# Elucidating the Migratory Routes of Waterbirds Wintering Along the Maharashtra Coast

Final Report June 2017 – July 2020

Submitted to Mangrove and Marine Biodiversity Conservation Foundation of Maharashtra

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Bombay Natural History Society Mumbai 2020

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Submitted to

Mangrove and Marine Biodiversity Conservation Foundation of Maharashtra

**Principal Investigator** 

P. Sathiyaselvam

**Project Advisor** 

Deepak Apte

**Project Scientist** 

Tuhina Katti, Madhumita Panigrahi, Ramesh Kumar Selvaraj,

# **Project Researcher**

Hrishikesh Rane, Omkar Joshi



Bombay Natural History Society Mumbai

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**Edited by: Maithreyi** 

**Designed by: Gopi Naidu** 

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Bombay Natural History Society Hornbill House, S. B. Singh Road Mumbai – 400001 Maharashtra, India. Tel.: (91-22) 2282 1811 Fax.: (91-22) 2283 7615 Email: director@bnhs.org

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# SUMMARY

Coastal wetlands in Maharashtra are important for the migratory waterbirds in the Central Asian Flyway. This study was conducted to understand the population dynamics, movement patterns, migratory routes, wetlands utilized and the functions performed by the coastal wetlands for the long-distance as well as local migratory species along the Maharashtra coast. Field surveys were conducted from June, 2017 to September, 2019 along the Maharashtra coast. The coastal sites along the Konkan coast between Alibaug and Terekhol in Maharashtra were surveyed to understand their significance to the wintering migratory waterbirds. During the surveys, a total of 70 waterbird species belonging to 14 families were recorded from all the sites. Of the 99 sites monitored, seven supported over 1000 waterbirds, six supported 500–1000 waterbirds and six others supported 300–500 waterbirds during one or more survey periods.

The major sites selected for monthly monitoring were Sewri Jetty, Bhandup Pumping Station (BPS), Airoli Jetty (Thane Flamingo Sanctuary), Delhi Public School pond, Training Ship Chanakya (TSC) wetland, NRI Complex ponds, Jasai and Panje/Panje Dongri wetlands. Another site, Akshi Beach, which is less than 50 km of aerial distance from Mumbai, was also surveyed monthly. The factors affecting the waterbird numbers (direct and indirect) were recorded.

During the study, the focus was on understanding the status of the threatened bird species along the Maharashtra coast. Totally nine threatened waterbird species were recorded including one Endangered (Great Knot *Calidris tenuirostris*), two Vulnerable (Asian Woollyneck *Ciconia episcopus* and Indian Skimmer *Rynchops albicollis*) and six Near Threatened species (Black-tailed Godwit *Limosa limosa*, Curlew Sandpiper *Calidris ferruginea*, Black-headed Ibis *Threskiornis melanocephalus*, Eurasian Curlew *Numenius arquata*, Eurasian Oystercatcher *Haematopus ostralegus* and Lesser Flamingo *Phoeniconaias minor*).

During the study, the threats to the wetlands and waterbirds were observed and recorded. Some pressures to the areas in recent times were also noted through questionnaire surveys conducted with the locals in the vicinity of each site. The major threats recorded to the wetlands and waterbirds were plastic and solid waste pollution, free ranging dogs, disturbance due to tourist activities, land reclamation and disturbance due to fishing in the inland wetlands. Further study is needed to qualitatively and quantitatively assess the impact of these pressures on the migratory waterbirds recorded at these sites.

In September 2019, a total of 105 individuals belonging to 15 bird species of seven families were ringed. Of these, 97 were also colour flagged. Lesser Sandplover *Charadrius mongolus* was the predominant among the captured species, followed by Kentish Plover *Charadrius alexandrinus* Ruddy Turnstone *Arenaria interpres* and Terek Sandpiper *Xenus cinereus*. Only one individual each of Near Threatened Bartailed Godwit *Limosa lapponica* and Eurasian Oystercatcher were ringed. During the ringing session, nine individuals were re-trapped in the subsequent days, eight of which were Lesser Sandplover and one Bar-tailed Godwit. Totally, 31 ringed individuals belonging to five species were resighted at Akshi Beach between October and December 2019. A Kentish Plover ringed in Akshi on September 24, 2019 was recorded at Merces Beach in Vasai on October 17, 2019, which demonstrated local movement. Additionally, a Broad-billed Sandpiper *Calidris falcinellus* ringed in Uran, Mumbai in February 2015 was recorded two years later in November 2017 from Jamnagar, Gujarat, highlighting the connectivity of these wetlands. Bird ringing in the following season and periodic monitoring will reveal information on the site fidelity as well as the connectivity of wetlands in their migratory route.

In order to collate the re-sighting records of banded birds that would also give detailed information of the movement, health and ecology of the bird as well as the state of the habitat, a bird band sighting form was designed and circulated in various birdwatchers' groups. The replies and comments were reviewed in order to develop a dedicated mobile application for obtaining re-sighting data. The mobile application was named 'Bird Band', and was designed and developed with adequate field testing. It was officially launched on June 05, 2019 by Mangrove Foundation as a part of the World Environment Day celebrations.

A concise bi-lingual training manual – "Bird Monitoring, Handling and Marking: A Training Manual" – was compiled to provide an orientation to stakeholders regarding the standardized methods and protocols involved in bird monitoring, bird migration, collection of data on the ringed bird sightings and identification of important wetlands. A total of seven workshops were conducted in five coastal districts of Maharashtra State *viz*. Palghar, Mumbai Suburban, Mumbai, Thane, Raigad and Sindhudurg. During these workshops, 151 members including Forest Officials, Forest Department front-line staff, local students, researchers, birdwatchers, ornithologists, self-help group members and members of local non-governmental organizations were trained. Along with these, one workshop was conducted on the 'Bird Band' Mobile Application specifically for researchers, birdwatchers and photographers who had been monitoring the coastal wetlands as well as reporting tagged bird sightings.

# **I.** INTRODUCTION

Wetlands are "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres" (Ramsar 2016). They are among the most productive habitats with intense connectivity and supporting high concentrations of birds, mammals, reptiles, amphibians, fish and invertebrate species (Ramsar 2016, Wolanski et al. 2019). Wetlands support enormous biodiversity according to their drainage, location, hydrology, chemistry, fauna, flora, and sediment characteristics (NWA 2009).

Coastal wetlands are special types of waterbodies found between land and open sea, which are influenced by fluctuating water levels. They provide refuge to a vast array of organisms, including many endangered species. These critically important features act as water purifiers, fish spawning areas, feeding grounds, and habitats for many animal species. The wetlands buffer coastal areas against storm and wave damage, and help to stabilize shorelines, which are increasingly important functions in the face of climate change. The economic value of coastal habitats is likely to be hundreds of billions of dollars, if not more (NOAA 2020). These diverse and dynamic ecosystems provide goods and services that contribute towards a nation's economy. They play a significant role in supporting water-dependent species of plants and animals along the coast, as well as maintaining the ecological cycle. The ecosystem services provided by these wetlands to the communities are broadly classified as provisioning services, regulating services, supporting services, and cultural services (Wolanski et al. 2019).

Coastal birds play the role of primary and tertiary consumers, thus contributing to the ecological balance. Their role in recycling the nutrients to the ecosystem through guano deposition is of considerable importance too and helps to enhance the local fisheries. Many coastal birds are efficient scavengers. Then there are those that feed on harmful insects, thus playing their part in vector control (Balachandran 2012). Among the globally threatened species of the Indian coast, the rarest is Spoon-billed Sandpiper *Eurynorhyncghus pygmeus,* once a regular visitor to the east coast of India and now on the verge of extinction due to various reasons. Another globally threatened bird Great Knot *Calidris tenuirostris,* listed as Endangered by BirdLife International and IUCN, is also dependent on Indian coastal wetlands during winter. Besides these globally threatened Indian species, several other species of waders, gulls, and terns depend on the coastal wetlands for feeding and roosting (Balachandran 2012).

## **Bird Migration**:

Migration is one of the most fascinating aspects of bird behaviour, where birds undertake arduous long-distance journeys twice every year. The migratory birds travel from their breeding grounds to their non-breeding sites, covering astounding distances and crossing provincial boundaries, countries and oceans (Russell-French 2008). They rely on a series of habitats within and across regions to rest and feed during their journey. The migratory waterbirds connect continents and countries through the wetlands they use on their journey and are therefore excellent environmental indicators at both global and local scales (Newton 2007, Myers 1983, Sathiyaselvam and Katti 2018). During much of their life cycle, and particularly while undertaking migration, shorebirds are invisible to us. They are undetectable while flying hundreds of metres above oceans for days on end without stopping to rest, feed, or sleep. With the help of recent advances in technology, scientists have finally begun to unravel the interesting patterns of migratory flights of shorebirds (Russell-French 2008).

