.	Jagheer Dhand	**26 54 19. 9 N; 69 00 09. 4 E**
10.	Kinrhi Dhand	**26 47 05. 9 N; 68 54 22. 6 E**
11.	Kirchan Dhand	**27 05 34. 2 N; 68 9 96. 0 E**
12.	Lalari Dhand	**26 40 10. 0 N; 68 57 58. 3 E**
13.	Manjerka Dhand	**26 44 07. 1 N; 68 59 33. 4 E**
14.	Muqamwari Dhand	**26 42 47. 5 N; 68 58 43. 1 E**
15.	Nagiopeer Dhand	**26 43 57. 8 N; 68 52 21. 0 E**
16.	NARA Canal	**26 53 39. 2 N; 68 57 38. 8 E**
17.	Pallaywari Dhand	**26 46 40. 6 N; 68 54 32. 2 E**
18.	Phariaro Dhand	**27 12 33. 2 N; 68 59 44. 8 E**
19.	Putkan Dhand	**26 42 35. 6 N; 68 59 04. 9 E**
20.	Samabi Dhand	**26 44 54. 5 N; 68 53 44. 3 E**
21.	Simni Dhand	**26 44 06. 9 N; 68 58 48. 9 E**
22.	Terai Dhand	**26 44 51. 9 N; 69 02 48. 5 E**

Pellet Counts

This technique involved animal use of areas between sampling periods. The plots were checked taking care that the pellets be safe from being destroyed by weather or insects (Brower *et al*., 1990).

Point Count Surveys

In this method, observation points are established at suitable points for viewing the habitat. The observer records all sightings at each observation point then an index of abundance of each species is expressed as the number of animals seen per hour of observations (Brower *et al*., 1990).

Point surveys were conducted twice daily, once in early morning, i.e. one hour earlier than the sunrise till noon and secondly, in the evening, i.e. half an hour before the sunset till dark.

Line Transects

The line transect or strip census method involves counting the animals seen by an observer traversing a predetermined transect line and recording the distances at which they were seen or flushed (Khan *et al*., 2012).

Survey of Small Mammals

Sightings of small mammals by active searching in suitable microhabitats along agriculture fields, open plains, bushy areas and canal banks were made. To investigate nocturnal species, night surveys were conducted. In this method search lights are used for locating the animals (Khan *et al*., 2012).

Trapping procedure

Sherman traps were used for the collection of rodents. Fifty traps were placed on a line approximately 350 m long. Colorful ribbons were used for locating the traps easily. The traps were placed in afternoon and left overnight. Trapped specimens were transferred into polyethylene bags for identification and afterwards released.

Fragrant seeds and grains were mixed as a bait for attracting the small mammals. Onion, oat, coriander and peanut butter were used with wheat and rice for fragrance (Khan *et al*., 2012).

Survey of Birds

Each major habitat type was identified and surveys were made to record the species of birds found in each discrete habitat such as lakes, canals, ponds, marshes, forest, agriculture fields, vicinity of human habitation and fallow lands.

The most commonly used field method in bird surveying is the " Line Transects" method and it is used for recording the birds continually along a predetermined transect line (Khan *et al*., 2012).

Counting the water birds

Binoculars and telescope were used for counting water birds at different sites. For accurate counting of water birds, the principal methods are given below:

Counting individual birds within an area

It may be easily done for lesser number of birds present i.e. < 1,000; provided that there is restricted movement of water birds i.e. the birds stay at roost site. There is no disturbance to birds to fly frequently within the site and the birds are having spaces i.e. foraging in an open area.

Estimating the numbers of birds within an area

It may be taken up when large number of birds are present i.e. >1,000 and birds are continually in flight i.e. moving in large flocks; there is lot of disturbance forcing birds to be unsettled and continually take flight, making prolonged observations on the ground difficult; closely-packed flock of birds, where due to the 'tightness' of the flock counting individual birds is difficult i.e. at a large roost, and due to poor light conditions i.e. viewing into the sun or over a great distance, identification of particular species is not possible.

Methods of Accurate Count

In this method, binoculars and telescopes were used for counting as 1, 2, 3, 4, 5, 6, 7…….etc. Distant viewing of an evenly distributed flock is made by Counting 1, 2, 3, 4, 5, 6, 7….. etc. and visually dividing birds into small groups and counting each group individually, i.e. when there is an uneven distribution of numbers. Totals for each group are then added to form the final total; or counting flocks in multiples i.e. 3, 6, 9, 12, 15…..etc or 2, 4, 6, 8, 10……etc.

Survey of Reptiles and Amphibians

Various methods were employed for observation of reptiles and amphibians as given below:

A. Direct counting
B. Indirect counting

Direct Counting

Plot Searching

At each site, search was made to detect as many reptile and amphibian species as possible within a circular central zone. This consists of searching approximately 20 ha (within a 250 meter radius of sampling points) exactly and recording the number of individuals of each species seen (Khan *et al*., 2012).

