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# Influence of Anthropogenic Disturbance and Vegetation Structure on Resident Migratory and Migratory Bird Species in Abhera Wetland of Kota, Rajasthan, India

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## ABSTRACT

*A study was carried out in Kota District (Rajasthan) to investigate the effects of anthropogenic disturbance caused by biomass extraction on the bird communities of Abhera wetland of Kota. The study was based on comparisons of the aquatic bird community and vegetation structure of Abhera wetland site that was demarcated a priori on the basis of disturbance indicators. Three years survey was carried out specially in winter season. There was significant difference in the number of recorded species and bird abundance. Changes in bird species composition occurred because of 24 of 58 Resident migratory and migratory abundant bird species (41.37%) responding significantly to the disturbance regime. All the affected bird species are both herbivores and insectivores. Bird species composition was significantly related to vegetation structural variables, including two that were significantly altered by disturbance. Changes in vegetation structure accounted for all the changes in bird species composition caused by disturbance. However, vegetation structure had additional effects on bird species composition besides those caused simply by disturbance. Thus, our study indicates that use of wetlands for fishing and cattle grazing have significant effects upon bird diversity and species composition. There is a need to retain a proportion of natural ecosystems as inviolate if the full complement of biodiversity is to be conserved.*

***Keywords:*** *Anthropogenic disturbance, Abhera wetland, Resident migratory and migratory, Vegetation structure.*

## INTRODUCTION

The inland freshwater eco-systems both lentic and lotic are being increasingly subjected to great stress from various human activities[10,6]. Freshwater ecosystems include lakes, ponds, wells and wetlands also. Wetland plants and small animals -- especially insects -- are essential links at the lowest levels of the food chain. A wetlands environment supports these plants and animals, which in turn support the larger animals that feed on them. While an otter or a trout may be a more attractive species to protect than some anonymous insect or plant, the latter are no less important in the overall scheme. If we diminish the lowest levels of the food chain, the higher levels will suffer as well.

Wetlands are most important ecosystem of Kota, as these provide habitat for local and migratory birds as well as for turtles, fishes, snails etc. Wetlands are among the world's most productive environments and provide a wide variety of benefits. They are cradles of biological diversity, providing the water and primary productivity upon which countless species of plants and animals depend for survival. Birds are one of the forest taxa that are sensitive to changes in habitat caused by human use such as logging, conversion to plantations and shifting cultivation[4,13,14]. Overall bird diversity itself is also expected to decline significantly after habitat disturbance if disturbance involves the simplification of vegetation structure[9]. However, it is still unclear to what extent, in what direction and at which spatial scales habitat modification actually influences various components of faunal diversity[8]. Most studies of faunal change due to human use have focused on larger-scale and more intense forms of disturbance such as logging[14]

and monocultural plantations[11]. There is an urgent need to document the effects of small-scale extractive human uses on native forest fauna so that considerations of biodiversity can be incorporated into conservation planning. Kota have two major wetland water bodies as Abhera and Ummedganj and every year a lot of birds including Migratory and Resident migratory, visit these beautiful places. In this study, we quantify the effects of anthropogenic disturbance on biodiversity measures of Abhera wetland using birds as indicators. We studied the diversity, abundance and species composition of vegetation while characterizing the changes in numbering of birds.

## STUDY SITE

It is situated between N 25°11'57.82" and E 075°47'19.01". This pond of mediaeval time was constructed by King Dheer Deh in 1346. It is surrounded by open wetland to its east and West; Karni Mata Temple to its north and in South by Abhera Palace. Recently it is notified for Biological Park for Kota City in the Indian state of Rajasthan.

