Third trimonthly report of the Avifaunal survey carried out in 10 km radius area of Navi Mumbai International Airport (NMIA)

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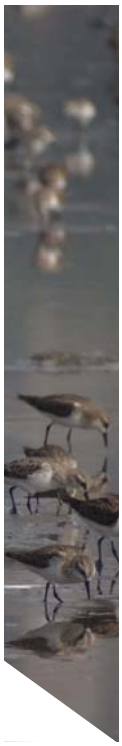


Third Tri-monthly report of the Avifaunal survey carried out in 10 km radius area of Navi Mumbai International Airport (NMIA)

Summary

The avifaunal surveys were carried out during June to August 2012, in 10 km radius area of proposed Navi Mumbai International Airport (NMIA). Study period was monsoon season. Most of the creeks and coastal areas were inaccessible because of water logging, tall monsoon vegetation and heavy rains. This report is mainly focussed on review of bird hazard problems in world as well as in India. We also included information on flocking and congregating birds which may be problem birds according to air safety.

Keywords: Navi Mumbai International Airport, Avifauna, winter, summer, Wetlands

Chapter 1) Review of Bird Hazard problem Worldwide & India

I) Introduction to the Wildlife Strike Problem

Throughout history, humans have been intrigued and inspired by the beauty of birds and their ability to fly. Birds first took to the air about 150 million years ago. Humans first began to share their airspace only 100 years ago. Unfortunately, when aircraft and birds attempt to use the same airspace at the same time, collisions occur (Jayarathna, 2011).

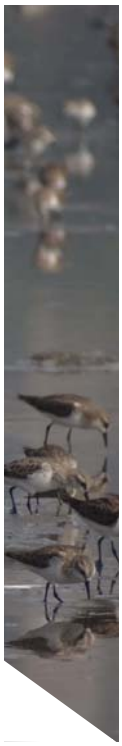
Bird strikes have been a concern to aviation safety from the early days of powered flight. The first fatality due to a bird strike was caused in 1912 when a Wright Flyer encountered a flock of gulls whilst conducting a demonstration flight along a beach. The investigation found that one of the gulls had jammed the rudder control causing the aeroplane to dive into the surf, breaking the pilot's neck (Maragakis, 2009).

Highest number of accidents occurred during the take-off phase (48%), followed by the approach (30%) and the en-route phase (15%) (including the phases of climb and descent).During the take-off phase (acceleration and lift-off) an aircraft is more susceptible to partial or total loss of control if a bird strike does occur, compared to other phases of flight. In regard to the type of bird species involved in the accidents, only for 60% of the accidents species of concern were known. The majority of birds involved were flocks of large birds (45%) followed by strikes from single large birds (31%) such as geese, ducks, cormorants, hawks etc (Maragakis, 2009).

Bird Strikes in the Asia/Pacific Region

- Bird Strike statistics for the Asia/Pacific regions collected from a total of 6996 bird strikes and reported by eighteen states in the Asia/Pacific region during the 1996 to 2006. Bird strikes occurred throughout the year with two peak periods – April/May and September/October. The months with least reported strikes were February and July (Jayarathna, 2011).
- Bird strikes were reported to be most prevalent during day/light conditions and at night, where 61% and 29% respectively of the cases were reported.
- 10% of the cases were reported during the hours of dawn and dusk.

In 88% of call cases, pilots received no prior warning about impending bird strikes. A great majority of aircraft (88%) collided with (1) bird with another 12% having struck between 2 and 10 birds. There were 2 cases where pilots reported having struck flocks with more than 100 birds.



Bird type unreported in 3799 cases (54%), small perching birds struck most frequently with 816 strikes (12%), birds of prey were second with 742 strikes (11%), shore birds accounted for 613 strikes (9%), other types of birds including parrots, heron, gulls accounted for 14% strikes (Jayarathna, 2011)

Importance of wild life/Bird hazard management

Collisions between aircraft and avifauna are a concern throughout the world because they threaten passenger's safety (Thrope, 1977); result in loss of revenue and costly repairs to aircraft (Milsom & Horton, 1990) and can also erode public confidence in the air transport industry as a whole (Conover, et. al 1995). Most wildlife strikes do not result in fatalities but safety hazards exist and the proportion of wildlife strikes that result in damage is substantial. Bird strike is widely regarded with increasing concern, for reasons including the rising populations of certain hazardous species and the replacement of turboprop fleets by jets (Nicholls & Bell, 2005).

The hazard has become more severe as aircraft speed has increased. This is because though birds are relatively small in comparison to modern aircraft, the impact energy in collisions increases with the square of the relative impact speed (CAA UK - SRG, 2002). Aircraft collisions with wildlife, also commonly referred to as bird strikes, annually cost the civil aviation industry at least US$ 1.3 billion in direct damage. Although the economic costs of wildlife strikes are extreme, the cost in human lives lost when aircraft crash as a result of strikes best illustrates the need for management of the bird strike problem. The presence of wildlife (birds and animals) on and in the aerodrome vicinity poses a serious threat to aircraft operational Safety (Jayarathna, 2011).

II) Recognizing Hazardous Wildlife Attractants on or Near Airports

Wildlife is attracted to airports because, Airports provide food, Habitat, Shelter, Water and secure environment (Jayarathna, 2011)

A) Food

Birds are attracted to airports because of availability of rodents, birds, and other small animals as food that is harbored by tall, poorly maintained grass stands and borders. Occasionally, food becomes available through careless waste disposal practices by restaurants and airline flight kitchens. Many airports have inadequate garbage disposal systems that permit access to various food items. Nearby landfills or sewage outlets may also provide food for birds and other wildlife. Landfills are often located on or near airports because both are often built on publicly owned lands. Landfills contribute to bird strike hazards by providing food sources and loafing areas that attract and support thousands of crows, mynas, egrets and other species

Solution: Grass stands and borders should be maintained and improvement in waste disposal practices.

B) Water

Birds of all types are drawn to open water for drinking, bathing, feeding, loafing, roosting, and protection. Rainy periods provide temporary water pools at many airports. Many airports have permanent bodies of water near or between runways for landscaping, flood control, or wastewater purposes. These permanent sources of water provide a variety of bird foods, including small fish, tadpoles, frogs, insect larvae, other invertebrates, and edible aquatic plants.

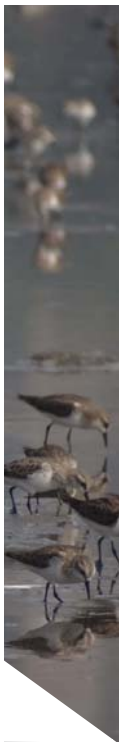
Solution: Remove unnecessary open water or use methods such as netting, floating bird balls.

C) Cover

Birds need cover for resting, loafing, roosting, and nesting. Trees, brushy areas, weed patches, shrubs, and airport structures often provide suitable habitat to meet these requirements. Almost any area that is free from human disturbance may provide a suitable roosting site for one or more species of birds.

Solution: Remove unnecessary cover/regular trimming- to reduce small bird population at Airports.

Wildlife Attractants (FOOD) in the 10 km radius area from the proposed NMIA site



Glossy Ibis probing in mud for food

Foraging sites for Flamingos

Pied Starling on Garbage dump

Dumping sites attract birds such as kites and other animals for food

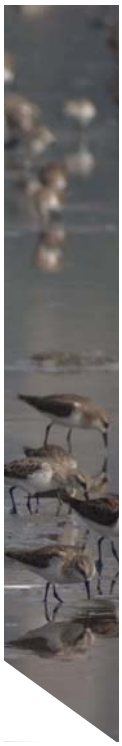
Insects are food attractant for many birds

Crows and egrets are often attracted to garbage for scavenging

Wildlife Attractants (WATER) in the 10 km radius area from the proposed NMIA site

Invertebrates in permanent pool of water attract birds feeding on them

Water in tiny water pools is used for drinking purpose



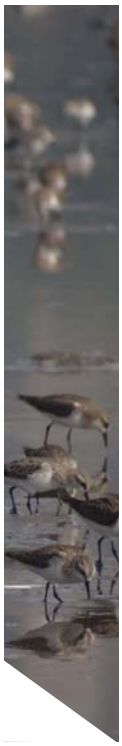
Temporary pools provide water for bathing

Water bodies act as roosting sites for many birds

Roosting sites for Lesser whistling Ducks

Tall Grasses often provide suitable habitat for small birds which in return attract Raptors

Cormorants roosting sites are often seen in shallow water bodies having small bushes in between



III) Remedial Measures used to avoid bird hazard in all over the world

(Anon, 1988)

Action should be lead by some preliminary study of bird species seen on specific airport which should also encompass data on migratory or resident birds, increase or decrease in population of birds, movement of the bird in particular area.

Measures could be divided into 2 categories such as Ecological and Scaring.

