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Caption: Stripe-backed Weasel *Mustela strigidorsa*. Medium—digital, Software—procreate, Device—iPad + Apple pencil © Dhanush Shetty.

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COMMUNICATION

Abundance and diversity of threatened birds in Nangal Wetland, Punjab, India

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Abstract: Anthropogenic threats to wetland ecosystems, including discharge of industrial effluents, municipal sewerage, land reclamation, erosion and deforestation, have contributed to the rapid declines in populations of many bird species. The present study aimed to document avian diversity, including birds on the IUCN Red List, at Nangal Wetland, Punjab from February 2013 to January 2015. A total of 155 species belonging to 48 families (resident and migratory) under 17 orders were recorded, of which 13 come under various IUCN Red List categories: one 'Endangered'—Egyptian Vulture *Neophron percnopterus*; five 'Vulnerable'—Common Pochard *Aythya ferina*, Greater-Spotted Eagle *Aquila clanga*, Sarus Crane *Grus antigone*, Lesser White-Fronted Goose *Anser erythropus*, and Woolly-necked Stork *Ciconia episcopus*; and seven 'Near Threatened'—Ferruginous Duck *Aythya nyroca*, River Lapwing *Vanellus duvaucelii*, Indian River Tern *Sterna aurantia*, Painted Stork *Mycteria leucocephala*, Oriental Darter *Anhinga melanogaster*, Blossom-headed Parakeet *Psittacula roseata*, and Alexandrine Parakeet *Psittacula eupatria*. The Shannon-Weaver index of diversity was highest during winter (H'= 1.9) followed by autumn (H'= 1.9) then spring (H'= 1.5), and was lowest during summer (H'= 1.4). Though this wetland is highly productive and provides homes to many threatened species, untreated industrial effluents from adjoining areas sometimes create problems. The discharge of pollutants should be stopped through strict enforcement of environmental laws and policies.

Keywords: Avifauna, conservation, IUCN Red List.

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Author contributions: RK—done this research work during PhD degree. OS—supervised and guided throughout.

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INTRODUCTION

Wetlands are important bird habitats (Mitsch & Gosselink 1986; Guadagnin et al. 2005) that provide suitable breeding, staging, and wintering grounds for a wide array of migratory birds (Kristen & Brander 1991). Wetland with multiple sub-habitats or micro habitats attract diverse species of waterbirds. Being ecologically important with high nutritional value and productivity, wetlands support a good diversity of birds (Gibbs 1993; Paracuellos 2006).

It might be predicted that migratory species are more likely to be threatened because they are dependent on different sites and habitats during breeding and non-breeding seasons. A threat operating in just one of these areas could have a severe impact (Salathe 1991). Several studies suggest that habitat destruction is one of the prime reasons for the decline of birds. For instance, it was reported that over 90 % of globally threatened birds and 86 % of other bird species are facing a serious threat mainly due to habitat degradation (Kauzeni & Kiwasila 1994; Kideghesho et al. 2006). Information on status and distribution of threatened and endemic birds, therefore, aids in prediction of disturbance level and execution of conservation measures at all potential sites where they occur (Stattersfield et al. 1998; Riley 2002; Robin & Sukumar 2002). In 2000, the 'Threatened Birds of the World', which listed 1,186 species worldwide and 123 species in India (BirdLife International 2000).

Restricted range and threatened bird species require special attention from ecologists and conservationists. These species are more sensitive to disturbance and invite immediate conservation concern (BirdLife International 2001; Lei et al. 2003, 2007; Wijesinghe & Brooke 2005; Pandit et al. 2007). The present article documented the threatened and near-threatened bird species recorded at Nangal wetland to provide information about the current distribution and status of bird species as baseline data where future population trends can be compared.

MATERIAL AND METHODS

Study Area

Nangal Wetland is (Figure 1) (31.404°N & 76.368°E) located in Ropar District over the Sutlej River at 357m (1172ft). It spreads over an area of 700 acres and is enriched with diverse flora, fauna and hydrology. This wetland was created in the downstream of Bhakhra Reservoir for its strategic importance as balancing reservoir to adjust the extra water during the rainy season. The water of Nangal wetland is used for drinking and irrigation purposes. This wetland is important for socio-economic, ecological, hydrological and recreational values. This unique wetland ecosystem attracts thousands of migratory birds during winter season every year for feeding and also provides suitable feeding and breeding grounds for resident birds. However, it is very important to document its various components of biodiversity and its conservation needs and management measures due to its strategic importance (PSCST 1994). It was announced as a wetland of national importance by the Ministry of Environment, Forests & Climate Change, Government of India in January, 2008 and included it under the National Lake Conservation Program. It was also declared as a wildlife sanctuary on 10 August 2009. In 2020, Nangal wetland was declared as a Ramsar site. The study area experiences various seasons and broadly divided into spring (March, April, May), summer (June, July, August), autumn (September, October, November), and winter (December, January, February) seasons.

