

RESEARCH ARTICLE

Impact assessment of avifauna from the selected lakes around Adani thermal power station in Gondia district, MS, India

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ABSTRACT

The study was conducted during February 2014 to January 2016 aims to examine the monthly diversity and impact assessment of the avifauna from the selected lakes in Gondia district, Maharashtra. A total of 103 species including 51 water bird species and 52 land bird species belonging to 13 orders and 40 families were recorded during two years study period. Out of recorded 103 bird species, 65 species were residents (63%), 25 species were winter visitors (24%), 03 species were summer visitors (03%) and 10 species were passage visitors (10%). According to relative abundance as per their sightings frequency, 35 species were very common (34%), 12 species were common (12%), 20 species were uncommon (19%), 26 species were occasional (25%) and 10 species were rare (10%) for the study area. The population diversity of the birds in the study area is significantly fluctuating between months and diversity index values ranged from 1.804 to 4.028 at study area. The present study does not take into more consideration as the climate change and global warming is still a nascent in the present study area. The less impact might be because of acclimatization phenomenon. No more impacts on the avifauna noticed due to Adani thermal power station in Gondia district. From conservation point of view, the situation is still within control, and we still have chance to save and preserve most bird species. But in future the present study area may be affected due to the warming by Adani thermal power station in Gondia district, Maharashtra.

Keywords: Avifauna, impact assessment, diversity, lakes, Gondia.

INTRODUCTION

Biodiversity is the variety of life on the Earth within and between all species of plants, animals and microorganisms and the ecosystems within which they live and interact. The birds found in the World and India shows great biodiversity. The eastern Vidarbha region of Maharashtra State, especially Gondia district is important to the water birds and land birds as there are many lakes in the district. A bird has been described as a feathered biped. Birds are vertebrate warm-blooded animals that is whose temperature remains more or less constant and independent of

the surrounding temperature (Ali, 2002). Wetlands and water birds are inseparable elements and thus form a rich array of water bird communities (Grimmett and Inskipp, 2007). Water birds are an important component of most of the wetland ecosystems as they occupy several trophic levels in the food web of wetland nutrient cycles (Rajashekara and Venkatesha, 2010). The bird habitats of the Indian subcontinent can be roughly divided into forest, scrub, wetlands, marine, grassland, desert and agricultural land habitat. Many bird species require mixed habitat types (Grimmett *et al.*, 2011). The species density, diversity, richness and relative abundance of water birds depend upon wetland characteristics such as size, water level, quality of water, availability and distribution of food resources (Manikannan, 2011). The value of each wetland is intimately tied up with the culture and the needs of the people who exploit it and is dependent to a great degree upon its location. In a developing country like India, large number of people living around wetlands depend heavily on their resources for subsistence and traditional activities like fishing, grazing, farming, reed-gathering, etc. (Vachanth, 2013).

Bock *et al.* (1993) studied that the livestock grazing showed positive, negative and mixed responses on neotropical migratory birds in four major ecosystems in western North America: grasslands of the Great Plains and Southwest, riparian woodlands, intermountain shrub steppe, and open coniferous forests. The North American breeding bird survey has shown that grassland birds are under going declines that are more widespread than any other group of birds. Due to the dynamic nature of the ecosystems and the anthropogenic impacts on them, the status of wetland biodiversity in India had changed drastically in the recent past (Mishra, 1999). Tasker *et al.* (2000) studied the impacts of fishing on marine birds in view the most direct effects of fishing on the birds involve killing by fishing gears, although on lesser scale some fishing activities also disturbs the birds. The loss of shade from cattle trampling and grazing on riparian vegetation raises the water temperature and reduces water oxygen levels (Carter, 2002).

The study at Kurukshetra has revealed that the anthropogenic activities like mass bathing in holy ponds, cutting of emergent and fringed vegetation, draining of water, release of sewage, throwing of domestic garbage, developmental activities like

construction of roads and retaining walls are some major threats to the bird diversities of the aquatic habitats (Kumar and Gupta, 2009). Different anthropogenic activities in the wetlands of Kolhapur city of Maharashtra State have increased the pollution and human encroachment area which adversely affected the bird population (Kachare *et al.*, 2011).

Gondia is known as the district of lakes as numbers of waterbodies are present in the district. Even though it represents only a small fraction of the geographical area of the Vidarbha region of Maharashtra State, India, Gondia district has a unique diversity of flora and fauna. The rich faunal wealth of Gondia district, especially near and around the Navegaon National Park has been recorded notably by several researchers; especially near and around the Srinagar lake (Chinchkhede and Kedar, 2012), Navegaon lake (Chitampalli, 1976; Chinchkhede and Kedar, 2013; Paliwal and Bhandarkar, 2014), Shrungarbandh lake (Bhandarkar and Paliwal, 2014). But the other lakes had not been given proper attention in terms of avifaunal research and the unavailability of detail report on the avifaunal wealth was the inspiring force behind the selection of the presented study. As the different anthropogenic activities and environmental changes are the biggest threats to the avifauna and our current knowledge about behaviour, natural history and status of avifaunal species is far from complete. Thus, the scientific study was launched to examine the "Impact assessment of avifauna of the selected lakes around Adani thermal power station in Gondia district, Maharashtra." Hence, this research makes the contribution to the theoretical knowledge and conservation of the avifauna in and around the Gondia district, Maharashtra State, India.