Spot Lighting or Night Observations

In order to detect and record some nocturnal snakes and lizards, spotlight transects were conducted. Each transect was surveyed after dark with a potable spotlight. Each transect was 3 km long. The same route was traveled on the return trip.

Turning of Stones, Rocks and Rotten Trees

Nocturnal reptiles and amphibians take shelter or rest hiding themselves under the space of stones or rocks. Therefore, in the day time survey, stones or rocks or rotten fallen trees are turned to locate and record the presence of species (Khan *et al*., 2012)

Study of Basking Behavior

In winter, the temperature of the water of the water bodies becomes very low. Crocodiles come outside the lake for enjoying sunshine to keep them warm. Thus, counting of crocodiles becomes very easy at particular area during this season (Khan *et al*., 2012).

B. Indirect Counting

Indirect record of occurrence of species was made by noting the presence of signs like faecal pellets, tracks, den or tunnels (egg laying excavation), evidences from the impression of foot prints, or tail, presence of faecal pellets etc.

Fish Collection Methodology

The representative sample of fish species were made through gill netting and cast netting. A standard length of 200 m covering maximum of representative habitats, was used to obtain a representative sample (Rafiq, 2009).

Gill Netting

Three nets each measuring 15 m length with mesh size 2.5x2.5 and 1.5x1.5 was used for gill netting. The gill nets were used in the morning.

Cast Netting

Cast nets with known circumference were cast in a stretch of 200m. Fish species were collected and identified and released after identification.

The data collected by the two methods were pooled and called as the representative sampling of the study site.

Table 2. List of Mammals of Nara Game Reserve.

S. No.	Order	Family	Scientific Name	Common Name
1.	Insectivora	Erinaceidae	*Hemiechinus collaris*	Long-eared Desert Hedgehog
2.	Insectivora	Soricidae	*Suncus stoliczkanus*	Anderson's Shrew
3.	Carnivora	Canidae	*Canis aureus*	Indian Jackal
4.	Carnivora	Canidae	*Vulpes vulpes*	Desert Fox
5.	Carnivora	Mustellidae	*Lutrogale perspicillata*	Smooth-coated Otter
6.	Carnivora	Herpestidae	*Herpestes edwardsi*	Grey Mongoose
7.	Carnivora	Herpestidae	*Herpestes javanicus*	Small Mongoose
8.	Carnivora	Felidae	*Felis chaus*	Jungle Cat
9.	Carnivora	Felidae	*Felis sylvestris*	Indian Desert Cat
10.	Carnivora	Felidae	*Prionailurus viverrina*	Fishing Cat
11.	Artiodactyla	Suidae	*Sus scrofa*	Indian Wild Boar
12.	Artiodactyla	Cervidae	*Axis porcinus*	Hog Deer
13.	Lagomorpha	Leporidae	*Lepus nigricollis*	Indian Hare
14.	Rodentia	Sciuridae	*Funambulus pennanti*	Five-striped Palm Squirrel
15.	Rodentia	Hystricidae	*Hystrix indica*	Indian Crested Porcupine
16.	Rodentia	Muridae	*Rattus rattus*	Roof Rat
17.	Rodentia	Muridae	*Mus musculus*	House Mouse
18.	Rodentia	Muridae	*Nesokia indica*	Short-tailed Mole Rat
19.	Rodentia	Muridae	*Gerbillus nanus*	Balochistan Gerbil
20.	Rodentia	Muridae	*Tatera indica*	Indian Gerbil
21.	Rodentia	Muridae	*Meriones hurrianae*	Indian Desert Gerbil

Table 3. List of Birds of Nara Game Reserve.