The management and protection of major wetlands critically important to waterbirds on their traditional migratory flyways is the first priority for conserving the species. Moreover, 'stopover sites' along the migratory routes provide a crucial link between wintering (non-breeding) and breeding areas for migratory birds. Food obtained at stopover sites provides energy to continue their migratory flight and the nutritional reserves that may be essential for a successful reproduction upon arrival at the breeding grounds (Ricklefs 1974, Davidson and Evans 1982, Adrian and Alfred 1997). Hence, it is important to understand the seasonal dynamics of waterbirds so that management can be timed to meet the special needs of breeding, stopover, and wintering periods (Isola et al. 2002, Czech and Parsons 2002).

# Flyways:

"A flyway is a geographical region within which a single migratory species, a group of migratory species or a distinct population of a given migratory species completes all components of its annual cycle such as breeding, moulting, staging and wintering. For some species and groups of species these flyways are distinct 'pathways' linking a network of key sites whereas for other species/groups, flyways are more dispersed" (UNEP/CMS Secretariat 2014). "It is evident that the processes that determine the distributions, abundances and movement patterns of migratory birds operate across geographical and political boundaries. Hence the studies covering groups of countries, continents or flyways are needed" (du Feu et al. 2016).



Figure I.1: Major flyways of the world

The Central Asian Flyway (CAF), one among the nine flyways in the world, encompasses overlapping migration routes covering a large continental area of Eurasia between the Arctic and Indian Oceans and the associated island chains (Fig. 1.1). The Flyway comprises annual migration route of several important waterbirds, most of which cross the borders of over 30 countries extending from the northernmost breeding grounds in Russia (Siberia) to the southernmost wintering grounds in West and South Asia, the Maldives and British Indian Ocean Territory. CAF comprises 182 migratory waterbird species and 244 landbird species, which breed, migrate, and winter within the region (MoEFCC 2018).

The 'Assessment of strengths and weaknesses of flyway instruments', a document of CMS elaborates that for an effective implementation of flyway-based conservation, it is essential to address the drivers of species/population trends for a given flyway. These drivers will vary according to region, species, or population. The drivers are summarized as direct impacts (hunting pressure or illegal trapping) and indirect impacts (habitat loss or degradation through conversion of natural and semi-natural habitats and climate change; UNEP/CMS Secretariat 2014).

The major traditional wintering grounds for the waterbirds of the Central Asian Flyway (CAF) are located in India. During peak annual migration periods, hundreds of thousands of birds travelling along the CAF descend upon the wetlands of India in search of refuge and food. Coastal wetlands in India provide winter refuge for migratory waterfowl from different parts of the world such as north, central and west Asia, Europe, and Mediterranean regions. Birds migrating from Arctic to east Africa use the coastal wetlands along the west coast of India as stopover sites.

#### **Bird Migration Studies in India:**

Studies of ringed/tagged individuals still remain the backbone of pure and applied research in avian biology, particularly with respect to movements, habitat preferences, dispersal, and matters such as ecological issues, migration, hunting, mortality causes, disease transmission and population dynamics (Walker et al. 2017). Bird ringing has been and continues to be undertaken on a large scale in Europe with more than four million birds ringed each year. Several countries have national ringing schemes that cover large geographic areas and, in some countries, such exercises have been prevelant for more than 100 years.

In India, the first attempt at bird migration studies was undertaken in 1927 through a small-scale bird ringing programme (200 birds) by BNHS with support from the Maharaja of Dhar State. During the programme, migrant ducks were ringed to establish their origins. The year 1959 was a significant step for Indian ornithology and the study of bird migration when the first ever organized scheme for bird banding and migration study in the Subcontinent was taken up by BNHS. During the intensive bird ringing programmes undertaken by BNHS from 1959 to 1973, and 1980 to 1992, over 700,000 birds were ringed in India, and many interesting recoveries were obtained. BNHS has generated a large amount of bird banding data through various bird migration study schemes funded by the sponsors World Health Organisation (WHO), Smithsonian institute, US Fish & Wildlife Service, U.S. Research and Development Group and Ministry of Environment and Forest, Government of India. During these bird ringing programmes, effort was focussed on important wetlands, besides covering several other wetlands and forest areas across the country. Since then, ringing has been carried out sporadically in different habitats and regions on project basis. The birds ringed in India have been recovered from 29 countries spread over 5 continents. More than 100 species of birds have been recovered and data of breeding grounds, stopover sites and migratory routes of 40 species have been recorded (Balachandran et al. 2018). The recovery data was pivotal in delineating the boundaries of East Asian-Australasian, Central Asian and African-Eurasian Flyways, with some species utilizing the staging sites of the West Pacific Flyway.

In addition to the traditional methods of marking birds with metal rings, BNHS has in recent years adopted newer methods of tagging birds with colour flags and neck collars. Though the recoveries obtained through these banding programmes have provided a general profile of the movement in and out of the Indian Subcontinent, other marking schemes have also been employed to have a better understanding on the seasonality of movement, wetland connectivity and site fidelity of the species.

A constraint with bird banding is that the birds need to be recaptured in order to obtain data on their movements. This is a strain on finances and it is difficult to implement due to the need for long-term bird banding field stations and trained personnel who can handle birds. Colour tagging (leg band, neck collar, leg flag) has helped garner citizen science data on resighting records, filling gaps on the recapturing constraint. Satellite Telemetry study, where birds are fitted with PTTs (platform transmitter terminals), can track species throughout their journey and provide comprehensive information on the stopover sites – the duration of their stay in these sites, the pathways for northward and southward passage migration and, most importantly, the connectivity between the networks of wetlands used in the migratory pathway for each species. With the use of different tags to reveal information on the movement of birds, a need was felt to provide a common platform to record all the tagged bird-sighting records. This led to the development of the 'Bird Band' Mobile Application.

## Status of wetlands important for migratory birds:

The coastal wetlands, being dynamic, have been and will continue to be impacted in several ways by global climate changes and habitat alterations. These include temperature and sea-level rise, introduction of non-native species, habitat issues leading to the degradation of coastal wetlands primarily through the modification of hydrological and sedimentation regimes, promoting eutrophication and changing the dynamics of nutrients and chemical pollutants. Around 50% of the earth's wetland area is estimated to have already disappeared over the last hundred years through the alteration of habitats for industrial, agricultural and residential spaces. Such alteration would impact the structure and function of coastal wetlands and the pressures could pose both natural and anthropogenic hazards (Lee et al. 2006, NWA 2009, Ramesh et al. 2017).

The narrow coastal intertidal zones are rapidly declining, and many species that use these habitats are threatened with extinction. Of the monitored populations of Arctic breeding shorebirds, 89% show declines. From the studies carried out in other flyways, a link between habitat loss and decline of birds is evident. Similar studies from the Asian perspective to understand the correlation between habitat loss and population trend is the need of the hour (MacKinnon et al. 2012). Extensive long-term monitoring-based studies are required to assess the situation and identify threats to waterbirds using these habitats. The outcomes of these studies would be pivotal in developing management actions for protected areas as well as creating conservation actions for non-protected areas.

## **Conventions and Policies for conservation of wetlands**

The 'National Action Plan (NAP) for conservation of Migratory Birds and their habitats along Central Asian Flyway' has been prepared by the Government of India to achieve the activities envisaged in the CAF Action Plan. It elaborates on the national priority and specific actions required to ensure a healthy population of migratory species in India. Drawing from the CAF Action Plan, it aims at enabling nationaland state-level policy makers responsible for the conservation and management of habitats, stakeholders, and the society to take coordinated actions for securing and enhancing populations of migratory birds. To achieve the goal, the NAP is structured under six interrelated components:

- 1. Species conservation
- 2. Habitat conservation and sustainable management
- 3. Capacity development
- 4. Communication and outreach
- 5. Research and knowledge base development
- 6. International cooperation

In the CAF National Action Plan, 48 sites comprising 20 major wetlands and nine wetland clusters have been identified as critical, crucial and bottleneck sites for migratory waterbirds (MoEFCC 2018). These critical sites for waterbirds have been selected based on several criteria and insights gained from the two major flagship programmes of BNHS – IBA and bird migration study programme (for 90 years).

The United Nations Conference on Environment and Development (UNCED), also known as the *Earth Summit 1992*, was held in Rio de Janeiro, Brazil. During the summit, the Agenda 21 brought out during the conference has been considered a blueprint for sustainable development. The chapter 17, Agenda 21 discusses the need and ways of protecting coastal sites from the perspective of rational use and development through Integrated Coastal Zone Management (ICZM). It highlights the need for 'strengthening the international and regional cooperation for integrated management' and 'sustainable development of coastal areas' (United Nations Sustainable Development 1992).

#### Justitication:

India boasts of a coastline of around 7515 km (from Gujarat to Sunderbans), of which 720 km lies in Maharashtra. The coastline is indented and comprises 10.56% of the total wetlands of Maharashtra (Ramesh et al. 2017, NWA 2009). It includes the districts of Thane, Palghar, Raigad, Greater Mumbai, Ratnagiri and Sindhudurg. The Maharashtra coast, popularly known as Konkan coast, is an important sector on the west coast of India because of its physical distinctiveness, biota and marine resources. It is characterized by pocket beaches flanked by rocky cliffs of Deccan basalt, estuaries and patches of mangroves. Maharashtra is one of the fast-growing states of India, and many developmental projects like thermal power plants, major and minor ports, and tourism establishments are proposed/implemented all along the Maharashtra coast (Apte & Bhave 2010).