MATERIALS AND METHODS

Study Area

The study area comprises three reservoirs around Adani thermal power station from Gondia district. A reservoir is impounding of water of a flowing river and is called a lake. These three reservoirs are Bodalkasa, Chorkhamara and Khairbandha. As these are the artificial lakes, hence these are locally called as Bodalkasa lake, Chorkhamara lake and Khairbandha lake. The location of three study sites are shown in the figure 1.1 and 1.2 by the help of google map. Bodalkasa lake lies at the geographic coordinates of 21°21'15"N

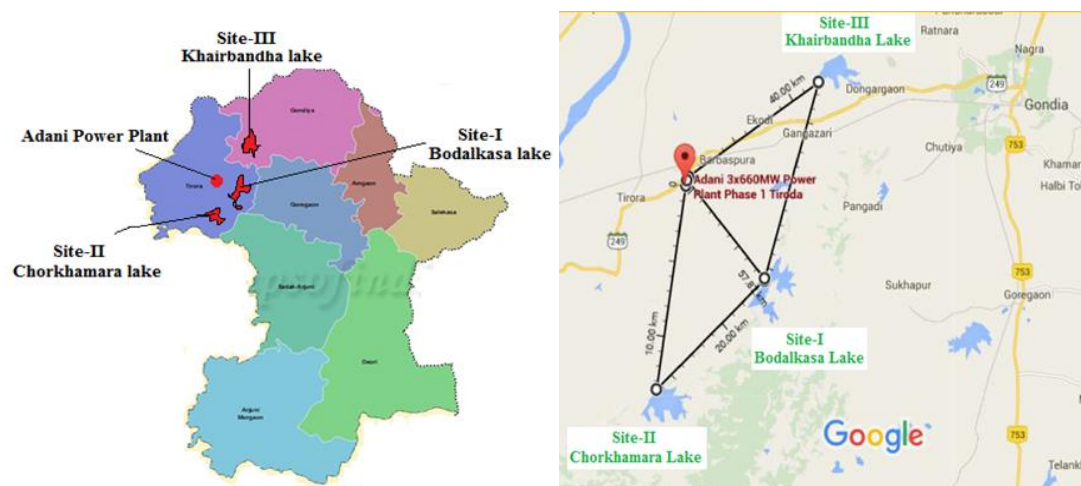


Fig. 1.1 & 1.2: Position View & Satellite View of three study sites around Adani Thermal Power Station in Gondia district (M. S.) India

latitude and $80^{\circ}01'00''$ E longitudes, and situated near about 9 km south of Adani thermal power station. Chorkhamara lake lies at the geographic coordinates of $21^{\circ}18'00''$ N latitude and $79^{\circ}57'00''$ E longitudes, and situated near about 14 km south-west side of Adani thermal power station. Khairbandha lake lies at the geographic coordinates of $21^{\circ}28'30''$ N latitude and $80^{\circ}03'45''$ E longitudes, and situated 13 km away from Adani thermal power station on north-east side in Gondia district, Maharashtra.

The flora and fauna of the study area is typical of the aquatic, semi aquatic and surrounding habitats. There are floating weeds, grasses, herbs, bushes and large trees in and around the lakes. The observed floral species were Typha species, Water hyacinth, Hydrilla species, Azolla species, *Durva* grass, Crown grass, Paspalum species, Ipomoea species, etc. The shrubs and larger trees include *Bamboo*, *Butea* species, *Ziziphus*, *Jambul*, Mango tree, *Tendupatta*, *Mahua* tree, Banyan tree, Tamarind tree, *Bael* tree, Indian Fig tree (*Umbar*), *Neem* tree, Jackfruit tree, etc. The lakes also harbours the different species of fauna as insects (Moths, Butterflies and aquatic insects), crustaceans (Prawns), crabs, molluscs (Snail), fishes (Catla, Rohu, Mrigal, *Magur*, *Shingur*, *Botri*, *Pabda*, *Kanoshi*, *Poshti*, *Chital*, *Bhadar*, etc.), amphibians (Frogs), lizards and other animals (Deer, Dogs, Cows, Buffaloes, Goats, Monkeys, Squirrels, etc).