Ecological methods: Long term prevention of the risk. Most of the measures are of general use & could be considered as first step.

Scaring methods: It covers different technical measures. Necessity of ecological background research before applying any methods should be always kept in mind.

A) Ecological measures

I. Measures implemented under National rules & Regulations

1) Garbage dumps in vicinity of Airport: At airports all garbage, must nowadays be covered with soil. For example in Sweden according to building law new construction are not allowed to be located in a way that they interfere with earlier establishment and activities originating from them.
2) National/Local regulations which prevent breeding pigeons or racing of homing pigeons in vicinity of Airports.
3) Regulation that prevent the use of land within a certain distance from any runways. For example in Belgium zones of 150 m from the centre line of each runway and 60m over both ends of each runway may not be use for agriculture & in case of military airport 30m from the edge of the runways and 50m from the edge of the taxiways may not be used for agriculture.
4) Airport operational standards for Bird Hazard control (BHC): Operational Standard for BHC should be based upon research report published. For example NRCAC (National research council associate committee), suggested some measures as mentioned below:
    i. Land which is within 1200 ft. of any runway centre line or runway end and within infield area shall not be used for

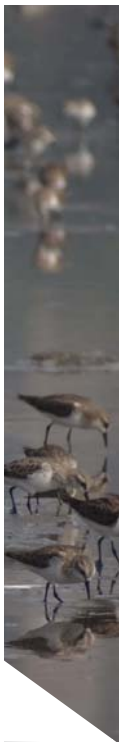
the grazing of dairy cattle/ beef /other animals.

ii. No trees shall be allowed on land within 500 ft. of runway centre line as well as runway ends

iii. For those airports where the average number of bird strike over the previous 5 yrs is greater than 5 strikes a year, there shall be no agricultural leases for the use of land within 1200 ft. of runway centre line/runway ends. For example in Czechoslovakia if Airports belong to non hunting ground the airport authority is obliged to ask for a permission to shoot animals at the airport exceptionally. In Denmark zones of 600 m from the border of the runway may not be used for agriculture. Exceptions have been made for private owned land to a distance of 300 m from the border of the runway. In South Africa within airport boundaries, the airport authorities have complete control of land usage. Outside the airport area, the relevant authorities have powers to zone land usage in accordance with proclaimed noise contours. In addition, local authorities can control the use to which land in the areas under their jurisdiction is put, in accordance with two planning principles. The civil aviation authority is thus dependent on the authorities mentioned above for influencing land use but usually receives full co-operation from them in this respect. While in Switzerland no sheep grazing within 150-200 m on both the sides of runways. Grass has to be kept longer than 10-12 cm within three stripes. No natural fertilizer within the confines of the airport.

II. Implemented under Local Rules or Actions

1) Rules regarding the existence of trees and bushes in the vicinity of airport India: section 9-A of Indian Aircraft (1934) empowers the central Government to restrict construction of buildings and growing of trees within 20 km, from the aerodrome reference point. However, the government can enforce such a restriction only after issuing a notification in the official Gazette, which is yet to be done. The International Airports authority of India (IAAI) actively helps in bird hazard prevention measures.



2) Sanctuaries in the vicinity of Airports. For example in Denmark in 1970 about 37000 pairs of Herring gulls *Larus argentatus* were breeding on the island Saltholm, 5 km from the airport of Copenhagen. In 1969 the airport authorities in close co-operation with ornithologists and the department of nature conservation started an attempt to reduce the size of the colony. Every year since then the nests in the colony have been sprayed with an emulsion of oil in water. The oil closes the pores of the eggs and the embryos are killed, but the adults continue to incubate the eggs. One effect has been that the colony produces very few young birds, and since young gulls are more likely to hit the aircraft than adults, this should cause a reduction in gull strikes in the airport. In fact, the statistics show a much lower proportion of strikes with young Herring Gulls than with young gulls of other species. Herring population was decrease to about 20,000 pair during the first 4-5 yrs. A dead herring with chloralose tablet were used as bait for gulls.

3) Length of the grass along the runways: Grass height is generally kept within 15-20 cm, but in grassland areas management of species. Such as *Falco tenenculus* has become tricky.

B) Scaring measures

1. Distress calls/ Emergency calls: These calls are tape carefully and played either via fixed station or established on mobile units.

- Acoustic device: Such device reproduces the language of the birds either real or synthetic way. There can be fixed real bird sounds or mobile units. In Denmark natural sounds are used from the species such as Herring gull, Black headed gull, Common Gull, lapwing, starling, rook, jackdaw, etc. In Copenhagen flocks of oystercatchers (50-300) very frequently feed or rest on grass areas during spring or summer. When scared they usually move from one place to another within the airport, and therefore it was very difficult to remove them from the area. Yet concerned people have found no solution to the problem. According to the literature the distress call of this species has no scaring effect. In South Africa recorded distress calls are being used at most airports. Results are generally disappointing as birds quickly grow accustomed to the calls but at some airports good results have been obtained when the calls are used together with pyrotechnical scaring devices. Experiments with synthetic sounds have still to be carried out.

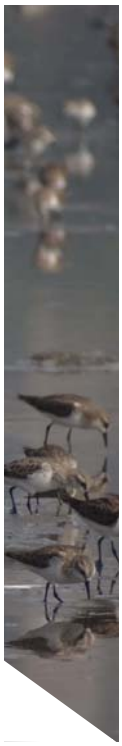
2. **Other techniques**
   a. In France noise generators are used along the runways. The sounds are played automatically from sunrise to sunset at high acoustic level (80dB) with silence period of 1 min duration between the emissions (30 seconds duration). This method, tested during 4 years, is effective on lapwings, gulls and pigeons.
   b. Conventional bird scaring methods are necessary together with this equipment during the periods of intense bird activity. In Japan fire crackers are sometimes used when the use of gun is not available. Soviet Union at the present time engineers and students of Riga Institute of Civil Aviation's Engineers make mobile synthesizers of bird distress calls, mobile bio acoustical devices with heightened power and different equipment on the microprocessor base. Special electro-stimulator was created there for obtaining of bird distress calls.
   c. Pyrotechnical Devices: They are covering a wide range. They are used alone or in conjunction with acoustical devices. The main methods are described hereaft.er.
      - Shell crackers: In India as well as other countries it is widely used on all civil airports. In Federal Republic of Germany pyroacoustic pistols with different cartridges as well as signal.
      - Gas cannon: In Finland liquid gas cannon fired automatically at regular intervals have proved cost effective at several airports. In India there is no use of gas cannon.
      - Gun shooting: In Denmark visual scaring with shotguns is used at all military and provincial civil airports in India it is occasionally used.

3. **Use of Birds** – methods such as falconry, bird mock up and radio controlled.

4. **Visual Scaring** – In Australia some use is made on vehicle mounted spotlights to shift the birds at night. Flashing lights have been found successful in Canada also. In Japan one company has been testing eyeball painting on an engine spinner. According to their four years record this device showed 20% reduction of bird strike.

5. Chemical repellents on Aerodromes

Although bird strikes are an issue as old as aviation, its significance as a hazard has not been diminished. In recent years very few fatal accidents have been caused by this hazard and most of these appear to involve a particular aircraft type. However, the cost of bird strikes to the civil aviation industry is not negligible.



IV) Indian perspective:

In India a pioneering study on bird strike was carried out in 1980s by the BNHS supported by Aeronautics R & D Board, Ministry of Defence and Government of India. This study was carried out at Gwalior, Gorakhpur, Jodhpur, Dundigal, Tezpur, Chabua, Sirsa, Srinagar, Jammu, Kalaikunda, Hyderabad, Trivandram, Bangaluru, Patna, Nagpur, Kolkata, Chennai, Mumbai, Delhi, Hindan, Agra and Ambala. It was mentioned that about 27 species of mainly terrestrial birds are potential problem birds at Indian Aerodromes (Grubh & Ali, 1984). Mainly vultures, kites, rock pigeons, lapwings, doves, myna, stone curlew, egrets, crows, sandgrouse, harriers, parakeets and quails were the bird species found involved in more than two bird strike incidences in 1980-90.

Main suggestions given – Removal of trees and shrubs, application of modern system for garbage disposal and slaughter houses, bird proofing of buildings, maintenance of vegetation. Modifying flight timings, levelling of infield areas, Control on cattle movement nearby airport area,

According to the BNHS initiative in 2006, a project entitled "Comprehensive study of Bird Hazard and remedial measures in selected airfields" was proposed and three airfields were surveyed for ecological study, i.e., Ambala, Adampur and Srinagar, in Northern India (Dookia, 2006).