The study on avifaunal diversity at Nangal Wetland was conducted from February 2013 to January 2015. The point count method (Sutherland 1999) was used for the census of birds at the study sites. The study was undertaken by establishing 15 counting stations of 50 m radius each in the study area with 100 m intervals between two counting stations to cover the whole wetland area. Data were collected every month during winter season for five days per month and twice a day from 0700 h to 1000 h and 1600 h to 1800 h and during the summer season from 0600 h to 0900 h and 1700 h to 1900 h. The observer waited for a few minutes after arrival at each station before beginning the count. The bird count was carried out for ten minutes at each station. Each bird was counted once either seen or heard within the radius. Average count of birds at each station for five days was calculated. Identification has been done with the help of various field guides (Ali & Ripley 1987; Grewal et al. 1995; Ali 1996; Grimmett et al. 2001; Kazmierczak 2002). Shannon diversity index (*H'*) (Shannon & Weaver 1949) was calculated by using PAST (PAST: Paleontological Statistics) Software.

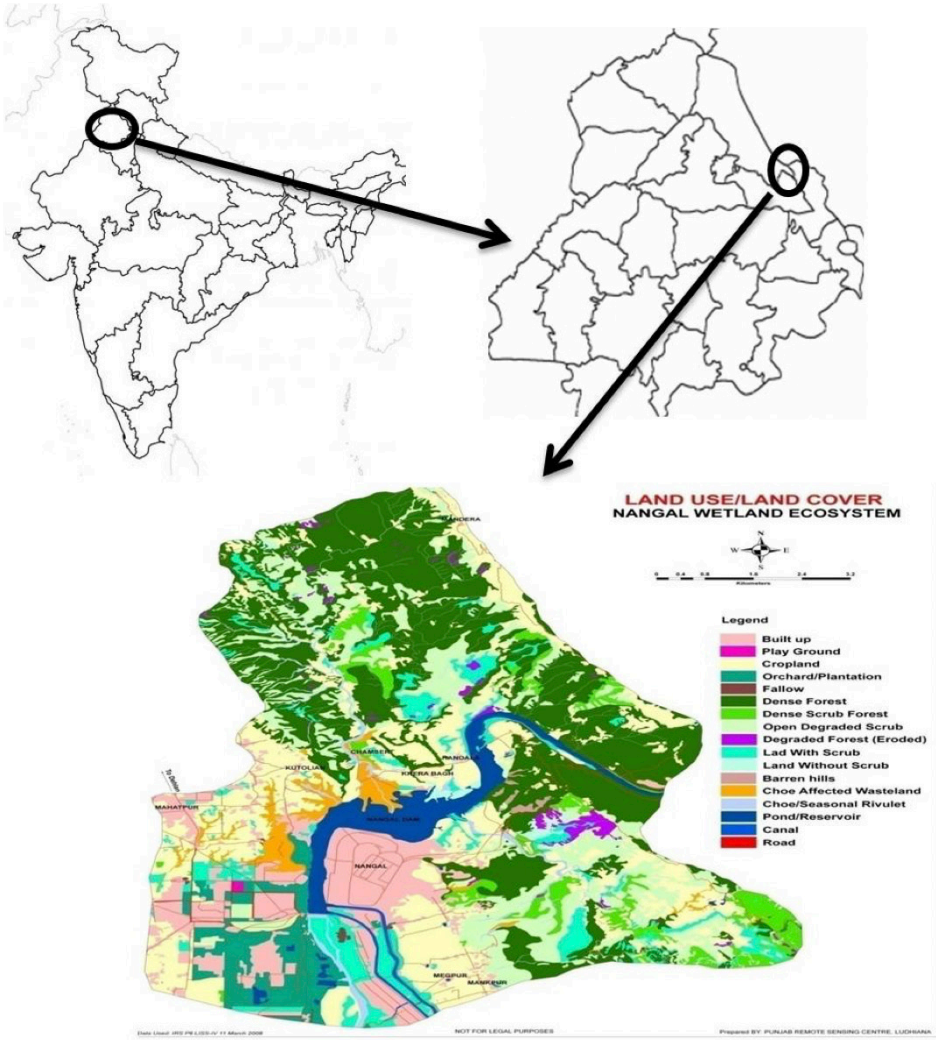

Figure 1. Map showing the Nangal Wetland.

RESULTS AND DISCUSSION

Nangal wetland harbours a significant number of threatened bird species, belonging to different categories of the IUCN Red List. During this study, a total of 155 bird species were recorded (Table 1). Of these, 13 species belonging to seven orders and eight families were in the globally threatened category of IUCN (Table 2). According to the IUCN Red List of birds (IUCN 2018), 7.7 % were EN (n= 1), 39 % were VU (n= 5) and 54 % were NT (n= 7) (Figure 2). The 'Endangered' species recorded from this wetland was Egyptian Vulture *Neophron percnopterus*; 'Vulnerable' species included Common Pochard *Aythya ferina*, Greater-Spotted Eagle *Aquila clanga*, Sarus Crane *Grus antigone*, Lesser White-Fronted Goose *Anser erythropus*, and Woolly-necked Stork *Ciconia episcopus*. The 'Near Threatened' species included Ferruginous Duck *Aythya nyroca*, River Lapwing *Vanellus duvaucelii*, Indian River Tern *Sterna aurantia*, Painted Stork *Mycteria leucocephala*, Oriental Darter *Anhinga melanogaster*, Blossom-headed Parakeet *Psittacula roseata*, and Alexandrine Parakeet *Psittacula eupatria*.