S. No.	Order	Family	Scientific Name	Common Name
1.	Podicipediformes	Podicipedidae	*Tachybaptes ruficollis*	Little Grebe/Dabchick
2.	Pelecaniformes	Phalacrocoracidae	*Phalacrocorax carbo*	Large Cormorant
3.	Pelecaniformes	Phalacrocoracidae	*Phalacrocorax carbo*	Little Cormorant
4.	Pelecaniformes	Anhingidae	*Anhinga rufa*	Indian Darter
5.	Ciconiiformes	Ardeidae	*Ardea cinerea*	Grey Heron
6.	Ciconiiformes	Ardeidae	*Ardea purpurea*	Purple Heron
7.	Ciconiiformes	Ardeidae	*Ardeola grayii*	Indian Pond Heron
8.	Ciconiiformes	Ardeidae	*Bubulcus ibis*	Cattle Egret
9.	Ciconiiformes	Ardeidae	*Egretta alba*	Large Egret/Great Egret
10.	Ciconiiformes	Ardeidae	*Egretta intermedia*	Smaller/Median Egret
11.	Ciconiiformes	Ardeidae	*Egretta garzetta*	Litte Egret
12.	Ciconiiformes	Ciconiidae	*Ciconia nigra*	Black Stork
13.	Ciconiiformes	Threskiornithidae	*Threskiornis melanocephala*	White Ibis
14.	Ciconiiformes	Threskiornithidae	*Plegadis falcinellus*	Glossy Ibis
15.	Anseriformes	Anatidae	*Tadorna ferruginea*	Ruddy Shelduck
16.	Anseriformes	Anatidae	*Marmaronetta angustirostris*	Marbled Teal
17.	Anseriformes	Anatidae	*Anas acuta*	Pintail
18.	Anseriformes	Anatidae	*Anas crecca*	Common Teal
19.	Anseriformes	Anatidae	*Anas platyrhynchos*	Mallard
20.	Anseriformes	Anatidae	*Anas strepera*	Gadwall
21.	Anseriformes	Anatidae	*Anas Penelope*	Wigeon
22.	Anseriformes	Anatidae	*Anas querquedula*	Garganey
23.	Anseriformes	Anatidae	*Anas clypeata*	Shoveller
24.	Anseriformes	Anatidae	*Aythya ferina*	Common Pochard
25.	Anseriformes	Anatidae	*Aythya fuligula*	Tufted Duck
26.	Anseriformes	Anatidae	*Aythya nyroca*	White-eyed Pochard/ Ferrugineus Duck
27.	Falconiformes	Accipitridae	*Elanus caeruleus*	Black-winged Kite
28.	Falconiformes	Accipitridae	*Pernis ptilorhynchus*	Oriental Honey Buzzard
29.	Falconiformes	Accipitridae	*Buteo buteo*	Common Buzzard
30.	Falconiformes	Accipitridae	*Buteo rufinus*	Long-legged Buzzard
31.	Falconiformes	Accipitridae	*Aquila rapax*	Tawny Eagle
32.	Falconiformes	Accipitridae	*Circus aeruginosus*	Eurasian Marsh Harrier
33.	Falconiformes	Falconidae	*Falco subbuteo*	Hobby
34.	Falconiformes	Falconidae	*Falco tinnunculus*	Kestrel
35.	Galliformes	Phasianidae	*Francolinus francolinus*	Black Partridge
36.	Galliformes	Phasianidae	*Francolinus pondicerianus*	Grey Partridge
37.	Gruiformes	Rallidae	*Porzana porzana*	Spotted Crake
38.	Gruiformes	Rallidae	*Amaurornis phoenicurus*	White-breasted Waterhen
39.	Gruiformes	Rallidae	*Gallinule chloropus*	Indian Moorhen
40.	Gruiformes	Rallidae	*Porphyrio porphyrio*	Indian Purple Moorhen
41.	Gruiformes	Rallidae	*Fulica atra*	Common Coot
42.	Gruiformes	Otididae	*Chlamydotis undulata*	Houbara Bustard
43.	Charadriiformes	Charadriidae	*Vanellus indicus*	Red-wattled Lapwing
44.	Charadriiformes	Charadriidae	*Vanellus leucurus*	White-tailed Lapwing
45.	Charadriiformes	Charadriidae	*Vanellus malabaricus*	Yellow-wattled Lapwing
46.	Charadriiformes	Charadriidae	*Charadrius alexandrinus*	Kentish Plover
47.	Charadriiformes	Scolopacidae	*Numenius arquata*	Curlew
48.	Charadriiformes	Scolopacidae	*Limosa limosa*	Black-tailed Godwit
49.	Charadriiformes	Scolopacidae	*Tringa hypoleucos*	Common Sandpiper
50.	Charadriiformes	Scolopacidae	*Tringa nebularia*	Greenshank
51.	Charadriiformes	Scolopacidae	*Tringa ochropus*	Green Sandpiper

Table 3. Contd.

