

Baseline survey of Birds at the Proposed Navi Mumbai International Airport (NMIA)

ANNUAL REPORT - III

January to December, 2014



Bombay Natural History Society

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Bombay Natural History Society

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Baseline Survey of Birds at the Proposed Navi Mumbai International Airport (NMIA)

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Summary

The field visits were conducted during January 2014 to December 2014, in the area falling under approximately 10-kilometre radius from the proposed site of Navi Mumbai International Airport (NMIA). A total of 266 bird species belonging to 56 families were observed in the study area till December 2014. Through the third annual report, we would like to address the monthly variation in bird count and seasonal variation in species count at the selected sites, in the year 2014. Additional account on spatial variation in the population of congregating species such as ducks and waders at the selected sites has also been given. Suggestions are given to avoid future bird hazard problems at proposed NMIA area.

Keywords: Navi Mumbai International Airport, Avifauna, population variation, tide level, water level, bird hazard.

Abbreviations and categories used

- 1) NMIA – Navi Mumbai International Airport
- 2) BNHS - Bombay Natural History Society
- 3) JNPT - Jawaharlal Nehru Port Trust
- 4) EIA - Environmental Impact Assessment
- 5) Habitats: P-Paddy field, GS-Mixed habitat of Grassland and Shrub land, RS-Rocky Seashore, W-Wetland, MD-Mudflats, MC-Mangrove and Creeks, NH-Near Human habitation, F-Forest
- 6) Threat categories: EN-Endangered, VU-Vulnerable, NT-Near threatened
- 7) Type of movements: R-Resident, M-Winter Migrant, LM Local Migrant, SM summer Migrant. BM Breeding Migrant, PM Passage Migrant
- 8) Seasons: Late winter – January to March, Summer – April and May, Monsoon – June to September, Early winter – October to December

CHAPTER I

Introduction

According to the Government of Maharashtra, the existing airport at Mumbai is fast reaching saturation level and the scope for further enhancement of passenger and cargo handling facilities, aircraft maintenance and the city-side facilities is limited (EIA Report, CIDCO, Navi Mumbai). The need for a second airport for Mumbai has become inescapable and imperative. City and Industrial Development Corporation of Maharashtra Limited (CIDCO) proposed to set up a new international airport at Navi Mumbai in Maharashtra.

The proposed Navi Mumbai International Airport (NMIA) is located near Panvel between the existing National Highway-4B (NH4B) and Aamra Marg in Panvel Tehsil of Raigad district. The total area demarcated for the airport area is 2,054 hectares; this includes the area for development; approximately 1,615 hectares as an Airport Zone and the remaining for off-site infrastructure such as diversion, training of rivers, and approach roads.

Environmental Impact Assessment (EIA) carried out for NMIA by the Centre for Environmental Science & Engineering at Indian Institute of Technology, Bombay (IIT-Bombay), reported 58 species of birds from 21 locations in the 10-kilometre radius area of the proposed NMIA site. The area comprised creeks, rivers and mangroves that serve as a good habitat for a variety of congregating bird species. Karnala Bird Sanctuary is located in proximity to the proposed NMIA site.

The Ministry of Environment and Forests (MoEF), Government of India has granted a conditional clearance to this project. One of the conditions (condition number xxxi provided under specific conditions) is that an avifaunal study should be carried out in consultation with the Bombay Natural History Society (BNHS). The BNHS survey was designed to document the bird diversity and species composition at various survey sites in the 10-kilometre radius area of NMIA. A total of 266 bird species were documented in the study area since December 2011.

CHAPTER II

Study area

Various sites in the 10-kilometre radius area of the proposed NMIA were divided by us into five blocks as mentioned below, however, excluding the industrial areas and the areas with dense human habitations.

1. The proposed site of NMIA: Data was collected from wetlands, creeks, paddy fields, mangrove-covered areas, mudflats, open scrubland and shrub-land. The study area included Kombadbhuja, Ulve, Dungi, Pargaon, Chinchpada and Kopar; the villages adjacent to the proposed NMIA site, and the creeks at Gadhi, Ulve, Kalamboli and Panvel.
2. North-west: This block includes the land primarily covered with grass and shrubs, the seashore parallel to Palm Beach Road and a part of Airoli Creek, and the water bodies around NRI Complex, DPS School on Palm Beach Road, Belapur Pond and a portion of Parsik Hills.
3. North-east: This block includes Taloja, Panvel, Tembhode, Kewale, Nere and Pali villages, which is a hilly area interspersed with paddy fields, human habitations and grasslands.
4. South-west or Uran-Jawaharlal Nehru Port Trust (JNPT) area: This block includes small wetlands, and mangroves areas near the villages such as Jasai, Sonari, Belpada, Karal, Gawhan, Uran, Jaskhar and Funde.
5. South-east: This block primarily consists of reserve forest patches adjoining villages such as Mosare, Patnoli and Ransai. The southern-moist, mixed deciduous forest patch was recently added to Karnala Bird Sanctuary; NH17 (National Highway number 17) cuts through this sanctuary.



Map 1: A Google Earth map showing selected study sites in the 10 kilometre radius from the proposed NMIA site

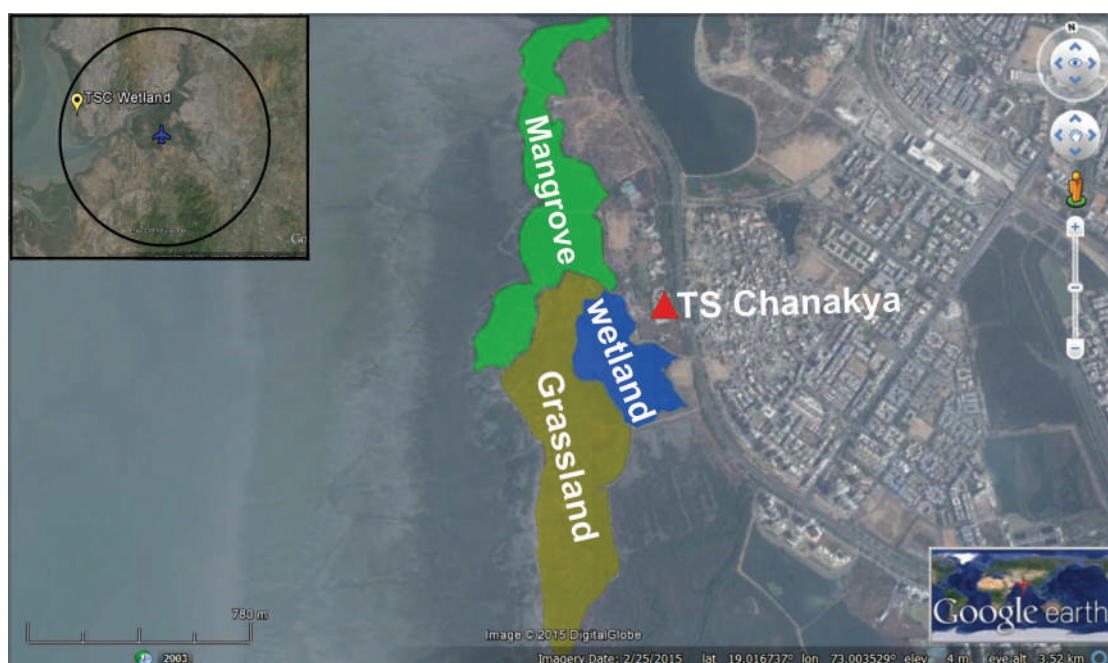
For the study of seasonal variations in the bird population, the BNHS survey team focussed on the following areas to collect data about temporal and spatial variation in the population of bird species.

1. Wetland behind Training Ship Chanakya (TSC Wetland)

This is a small wetland of about 15 hectares area, located behind the Training Ship Chanakya Maritime Institute, Palm Beach Road, Seawoods (GPS coordinates 19°0'56.92"N 73°0'19.33"E and see Map 2). This site is followed by a stretch of paddy fields, shrubland, mangroves and finally reaches the seashore. The water level here was seen controlled by the local fishermen who are using tidal cycles for effective fishing practises.

TSC wetland is one of the important resting grounds for congregating birds found in the coastal area of Navi Mumbai. The population at roosting sites is observed to be fluctuated by the water level in the wetland. Large congregations were usually observed when the fisherman empties the wetland through the small check dams and funnel-like water channels. During low tide, these birds were found foraging on open mudflats at the seas shore and during high tide, seen resting in this wetland.

Birds like starlings, crows, doves, orioles, sunbirds, flowerpeckers and parakeets were seen in adjoining shrubland and paddy fields. There is a thin stretch of mangroves before sea shore which comprises of species such as *Avicenna marina*, *Acanthus ilicifolius* with associated plant species like Glory Bower *Clerodendrum inerme*, Common Deris *Derris trifoliata*, Sea Purselane *Sesuvium portulacastrum* and Meswak *Salvadora persica*. We observed some land filling activities in part of the wetland in year 2013, resulting into loss of some crucial resting habitat. Due to the easy access road to the wetland some over enthusiastic tourists were seen approaching birds closely leading to disturbance to the birds.



Map 2: A Google Earth map of TSC Wetland

2. Wetland behind Non-resident Indian (NRI) colony

This site lies in the northwest direction of the proposed NMIA site and located in backyard of NRI Colony, Seawood Estates (GPS coordinates 19° 0'18.02"N, 73° 0'43.68"E and see map 3). This wetland is spread across some 20-hectare area and surrounded by grass, shrubs and mangroves. A small bund divided the wetland in two parts, and another side towards human settlements is mainly used for fishing activities by the locals. Part of wetland interior side of bund is having mangrove cover from two sides, a fencing wall of NRI colony on other. A thin stretch of vegetation on the periphery of the wetland makes it enclosed and safe habitat for the congregating birds.

Accessibility to wetland got restricted after a fence was constructed around it in year 2013, leaving a narrow entry path. Recently tree plantation has been done on the path and residents in surrounding societies have been using this path for jogging. Anthropogenic pressure in the form of local fisherman, joggers and bird watchers is increasing day by day here.



Map 3: A Google Earth map of NRI Wetland

3. Wetland adjacent to Delhi Public School (DPS)

This wetland is adjacent to the Delhi Public School (GPS coordinates 19°0'21.68"N, 73°1'11.62"E and see map 4), Palm Beach Road, Seawoods. The wetland occupies about 15-hectare area and is connected to the creek by a small canal. It is surrounded by tar roads on three sides and school compound on remaining one. The water level of this wetland was also observed fluctuating as per the tidal cycles. Few bird species were observed foraging in small groups near the shallower part of the wetland, in late winter. A new Sagar Sangam Railway Station connecting Seawoods and Uran area is just Proposed 500 metres from this wetland and the entire area is under various developmental schemes.

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TSC Wetland with high water level

SUJIT NARWADE



NRI Wetland with high water level in monsoon

SUJIT NARWADE



View of DPS Lake, Palm Beach road



Map 4: A Google Earth map of DPS Lake

4. Kharghar Creek

This creek is located between Kharghar and Mansarovar railway stations of harbour-line (GPS coordinates $19^{\circ} 1'48.76''\text{N}$, $73^{\circ} 4'45.46''\text{E}$ and see map 5) and also can be reached via unpaved road from Sion-Panvel Highway. The creek is nearly about 2 km long with dense mangroves on the edges. We conducted surveys by walking a trail of 1.5 km distance parallel to the creek. During the low tide, birds were seen foraging on the exposed benthos of open creek. Birds like bee-eaters, mynas, starlings, warblers, prinias and bulbuls were seen using mangroves and associated plants for perching and foraging. Incidences of sand mining, the illegal release of industrial effluents, and mangrove cuttings for road widening were observed. Because of the undergoing construction of a large flyover on Sion-Panvel Highway access to the particular road is blocked since the last one year.



Map 5: A Google Earth map of Kharghar Creek

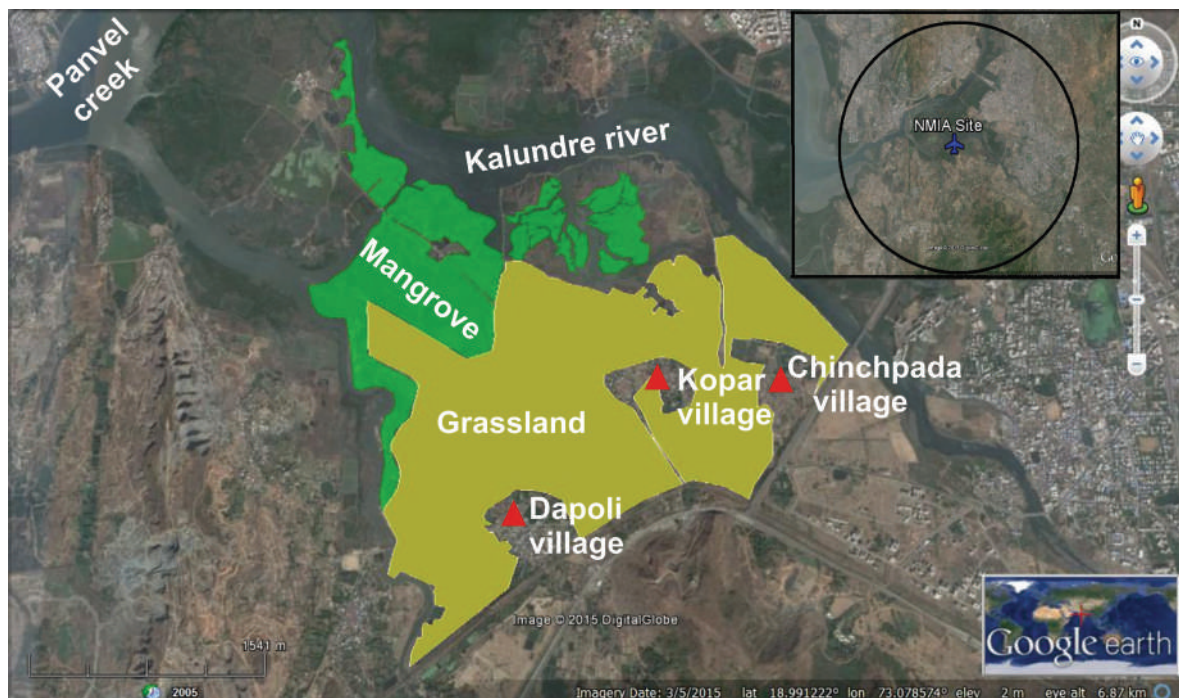
5. Kalundre River and the proposed NMIA site

Kalundre River joins the Panvel Creek and flows parallel to the proposed site of NMIA (GPS coordinates N 18°59'20.37" – E 73°03'37.55" and see map 6) near Kopar and Pargaon villages. Congregating birds were seen foraging in this creek, only during low tides.

The proposed NMIA site (1,160 hectares) is a mixed habitat of mangroves, open scrubland/shrubland, and complex of smaller wetlands created by backwater, paddy fields as well as creeks of Gadhi, Ulve, Kalamboli and Panvel rivers. This site was broadly classified into four categories, as listed below, on the basis of land use pattern observed by us.

- Mangrove patch are spread over approximately 20 per cent area of the proposed NMIA site
- Grassland, paddy fields and abandoned salt-pans cover about 50 per cent area of the proposed NMIA site
- Hilly undulating area, used as stone quarries, cover about 9 per cent of total NMIA area
- Area under human settlement is about 20 per cent of total NMIA area

Common mangrove species found in the area are *Avicennia marina* and *Acanthus ilicifolius*. Other associated plant species such as Glory Bower *Clerodendrum inerme*, Common Deris *Derris trifoliata*, Sea Purselane *Sesuvium portulacastrum*, Meswak *Salvadora persica*. *Avicennia* sp. is one of the dominant mangrove species on this coastal area because it is highly tolerant to salt concentrations. These are shrubby trees with an average height of three to seven metres. We conducted a line transect of 2 km distance parallel to the creek and comprising paddy fields, grassland, mangrove and associated plants.



Map 6: A Google Earth map of the proposed NMIA site



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Proposed NMIA site

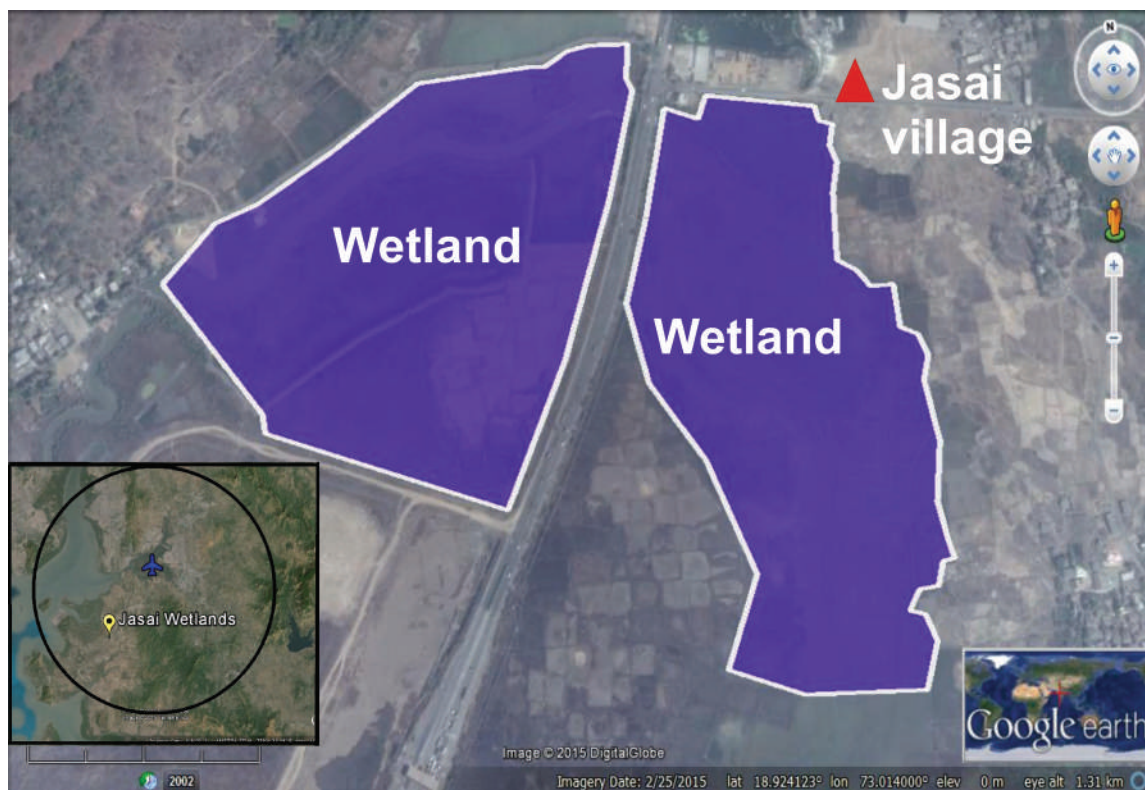


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Jasai Wetland in summer

6. Wetlands near Jasai and Dastan Phata

Two wetlands covering about 300 hectare area on either side of Panvel-JNPT Road and located between Jasai village and Dastan Phata of Uran tehsil ($18^{\circ}55'33.97''\text{N}$, $73^{\circ}0'42.20''\text{E}$ and see map 7) is another important area used by the birds. These wetlands are connected to the sea via small water channels that is controlled by local people. A portion of this wetland adjacent to JNPT toll plaza is a marshy area where birds like storks, ducks and jacanas were seen regularly. In year 2013, a bund was built in the wetland on the side of Belpada village which resulted into blocking the usual movement of water. Therefore, we could see water here only during peak high tides and rest of the period it was found completely dry. Land filling activities were seen in these wetlands in summer.



Map 7: A Google Earth map of Jasai and Dastan Phata Wetlands

7. Sonari-Belpada Wetland

It is located in the southwest direction of the proposed NMIA site between Sonari- Belpada villages (GPS coordinates $18^{\circ}54'41.97''\text{N}$ $72^{\circ}59'43.29''\text{E}$ and see map 8), adjacent to Speedy Services Ltd. This site is reachable from Panvel-JNPT road and is about 2-3 km from Jasai village. The size of wetland was about 50 hectare and is located next to JNPT toll plaza. It is surrounded by grass/shrubland from three sides and the boundary wall of Speedy Services Ltd. on the fourth side. Once part of coastal mudflat, now it has become isolated from the sea and become inland wetland that gets completely dry in summer.