The wetlands in Maharashtra are important in the migratory routes of waterbirds in the Central Asian Flyway and the East African-Eurasian Flyway. The inland and coastal wetlands of Maharashtra act as refuelling stations for birds that migrate further south and also during their return migration to the breeding sites. They provide suitable wintering grounds for the long-distance migratory birds and play a crucial role in their annual cycle. As they are the critical bottleneck sites for migratory birds, protecting such sites is of immense importance.

The conservation of birds also requires reliable and up-to-date information on population size and trends, which will help to identify species of concern and assess the impact of conservation efforts. However, the information on the status and trends of these species is insufficient and outdated and efforts are needed to fill the knowledge gap (Mundkar 2017). As far as avifauna is concerned, over 560 bird species have been reported and a total of 20 Important Bird Areas have been identified in Maharashtra, in which seven are wildlife sanctuaries (Rahmani et al. 2016). The knowledge about the waterbird population and congregation areas along the Maharashtra coast is mostly based on Asian Waterbird Census (AWC) and a few site-specific monitoring data. Information obtained from bird population monitoring and coordinated ringing studies will be helpful to India to involve in conservation programmes at the national and international level, to engage with agreements and treaties, and to address site-specific conservation issues.

In 2013, the Forest Department identified six sites to be declared as Ramsar sites in Maharashtra. These include Sewri Creek (Mumbai district), Ujjani Reservoir (Pune district), Jaikwadi Bird Sanctuary (Aurangabad district), Navegaon Bandh Reservoir (Gondia district), Nandur Madhmeshwar Wildlife Sanctuary (Nashik district), and Lonar Crater Wildlife Sanctuary. Along with this, 11 wetland sites are also listed as Important

Bird Areas (Rahmani et al. 2016). Moreover, in Maharashtra, Jaikwadi Bird Sanctuary, Gangapur Dam and Nandur-Madhmeshwar Wildlife Sanctuary along with a wetland cluster comprising Mahul-Sewri Mudflats, Thane Creek, Uran and Alibaug have been identified as important migratory waterbird sites of India for the conservation of CAF waterbird population.

In this context, it was proposed to study the population dynamics, movement patterns, migratory routes, wetlands utilized, duration of stay and the functions performed by the wetlands for the migratory and local migratory species along the Maharashtra coast. There is also a great need to enhance public awareness about migratory birds, their plight, and their migration flyways. All of this can be achieved through capacity building exercises. Hence, the study was chalked out with the following objectives:

# **Objectives**:

- 1. To monitor waterbird population to determine the role of coastal wetlands in Maharashtra and their importance for migratory birds.
- 2. To study the movement and dispersal pattern of short- and long-distance migrants and to document the existence of important staging/wintering areas along the coast of Maharashtra by using bird ringing and colour marking.
- 3. To study the current status of globally threatened and rare bird species (if any) that fly to the Indian wintering grounds.
- 4. To contribute to the Central Asian Flyway (CAF) population estimation and to fill the gaps in the knowledge of the movement patterns/migratory routes of priority species identified in the Convention on the Conservation of Migratory Species of Wild Animals (CMS) CAF Action Plan.
- 5. To develop special mobile application to collect information on bird population and track the movement of the colour-marked birds
- 6. To impart training to amateur birdwatchers, researchers, inter-department stakeholders, wildlife officials and the local public in bird monitoring techniques and the importance of bird migration studies.

# **II. METHODOLOGY**

# **A. STUDY AREA**

### Monthly survey areas:

Based on the available secondary information and previous studies conducted by BNHS, the sites supporting a large number of migratory waterbirds along the Maharashtra coast were selected for seasonal surveys during early, mid and late wintering season as well as during summer season.

Following which, a reconnaissance survey was carried out in the wetlands around Mumbai for two months (August and September) in 2017 to identify sites that support congregations of migratory waterbirds in the wetlands. The sites supporting good congregations of waterbirds were selected for monthly surveys. The sites that migratory birds were known to be using inconsistently were surveyed opportunistically to record the birds at the locations.

The major sites selected for monthly monitoring were Sewri Jetty, Bhandup Pumping Station (BPS), Airoli Jetty (Thane Flamingo Sanctuary), Delhi Public School pond, Training Ship Chanakya (TSC) wetland, NRI Complex ponds, and Jasai and Panje/Panje Dongri wetlands (Fig II.1). Another site, Akshi Beach, which is less than 50 km of aerial distance from Mumbai, was also surveyed monthly. Seasonal surveys were carried out in a few other migratory bird congregation sites.



Figure II.1: Areas selected around Mumbai Bay for monthly monitoring

### Seasonal surveys:

The coastal sites along the Konkan coast in Maharashtra (between Alibaug and Terekhol) were surveyed to understand their significance to the wintering migratory waterbirds. A total of four surveys were carried out during the study duration – one before the onset of wintering birds, two surveys in mid winter and one in late winter – to record the birds staging during northward passage.

The first reconnaissance survey along the Maharashtra coast was conducted in July 2017 during which period sites between Alibaug and Terekhol were surveyed.

From the field surveys and information obtained from the local communities, potential migratory waterbird sites were shortlisted for further surveys. A total of 37 potential bird habitats were recorded during the survey.

The second reconnaissance was conducted in January 2018 to record the mid-winter migratory waterbird population. Along with the initially identified 37 sites, 12 more sites were identified as feeding and roosting sites for the migratory waterbirds (Fig II.2). Besides enlisting the presence of waterbirds, the direct threats and pressures were also recorded.

🖉 Akshi Sakharkhadi	
Revdanda Bridge	
Nandgaon Beach	
Agardanda	
Diveagar outskirts	
<ul> <li>Kanjil Srivardhan Mudflats</li> <li>Velas Beach</li> </ul>	
Kelshi-Anjarle Beach Murud-Dapoli Mudflats	
🖲 Undi Beach	
Paishet Beach	
🤷 Kasari	
Malgund Beach	
Bhayte Bridge	
🔎 Kasheli bandh	
a Bakale fata	
Pural field	
B Taramumbrai	
Achra Crab Culture	
Pat Parule Lake	
Vengurla bandar	
😽 Siroda Saltpans	

Figure II.2: Areas surveyed along the Maharashtra coast to identify migratory waterbird congregation sites

One survey was conducted in April and early May 2018 to record the status of migratory bird population during return migration and understand the status of the habitats in late winter. Information on the recent trends and seasonality of birds was obtained from the locals.

The fourth survey was carried out in early December, during which a total of 99 sites were surveyed (Annexure III).

A vehicle was used to reach the nearest possible site, beyond which the sites were approached on foot. From these visited sites, the potential sites were selected for further surveys. The sites were categorized as feeding sites or roosting sites.

The coastal feeding sites were approached during low tide or nearing high tide. The roosting sites and inland feeding sites were approached during high tide. The sites used for night roosting were visited early evening. Information was collected from the local communities to know about the seasonality of the arriving birds and duration of stay, and understand the temporal changes in the timing and number of migratory birds arriving at the sites. Along with waterbird documentation, local fishermen were consulted in order to understand their perception of the movement of birds between adjoining beaches.

## **B. METHODS**

Monthly wetland bird surveys were conducted in the selected wetlands in the Mumbai Bay. Seasonal waterbird surveys were conducted in the other 49 sites along the Maharashtra coast between Alibaug and Shiroda.

## **Bird Monitoring**

The waterbird population was counted monthly by direct counts (Spindler et al. 1981). To do so, the bird congregations were approached as close as possible without disturbing. Conspicuous species present in relatively small numbers or dispersed widely were counted singly, whereas birds in large flocks were generally estimated by mentally dividing the congregation into small groups of 10 to 100 depending on the size of the flock, and by counting the number of groups. Waterbird species were counted individually or in units of 10 when flocks were up to 5000 individuals. Very large flocks (> 5,000) were counted in units of 100 to 500. Bird counts were carried out during low tide at the coastal and creek sites as the birds congregate to feed on the exposed mudflats. In inland wetlands, the bird count was carried out during high tide.

Basic identification was done using 'Birds of the Indian Subcontinent' (Grimmett et al. 2011) and for further identification and information on differentiating similar species, 'Handbook of the Birds of the World' (del Hoyo et al. 2018) and Ali & Ripley (1987) were referred.

To record the data, Nikon 10x50 and Nikon 8x42 binoculars were used. Wherever possible, Nikon Fieldscope 85 and Nikon P900 camera were used for counting and identifying species.

Birdlife International 2018 list was followed for nomenclature and status of birds. In the bird monitoring chapters, the species-wise waterbird counts are listed. In places where the count talks about 'a few' individuals, the number recorded is less than ten individuals.

Questionnaires: A questionnaire was circulated among the local residents to know their perception about the time when the birds arrive, how long they stay and the temporal changes in their numbers and arrival timings at the sites.