S. No.	Order	Family	Scientific Name	Common Name
52.	Charadriiformes	Scolopacidae	*Tringa stagnatilis*	Marsh Sandpiper
53.	Charadriiformes	Scolopacidae	*Tringa totanus*	Common Redshank
54.	Charadriiformes	Scolopacidae	*Capella gallinago*	Common/Fantail Snipe
55.	Charadriiformes	Scolopacidae	*Calidris alpinus*	Dunlin
56.	Charadriiformes	Scolopacidae	*Calidris minutus*	Little Stint
57.	Charadriiformes	Scolopacidae	*Philomachus pugnax*	Ruff
58.	Charadriiformes	Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt
59.	Charadriiformes	Glariolidae	*Cursorius cursor*	Cream-coloured/Desert Courser
60.	Charadriiformes	Sternidae	*Chlidonias hybrida*	Indian Whiskered Tern
61.	Charadriiformes	Sternidae	*Sterna albifrons*	Little Tern
62.	Charadriiformes	Sternidae	*Sterna aurantia*	River Tern
63.	Columbiformes	Pteroclididae	*Pterocles orientalis*	Imperial/Black-bellied Sandgrouse
64.	Columbiformes	Columbidae	*Columba livia*	Blue Rock Pigeon
65.	Columbiformes	Columbidae	*Streptopelia decaocto*	Ring Dove
66.	Columbiformes	Columbidae	*Streptopelia senegalensis*	Little Brown Dove
67.	Columbiformes	Columbidae	*Streptopelia tranquebarica*	Red Turtle Dove
68.	Psittaciformes	Psittacidae	*Psittacula krameri*	Rose-ringed Parakeet
69.	Cuculiformes	Cuculidae	*Centropus sinensis*	Common Crow-pheasant/ or Coucal
70.	Strigiformes	Strigidae	*Athene brama*	Northern Spotted Owlet
71.	Caprimulgiformes	Caprimulgidae	*Caprimulgus europaeus*	Hume's European Nightjar
72.	Caprimulgiformes	Caprimulgidae	*Caprimulgus mahrattensis*	Syke's/Sind Nightjar
73.	Coraciiformes	Alcedinidae	*Ceryle rudis*	Pied Kingfisher
74.	Coraciiformes	Alcedinidae	*Alcedo atthis*	Common Kingfisher
75.	Coraciiformes	Alcedinidae	*Halcyon smyrnensis*	Whitebreasted Kingfisher
76.	Coraciiformes	Meropidae	*Merops oreintalis*	Green Bee-eater
77.	Coraciiformes	Meropidae	*Merops superciliosus*	Blue-cheeked Bee-eater
78.	Coraciiformes	Coraciidae	*Coracias benghalensis*	Indian Roller
79.	Coraciiformes	Upupidae	*Upupa epops*	Common Hoopoe
80.	Piciformes	Picidae	*Dinopium benghalensis*	Sind Golden-backed Woodpecker
81.	Piciformes	Picidae	*Picoides asimilis*	Sind Pied Woodpecker
82.	Passeriformes	Alaudidae	*Calendrella brachydactyla*	Great Short-toed Lark
83.	Passeriformes	Alaudidae	*Galerida cristata*	Crested Lark
84.	Passeriformes	Alaudidae	*Alauda gulgula*	Oriental Small Skylark
85.	Passeriformes	Hirundinidae	*Riparia diluta*	Pale Sand Martin
86.	Passeriformes	Hirundinidae	*Riparia paludicola*	Plain/Grey-throated Sand Martin
87.	Passeriformes	Hirundinidae	*Hirundo rustica*	Barn/Common Swallow
88.	Passeriformes	Lanidae	*Lanius meridionalis*	Southern Grey Shrike
89.	Passeriformes	Lanidae	*Lanius schach*	Rufous-backed Shrike
90.	Passeriformes	Lanidae	*Lanius vittatus*	Bay-backed Shrike
91.	Passeriformes	Dicruridae	*Dicrurus adsimilis*	Black Drongo
92.	Passeriformes	Sturnidae	*Acridotheres ginginianus*	Bank Myna
93.	Passeriformes	Sturnidae	*Acridotheres tristis*	Indian Myna
94.	Passeriformes	Sturnidae	*Sturnus vulgaris*	Common Starling
95.	Passeriformes	Corvidae	*Dendrocitta vagabunda*	Indian Treepie
96.	Passeriformes	Corvidae	*Corvus splendens*	Sind House Crow
97.	Passeriformes	Pycnonotidae	*Pycnonotus cafer*	Red-vented Bulbul
98.	Passeriformes	Pycnonotidae	*Pycnonotus leucogenys*	White-cheeked Bulbul
99.	Passeriformes	Timaliidae	*Turdoides caudatus*	Common Babbler
100.	Passeriformes	Timaliidae	*Turdoides earlei*	Striated Babbler
101.	Passeriformes	Timaliidae	*Turdoides striatus*	Sind Jungle Babbler
102.	Passeriformes	Rhipiduridae	*Rhipidura aureola*	White-browed Fantail
103.	Passeriformes	Sylviidae	*Acrocephalus stentoreus*	Clamorous Reed Warbler
104.	Passeriformes	Sylviidae	*Cisticola juncidus*	Streaked Fantail Warbler

Table 3. Contd.