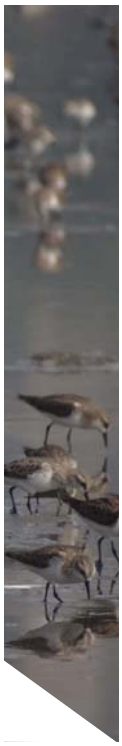
All the three airfields were a Bird strike prone area, as it has large population of problem birds such as the Black Kite, Black- shouldered Kite, Red-wattled Lapwing, Cattle Egret, Common Myna, Jungle Myna, larks and pipits. It was found that in Ambala & Adampur Black Kite, Cattle Egret and Red wattled Lapwing were main problem birds, due to their size, behaviour and flocking pattern, habit of flying over the runway and shoulder area. At Srinagar, in July 2001, Eurasian Collared Dove *Streptopelia decaocto* was involved in a bird strike incident. Though there are very less records of bird strike, the population of problem birds are increasing day by day and in future it will be a big menace.

At Ambala & Adampur Kite possess a threat from 0700 to 1200 hrs, during morning hours; Cattle Egret problem is restricted to monsoon only. Red-wattled Lapwing being resident of airfield causes problem almost round the year, especially at night, as they roost near the runway and any direct light on their eyes freezes them. This kind of behaviour makes them problematic mainly in the night movement of aircrafts. In Srinagar Black eared Kite is the main problem bird due to big size and habit of soaring. As per the study in Srinagar Black eared Kites remains potentially active from 0900 to 1600 hrs, however movement of Barn Swallow which is another problem bird, was found restricted during cloudy weather. Other birds were seen active from dawn to dusk.

On all three airfields reveals that the low grass (grass height < 10 cm) areas supports large number of sparrows and mynas, whereas high grass (grass height > 10 to 15 cm) areas do not supports them much. Soaring of Kites was also high over short grass area, as compared to the high grass area

V) Rationale

Ministry of Environment and Forests (MoEF) has given the clearance to NMIA project on the basis of many conditions. One of the conditions (condition number xxxi provided under specific conditions) is that an avifaunal study shall be carried out in consultation with BNHS. First bird survey was carried out in 10 km radius area of Navi Mumbai International Airport (NMIA). This study was designed to document bird diversity and species composition in the various habitats in 10 km radius area of NMIA. Thus first tri-monthly report was submitted in April 2012 and second tri-monthly report in June 2012, based on study carried out in about 300 sq km area (Narwade & Rahmani, 2012a, 2012b).



Chapter 2) Methodology

Study was carried out in rainy season. For details, please see the maps provided on page 16. Based on earlier studies of first and second tri-monthly surveys (December 2011 to May 2012), we were able to reach few areas because of restrictions in road accessibility due to rain and monsoon vegetation and full of water.

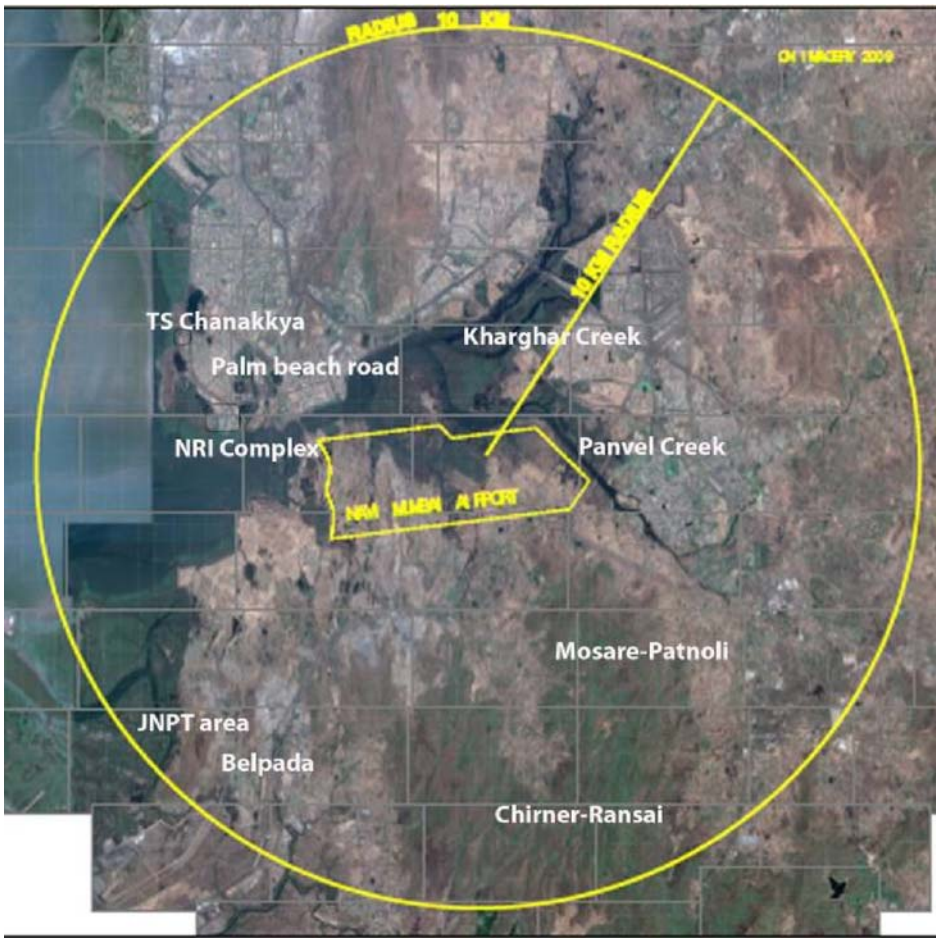
The areas were surveyed using binoculars and digital camera for proper bird records from June, 2011 to August, 2012. Data from earlier reports was used for comparative study. The birds species were recorded (sighting or call) on the field. Direct observations were made by walking along roads, hills, forest paths, wetlands, mangroves and creek areas. Birds were identified following Ali & Ripley (1983), Grimmett *et. al* (2000) and Rasmussen & Anderton (2005). Photographs of unidentified birds were kept for future study. The list of birds was arranged family-wise following Manakadan & Pittie (2001). GPS locations were taken for preparation of distribution maps and details of the coordinates of the sites visited were collected.

Detailed literature survey was incorporated in first tri-monthly report (Narwade & Rahmani, 2012) and can be used as per the requirement. To study the movement of the birds, known roosting and foraging areas were monitored at the same time by the team members.

Abbreviations used

1) 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 (thick vegetation)
2) IUCN Threat categories: EN- Endangered, VU - Vulnerable, NT- Near threatened
3) Type of movements: R-Resident, M-Migratory
4) NMIA – Navi Mumbai International Airport, BNHS - Bombay Natural History Society, JNPT - Jawaharlal Nehru Port Trust, EIA - Environmental Impact Assessment

10 kms radius of proposed NMIA



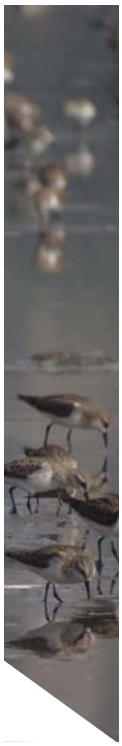
Birding areas in 10 km radius from proposed NMIA

Birding Sites (Habitat) In Monsoon

Proposed NMIA site in monsoon

Forest at Mosare village

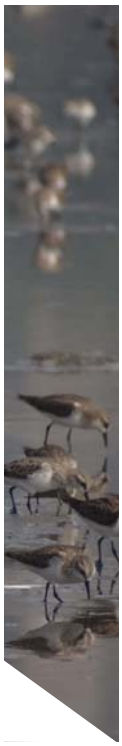
NRI Lake



All hills were covered with vegetation after rains

Streams and water pools at proposed NMIA site

Panvel creek filled with water



Chapter 3) Results

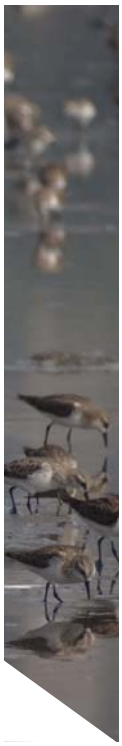
A total of 204 bird species was recorded during the above mentioned survey. There were 47 bird families representing 204 species, out of which Muscicapidae family shows the highest number of species (22), followed by Scolopacidae (15), Accipitridae (13) and Anatidae (9). Variation in species occurrence and population observed during the study period indicates dynamic nature of the avifauna of the study area which is mainly affected by seasonal changes in water level and tide timing.

I) Estimated population and flocking/congregating movement of birds observed during survey period

Our study was focussed on population and flock movement of congregating birds, raptors and birds observed within proposed airport area.