In April 2013, the wetland was dried up leaving few puddles of water and very few birds were seen here. After monsoon, the wetland was found with full of water and birds like grebes, coots and ducks were seen here. In September 2014, a drainage outlet was constructed by adjoining Speedy Company for removing the water from particular wetland followed by a landfilling activity. This site was found land filled in December 2014 losing its status of wetland fully.



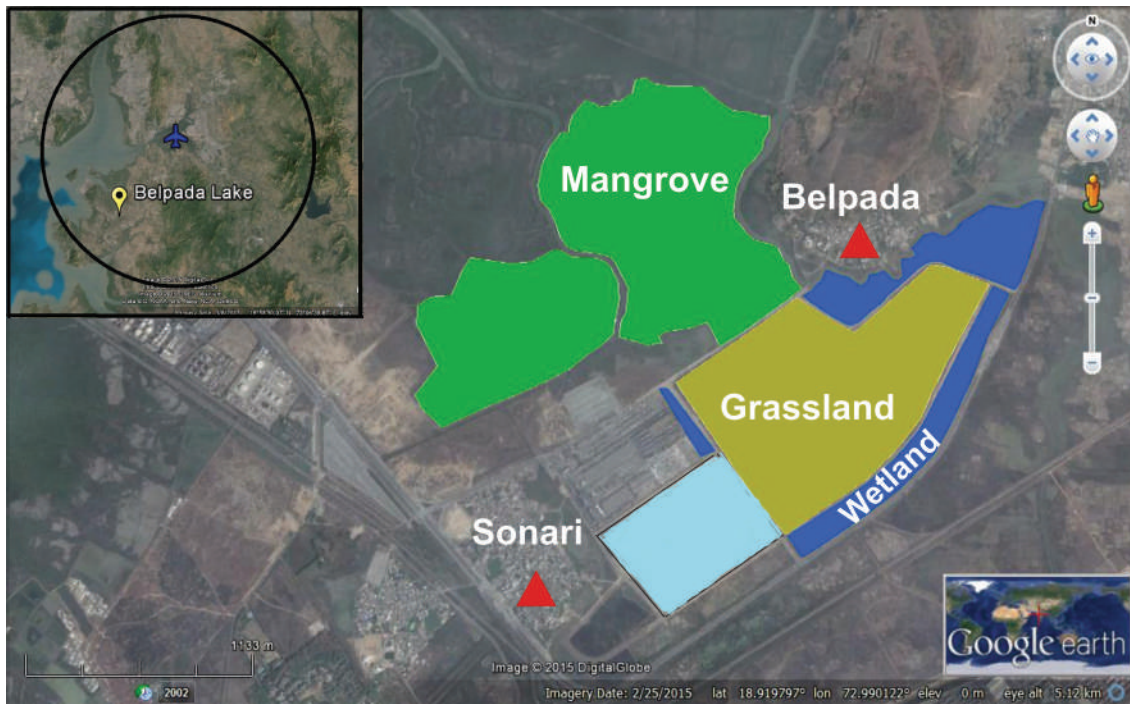
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Belpada Lake before the lanfilling



PARVEEN SHAIKH

Panje Wetland with high water level



Map 8: A Google Earth map of the wetland near Sonari and Belpada

8. Wetland near Panje, Uran

A wetland area sandwiched between villages Dongri, Funde and Panje (GPS coordinates 18°54'3.04"N 72°57'1.86"E and see map 9) was seen used by waders during high tides. The size of this wetland is of 100 hectare and is located within the boundary of the Special Economic Zone (SEZ) of Uran, Navi Mumbai. This site is situated 3 km distance from Nhava Sheva Police station and is easily accessible via tar road. This site was created as a SEZ in 2009, and a boundary wall was constructed around the wetland separating it from shore. This wetland has less anthropogenic pressure due to which it has become a safe area for foraging as well as roosting for congregating birds.

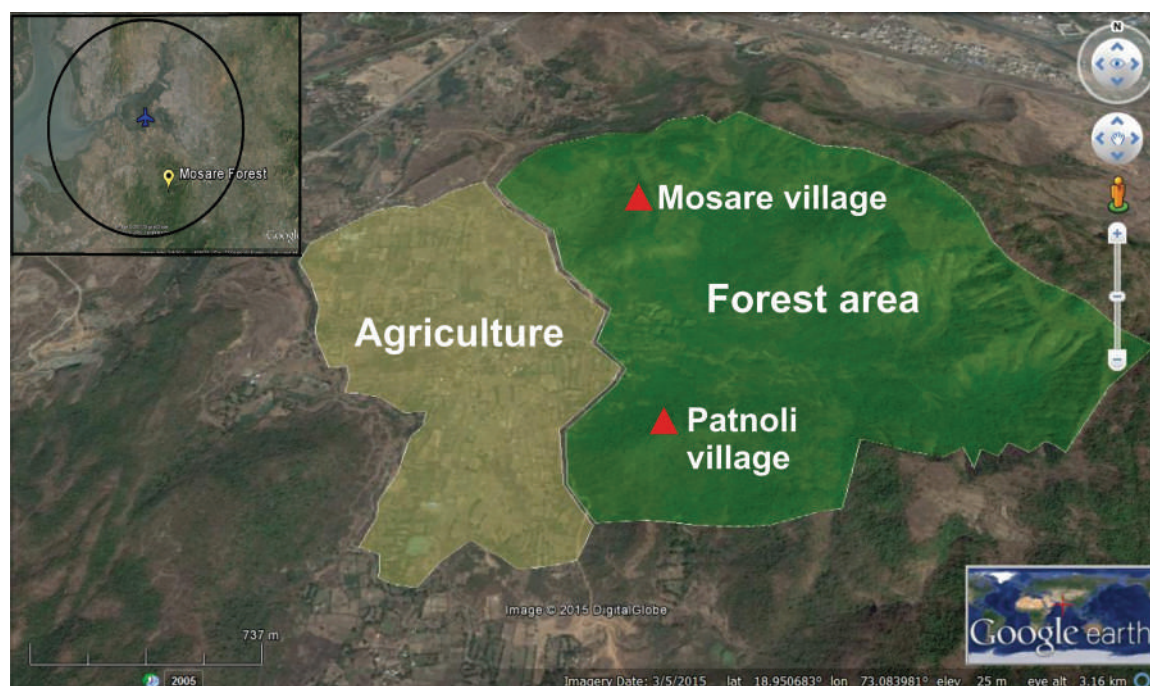


Map 9: A Google Earth map of the wetland at Uran (Panje)

9. The forest patch near Mosare-Patnoli villages

A deciduous reserved forest patch on top of a hillock situated between the Mosare and Patnoli villages (GPS coordinates 18°57'23.97"N, 73° 5'8.47"E and see map 10) was selected for survey of forest birds. Agricultural lands cultivated by the people from nearby villages surround the base of this hillock. The forest is a mix deciduous type and represented by vegetation like Jamun *Syzygium cumuni*, Ber *Zizipus jujuba*, Banyan *Ficus bengalensis*, Teak *Tectona grandis*, Red Silk Cotton *Bombax ceiba*, Karanj *Pongamia pinnata* and Anjan *Hardwickia binata*.

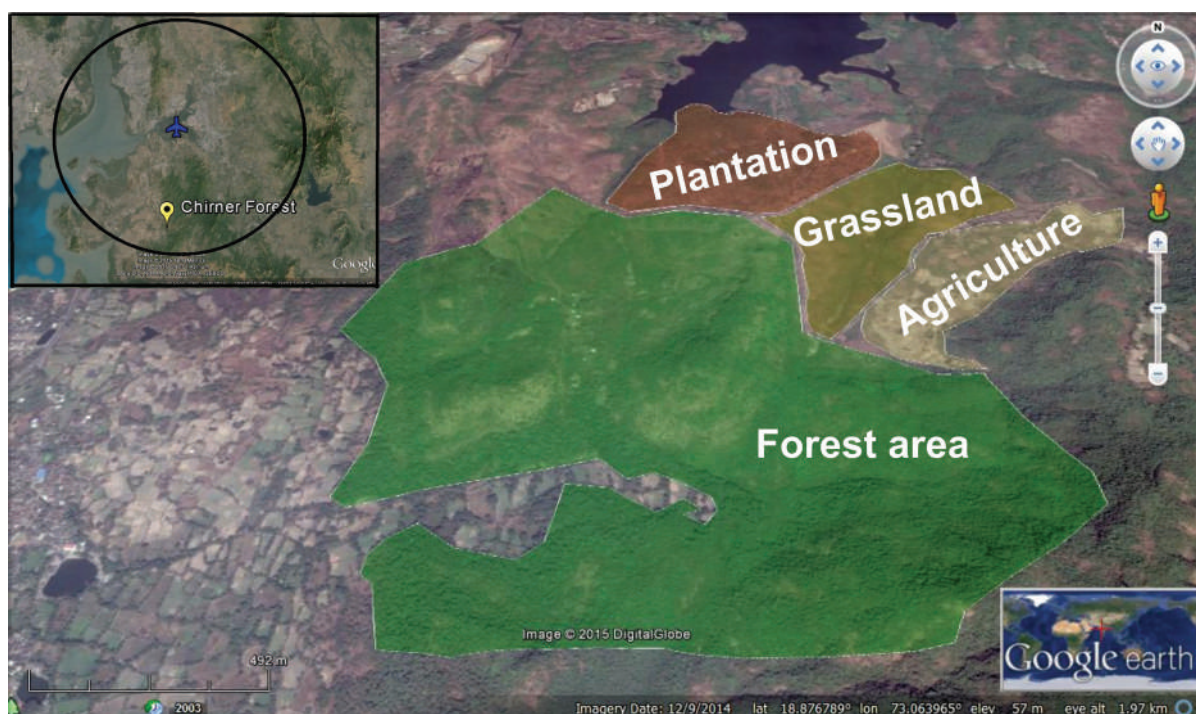
We regularly surveyed a 3-km transect started from agriculture patch at the base of the hillock, through deciduous forest and end at a stream bed. A plantation patch near a stream flowing from Mosare village is a communal roosting site for egrets, crows, parakeets, and herons.



Map 10: A Google Earth map of Mosare-Patnoli forest area

10. Chirner forest

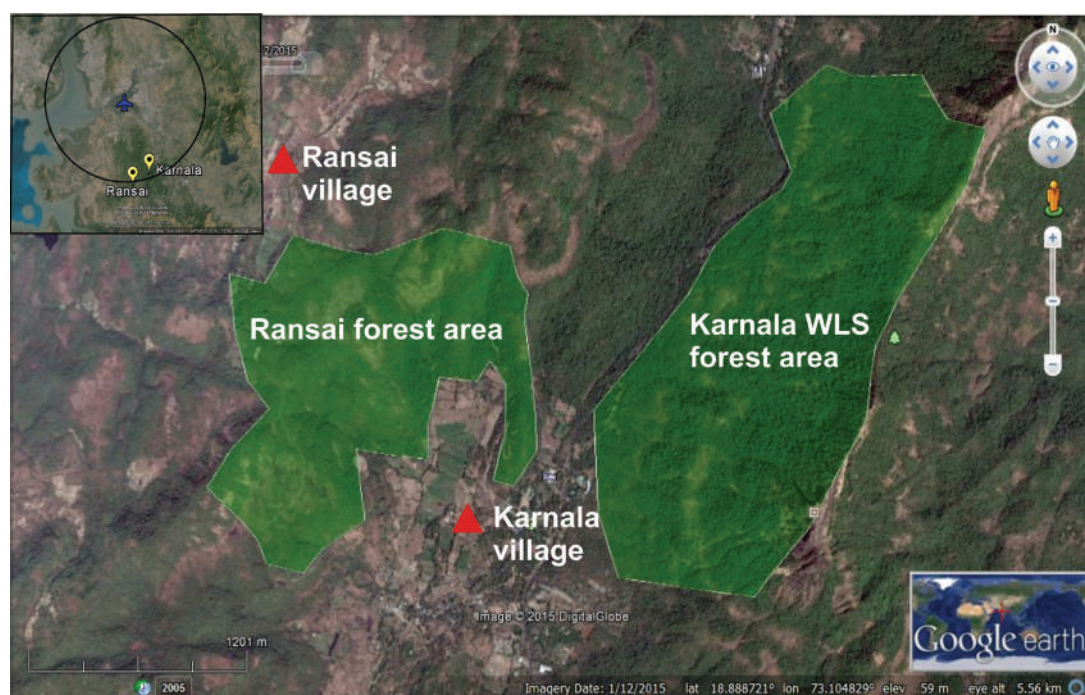
A deciduous forest patch sandwiched between Chirner village and Ransai Dam (GPS coordinates 18°53'4.43"N 73° 3'22.50"E and see Map 11) – dominated by Jamun *Syzygium cumuni*, Goose Berry *Zizipus jujuba*, Banyan *Ficus bengalensis*, Teak *Tectona grandis*, Red Silk Cotton *Bombax ceiba* and Anjan *Hardwickia binata* plants – was selected for regular surveys. This site is a mosaic of different land-use-patterns such as forest, grassland, agriculture and plantations of Mango orchards, Teak and Cashew. The transect length of two kilometre was laid. Anthropogenic activities like quarrying, farming, firewood collection and cattle grazing were seen here during the surveys.



Map 11: A Google Earth map of Chirner forest area

11. Karnala Bird Sanctuary and Ransai Forest

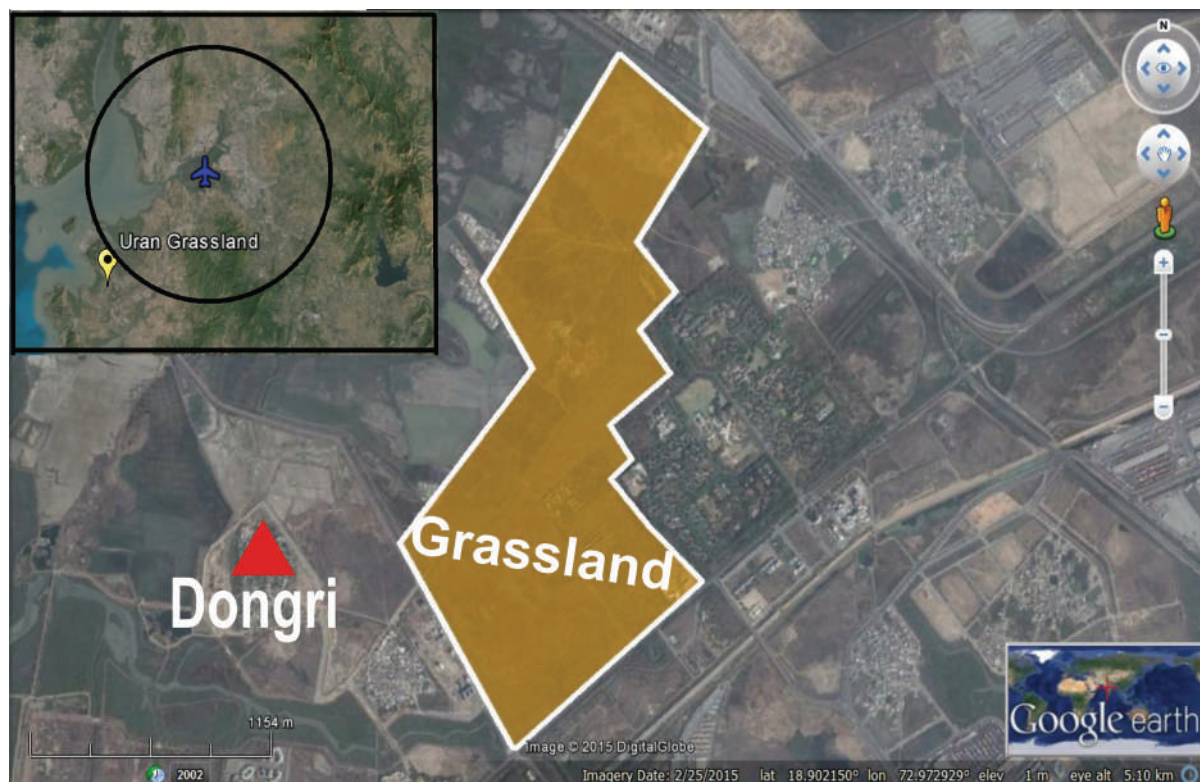
Karnala Bird Sanctuary is located in Panvel Taluka of Raigad District, outside Mumbai, India near Matheran and Karjat area (GPS coordinates $18^{\circ}53'39.97''\text{N}$, $73^{\circ}6'57.50''\text{E}$ and see map 12). The size of the sanctuary is about 14.12 sq km area with a centre point at historic Karnala Fort. Sanctuary is also approachable by road via Mumbai-Goa highway. Recently added area of Ransai opposite side of Mumbai-Goa highway of existing Karnala Bird Sanctuary was also surveyed. We used the existing paths and trails for bird surveys.



Map 12: A Google Earth map of Karnala Bird Sanctuary and Ransai forest

12. Grassland patch opposite to Nhava Sheva Police station, Uran

A grassland patch of 100 hectares located opposite to Nhava Sheva Police Station, Uran (GPS coordinates 18°54'34.51"N, 72°58'19.49"E and see map 13) was a cluster of wetlands before year 2009, which got land filled in year 2010. The site is surrounded by the JNPT-Uran Road on one side and mudflat, mangrove and seashore on the other side. Now grassland birds replaced the wetland birds. A power transmission lines running between the areas is being used by birds for perching. The existing trails in the grassland area were visited regularly for the surveys of grassland birds.



Map 13: A Google Earth map of Uran Grassland



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Mosare forest in Monsoon



SUJIT NARWADE

Chirner forest habitat



SUJIT NARWADE

Ransai Forest Habitat



SUJIT NARWADE

Landfilled grassland opposite to Nhava Sheva Police Station, Uran

CHAPTER III

Methodology

Multiple site surveys were conducted between January 2014 and December 2014. We used binoculars (Nikon Monarch 10x X 40x) for correct bird identification and a digital SLR-camera (Cannon 550D, Cannon with 400 mm fixed-focus lens) for documentation of bird-species and observations at each survey site. The bird species were recorded (sighting or call) on the field, and direct observations were made by walking along roads, hills, forest-paths, wetlands, mangroves and creek areas. The birds were identified by referring to, Ali & Ripley (1983), Grimmett et al. (1998) and Rasmussen & Anderton (2012). The list of birds was arranged family-wise following Manakadan & Pittie (2001), and Rasmussen & Anderton (2012) was followed for the nomenclature. A GPS device was used to collect accurate geographical coordinates.

Every selected wetland site was visited at least once in a month and birds were counted using the Estimated-block Method (Bibby, et al. 2000) for different species, according to the congregation size during roosting time. The observations were recorded continuously for two hours before and after high tide for each wetland. To understand the trends in population, diversity and movement of birds in wetlands, the quantitative data was collected and the maximum count of individuals of a species in a season was compared across seasons and presented through graphs. We considered winter from October to December, late winter from January to March, summer from April to June and monsoon from July to September for getting information about seasonal variation in the population of birds.

The Total Count Method was used to estimate the count of congregating water birds and waders during High Tide Wetland Surveys (Koffijberg et al. 2003, Donal and Clark, 1991) and the total bird count during the high tide roost at selected wetland was compared across the months. Some important flocking bird species were regularly monitored at the selected sites mentioned in study area and population change was compared across the months and the sites, considering the bird hazard these species may pose to the operations of the proposed airport. Line transects were conducted once every month on the existing trails in mangroves, forest and grassland. Strip transect sampling method was used, and birds were counted within 50 m distance from the line (Buckland, 2008).

CHAPTER IV

Observations & Results

4.1 Species diversity in selected wetlands in 10-km radius area of the proposed NMIA site

We observed high species diversity at Sonari-Belpada wetland among all selected wetland sites of the study area. Because of a mixture of habitats such as marshy area, salt pans, inland wetland we observed various birds such as waders, Storks, Egrets, Herons, ducks and Water hens. We observed a large congregation of waders at Panje wetland, Uran but species diversity was less as compared to Sonari-Belpada. The wetlands behind NRI and TSC on Palm Beach Road share similar species composition as these sites are located within 500-metre flight distance from each other. We saw comparatively high species diversity in birds at the proposed NMIA site as compared to the wetlands behind NRI and TSC, because of mixed type of habitats.