S. No.	Order	Family	Scientific Name	Common Name
105.	Passeriformes	Sylviidae	*Prinia buchanani*	Rufous-fronted Wren-warbler
106.	Passeriformes	Sylviidae	*Prinia burnesii*	Long-tailed Grass Warbler/ Rufous-vented Prinia
107.	Passeriformes	Sylviidae	*Prinia glacilis*	Indian Streaked Wren-warbler
108.	Passeriformes	Sylviidae	*Orthotomus sutorius*	Tailor Bird
109.	Passeriformes	Sylviidae	*Hippolais caligata*	Booted Tree Warbler
110.	Passeriformes	Sylviidae	*Sylvia curruca*	Lesser Whitethroat
111.	Passeriformes	Sylviidae	*Phylloscopus collybita*	Common Chiffchaff
112.	Passeriformes	Turdidae	*Erythropygia galacototes*	Rufous Chat/Grey-backed Warbler
113.	Passeriformes	Turdidae	*Luscinia svecicus*	Bluethroat
114.	Passeriformes	Turdidae	*Phoenicurus ochruros*	Black Redstart
115.	Passeriformes	Turdidae	*Saxicola caprata*	Pied Bush Chat
116.	Passeriformes	Turdidae	*Saxicola torquata*	Collared Indian Bush Chat/stone Chat
117.	Passeriformes	Turdidae	*Oenanthe deserti*	Desert Wheatear
118.	Passeriformes	Turdidae	*Oenanthe picata*	Variable Whaetear
119.	Passeriformes	Turdidae	*Oenanthe xanthoprymna*	Red-tailed Wheatear
120.	Passeriformes	Turdidae	*Saxicoloides fulicata*	Indian Robin
121.	Passeriformes	Turdidae	*Anthus campestris*	Tawny Pipit
122.	Passeriformes	Motacillidae	*Motacilla alba*	White/ Pied Wagtail
123.	Passeriformes	Motacillidae	*Motacilla citreola*	Yellow-headed Wagtail
124.	Passeriformes	Motacillidae	*Motacilla flava*	Yellow Wagtail
125.	Passeriformes	Nectariniidae	*Nectarinia asiatica*	Purple Sunbird
126.	Passeriformes	Passeridae	*Passer domesticus*	House Sparrow
127.	Passeriformes	Passeridae	*Passer pyrrhonotus*	Sind Jungle Sparrow
128.	Passeriformes	Ploceidae	*Ploceus philippinus*	Indian Baya
129.	Passeriformes	Estrildidae	*Lonchura malabarica*	Common Silverbill/white-throated Munia

Table 4. List of Reptiles of Nara Game Reserve.

S. No.	Order	Family	Scientific Name	Common Name
1.	Chelonia	Trionychidae	*Lissemys punctata*	Indian Flap-shell Turtle
2.	Chelonia	Trionychidae	*Aspideretes gangeticus*	Indian Softshell Turtle
3.	Chelonia	Emydidae	*Geoclemys hamiltonii*	Spotted Pond Turtle
4.	Squamata	Elapidae	*Naja naja*	Indian Cobra
5.	Squamata	Colubridae	*Lytorhynchus paradoxus*	Sindh Awl –headed Snake
6.	Squamata	Colubridae	*Platyceps ventromaculatus*	Glossy-bellied Racer
7.	Squamata	Colubridae	*Psammophis leithii*	Ribbon Snake
8.	Squamata	Colubridae	*Ptyas mucosus*	Dhaman
9.	Squamata	Viperidae	*Echis carinatus*	Saw-scaled Viper
10.	Squamata	colubridae	*Xenochrophis piscator*	Checkered-keel Back
11.	Squamata	Scincidae	*Ophiomorus tridactylus*	Three-toed Sand Swimmer
12.	Squamata	Varanidae	*Varanus griseus*	Desert Monitor Lizard
13.	Squamata	Varanidae	*Varanus bengalensis*	Indian Monitor
14.	Squamata	Geckonidae	*Cyrtopodian scaber*	Keeled Rock Gecko
15.	Squamata	Lacertidae	*Acanthodactylus cantoris*	Bluetail Lizard
16.	Squamata	Agamidae	*Trapelus agilis*	Brilliant Agama
17.	Squamata	Agamidae	*Calotes versicolor*	Garden Lizard
18.	Squamata	Uromastycidae	*Saara hardwickii*	Spiny-tailed Lizard
19.	Squamata	Boidae	*Exyx johnii*	Sand Boa
20.	Crocodilia	Crocodylidae	*Crocodylus palustris*	Marsh Crocodile

Table 5. List of Amphibians of Nara Game Reserve.

S. No.	Order	Family	Scientific Name	Common Name
1.	Anura	Ranidae	*Euphlyctis cyanophlyctis*	Skittering Frog
2.	Anura	Bufonidae	*Duttaphrynus stomaticus*	Common Toad

Table 6. List of Fishes of Nara Game Reserve.