#### **Training and Awareness Programme**

A total of seven training workshops were conducted for participants from six coastal districts of Maharashtra *viz*. Mumbai city, Mumbai Suburban, Thane, Palghar, Raigad and Sindhudurg. Different stakeholders were targeted during each training programme to maximize the impact and provide relevant orientation on bird migration. A concise bilingual training manual on bird migration and bird monitoring was compiled to highlight the standardized methods and protocols involved in the collection of data related to bird migration and wetlands. The manual also emphasizes the need for long-term monitoring data for a relevant and effective management of a site.

### Status of threatened species and their movements - Literature review

The information on the distribution of bird species has been sourced from Ali and Ripley (1987) and del Hoyo et al. (2018). Details about threats and population trends have been majorly sourced from Rahmani (2012) and IUCN Red List for Threatened Species. The movement records are from Balachandran et al. (2018). The population status, size and 1% estimate are taken from 'Waterbird Estimate V' (Wetlands International 2019).

# III. MONITORING OF IMPORTANT MIGRATORY WATERBIRD HABITATS IN AND AROUND MUMBAI BAY

Monthly surveys were conducted in major selected sites. To understand the importance of and the role played by these sites with regard to waterbirds, the survey exercises were divided into four seasons.

# August-October

It is the arrival time of migratory birds to the non-breeding sites, and also the period when those moving southward towards their wintering sites make a stopover to feed and rest.

# **November–February**

It is the wintering months for the migratory birds. Largely, the migratory species spend their winter in the particular area or move locally to feed and roost during this period.

# March-May

Migratory birds start accumulating fat and commence their journey to the breeding grounds. During this time, the birds returning from their wintering sites far south may be recorded making a stopover for a short duration before continuing with their northward journey.

# June-July

This duration is the breeding season for the long distance migratory waterbirds. Every year, a few birds, particularly those over summering, are seen.

# **Results and discussion**

# **NRI Complex Ponds**:

This site is located at Seawoods, off Palm Beach Road. The wetland is spread across 20 hectares. The water inlet is from the creek on the northern side and the water level is regulated by the fishermen to optimise the fish harvest. A bund divides the wetland into two ponds. Fishing activity is intensive throughout the year in the northern pond, while it is seasonal in the southern pond. This wetland has plantation along the edges on the western side, which is further surrounded by mangroves. During the bird surveys, on several occasions, roosting birds were seen settling in the open patches in the manarove to the south-western side of the wetland. The eastern side of the wetland is composed of a housing complex and a road (Fig. III.1). Due to the presence of a barbed fence along the road prohibiting direct entry, the birds are not seen to be affected by the disturbance from the road. The wooded vegetation patch on south-eastern edge provides good roosting



Figure III.1: Map showing NRI Ponds



Figure III.2: Flock of Lesser Flamingo Phoeniconaias minor recorded at NRI Ponds in October 2017



Figure III.3: Population fluctuation of waterbirds in NRI Ponds from October 2017 to March 2019

sites for storks and egrets. Water level, though dependent on tide, is regulated by the local fishing community. This site consists of two ponds, scrubs and mangroves.

During the study carried out by BNHS during the period 2013–2014, the bird counts were higher in October and March, coinciding with the southward and northward passage. This pattern was not observed during the present study period. During December 2014, a total of 422 birds belonging to 19 waterbird species and 12 landbird species were ringed at this site, some of which were resighted during the study period.

# August-October

Monthly monitoring in this wetland began in October 2017. The water level was high in the wetland and the waterbirds, particularly migratory duck species, were recorded at the edges of the ponds. Northern Pintail *Anas acuta* (23), Northern Shoveler *Spatula clypeata* (13), Indian Spot-billed Duck *Anas poecilorhyncha* (12), and a few individuals of Garganey *Spatula querquedula* were recorded along with two individuals of Tufted Duck *Aythya fuligula*. In the southern side of the wetland, species such as Little Cormorant *Microcarbo niger* (12), Little Egret *Egretta garzetta* (11), Glossy Ibis *Plegadis falcinellus*, Painted

Stork *Mycteria leucocephala*, Great Egret *Ardea alba*, and Indian Pond Heron *Ardeola grayii* were recorded. Little Tern *Sternula albifrons* (29), Whiskered Tern *Chlidonias hybrida* (17), and Gull-billed Tern *Gelochelidon nilotica* (9) were recorded feeding at this wetland.

In the subsequent season, August 2018, the water level was very high in these wetlands. A total of 29 Painted Stork were recorded roosting on the trees at the edge of the wetland, along with 11 Intermediate Egret *Ardea intermedia*.

In September 2018, a roosting flock of Lesser Flamingo *Phoeniconaias minor* (475) and Greater Flamingo *Phoenicopterus roseus* (12) was recorded. Little Cormorant (39), Painted Stork (29), and Intermediate Egret





(10) were also recorded roosting on the trees. The arrival of migratory duck species was recorded during September. Northern Shoveler (32) and Northern Pintail (12) along with a few individuals of Common Teal *Anas crecca* and Spot-billed Duck were recorded on the southern side of the wetland. Whiskered Tern (21) and Gull-billed Tern (11) were seen roosting along the edge of the wetland. The water level was still high, as a result of which no shorebirds were recorded at this site.

The number of waterbirds increased from August to October. Flamingos and ducks species were the dominant species from August to October (Fig.III.4).

# November-February:

In November 2017, 667 waterbirds were recorded, majority of which were ducks and coot, comprising Northern Pintail (336), Common Teal (36), and a few individuals of Northern Shoveler and Common Coot *Fulica atra*.

In November 2018, 2626 individuals of waterbirds were recorded, including Greater Flamingo (1105), Lesser Flamingo (79), and roosting flocks of Painted Stork (419) and Brown-headed Gull *Larus brunnicephalus* (354). Among the waders, a flock of Pied Avocet *Recurvirostra avosetta* (186) and Eurasian Curlew *Numenius arquata* (37) was recorded.

In December 2017, fishing activity intensified in the wetlands, which caused disturbance to the waterbirds. As a result, their numbers declined drastically.

But in the subsequent year, December 2018, with the fishing activities restricted to the northern side of the pond, the birds were confined to the southern pond. A total of 2023 Lesser Flamingo and 165 Northern Shoveler were recorded in the pond. The numbers of Pied Avocet (312) was higher than the previous year.



Figure III.5: Roosting Painted Stork Mycteria leucocephala congregation at NRI ponds in November 2018



Figure III.6: Relative composition of waterbird families at NRI ponds between November and February

In January 2018, migratory ducks were the predominant species, comprising Northern Pintail (539), Common Teal (217), and Northern Shoveler (58). A roosting flock of Brown-headed Gull (125) was observed, along with a few Slender-billed Gull *Larus genei*. In January 2019, a large flock of 7000 Lesser Flamingo and 1000 Greater Flamingo was recorded in the wetland. The number of Pied Avocet was higher than the previous years and 536 of them were recorded.

In February, the number of waterbirds declined in this wetland. A flock of 583 Lesser Flamingo and 12 Greater Flamingo was recorded. Other dominant species recorded were Northern Shoveler (241), Common Teal (12), and Pied Avocet (16).

During the winter months (November to February), waterbird species of Phoenicopteridae, Anatidae and Recurvirostridae families were predominant among all waterbirds recorded in this wetland (Fig. III.6).

## March-May:

When summer progressed, this wetland was gradually drained out and the water was retained only in the northern pond.

In March 2018, with water at low level, several birds were seen actively feeding at this site. Northern Shoveler (220) and a few Northern Pintail, Eurasian Spoonbill *Platalea leucorodia*, and Black-headed Ibis *Threskiornis melanocephalus* were seen feeding. The Pied Avocet numbers were still high and 391 individuals were seen feeding, along with a group of Eurasian Spoonbill (48), Black-winged Stilt *Himantopus himantopus* (29), Grey Plover *Pluvialis squatarola*, Common Sandpiper *Actitis hypoleucos*, and Marsh Sandpiper *Tringa stagnatilis*. Brown-headed Gull (119), Gull-billed Tern (13), and Lesser Flamingo (14) species were recorded roosting along the edge of the wetland.

A mixed-species flock of 70 individuals comprising Black-headed Gull *Larus ridibundus*, Brown-headed Gull, Whiskered Tern, Slender-billed Gull, Caspian Tern *Hydroprogne caspia*, and Gull billed Tern was seen feeding in the northern pond in April 2018. Small numbers of waders comprising Black-winged Stilt (37), Curlew Sandpiper *Calidris ferruginea* (32), Marsh Sandpiper (23), Common Greenshank *Tringa nebularia* (21), Little Stint *Calidris minuta* (17), a few individuals of Ruff *Calidris pugnax*, Eurasian Curlew, and Greater Sandplover *Charadrius leschenaultii* were seen feeding in the southern pond.