Narayanan et al. (2011) recorded a total of 225 species of birds from Kuttanad wetlands inclusive of 10 Red Listed species, namely, Greater Spotted Eagle *Clanga clanga*, Ferruginous Pochard *Aythya nyroca*, Painted Stork *Mycteria leucocephala*, Oriental White Ibis *Threskiornis melanocephalus*, Spot-billed Pelican *Pelecanus philippensis*, Oriental Darter *Anhinga melanogaster*, Greater-headed Fish Eagle *Haliaeetus ichthyaetus*, Black-tailed Godwit *Limosa limosa*, Eurasian Curlew *Numenius arquata*, and European Roller *Coracias*

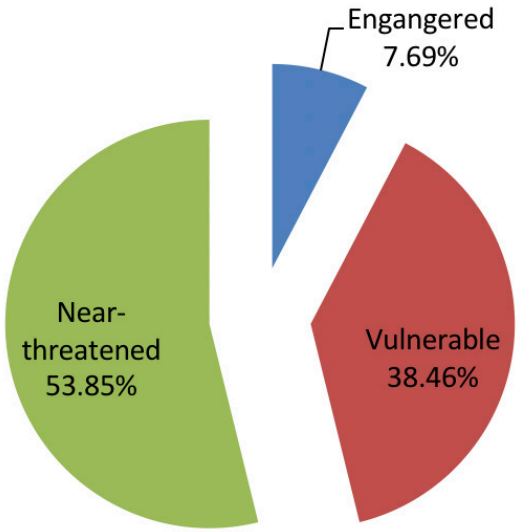

Figure 2. Percentage contribution of different groups of birds.

garrulous.

Some wetlands in Punjab are highly infested with unwanted weeds mostly *Eichhornia crassipes* which covers the entire surface area. But Nangal wetland does not support these weeds and provide plenty of space for migratory birds during winter season. Presence of 155 bird species in the Nangal wetland indicates that the area is able to give ecological security to the wetland dependent birds by providing sufficient quantity of food in the form of microflora (aquatic planktonic species, e.g., *Fragillaria* spp., *Spirogyra* spp., *Oedogonium* spp., *Tabellaria* spp., *Cymbella* spp., *Gomphnema* spp.), mesoflora (aquatic vegetations, e.g., *Lemna* spp., *Valisneria* spp., *Azolla* spp., *Pistia* spp.), microfauna (small microscopic animals), and mesofauna (fish, insects, and small animals) in the wetland. Besides these, resident birds were observed throughout the year due to the availability of favorable conditions for breeding, feeding, roosting, and nesting sites. This wetland not only attracts water birds, but is also favorable and rewarding spot for terrestrial birds. The occurrence of high number of terrestrial birds could be due to strong influence of vegetation cover and presence of varieties of microhabitats which provide niche to large numbers of terrestrial birds.

In the present investigations, birds were classified on the basis of their occurrence at the study area, of the 13 Red Listed species, three were migratory, eight were local migratory and two were residents. Similarly, birds were also classified on the basis of their feeding habits, it was observed that three species were herbivorous, four were omnivorous and six were carnivorous. Chaudhry et al. (2012) study on threatened and near-threatened avifauna of Pakistan recorded 16 species inclusive of resident and migratory species. Of the total recorded species, nine were 'Near Threatened', one 'Endangered', and one 'Critically Endangered'.

The mean value and standard deviation of occurrence of monthly birds count were calculated. A well-marked seasonal variation in bird populations was recorded (Table 3). Generally the population of waterbirds started increasing from August to January, with a peak in month of December and January and thereafter started decreasing. During the present study, a sharp decline in the waterbirds count was observed after the month of February due to the partial departure of migratory species. Almost complete absence of migratory waterbirds was noticed from April to July during both years, only local resident birds reside during the remaining months. Highest diversity in winter months was attributed to the influx of migratory waterbirds during this season. Least diversity in the summer months was due to the absence of migratory waterbirds species. Similar observations of seasonal variations were also made by Saxena (1975) on avifauna of Keoladeo National Park, Bharatpur and Bhat et al. (2009) on avifauna of Anekere wetland, Karnataka. Giri & Chalise (2008) also recorded a greater diversity in winter months due to the addition of migratory birds in this season. Kershaw & Cranswick (2003) studied waterbirds become highly mobile in winter season as living conditions rendered unfavorable during this cold weather. The waterbirds start moving to other areas in response to hostile weather conditions such as changes in water levels and diminishing availability of food.