S. No.	Order	Family	Scientific Name	Common Name
1.	Clupeiformes	Clupiedae	*Gadusia chapra*	Palora-Palli
2.	Osteoglossiformes	Notopteridae	*Notopterus notopterus*	Gandani
3.	Osteoglossiformes	Notopteridae	*Notopterus chitala*	Gandan
4.	Cypriniformes	Cyprinidae	*Securicola gora*	Palri-Dachi
5.	Cypriniformes	Cyprinidae	*Salmostoma bacaila*	Chal-Dahi
6.	Cypriniformes	Cyprinidae	*Chela lauba*	Dannahrah
7.	Cypriniformes	Cyprinidae	*Chela cachius*	Makhni
8.	Cypriniformes	Cyprinidae	*Aspidoparis morar*	Chal
9.	Cypriniformes	Cyprinidae	*Labeo calbasu*	Dahi
10.	Cypriniformes	Cyprinidae	*Labeo gonius*	Seereba
11.	Cypriniformes	Cyprinidae	*Labeo rohita*	Rohu-Dambra
12.	Cypriniformes	Cyprinidae	*Catla catla*	Thaila
13.	Cypriniformes	Cyprinidae	*Cirrhinus mrigala*	Morakha
14.	Cypriniformes	Cyprinidae	*Cirrhinus reba*	Sunni
15.	Cypriniformes	Cyprinidae	*Puntius conchonius*	Popri-Pottiah
16.	Cypriniformes	Cyprinidae	*Puntius sophore*	Chidu
17.	Cypriniformes	Cyprinidae	*Puntius ticto*	Chidu
18.	Cypriniformes	Cyprinidae	*Osteobrama cotio*	Dhambra
19.	Siluriformes	Bagridae	*Aorichthys aor*	Singhara
20.	Siluriformes	Bagridae	*Mystus cvasius*	Tengarah
21.	Siluriformes	Bagridae	*Mystus bleekeri*	Tengra
22.	Siluriformes	Bagridae	*Rita rita*	Khagga
23.	Siluriformes	Siluridae	*Wallago attu*	Potki-Jerki
24.	Siluriformes	Siluridae	*Ompok bimaculatus*	Malirah-Dimmon
25.	Siluriformes	Heteropneustidae	*Heteropneustes fossilis*	Singhi
26.	Siluriformes	Schilbeidae	*Eutropiichthys wacha*	Dongna
27.	Siluriformes	Sisoridae	*Bagarius bagarius*	Faugi Khagga
28.	Beloniformes	Belonidae	*Xenentodon cancila*	Kenga
29.	Channiformes	Channidae	*Channa marulius*	Chitra
30.	Channiformes	Channidae	*Channa punctata*	
31.	Channiformes	Channidae	*Channa striatus*	Daula
32.	Perciformes	Chandidae	*Chanda nama*	Makhni
33.	Perciformes	Chandidae	*Chanda ranga*	Shisha
34.	Perciformes	Gobiidae	*Glossogobius giuris*	Golo
35.	Perciformes	Osphronemidae	*Colisa fasciata*	Kangee
36.	Perciformes	Osphronemidae	*Colisa lalia*	Choti Kangi
37.	Perciformes	Cichlidae	*Oreochromis mossambica*	Talpo

RESULTS

The period of the studies was from January 2007 to December 2011. During the survey, the status and distribution of mammals, birds, reptiles, amphibians and fishes was recorded. A total of 21 species of mammals (Table 2), 129 species of birds (Table 3), 20 species of reptiles (Table 4), 2 species of amphibians (Table 5) and 37 species of fishes (Table 6) were enlisted.

Mammals

A total of 21 species of mammals were recorded from the area.

The common species recorded are Five-striped Palm Squirrel (*Funanbulus pennanti*), Roof Rat (*Rattus rattus*), House Rat (*Mus musculus*), Short-tailed Mouse Rat (*Nesokia indica*), Balochistan Gerbil (*Gerbillus nanus*), Indian Gerbil (*Tatera indica*) and Indian Desert Gerbil (*Meriones hurrianae*).

Fishing Cat (*Prionailurus viverrinus*) and Hog Deer (*Axis porcinus*) were recorded as endangered mammalian species of the area, while Smooth-coated Otter (*Lutrogale perspicillata*) was recorded as vulnerable species.

Birds

A total of 129 species of birds were recorded from the area including mostly the water birds, birds of prey and passerines. Among forest birds, kingfishers, bee-eaters, rollers, and doves are very common.

The less common species of birds include: Large Cormorant (*Phalacrocorax carbo*), Ferruginous Duck (*Aythya nyroca*), Garganey (*Anas querquedula*), Black Partridge (*Francolinus francolinus*), Marbled Teal (*Marmaronetta angustirostris*), Pintail (*Anas acuta*), White-tailed Lapwing (*Vanellus inicus*), Greenshank (*Tringa nebularia*), Redshank (*Tringa totanus*), Dunlin (*Calidris alpinus*), European Nightjar (*Caprimulgus europaeus*) and Black Redstart (*Phoenicurus ochruros*).

The threatened or near-threatened species of birds recorded from the area include: Marbled Teal (*Marmaronetta angustirostris*), Houbara Bustard (*Chlamydotis undulata*) which are Vulnerable while Indian Darter (*Anhinga rufa*) and Ferruginous Pochard (*Aythya nyroca*) are Near-threatened.

Reptiles

The area supports 198 crocodiles out of 480 reported in Sindh Province. Nara Canal and the following wetlands are important for supporting Marsh Crocodile: Torti, Somen, Ganjo, Shenhlo, Dholaho, Chaho, Nagiopeer, Simni, Samabi, Akhero, Badrami, Dehran and Chhoti dhand.