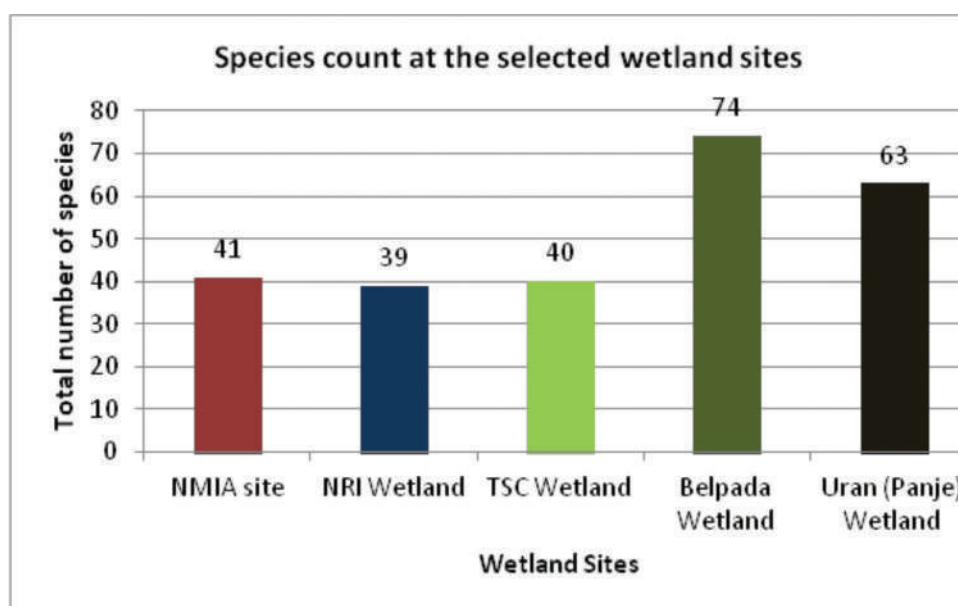


Figure 1: Site-wise variation in species diversity in the study area seen in year 2014

4.2 Temporal and spatial variation observed in bird population

The population of birds was observed fluctuating with the tide level and water level. Detailed site-wise observations are as follows:

4.2.1 TSC Wetland

A) Monthly variation in total bird count

During January to March 2014, a huge congregation of waders was seen along with flocks of gulls, terns and flamingos. The count was 14,000 birds in April 2014 which was declined later as the waders, and other migratory water birds including Lesser Flamingo *Phoeniconaias minor* started return migration. During July-August months of year 2014, very few overwintering migratory birds were seen along with the resident species. In September 2014, a flock of waders was seen in the wetland for a short time. Because of high water level, only Lesser Flamingo *Phoeniconaias minor* were seen congregating here during October to December, 2014.

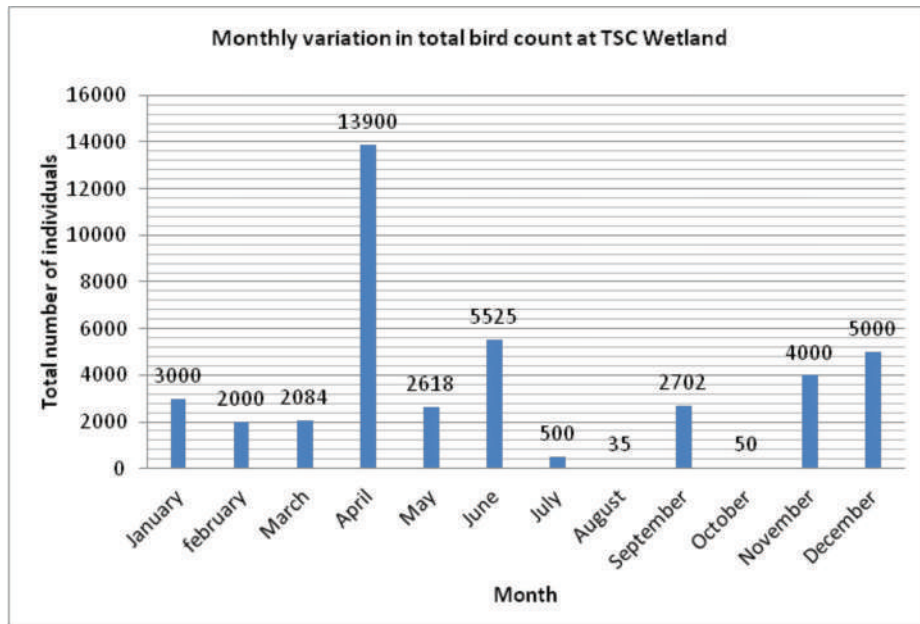


Figure 2: Monthly variation in total bird count at TSC Wetland

B) Seasonal variation in the population of selected bird species

During winter, we observed about 4,000-6,000 Lesser Flamingo *Phoeniconaias minor* with half of population comprising juveniles. In summer, a mixed flock of waders with approximately 3,000 Curlew Sandpiper *Calidris ferruginea*, 2,500 Lesser Sand Plover *Charadrius mongolus* and 2,000 Little Stint *Calidris minuta* were seen in March 2014. Slender-billed Gull *Chroicocephalus genei*, among other species, was observed only in summer during their return journey. From May 2014, the population of the majority of water birds declined. Even during the monsoon, we could observe an overwintering population of 500 Lesser Flamingo *Phoeniconaias minor* in the wetland. In September 2014, early arrival of waders was observed, and birds such as Curlew Sandpiper *Calidris ferruginea*, Little Stint *Calidris minuta*, Broad-billed Sandpiper *Limicola falcinellus* and Black-tailed Godwit *Limosa limosa*.

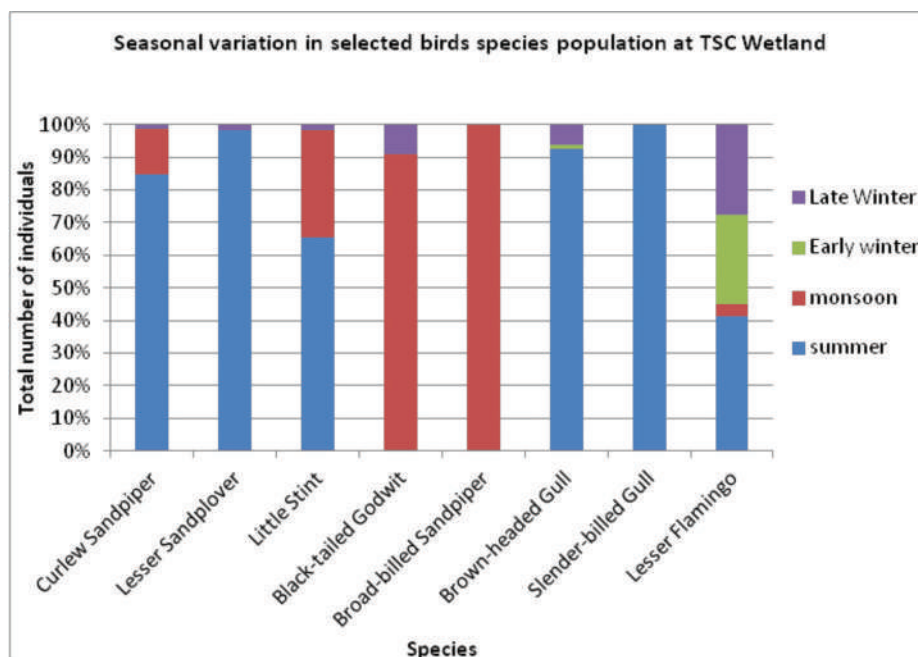


Figure 3: Seasonal variation in the population of selected bird species at TSC Wetland



PARVEEN SHAIKH

A mass congregation of waders was seen at TSC Wetland in winter



PARVEEN SHAIKH

Mix flock of waders gather in wetland for resting during high tide



VIKAS PISAL

Flock of Lesser Flamingo at TSC in summer



PARVEEN SHAIKH

Waders congregate at TSC Wetland for high tide roost

4.2.2 NRI Wetland

A) Monthly variation in total bird count

During January-March 2014, mainly Lesser Flamingo *Phoeniconaias minor* was seen in this wetland along with small flocks of Eurasian Curlew *Numenius arquata*, Pied Avocet *Recurvirostra avosetta*, Eurasian Spoonbill *Anas crecca* and Northern Shoveller *Anas clypeata*. The bird count was 10,000 individuals, with over 50 per cent Lesser Flamingo *Phoeniconaias minor*, in March 2014. The population of migratory birds was seen very less during summer 2014. We did not observe Lesser Flamingo *Phoeniconaias minor* between August and October in 2014. From November onwards the flocks of waders, ducks and other migratory water birds started arriving here.

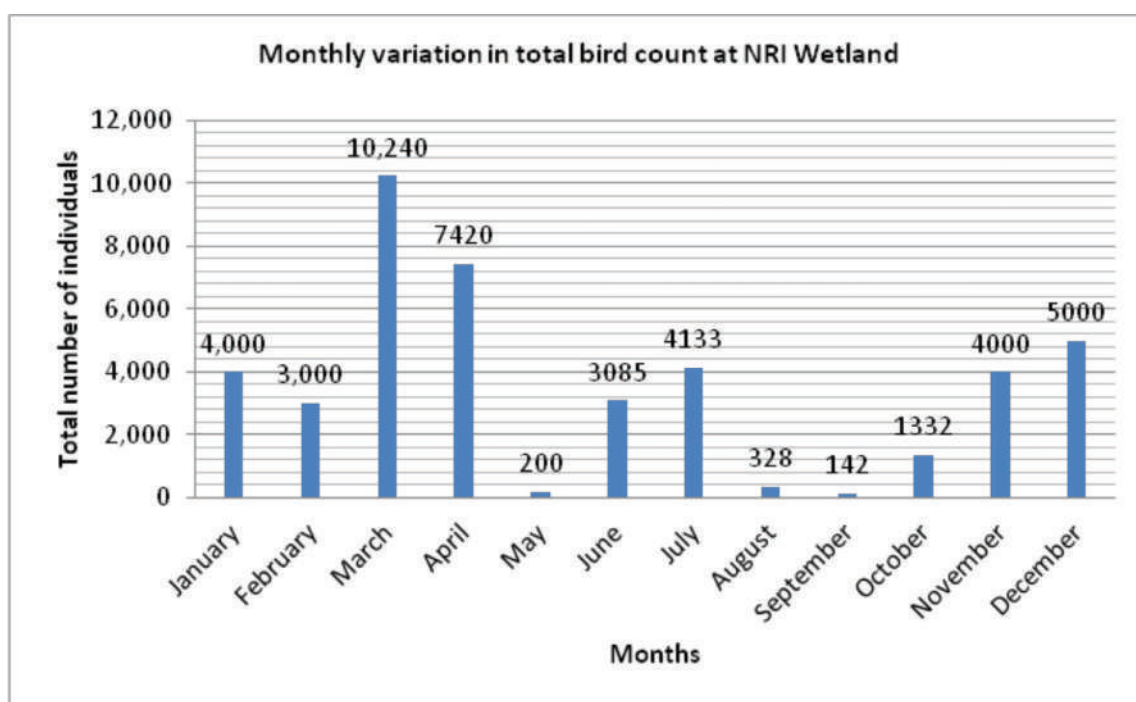


Figure 4: Monthly variation in total bird count at NRI Wetland

B) Seasonal variation in the population of selected bird species

In late winter we observed more than 5,000 Lesser Flamingo *Phoeniconaias minor* along with mix flock of waders including 2,000 Curlew Sandpiper *Calidris ferruginea*, 1,000 Lesser Sand Plover *Charadrius mongolus*, 3,000 Little Stint *Calidris minuta*, and the duck species such as 100 individuals of Common Teal *Anas crecca*. In summer, most of the wetlands in the study area were seen dried up, and an increase in the population of birds at this site was noted because of availability of water. In monsoon, we observed an overwintering population of about 50 Whimbrel *Numenius phaeopus*, 100 Eurasian Curlew *Numenius arquata* and over thousand individuals of Lesser Flamingo *Phoeniconaias minor*. In 2013, we recorded a congregation of over 500 Gulls and Terns, however, in 2014 we spotted a few flocks of Gulls and Terns.

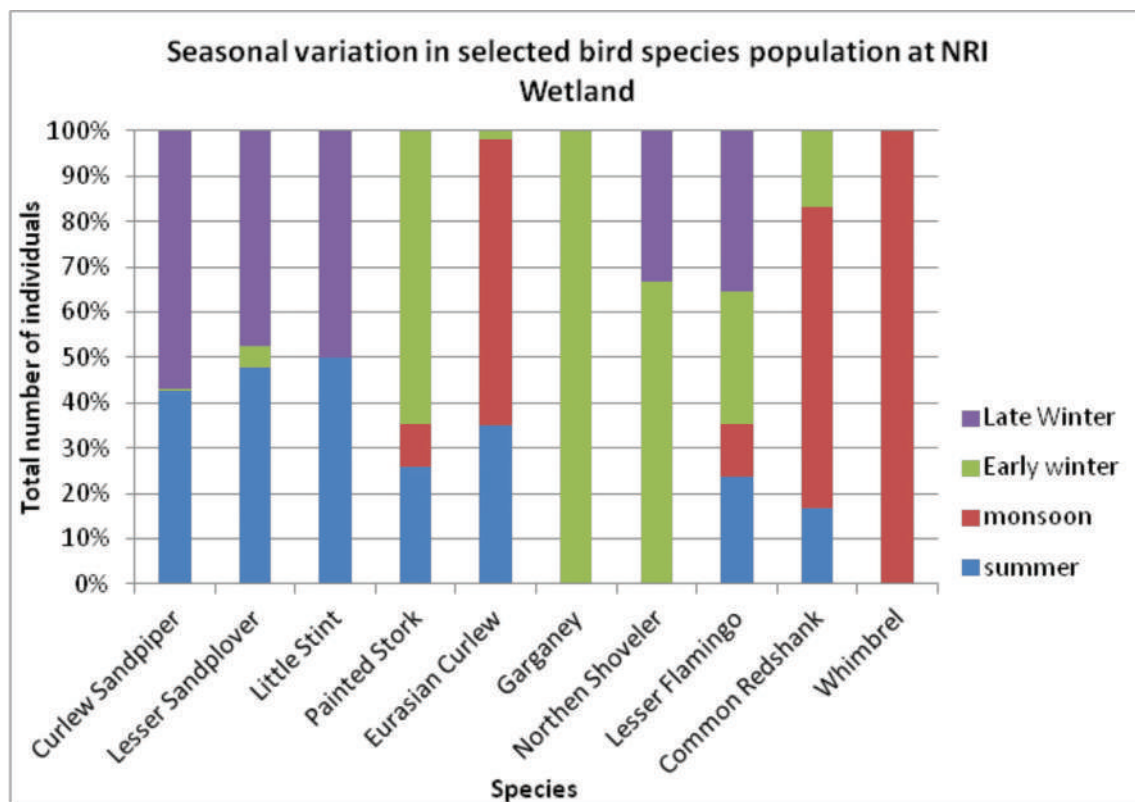


Figure 5: Seasonal variation in population of selected bird species at NRI Wetland



PARVEEN SHAIKH

Birds occupy NRI Wetland during high tide for resting



PARVEEN SHAIKH

Flock of Lesser Flamingo at NRI Wetland



PARVEEN SHAIKH

Flock of Pied Avocet

4.2.3 The proposed NMIA site (Creek and Wetland areas)

A) Monthly variation in total bird count of water birds

Pacific Golden Plover *Pluvialis fulva*, Curlew Sandpiper *Calidris ferruginea* and Common Redshank *Tringa totanus* were most abundant in this area. The bird count in April 2014 was high as compared to March 2014 as a large group of Little Cormorant *Phalacrocorax niger* or *Microcarbo niger* started using this area for day roosting (Graph 6). From June to August 2014, only Egrets and Herons were seen. From September 2014 onwards, the bird count gradually increased because of the arrival of migratory birds.

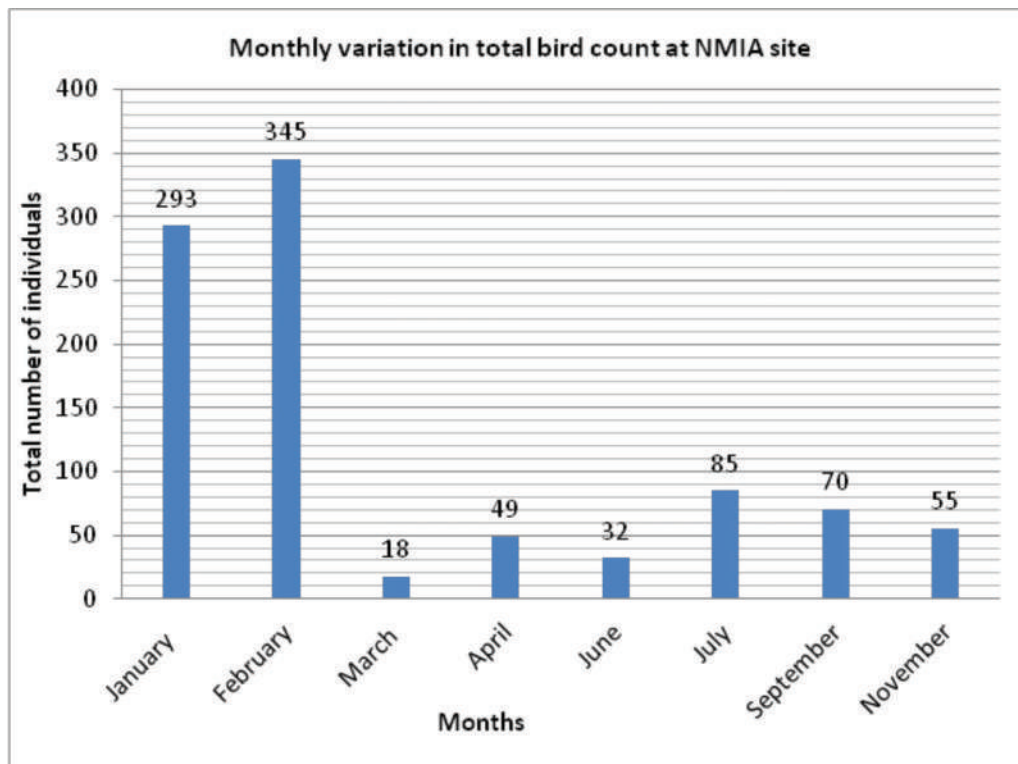


Figure 6: Monthly variation in total bird count of water birds at the proposed NMIA site (creek and wetland combined)

B) Seasonal variation in selected species population

Some bird species were seen using the creek and wetland areas in the early and late winter periods. Pacific Golden Plover *Pluvialis fulva*, Curlew Sandpiper *Calidris ferruginea*, Black-tailed Godwit *Limosa limosa*, Eurasian Curlew *Numenius arquata*, Common Redshank *Tringa totanus* and Little Stint *Calidris minuta* were seen foraging in creek areas during low tide in early winter. Ducks such as Northern Shoveller *Anas clypeata*, Northern Pintail *Anas acuta* and Indian Spot-billed Duck *Anas poecilorhyncha* were seen in the deep water during high tide. The population of Little Stint *Calidris minuta* was high in late winter as compared to the early winter season. During summer and monsoon, we observed low species diversity as well as bird count. Other species such as Painted Stork *Mycteria leucocephala*, egrets and cormorants were seen here occasionally.