Figure III.7: Relative composition of waterbird families at NRI ponds between March and May

In May 2018, the southern pond had completely dried up, restricting birds only to the northern pond. The composition of gulls and terns recorded at the wetlands increased from March to May. A feeding flock of 268 Gull-billed Tern, 144 Brown-headed Gull, 24 Caspian Tern, and a few individuals of Black-headed Gull, Whiskered Tern, and Lesser Crested Tern *Thalasseus bengalensis* were seen hovering, looking for prey. As many as 51 Eurasian Curlew and 32 Black-winged Stilt were recorded along the boundary of the pond (Fig III.7).

## June-July:

In June 2018, both the adjoining ponds were filled with water. During low tide on one of the survey days, a small feeding flock of Whiskered Tern, and Gull-billed Tern was recorded. Later during the same day, with the approaching high tide, several flocks of Lesser Flamingo were recorded flying into the ponds in a span of 20 minutes, numbering 2870 individuals in all. These flocks were disturbed by the intermittent showers, but were seen settling back.

## Wetland behind TSC (henceforth mentioned as TSC wetland)

This wetland is located off Palm Beach Road, behind the TSC campus. Spread across 15 hectares, this wetland is divided by small bunds to make fishing ponds. The water level is managed by the fishermen for effective fishing practices. The wetland is surrounded by the TSC campus to the east and scrubland and fields to the south as well as to the west. Beyond the field to the west, it is connected to the Thane Creek and mangroves. Large congregations of shorebirds were known to use this wetland during a

short period when the fishermen emptied it for maintenance purpose.

# **August-October**

In October 2017, a feeding flock of 230 Black-winged Stilt, along with Glossy Ibis and Common Greenshank, was observed on the eastern edge of the wetland. Other roosting birds recorded included Grey Plover, Wood Sandpiper *Tringa glareola*, and Common Redshank *Tringa totanus*.

In August 2018, the water level in the wetland was very high and no birds were recorded in the wetland. The water level remained high until September and only a small roosting flock of Painted Stork and Little Cormorant was recorded on the wooded vegetation on the edge of the wetland.

In October 2018, the water level was not very high and scattered flocks of waders were recorded in the wetland. Of the species counted, the highest recorded species was Little Stint (100), followed by Grey Plover



Figure III.8: Map showing the wetlands behind TSC

(36), Black-winged Stilt (32), Common Redshank (26), Lesser Sandplover *Charadris mongolus* (25), Marsh Sandpiper (17), and Common Greenshank. Species such as Gull-billed Tern (40) and Whiskered Tern (35) were also recorded. The tern species were found feeding in the wetland.



Figure III.9: Population fluctuation of waterbirds in TSC wetland from October 2017 to March 2019

## **November-February**

In November 2017, a total of 564 birds were recorded. Of them gulls and terns *viz*. Black-headed Gull (200), Gull-billed tern (47), Whiskered Tern (45), Slender-billed Gull (40), and Caspian Tern (32) were collectively more common than the other species. Of the waders, Black-winged Stilt (77), Common Redshank (53), and Common Greenshank (10) were recorded along with a few individuals of Grey Plover and Common Sandpiper.

In November 2018, as the water was drained out, large congregations of waterbirds were seen feeding and roosting in the wetland. A large roosting congregation of wader species was recorded, comprising Curlew Sandpiper (5000), Little Stint (2000), Lesser Sandplover (2000), Dunlin *Calidris alpina* (1000), Marsh Sandpiper (500), Common Redshank (200), Eurasian Curlew (153), Common Greenshank (100). Other shorebirds recorded in small numbers were Grey Plover (83) and Pacific Golden Plover *Pluvialis fulva* (56).



Figure III.10: Relative composition of waterbird families at TSC wetland between November and February

A flock of Greater Flamingo (163) and Lesser Flamingo (70), along with Gull-billed Tern (259), Black-headed Gull (80), and Brown-headed Gull (66), was recorded roosting at the edge of the wetland. A few days after the wetland was inundated again, the bird count decreased considerably.

In December 2018, due to high water level, only a few individuals of Curlew Sandpiper and Blacktailed Godwit *Limosa limosa* were seen on the bunds. A flock of 3000 Lesser Flamingo and 1000 Greater Flamingo was seen feeding in the wetland. A feeding flock of gulls and terns, including Brown-headed Gull (74) and Gull-billed Tern (26), was also recorded.

In January 2019 150 Painted Stork were seen roosting on the trees along the pond, which was not recorded in the previous months. Along with the Painted Stork, 33 individuals of roosting Little Cormorant were also seen on these trees. A few feeding individuals of Common Greenshank, Grey Plover, Pacific Golden Plover, Marsh Sandpiper, Caspian Tern, and Black-headed Gull were recorded. In January 2019, the major count comprised Brown-headed Gull (77) and a few Caspian Tern, Whiskered Tern, and Gull-billed Tern.

In February 2019, a flock of Greater Flamingo (583) along with a few Lesser Flamingo was seen feeding in the wetland (Fig. III.10)

# March-May

In March 2018, the water level was high with signs of eutrophication. Only a few waders namely Curlew Sandpiper (32), Common Redshank (29) and a few individuals of Little Stint, Kentish Plover *Charadrius* 

*alexandrinus*, Lesser Sandplover, Eurasian Curlew, Green Sandpiper *Tringa ochropus*, Wood Sandpiper, and Broad-billed Sandpiper *Calidris falcinellus* were recorded along the edge of the water (Fig. III.12). Also, a few Brown-headed Gull and Slender-billed Gull were recorded feeding in the pond. Even though the water level was less, a few waterbirds were recorded at the wetland.

In April 2018, 73 Common Greenshank were recorded, along with a mixed flock of 200 waders comprising Dunlin, Curlew Sandpiper Lesser Sandplover, Ruddy Turnstone *Arenaria interpres*, and Broadbilled Sandpiper. A flock of Black-headed Ibis *Threskiornis melanocephalus* (24), Painted Stork (17), Little Cormorant (13), and a few egrets were seen roosting on the trees along the periphery of the wetland. In May 2018, the water in the ponds was partially drained out. At that time, a total of 3521 Lesser Flamingo were recorded along with 28 Greater Flamingo. A large number of egrets and cormorants were recorded at this site, and also Gull-billed Tern and Whiskered Tern.



Figure III.11: Flock of flamingos recorded at TSC wetland in May 2018



Figure III.12: Relative composition of waterbird families at TSC wetland between March and May

# June-July

In June 2018 the water level in the wetlands was high due to rains and only 67 Lesser Flamingo along with a few Indian Spot-billed Duck were recorded during the survey.

# **DPS Pond**

This is a shallow pond adjacent to Delhi Public School along the Palm Beach Road, Navi Mumbai. The wetland is spread across 15 hectares' area and a small canal connects this wetland to the Kharghar Creek. The water level fluctuates according to the tide. A service road is present between the northern edge of the wetland and a school to the west.

# August-October

The water level was high and only a few individuals of Little Cormorant, Great Egret, Little Egret, Intermediate Egret and Pond Heron were seen in this wetland in August and September 2017–2018 and 2018–2019 migratory season. In October, the inlet was blocked and the pond was dried up. No birds were recorded in October.



Figure III.13: Map showing DPS Pond



Figure III.14: Population fluctuation of waterbirds in DPS Pond from November 2017 to March 2019

# November-February

During the count in December 2018, a flock of Lesser Flamingo (853) was recorded at this site. A flock of Brown-headed Gull (237) and Gull-billed Tern (71) was seen roosting at the edge of the pond. Among shorebirds Pied Avocet (76) was the dominant species followed by Black-winged Stilt (26). Totally 22 Northern Shoveler and a few individuals of Common Redshank, Wood Sandpiper and Common Teal were also recorded.

In January 2018, a mixed flock of gulls (430) comprising Black-headed Gull, Brown-headed Gull, and Slender-billed Gull, and 13 individuals of Common Redshank were recorded. Totally 34 Little Cormorant were roosting on one tree along the southern bank. A flock of Brown-headed Gull (354) was also seen in January 2019 along with a flock of 273 Lesser Flamingo and 123 Pied Avocet (Fig. III.15).

In February 2019, a large flock of 460 Pied Avocet was seen feeding, along with Black-winged Stilt (117), Eurasian Spoonbill (18), and a few individuals of Common Redshank and Black-headed Ibis. A roosting flock of gulls and terns, mainly comprising Gull-billed Tern (521), Brown-headed Gull (213), and Caspian Tern (25), was seen.



Figure III.15: Relative composition of waterbird families at DPS Pond between November and February

## March-May

In March 2018, the bird numbers declined considerably as one part of the pond had dried up. A total of 226 individuals were recorded, with major composition of Black-winged Stilt (64), Little Cormorant (48), and Whiskered Tern (38). A year later, in March 2019 it was inundated with water, but heavy algal growth was seen.

In April 2018, a roosting flock (37) of gulls and terns, comprising Brown-headed Gull, Black-headed Gull, Whiskered Tern, Caspian Tern, and Gull-billed Tern, was recorded. A total of 27 Black-winged Stilt were also recorded.

In May 2018, the pond had almost dried up and merely 34 individuals were recorded at this site. Of which, 19 were Black-winged Stilt and the rest, Common Redshank and Slender-billed Gull.