In order to investigate the variations in diversity of bird species and ecological groups during different seasons of the study period, the species diversity was calculated using Shannon-wiener index. The Shannon-Weaver index of diversity was highest during winter (H'= 1.915) followed by autumn (H'= 1.868) then spring (H'= 1.534) and was lowest during summer season (H'= 1.436). Value of index during autumn and winter seasons had revealed the greatest diversity in terms of both species richness and evenness. Gerritsen et al. (1998) revealed that the increase in the value of H' is directly associated with the increase in the number and distribution of species during favorable periods (biotic diversity) within the community, thereby confirming the present observations.

Table 1. Check list of birds recorded from Nangal Wetland.

	Zoological name	Common name
	Order: Anseriformes	
	Family: Anatidae	
1.	*Anas poecilorhyncha* J.R. Forester, 1781	Indian Spot-billed Duck
2.	*Anas strepera* Linnaeus, 1758	Gadwall
3.	*Aythya ferina* (Linnaeus, 1758)	Common Pochard
4.	*Netta rufina* (*Pallas* 1773)	Red-crested Pochard
5.	*Aythya nyroca* (Guldenstadt, 1770)	Ferruginous Duck
6.	*Anas platyrhynchos* Linnaeus, 1758	Mallard
7.	*Tadorna ferruginea* (Pallas, 1764)	Ruddy Shelduck
8.	*Tadorna tadorna* (Linnaeus, 1758)	Common Shelduck
9.	*Anser indicus* (Latham, 1790)	Bar-headed Goose
10.	*Anser anser* (Linnaeus, 1758)	Graylag Goose
11.	*Anser erythropus* (Linnaeus, 1758)	Lesser White-Fronted Goose
12.	*Anas acuta* (Linnaeus, 1758)	Northern Pintail
13.	*Anas clypeata* Linnaeus, 1758	Northern Shoveller
14.	*Anas crecca* Linnaeus, 1758	Common Teal
15.	*Anas querquedula* Linnaeus, 1758	Garganey
16.	*Aythya fuligula* (Linnaeus, 1758)	Tufted Duck
17.	*Anas penelope* Linnaeus, 1758	Eurasian Wigeon
18.	*Sarkidiornis melanotos* (Pennant, 1769)	Knob-billed Duck
	Order: Accipitriformes	
	Family: Accipitridae	
19.	*Accipiter badius* (Gmelin, 1788)	Shikra
20.	*Milvus migrans* (Boddaert, 1783)	Black Kite
21.	*Elanus caeruleus* (Desfontaines, 1789)	Black-winged Kite
22.	*Aquila rapax* (Temminck, 1828)	Tawny Eagle
23.	*Aquila pomarina* (Brehm CL, 1831)	Lesser-spotted Eagle
24.	*Aquila clanga* Pallas, 1811	Greater-spotted Eagle
25.	*Aquila nipalensis* Hodgson, 1833	Steppe Eagle
26.	*Pandion haliaetus* (Linnaeus, 1758)	Osprey
27.	*Circus aeruginosus* (Linnaeus, 1758)	Western Marsh Harrier
28.	*Accipiter nisus* (Linnaeus, 1758)	Asiatic Sparrowhawk
29.	*Haliastur indus* (Boddaert, 1783)	Brahminy Kite
30.	*Neophron percnopterus*	Egyptian Vulture
	Order: Apodiformes	
	Family: Apodidae	
31.	*Apus affinis* (J.E. Gray, 1830)	Indian House Swift
	Order: Bucerotiformes	
	Family: Bucerotidae	
32.	*Ocyceros birostris* (Scopoli, 1786)	Indian Grey Hornbill
	Order: Charadriiformes	
	Family: Charadriidae	
33.	*Vanellus indicus* (Boddaert, 1783)	Red-wattled Lapwing
34.	*Vanellus duvaucelii* (Lesson, 1826)	River Lapwing
35.	*Vanellus leucurus* (Lichtenstein, 1823)	White-tailed Lapwing
36.	*Himantopus himantopus* (Linnaeus, 1758)	Black Winged Stilt
37.	*Actitis hypoleucos* Linnaeus, 1758	Common Sandpiper
38.	*Charadrius dubius* Scopoli, 1786	Little Ringed Plover
39.	*Charadrius hiaticula* Linnaeus, 1758	Common Ringed Plover
40.	*Sterna aurantia* J.E. Gray, 1831	Indian River Tern
	Order: Ciconiformes	
	Family: Ardeidae	
41.	*Bubulcus ibis* (Linnaeus, 1758)	Cattle Egret
42.	*Ardea alba* Linnaeus, 1758	Eastern Large Egret
43.	*Egretta garzetta* (Linnaeus, 1766)	Little Egret
44.	*Ardea intermedia* Wagler, 1829	Intermediate Egret
45.	*Ardeola grayii* (Sykes, 1832)	Indian Pond Heron
46.	*Nycticorax nycticorax* (Linnaeus, 1758)	Black-crowned Night Heron
47.	*Ardea purpurea* Linnaeus, 1766	Purple Heron
48.	*Ardea cinerea* Linnaeus, 1758	Grey Heron
	Ciconiidae	
49.	*Mycteria leucocephala* (Pennant, 1769)	Painted Stork
50.	*Ciconia episcopus* (Boddaert, 1783)	Woolly-necked Stork
	Laridae	
51.	*Larus brunnicephalus* (Jerdon, 1840)	Brown-headed Gull
52.	*Ichthyaetus ichthyaetus* (Pallas, 1773)	Palla's Gull/ Great Black-headed Gull
	Phalacrocoracidae	
53.	*Phalacrocorax niger* (Vieillot, 1817)	Little Cormorant
54.	*Phalacrocorax carbo* (Linnaeus, 1758)	Great Cormorant
55.	*Anhinga melanogaster* Pennant, 1769	Oriental Darter
	Podicipedidae	
56.	*Podiceps cristatus* (Linnaeus, 1758)	Great Crested Grebe
57.	*Tachybaptus ruficollis* (Pallas, 1764)	Little Grebe
58.	*Podiceps nigricollis* Brehm, CL, 1831	Black Necked Grebe
	Order: Columbiformes	
	Family: Columbidae	
59.	*Streptopelia decaocto* (Frivaldszky, 1838)	Eurasian Collared Dove
60.	*Streptopelia senegalensis* (Linnaeus, 1766)	Laughing Dove
61.	*Streptopelia chinensis* (Scopoli, 1786)	Spotted Dove
62.	*Columba livia* Gmelin, 1789	Blue Rock Pigeon
63.	*Treron phoenicoptera* (Latham, 1790)	Yellow Footed Pigeon