Sr. No.	Common and scientific names of the birds	R/M	Estimated count of birds	Seasonal movement of the birds
	Family –Phalacrocoracidae			
1.	Little Cormorant *Phalacrocorax niger*	R	400-500	In summer congregated in Panvel creek else found in all wetland areas
2.	Great Cormorant *Phalacrocorax carbo*	R	200-300	In summer congregated in Panvel creek else found in all wetland areas
3.	Indian Cormorant or Indian Shag *Phalacrocorax fuscicollis*	R	500-600	In summer congregated in Panvel creek else found in all wetland areas
	Family – Ardeidae			
4.	Eastern Cattle Egret *Bubulcus coromandus*	R	400-500	All over
5.	Intermediate Egret *Egretta intermedia*	R	100-200	Mainly observed at Belpada lake and spread in peak summer and monsoon
6.	Great Egret *Egretta alba*	R	50-100	Mainly observed at Belpada lake and spread in peak summer and monsoon
7.	Little Egret *Egretta garzetta*	R	200-300	All over in group of 5-6 birds
8.	Grey Heron *Ardea cinerea*	R	50-100	Mainly observed at Belpada lake and spread in peak summer and monsoon
9.	Indian Pond Heron *Ardeola grayii*	R	300-400	All over
10.	Purple Heron *Ardea purpurea*	R	50-100	In Mangrove areas single individual
11.	Western Reef Egret *Egretta gularis*	M	30-40	All wetlands mainly single individual
12.	Black-crowned Night-heron *Nycticorax nycticorax*	R	20-30	Mangroves in 2-3 individuals

Sr. No.	Common and scientific names of the birds	R/M	Estimated count of birds	Seasonal movement of the birds
	Family – Ciconiidae			
13.	Painted Stork *Mycteria leucocephala*	R	50-60	Mainly observed at Belpada lake and spread in peak summer and monsoon
14.	Asian Openbill *Anastomus oscitans*	R	30-40	Mainly observed at jasai wetland and move in peak summer and monsoon
15.	Woolly-necked Stork *Ciconia episcopus*	R	20-30	All areas
	Family – Threskiornithidae			
16.	Oriental White Ibis *Threskiornis melanocephalus*	R	20-25	Flock of 5-6 birds in mangrove areas
17.	Eurasian Spoonbill *Platalea leucorodia*	R	40-50	Mainly at Belpada, moves to Palm beach road areas in summer
18.	Glossy ibis *Plegadis falcinellus*	M	20-30	All fresh water wetlands
	Family – Phoenicopteridae			
19.	Lesser Flamingo *Phoenicopterus minor*	M	5000-6000	Wetlands and seashore areas of palm beach road, airoli creek
	Family – Anatidae			
20.	Ruddy Shelduck *Tadorna ferruginea*	M	25-30	Belpada, jasai lake observed only during November to February
21.	Northern Pintail *Anas acuta*	M	50-60	Belpada lake in December-February
22.	Common Teal *Anas crecca*	M	60-70	Wetland behind NRI complex and Belpada lake in December-February
23.	Spot-billed Duck *Anas poecilorhyncha*	R	70-80	All wetland areas
24.	Garganey *Anas querquedula*	M	30-40	Wetland behind NRI complex and Belpada lake in December-March
25.	Northern Shoveler *Anas clypeata*	M	300-400	Kharghar creek, NRI complex in December to February
26.	Comb Duck *Sarkidiornis melanotos*	R	15-20	Observed only at Jasai
27.	Lesser Whistling-duck *Dendrocygna javanica*	R	250-300	Largest congregation in summer season at wetlands of Palm beach road and post summer at Belpada lake
28.	Cotton Teal *Nettapus coromandelianus*	R	40-50	Belapur pond and JNPT area
	Family – Accipitridae			
29.	Black Kite *Milvus migrans*	R	20-25	Near Belpada lak
	Family – Pandionidae			
30.	Osprey *Pandion haliaetus*	R	5-6	Nesting at Belpada and movement to other areas



Sr. No.	Common and scientific names of the birds	R/M	Estimated count of birds	Seasonal movement of the birds
	Family – Rallidae			
31.	Purple Swamphen *Porphyrio porphyrio*	R	20-25	Jasai, Belpada
32.	Common Moorhen *Gallinula chloropus*	R	30-40	Jasai, JNPT, Belpaur
33.	Eurasian Coot *Fulica atra*	R	50-60	Uran
	Family – Jacanidae			
34.	Bronze-winged Jacana *Metopidius indicus*	R	15-20	Uran, Belpaur pond
35.	Pheasant-tailed jacana *Hydrophasianus chirurgus*	R	30-40	Uran, Belpaur pond
	Family – Charadriidae			
36.	Red-wattled Lapwing *Vanellus indicus*	R	60-70	All areas
37.	Lesser Sand Plover *Charadrius mongolus* for feeding	M	2000-2200	Mainly Palm Beach road and other areas
38.	Greater Sand Plover *Charadrius leschenaultia*	M	1000-1200	Mainly Palm Beach road and other areas for feeding
39.	Little Ringed Plover *Charadrius dubius*	R	30-40	
40.	Pacific Golden Plover *Pluvialis fulva*	M	50-60	Panvel Creek, Rocky seashore of palm beach road
41.	Grey Plover *Pluvialis squatarola*		25-30	Belpada, Palm beach Road wetlands
	Family – Scolopacidae			
42.	Common Redshank *Tringa tetanus*	M	250-300	Roost at Kharghar Creek and feeds all other wetland areas
43.	Terek Sandpiper *Xenus cinereus*	M	200-250	Kharghar and Panvel Creeks
44.	Marsh Sandpiper *Tringa stagnatilis*	M	20-25	Belpada, Uran
45.	Black-tailed Godwit *Limosa limosa*	M	400-500	Near Sanjivani School (Kharghar), Jaskhar, Belpada
46.	Eurasian Curlew *Numenius arquata*	M	30-40	Wetlands of Palm beach road
47.	Ruddy Turnstone *Arenaria interpres*	M	20-25	Rocky seashore of Palm beach road
48.	Temminck's Stint *Calidris temminckii*	M	1000-1200	Mainly Palm Beach road and other areas for feeding
49.	Little Stint *Calidris minuta*	M	200-300	Mainly Palm Beach road and other areas for feeding
50.	Curlew Sandpiper *Calidris ferruginea*	M	1500-1600	Mainly Palm Beach road and other areas for feeding
51.	Ruff *Philomachus pugnax*	M	100-120	Jasai, Belpada
52.	Dunlin *Calidris alpine*	M	10-12	Rocky seashore of Palm beach road

Sr. No.	Common and scientific names of the birds	R/M	Estimated count of birds	Seasonal movement of the birds
	Family – Recurvirostridae			
53.	Black-winged Stilt *Himantopus himantopus*	R	200-250	All wetland areas
	Family – Laridae			
54.	Gull-billed Tern *Gelochelidon nilotica*	M	30-40	All wetland areas, mainly at wetlands of Palm beach road
55.	Caspian Tern *Sterna caspia*	M	40-50	All wetland areas, mainly at wetlands of Palm beach road
56.	Saunders's Tern *Sterna saundersi*	M	10-12	All wetland areas, mainly at wetlands of Palm beach road
57.	Whiskered Tern *Chlidonias hybridus*	M	200-250	Jasai
58.	River Tern *Sterna aurantia*	M	10-12	Belpada
59.	White-cheeked Tern *Sterna repressa*	M	25-30	Jasai
60.	Brown-headed Gull *Larus brunnicephalus*	M	300-350	All wetland areas, mainly at wetlands of Palm beach road
61.	Black-headed Gull *Larus ridibundus*	M	200-250	All wetland areas, mainly at wetlands of Palm beach road
	Family – Columbidae			
62.	Rock Pigeon *Columba livia*	R	500-600	All human habituated areas
	Family – Meropidae			
63.	Blue-tailed Bee-eater *Merops philippinus*	R	25-30	Kharghar creek
	Family – Hirundinidae			
64.	Wire-tailed Swallow *Hirundo smithii*	R	30-40	NMIA area
65.	Barn Swallow *Hirundo rustica*	R	40-50	NMIA area
66.	Clamorous Reed-warbler or Indian Great Reed-warbler *Acrocephalus [strentoreus] bruniscens*	R	200-250	All mangrove areas
	Family – Emberizidae			
67.	Red-headed Bunting *Emberiza bruniceps*	M	1000	Pargaon, NMIA site
68.	Black-headed Bunting *Emberiza melanocephala*	M	500	Pargaon, NMIA site
	Family – Estrildidae			
69.	Red Avadavat *Amandava amandava*	R	140-150	Kharghar creek, Belpada,
70.	Scaly-breasted Munia *Lonchura punctulata*	R	30-40	Kharghar creek, Palm beach road
	Family – Sturnidae			
71.	Rosy Starling *Sturnus roseus*	M	500-1000	Kharghar Creek, DPS School,