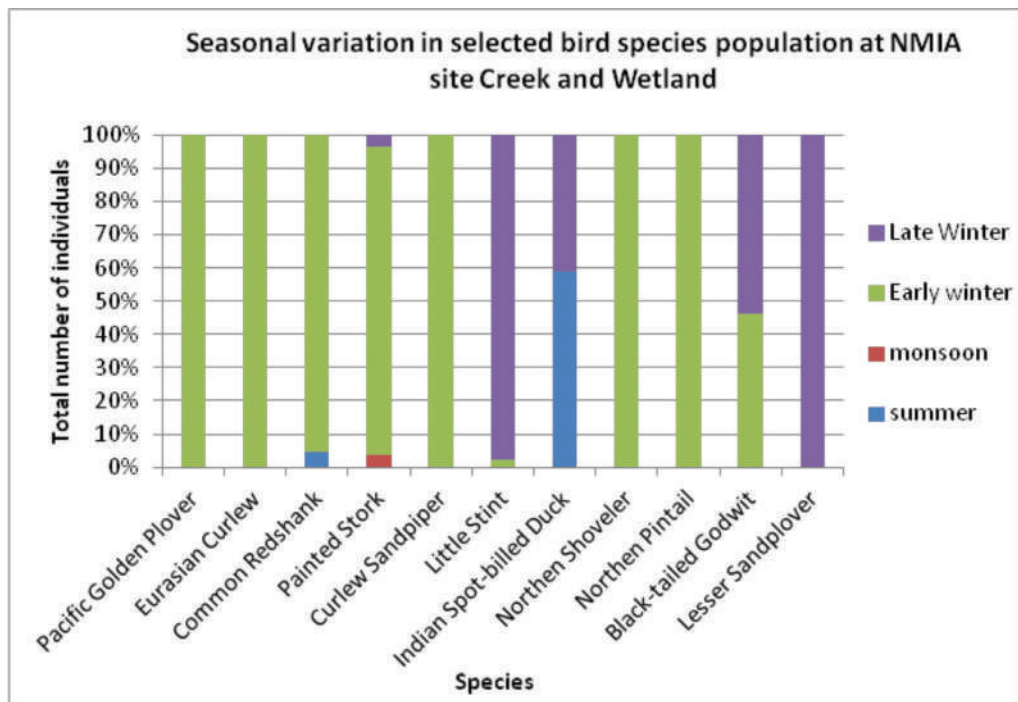


Figure 7: Seasonal variation in population of selected water birds species at the proposed NMIA site (creek and wetland combined)



Flock of waders at NMIA site

PARVEEN SHAIKH

PARVEEN SHAIKH



Cormorants and Storks resting at the proposed NMIA site

SUJIT NARWADE



Birds in flight at the proposed NMIA site

4.2.4 Sonari- Belpada wetland

A) Monthly variation in total bird count

In January 2014, this wetland was occupied by duck species such as Northern Shoveller *Anas clypeata*, Northern Pintail *Anas acuta*, Common Teal *Anas crecca* and Garganey *Anas querquedula*. In February 2014, water level of the wetland decreased and waders such as Marsh Sandpiper *Tringa stagnatilis*, 'Western' Black-tailed Godwit *Limosa limosa*, Common Redshank *Tringa totanus*, Common Greenshank *Tringa nebularia*, Black-winged Stilt *Himantopus himantopus*, Little Stint *Calidris minuta*, Ruff *Philomachus pugnax* and Lesser Sand Plover *Charadrius mongolus* started using shallow water. After March 2014, bird population, especially ducks, started declining as the wetland was almost dried with few leftover puddles. In April 2014, we observed more than 40 Black Kite *Milvus migrans* resting in mud in the dry wetland area. Few individuals of Eastern Cattle Egret *Bubulcus coromandus*, Painted Stork *Mycteria leucocephala*, Little Egret *Egretta garzetta*, Intermediate Egret *Egretta intermedia* and Great Egret *Egretta alba* were here till the wetland completely dried.

After the first shower of rains in June 2014, we observed about 500 Lesser Whistling-duck *Dendrocygna javanica* and 150 Indian Spot-billed Duck *Anas poecilorhyncha* in the wetland for a short duration. We assume that this congregation as a pre-breeding behaviour in Ducks. In July and August 2014, nesting activities of Eurasian Coot *Fulica atra* and Little Grebe *Tachybaptus ruficollis* were seen. In September 2014, a drainage outlet was constructed by the adjoining Speedy Container Yard for removing the water and within a week entire wetland was found empty. The land filling activity got started on the wetland in October 2014, and whole wetland was found land filled in December 2014, resulting into total absence of water birds at this site.

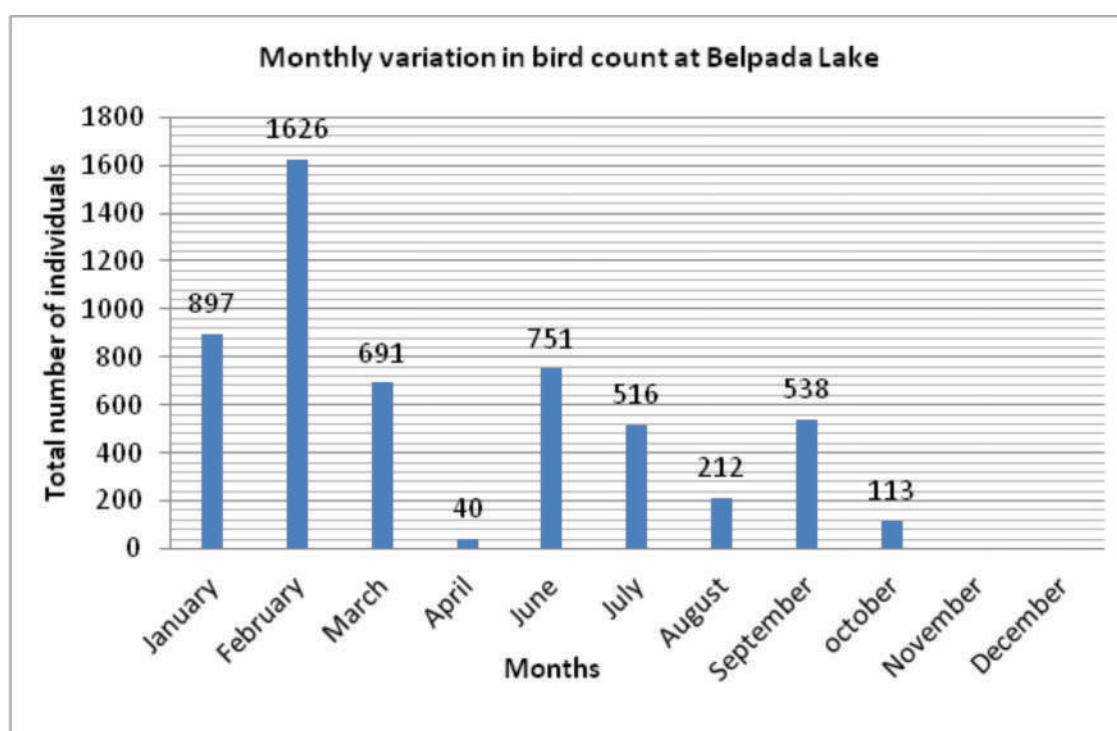


Figure 8: Monthly variation in total bird count at Belpada Lake

B) Seasonal variation in the population of selected bird species

Duck species like Common Teal *Anas crecca*, Northern Pintail *Anas acuta* and Northern Shoveller *Anas clypeata* were seen at NRI Wetland during early winter. These birds were later observed only at Sonari-Belpada wetland. Ducks, coots and water hens were seen using Typha grass for hiding, foraging and nesting. The population of Black-tailed Godwit *Limosa limosa* was 30-40 in summer as compared to more than 150 individuals in winter. Large water birds such as Glossy Ibis *Plegadis falcinellus*, Eurasian Spoonbill *Anas crecca* and Painted Stork *Mycteria leucocephala* were seen throughout the year except the monsoon. A flock of 25-30 Common Redshank *Tringa totanus* was seen overwintering at this site. In monsoon, we observed nesting activities of Lesser Whistling-duck *Dendrocygna javanica*, Indian Spot-billed Duck *Anas poecilorhyncha*, Red-wattled Lapwing *Vanellus Indicus*, Bronze-winged Jacana *Metopidius indicus*, Eurasian Coot *Fulica atra* and Pheasant-tailed Jacana *Hydrophasianus chirurgus*.

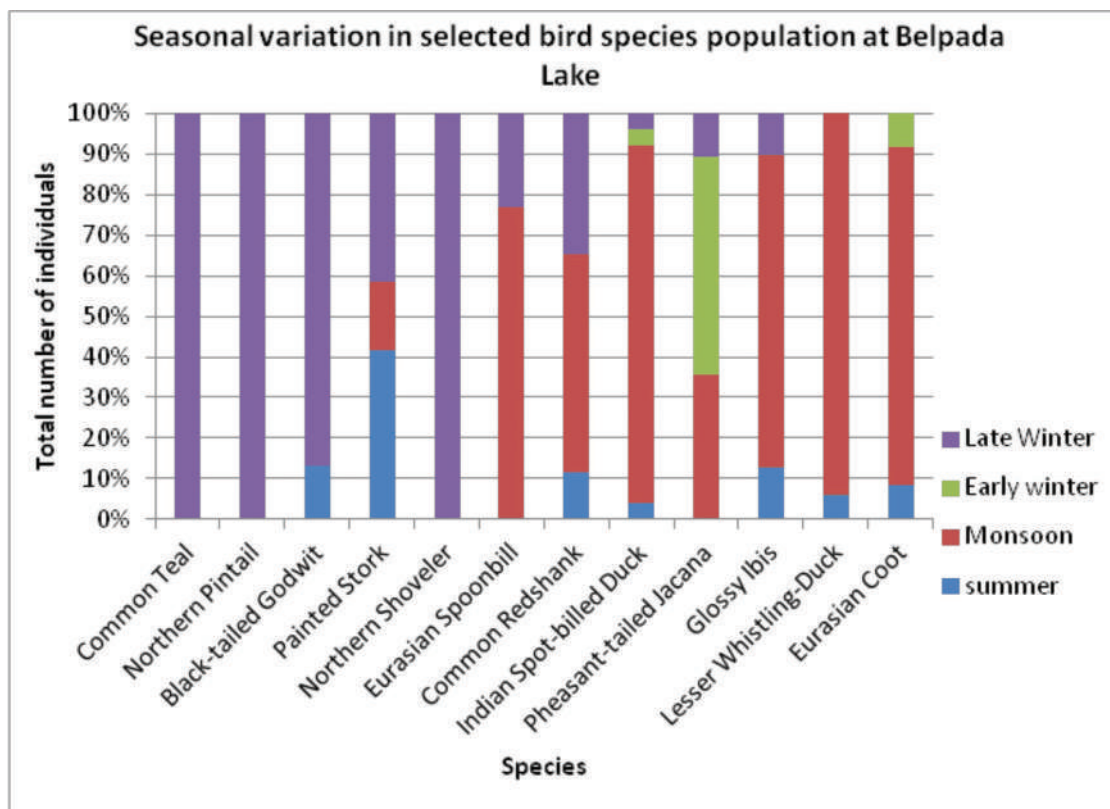


Figure 9: Seasonal variation in the population of selected species at Belpada Lake



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Congregation of ducks at Belpada Lake



PARVEEN SHAIKH

Eurasian Spoonbill foraging at Belpada Lake

4.2.5 Panje, Uran wetland

A) Monthly variation in total bird count

Fluctuations in bird count were observed in the range of 8,000 to 12,000 individuals, during January to April 2014 at Panje wetland because of tide dependent water availability. In May-June of year 2014, we counted a mixed group of 150-200 individuals comprising Lesser Flamingo *Phoeniconaias minor*, Eurasian Curlew *Numenius arquata*, Gull-billed Tern *Gelochelidon nilotica* and Caspian Tern *Hydroprogne caspia*. In July, only a small flock of 30 Greater Flamingo *Phoenicopterus roseus* was seen foraging in the wetland. Arrival of about 100 Black-tailed Godwit *Limosa limosa* was seen in August 2014. We counted more than 40,000 birds in the wetland in September 2014 which reached up to 50,000 to 80,000 individuals in winter season. We observed the majority of the waders using this wetland during high tide. Occasionally, very few birds were counted here during peak high tide because of high water level with no shallow areas for waders.

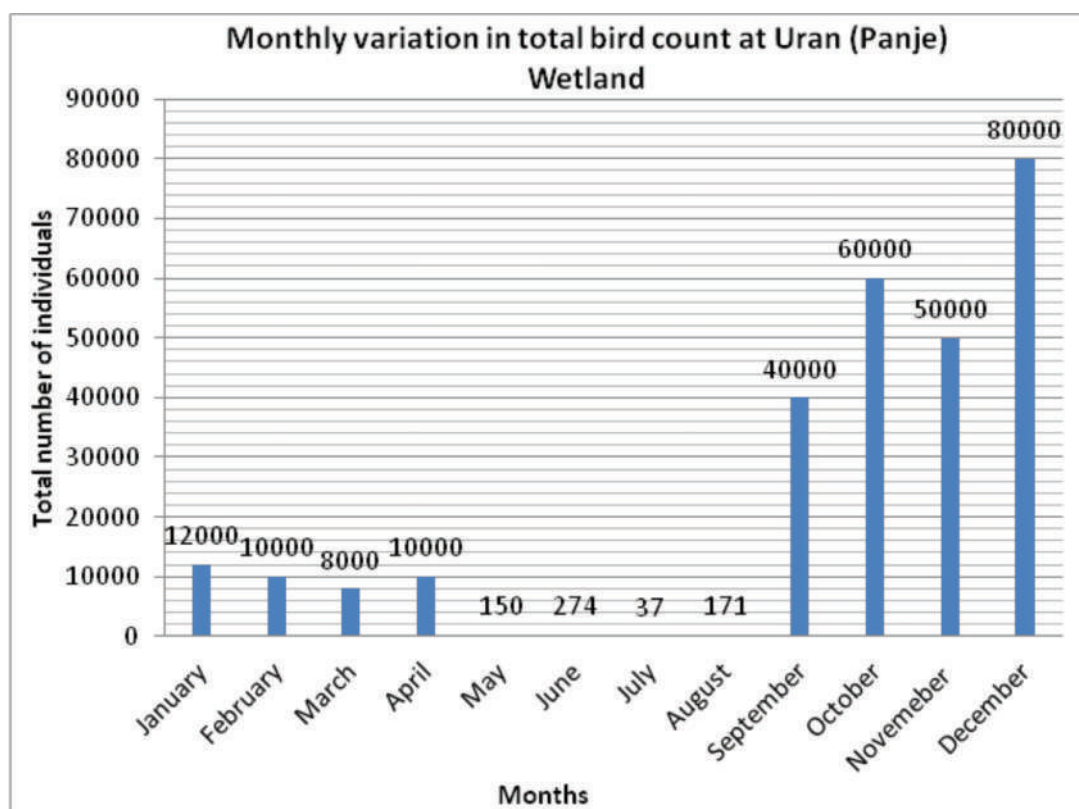


Figure 10: Monthly variation in total bird count at Uran (Panje) Wetland

B) Seasonal variation in the population of selected bird species

In early winter, the arrival of migratory birds was prominently observed at Panje wetland. Large flocks of thousands of waders such as Lesser Sand Plover *Charadrius mongolus*, Curlew Sandpiper *Calidris ferruginea*, Little Stint *Calidris minuta*, Broad-billed Sandpiper *Limicola falcinellus* and Dunlin *Calidris alpina* were seen here. The population of these birds was high in late winter and very low in summer because of water availability. Common Redshank *Tringa totanus* was observed here from early winter to summer, and we counted about 1,000 individuals in late winter. Caspian Tern *Sterna caspia* and Gull-billed Tern *Gelochelidon nilotica* were the other flocking species observed along with the waders.

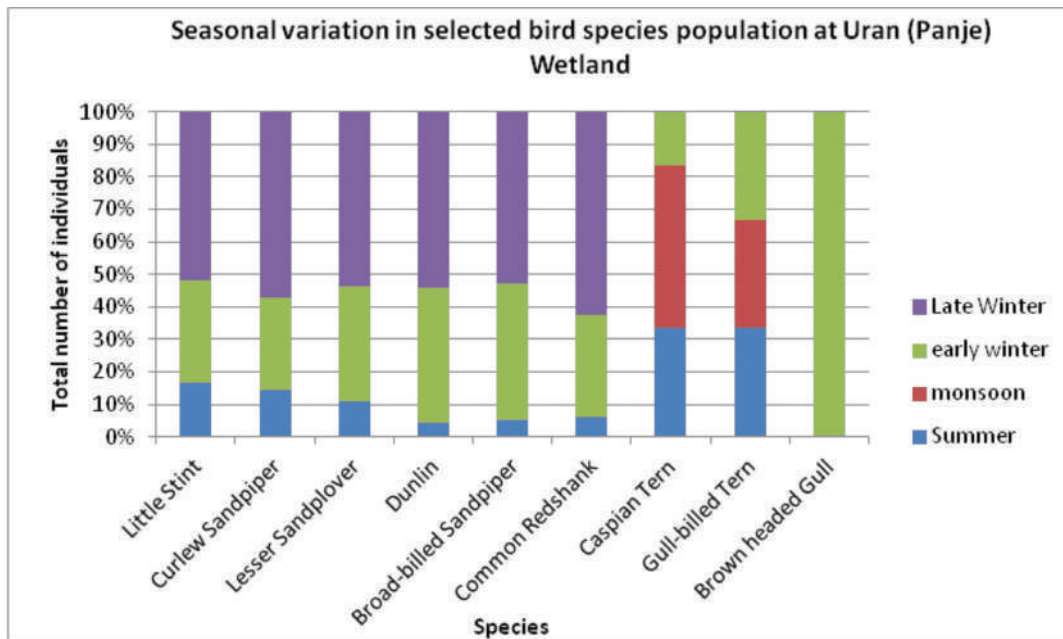


Figure 11: Seasonal variation in the population of selected bird species at Uran (Panje) Wetland



A flock of thousands of waders at Panje Wetland

VIKAS PISAL



PARVEEN SHAIKH

Gulls and terns congregation at Panje Wetland



PARVEEN SHAIKH

Indian Skimmer was often observed at Panje Wetland

4.3 Site wise variation in the population of congregating birds at the selected sites

We have short listed ducks and waders as congregating bird species that may be hazardous to the upcoming airfield operations in future. The species belonging to these groups were seen congregating in flocks of hundreds and thousands individuals and their movement was observed between foraging and resting sites. These birds tend to fly in huge flocks due to which it is necessary to study their daily movement pattern and habitat use.

4.3.1 Population variation observed in Ducks

We selected five species of Ducks, three migratory including Northern Shoveller *Anas clypeata*, Northern Pintail *Anas acuta*, Common Teal *Anas crecca*, and two resident species namely Indian Spot-billed Duck *Anas poecilorhyncha* and Lesser Whistling Duck *Dendrocygna javanica* showing the congregating behaviour. These species were recorded from wetlands at Sonari-Belpada, NRI Complex, Panvel creek, Kharghar creek and Kalundre River. Ducks were seen at NRI wetland during early winter that were later found using Sonari-Belpada wetland during the entire winter season. Sometimes, large flocks of Northern Pintail *Anas acuta* and Northern Shoveller *Anas clypeata* were seen in the deep water of creek and river during high tides. About couple of thousands of ducks were observed at Sonari-Belpada wetland till the arrival of summer. In monsoon, resident ducks were seen foraging, resting and breeding here.