	Zoological name	Common name
	Order: Coraciiformes	
	Family: Alcedinidae	
64.	*Halcyon smyrnensis* (Linnaeus, 1758)	White Breasted Kingfisher
65.	*Alcedo atthis* (Linnaeus, 1758)	Small Blue Kingfisher
66.	*Ceryle rudis* (Linnaeus, 1758)	Lesser Pied Kingfisher
	Meropidae	
67.	*Coracias benghalensis* (Linnaeus, 1758)	Indian Roller
68.	*Merops orientalis* Latham, 1801	Little Green Bee-Eater
69.	*Merops leschenaulti* Vieillot, 1817	Chestnut Headed Bee-Eater
	Order: Cuculiformes	
	Family: Cuculidae	
70.	*Centropus sinensis* (Stephens, 1815)	Greater Coucal
71.	*Eudynamys scolopacea* (Linnaeus, 1758)	Asian Koel
72.	*Hierococcyx varius* (Vahl, 1797)	Common Hawk Cuckoo
73.	*Clamator jacobinus* (Boddaert, 1783)	Jacobin Cuckoo
	Order: Galliformes	
	Family: Phasianidae	
74.	*Coturnix coturnix* (Linnaeus, 1758)	Grey Or Common Quail
75.	*Perdicula asiatica* Latham, 1790	Jungle Bush Quail
76.	*Gallus gallus* (Linnaeus, 1758)	Red Jungle Fowl
77.	*Francolinus pondicerianus* (Gmelin, 1789)	Grey Francolin
78.	*Melanoperdix niger* (Vigors, 1829)	Black Partridge
79.	*Pavo cristatus* Linnaeus, 1758	Indian Peafowl
	Order: Gruiformes	
	Family: Gruidae	
80.	*Grus antigone* (Linnaeus, 1758)	Sarus Crane
	Rallidae	
81.	*Gallinula chloropus* (Linnaeus, 1758)	Common Swamphen
82.	*Porphyrio porphyrio* (Linnaeus, 1758)	Indian Purple Moorhen
83.	*Amaurornis phoenicurus* (Pennant, 1769)	White-breasted Water Hen
84.	*Fulica atra* Linnaeus, 1758	Common Coot
	Order: Passeriformes	
	Family: Acrocephalidae	
85.	*Acrocephalus dumetorum* (Vieillot, 1817)	Blyth's Reed Warbler
	Alaudidae	
86.	*Alauda gulgula* Franklin, 1831	Oriental Or Small Skylark
87.	*Galerida cristata* (Linnaeus, 1758)	Indian Crested Lark
88.	*Mirafra cantillans* Blyth, 1845	Singing Bush Lark
	Campephagidae	
89.	*Pericrocotus cinnamomeus* (Linnaeus, 1766)	Small Minivit
90.	*Pericrocotus ethologus* Bangs & Phillips, 1914	Long Tailed Minivet