Birds seen commonly in monsoon season

Black-headed Munia at proposed NMIA site

Spot-billed Duck

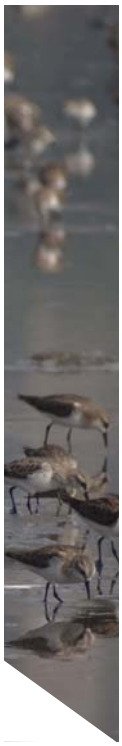
Flock of Sand Plovers behind T. S. Chanakya

Birds seen commonly in monsoon season

Black winged Stilt with a pair of Pheasant-tailed Jacana

Black-shouldered Kite

Birds seen commonly in monsoon season



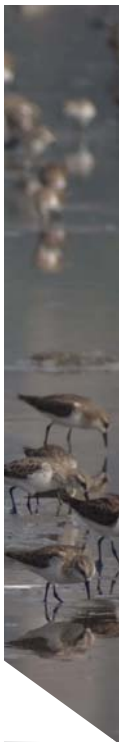
A Mixed Flock of Caspian Tern and Gull billed Tern were also seen in monsoon season

Coppersmith Barbet

Birds seen commonly in monsoon season

Barred Buttonquail

River Tern



Chapter 4) Discussion

The literature survey revealed that Bird strike has been a concern to the aviation safety from a decade. There is no straightforward relationship between the number of birds at a particular geographic location and the risk of bird strikes. Location factors (e.g. aerodrome or landfill sites) as well as flock size and flight line patterns play a significant role as it has been shown in past research (Dekker, 1994). The seasonal pattern of bird strikes is confirmed from all sources, indicating that the highest number of bird strikes occurs in the months between April and October. It is not random that this period coincides with the airline summer schedule of increased air traffic activity. However, after using normalized data there appears to be a seasonal pattern for bird strikes in spring time and autumn (Maragakis, 2009). The seasonal pattern may also affect the altitudes with the highest risk of a bird strike. For example, July to November is considered the worst months for damaging strikes in the airport environment (below 500 ft. AGL). During late summer bird populations are at their highest levels and contain many young birds that are not skilled flyers. Above 500 ft. September-November and March are considered the most dangerous months because these are the peak times of migration (Dolbeer, 2004).

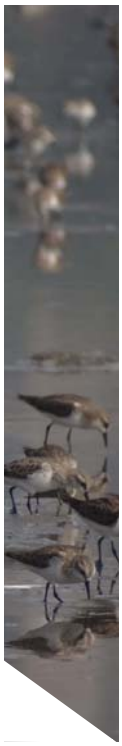
Using various sources of raw and derived data it was concluded that most of the bird strikes (95%) occur below 2500 ft and around 70% occur below 200 ft (Eschenfelder, 2005). At Kavala airport, potentially dangerous birds were observed within an 8-km radius (general zone) of the runway center line because most bird – aircraft collisions occur when aircrafts are at low altitudes (Lykos *et al*., 2005). Turbine powered aircrafts normally reach 601 m above ground level (AGL) before leaving the general zone and 88% at least in the USA, of bird strikes occur below 610 m AGL (Clearly *et al*., 1997). They emphasized areas within the 3.2 km radius of the runway center line (critical zone) because turbine powered aircraft are usually under 150 m AGL and 72% of the USA bird strikes occur at or below this level (Clearly *et al*., 1997).

Various sources quote different percentages for each altitude threshold, but they all concur that most occurrences take place very close to the ground. This highlights the fact that the risk of bird strikes can be mitigated by measures taken primarily at an aerodrome level, such as avifauna assessment and management.

Although in recent years the overall bird population has declined in Europe by over 10%, the bird strike hazard for aviation has not reduced proportionally. The reason is that not all birds pose the same hazard to aviation safety, as this depends on the size of the birds and their foraging or migratory patterns. Birds may pose a threat to aviation due to their individual size or due to their tendency to fly in large flocks. It is likely that the smaller the birds are, the greater their need to travel in flocks in order to avoid predators (Maragakis, 2009).

In the category of flocking birds, some of the most hazardous are considered to be the Gulls and the Starlings. The Gulls are considered of high risk because of their tendency to feed on soil invertebrates on aerodromes, farmland etc. as well as on landfill sites. It has been observed that flightiness of gulls is most likely to occur between landfill areas and roost sites causing great concern. The Starlings *Sturnus vulgaris* are another bird species considered a hazard to aviation activities as they usually fly in dense flocks of up to 100,000 individuals (Feare, CJ et al 1999). With a mass density 27% greater than that of Gulls, they are considered a great bird strike risk, though they are involved in a small percentage of bird strikes (CAA UK, 2008). In the past 35 years the general population of European Starling birds is believed to have decreased by almost 50%. Changes in their population might not reflect a proportional decrease of the risk to aviation.

Large birds pose a risk primarily due to their individual size. In this category belong birds such as waterfowl (loons, ducks, geese and swans) or wild predatory birds such as raptors or eagles. Particular case for Europe is the Canadian Goose *Branta Canadensis*, the population of which, in recent years, has increased by more than 100% in northwest Europe (Banks *et al.,* 2006). Additionally there is a smaller threat from Greylag Goose. The interest of aviation organizations has been attracted to this particular species because of their large size (2.3kgs – 7.3kgs) and tendency to fly in flocks, traditional migration. Whilst they usually fly at altitudes below 5,000 ft. they have been encountered at altitudes up to 20,000 ft. Geese fly in v-shaped 'skeins', diagonal formations, with birds spaced about 10 to 12 ft. (about 3 to 3.5 m) apart. Thus they must be considered as flocking birds since the same skein could strike multiple engines (CAA UK - SRG, 2002).



Although the Canada Goose is a migratory species, in recent years a non-migratory trend has been observed, as the species has adapted to urban environments (Smith, A. *et al,* 1999). Because of the species habitat preference, near standing water, it has become of primary concern for airport avifauna management in north-western Europe.

In recent decades there has been a change in the number and the composition of the bird population as well as in the habitat of some of the species. Some bird species have adjusted to the urban environment while others have experienced a significant increase in their population. Furthermore, climatic changes have allowed new species to forage and breed in geographic areas which were not particularly suitable to them several decades ago. The ban of organochloride pesticides has also enabled some bird species population to increase from their low levels in the 1970's.

Eurasian Spoonbill

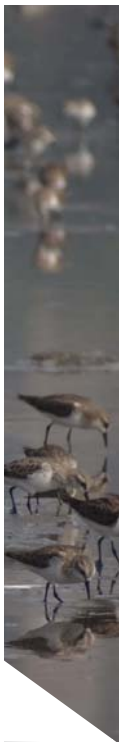
Table 1) Family wise bird species count (N=47)

No.	Family	No. of species	No.	Family	No. of species	No.	Family	No. of species
1.	Podicipedidae	1	17.	Laridae	7	33.	Alaudidae	3
2.	Phalacrocoracidae	3	18.	Columbidae	5	34.	Hirundinidae	2
3.	Ardeidae	8	19.	Psittacidae	2	35.	Campephagidae	4
4.	Ciconiidae	4	20.	Cuculidae	5	36.	Laniidae	3
5.	Threskiornithidae	3	21.	Tytonidae	1	37.	Muscicapidae	22
6.	Anatidae	9	22.	Strigidae	1	38.	Paridae	1
7.	Accipitridae	13	23.	Caprimulgidae	2	39.	Motacillidae	7
8.	Falconidae	1	24.	Apodidae	2	40.	Nectariniidae	2
9.	Pandionidae	1	25.	Alcedinidae	4	41.	Emberizidae	2
10.	Phasianidae	1	26.	Meropidae	2	42.	Estrildidae	5
11.	Phonoecopteridae	1	27.	Coraciidae	1	43.	Passeridae	3
12.	Rallidae	5	28.	Upupidae	1	44.	Sturnidae	3
13.	Recurvirostridae	1	29.	Bucerotidae	1	45.	Oriolidae	2
14.	Jacanidae	2	30.	Capitonidae	2	46.	Dicruridae	2
15.	Charadriidae	7	31.	Picidae	1	47.	Corvidae	3
16.	Scolopacidae	15	32.	Pittidae	1			

Annexure I: List of birds observed during surveys carried out in 10km radius area of NMIA

Sr. No.	Common and scientific names of the birds	Habitat	WPA schedule	IUCN status	R/M	Sites
1.	**Family – Podicipedidae**					
2.	Little Grebe *Tachybaptus ruficollis*	W	IV	LC	R	Dastan Phata, DPS lake, Belapur pond
	Family –Phalacrocoracidae					
3.	Little Cormorant *Phalacrocorax niger*	W	IV	LC	R	All wetland areas
4.	Great Cormorant *Phalacrocorax carbo*	W	IV	LC	R	Ulve
5.	Indian Cormorant or Indian Shag *Phalacrocorax fuscicollis*	W	IV	LC	R	All wetland areas
	Family – Ardeidae					
6.	Eastern Cattle Egret *Bubulcus coromandus*	W/P	IV	LC	R	All wetland areas
7.	Intermediate Egret *Egretta intermedia*	W/P	IV	LC	R	All wetland areas
8.	Great Egret *Egretta alba*	W	IV	LC	R	All wetland areas
9.	Little Egret *Egretta garzetta*	W/P/C	IV	LC	R	All wetland areas
10.	Grey Heron *Ardea cinerea*	W/C	IV	LC	R	All wetland areas
11.	Indian Pond Heron *Ardeola grayii*	W	IV	LC	R	All wetland areas
12.	Purple Heron *Ardea purpurea*	W/C	IV	LC	R	All wetland areas
13.	Western Reef Egret *Egretta gularis*	W/MD	IV	LC	M	Dastan Phata, Nere, Belpada

Annexure I: List of birds observed during surveys carried out in 10km radius area of NMIA (contd.)