Survey and Methodology

The study was conducted during February 2014 to January 2016 aims to examine the monthly and seasonal diversity, and population dynamics of the

avifauna from the present study area. Data were collected weekly during three seasons viz. summer (February to May), monsoon (June to September) and winter (October to January) of two successive years. The study was started with the permission of irrigation and forest departments of Gondia district, Maharashtra State, India. The counting of the birds was made at morning and evening timings of the day when the birds are most active (Rajashekara and Venkatesha, 2010, 2014) and depending on the light conditions (Namgail *et al.*, 2009). Weekly visits to the site were made for two years and an average of 4 weeks was accounted for a month (Wanjari, 2012).

No single survey can provide all data to answer every research question (Turner, 2003). There is no single technique that can be used for counting all types of birds. This is mainly because birds differ in terms of their size, behavior traits, habitat preferences etc. (Urfiet *et al.*, 2005). Based on the experience in the field considering the habitat status and area of each study site, the visual encounter surveys were conducted to the entire lake for 'direct counts' of the birds by randomized walking along the bank of lakes (Crump and Scott, 1994; Whitakar, 2002; Manley *et al.*, 2005; Manikannan, 2011; Vachanth, 2013; Joshi, 2014). Because most species of birds tend to be visible, methods to survey them generally rely on observers seeing them. Stationary and double counting methods were also employed for the counting the birds in the flocks (Gregory *et al.*, 2004).

A field binocular was used to observe the birds and the photographs were taken from the study area by using

Nikon camera with different zoom lenses. After detection, specimens were photographed by camera and identified with the help of visible structural features (Ali, 2002). The threats to the present study were assessed during the study period by direct observations in and around the study lakes and also by enquiring local villagers. For assessing the impact of these factors on the birds the Impact matrix method was used (Nalavade, 2013).

A systematic checklist of all recorded bird species from three sites was prepared on the basis of observations. The scientific names, common names, family sequence and IUCN status were ascertained as per BirdLife international (2013 version 6) and Grimmett *et al.* (2011). The order sequence was followed from a field guide by Manakadan *et al.* (2011). The residential local status of the bird species was assigned strictly with reference to the study area on the basis of presence or absence method as followed the techniques developed by Thakur *et al.* (2010); Grimmett *et al.* (2011); Koli (2014); Shekhawat and Bhatnagar (2014) as resident (R), winter visitor (WV), summer visitor (SV) and

passage visitor (PV). The abundance status of the birds was recorded on the basis of the percent frequency (encounter rates) of sightings as followed the techniques developed by Kasambe and Wadatar (2007), Kasambe and Sani (2009), Tak *et al.* (2010), Priyanka (2012); as Vc-Very Common (75-100%), C-Common (50-74%), Uc-Uncommon (25-49%), O-Occasional (5-24%) and Rr-Rare (less than 5%). The IUCN status was ascertained as per Bird Life International (2013 version 6) as *LC-Least concern and **NT-Near threatened.

RESULTS AND DISCUSSION

The results of the observed species of avifauna are inventory at three study lakes in Gondia district, Maharashtra State, India. A total of 103 species including 51 water bird species and 52 land bird species belonging to 13 orders and 40 families were recorded during two years study period from February 2014 to January 2016 (Table 1.1).

Table 1.1: A systematic list of Bird Species at three lakes in Gondia district, Maharashtra, India (Feb. 2014 to Jan. 2016)

Order / Family	Sp. Sr. No	Scientific Names	Common Names	Residential Status #	Abundance Status [□]
Order - I: Anseriformes 1) Anatidae	1	a) Water Birds: <i>Dendrocygnajavanica</i> *	Lesser Whistling-duck	SV	Uc
	2	<i>Anseranser</i> *	Greylag Goose	PV	Rr
	3	<i>Anserindicus</i> *	Bar-headed Goose	WV	O
	4	<i>Sarkidiornismelanotos</i> *	Comb Duck	PV	Rr
	5	<i>Tadornaferruginea</i> *	Ruddy Shelduck	WV	Uc
	6	<i>Nettapuscoromandelianus</i> *	Cotton Pygmy-goose	R	Vc
	7	<i>Anasstrepera</i> *	Gadwall	WV	O
	8	<i>Anaspenelope</i> *	Eurasian Wigeon	PV	Rr
	9	<i>Anasplatyrhynchos</i> *	Mallard	PV	Rr
	10	<i>Anaspoecilorhyncha</i> *	Western Spot-billed Duck	R	C
	11	<i>Anasacuta</i> *	Northern Pintail	WV	Uc
	12	<i>Anascrecca</i> *	Common Teal	WV	O
	13	<i>Nettarufina</i> *	Red-crested Pochard	WV	O
	14	<i>Aythyaferina</i> *	Common Pochard	WV	O
	15	<i>Aythyaanyroca</i> **	Ferruginous Duck	PV	Rr
	16	<i>Aythyafuligula</i> *	Tufted Duck	WV	O
Order II: Podicipediformes2) Podicipedidae	17	<i>Tachybaptusruficollis</i> *	Little Grebe	R	Uc
Order III: Ciconiiformes 3) Ciconiidae	18	<i>Mycterialeucocephala</i> **	Painted Stork	WV	O
	19	<i>Anastomusoscitans</i> *	Asian Openbill	R	Vc
	20	<i>Ciconianigra</i> *	Black Stork	WV	O
	21	<i>Ciconiaepiscopus</i> *	Woolly-necked Stork	WV	O
4) Threskiornithidae	22	<i>Threskiornismelanocephalus</i> **	Black-headed Ibis	SV	Uc
	23	<i>Pseudibispapillosa</i> *	Red-naped Ibis	R	C
5) Ardeidae	24	<i>Ardeolagrayerii</i> *	Indian Pond Heron	R	Vc