#### June-July

In June, despite the pond being filled with water, only 20 egrets were recorded.

It is important to mention here that fishermen were seen moving frequently to the wetland and there was a great deal of disturbance. This could be the reason that despite ideal water level, the waterbird numbers were very less in this wetland.

## Sewri Jetty

The site consists of open mudflats near Mahul-Sewri-Trombay located along the Arabian Sea, and is notified as a whole as an Important Bird Area. The mudflats have been feeding sites for large congregations of shorebirds and flamingos. The habitat comprising Mahul-Sewri mudflats is a proposed Ramsar Site under Criteria 2 (wetland supporting threatened ecological communities), Criteria 4 (wetland providing refuge during adverse conditions to threatened species), Criteria 5 (wetland regularly supporting 20,000 or more waterbirds) and Criteria 6 (wetland regularly supporting 1% biogeograhic population of one species or subspecies; Rahmani et al. 2016). This site was surveyed during low-tide.

The construction of the Mumbai Trans Harbour Link started during the study period. The access to the vantage points used for counting the waterbirds were restricted at times. Therefore, the counts were carried out whenever the permission to access the jetty was granted. During the initial phase of the



Figure III.16: Population fluctuation of waterbirds in Sewri from November 2017 to March 2019

construction, a lot of disturbance was recorded due to the drilling activity as well as the movement of the construction staff around the Sewri jetty. During the survey period, significant amount of anthropogenic disturbance was observed at the Sewri jetty pertaining to construction activity, with a large number of construction staff operating on the site. Unlike earlier times, birds were rarely recorded close to the jetty. In most of the months, no birds were recorded close to the jetty; only a few birds were sighted deeper towards the centre of the creek.

# August-October

In August and September 2018, birds were barely recorded as a result of the disturbance near the jetty. In October 2018, despite the disturbance, feeding birds were recorded at the mudflats. A total of 3100 Lesser Flamingo were seen feeding along with congregations of Lesser Sandplover (260), Black-tailed Godwit (190), Little Stint (150) and a few scattered individuals of Dunlin, Curlew Sandpiper and Common Sandpiper. A roosting flock of 500 Gull-billed Tern was also recorded at the mudflats.

## November-February

In November 2018, a feeding flock of 5300 Lesser Flamingo and 105 Greater Flamingo was recorded from Sewri Jetty. A roosting flock of 700 individuals, comprising Brown-headed Gull, Black-headed Gull, Whiskered Tern, Gull-billed Tern and Caspian Tern, was recorded in the northern side of Sewri from the jetty. The shorebirds counted were Black-tailed Godwit (350), Lesser Sandplover (165) and a few individuals of Curlew Sandpiper, Whimbrel, Eurasian Curlew, Common Redshank and Common Sandpiper.



Figure III.17: Relative composition of waterbird families recorded at Sewri Jetty between November and February

In December 2018, a flock of 125 Lesser Flamingo and 20 Greater Flamingo, along with a small wader flock of Grey Plover, Lesser Sandplover, Curlew Sandpiper and Dunlin, was observed scattered in the creek. In the same month in the previous year, a flock of over 100 gulls were observed feeding in the creek. Apart from these, only a few scattered individuals of Common Greenshank, Eurasian Curlew, Common Sandpiper, Common Redshank and Western Reef Egret *Egretta gularis* were seen feeding.

In January 2019, despite the disturbance from the movement of the construction staff near the jetty, a congregation of estimated 2700 Lesser Flamingo and 94 Greater Flamingo was recorded near the jetty (Fig. III.17). A flock of 200 waders, with the major composition of Lesser Sandplover and a few individuals of Eurasian Curlew, Common Sandpiper and Wood Sandpiper, was observed along with a roosting flock of 54 Brown-headed Gull.

In February 2019, as the disturbance intensified, a total of 75 migratory and resident waterbirds predominantly comprising Caspian Tern, Brown-headed Gull and Common Redshank were recorded from the jetty.

## March-May

In March 2018, a few waders namely Little Stint, Temminck's Stint *Calidris temminckii* and Little Ringed Plover *Charadrius dubius* were recorded near the jetty. In March 2019, a flock of 3160 Lesser Flamingo and 303 Greater Flamingo was seen feeding in the creek. Waders namely Common Redshank (303), Lesser Sandplover (47) and Eurasian Curlew were recorded. These wader species were found with partial breeding plumage.

In May, despite the disturbance, a total of 8253 Lesser Flamingo along with 190 Lesser-whistling Ducks were recorded feeding at this site during the receding tide.

## June-July

A flock of over 9000 individuals of flamingo (Lesser Flamingo and Greater Flamingo) was recorded in the creek during low tide more than 500 m east of the creek from the jetty in June 2018. Small congregations of Painted Stork, Black-headed Ibis and Common Greenshank were also recorded from this location.



Figure III.18: Flamingo congregation recorded at Sewri mudflats in June 2018

# **Jasai Wetland**

This wetland has water source at the northern edge from the creek inlet at Nhava and the flow is managed by the local communities. This wetland is bordered by Uran-Panvel Road on the eastern side, Jasai village to the north and Ranjanpada settlement to the southeastern edge. At the onset of the study, landfilling activity was seen initiated at the wetland and by September 2018, a major part had been reclaimed and construction work was in progress. The surveys were conducted during high tide when birds were known to use this site for feeding and roosting. During the



Figure III.19: Landfilling activity at Jasai in May 2018

initial months of the study, waterbirds were recorded scattered at Jasai, but during the later months, due to reclamation activities, birds were restricted to the southern side of the Jasai Wetland.



Figure III.20: Landcover change at Jasai wetland

# August–October

In October 2017, the water level was low and a feeding congregation comprising Black-Tailed Godwit (206), Black-winged Stilt (196), Painted Stork (170), and Eurasian Spoonbill (152) was recorded. A few individuals of Ruff, Curlew Sandpiper, and Marsh Sandpiper were also seen.
In August 2018, it was observed that the major portion of the wetland had already been reclaimed. Heavy vehicular movement was also observed on the reclaimed land. No birds were recorded at this site in August and September 2018, probably owing to disturbances from the vehicular activities.

# November-February

In November 2017, Black-winged Stilt (157) were recorded along with Common Redshank (110) and Black-tailed Godwit (47), and a few individuals of Ruff and Kentish Plover. In December 2017, a large number of waterbirds were recorded (388), the majority being egrets. A total of 54 Asian Openbill *Anastomus oscitans*, 49 Common Coot, 35 Painted Stork, and 11 Ruddy Shelduck *Tadorna ferruginea* were recorded in the wetland.

In January 2018, the reclamation work had intensified. Human disturbance was high, no birds were recorded at the site. In January 2019, a small congregation of waterbirds was recorded in the southern edge of the unreclaimed wetland. A flock of Pied Avocet (255), Black-winged Stilt (72), Lesser Flamingo (43), and Curlew Sandpiper (28) were recorded in this area.

# March-May

In March 2018, a flock of 370 Little Stint, 99 Black-winged Stilt, 56 Common Redshank and 26 Marsh Sandpiper was seen along with two individuals of Greater Flamingo in the southern part of the wetland. During this survey, 160 Little Stint and 23 Greater Flamingo were also seen in the nearby NSP Saltpans. In April 2018, a total of 53 Greater Flamingo, and 26 Black-winged Stilt were recorded. From May, no waterbirds were recorded.

# **Panje Wetlands**

Panje wetland is a network of ponds located between Panje Koliwada and Dongri villages. The water inlet from the adjoining creek is managed by the villagers for fishing as well as recreation.

# August-October

In August 2018, during the arrival season of migratory waterbirds, all the ponds were filled with water and the water level was not very high. Over 3000 waterbirds were recorded at this wetland. A majority of them were Greater Flamingo (960) followed by a large roosting flock of Whiskered Tern (880). Totally, eleven species of waders were recorded here, of which Little Stint (490) was the dominant species followed by Common Redshank (240), Black-tailed Godwit (176), and Black-winged Stilt (154).

In September 2018, the water level receded and the birds were confined to the northern



Figure III.21: Map showing Panje wetlands

ponds. A large number of shorebirds such as Curlew Sandpiper (1040), Little Stint (930), Lesser Sandplover (450), Black-tailed Godwit (245), and Black-winged Stilt (123) were recorded. Broad-billed Sandpiper (62), Temminck's Stint (60), Pied Avocet (45), Marsh Sandpiper (28), and Eurasian Curlew (21) were also recorded. A flock of 586 Greater Flamingo was reported along with 26 Lesser Flamingo. One individual of Indian Skimmer *Rynchops albicollis* was also recorded during this month.



Figure III.22: Population fluctuation of waterbirds in Panje from November 2017 to March 2019



Figure III.23: Roosting flock of ducks recorded at Panje wetlands in October 2017

During October 2018, due to high water level and disturbance, no birds were recorded during the survey. A year earlier, in October 2017, a mixed flock of 560 ducks (Northern Shoveler and Northern Pintail) was seen in the southern ponds, while shorebirds were recorded in the northern ponds (Fig III.24). A flock of 278 Black-winged Stilt, 256 Little Stint, 98 Black-tailed Godwit, and 70 Ruff were seen along with a few individuals of Pied Avocet, Marsh Sandpiper, Curlew Sandpiper, and Wood Sandpiper. Four individuals of Indian Skimmer, which is an uncommon species in this area, were recorded at this site.