Common species of reptiles of the area are Indian Flap-shell Turtle (*Lissemys punctata*), Spotted Pond Turtle (*Geoclemys hamiltonii*), Glossy-bellied Racer (*Platyceps ventromaculatus*), Bluetail Lizard (*Acanthodactylus cantoris*) Garden Lizard (*Calotes versicolor*) and Dhaman (*Ptyas mucosus*).

The less common species of reptiles include Indian Softshell Turtle (*Aspideretes gangeticus*), Indian Cobra (*Naja naja*), Sindh Awl-headed Snake (*Lytorhynchus paradoxus*), Ribbon Snake (*Psammophis leithii*), Saw-scaled Viper (*Echis carinatus*), Checkered-keel Back (*Xenochrophis piscator*), Three-toed Sand Swimmer (*Ophiomorus tridactylus*), Desert Monitor Lizard (*Varanus griseus*), Brilliant Agama (*Trapelus agilis*), Keeled Rock Gecko (*Cyrtopodian scaber*), Marsh Crocodile (*Crocodylus palustris*), Indian Monitor Lizard (*Varanus bengalensis*), Spiny-tailed Lizard (*Saara hardwickii*) and Sand Boa (*Eryx johnii*).

The threatened species of reptiles of the area include Marsh Crocodile (*Crocodylus palustris*) and Indian Soft-shell Turtle (*Aspideretes gangeticus*) which are Vulnerable.

Amphibia

Two amphibian species viz. Skittering Frog (*Euphlyctis cyanophlyctis*) and Indus Toad (*Duttaphrynus stomaticus*) were recorded from the area as common.

Fishes

A total of 37 fish species have been recorded from the study area in which family ciprinidae was dominant. Of these Dahi (*Labeo calbasu*), Seereba (*Labeo gonius*), Dambra (*Labeo rohita*), Thaila (*Catla catla*), Morakha (*Cirrhinus mrigala*), Singhara (*Aorichthys cotio*) and Khagga (*Rita rita*) have commercial importance (Khan, 2004).

DISCUSSION

The Nara Wetland Complex includes the Nara Canal and the associated wetlands. As many as 200 wetlands have been recorded / listed from the area. The wetlands of Nara Wetland Complex are important because of birds particularly migratory water birds which are the characteristic wildlife of the area (Ghalib *et al.*, 2006).

The main habitats have been identified in the Nara Game Reserve viz.

1. The Nara Canal and the associated marshes.
2. The desert wetlands in the periphery of Nara Canal.
3. Nara Desert.
4. Farmlands.

5. Villages and human habitations.
6. Forests.

During the present study, 21 species of Mammals, 129 species of Birds, 20 species of Reptiles, 2 species of amphibians and 37 species of Fishes were recorded from the area.

The key species of the Nara Game Reserve include Hog Deer, Smooth-coated Otter, Fishing Cat, Marbled Teal, Grey and Black Partridges, Houbara Bustard and Marsh crocodile.

Hog Deer has been reported along the Nara Canal from RD 463 to RD 424. It has mostly declined in numbers due to habitat degradation and disturbance. Fishing Cat has been reported from around Jamrao Head. It is quite rare now.

Studies on the distribution and population status of Smooth-coated Otter have been undertaken and it has been reported from near Jamrao Head area (Khan *et al.*, 2010).

The status of large mammals especially ungulates and carnivores has declined over the past decades in the area due to increase in human population, habitat deterioration, hunting and other ecological changes taking place due to development. Small mammals and rodents are quite common as noticed by their burrow system and direct sightings
The study area is a blend of different habitats and supports a variety of avifauna both resident and migratory. The agriculture fields and the villages at the edge of desert habitat provide favorable environment to a number of bird species which have adapted to the human settlement.

The Houbara Bustard, a winter visitor to the desert areas, is under severe hunting pressure from the Arab dignitaries who practise large scale hunting of the bird through their trained falcons during November to February each year. In addition to that, Grey Partridge and some species of ducks such as Mallard and Common Teal are widely hunted.

Marbled Teal is another threatened species of the area. It has been recorded in winter from Kathor Dhand, Jagheer and Simnowahid dhands. Its breeding has been recorded from Dangri and Baboo dhands where the species comes for breeding starting from late March.

Some other rare species of birds have also been recorded from the area, such as Black Ibis recorded from Nagiopeer, Jerdon's Babbler recorded on Phragmites from Nara Gate and Striated Babbler recorded from Bhog Forest.

The most important reptile of the study area i.e. Marsh Crocodile has been recorded from 14 wetlands of Nara Game Reserve (Ghalib *et al.*, 2006).

Important forests of the area include Belahat, Tokno and Bog Forest, which are good sites for the captive breeding of Hog Deer and Partridges.

The Threatened/Near species recorded from the area include: Hog Deer (E), Fishing Cat (E), Smooth – Coated Otter (V), Marbled Teal (V), Houbara Bustard (V), Marsh Crocodile (V), Indian Flap-shell Turtle (V), Indian Darter (NT), Ferruginous Duck (NT) and Long-tailed Grass Warbler (NT).