	25	<i>Ardeacinerea*</i>	Grey Heron	WV	O
	26	<i>Ardeapurplea*</i>	Purple Heron	R	C
	27	<i>Bubulcus ibis*</i>	Cattle Egret	R	Vc
	28	<i>Casmerodiusalbus*</i>	Great Egret	R	Vc
	29	<i>Mesophoxintermedia*</i>	Intermediate Egret	WV	Uc
	30	<i>Egrettaarazetta*</i>	Little Egret	R	Vc
Order IV: Pelecaniformes	31	<i>Phalacrocoraxniger*</i>	Little Cormorant	R	Vc
6)Phalacrocoracidae	32	<i>Phalacrocoraxfuscicollis*</i>	Indian Cormorant	WV	O
	33	<i>Phalacrocoraxcarbo*</i>	Great Cormorant	WV	O
7) Anhingidae	34	<i>Anhinga melanogaster**</i>	Oriental Darter	PV	Rr
Order V: Gruiformes8)	35	<i>Porphyrioporphyrion*</i>	Purple Swamphen	R	Uc
Rallidae	36	<i>Gallinulachloropus*</i>	Common Moorhen	R	Uc
	37	<i>Fulicaatra*</i>	Common Coot	WV	O
Order VI: Charadriiformes	38	<i>Himantopus himantopus*</i>	Black-winged Stilt	R	C
9)Recurvirostridae					
10) Charadriidae	39	<i>Vanellusduvaucelii**</i>	River Lapwing	PV	Rr
	40	<i>Vanellusindicus*</i>	Red-wattled Lapwing	R	Vc
	41	<i>Pluvialisfulva*</i>	Pacific Golden Plover	PV	Rr
	42	<i>Charadriusdubius*</i>	Little Ringed Plover	R	Vc
11) Jacanidae	43	<i>Hydrophasianuschirurgus*</i>	Pheasant-tailed Jacana	R	Uc
	44	<i>Metopidiusindicus*</i>	Bronze-winged Jacana	R	Uc
12) Scolopacidae	45	<i>Gallinagogallinago*</i>	Common Snipe	WV	O
	46	<i>Tringastagnatilis*</i>	Marsh Sandpiper	WV	Uc
	47	<i>Tringanebularia*</i>	Common Greenshank	WV	O
	48	<i>Tringaglareola*</i>	Wood Sandpiper	WV	Uc
	49	<i>Actitishypoleucos*</i>	Common Sandpiper	WV	O
	50	<i>Calidristemminckii*</i>	Temminck's Stint	WV	O
	51	<i>Calidrisalpina*</i>	Dunlin	PV	Rr
Order VII: Columbiformes13)	52	b) Land Birds: <i>Columba livia*</i>	Rock Pigeon	R	Uc
Columbidae	53	<i>Streptopeliadecaocta*</i>	Eurasian Collared Dove	R	Vc
	54	<i>Stigmatopeliachinensis*</i>	Spotted Dove	R	Vc
	55	<i>Stigmatopeliasenegalensis*</i>	Laughing Dove	R	Vc
	56	<i>Treronphoenicopterus*</i>	Yellow-footedGreen Pigeon	R	C
Order VIII: Psittaciformes	57	<i>Psittaculakrameri*</i>	Rose-ringed Parakeet	R	Vc
14) Psittacidae	58	<i>Psittaculacyanocephala*</i>	Plum-headed Parakeet	R	Uc
Order IX: Cuculiformes15)	59	<i>Cuculusvarius*</i>	Common Hawk Cuckoo	R	O
Cuculidae	60	<i>Eudynamysscolopaceus*</i>	Asian Koel	R	Uc
	61	<i>Centropussinensis*</i>	Greater Coucal	R	Vc
Order X: Caprimulgiformes1	62	<i>Caprimulgusasiaticus*</i>	Indian Nightjar	PV	Rr
6) Caprimulgidae					
Order XI: Coraciiformes	63	<i>Coraciasbenghalensis*</i>	Indian Roller	R	Vc
17) Coraciidae					
18) Alcedinidae	64	<i>Halcyon smyrnensis*</i>	White-throated Kingfisher	R	Vc
	65	<i>Alcedoatthis*</i>	Common Kingfisher	R	Vc
	66	<i>Cerylerudis*</i>	Pied Kingfisher	R	Vc