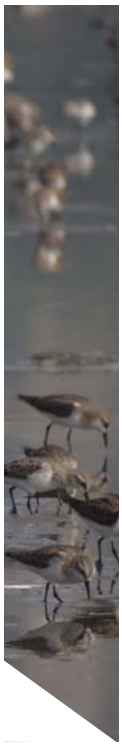


Sr. No.	Common and scientific names of the birds	Habitat	WPA schedule	IUCN status	R/M	Sites
14.	Black-crowned Night-heron *Nycticorax nycticorax*	W	IV	LC	R	Kharghar creek, Panvel creek
15.	Striated Heron *Butorides striatus*	W	IV	LC	R	Uran
	Family – Ciconiidae					
16.	Painted Stork *Mycteria leucocephala*	W	IV	NT	R	Belpada, Kopar, wetlands at Palm Beach road
17.	Asian Openbill *Anastomus oscitans*	W	IV	LC	R	Dastan Phata,
18.	Woolly-necked Stork *Ciconia episcopus*	W	IV	LC	R	Dastan Phata, Mosare
19.	Black Stork *Ciconia nigra*	W	IV	LC	M	Ransai dam
	Family – Threskiornithidae					
20.	Oriental White Ibis *Threskiornis melanocephalus*	W/C	IV	NT	R	All wetlands and mangroves
21.	Eurasian Spoonbill *Platalea leucorodia*	W	I	LC	R	Jasai, Sanjivani Sch, Belpada
22.	Glossy ibis *Plegadis falcinellus*	W	IV	LC	M	Karal
	Family – Phoenicopteridae					
23.	Greater Flamingo *Phoenicopterus major*	W	I	LC	M	Belpada, NRI
24.	Lesser Flamingo *r Phoenicopterus mino*	W	I	NT	M	Wetlands and Seashore of Palm Beach road
	Family – Anatidae					
25.	Ruddy Shelduck *Tadorna ferruginea*	W	IV	LC	M	Jasai, Sanjivani Sch, Belpada
26.	Northern Pintail *Anas acuta*	W	IV	LC	M	Belpada
27.	Common Teal *Anas crecca*	W	IV	LC	M	Belpada
28.	Spot-billed Duck *Anas poecilorhyncha*	W/C	IV	LC	R	All
29.	Garganey *Anas querquedula*	W	IV	LC	M	Belpada
30.	Northern Shoveler *Anas clypeata*	W/C	IV	LC	M	Kharghar creek
31.	Comb Duck *Sarkidiornis melanotos*	W	IV	LC	R	Dastan Phata
32.	Lesser Whistling-duck *Dendrocygna javanica*	W	IV	LC	R	Dastan Phata, Belapur pond, Belpada, Palm Beach raod
33.	Cotton Teal *Nettapus coromandelianus*	W	IV	LC	R	Dastan Phata, Belapur pond
	Family – Accipitridae					
34.	Black-shouldered Kite *Elanus caeruleus*	All	I	LC	R	All areas
35.	Black Kite *Milvus migrans*	All	I	LC	R	All areas

Annexure I: List of birds observed during surveys carried out in 10km radius area of NMIA (contd.)

Sr. No.	Common and scientific names of the birds	Habitat	WPA schedule	IUCN status	R/M	Sites
36.	Brahminy Kite *Haliastur Indus*	W/P	I	LC	R	Belpada, Dastan Phata
37.	Shikra *Accipiter badius*	All	I	LC	R	All areas
38.	White-eyed Buzzard *Butastur teesa*	F	I	LC	R	Jasai
39.	Oriental Honeybuzzard *Pernis ptiylorhychus*	F	I	LC	R	Mosare
40.	Common Buzzard *Buteo buteo*	F	I	LC	R	Ransai, Chirner
41.	Long-legged Buzzard *Buteo rufinus*	F	I	LC	R	Mosare
42.	Western Marsh Harrier *Circus aeruginosus*	W	I	LC	M	All areas
43.	Crested Serpent-eagle *Spilornis cheela*	F	I	LC	R	Ransai, Mosare
44.	Short-toed Snake-eagle *s Circaetus gallicu*	GS	I	LC	R	Chirner road
45.	Booted Eagle *Hieraaetus pennatus*	F	I	LC	M	Mosare
46.	Greater Spotted Eagle *Aquila clanga*	F	I	VU	M	Belpada, Mosare
	Family – Falconidae	V	I	LC	R	
47.	Common Kestrel *Falco tinnunculus*	GS	IV	LC	R	Chirner road
	Family – Pandionidae					
48.	Osprey *Pandion haliaetus*	W/C	I	LC	R	Kharghar creek, Belpada
	Family – Phasianidae					
49.	Red Spurfowl *Galloperdix spadicea*	F	-	LC	R	Kaharghar hills
50.	Jungle Bush-quail *Perdicula asiatica*	F	-	LC	R	Ransai, Chirner Road
	Family – Turnicidae					
51.	Barred Buttonquail *Turnix suscitator*					
52.	Rain Quail *Coturnix coromandelica*					
	Family – Rallidae					
53.	White-breasted Waterhen *Amaurornis phoenicurus*	W/C	IV	LC	R	Dastan Phata, Pargaon
54.	Purple Swamphen *Porphyrio porphyrio*	W	IV	LC	R	Dastan Phata, Pargaon
55.	Common Moorhen *Gallinula chloropus*	W	IV	LC	R	Belapur pond, Dastan Phata
56.	Eurasian Coot *Fulica atra*	W	IV	LC	R	Belapur pond, Dastan Phata
57.	Slaty-breasted Rail *Gallirallus striatus*	W/C	IV	LC	R	Kharghar creek, Panvel Creek
58.	Red-breasted Crake *Porzana fusca*	W/C	IV	LC	R	Kharghar creek, Panvel Creek
59.	Brown Crake *Porzana akool*	W/C	IV	LC	R	Chirner, Uran

Annexure I: List of birds observed during surveys carried out in 10km radius area of NMIA (contd.)

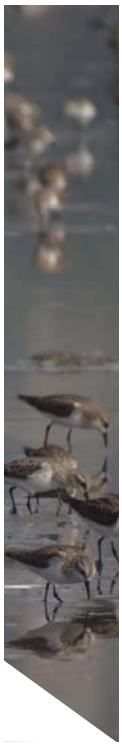


Sr. No.	Common and scientific names of the birds	Habitat	WPA schedule	IUCN status	R/M	Sites
	Family – Jacanidae					
60.	Bronze-winged Jacana *Metopidius indicus*	W	IV	LC	R	Belapur pond, Dastan Phata
61.	Pheasant-tailed jacana *Hydrophasianus chirurgus*	W	IV	LC	R	Belapur pond, Dastan Phata
	Family – Charadriidae					
62.	Red-wattled Lapwing *Vanellus indicus*	ALL	IV	LC	R	All areas
63.	Lesser Sand Plover *Charadrius mongolus*	W/MD	IV	LC	M	All Mudflats in study area
64.	Greater Sand Plover *Charadrius leschenaultia*	W/MD	IV	LC	M	Behind NRI complex
65.	Little Ringed Plover *Charadrius dubius*	W/MD	IV	LC	R	All wetlands
66.	Pacific Golden Plover *Pluvialis fulva*	W/MD	IV	LC	M	Behind TS Chanakya, Panvel creek
67.	Kentish Plover *Charadrius alexandrines*	W/MD	IV	LC	..	All wetlands
68.	Grey Plover *Pluvialis squatarola*	W/MD	IV	LC		Belpada, wetlands of Palm Beach Road area
	Family – Scolopacidae					
69.	Common Snipe *Gallinago gallinago*	W	IV	LC	R	Belpada, Dastan Phata
70.	Common Redshank *Tringa tetanus*	W/MC	IV	LC	M	All (congregation at Kharghar creek)
71.	Wood Sandpiper *Tringa glareola*	W/MC	IV	LC	M	All wetlands
72.	Common Sandpiper *Tringa hypoleucos*	W/MC		LC	R	All wetlands
73.	Common Greenshank *Tringa nebularia*	W/RS	IV	LC	M	Seashore of Palm Beach road, Belpada
74.	Terek Sandpiper *Xenus cinereus*	W/MC	IV	LC	M	Kharghar Creek, Kopar
75.	Green Sandpiper *Tringa ochropus*	W/MC	IV	LC	M	Belpada
76.	Marsh Sandpiper *Tringa stagnatilis*	W		LC	M	All wetlands (more at belpada)
77.	Black-tailed Godwit *Limosa limosa*	W	IV	LC	M	Belpada, Sanjivani Sch
78.	Eurasian Curlew *Numenius arquata*	W	IV	LC	M	Behind NRI complex
79.	Ruddy Turnstone *Arenaria interpres*	RS	IV	LC	M	Behind TS Chanakya,
80.	Temminck's Stint *Calidris temminckii*	W		LC	M	All (Large congregation behind NRI complex)
81.	Little Stint *Calidris minuta*	W	IV	LC	M	All wetland areas