The Threats to the biodiversity of the area include habitat degradation due to poor management practices and fragmentation of the main wildlife habitats due to rapidly increasing human population. There is also the impact of 7 Farm-to Market Rural Roads passing through the Protected Area. There is also some disturbance due to gas exploration activities in the area. Two main gas fields viz. Sawan and Kadanwari are located in the area. However, there are no severe impacts of these projects on the wildlife of the area as EIA studies have been already made in the sensitive areas and Environmental Management Plans are already under execution. But there is still the need for a Monitoring Programme.

More than 200 wetlands have been recorded in the area. Most of them are brackish due to very high percentage of dissolved salts. These are low-lying wetlands and receive water through seepage from the Nara Canal. These wetlands support large numbers of migratory waterbirds during the migratory season and more than 14 wetlands support Marsh Crocodile. As there are no effluents coming to these wetlands, hence, there is no serious issue of pollution affecting of the biodiversity.

Very few wetlands contain freshwater which is used for drinking purposes by the local communities. Mostly, the people subsist on water obtained through boring or tube wells.

The Nara Wetland Complex was identified as a priority site for Bioecological studies under the Indus For All Programme of the WWF-P and waterbird surveys were undertaken during 2011 and 2012 (IFAP, 2012). Some useful data were collected from the major wetlands of the area viz. Nagiopeer, Kathor, Maqamwari, Daysan, Akhero, Berwari, Simno Wahid, Jagheer, Kinni, Manjerka, Sukiyal, Lalori, Samabi and Kirchan. Recently, Marbled Teal and Ferruginous Duck have been recorded from Dangewari during the AWC, 2012 (Chaudhry *et al.*, 2012).
As these wetlands support significant number of water birds during the season, so the study recalls for regular monitoring of water bird populations particularly during the migratory season.

CONCLUSION

Nara Canal which is largest canal in Sindh running from the Sukkur barrage to Jamrao Headworks is the basic source of drinking water, agriculture and livestock. The area contains important habitats including desert, forests, villages, human habitations, Nara Canal and associated marshes etc. Main threats to the wildlife of the area are human population pressure, hunting, habitat destruction, disturbance and ecological changes. The Nara Wetland Complex is an important bio-ecological site which needs conservation and management plan for the sustainability of its biodiversity resources and its potential for ecotourism.

REFERENCES

Bhaagat., H.B. (2005). Biological and Ecological Importance of Nara Game Reserve, Sindh, Pakistan. *Tiger paper*. 32(2): 26-32.

Brower, J.E., J. H. Zar and C. N. von Ende (1990). *Field and laboratory methods for general ecology*. Wm . C . Brown Publishers. 2460 Kerper Boulevard, Dubuque. A 52001.

Chaudhry, M. J. I., M. Arshad and G. Akbar (2012). Some observations on Threatened and Near Threatened Avifauna of Pakistan. *Rec. Zool. Surv. Pakistan*, 21: 65-72.

Ghalib, S.A., H. Rehman and A.R. Khan (2006). Observations on the wildlife of Nara Wetland Complex, Tehsil Nara, District Khairpur, Sindh with special Reference to the Water birds. *Pakistan. J. Zool.*, 38(1): 21-25.

IFAP (Indus for All Programs). (2012). *Ecological Assessment of Fauna of Nara Wetland Complex, District Khairpur, Sindh. Baseline Survey, 2010-2011*. WWF-Pakistan, Karachi. 101 pp. (Unpublished).

Khan, M.Z. (2006). *Current Status and Biodiversity of Indus Dolphin Reserve and Indus Delta Wetlands (Ramsar Sites)*. Proc. 9th International River Symposium, Brisbane, Australia. 01-26.

Khan, M.Z., D. Abbas, S.A. Ghalib, R. Yasmeen, S. Siddiqui, N. Mehmood, A. Zehra, A. Begum, T. Jabeen, G. Yasmeen and T.A. Latif (2012). Effects of Environmental pollution on Aquatic Vertebrates and Inventories of Haleji and Keenjhar Lakes. *Canadian Journal of Pure and Applied Sciences*, 6 (1): 1759-1783.

Khan, S.A. (2004). A Checklist of freshwater fishes of Nara Game Reserve. *Rec. Zool. Surv. Pakistan*, 15: 45 – 48.

Khan, W.A., M. Qasim, E. Ahmad, A.A. Chaudhry, H.B. Bhaagat and M. Akhtar (2010). Status of Smooth-coated Otter (*Lutragale perspicillata*) in Pakistan. *Pakistan J. Zool*., 42 (6): 817-824.

Rafiq, M. (2009). Fish Fauna of Haleji Lake, Sindh, Pakistan. *Rec. Zool. Surv. Pakistan*, 19: 61-65.

Scott, D.A. (ed.), (1989). *A Directory of Asian Wetlands.* Pakistan Section, 295-365. IUCN, Gland, Switzerland. 1181 pp.

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