19) Meropidae	67	<i>Meropsorientalis</i> *	Little Green Bee-eater	R	Vc
20) Upupidae	68	<i>Upupaepops</i> *	Common Hoopoe	R	Vc
21) Bucerotidae	69	<i>Ocyrocerosbistrostris</i> *	Indian grey Hornbill	R	Uc
Order XII: Piciformes	70	<i>Megalaimahaemacephala</i> *	Coppersmith Barbet	R	O
22) Ramphastidae					
23) Picidae	71	<i>Dinopiumbenghalense</i> *	Black-rumped Flameback	R	Vc
	72	<i>Chrysocolaptesfestivus</i> *	White-naped Woodpecker	R	Vc
Order XIII: Passeriformes	73	<i>Pitta brachyura</i> *	Indian Pitta	SV	O
24) Pittidae					
25) Aegithinidae	74	<i>Aegithinatiphia</i> *	Common Iora	R	O
26) Oriolidae	75	<i>Oriolusoriolus</i> *	Eurasian Golden Oriole	R	C
	76	<i>Oriolusxanthornus</i> *	Black-hooded Oriole	R	Uc
27) Dicruridae	77	<i>Dicrurusmacrocerus</i> *	Black Drongo	R	Vc
28) Corvidae	78	<i>Dendrocittavagabunda</i> *	Rufous Treepie	R	Vc
	79	<i>Corvusculminatus</i> *	Indian Jungle Crow	R	Vc
	80	<i>Corvussplendens</i> *	House Crow	R	Vc
39) Alaudidae	81	<i>Ammomanesphoenicura</i> *	Rufous tailed lark	R	C
	82	<i>Eremopterixgriseus</i> *	Ashy-crowned Sparrow Lark	R	Vc
30) Pycnonotidae	83	<i>Pycnonotuscafer</i> *	Red-vented Bulbul	R	Vc
31) Sylviidae	84	<i>Orthotomussutorius</i> *	Common Tailorbird	R	C
32) Timaliidae	85	<i>Turdoidesmalcolmi</i> *	Large Grey Babbler	R	Uc
	86	<i>Turdoidesstriata</i> *	Jungle Babbler	R	Vc
33) Zosteropidae	87	<i>Zosteropsalpebrosus</i> *	Oriental White-eye	R	C
34) Sturnidae	88	<i>Acridotherestrictis</i> *	Common Myna	R	Vc
	89	<i>Sturnus contra</i> *	Asian Pied Starling	R	Vc
	90	<i>Sturnuspagodarum</i> *	Brahminy Starling	R	Vc
35) Muscipidae	91	<i>Copsychussaularis</i> *	Oriental Magpie Robin	R	C
	92	<i>Saxicoloidesfulicatus</i> *	Indian Robin	R	Vc
36) Nectariniidae	93	<i>Nectariniazeylonica</i> *	Purple-rumped Sunbird	R	O
	94	<i>Nectariniaasiatica</i> *	Purple Sunbird	R	C
37) Passeridae	95	<i>Passer domesticus</i> *	House Sparrow	R	C
38) Ploceidae	96	<i>Ploceusphilippinus</i> *	Baya Weaver	R	Uc
39) Estrildidae	97	<i>Amandavaamandava</i> *	Red avadavat	WV	O
	98	<i>Lonchurapunctulata</i> *	Scaly-breasted Munia	R	Uc
	99	<i>Lonchuramalacca</i> *	Black-headed Munia	R	O
40) Motacillidae	100	<i>Motacillaflava</i> *	Yellow Wagtail	WV	O
	101	<i>Motacilla alba</i> *	White Wagtail	WV	O
	102	<i>Motacillamaderaspatensis</i> *	White-browed Wagtail	R	Vc
	103	<i>Anthusrufulus</i> *	Paddyfield Pipit	R	Vc

Grimmeret al. (2011); Koli (2014); Shekhawat and Bhatnagar (2014): R - Resident, WV - Winter visitor, SV - Summer visitor, PV - Passage visitor.

▣ Kasambe and Sani (2009), Taket al. (2010), Priyanka (2012): Rr - Rare (<5%), O - Occasional (5-24%), Uc - Uncommon (25-49%), C - Common (50-74%), Vc - Very common (75-100%).

* BirdLife International (2013): LC* - Least concern, NT** - Near threatened.