## METHODOLOGY

### Vegetation structure

Sampling with quadrate can be used for most plant communities[5]. A quadrate delimits an area in which vegetation cover can be estimated, plants counted, or species listed. A plot size should be large enough to include significant numbers of individuals, but small enough so that plants can be separated, counted and measured without duplication or omission of individuals[5,2]. Here we have plotted 5 quadrates in each wetland of 10-10. Abundance was calculated using

$$\text{Abundance (A)} = \frac{\text{Total No. of Plants}}{\text{Total No. of Quadrates in which that species is present}}$$

The Shannon entropy quantifies the uncertainty (entropy or degree of surprise) associated with this prediction. It is calculated as follows:

$$H' = -\sum_{i=1}^{R} p_i \log p_i$$

where $p_i$ is the proportion of characters belonging to the *i*th type of letter in the string of interest. In ecology, $p_i$is often the proportion of individuals belonging to the *i*th species in the dataset of interest. Then the Shannon entropy quantifies the uncertainty in predicting the species identity of an individual that is taken at random from the dataset.

### Bird Counts

We used fixed-radius point counts for collecting data on bird abundance[3,12]. Survey carried out in clear weather by us about an hour after sunrise from January 2010 to January 2012, twice a month. A pair of good binoculars and spotting scope was used to aid identification of distant birds. Birds were identified using the work of Ali & Ripley[1] and Grimmett, Inskipp & Inskipp[7]. Inthis paper we are not including resident birds only resident migratory and migratory birds are included in it. We started counts half an hour after sunrise and continued for 2 h after that, approximately between 07.30 and 09.30 h, each studied morning.

## OBSERVATION AND RESULT

### Effect of disturbance on vegetation structural attributes-

Vegetation distribution of Abhera wetland is listed in Table-1 and Shannon diversity is in Table-2. Survey indicates that *Ceratophyllum demersum, Dentella repens, Dichanthium annulatum, Elytraria acaulis, Indigofera linnaei, Indigofera tinctoria L.,* and *Potamogeton nodosus,* are declining frequently. Diversity of vegetation is also reducing every year. Most of the residents, living in earby areas, are livestock herders or fishermen by occupation. Their source of income is the production of milk, for which they graze their livestock in wetland. Except this illegal fishing is also very prominent here, which losses a lot of biomass. Three indicators of disturbance due to biomass extraction were recorded for each plot: number of human

trails traversing the plot, number of piles of livestock dung, and finding of fishnets. These variables were chosen to reflect the intensity of use of site for grazing, and fishing by local people.

**Table-1. Abundance of Plants in Wetland During 2010-2012**

| S. No. | Name of Plant | 2010 | 2011 | 2012 |
|---|---|---|---|---|
| **1** | *Alternanthera paronychioides* St. Hill. | 18.5 | 40 | 25 |
| **2** | *Alysicarpus spp* | 16 | 36.66 | 15 |
| **3** | *Bergia ammanioides Roth.* | 150 | 14 | 23.33 |
| **4** | *Caesulia axillaris* Roxb. | 20 | 10 | 27.5 |
| **5** | *Ceratophyllum demersum L.* | 45 | Absent | 10 |
| **6** | *Cotula anthemoides L.* | 172.5 | 37.5 | 50 |
| **7** | *Cynodon dactylon (L.) Pers.* | 283.33 | 10 | 22 |
| **8** | *Cyperus exaltatus* Retz. | 60 | 11.66 | 3 |
| **9** | *Dentella repens* | 24 | Absent | 12.5 |
| **10** | *Dichanthium annulatum (Forssk) Stapf.* | 160 | 10 | Absent |
| **11** | *Elytraria acaulis* | 45 | 11 | Absent |
| **12** | *Glinus lotoides* | 15 | 70 | 18 |
| **13** | *Hydrilla verticillata (L.f.) Royle* | 350 | 60 | 22 |
| **14** | *Indigofera hirsuta* | 75 | 10 | 14 |
| **15** | *Indigofera linifolia* | 30 | 10 | 16 |
| **16** | *Indigofera linnaei* | 45 | Absent | 5 |
| **17** | *Indigofera tinctoria L.* | 500 | Absent | 15 |
| **18** | *Limnophyton obtusifolium (L.) Miq.* | 315 | 17.5 | 2 |
| **19** | *Monochoria vaginalis (Burm.f.) Presl.* | 500 | 2 | 22 |
| **20** | *Nymphaea pubescens* | 22.5 | 10 | 11 |
| **21** | *Nymphoides cristata (Roxb.) Kuntze* | 22.5 | 16 | 15 |
| **22** | *Polygonum spp.* | 300 | 7 | 13.75 |
| **23** | *Potamogeton nodosus* | 60 | Absent | 16.66 |
| **24** | *Sphaeranthus indicus* | 40 | 13.33 | 11.25 |
| **25** | *Trianthema portulacastrum* | 60 | 9 | 13.75 |
| **26** | *Trigonella monantha* | 43.33 | 20 | 12 |
| **27** | *Utricularia exoleta* R. Br. | 50 | 16 | 15 |
| **28** | *Vallisneria natans* (Lour.) Hara | 82.5 | 28 | 34 |
| **29** | *Wolffia globosa* (Roxb.) Hartog & Plas | 275 | 40 | 80 |