Panje held conducive sites for the waterbirds during the arrival time from August to October. The numbers of both shorebirds and ducks were high. Interestingly, the Flamingo numbers were also high during that period. Their numbers declined when the water level receded.



Figure III.24: Relative composition of waterbird families at Panje wetlands between August and October

In October 2018, these ponds dried and only a few waterbirds were recorded from this area.

# November-February

In November 2017, over 1420 individuals of ducks comprising Northern Pintail, Northern Shoveler, Garganey, Gadwall *Mareca strepera*, and Common Teal were recorded in Panje. Four individuals of Ruddy Shelduck were also recorded. This apart, a flock of 680 gulls and terns comprising Black-headed Gull, Gull-billed Tern and Whiskered Tern was seen roosting at this site. Over 500 individuals of shorebirds *viz*. Little Stint (283), Black-winged Stilt (104), Eurasian Curlew (51), Black-tailed Godwit (48), and Common Redshank (31) were recorded.

In December 2017, over 2500 waterbirds were recorded. Of them 2100 were Little Stint. A roosting flock of gulls and terns including Black-headed Gull (130), Brown-headed Gull (70), and Whiskered Tern (30) was also recorded.

In January 2018, due to low water level in the wetland, birds were recorded in less numbers. In February 2018, the wetland had a total of 2980 waterbirds, of which 90% were Curlew Sandpiper. A small roosting flock of Caspian, Gull-billed and Whiskered terns, and Brown-headed Gull were recorded at the site.

In November 2018, a large number of waterbirds were seen scattered across the ponds. A total of 3450 waders were counted. Little Stint (1530), Lesser Sandplover (820), and Black-tailed Godwit (750) were the dominant species. Common Greenshank (169), Common Redshank (88), and Black-winged Stilt (70) were also recorded along with a few individuals of Pacific Golden Plover, Dunlin, and Curlew Sandpiper. A roosting flock of Brown-headed Gull (490), Gull-billed Tern (67), Slender-billed Gull (55), and Caspian Tern (47) was recorded. Migratory ducks namely Northern Pintail (435), Common Teal (247), and Northern Shoveler (70) were also counted (Fig. III.25). A single individual of Indian Skimmer was noticed during this survey. A feeding flock of 622 Lesser Flamingo and 228 Greater Flamingo was seen in the northern ponds.

In December 2018, the water level was adequate and over 7000 waterbirds were recorded in the ponds. The flamingos were seen in larger numbers compared to November 2018. A total of 1110 Lesser Flamingo and 275 Greater Flamingo were reported. A large congregation of waders was also recorded in Panje during this month. Lesser Sandplover (2450) was the predominant species followed by Little Stint (2030). Other shorebirds found in large numbers were Curlew Sandpiper (420), Common Redshank (190), Dunlin (150), Broad-billed Sandpiper (120), Marsh Sandpiper (51), Common Greenshank (48), and Greater Sandplover (31).

In January 2019, large congregations of birds were seen across the wetland. Lesser Sandplover (5060) was the predominant species followed by Little Stint (2410), Curlew Sandpiper (1140), Common Redshank (700), and Black-winged Stilt (450). A flock of 500 Northern Shoveler, 310 Common Teal, and 73 Northern Pintail was recorded, most of which were females.

In February 2019, the water level was optimum and not very high. A large congregation of waders were recorded in the northern ponds. A total of 786 Curlew Sandpiper and 743 Lesser Sandplover were reported along with 198 Common Redshank, 96 Little Stint, 33 Eurasian Curlew, 30 Little Stint, and a few individuals of Common Greenshank and Black-tailed Godwit. A flock of 63 Greater Flamingo was observed.

The shorebird composition was high in the winter months. The duck and flamingo composition using this wetland declined from November to February



Figure III.25: Relative composition of waterbird families at Panje wetlands between November and February

# March-May

The water level was not very high in March 2018, a large flock of Little Stint (1645) was recorded along with 214 Black-winged Stilt, 209 Curlew Sandpiper, 88 Common Redshank, 74 Marsh Sandpiper, 60 Lesser Sandplover, and 30 Dunlin. A few individuals of Kentish Plover, Black-tailed Godwit, Eurasian Curlew, and Little-ringed Plover were also noted (Fig III.27).

In April 2018, the trend and composition of waterbirds recorded was similar to those in March. A total of 1485 Little Stint were recorded along with Curlew Sandpiper, Common Redshank, and Marsh Sandpiper. As many as 56 Caspian Tern, 42 Gull-billed Tern, 30 Whiskered Tern, and a few Slender-billed Gull and Brown-headed Gull were also recorded.

In May 2018, a total of 717 Lesser Sandplover was recorded, which was the predominant species among all shorebirds recorded from this site. A few individuals of Curlew Sandpiper, Common Redshank, Little Stint, and Eurasian Curlew were recorded. Gull-billed Tern (58), Slender-billed Gull (55), and Caspian Tern were also recorded.

In March 2019, Little Stint predominated (1030) among the shorebirds, followed by 87 Common Redshank, 81 Black-winged Stilt, and a few individuals of Eurasian Curlew, Common Greenshank, and Grey Plover. Most of the shorebirds were seen attaining partial breeding plumage. Apart from these, 61 roosting Greater Flamingo were seen along with a flock of Caspian and Gull-billed terns.



Figure III.26: Lesser Sandplover *Charadrius mongolus* recorded in May 2018, with a few individuals in partial breeding plumage



Figure III.27: Relative composition of waterbird families at Panje wetlands between March and May

# June-July

In June 2018, due to the rain, water level was high and a few other waterbirds were recorded along with 172 Lesser Cormorants.

It is important to mention here that the bird composition and numbers at this site was influenced by the water level fluctuations. The fluctuation in the waterbird numbers in a day also indicated that during high tide, the waterbirds foraging in the creek moved to this wetland for roosting. And during low-tide the waterbirds moved to the creek for feeding.

During the previous studies carried out by BNHS, over 1,00,000 individuals of waterbirds were recorded at this site in the winter months in 2015 (Narwade 2017). During this study period, no such number of waterbirds were recorded.

# Other sites surveyed during the study period

A few surveys were carried out at sites in Mumbai Bay environs where waterbird congregations were reported.

# **Bhandup Pumping Station**

It is a network of wetlands including the inland wetlands and saltpans near Bhandup Pumping Station. Waterbirds use this site as high-tide roosting sites when the water level in the site becomes optimum. The inland ponds are deep and only larger waders and waterbirds were recorded here.

During a survey in November 2017, 450 Black-tailed Godwit were recorded during high tide, along with 80 Black-winged Stilt, 36 Northern Shoveler, and 31 Common Coot. In December 2017, only 17 Little Ringed Plover and four Common Redshank were recorded.

In February 2018, 10,000 Lesser Flamingo and 400 Greater Flamingo were recorded. Migratory ducks namely Northern Shoveler, Garganey, and Common Teal were also recorded along with a roosting flock of Brown-headed Gull and Black-headed Gull.

In October 2018, the saltpans were filled with water and 7000 individuals of Little Stint were recorded here, most of them in partial breeding plumage. In the inland pond, 283 Greater Flamingo were recorded. Following this month, the saltpans dried out and very few shorebirds were seen at this site. In the inland ponds, 1190 Greater Flamingo and 123 Lesser Flamingo were reported along with 122 Black-tailed Godwit in November, and the Lesser Flamingo number increased to 950 and Black-tailed godwit to 750 in December 2018.

In February 2019, 291 Lesser Flamingo and 525 Greater Flamingo were seen in the ponds. The saltpans were partially filled up in the same month and almost 1000 Little Stint were recorded. In March, the Little Stint number declined to 800, and almost 30 % of the individuals were recorded with partial breeding plumage.



Figure III.28: Flock of Little Stint Calidris minuta recorded in the saltpans at Bhandup Pumping Station in February 2019

Waterbirds were recorded in the saltpans only when optimum water was present. Very few were recorded at this site in the rest of the months.

# **Bhuigaon Beach**

Bhuigaon Beach near Vasai is one of the sites where feeding flocks of shorebirds were recorded.

Two surveys were carried out at this site during the study period. During the February 2018 survey, when the bird congregation was known to be maximum, a total of 866 shorebirds were recorded. Of them 65% were Lesser Sandplover. Totally 163 Little Stint, 70 Terek Sandpiper *Xenus cinereus*, 32 Ruddy Turnstone, 31 Greater Sandplover, and one Sanderling *Calidris alba* were recorded. Also, 58 Lesser Blackbacked Gull *Larus fuscus* and 16 Caspian Tern were noted.