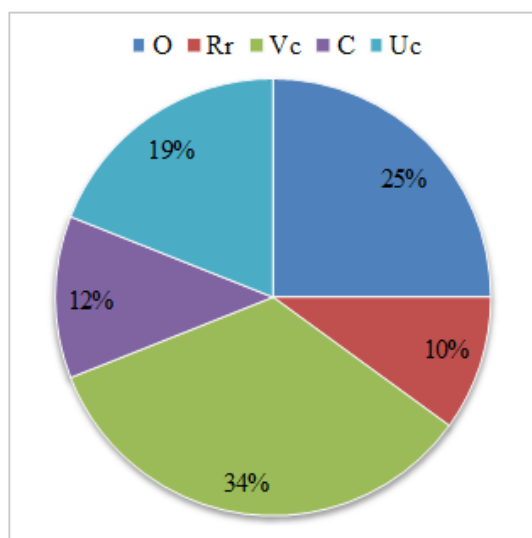


Fig. 1.3: Overall Residential status of Avifauna at study area

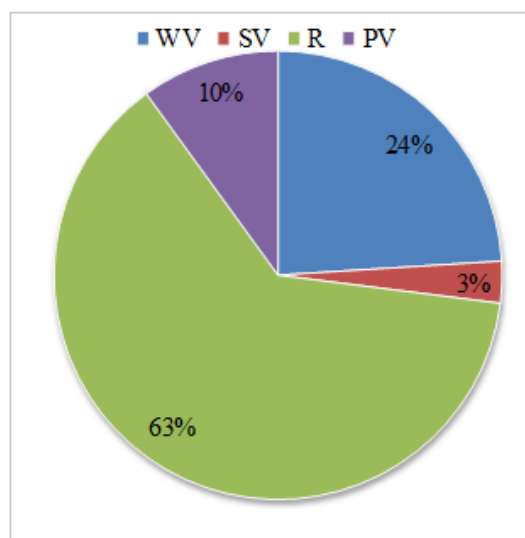


Fig. 1.4: Overall Abundance status of Avifauna at study area

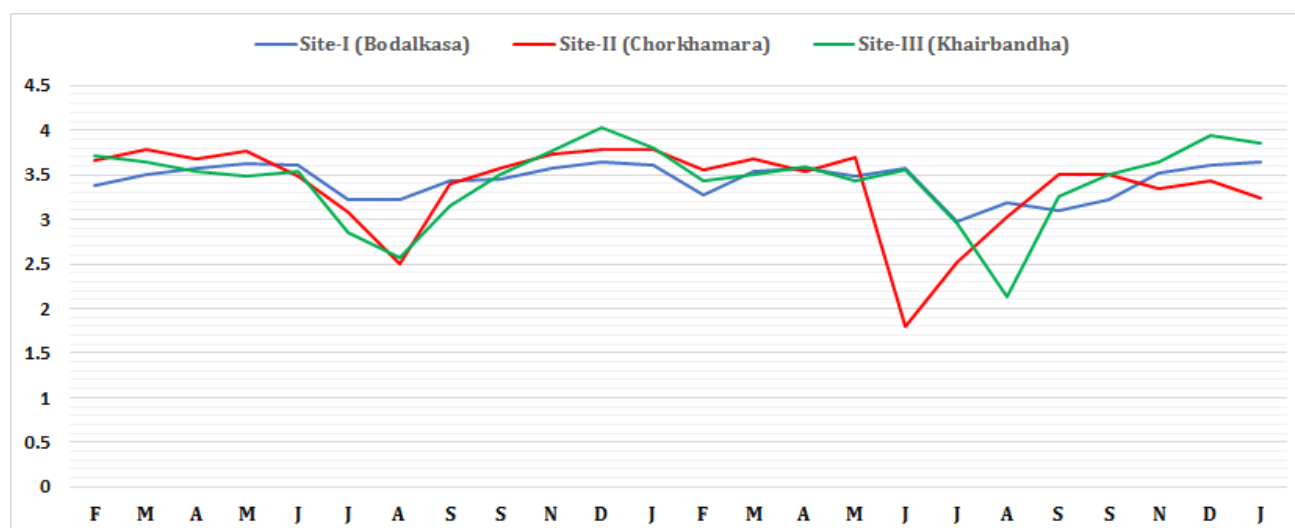


Figure 1.5: Monthly Shannon Diversity

Out of recorded 103 bird species, 65 species were residents (63%), 25 species were winter visitors (24%), 03 species were summer visitors (03%) and 10 species were passage visitors (10%) (Figure 1.3). According to relative abundance as per their sightings frequency, 35 species were very common (34%), 12 species were common (12%), 20 species were uncommon (19%), 26 species were occasional (25%) and 10 species were rare (10%) for the study area (Figure 1.4). As per IUCN status (2013), 98 bird species (95%) were least concern (LC) and 05 were near threatened (NT) species (05%).

The population diversity of the birds in the study area is significantly fluctuating between months. The monthly diversity index values ranged from 1.804 to

4.028 at study area (Figure 1.5). Every year from October onwards a considerable number of birds reach to the present study area. The peak population of the birds has been during November to January, this is due to the arrival of migratory birds and availability of food at study area. The low population was during the month of July and August due to the heavy rain fall the birds leave the study area and food sources disturbed due full water level in the lakes. The basic requirement of migratory water birds at their wintering sites are adequate food supply (Lakshmi, 2006; Mohan and Gaur, 2008), which are fulfilled by the lakes. Most of the water bird species leave the lakes by March-end or early April. The land birds were commonly seen throughout the year simultaneously.