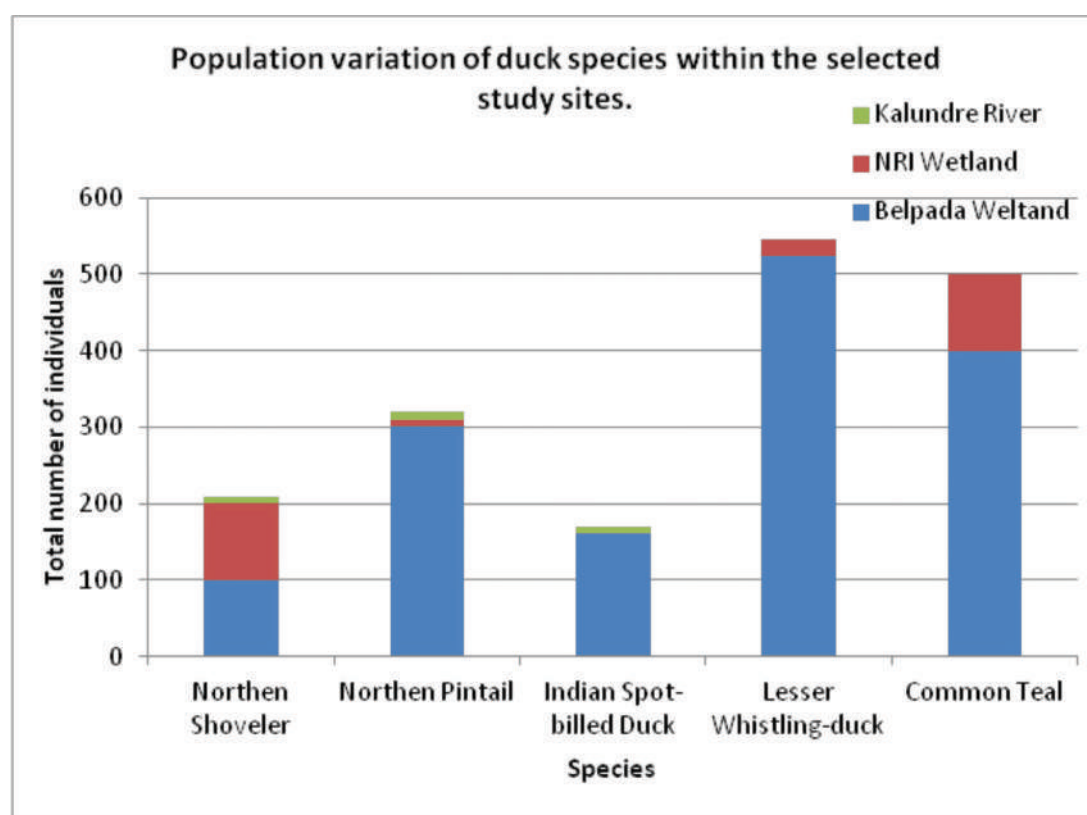


Figure 12: Population variation of duck species at the selected study sites

4.3.2 Population variation observed in waders

We selected five species of waders showing the congregating behaviour for understanding their site preference and population variation. Little Stint *Calidris minuta* and Curlew Sandpiper *Calidris ferruginea* form the major part of the wader population visiting the study area followed by Lesser Sand Plover *Charadrius mongolus*, Broad-billed Sandpiper *Limicola falcinellus* and Dunlin *Calidris alpina*. These waders were seen using Panje, Uran wetland intensively for resting ground during high tide because of its large size, the shortest distance from the shoreline as well as fewer anthropological disturbances. Similarly, pattern of tide dependent movement in birds was seen at wetlands of TSC and NRI but due to continuous attempts of controlling water level by local people, opportunistically birds were seen congregating here.

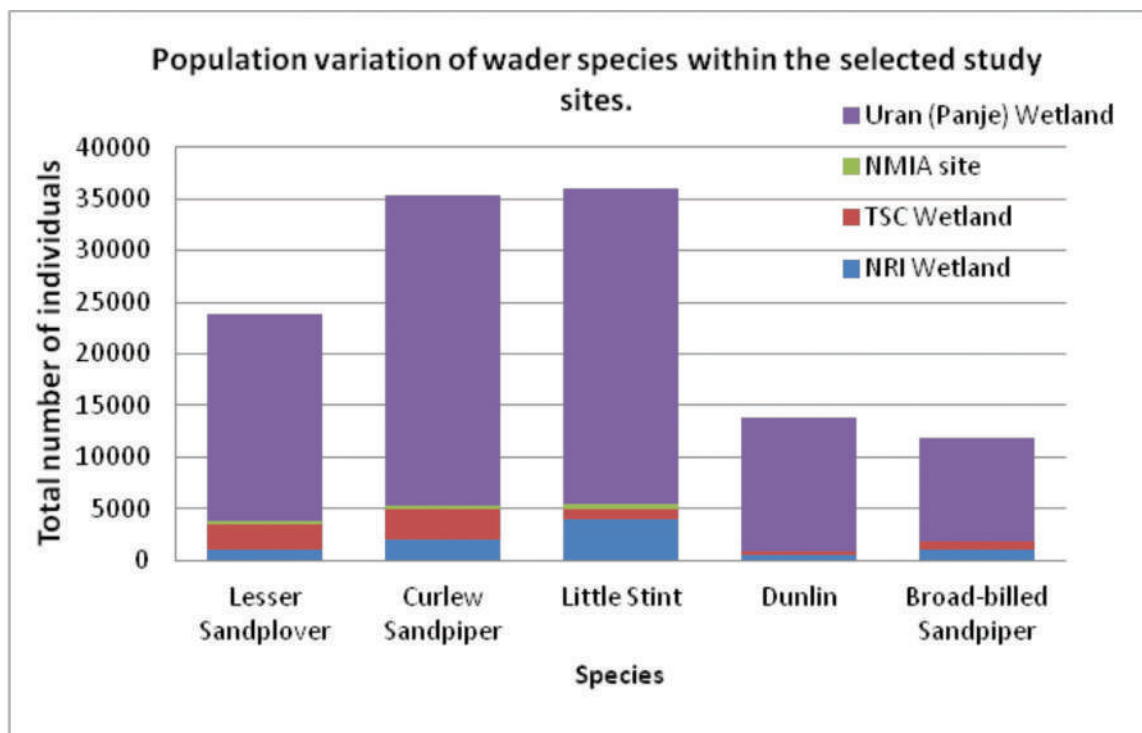


Figure 13: Population variation of wader species at the selected study sites

4.3.3 Population variation observed in Lesser Flamingo *Phoeniconaias minor*

The population of Lesser Flamingo *Phoeniconaias minor* was seen in the range of 100-5,000 individuals at counts taken during various times. They usually had seen foraging on mudflats at low tide and use inland wetlands for resting during high tide. These birds usually arrive in the study area in winter, and their population was found high in late winter. Movement in flamingos was seen from the foraging ground (shore) to resting area (inland wetlands) regularly before two hours of peak high tide times and from wetland to shore before an hour of low tide. Whenever these birds commute between the wetland and shore they fly in a flock of 200-500 individuals. In January 2014, we observed about 3,000-4,000 individuals of Lesser Flamingo at NRI and TSC wetlands. In March 2014, about 6,000 individuals were counted at NRI wetland. During October-November 2014, we recorded about 7,000 individuals at NRI and TSC Wetland.

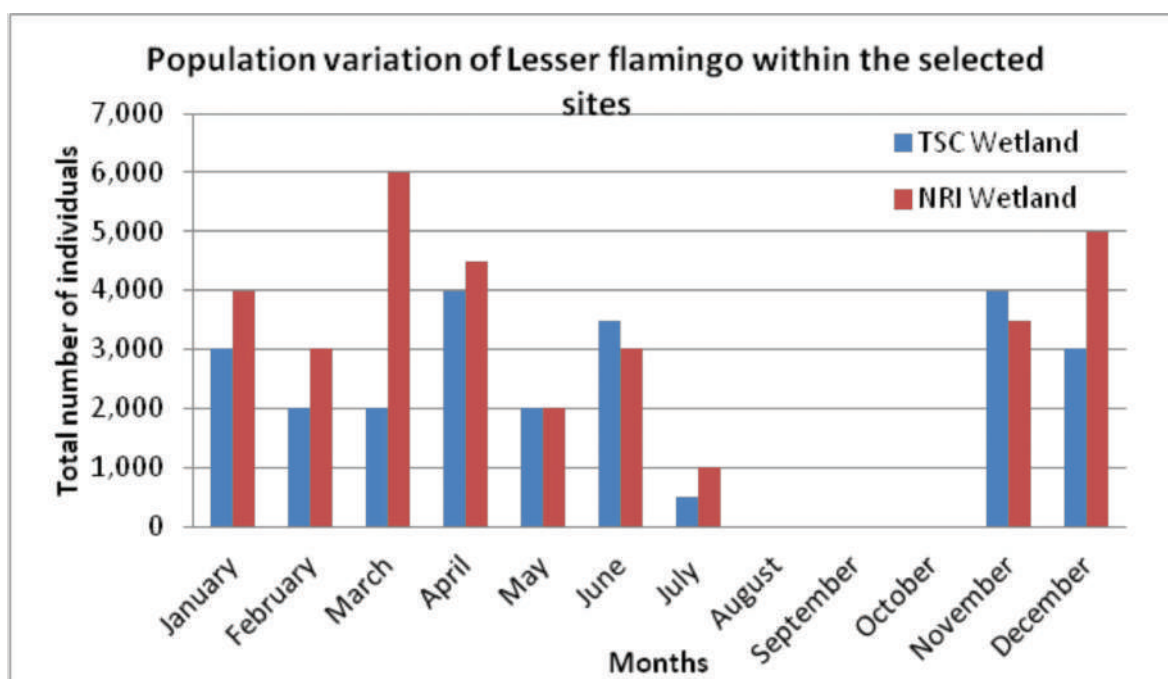


Figure 14: Population variation of Lesser Flamingo *Phoeniconaias minor* at the selected study sites



PARVEEN SHAIKH

Ducks gather at Belpada Lake during winter



PARVEEN SHAIKH

Flocks of Lesser Flamingo usually seen flying towards seashore during low tide and towards TSC Wetland during high tide



PARVEEN SHAIKH

Mixed flock of waders at TSC Wetland

4.4 Observations on the birds in the selected forest areas

All the forest patches shown in Map 1 were visited once every month from January to December in 2014.

4.4.1 Karnala Bird Sanctuary

Karnala Bird Sanctuary is the only Sanctuary protected for birds in the Navi Mumbai area. We monthly visited this site. Bird species such as Common Iora *Agithina tiphia*, Red-vented Bulbul *Pycnonotus cafer*, Red-whiskered Bulbul *Pycnonotus jocosus*, Black-naped Blue Monarch *Hypothymis azurea*, Plum-headed Parakeet *Psittacula cyanocephala*, Brown-headed Barbet *Megalaima zeylonica*, Coppersmith Barbet *Megalaima haemacephala*, Thick-billed Flowerpecker *Dicaeum agile*, Black-headed Oriole *Oriolus xanthornus*, Puff-throated Babbler *Pellorneum ruficeps*, Black Drongo *Dicrurus macrocercus*, Rufous Treepie *Dendrocitta vagabunda*, Oriental Magpie Robin *Copsychus saularis*, Purple-rumped Sunbird *Leptocoma zeylonica*, Purple Sunbird *Cinnyris asiatica*, Crested Serpent Eagle *Spilornis cheela*, Common Kestrel *Falco tinnunculus* were commonly seen here.

During May and June 2014, we observed nesting activities of Thick-billed Flowerpecker *Dicaeum agile*, White-rumped Shama *Copsychus saularis* and Purple Sunbird *Cinnyris asiatica* in the forest areas. In June 2014, we recorded the presence of Jacobin Cuckoo *Clamator jacobinus*, Common Hawk-cuckoo *Hierococcyx varius* and Indian Cuckoo *Cuculus micropterus* with the help of their prominent calls. We also observed some passage migrant and breeding visitors such as Black-backed Dwarf Kingfisher *Ceyx erithaca*, Jacobin Cuckoo *Clamator jacobinus*, Indian Pitta *Pitta brachyura* and Common Hawk-cuckoo *Hierococcyx varius* at Karnala Bird Sanctuary.

4.4.2 Chirner

Forest area of Chirner village consists of plantations and farmlands interspersed with degraded patches of reserved forests. This site is facing threats from anthropogenic activities such as quarrying, farming, firewood collection and cattle grazing in forest areas. Frugivorous birds were observed preferring the fruits of *Carissum sp.*, *Ficus sp.*, *Syzygium jambolanum*. We observed common birds including Black Drongo *Dicrurus macrocercus*, House crow *Corvus splendens*, Indian Black Robin *Saxicoloides fulicatus*, Little-green Bee-eater *Merops orientalis*, Red-whiskered Bulbul *Pycnonotus jocosus*, Common Iora *Aegithina tiphia*, Crested Serpent Eagle *Spilornis cheela* and Common Kestrel *Falco tinnunculus*.

We observed the high activity of birds in fruiting season. We saw 24 individuals of Red-vented Bulbul *Pycnonotus cafer* and 17 individuals of Red-whiskered Bulbul *Pycnonotus jocosus*, eight individuals of Coppersmith Barbet *Megalaima haemacephala*, four Brown-headed Barbet *Megalaima zeylonica* and male Common Iora *Aegithina tiphia* feeding on the fruits of *Carissum sp.* and *Syzygium jambolanum*, four individuals of Tawny-bellied Babbler *Turdoides hypertythra* on the fruits of *Ficus sp.* during an hour of observations on 7th May 2014.

4.4.3 Mosare Forest

We selected a small patch of deciduous reserved forest on top of a hillock that is very adjacent to Karnala Bird Sanctuary by aerial distance. The base of the particular hillock is surrounded by agricultural fields cultivated by the local people. The forest also serves as an important source of firewood for the locals.

Birds such as Indian Jungle Crow *Corvus culminatus*, Black Drongo *Dicrurus macrocercus*, Indian Robin *Saicoloides fulicatus*, Common Iora *Aegithina tiphia*, Thick-billed Flowerpecker *Dicaeum agile*, Little Green Bee-eater *Merops orientalis*, Shikra *Accipiter badius*, Common Kestrel *Falco tinnunculus*, Crested Serpent Eagle *Spilornis cheela*, Vigors' Sunbird *Aethopyga vigorsii*, Red-vented Bulbul *Pycnonotus cafer*, Red-whiskered Bulbul *Pycnonotus jocosus*, Common Tailorbird *Orthotomus sutorius*, Grey-breasted Prinia *Prinia hodgsonii* Brown-headed Barbet *Megalaima zeylonica*, and Coppersmith Barbet *Megalaima haemacephala* were commonly seen at Mosare forest area. We recorded calls of Malabar Whistling Thrush *Myophonus horsfieldi* only during the monsoons.



Asian Paradise flycatcher at Chirner Forest

SUJIT NARWADE



SUJIT NARWADE

Red-whiskered Bulbul at Mosare Forest



SUJIT NARWADE

Vigors Sunbird at Karnala Bird Sanctuary

CHAPTER V

Discussion

Habitat use and movement of birds at the proposed NMIA site suggest specialized study and mechanism to avoid future bird hazard problems. Here we would like to provide the gist of observations based on our three-year study conducted during 2012 to 2014 on the movement of birds seen in the study area for better understanding of the issue.

5.1 Tide dependent movement of birds at Creek and Wetland

A number of coastal shorebirds feed on intertidal mudflats during low tide. At high tide, the birds are usually forced to alternative resting sites, known as high tide roosts. Shorebirds spend much time roosting, and any specific roost may hold a few thousand birds at a time. High-tide roosts tend to be small areas near the coast but above the tide line, a combination of characteristics that makes them vulnerable to human development or disturbance (e.g. Mitchell et. al. 1988).

We are observing high tide roosting of birds, during the October to May period at the wetlands near NRI and TSC on Palm Beach Road and the wetlands in the Uran area. The roosting bird species include Lesser Flamingo *Phoeniconaias minor*, Lesser Sand Plover *Charadrius mongolus*, Greater Sand Plover *Charadrius leschenaultia*, Grey Plover *Pluvialis squatarola*, Eurasian Curlew *Numenius arquata*, Common Redshank *Tringa tetanus*, and Little Stint *Calidris minuta*. These birds were seen moving in flocks from roosting sites to the creeks and open mudflats on the seashore for foraging during low tide and returning during high tide (Map 16 and 17). In our study, we also observed that the birds use different sites in different seasons.

Tide and water level are influential factors, resulting in seasonal variations in the species abundance at roosting and foraging sites. It is known that the choice of a day roost was affected by distance from the foraging area and other micro-climatic conditions (Rogers et. al. 2006). Birds select day roosts closer to the foraging areas while, during the night, birds select safer but more distant roosts (Rogers et al. 2006). It was observed that in communal roosting, birds are benefited by increased ability to spot approaching predators, opportunity to explore new foraging areas (Donald & Clark 1991). It would be necessary to study the long-term impact of rapidly changing environment on the birds in the study area and correlate it with the status of birds in their breeding grounds. It will give an idea about how particular species is doing at local as well as global level.

During the arrival of migratory birds in October each year, as well as during the departure time in April, we recorded a sharp fluctuation in the population of birds in the study area (Narwade et. al. 2012). This indicates that birds use this area on arrival and then later get distributed. It was observed that the birds usually congregate in the shallow waters, and the population of the congregating birds in different roosting

areas is affected by a number of factors. In 2014, we recorded a sudden increase in the population of Lesser Flamingo *Phoenicopterus minor*, especially the juveniles, which indicates a good season for these birds at the breeding site.

The two arms of the Panvel creek fill with water during a high tide, and its surface gets exposed during the low tide. The population of birds in the open creek was observed to be inversely proportionate to the tide level, lower the tide greater the number of birds. Birds were seen foraging in the creek during low tide and later seen resting in the adjoining wetlands during high tide. To further demonstrate the tide dependent movement of birds, we are providing the results of observations carried out on the 10th and the 18th January 2013. We saw decreasing count of birds during high tide to low

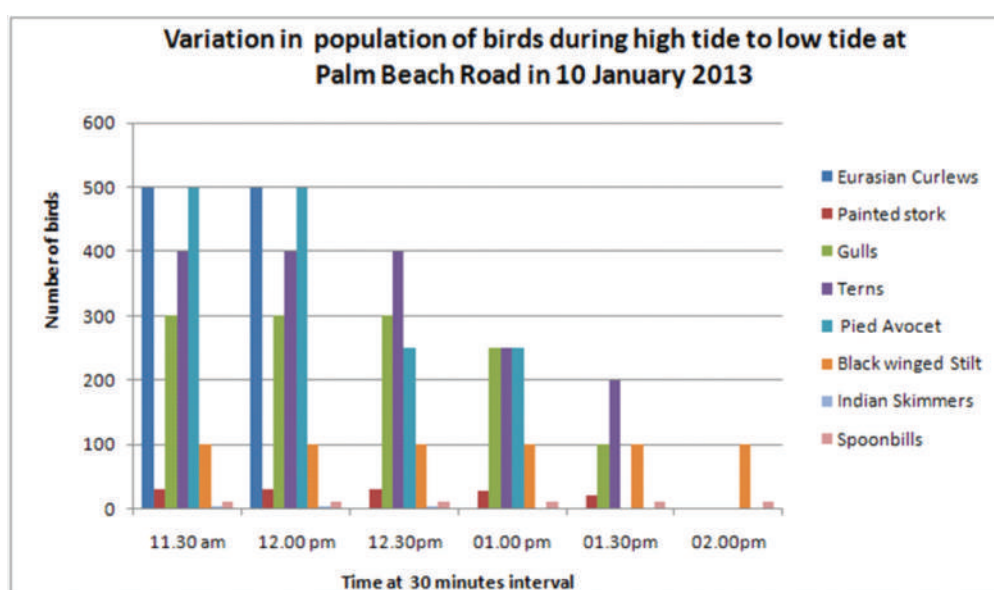


Figure 15: Variation in the population of birds during high tide to low tide period

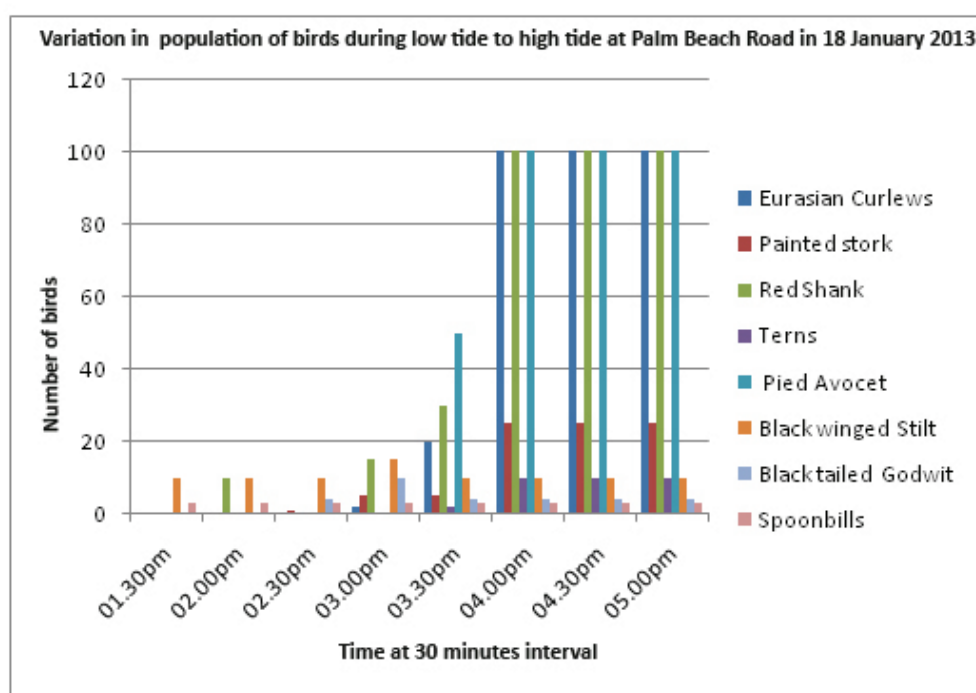


Figure 16: Variation in the population of birds during low tide to high tide period