**Table-2: Diversity of Plants during 2010-2012**

| Shannon Diversity | 2010 | 2011 | 2012 |
|---|---|---|---|
| **Value** | 2.254 | 2.693 | 3.107 |

- **Effects of disturbance and vegetation structure on bird species composition-**

**Table-3: Bird Species Distribution status during 2010-12**

| No. | Common Name | Zoological Name | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|
| **1** | Darter | *Anhinga melanogaster* | +++ | + | ++ |
| **2** | Great Cormorant | *Phalacrocorax carbo* | ++ | – | – |
| **3** | Little Cormorant | *Phalacrocorax niger* | +++ | +++ | ++ |
| **4** | Purple Heron | *Ardea pupurea* | ++ | ++ | +++ |
| **5** | Grey Heron | *Ardea cinerea* | ++ | ++ | ++ |
| **6** | Great Bittern | *Botaurus stellaris* | +++ | ++ | + |
| **7** | Painted Stork* | *Mycteria leucocephala* | ++ | ++ | + |
| **8** | Black Stork (M) | *Ciconia nigra* | ++ | + | + |
| **9** | Glossy Ibis | *Plegadis falcinellus* | ++ | ++ | +++ |
| **10** | Eurasian Spoonbill | *Platalea leucorodia* | + | – | – |
| **11** | Grey-Leg Goose (M) | *Anser anser* | ++ | + | – |
| **12** | Bar-Headed Goose | *Anser indicus* | ++ | ++ | – |
| **13** | Cotton Teal (M) | *Nettapus coromandelianus* | + | _ | + |
| **14** | Brahminy/ Ruddy Shelduck | *Tadorna ferruginea* | ++ | ++ | ++ |
| **15** | Common Shelduck (M) | *Tadorna tadorna* | ++ | + | _ |
| **16** | Comb Duck (M) | *Sarkidiornis melanotos* | +++ | +++ | +++ |
| **17** | Lesser Whistling Duck (M) | *Dendrocygna javanica* | ++ | ++ | +++ |