Annexure I: List of birds observed during surveys carried out in 10km radius area of NMIA (contd.)

Sr. No.	Common and scientific names of the birds	Habitat	WPA schedule	IUCN status	R/M	Sites
82.	Curlew Sandpiper *Calidris ferruginea*	W	IV	LC	M	Belpada, Dastan Phata, Sanjivani sch (congregation of 2000 birds behind NRI complex)
83.	Ruff *Philomachus pugnax*	W	IV	LC	M	Belpada, dastan phata
84.	Dunlin *Calidris alpine*	W	IV	LC	M	Seashore of Palm Beach road
	Family – Recurvirostridae					
85.	Black-winged Stilt *Himantopus himantopus*	W	IV	LC	R	All wetland areas
	Family – Laridae					
86.	Gull-billed Tern *Gelochelidon nilotica*	W	IV	LC	M	All wetland areas
87.	Caspian Tern *Sterna caspia*	W/C	IV	LC	M	Wetlands of Kamothe, Panvel, Palm Beach Road
88.	Saunders's Tern *Sterna saundersi*	W/C	IV	LC	M	Wetlands of Palm Beach Road
89.	Whiskered Tern *Chlidonias hybridus*	W/C	IV	LC	M	Wetlands of Palm Beach Road, Panvel Creek
90.	River Tern *Sterna aurantia*	W/C	IV	LC	M	Wetlands of Belpada, Palm Beach Road, Panvel Creek
91.	White-cheeked Tern *Sterna repressa*	W	IV	LC	M	Jasai
92.	Brown-headed Gull *Larus brunnicephalus*	W	IV	LC	M	All wetland areas (more than 200 at DPS lake)
93.	Black-headed Gull *Larus ridibundus*	W	IV	LC	M	All wetland areas
	Family – Columbidae					
94.	Rock Pigeon *Columba livia*	All/NH		LC	R	All areas
95.	Yellow-footed Green-pigeon *Treron phoenicoptera*	F	IV	LC	R	Ransai
96.	Little Brown Dove *Streptopelia senegalensis*	All	IV	LC	R	All areas
97.	Eurasian Collared Dove *Streptopelia decaocto*	GS	IV	LC	R	Uran
98.	Spotted Dove *Streptopelia chinensis*	All	IV	LC	R	All areas
	Family – Psittacidae					
99.	Rose-ringed Parakeet *Psittacula krameri*	All	IV	LC	R	All areas
100.	Plum-headed Parakeet *Psittacula cynocephali*	F	IV	LC	R	Ransai

Annexure I: List of birds observed during surveys carried out in 10km radius area of NMIA (contd.)

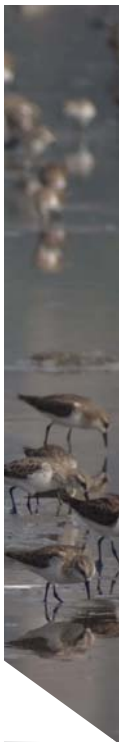


Sr. No.	Common and scientific names of the birds	Habitat	WPA schedule	IUCN status	R/M	Sites
	Family – Cuculidae					
101.	Asian Koel *Eudynamys scolopaceus*	All	IV	LC	R	All areas
102.	Greater Coucal (Southern Coucal) *Centropus sinensis*	All	IV	LC	R	All areas
103.	Common Hawk Cuckoo *s Hierococcyx variu*	All	IV	LC	R	Mosare, Ransai
104.	Blue-faced Malkoha *Phaenicophaeus viridirostris*	All	IV	LC	R	Mosare
105.	Sirkeer Malkoha *Phaenicophaeus leschenaultia*	All	IV	LC	R	Mosare
	Family – Tytonidae					
106.	Common Barn-owl *Tyto alba*	NH	IV	LC	R	Kharghar
	Family – Strigidae					
107.	Spotted Owlet *Athene brama*	F/NH	IV	LC	R	Mosare, Ransai
108.	Indian Eagle-Owl *Bubo bengalensis*	NH	IV	LC	R	Jasai
	Family – Caprimulgidae					
109.	Indian Little Nightjar *Caprimulgus asiaticus*	A/GS	IV	LC	R	Ransai
110.	Indian Jungle Nightjar *Caprimulgus indicus*	F	IV	LC	R	Ransai
	Family – Apodidae					
111.	Little or House Swift. *Apus affinis*	NH		LC	R	All areas
112.	Asian Palm-swift. *Cypsiurus balasiensis*	F/NH		LC	R	All areas
	Family – Alcedinidae					
113.	Lesser Pied Kingfisher W *Ceryle rudis*	IV	LC	R	Kopar	
114.	White-breasted Kingfisher *Halcyon smyrnensis*	All	IV	LC	R	All areas
115.	Common Kingfisher *Alcedo atthis*	W	IV	LC	R	All areas
116.	Black-capped Kingfisher *Halcyon pileata*	W/F	IV	LC	R	Ransai
	Family – Meropidae					
117.	Little Green Bee-eater *Merops orientalis*	All		LC	R	All areas
118.	Blue-tailed Bee-eater *Merops philippinus*	F/MC		LC	R	Kharghar creek, Mosare

Annexure I: List of birds observed during surveys carried out in 10km radius area of NMIA (contd.)

Sr. No.	Common and scientific names of the birds	Habitat	WPA schedule	IUCN status	R/M	Sites
	Family – Coraciidae					
119.	Indian Roller *Coracias benghalensis*	All	IV	LC	R	All areas
	Family – Upupidae					
120.	Common Hoopoe *Upupa epops*	MC/GS		LC	M	All areas
	Family – Bucerotidae					
121.	Indian Grey Hornbill *Ocyceros birostris*	F	I	LC	R	Mosare, Ransai
	Family – Capitonidae					
122.	Coppersmith Barbet *Megalaima haemacephala*	F	IV	LC	R	Mosare, Ransai
123.	Brown-headed Barbet *Megalaima zeylonica*	F	IV	LC	R	Mosare, Ransai
124.	White-cheeked Barbet *Megalaima viridis*	F	IV	LC	R	Patnoli, Chirner
	Family – Pittidae					
125.	Indian Pitta *Pitta brachyura*	F	IV	LC	R	Mosare
	Family – Picidae					
126.	Eurasian Wryneck *Jynx torquilla*	F	IV	LC	R	Mosare
127.	Rufous Woodpecker *Micropternus brachyurus*	F	IV	LC	R	Patnoli, Chirner
128.	Yellow-fronted Pied Woodpecker *Dendrocopos mahrattensis*	F	IV	LC	R	Mosare, Nere
	Family – Alaudidae					
129.	Ashy -crowned Sparrowlark *Eremopterix griseus*	GS	IV	LC	R	Uran
130.	Rufous-tailed Finch-Lark *Ammomanes phoenicura*	All	IV	LC	R	All areas
131.	Malabar Lark *Galerida malabarica*	ALL	IV	LC	R	All areas
	Family – Motacillidae					
132.	Citrine Wagtail *Motacila citreola*	W/M	IV	LC	M	All areas
133.	Yellow Wagtail *Motacila flava*	W/M	IV	LC	M	All areas
134.	Grey Wagtail *Motacila cinerea*	W	IV	LC	M	All areas
135.	White Wagtail *Motacila alba*	W	IV	LC	M	All areas
136.	Large Pied Wagtail *Motacia maderaspatensis*	W	IV	LC	R	All areas
137.	Tree Pipit *Anthus trivialis*	P/GS	IV	LC	M	All areas
138.	Paddyfield Pipit *Anthus rufulus*	ALL	IV	LC	R	All areas

Annexure I: List of birds observed during surveys carried out in 10km radius area of NMIA (contd.)