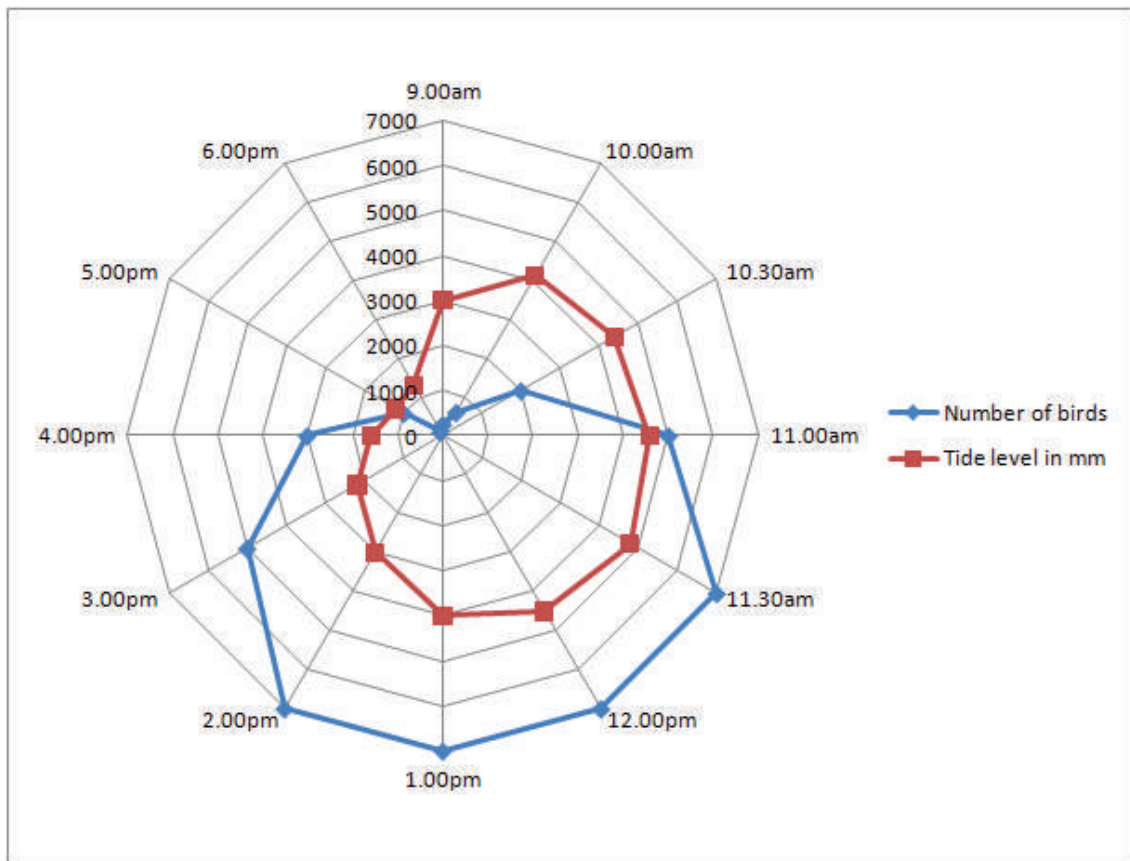


Figure 17: Radar chart showing the time-dependent count of Lesser Flamingo *Phoeniconaias minor*

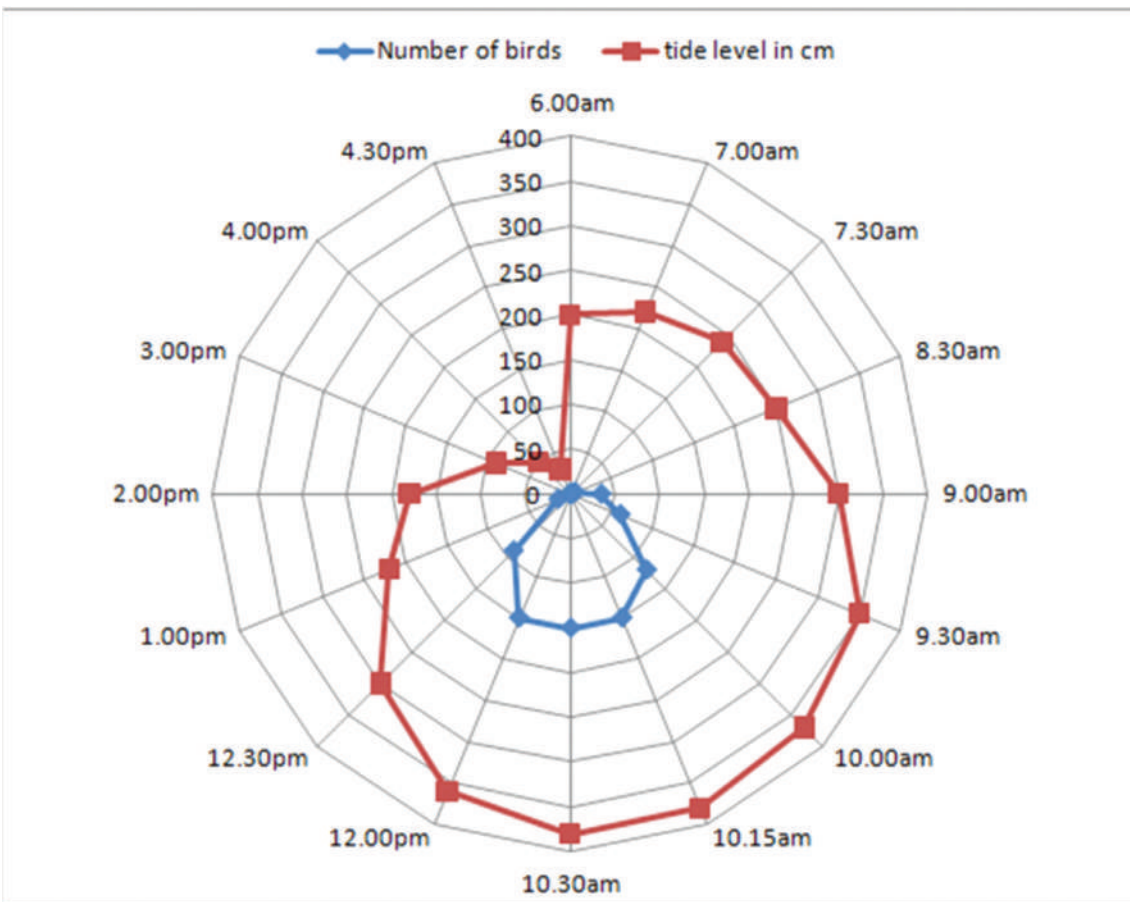
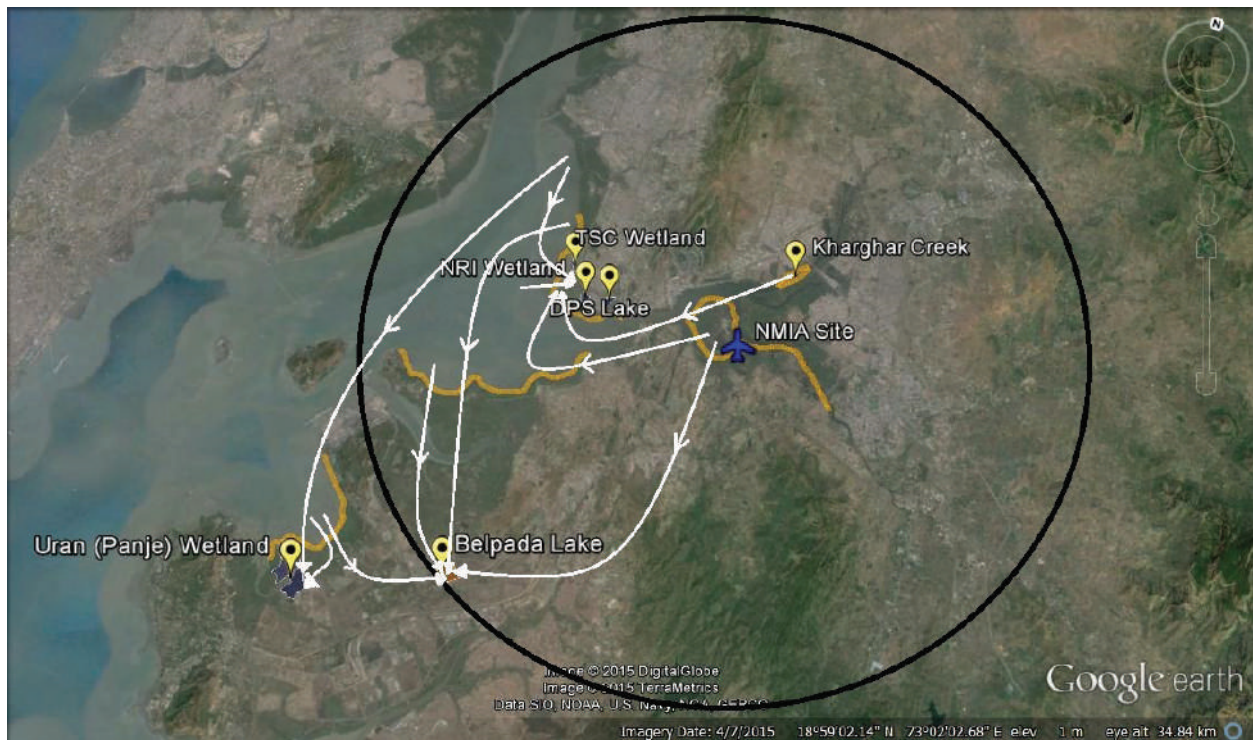
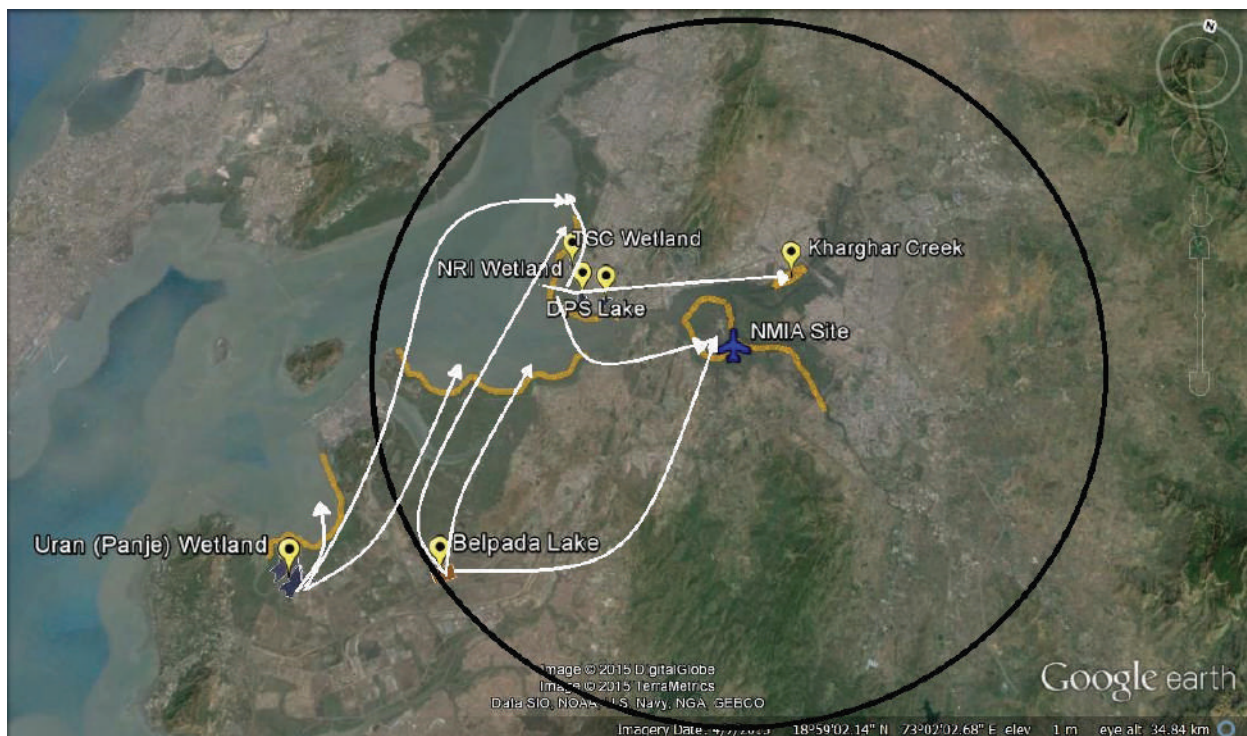


Figure 18: Radar chart showing the time-dependent count in Eurasian Curlew *Numenius arquata*



Map 14: A Google Earth map showing the movement of birds from foraging areas to roosting sites



Map 15: A Google Earth map showing the movement of birds from roosting sites to foraging areas

tide as birds started flying from roosting site to open shore for foraging (Figure 16) and increasing count of birds during low tide to high tide when birds were seen arriving from foraging areas to roosting site (Figure 15). We would like to explain this pattern of tide dependent movement with the help of Radar graphs prepared for count taken for Eurasian Curlew *Numenius arquata* (Figure 18) and Lesser Flamingo *Phoenicopterus minor* (Figure 17).

5.2 Birds using mangrove areas of the proposed NMIA site

Biodiversity is prevalent in the tropical estuarine system, particularly in the intertidal forested vegetation known as Mangrove (Mooney et al. 1995). The mangrove vegetation possesses many structural and physiological peculiarities and is composed of species with strongly marked characterised grouped under 'true mangroves'. There are also plants with less strongly marked characteristics, which are known as semi-mangrove (Tansley & Fritch, 1905). There is yet another group of plants, which grow adjoining the mangrove areas but thrive on the land which does not submerge in brackish water even during the high tides, but can withstand some amount of brackish water stagnation for the short period. These can be grouped as mangrove associated species (Basha, 1992).

The dominant mangroves species found at the proposed NMIA site are *Avicenna marina*, and *Acanthus ilicifolius*. We also documented the mangrove-associated plant species such as Glory Bower *Clerodendrum inerme*, Common Deris *Derris trifoliata*, Sea Purselane *Sesuvium portulacastrum*, Meswak *Salvadora persica*. The dominant mangrove species on the West coast are *Avicennia* sp., which, has high salt tolerance among all the mangrove species. These are shrubby trees with an average height of three to seven metres. The mangroves at the proposed NMIA site provide a habitat for a variety of bird species such as Indian Reed-warbler *Acrocephalus stentoreus*, Plain Prinia *Prinia inornata*, White-eared Bulbul *Pycnonotus leucotis*, Ashy Prinia *Prinia socialis*, Little Egret *Egretta garzetta* and Little Cormorant *Phalacrocorax niger*. We observed seasonal fluctuation in the population of these bird species.

In 2013, we particularly observed Little Cormorant *Phalacrocorax niger* and Little Egret *Egretta garzetta* in the area. Ashy Prinia *Prinia socialis* and Plain Prinia *Prinia inornata* were particularly vocal and were seen perching and flying from one perch to another. Indian Reed Warbler *Acrocephalus [stentoreus] bruniscens* were often heard in the mangroves, with an occasional record in flight. Scaly-breasted Munia *Lonchura punctulata*, Tricoloured Munia *Lonchura malacca* and White-cheeked Bulbul *Pycnonotus leucotis* were often seen in the mangroves.

During winter, we usually observed flocks of Rosy Starling *Sturnus roseus* foraging and roosting in the mangroves. The other birds including Blyth's Reed Warbler *Acrocephalus dumetorum*, Lesser Whitethroat *Sylvia curruca*, Yellow-eyed Babbler *Chrysomma sinense*, Purple Sunbird *Cinnyris asiaticus*, Red Avadavat *Amandava amandava*, White-browed Fantail Flycatcher *Rhipidura aureola*, Common Tailorbird *Orthotomus*

sutorius, Long-tailed Shrike *Lanius schach* and Baya Weaver *Ploceus philippinus* were often seen perching on the mangroves. The raptors such as Black Kite *Milvus migrans*, Black-winged Kite *Elanus caeruleus*, Osprey *Pandion haliaetus*, Booted Eagle *Hieraaetus pennatus* and Western Marsh Harrier *Circus aeruginosus* were observed flying in the skies and perching on the mangroves at the proposed site of NMIA and the adjoining areas.

5.2.1 Bird roosting in the mangroves

Mangroves were seen used for roosting by birds such as Grey Heron *Ardea cinerea*, Purple Heron *Ardea purpurea*, Eurasian Spoonbill *Platalea leucorodia* and Black-headed Ibis *Threskiornis melanocephalus*. During winters, a large number of Rosy Starlings *Pastor roseus* were seen foraging and resting in the mangroves. The birds were often seen foraging on the open mudflats during a low tide at the proposed NMIA site and resting in the Mangroves during a high tide. During monsoon, many water birds were seen foraging in puddles in the adjoining grasslands.

The birds such as Red-vented Bulbul *Pycnonotus cafer*, Red-whiskered Bulbul *Pycnonotus jocosus*, Cattle Egret *Bubulcus ibis*, Indian Pond Heron *Ardeola grayii*, Little Egret *Egretta garzetta* and Purple Sunbird *Cinnyris asiaticus* were often seen moving from grasslands to the mangrove areas. These birds were observed using the grassland areas for foraging and the mangroves for perching. Painted Stork *Mycteria leucocephala*, Eurasian Spoonbill *Platalea leucorodia*, Asian Openbill *Anastomus oscitans*, Grey Heron *Ardea cinerea*, and Purple Heron *Ardea purpurea* were often seen foraging on open mudflats during low tide and roosting in the mangroves during high tide at the proposed NMIA site.

5.2.3 Birds breeding in the mangrove areas

Many bird species use mangroves for resting. The resident bird species often used the mangrove areas for breeding. The higher density of mangroves makes them a secure habitat for a nest and the fledglings. While surveying the mangroves at the proposed NMIA site in June 2014, we observed increased activity of Indian Reed Warbler *Acrocephalus stentoreus*. The birds were continuously calling from various directions. On further investigation, we found that a bird was sitting on the nest and was shaping it to perfection. The cup-shaped nest, made with fine grass blades, was about four feet above the ground on an *Avicennia marina* tree. The nest was well camouflaged in the mangroves. We found a similar nest located about five feet from the first nest. We visited the site again in the subsequent week but due to the thick growth of the mangrove associated plants we could not get close enough to the nest for us to be able to record any observations.

Ashy Prinia *Prinia socialis*, Plain Prinia *Prinia inornata*, Scaly-breasted Munia *Lonchura punctulata*, Baya Weaver *Ploceus philippinus* and White-eared Bulbul *Pycnonotus leucotis* were also seen breeding in the mangroves and associated plants, especially in the monsoon.