The anthropogenic activities and other impacting factors influence the bird diversity (Walls, 1999; Datta, 2011; Manikannan, 2011; Sharma and Saini, 2012; Bhadja and Vaghela, 2013; Vachanth, 2013; Nalavade, 2013; Ramamurthy and Rajakumar, 2014; Sulaiman *et al.* 2014). In all there are 13 drivers (impacting factors) and two bird groups. During present study the main threats were noticed from the study area namely, population growth (PG), washing activities (WA), recreational activities and tourism (RA), MFP collection (FC), agricultural practices (AP), cattle

grazing (CG), fishing practices (FP), forest fires (FF), loss and degradation of habitats (LH), poaching of birds (PB), dogs menace (DM), pollution (P), industrialization (I), etc. The impact of each driver on the concerned bird group is judged on the basis of actual field observations, field experience of the author supported by the data collected during the study period. The intensity of impact was arrived at by assigning a certain score to each bird group. The range of score is expressed numerically on a scale ranging from 0 to 5.

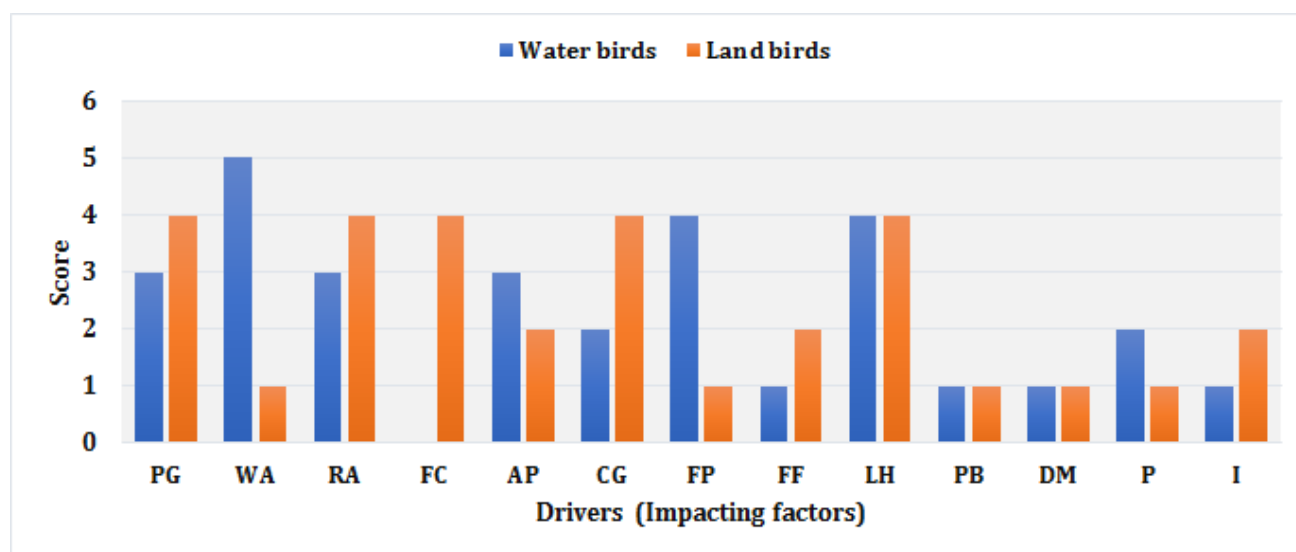


Figure 1.6: Impacts of drivers on Bird groups

Table 1.2: Grouping of Drivers on the basis of Impact level

Impact Category	Impacting drivers	Total Score	% Score
High	Loss and degradation of habitats	22	36.07
	Population growth		
	Recreational activities and tourism		
Moderate	Washing activities	26	42.62
	Cattle grazing		
	Agricultural practices		
	Fishing practices		
	MFP collection		
Low	Forest fires	13	21.31
	Pollution		
	Industrialization		
	Poaching of birds		
	Dogs menace		
Total:		61	100.00

Where,

0 = No impact.

1 = In significant impact: There is very weak relation between driver and bird group.

2 = Low impact: The Impact may not be clearly recognizable to a layman unless watched carefully.

3 = Moderate impact: The impact is visible but not threatening to the bird group.

4 = High Impact: The impact level is such that the diversity and population level of the group of species is likely to suffer.

5 = Very high Impact: The impact level is so intense, the group of species concerned is already threatened or is likely to become critical in the near future.

Total score for every driver and every bird group was also calculated (Figure 1.6).

On the basis of impact category, three drivers fall under the high impact category (36.07%), five in moderate impact category (42.62%) and five in low impact category (21.31%) (Table 1.2).