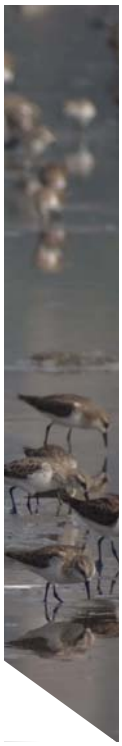


Sr. No.	Common and scientific names of the birds	Habitat	WPA schedule	IUCN status	R/M	Sites
	Family – Hirundinidae					
139.	Wire-tailed Swallow *Hirundo smithii*	All		LC	R	All areas
140.	Barn Swallow *Hirundo rustica*	W		LC	R	All areas
	Family – Campephagidae					
141.	Common Woodshrike *T ephrodornis pondicerianus*	F	IV	LC	R	Mosare
142.	Large Cuckooshrike *Coracina macei*	F	IV	LC	R	Patnoli
143.	Common Iora *Aegithina tiphia*	F	IV	LC	R	Ransai
144.	Red-vented Bulbul *Pycnonotus cafer*	All	IV	LC	R	All areas
145.	Red-whiskered Bulbul *Pycnonotus jocosus*	F/MC	IV	LC	R	All areas
	Family – Laniidae					
146.	Bay-backed Shrike *Lanius vittatus*	All		LC	R	All areas
147.	Long-tailed Shrike *Lanius schach*	All		LC	R	All areas
148.	Southern Grey Shrike *Lanius meridionalis*	GS		LC	R	Chirner road
	Family – Muscicapidae					
149.	Orange-headed Thrush *Zoothera citrina*	F	IV	LC	R	Ransai
150.	Jungle Babbler *Turdoides striatus*	F	IV	LC	R	Ransai, Mosare, Patnoli
151.	Tawny-bellied Babbler *Turdoides hyperythra*	F	IV	LC	R	Mosare, Patnoli
152.	Yellow-eyed Babbler *Chrysomma sinense*	F	IV	LC	R	Chirner
153.	Indian Scimitar-babbler *Pomatorhinus [schisticeps] horsfieldii*	F	IV	LC	R	Chirner, Mosare
154.	Puff-throated Babbler F *Pellorneum ruficeps*	IV	LC	R	Mosare, Patnoli	
155.	Brown-cheeked Fulvetta *Alcippe poioicephala*	F	IV	LC	R	Ransai
156.	Black Redstart *Phoenicurus ochruros*	GS	IV	LC	M	Mosare
157.	Malabar Whistling-thrush *Myophonus horsfieldi*	F	IV	LC	M	Ransai
158.	Oriental Magpie-robin *Copsychus saularis*	All	IV	LC	R	All areas
159.	Common Stonechat *Saxicola torquatus*	All	IV	LC	M	All areas

Annexure I: List of birds observed during surveys carried out in 10km radius area of NMIA (contd.)

Sr. No.	Common and scientific names of the birds	Habitat	WPA schedule	IUCN status	R/M	Sites
160.	Pied Bushchat *Saxicola caprata*	All	IV	LC	R	Uran
161.	Indian Black Robin *Saxicoloides fulicatus*	All	IV	LC	R	All areas
162.	White-rumped Shama *Copsychus saularis*	F	IV	LC	R	Ransai
163.	Bluethroat *Luscinia svecica*	MC	IV	LC	M	Belpada, Kharghar creek, Pargaon
164.	Small Minivet *Pericrocotus cinnamomeus*	F	IV	LC	R	Mosare
165.	Blue Rockthrush *Monticola solitaries*	GS	IV	LC	M	Uran
166.	Zitting Cisticola *Cisticola juncidis*	MC	IV	LC	R	Kopar
167.	Plain Prinia *Prinia inornata*	All	IV	LC	R	All areas
168.	Ashy Prinia *Prinia socialis*	All	IV	LC	R	All areas
169.	Grey-breasted Prinia *Prinia hodgsonii*	All	IV	LC	R	Mosare
170.	Clamorous Reed-warbler or Indian Great Reed-warbler *Acrocephalus [strentoreus] bruniscens*	MS	IV	LC	M	All creeks and mangrove areas
171.	Common Tailorbird *Orthotomus sutorius*	All		LC	R	All areas
172.	Lesser Whitethroat *Sylvia curruca*	GS	IV	LC	M	Uran
173.	Red-breasted Flycatcher *Ficedula parva*	GS/F	IV	LC	M	Nere
174.	Asian Brown Flycatcher *Muscicapa dauurica*	MC	IV	LC	M	Kopar
175.	White-browed Fantail-flycatcher *Rhipidura albicollis*	MC	IV	LC	M	Khargahr creek
	Family – Paridae					
176.	Great Tit *Parus major*	NH	IV	LC	R	Uran
	Family – Nectariniidae					
177.	Purple Sunbird *Cinnyris asiatica*	All	IV	LC	R	Uran
178.	Purple-rumped Sunbird *Leptocoma zeylonica*	GS	IV	LC	R	Uran
	Family – Emberizidae					
179.	Red-headed Bunting *Emberiza bruniceps*	GS	IV	LC	M	Paragon
180.	Black-headed Bunting *Emberiza melanocephala*	GS	IV	LC	M	Paragon, Kharghar Creek

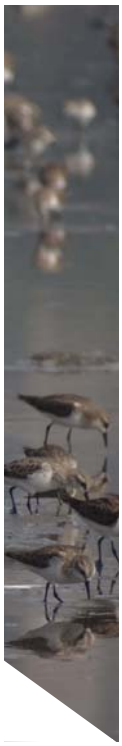
Annexure I: List of birds observed during surveys carried out in 10km radius area of NMIA (contd.)



Sr. No.	Common and scientific names of the birds	Habitat	WPA schedule	IUCN status	R/M	Sites
	Family – Estrildidae					
181.	Indian Silverbill P *Euodice malabarica*	IV	LC	R	All areas	
182.	Red Avadavat *Amandava amandava*	W/MC	IV	LC	R	Belpada, TS Chanakya
183.	Black-headed Munia *Lonchura malacca*	MC	IV	LC	R	Kharghar creek, TS Chanakya
184.	Scaly-breasted Munia *Lonchura punctulata*	MC/F	IV	LC	R	Kharghar creek, TS Chanakya, Mosare
185.	White-rumped Munia *Lonchura striata*		F	IV	LC	R Mosare
	Family – Passeridae					
186.	House Sparrow *Passer domesticus*	All	IV	LC	R	All areas
187.	Baya Weaver *Ploceus philippinus*	All	IV	LC	R	All areas
188.	Black-breasted Weaver *Ploceus benghalensis*	All	IV	LC	R	All areas
189.	Yellow-throated Sparrow *Petronia xanthocollis*	F/GS	IV	LC	R	Uran, Mosare
	Family – Sturnidae					
190.	Rosy Starling *Sturnus roseus*	All	IV	LC	M	Belpada, Nhava, Kharghar Creek, Pargaon, Kopar
191.	Brahminy Starling *Temenuchus pagodarum*	GS	IV	LC	R	Uran
192.	Grey-headed Starling *Temenuchus malabarica*	GS	IV	LC	R	Behind TS Chanakya
193.	Malabar White-headed Starling *Temenuchus blythii*	GS	IV	LC	R	Behind TS Chanakya
194.	Asian Pied Starling *Gracupica contra*	GS	IV	LC	R	All areas
195.	Common Myna *Acridotheres tristis*	All	IV	LC	R	All areas
196.	Jungle Myna *Acridotheres fuscus*	All	IV	LC	R	Mosare
	Family – Oriolidae					
197.	Eurasian Golden Oriole *Oriolus oriolus*	All	IV	LC	R	All areas
198.	Black-hooded Oriole *Oriolus xanthornus*	F	IV	LC	R	Ransai
	Family – Dicruridae					
199.	Black Drongo *Dicrurus macrocercus*	All	IV	LC	R	All areas
200.	Ashy Drongo *Dicrurus leucophaeus*	F	IV	LC	R	Ransai

Annexure I: List of birds observed during surveys carried out in 10km radius area of NMIA (contd.)

Sr. No.	Common and scientific names of the birds	Habitat	WPA schedule	IUCN status	R/M	Sites
201.	White-bellied Drongo *Dicrurus caerulescens*	F	IV	LC	R	Ransai, Patnoli
	Family – Corvidae					
202.	House Crow *Corvus splendens*	NH	V	LC	R	All areas
203.	Jungle Crow *Corvus macrorhynchos*	All	IV	LC	R	All areas
204.	Rufous Treepie *Dendrocitta vagabunda*	F	IV	LC	R	Mosare



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