5.3 Birds using grassland and shrubland

The small birds such as Larks, Pipits and Buntings used the grass and shrub areas at the proposed NMIA site as the foraging grounds. In the winter of 2013 we observed a flock of 50 Baya Weaver *Ploceus philippinus* and 100 Black-headed Bunting *Emberiza melanocephala* foraging in the grassland and paddy fields at the proposed NMIA site, and roosting in the adjoining mangrove areas. Earlier in the winter of 2012, we recorded about 500 Black-headed Bunting *Emberiza melanocephala* and 500 Baya Weaver *Ploceus philippinus*. In 2014, we saw about 200 Streak-throated Weavers *Ploceus manyar* in the same area. They were seen foraging in the paddy fields and grassland areas at the proposed NMIA site, and roosting in the mangroves in the vicinity. Rufous-tailed Lark *Ammomanes phoenicurus*, Malabar Lark *Galerida malabarica* and Paddy field Pipit *Anthus rufulus* were seen foraging in the grasslands. In the evening larks and pipits were seen roosting on the ground. During winter, Black-headed Ibis *Threskiornis melanocephalus* and Woolly-necked Stork *Ciconia episcopus* were seen roosting the grassland and later moving to adjoining wetlands, in the small groups of about 10 to 12 individuals. We observed a flock of about 30-40 Blue-tailed Bee Eaters *Merops philippinus* a passage migrant species during August-September through 2012 to 2014.

In September 2014, we observed a couple of breeding colonies with about ten nests of Baya Weaver *Ploceus philippinus*. The nests were seen on the trees in the shrubland as well as in the mangrove areas. The Weaver males made the nest – a hanging bag like structure, with a tubular entrance – with closely woven grass blades. We also saw the nests of Red-wattled Lapwing *Vanellus indicus*, made with pebbles arranged on the open ground. The Lapwing parents were observed chasing other birds and animals that came closer to their nests. We observed the hatchlings and the dull coloured chicks later in the season. We recorded a few nests of Scaly-breasted Munia *Lonchura punctulata* and Long-tailed Shrike *Lanius schach* on the *Acacia* sp. Trees.

5.4 Movement of birds from roosting sites to foraging sites

A number of bird species of diverse orders and families, and with a diversity of habits and habitats roost together for at least a part of the year. In a few cases, such social gathering or roosting may be a simple consequence of the paucity of a suitable roosting site forcing the birds to crowd together. However, in a majority of cases communal roosting, the birds associate through some social attraction and do not disperse even if alternative roosting sites available. Some of these social groups merely comprise foraging migratory flocks, which, remain together outside the roosting as well. There are number of bird species that voluntarily form new social groups specifically at the time of roosting (Gadgil Ali, 1975). Aggregation of the roosting individuals are common primates (Anderson, 1998), bats (Lewis, 1995; Wilkinson, 1995), and birds (Eiserer, 1984). In birds, and in other animals as , the adaptive value of communal roosting is not clearly understood. Avian communal roosting is thought to confer benefits in terms of reduced thermo regulation costs, decreased predation risk, and increased foraging

efficiency (Eiserer, 1984; Ydenberg and Prins, 1984) but the results are still controversial (Richner and Hebb, 1996).

Zahavi (1971) has reviewed the problem of the functional significance of roosting in birds. He is inclined to the view that efficiency in food location promoted by the communal roosts acting as information centres (Ward, 1965) is the primary function of communal roosts, while the adaptations against predation are a response to increased predation pressure consequent on the assemblage of birds (Gadgil, 1972). However, mixed roosting need not be mutually beneficial to all the species involved. Thus, the Common Myna *Acridotheres tristis* may benefit from the association of the more aggressive crows, but from the viewpoint of the crows the advantage conferred by the mynas in warning of the approach of predators may not compensate for the disadvantage of making the roost more attractive to predators (Gadgil, 1972). The majority of come together for different reasons. One of the purposes of aggregation is roosting, to spend the night in relative security. We found communal roosting of birds at Mosare village, CDICO Garden at sector 9 of Khanda Colony, Panchshil Rest House of Belapur, near Panvel Railway Station area. We observed that the birds such as Indian Shag *Phalacrocorax fuscicollis*, Little Cormorant *Phalacrocorax niger*, Little Egret *Egretta garzetta* and Intermediate Egret *Ardea intermedia* visited the mangroves for foraging from the tree-roosting areas (Map 14).

It has been studied that the day roost choice was affected by its from the feeding area and other microclimates (Rogers et. al. 2006). Birds select day roosts closer to the feeding areas while, during the night, birds select safer but more distant roosts (Rogers et al. 2006) at Roebuck Bay of Australia. Similarly there was an assessment of the effects of the development on roosting behaviour of water birds in Cardiff Bay and Cardiff Bay Development Corporation (CBDC) which has produced alternative roost sites within the bay to mitigate against the loss of salt marsh (Donald & Clark, 1991a). It was observed that by communal roosting, birds are by increased ability to spot approaching predators, opportunity to explore new feeding areas (Donald & Clark, 1991b). Secure roosts are essential for wading birds and wildfowl.

Conclusion

Need for Cumulative Impact Assessment (CIA) Study and Conservation offsets to be carried out

Study should be conducted to assess cumulative impact of various developmental activities proposed in Navi Mumbai Airport Influence Notified Area (NAINA) which will be covering almost 70 villages adjoining to Navi Mumbai. A new Belapur-Seawood-Uran railway line, Mumbai Trans Harbour Link (MTHL) or Sewri-Nhava Sheva Trans Harbour Link, the extension of Jawaharlal Nehru Port Trust (JNPT) are also proposed in Navi Mumbai and Uran areas. Therefore, need to study the impact of all such developmental activities on birds in Navi Mumbai area is necessary.

The proposed airport is coming in high bird diversity area because of a mixture of habitats such as creeks, seashore, paddy fields, forest, inland wetlands and mangroves. Even the runways are proposed to be developed parallel to the creeks flowing adjacent to the airport area. BNHS has concern over human life and we want to avoid bird strikes at proposed NMIA site. Therefore, attempts should be done to make proposed NMIA site and adjoining areas non-attractive to the birds. However, there is need of providing conservation offsets by developing agency to establish bird sanctuaries on coast and mangroves away from the influence of air traffic. Instead of creating some protected areas as Mangrove Park nearby the airport site we suggest concerned authorities to protect potential areas from study area outside the airport influence region. This will be helpful for managing the nearby landscape of proposed NMIA site to avoid bird hazard problems in future.

It would be interesting to study the long-term impact of rapidly changing environment on the birds in the study area and correlate it with the status of birds in their breeding grounds. It will give an idea about how particular species is doing at local as well as global level. Movement of birds within the airport influence zone would be a concern considering air safety in the future.

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Annexure I						
Checklist of birds observed in the 10 km radius from the proposed NMIA site						
Sr. no.	Common/scientific names	Habitat	WPA schedule	IUCN status	R/M	Sites
	Family Podicipedidae					
1	Little Grebe <i>Tachybaptus ruficollis</i>	W	IV	LC	R	Dastan Phata, DPS Lake
	Family Phalacrocoracidae					
2	Little Cormorant <i>Phalacrocorax niger</i>	W	IV	LC	R/LM	All wetlands
3	Great Cormorant <i>Phalacrocorax carbo</i>	W	IV	LC	R/LM	NRI Wetland
4	Indian Shag <i>Phalacrocorax fuscicollis</i>	W	IV	LC	R/LM	All wetlands
	Family Ardeidae					
5	Eastern Cattle Egret <i>Bubulcus coromandus</i>	W/P	IV	LC	R/LM	All wetlands
6	Intermediate Egret <i>Egretta intermedia</i>	W/P	IV	LC	R/LM	All wetlands
7	Great Egret <i>Egretta alba</i>	W	IV	LC	R	All wetlands
8	Little Egret <i>Egretta garzetta</i>	W/P/C	IV	LC	R/LM	All wetlands
9	Grey Heron <i>Ardea cinerea</i>	W/C	IV	LC	R/LM	All wetlands
10	Indian Pond-heron <i>Ardeola grayii</i>	W	IV	LC	R/LM	All wetlands
11	Purple Heron <i>Ardea purpurea</i>	W/C	IV	LC	R/LM	All wetlands
12	Western Reef-heron <i>Egretta gularis</i>	W/MD	IV	LC	R/LM	Dastan Phata, Sonari-Belpada
13	Black-crowned Night-heron <i>Nycticorax nycticorax</i>	W	IV	LC	R/LM	Kharghar Creek, NRI Wetland, Kalundre River
14	Striated Heron <i>Butorides striata</i>	W	IV	LC	R	Panje
15	Black Bittern <i>Dupetor flavicollis</i>	W	IV	LC	R/LM	NRI Wetland
16	Chestnut Bittern <i>Ixobrychus cinnamomeus</i>	W	IV	LC	R/LM	Mosare, Sonari-Belpada
	Family Ciconiidae					
17	Painted Stork <i>Mycteria leucocephala</i>	W	IV	NT	R/LM	Sonari-Belpada, NRI Wetland
18	Asian Openbill <i>Anastomus oscitans</i>	W	IV	LC	R/LM	Dastan Phata
19	Woolly-necked Stork <i>Ciconia episcopus</i>	W	IV	LC	R	Dastan Phata, Mosare
20	Black Stork <i>Ciconia nigra</i>	W	IV	LC	M	Uran
	Family Threskiornithidae					
21	Black-headed Ibis <i>Threskiornis melanocephalus</i>	W/C	IV	NT	R/LM	All wetlands and mangroves
22	Indian Black Ibis <i>Pseudibis papillosa</i>	W	IV	LC	R/LM	On old Mumbai-Pune highway near shedung village.
23	Eurasian Spoonbill <i>Platalea leucorodia</i>	W	I	LC	R/LM	Jasai, Sonari-Belpada
24	Glossy Ibis <i>Plegadis falcinellus</i>	W	IV	LC	M	Sonari-Belpada
	Family Phoenicopteridae					
25	Greater Flamingo <i>Phoenicopterus roseus</i>	W	I	LC	LM	Sonari-Belpada, NRI Wetland

Checklist of birds observed in the 10 km radius from the proposed NMIA site

Sr. no.	Common/scientific names	Habitat	WPA schedule	IUCN status	R/M	Sites
26	Lesser Flamingo <i>Phoeniconaias minor</i>	W	I	NT	LM	NRI Wetland, Panje, TSC Wetland
27	Greylag Goose <i>Anser anser</i>	W	IV	LC	M	Sonari-Belpada
28	Ruddy Shelduck <i>Tadorna ferruginea</i>	W	IV	LC	M	Sonari-Belpada, Panje
29	Northern Pintail <i>Anas acuta</i>	W	IV	LC	M	Sonari-Belpada
30	Common Teal <i>Anas crecca</i>	W	IV	LC	M	Sonari-Belpada
31	Indian Spot-billed Duck <i>Anas poecilorhyncha</i>	W/C	IV	LC	R	All wetlands
32	Mallard <i>Anas platyrhynchos</i>	W	IV	LC	M	NRI Wetland
33	Garganey <i>Anas querquedula</i>	W	IV	LC	M	Sonari-Belpada
34	Northern Shoveler <i>Anas clypeata</i>	W/C	IV	LC	M	Kharghar Creek
35	Comb Duck <i>Sarkidiornis melanotos</i>	W	IV	LC	R	Dastan Phata
36	Lesser Whistling-duck <i>Dendrocygna javanica</i>	W	IV	LC	R/LM	Dastan Phata, Sonari-Belpada, NRI Wetland
37	Cotton Teal <i>Nettapus coromandelianus</i>	W	IV	LC	R/LM	Dastan Phata
38	Gadwall <i>Anas strepera</i>	W	IV	LC	M	Sonari-Belpada
39	Eurasian Wigeon <i>Anas penelope</i>	W	IV	LC	M	Sonari-Belpada
	Family Accipitridae					
40	Black-winged Kite <i>Elanus caeruleus</i>	All	I	LC	R	All wetlands
41	Black Kite <i>Milvus migrans migrans/govinda</i>	All	I	LC	R	All wetlands
42	Brahminy Kite <i>Haliastur indus</i>	W/P	I	LC	R	Sonari-Belpada, Dastan Phata
43	Black-eared Kite <i>Milvus [migrans] lineatus</i>	W	I	LC	M	Sonari-Belpada
44	Shikra <i>Accipiter badius</i>	All	I	LC	R	
45	White-eyed Buzzard <i>Butastur teesa</i>	F	I	LC	R	Jasai
46	Oriental Honey-buzzard <i>Pernis ptilorhynchus</i>	F	I	LC	R	Mosare
47	Common Buzzard <i>Buteo buteo</i>	F	I	LC	R	Ransai, Chirner
48	Long-legged Buzzard <i>Buteo rufinus</i>	F	I	LC	M	Mosare
49	Western Marsh Harrier <i>Circus aeruginosus</i>	W	I	LC	M	All wetlands
50	Palid Harrier <i>Circus macrourus</i>	W	I	LC	M	Panje
51	Montagu's Harrier <i>Circus pygargus</i>	W	I	LC	M	Panje
52	Crested Serpent-eagle <i>Spilornis cheela</i>	F	I	LC	R/LM	Ransai, Mosare
53	Changeable Hawk-eagle <i>Nisaetus cirrhatus</i>	F	I	LC	R	Ransai
54	Short-toed Snake-eagle <i>Circaetus gallicus</i>	GS	I	LC	R	Chirner road
55	Booted Eagle <i>Hieraaetus pennatus</i>	F	I	LC	M	Mosare
56	Greater Spotted Eagle <i>Aquila clanga</i>	F	I	LC	M	Sonari-Belpada, Mosare

Checklist of birds observed in the 10 km radius from the proposed NMIA site

Sr. no.	Common/scientific names	Habitat	WPA schedule	IUCN status	R/M	Sites
57	Indian Spotted Eagle <i>Aquila pomarina</i>	W	I	VU	R	Sonari-Belpada
58	White-bellied Sea-eagle <i>Haliaeetus leucogaster</i>	W	I		R	Panje
59	Black Eagle <i>Ictinaetus malayensis</i>	F	I		R	Karnala Bird Sanctuary
	Family Falconidae					
60	Common Kestrel <i>Falco tinnunculus</i>	GS	IV	LC	R/LM	Chirner, Sonari-Belpada
61	Peregrine Falcon (Shaheen) <i>Falco peregrinus perigrinator</i>	W	IV	LC	R/LM	Panje
	Family Pandionidae					
62	Western Osprey <i>Pandion haliaetus</i>	W/C	I	LC	M	Kharghar Creek, Sonari-Belpada
	Family Phasianidae					
63	Rain Quail <i>Coturnix coromandelica</i>	P	-	LC	R/LM	Chirner
64	Red Spurfowl <i>Gallus spadicea</i>	F	-	LC	R	Kharghar hills
65	Jungle Bush-quail <i>Perdica asiatica</i>	F	-	LC	R	Ransai, Chirner Road
66	Indian Peafowl <i>Pavo cristatus</i>	F	I	LC	R	Mosare
67	Painted Francolin <i>Francolinus pictus</i>	GS	-	LC	R	Taloja industrial area
68	Grey Francolin <i>Francolinus pondicerianus</i>	GS	-	LC	R	Taloja industrial area
	Family Turnicidae					
69	Barred Buttonquail <i>Turnix suscitator</i>	P	-	LC	R	Chirner
70	Yellow-legged Buttonquail <i>Turnix tanki</i>	P	-	LC	R/LM	Chirner
	Family Gruidae					
71	Demoiselle Crane <i>Grus virgo</i>	W		LC	M	Sonari-Belpada
	Family Rallidae					
72	White-breasted Waterhen <i>Amaurornis phoenicurus</i>	W/C	IV	LC	R	Sonari-Belpada
73	Purple Swampphen <i>Porphyrio porphyrio</i>	W	IV	LC	R	Sonari-Belpada
74	Watercock <i>Gallicrex cinerea</i>	W	IV	LC	R/LM	Sonari-Belpada (In September 2013)
75	Common Moorhen <i>Gallinula chloropus</i>	W	IV	LC	R	Sonari-Belpada
76	Eurasian Coot <i>Fulica atra</i>	W	IV	LC	R/LM	Sonari-Belpada
77	Slaty-breasted Rail <i>Gallirallus striatus</i>	W/C	IV	LC	R	Kharghar Creek, Kalundre River
78	Ruddy-breasted Crake <i>Porzana fusca</i>	W/C	IV	LC	R/LM	Kharghar Creek, Kalundre River
79	Brown Crake <i>Porzana akool</i>	W/C	IV	LC	R	Chirner, Panje

Checklist of birds observed in the 10 km radius from the proposed NMIA site						
Sr. no.	Common/scientific names	Habitat	WPA schedule	IUCN status	R/M	Sites
	Family Jacanidae					
80	Bronze-winged Jacana <i>Metopidius indicus</i>	W	IV	LC	R	Sonari-Belpada
81	Pheasant-tailed Jacana <i>Hydrophasianus chirurgus</i>	W	IV	LC	R/LM	Sonari-Belpada
	Family Rostratulidae					
82	Greater Painted Snipe <i>Rostratula benghalensis</i>	W	IV	LC	R	Sonari-Belpada
	Family Charadriidae					
83	Red-wattled Lapwing <i>Vanellus indicus</i>	ALL	IV	LC	R	All wetlands
84	Lesser Sand Plover <i>Charadrius mongolus</i>	W/MD	IV	LC	M	All wetlands
85	Greater Sand Plover <i>Charadrius leschenaulti</i>	W/MD	IV	LC	M	NRI Wetland
86	Little Ringed Plover <i>Charadrius dubius</i>	W/MD	IV	LC	R	All wetlands
87	Common Ringed Plover <i>Charadrius hiaticula</i>	W/MD	IV	LC	M	Panje
88	Pacific Golden Plover <i>Pluvialis fulva</i>	W/MD	IV	LC	M	Kalundre river, TSC Wetland
89	Kentish Plover <i>Charadrius alexandrinus</i>	W/MD	IV	LC	M	All wetlands
90	Grey Plover <i>Pluvialis squatarola</i>	W/MD	IV	LC	M	NRI Wetland, TSC Wetland
	Family Scolopacidae					
91	Common Snipe <i>Gallinago gallinago</i>	W	IV	LC	M	Sonari-Belpada, Dastan Phata
92	Common Redshank <i>Tringa totanus</i>	W/MC	IV	LC	M	All wetlands
93	Wood Sandpiper <i>Tringa glareola</i>	W/MC	IV	LC	M	All wetlands
94	Common Sandpiper <i>Tringa hypoleucos</i>	W/MC	IV	LC	M	All wetlands
95	Common Greenshank <i>Tringa nebularia</i>	W/RS	IV	LC	M	Sonari-Belpada, NRI Wetland, TSC Wetland
96	Terek Sandpiper <i>Xenus cinereus</i>	W/MC	IV	LC	M	Kharghar Creek, Kopar
97	Green Sandpiper <i>Tringa ochropus</i>	W/MC	IV	LC	M	Sonari-Belpada
98	Marsh Sandpiper <i>Tringa stagnatilis</i>	W	IV	LC	M	All wetlands
99	'Western' Black-tailed Godwit <i>Limosa limosa</i>	W	IV	LC	M	Sonari-Belpada,
100	Eurasian Curlew <i>Numenius arquata</i>	W	IV	LC	M	NRI Wetland
101	Ruddy Turnstone <i>Arenaria interpres</i>	RS	IV	LC	M	TSC Wetland
102	Temminck's Stint <i>Calidris temminckii</i>	W	IV	LC	M	All wetlands
103	Little Stint <i>Calidris minuta</i>	W	IV	LC	M	All wetlands
104	Curlew Sandpiper <i>Calidris ferruginea</i>	W	IV	LC	M	Sonari-Belpada, Dastan Phata, NRI Wetland
105	Broad-billed Sandpiper <i>Limicola falcinellus</i>	W	IV	LC	M	Belpada, NRI Wetland, TSC Wetland
106	Ruff <i>Philomachus pugnax</i>	W	IV	LC	M	Sonari-Belpada, Dastan Phata, Panje