	Zoological name	Common name
	Certhiidae	
91.	*Certhia nipalensis* Blyth, 1845	Rusky-flanked Treecreeper
	Cisticolidae	
92.	*Prinia socialis* Sykes, 1832	Ashy Prinia Or Ashy Wren Warbler
93.	*Prinia gracilis* (Lichtenstein, MHC, 1823)	Streaked Wren Warbler
	Corvidae	
94.	*Corvus splendens* Vieillot, 1817	House Crow
95.	*Corvus macrorhynchos* Wagler, 1827	Indian Jungle Crow
96.	*Dendrocitta vagabunda* (Latham, 1790)	Rufous Treepie
97.	*Dicrurus macrocercus* Vieillot, 1817	Black Drongo
	Emberizidae	
98.	*Emberiza melanocephala* Scopoli, 1769	Black-headed Bunting
99.	*Emberiza buchanani* Blyth, 1845	Grey-necked Bunting
	Estrildidae	
100.	*Lonchura malabarica* (Linnaeus, 1758)	White-throated Munia
101.	*Lonchura punctulata* (Linnaeus, 1758)	Scaly-breasted Munia
102.	*Amandava amandava* (Linnaeus, 1758)	Red Avadavat
	Hirundinidae	
103.	*Hirundo smithii* Leach, 1818	Indian Wire-tailed Swallow
104.	*Hirundo rustica* Linnaeus, 1758	Barn Swallow
	Laniidae	
105.	*Lanius excubitor* Linnaeus, 1758	Great Grey Shrike
106.	*Lanius vittatus* Valenciennes, 1826	Bay-backed Shrike
107.	*Lanius schach* Linnaeus, 1758	Long Tailed Shrike
	Locustellidae	
108.	*Megalurus palustris* Horsfield, 1821	Striated Marsh Warbler
	Motacilladae	
109.	*Motacilla alba* Linnaeus, 1758	White Wagtail
110.	*Motacilla cinerea* Tunstall, 1771	Grey Wagtail
111.	*Motacilla maderaspatensis* Gmelin, JF, 1789	White-browed Wagtail
112.	*Motacilla citreola* Pallas, 1776	Citrine Wagtail
	Muscicapidae	
113.	*Saxicoloides fulicata* (Linnaeus, 1776)	Indian Robin
114.	*Copsychus saularis* (Linnaeus, 1758)	Oriental Magpie Robin
115.	*Phoenicurus ochruros* (Gmelin, 1774)	Black Redstart
116.	*Orthotomus sutorius* (Pennant, 1769)	Indian Tailor Bird
117.	*Cercomela fusca* (Blyth, 1851)	Indian Chat
118.	*Saxicola torquata* (Linnaeus, 1766)	Common Stone Chat
119.	*Luscinia svecica* (Linnaeus, 1758)	Blue Throat
120.	*Myiophonus caeruleus* (Scopoli, 1786)	Himalayan Whistling Thrush

	Zoological name	Common name
121.	*Terpsiphone paradisi*	Asian Paradise Flycather
122.	*Ficedula westermanni* (Sharpe, 1888)	Little Pied Flycather
123.	*Eumyias thalassinus* (Swainson, 1838)	Verditer Flycather
	Oriolidae	
124.	*Oriolus oriolus* (Linnaeus, 1758)	Golden Oriole
	Paridae	
125.	*Parus major* Linnaeus, 1758	Great Tit
	Passeridae	
126.	*Passer domesticus* (Linnaeus, 1758)	Indian House Sparrow
	Pittidae	
127	*Pitta brachyuran* (Linnaeus, 1766)	Indian Pitta
	Ploceidae	
128.	*Ploceus philipinus* (Linnaeus, 1766)	Weaver Bird
129.	*Ploceus benghalensis* (Linnaeus, 1758)	Black-breasted Weaver
130.	*Ploceus manyar* (Horsfield, 1821)	Streaked Weaver
	Pycnonotidae	
131.	*Pycnonotus cafer* (Linnaeus, 1766)	Red-Vented Bulbul
132.	*Pycnonotus leucotis* (Gould, 1836)	White-Eared Bulbul
	Rhipiduridae	
133.	*Rhipidura albicollis* (Vieillot, 1818)	White-Throated Fantail
	Sturnidae	
134.	*Sturnus pagodarum* (Gmelin, 1789)	Brahminy Starling
135.	*Acridotheres tristis* (Linnaeus, 1766)	Common Myna
136.	*Acridotheres ginginianus* (Latham, 1790)	Bank Myna
137.	*Sturnus contra* Linnaeus, 1758	Asian Pied Starling
	Sylviidae	
138.	*Turdoides striatus* (Dumont, 1823)	Jungle Babbler
139.	*Turdoides caudatus* (Dumont, 1823)	Common Babbler
140.	*Turdoides earlei* (Blyth, 1844)	Striated Babbler
131.	*Chrysomma sinense* (Gmelin, 1789)	Yellow Eyed Babbler
	Nectariniidae	
142.	*Dicaeum agile* (Tickell, 1833)	Thick-billed Flowerpecker
143.	*Nectarinia asiatica* (Latham, 1790)	Purple Sunbird
	Zosteropidae	
144.	*Zosterops palpebrosus* (Temminck, 1824)	Indian White-Eye
	Order: Pelecaniformes	
	Family: Threskiornithidae	
145.	*Pseudibis papillosa* (Temminck, 1824)	Red-naped Ibis
	Order: Piciformes	
	Family: Megalaimdae	
146.	*Megalaima zeylanica* (Gmelin, JF, 1788)	Large Green Barbet
147.	*Megalaima haemacephala* (Statius Muller, 1776)	Crimson-breasted Barbet
	Picidae	
148.	*Dinopium benghalense* (Linnaeus, 1758)	Black-rumped Flameback
	Order: Psittaciformes	
	Family: Psittacidae	
149.	*Psittacula krameri* (Scopoli, 1769)	Roseringed Parakeet
150.	*Psittacula cyanocephala* (Linnaeus, 1766)	Plum Headed Parakeet
151.	*Psittacula eupatria* (Linnaeus, 1766)	Alexandrine Parakeet
152.	*Psittacula roseata* Biswas, 1951	Blossom-headed Parakeet
	Order: Strigiformes	
	Family: Strigidae	
153.	*Athene brama* (Temminck, 1821)	Spotted Owlet
	Tytonidae	
154.	*Tyto alba* (Scopoli, 1769)	Barn Owl
	Order: Upupiformes	
	Family: Upupidae	
155.	*Upupa epops* Linnaeus, 1758	Common Hoopoe