As Adani thermal power plant was started in 2012 in Tirora tehsil of Gondia district, the population of birds is decreasing. Even though the super-critical technology used by Adani power plant, but there is a lot of steam evolving from the boilers of the power plant. The maximum temperature 47.5°C was recorded in the year 2011 in Gondia district. After two years, the maximum temperature 48°C was recorded in the month of May 2013 at Tirora in Gondia district (India Weather Report) and this may be because of the increasing industrialization like Adani thermal power station in the district. The change is not abrupt, it is gradual so may not have direct impact. That may be responsible for the day by day increasing temperature which affects the nutrient cycle in the lakes, hence adversely affects the birds directly or indirectly.

Only 103 birds species have been recorded from three lakes viz. Bodalkasa, Chorkhamara and Khairbandha in Gondia district, Maharashtra during February 2014 to January 2016. Earlier, Chitampalli (1976) has recorded 209 birds species, Chinchkhede and Kedar (2013) recorded 126 bird species from the Navegaon National Park respectively in Gondia district. Misra (undated) recorded 166 bird species from Nagzira Wildlife Sanctuary including Chorkhamara lake in Gondia district. While Pimplapure and Sawji (2009) were

recorded 412 bird species from Vidarbha region of Maharashtra State. Compared to previous studies in the district, the present study indicates a decline in the number of birds species. The main reasons for decline of birds in the study area may be due to anthropogenic pressure, irrational practices of fish catching in the lakes, cattle grazing, agricultural practices in encroachment area, changing climate and many other factors.

CONCLUSION

Various different studies have already been done, or are still going on, world over, on the possible impact of global warming on biodiversity and wild life in general and birds in particular. Global warming has set in motion and is affecting the timing of migration of birds (Jain, 2015). The present study does not take into more consideration as the climate change and global warming is still a nascent in the present study area. The less impact might be because of acclimatization phenomenon. No more impacts on the avifauna noticed due to Adani thermal power plant in Gondia district. This power plant near about 10-15 km away from each site of present study area. Also the power plant runs on the basis of super critical technology which helpful to reduce the pollution. Hence no more pollution caused, only steam and ash is produced in large quantity. The steam may be responsible to increase in temperature of surrounding present study area in future. Also the ash is responsible for degradation and loss of the bird habitats. Hence, in present study the avifauna was not impacted due to Adani thermal power plant in Gondia district except slight variations.

From conservation point of view, the situation is still within control and we still have chance to save and preserve most bird species. But in future the present study area may be affected due to the warming by Adani thermal power plant in Gondia district, hence particular conservative management is needed. The laws and legislations are not just sufficient for protection of the avifauna but it is necessary to raise the awareness levels by providing important information about birds among different sections of people for conservation of avian biodiversity in Gondia district, Maharashtra State. To overcome the problems related bird diversity, this research work has been done in the hope that it will help in raising the conservative awareness about the bird biodiversity among the people in Gondia district as well as

neighbor hood. Some following recommendations are suggested here to conserve the bird biodiversity and natural resources.

Recommendations

- Integrated grazing policy like alternative grazing, and based on the recommendations of advisory and expert committee must follow to help in the preservation of forest resources and biodiversity. Direct cattle grazing near the edges of the lake should be totally prohibited. The local people must be educated in this aspect.
- Stocking lakes through fishermen cooperative societies with a particular guideline manual. Fishermen only allowed at noon time and after a particular gap of days and not continuously in the lakes to catch fishes. The fisheries department should initiate immediate steps for the sustainable use of these lakes in this regarded.
- Ground fires for the roasting of the prawns and smaller fishes by fishermen must be prohibited near the lakes. Instead of it, they may use any particular large utensil for the roasting purposes.
- Dumping and flying of ash from Adani power plant in Gondia district must be properly managed by following the rules of environmental pollution and industrial acts. Also that ash should be used for making the bricks.
- Regular checking of the poaching and illegal hunting by appointing more staff from concerning departments, Lake protection committees (LPCs) and NGOs to prevent further population loss of the birds.
- Pollution and siltation may be avoided by maintaining special water tanks beside to the lakes separately for the immersion of the idols. After one month of the immersion of idols, the lakes may be desilted by the department if necessary.
- Setting up of Bird-clubs in schools to impart environment education, to encourage and mobilise participation of school children in various bird conservation activities in their localities. The curriculum should include chapters on the importance of birds in nature and to humans, and the need to conserve them.
- As there are Sarus Conservation Committees and organisation of Sarus-Vulture Conservation Rally in Gondia district (Dhurveet *et al.*, 2010); that should be follow for all other birds by increasing the scope of these committees modifying as Bird

Conservation Committee and Bird Conservation Rally in the present research study area.

Every people at local level must participate with own interest for the prevention of the forests, water bodies, bird diversity and all other natural resources at present study area as well as throughout the World.

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