| | | | | | |
|---|---|---|---|---|---|
| **18** | Northern Pintail (M) | *Anas acuta* | ++ | ++ | + |
| **19** | Common Teal (M) | *Anas crecca* | ++ | ++ | + |
| **20** | Spot-Billed Duck (M) | *Anas poecilorhyncha* | ++ | ++ | +++ |
| **21** | Northern Shoveler (M) | *Anas clypeata* | + | − | − |
| **22** | Mallard (M) | *Anas platyrhynchos* | + | − | − |
| **23** | Gadwall (M) | *Anas strepera* | + | − | − |
| **24** | Garganey (M) | *Anas querquedula* | + | + | − |
| **25** | Eurasian Wigeon (M) | *Anas penelope* | + | − | − |
| **26** | Tufted Pochard (M) | *Aythya fuligula* | _ | − | + |
| **27** | Common Pochard (M) | *Aythya ferina* | _ | − | + |
| **28** | Red-Crested Pochard (M) | *Rhodonessa rufina* | + | + | + |
| **29** | Ferruginous Pochard* (M) | *Aythya nyroca* | + | − | − |
| **30** | Peregrine Falcon (M) | *Falco peregrinus* | + | + | − |
| **31** | Common Kestrel | *Falco tinnunculus* | + | + | − |
| **32** | Western Marsh Harrier (M) | *Circus aeruginosus* | + | − | − |
| **33** | Pallid Harrier* (M) | *Circus macrourus* | + | − | − |
| **34** | Osprey | *Pandilon haliaetus* | + | + | − |
| **35** | Common Quail | *Coturnix coturnix* | + | + | + |
| **36** | Common Coot | *Fulica atra* | +++ | +++ | +++ |
| **37** | Common Moorhen | *Gallinula chloropus* | +++ | +++ | +++ |
| **38** | Bar Tailed Godwit (M) | *Limosa lapponica* | ++ | + | − |
| **39** | Black-Tailed Godwit* (M) | *Limosa limosa* | ++ | − | − |
| **40** | Common Redshank | *Tringa tetanus* | ++ | ++ | + |
| **41** | Spotted Redshank (M) | *Tringa erythropus* | ++ | + | + |
| **42** | Marsh Sandpiper (M) | *Tringa stagnatalis* | + | + | − |
| **43** | Common Sandpiper (M) | *Tringa hypoleucos* | ++ | ++ | ++ |
| **44** | Wood Sandpiper (M) | *Tringa glareola* | ++ | ++ | ++ |
| **45** | Green Sandpiper (M) | *Tringa ochropus* | ++ | − | − |
| **46** | Little Stint (M) | *Calidris minuta* | ++ | − | + |
| **47** | Temminck's Stint (M) | *Calidris temminckii* | ++ | ++ | − |
| **48** | Common Greenshank (M) | *Tringa nebularia* | ++ | ++ | + |
| **49** | Little Ringed Plover | *Charadrius dubius* | ++ | + | ++ |
| **50** | White Tailed Plover (M) | *Vanellus leucurus* | + | − | − |
| **51** | Ruff (M) | *Philomachus pugnax* | + | + | + |
| **52** | Yellow-Legged Gull (M) | *Larus cachinnans* | ++ | + | + |
| **53** | Brown-Headed Gull (M) | *Larus brunnicephalus* | + | + | − |
| **54** | Small Blue Kingfisher | *Alcedo atthis* | + | + | + |
| **55** | White Wagtail | *Motacilla alba* | + | + | + |
| **56** | Black Redstart (M) | *Phoenicurus ochruros* | + | + | − |
| **57** | Lesser Whitethroat (M) | *Sylvia curruca* | + | + | + |
| **58** | Eurasian/ Northern Wryneck (M) | *Jynx torquilla* | + | − | + |

* : Endangered bird species

Table-3 indicates the bird species composition in studied wetland during the surveyed period. This indicates that there are residual effects of vegetation structure on bird species composition. This shows that all the effects of disturbance on bird species composition could be accounted for by the accompanying differences in vegetation structure. Some of the migratory birds are not coming here since last two years (indicated in Table-3). There were no additional effects of disturbance on bird species composition besides those caused by vegetation structure.

## DISCUSSION

The current study shows that there can be impacts of intensive biomass extraction on vegetation structure and, in turn, on aquatic bird communities of wetlands. While disturbance caused changes in vegetation, these changes, in turn, caused changes in bird species composition. The results indicate the need for certain inviolate areas where the entire range of faunal diversity can be conserved. However, along with strict nature protection, there is an urgent need to develop alternatives to the biomass-based livelihood needs of people living in and around the city.

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