Brief account of the IUCN Red Listed species at Nangal Wetland

1. Lesser White-Fronted Goose *Anser erythropus* (VU)

This migratory species was rarely sighted and only a single individual of this species was recorded at this wetland in the month of January, 2015.

This is a vagrant species to northern India and generally found in islands, on foothills and mountain lakes. This species feeds mainly on plant matter, such as grass, moss, and seeds (Grimmett et al. 2001). Therefore, this wetland ensures the basic requirements of Lesser White-Fronted Goose and considered as suitable place for this bird.

2. Common Pochard *Aythya ferina* (VU)

This species was mainly found in open water with submerged and emergent vegetation at Nangal wetland.

3. Ferruginous Duck or White-eyed Pochard *Aythya nyroca* (NT)

This species is chiefly migratory and forms a small contributor to the duck population. During the entire study period it occurred in small numbers. This duck remains hidden in the patches of *Typha angustifolia*. This wetland meets the basic characteristics of a habitat preferred by the Ferruginous Duck, i.e., floating, submerged vegetation, and shallow marshy areas. The

ducks leave the site by April end.

4. River Lapwing *Vanellus duvaucelii* (NT)

The River Lapwing is a shore bird and its preferred habitats include shallower areas (Ali 1996). This wetland fulfils its habitat requirements as well as food and feeding habitat. They make nests on sand banks and forage mainly on ground.

5. Indian River Tern *Sterna aurantia* (NT)

This species locally migrates during the winter season and found in the study area during winter months only. It arrived in August to September. It was found in the range of 2–6 individuals during different months of the winter season.

6. Painted Stork *Mycteria leucocephala* (NT)

Painted Storks locally migrate along with other water birds. They arrived in the study area during September and left the area by March and mid April. Painted Storks are colonial nesting species and build their nests on trees in small islands situated in Nangal wetland. Nests were made of dry branches and twigs of plants.

7. Oriental Darter *Anhinga melanogaster* (NT)

It occurs at Nangal wetland due to roosting, feeding and breeding habitats provided by the wetland. It is found in a range of 1–10 individuals during different months of the year.

8. Sarus Crane *Grus antigone* (VU)

It is a resident bird of India but locally migrates to different localities subject to the availability of feeding and nesting habitats. During winter season, it prefers the nearby grasslands in the study area which provide nesting site for Sarus Crane. Their nests were located in shallow water where short emergent vegetation was dominant. Two adult pairs were seen in the surrounding area of Nangal wetland.

9. Woolly-necked Stork *Ciconia episcopus* (VU)

The Woolly-necked Stork is a widespread tropical species, which breeds in Africa and in Asia from India to Indonesia (Ali & Ripley 1987). It migrates locally in the winter season in India. It is observed that this bird stands calmly in an isolated shallow bank of the wetland and abruptly pounced upon the fishes and other small organisms in the water. Only a pair of this species was recorded at study area during January 2015.

10. Greater-Spotted Eagle *Aquila clanga* (VU)

Mainly a winter visitor, it was spotted in the wetland during the month of August and finally left the wetland completely by the end of March or mid April. Presence of feeding and roosting sites, i.e., large trees (e.g., *Acacia catechu*, *Acacia nilotica*, *Dalbergia sissoo*, *Eucalyptus globules*, *Ficus religiosa*, *Ficus benghalensis*, *Mangifera indica*), stumps of broken trees, crevices in the Shiwalik Hills largely attract this bird. It was seen in the range of 1–4 individuals during different months of the two-year period.

11. Egyptian Vulture *Neophron perenopterus* (EN)

It is a resident species and spotted mainly on large trees (*Acacia catechu*, *Acacia nilotica*, *Dalbergia sissoo*, *Eucalyptus globules*, *Ficus religiosa*, *Ficus benghalensis*, *Mangifera indica*) adjoining this wetland. Egyptian Vultures feed upon animal carcasses nearby this wetland. It was found in the range of 2–5 individuals during different months of the years.