Checklist of birds observed in the 10 km radius from the proposed NMIA site						
Sr. no.	Common/scientific names	Habitat	WPA schedule	IUCN status	R/M	Sites
107	Dunlin <i>Calidris alpina</i>	W	IV	LC	M	Panje
108	Whimbrel <i>Numenius phaeopus</i>	W	IV	LC	M	Sonari-Belpada
	Family Recurvirostridae					
109	Black-winged Stilt <i>Himantopus himantopus</i>	W	IV	LC	R/LM	All wetlands
110	Pied Avocet <i>Recurvirostra avosetta</i>	W	IV	LC	M	Jasai, NRI Wetland
	Family Phalaropidae					
111	Red-necked Phalarope <i>Phalaropus lobatus</i>	W	IV	LC	M	Uran
	Family Laridae					
112	Gull-billed Tern <i>Gelochelidon nilotica</i>	W	IV	LC	M	All wetlands
113	Caspian Tern <i>Sterna caspia</i>	W/C	IV	LC	M	NRI Wetland, TSC Wetland, Panje
114	Saunders' Tern <i>Sterna saundersi</i>	W/C	IV	LC	M	NRI Wetland, TSC Wetland
115	Whiskered Tern <i>Chlidonias hybridus</i>	W/C	IV	LC	M	NRI Wetland, TSC Wetland, Panje
116	River Tern <i>Sterna aurantia</i>	W/C	IV	LC	R/LM	Sonari-Belpada, NRI Wetland, TSC Wetland, Panje
117	White-cheeked Tern <i>Sterna repressa</i>	W	IV	LC	M	Jasai Wetland
118	Slender-billed Gull <i>Larus genei</i>	W	IV	LC	M	NRI Wetland, TSC Wetland
119	Brown-headed Gull <i>Larus brunnicephalus</i>	W	IV	LC	M	All wetlands
120	Common Black-headed Gull <i>Larus ridibundus</i>	W	IV	LC	M	All wetlands
121	Heuglin's Gull <i>Larus fuscus heuglini</i>	W	IV	LC	M	NRI Wetland, TSC Wetland, Panje
122	Pallas's Gull <i>Ichthyiaetus ichthyiaetus</i>	W	IV	LC	M	NRI Wetland, TSC Wetland, Panje
	Family Rynchopidae					
123	Indian Skimmer <i>Rynchops albicollis</i>	W	IV	VU	R/LM	NRI Wetland, Panje
	Family Columbidae					
124	Rock Pigeon <i>Columba livia</i>	All /NH		LC	R	All areas
125	Yellow-footed Green-pigeon <i>Treron phoenicoptera</i>	F	IV	LC	R	Chirner, Mosare
126	Grey-fronted Green-pigeon <i>Treron affinis</i>	F	IV	LC	R	Karnala Bird Sanctuary
127	Laughing Dove <i>Streptopelia senegalensis</i>	All	IV	LC	R	All areas
128	Eurasian Collared-dove <i>Streptopelia decaocto</i>	GS	IV	LC	R	All areas
129	Spotted Dove <i>Streptopelia chinensis</i>	All	IV	LC	R	All areas
	Family Psittacidae					
130	Rose-ringed Parakeet <i>Psittacula krameri</i>	All	IV	LC	R	All areas
131	Plum-headed Parakeet <i>Psittacula cyanocephala</i>	F	IV	LC	R	Karnala Bird Sanctuary

Checklist of birds observed in the 10 km radius from the proposed NMIA site

Sr. no.	Common/scientific names	Habitat	WPA schedule	IUCN status	R/M	Sites
132	Alexandrine Parakeet <i>Psittacula krameri</i>	F	IV	VU	R	Chirner
	Family Cuculidae					
133	Asian Koel <i>Eudynamys scolopaceus</i>	All	IV	LC	R	All areas
134	Greater Coucal (Southern Coucal) <i>Centropus sinensis</i>	All	IV	LC	R	All areas
135	Common Hawk-cuckoo <i>Hierococcyx varius</i>	All	IV	LC	R	Mosare, Ransai
136	Jacobin Cuckoo <i>Clamator jacobinus</i>	F	IV	LC	SM	Chirner, Karnala Bird Sanctuary
137	Indian Cuckoo <i>Cuculus micropterus</i>	F	IV	LC	R	Chirner, Ransai, Mosare
	Family Cuculidae					
138	Blue-faced Malkoha <i>Phaenicophaeus viridirostris</i>	All	IV	LC	R	Mosare
139	Sirkeer Malkoha <i>Phaenicophaeus leschenaulti</i>	All	IV	LC	R	Mosare
	Family Tytonidae					
140	Common Barn-owl <i>Tyto alba</i>	NH	IV	LC	R	
	Family Strigidae					
141	Spotted Owlet <i>Athene brama</i>	F/NH	IV	LC	R	Mosare, Ransai
142	Indian Eagle-owl <i>Bubo bengalensis</i>	NH	IV	LC	R	Jasai
	Family Caprimulgidae					
143	Indian Little Nightjar <i>Caprimulgus asiaticus</i>	A/GS	IV	LC	R	Ransai
144	Indian Jungle Nightjar <i>Caprimulgus indicus</i>	F	IV	LC	R	Ransai
	Family Apodidae					
145	Little Swift <i>Apus affinis</i>	NH		LC	R	All areas
146	Asian Palm-swift <i>Cypsiurus balasiensis</i>	F/NH		LC	R	All areas
	Family Alcedinidae					
147	Lesser Pied Kingfisher <i>Ceryle rudis</i>	W	IV	LC	R	Panje
148	White-throated Kingfisher <i>Halcyon smyrnensis</i>	All	IV	LC	R	All areas
149	Common Kingfisher <i>Alcedo atthis</i>	W	IV	LC	R	All wetlands
150	Black-capped Kingfisher <i>Halcyon pileata</i>	W/F	IV	LC	M	NRI Wetland
151	Black-backed Dwarf Kingfisher <i>Ceyx erithaca</i>	F	IV	LC	BM	Mosare, Karnala Bird Sanctuary
	Family Meropidae					
152	Little Green Bee-eater <i>Merops orientalis</i>	All		LC	R	All areas
153	Blue-tailed Bee-eater <i>Merops philippinus</i>	F/MC		LC	PM	Kharghar Creek, Panje, Sonari-Belpada
154	Blue-cheeked Bee-eater <i>Merops persicus</i>	GS/W		LC	PM	Sonari-Belpada, Panje

Checklist of birds observed in the 10 km radius from the proposed NMIA site						
Sr. no.	Common/scientific names	Habitat	WPA schedule	IUCN status	R/M	Sites
	Family Coraciidae					
155	Indian Roller <i>Coracias benghalensis</i>	All	IV	LC	R	All wetlands areas
156	European Roller <i>Coracias garrulus</i>	All	IV	LC	PM	Panje
	Family Upupidae					
157	Common Hoopoe <i>Upupa epops</i>	MC/GS		LC	R/LM	All areas
	Family Bucerotidae					
158	Indian Grey Hornbill <i>Ocyrceros birostris</i>	F	I	LC	R	Mosare, Ransai
	Family Capitonidae					
159	Coppersmith Barbet <i>Megalaima haemacephala</i>	F	IV	LC	R	Mosare, Ransai
160	Brown-headed Barbet <i>Megalaima zeylonica</i>	F	IV	LC	R	Mosare, Ransai
161	White-cheeked Barbet <i>Megalaima viridis</i>	F	IV	LC	R	All Forest areas
	Family Pittidae					
162	Indian Pitta <i>Pitta brachyura</i>	F	IV	LC	BM	Mosare, Karnala Bird Sanctuary
	Family Picidae					
163	Eurasian Wryneck <i>Jynx torquilla</i>	F	IV	LC	M	Sonari-Belpada
164	Rufous Woodpecker <i>Celeus brachyurus</i>	F	IV	LC	R	Chirner, Karnala Bird Sanctuary
165	Black-rumped Flameback <i>Dinopium benghalense</i>	F	IV	LC	R	Ransai, Karnala Bird Sanctuary
166	Common Flameback <i>Dinopium javanense</i>	F	IV	LC	R	Ransai, Karnala Bird Sanctuary
167	Yellow-fronted Pied Woodpecker <i>Dendrocopos maharattensis</i>	F	IV	LC	R	Mosare, Karnala Bird Sanctuary
168	Heart-spotted Woodpecker <i>Hemicircus canente</i>	F	IV	LC	R	Karnala Bird Sanctuary
169	Indian Pygmy Woodpecker <i>Dendrocopos nanus</i>	F	IV	LC	R	Karnala Bird Sanctuary
	Family Alaudidae					
170	Ashy-crowned Finch-lark <i>Eremopterix griseus</i>	GS	IV	LC	R	Uran
171	Rufous-tailed Lark <i>Ammomanes phoenicurus</i>	All	IV	LC	R	All Grassland areas
172	Malabar Lark <i>Galerida malabarica</i>	ALL	IV	LC	R	All wetlands areas
	Family Motacillidae					
173	Citrine Wagtail <i>Motacilla citreola</i>	W/M	IV	LC	M	All areas
174	Yellow Wagtail <i>Motacilla flava</i>	W/M	IV	LC	M	All areas
175	Grey Wagtail <i>Motacilla cinerea</i>	W	IV	LC	M	All areas

Checklist of birds observed in the 10 km radius from the proposed NMIA site						
Sr. no.	Common/scientific names	Habitat	WPA schedule	IUCN status	R/M	Sites
176	White Wagtail <i>Motacilla alba</i>	W	IV	LC	M	All areas
177	White-browed Wagtail <i>Motacilla maderaspatensis</i>	W	IV	LC	R	All areas
178	Tree Pipit <i>Anthus trivialis</i>	P/GS	IV	LC	M	All areas
179	Paddyfield Pipit <i>Anthus rufulus</i>	ALL	IV	LC	R	All areas
	Family Hirundinidae					
180	Wire-tailed Swallow <i>Hirundo smithii</i>	All	IV	LC	R	All areas
181	Barn Swallow <i>Hirundo rustica</i>	W	IV	LC	M	All areas
	Family Campephagidae					
182	Common Woodshrike <i>Tephrodornis pondicerianus</i>	F	IV	LC	R	Mosare
183	Large Cuckoo-shrike <i>Coracina macei</i>	F	IV	LC	R	Ransai
184	Black-headed Cuckoo-shrike <i>Coracina melanoptera</i>	F	IV	LC	R	Ransai
185	Small Minivet <i>Pericrocotus cinnamomeus</i>	F	IV	LC	R	Mosare
186	Orange Minivet <i>Pericrocotus flammeus</i>	F	IV	LC	R	Ransai
	Family Irenidae					
187	Common Iora <i>Aegithina tiphia</i>	F	IV	LC	R	Ransai
188	Gold-fronted Leafbird <i>Chloropsis aurifrons</i>	F	IV	LC	R	Ransai, Mosare
	Family Pycnonotidae					
189	Red-vented Bulbul <i>Pycnonotus cafer</i>	All	IV	LC	R	All areas
190	Red-whiskered Bulbul <i>Pycnonotus jocosus</i>	F/MC	IV	LC	R	All areas
191	White-eared Bulbul <i>Pycnonotus leucotis</i>	MC	IV	LC	R	All areas
192	White-browed Bulbul <i>Pycnonotus luteolus</i>	F	IV	LC	R	Chirner
	Family Laniidae					
193	Bay-backed Shrike <i>Lanius vittatus</i>	All	IV	LC	R	All areas
194	'Rufous-backed' Long-tailed Shrike <i>Lanius schach erythronotus group</i>	All	IV	LC	R/LM	All areas
195	Southern Grey Shrike <i>Lanius meridionalis</i>	GS	IV	LC	R	Chirner
	Family Muscicapidae					
196	Orange-headed Thrush <i>Zoothera citrina</i>	F	IV	LC	R/LM	Ransai
197	Jungle Babbler <i>Turdoides striatus</i>	F	IV	LC	R	Ransai, Mosare
198	Tawny-bellied Babbler <i>Turdoides hyperythra</i>	F	IV	LC	R	Mosare
199	Yellow-eyed Babbler <i>Chrysomma sinense</i>	F	IV	LC	R	Chirner

Checklist of birds observed in the 10 km radius from the proposed NMIA site

Sr. no.	Common/scientific names	Habitat	WPA schedule	IUCN status	R/M	Sites
200	Indian Scimitar-babbler <i>Pomatorhinus [schisticeps] horsfieldii</i>	F	IV	LC	R	Chirner, Mosare
201	Puff-throated Babbler <i>Pellorneum ruficeps</i>	F	IV	LC	R	Mosare
202	Brown-cheeked Fulvetta <i>Alcippe poioicephala</i>	F	IV	LC	R	Ransai
203	Black Redstart <i>Phoenicurus ochruros</i>	GS	IV	LC	M	Mosare
204	Malabar Whistling-thrush <i>Myophonus horsfieldi</i>	F	IV	LC	R	Ransai
205	Oriental Magpie-robin <i>Copsychus saularis</i>	All	IV	LC	R	All areas
206	Common Stonechat <i>Saxicola torquatus</i>	All	IV	LC	M	All areas
207	Pied Bushchat <i>Saxicola caprata</i>	All	IV	LC	R	All areas
208	Isabelline Wheatear <i>Oenanthe isabellina</i>	GS	IV	LC	M	TSC Wetland
209	Indian Black Robin <i>Saxicoloides fulicatus</i>	All	IV	LC	R	All areas
210	White-rumped Shama <i>Copsychus saularis</i>	F	IV	LC	R	Ransai
211	Bluethroat <i>Luscinia svecica</i>	MC	IV	LC	M	Sonari-Belpada, Kharghar Creek,
212	Blue Rock-thrush <i>Monticola solitaries</i>	GS	IV	LC	M	Karnala Bird Sanctuary
213	Blue-headed Rock-thrush <i>Monticola cinclorhynchus</i>	F	IV	LC	M	Karnala Bird Sanctuary
214	Zitting Cisticola <i>Cisticola juncidis</i>	MC	IV	LC	R	Sonari-Belpada
215	Plain Prinia <i>Prinia inornata</i>	All	IV	LC	R	All areas
216	Ashy Prinia <i>Prinia socialis</i>	All	IV	LC	R	All areas
217	Grey-breasted Prinia <i>Prinia hodgsonii</i>	All	IV	LC	R	Mosare
218	Indian Reed-warbler <i>Acrocephalus [stentoreus] brunescens</i>	MS	IV	LC	R/LM	All mangrove areas
219	Common Tailorbird <i>Orthotomus sutorius</i>	All	IV	LC	R	All areas
220	Lesser Whitethroat <i>Sylvia curruca</i>	GS	IV	LC	M	Panje
221	Red-breasted Flycatcher <i>Ficedula parva</i>	GS/F	IV	LC	M	Mosare
222	Asian Brown Flycatcher <i>Muscicapa dauurica</i>	MC	IV	LC	R/LM	Kopar
223	White-browed Fantail <i>Rhipidura albicollis</i>	MC	IV	LC	R	NRI Wetland
224	White-spotted Fantail <i>Rhipidura albogularis</i>	MC	IV	LC	R	NRI Wetland
225	Grey-headed Canary-flycatcher <i>Culicicapa ceylonensis</i>	F	IV	LC	R/LM	Ransai
226	Asian Paradise Flycatcher <i>Terpsiphone paradisi</i>	F	IV	LC	R/BM	Ransai, Karnala Bird Sanctuary, Chirner
227	Tickell's Blue Flycatcher <i>Cyornis tickelliae</i>	F	IV	LC	R/LM	Ransai, Karnala Bird Sanctuary, Morbe

Checklist of birds observed in the 10 km radius from the proposed NMIA site

Sr. no.	Common/scientific names	Habitat	WPA schedule	IUCN status	R/M	Sites
228	Black-naped Blue Monarch <i>Hypothymis azurea</i>	F	IV	LC	R	Karnala Bird Sanctuary, Morbe
	Family Paridae					
229	Cinereus Tit <i>Parus cinereus</i>	NH	IV	LC	R	Panje
	Family Dicaeidae					
230	Thick-billed Flowerpecker <i>Dicaeum agile</i>	F	IV	LC	R	Ransai, Karnala Bird Sanctuary, Chirner.
231	Pale-billed Flowerpecker <i>Dicaeum erythrorhynchos</i>	F	IV	LC	R	Ransai, Karnala Bird Sanctuary, Chirner.
	Family Nectariniidae					
232	Purple Sunbird <i>Cinnyris asiatica</i>	All	IV	LC	R	Ransai, Karnala Bird Sanctuary, Chirner.
233	Purple-rumped Sunbird <i>Leptocoma zeylonica</i>	GS	IV	LC	R	Ransai, Karnala Bird Sanctuary, Chirner
234	Small Sunbird <i>Leptocoma minima</i>	F	IV	LC	R	Ransai
235	Vigors' Sunbird <i>Aethopyga vigorsii</i>	F	IV	LC	R	Ransai
236	Loten's Sunbird <i>Cinnyris lotenius</i>	F	IV	LC	R	Karnala Bird Sanctuary
	Family Emberizidae					
237	Red-headed Bunting <i>Emberiza bruniceps</i>	GS	IV	LC	M	NMIA
238	Black-headed Bunting <i>Emberiza melanocephala</i>	GS	IV	LC	M	NMIA
	Family Fringillidae					
239	Common Rosefinch <i>Carpodacus erythrinus</i>	GS	IV	LC	M	Mosare
	Family Estrildidae					
240	Indian Silverbill <i>Euodice malabarica</i>	P	IV	LC	R	All areas
241	Red Avadavat <i>Amandava amandava</i>	W/MC	IV	LC	R	Sonari-Belpada, TSC Wetland
242	Tricoloured Munia <i>Lonchura Malacca</i>	MC	IV	LC	R	Kharghar Creek, TSC Wetland
243	Scaly-breasted Munia <i>Lonchura punctulata</i>	MC/F	IV	LC	R	Kharghar Creek, TSC Wetland, Mosare
244	White-rumped Munia <i>Lonchura striata</i>	F	IV	LC	R	Mosare
	Family Passeridae					
245	House Sparrow <i>Passer domesticus</i>	All	IV	LC	R	All areas
246	Baya Weaver <i>Ploceus philippinus</i>	All	IV	LC	R	All areas
247	Black-breasted Weaver <i>Ploceus benghalensis</i>	All	IV	LC	R	All areas
248	Yellow-throated Sparrow <i>Petronia xanthocollis</i>	F/GS	IV	LC	R	Uran, Mosare

Checklist of birds observed in the 10 km radius from the proposed NMIA site

Sr. no.	Common/scientific names	Habitat	WPA schedule	IUCN status	R/M	Sites
	Family Sturnidae					
249	Rosy Starling <i>Sturnus roseus</i>	All	IV	LC	M	Sonari-Belpada, Kharghar Creek,
250	Brahminy Starling <i>Temenuchus pagodarum</i>	GS	IV	LC	R	All areas
251	Grey-headed Starling <i>Sturnia malabarica</i>	GS	IV	LC	R/LM	TSC Wetland
252	Malabar White-headed Starling <i>Sturnia blythii</i>	GS	IV	LC	R	TSC Wetland
253	Asian Pied Starling <i>Gracupica contra</i>	GS	IV	LC	R	All areas
254	Common Myna <i>Acridotheres tristis</i>	All	IV	LC	R	All areas
255	Jungle Myna <i>Acridotheres fuscus</i>	All	IV	LC	R	All areas
	Family Oriolidae					
256	Indian Golden Oriole <i>Oriolus kundoo</i>	All	IV	LC	R/LM	All areas
257	Black-hooded Oriole <i>Oriolus xanthornus</i>	F	IV	LC	R	Ransai
258	Black-naped Oriole <i>Oriolus chinensis</i>	F	IV	LC	M	Ransai
	Family Dicruridae					
259	Black Drongo <i>Dicrurus macrocercus</i>	All	IV	LC	R	All areas
260	Ashy Drongo <i>Dicrurus leucophaeus</i>	F	IV	LC	M	Ransai
261	Bronzed Drongo <i>Dicrurus aeneus</i>	F	IV	LC	R	Karnala Bird Sanctuary
262	White-bellied Drongo <i>Dicrurus caerulescens</i>	F	IV	LC	R	Ransai
263	Greater Racket-tailed Drongo <i>Dicrurus paradiseus</i>	F	IV	LC	R	Ransai, Karnala Bird Sanctuary
	Family Corvidae					
264	House Crow <i>Corvus splendens</i>	NH	V	LC	R	All areas
265	Indian Jungle Crow <i>Corvus [macrorhynchos] culminatus</i>	All	IV	LC	R	All areas
267	Rufous Treepie <i>Dendrocitta vagabunda</i>	F	IV	LC	R	Mosare

R: Resident; M: Winter Migrant; LM: Local Migrant; SM: Summer Migrant; BM: Breeding Migrant; PM: Passage Migrant

Annexure II

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