12. Alexandrine Parakeet *Psittacula eupatria* (NT)

Alexandrine Parakeet is a local migratory species and found in maximum number during the winter months. Its preferred habitat is forested area where it lives in holes of dry trees, thick canopy of shady trees, and hill crevices. This area also provides a variety of food (i.e. plant buds, fruits, figs, berries), safe nesting and roosting sites. Maximum of 30–32 individuals were seen in the month of January 2014.

13. Blossom-headed Parakeet *Psittacula roseata* (NT)

Its preferred habitats were the open woodland and forested areas; generally found in flocks of 10–12. Its occurrence in the study area concluded that the area provides favorable conditions for breeding, feeding, and nesting purposes.

In the present study, the diversity of birds reflects that most of the species were observed mainly due to the availability of various types of microhabitats used by different species of birds. Each of these microhabitats (e.g., beneath the boulders, large stones, pebbles, and submerged vegetation) was supported with a variety of food such as fishes, crustaceans, mud-dwelling invertebrates, aquatic plants, and plankton. Unfortunately, it is observed that these organisms are on declining spree due to fragmentation of habitats caused by reclamation. During the last five decades, rampant deforestation has occurred in the catchment area of the wetland – hills were denuded which cause the silting up of the wetland. The siltation ultimately reduces the depth as well as water carrying capacity of the wetland.

Besides fragmentation of habitats, other anthropogenic activities like discharge of effluents from adjoining industries (National fertilizer limited; PACL), domestic sewage from Nangal township, rampant deforestation in the catchment area, siltation, and tourism pose a major threat to its existence. The discharge of pollutants should be stopped by strictly enforcing stringent environmental legislations of the

Table 2. Checklist of threatened and near-threatened bird species observed at Nangal Wetland during February 2013–January 2015.

Order	Family	Scientific name	Common name	Feeding habit	Status	IUCN status
Anseriformes	Anatidae	*Anser erythropus*	Lesser White-Fronted Goose	Herbivorous	Migratory	VU
		Aythya ferina	Common Pochard	Omnivorous	Omnivorous	VU
		Aythya nyroca	Ferruginous Duck	Omnivorous	Migratory	NT
Charadriiformes	Charadriidae	*Vanellus duvaucelii*	River Lapwing	Omnivorous	Local Migratory	NT
		Sterna aurantia	Indian River Tern	Carnivorous	Local Migratory	NT
Ciconiformes	Ciconiidae	*Mycteria leucocephala*	Painted Stork	Carnivorous	Local Migratory	NT
		Ciconia episcopus	Woolly-necked Stork	Carnivorous	Local Migratory	VU
	Phalacrocoracidae	*Anhinga melanogaster*	Oriental Darter	Carnivorous	Resident	NT
Gruiformes	Gruidae	*Grus antigone*	Sarus Crane	Omnivorous	Local Migratory	VU
Accipitriformes	Accipitridae	*Aquila clanga*	Greater-spotted Eagle	Carnivorous	Local Migratory	VU
		Neophron perenopterus	Egyptian Vulture	Carnivorous	Resident	EN
Psittaciformes	Psittacidae	*Psittacula eupatria*	Alexandrine Parakeet	Herbivorous	Local Migratory	NT
		Psittacula roseata	Blossom-headed parakeet	Herbivorous	Local Migratory	NT

Table 3. Seasonal average variations of threatened bird species of Nangal Wetland during February 2013– January 2015.

	Name of the Bird	Spring	Summer	Autumn	Winter	Annual Count	Mean
1.	Lesser White-Fronted Goose	-	-	-	0.1	0.1	0.025
2.	Common Pochard	-	-	-	1.133	1.133	0.283
3.	Ferruginous Duck	0.86	-	5.12	4.896	10.876	2.719
4.	River Lapwing	-	0.25	2.01	2.145	4.405	1.101
5.	Indian River Tern	0.333	0.233	3.418	3.546	7.53	1.882
6.	Painted Stork	0.508	-	10.636	11.133	22.277	5.569
7.	Woolly-necked Stork	-	-	-	0.333	0.333	0.083
8.	Oriental Darter	1.003	0.528	2.993	3.965	8.489	2.122
9.	Sarus Crane	-	0.333	1.375	1.633	3.341	0.835
10.	Greater-spotted Eagle	0.4	0.525	2.133	3.133	6.191	1.547
11.	Egyptian Vulture	1.701	1.206	2.376	2.718	8.001	2.0
12.	Alexandrine Parakeet	5.8	4.205	22.773	26.778	59.556	14.889
13.	Blossom-headed Parakeet	-	-	23.055	30.103	53.158	13.289
Total avifaunal count		**10.605**	**7.28**	**75.889**	**91.613**	**185.39**	**46.061**
Shannon-Weaver diversity index H'		**1.534**	**1.436**	**1.868**	**1.915**		

nation. Awareness should be created amongst the local people towards conservation and to understand the importance of such diverse avifauna existing in this wetland.

CONCLUSIONS

This study provides an ornithological baseline data of Red Listed species of the wetland for researchers and general public. It will also provide an opportunity to compare trends of population of these birds in future. Therefore, it is recommended that the sites, where threatened bird species were recorded should be monitored regularly in future especially during midwinter waterfowl counts.

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