Figure III.29: Visitors disturb the feeding birds by chasing them in a vehicle at Bhuigaon Beach

The second survey was carried out in September 2018. A few Greater Flamingo were recorded at this site, along with a small congregation of Lesser Sandplover and a few individuals of Lesser Black-backed Gull.

During this month, the human disturbance was high and the beach was also littered with plastic waste.

Though the inter-tidal mudflat at Bhuigaon Beach was an ideal feeding habitat for waterbirds, the human disturbance was high, which affected the waterbird distribution in this area and the birds were seen moving from one place to another frequently to get away from the disturbance.

# **Arnala Beach**

A survey was carried out at this site during the arrival time of the migratory birds in September 2018. A total of 47 Greater Flamingo were recorded at the beach. Of the shorebirds, Little Stint (166) and Lesser Sandplover (112) were recorded, along with Ruddy Turnstone (20) and a few individuals of Common Redshank, Eurasian Curlew, Sanderling, and Pied Avocet. A small flock of 22 roosting Northern Shoveler was reported along with a small roosting flock of Lesser Black-backed Gull (25)

# Madhuban Ponds

These (construction excavation) dug-out ponds in Vasai East are rain-fed, besides receiving water through an inlet from Sopara Creek. These ponds are used as high-tide roosting as well as night roosting

sites by a few species. During the survey in February 2018, a mixed flock of 900 gulls was recorded hovering over the ponds, potentially in search of a roosting site (70% were Brown-headed Gulls and the remaining were Black-headed and Slender-billed Gulls). A total of 116 Black-winged Stilt, 108 Marsh Sandpiper, 75 Ruff, 52 Common Greenshank, and 20 Ruddy Shelduck were also reported.

# **Belpada Wetland**

This wetland is adjacent to the Uran-Panvel road, close to Jasai pond. It has gone through land filling and has been subjected to a lot of anthropogenic disturbances. Three surveys were carried out at this site. In October 2018, less than 20 birds were counted at this site. In November 2018, shorebirds comprising Lesser Sandplover (388), Little Stint (55), Pied Avocet (46), Curlew Sandpiper (43), and a few individuals of Common Greenshank, Wood Sandpiper, and Black-winged Stilt were recorded. A feeding flock of 64 Greater Flamingo was seen along with 31 Painted Stork, egrets and two individuals of vulnerable Asian Woollyneck *Ciconia episcopus*. In December 2018, due to disturbance, very few waterbirds were recorded here compared to the previous month. A flock of 170 shorebirds was recorded, half of which were Little Stint, other notable species being Common Redshank (33), Pied Avocet (22), and Lesser Sandplover (20).

# IV MIGRATORY WATERBIRD SURVEYS ALONG THE MAHARASHTRA COAST

The coastal sites along the Konkan coast between Alibaug and Terekhol in Maharashtra were surveyed in 2017 and 2018 to understand their significance to the wintering migratory waterbirds. Four surveys were carried out during the study duration: one before the onset of migratory season, two in midwinter to understand the role played by coastal areas for the migratory waterbirds and one during the return migration period to record the status of waterbirds using the coastal areas as staging sites during northward passage.

The first reconnaissance survey along the Maharashtra coast was conducted in July 2017. From the field surveys and information obtained from the local communities, potential migratory waterbird sites were shortlisted for further surveys. A total of 37 potential bird habitats were recorded during the survey.

The second survey was conducted in January 2018, where the mid-winter migratory waterbird population was recorded. Along with the initially identified 37 sites, 12 more sites were identified as feeding and roosting sites for the migratory waterbirds. Besides enlisting the presence of waterbirds, the direct threats and pressures to the sites and to the waterbirds were also recorded. During the survey, the species recorded in maximum number was Lesser Black-backed Gull (3,971) from seven sites, followed by Lesser Sandplover (2,361) recorded from eight sites. While mapping the surveyed sites, it was decided that the satellite wetland areas near selected sites also need to be surveyed to understand the movement patterns of the waterbirds.

One survey was conducted in April and early May 2018 to record the status of migratory bird population during return migration and understand the status of the habitats in late winter. Information on the recent trends and seasonality of birds was obtained from the locals. During this survey, Lesser Sandplover was the species recorded in maximum number, while Common Sandpiper and Lesser Crested Tern were the most frequently observed species.

The fourth survey was carried out in early December 2018, and surveys were conducted in 99 sites including both coastal and adjoining inland wetlands (Annexure III). Along with waterbird documentation, information was collected from local fishermen regarding the status of waterbirds in comparison to previous years and their perception of the movement of birds between adjoining beaches. During this extensive survey, the species recorded in large numbers was Lesser Black-backed Gull (12,463), from 16 sites, followed by Lesser Sandplover (6741) from 21 sites, Brown-headed Gull (4419) from 17 sites, and Kentish Plover (1220) from 16 sites. The most commonly recorded species was Common Sandpiper, recorded from 23 sites with sporadic numbers.

During the surveys, a total of 70 waterbird species belonging to 14 families were recorded from all the sites (Annexure I). Based on the numbers recorded, the waterbirds were classified under four categories, the details of which are given in Table IV.1. The overall status of waterbirds along the Maharashtra coast during the study period is presented in the Fig. IV.1





- Count > 1000







Figure IV.1: Status of waterbirds at the sites selected along Maharashtra coast between July 2017 and March 2019



# Figure IV.2: District-wise sites covered during the surveys between July 2017 and March 2019

# Sites surveyed in Sindhudurg district

Sites surveyed in Ratnagiri district

Sites surveyed in Raigad district

#### Table IV.1: Categorization of wetlands based on the number of waterbirds recorded

	Sites that supported over 1000 waterbirds during one or more surveys
	1. Alibaug Jetty 2. Akshi Beach 3. Kalinje Mudflat and Mangrove 4. Palande Beach
	5. Velas agar 6. Ware Beach 7. Devbag Beach
	Sites that supported 500-1000 waterbirds during one or more surveys
11	1. Bharadkhol Beach 2. Harnai Beach 3. Bhatye Beach 4. Malgund Beach 5. Pat Parule Lake
	6. Mochemad Beach
111	Sites that supported 300-500 waterbirds during one or more surveys
	1. Murud Beach 2. Bagmandla Beach 3. Kondvili Beach 4. Taramumbri Beach
	5. Vetye Beach 6.Shiroda Saltpans
IV	Sites that supported 100-300 waterbirds during one or more surveys
	1. Agardanda Beach 2. Dandi Beach 3. Diveagar environs 4. Tondivali Beach
	5. Kelshi Beach 6. Tarkarli Beach 7. Vengurla Beach

# **BRIEF SUMMARY OF THE WATERBIRD SITES ALONG THE MAHARASHTRA COAST**

# Alibaug Jetty, Akshi Beach, Nagaon Beach

Alibaug Jetty is a fish landing jetty with regular anthropogenic activity. Akshi Beach and Nagaon Beach are adjacent shores. During the survey between December 2017 and March 2019, the waterbird movements were observed between these three sites. Major congregations of shorebirds were seen at Akshi Beach. The shorebirds were recorded feeding at Akshi Beach during low-tide and roosting further upshore on the same beach during high tide. When the congregation at high-tide roost was disturbed at Akshi, the roosting shorebirds moved towards Nagaon Beach, but returned to Akshi eventually. Gulls and terns were seen roosting at Akshi and Nagaon beaches, and shifting between the two sites in response to disturbance. During high tide, they moved to Alibaug Jetty and scattered around the boats, feeding on the fish debris. At a medium height of high tide, when the rocky patches near Alibaug Fort were exposed, the gulls and terns moved there to roost. Though these sites host large congregations of roosting gulls and terns, it is more important for the shorebirds as they use them both for roosting and feeding.

Among the shorebirds, the species that were recorded in the maximum numbers were Lesser Sandplover, Ruddy Turnstone, Terek Sandpiper, and Kentish Plover. The arrival of migratory waterbirds was recorded in September (2018 and 2019). Gulls and terns arrived to these sites prior to the shorebirds. Gull-billed Tern (420 recorded in September 2018) dominated in numbers. The maximum shorebird numbers recorded in September (2018) was 500. By October, a majority of the wintering population had arrived. In October 2017, a mixed flock of over 2000 gulls and terns was recorded, majorly comprising Brown-headed Gull and Gull-billed Tern. Eurasian Oystercatcher Haematopus ostralegus was also recorded during the period. In the same month of 2018, 700 Brown-headed Gull, 300 Slender-billed Gull, 250 Black-headed Gull, and 120 Lesser Black-backed Gull were seen. A total of 800 Lesser Sandplover, 40 Ruddy Turnstone, and a few individuals of Terek Sandpiper, Dunlin, and Curlew Sandpiper were recorded along with gulls. In November 2018, the tourist footfall and anthropogenic disturbance was higher. A total of 440 Brown-headed Gull, 360 Lesser Sandplover, 180 Lesser Black-backed Gull, 80 Black-headed Gull, and 60 Ruddy Turnstone were recorded along with 13 other species of waterbirds. The anthropogenic pressure was recorded to be very high at these two beaches in the month of December. Though a large number of birds were recorded, due to continuous disturbances, the overall numbers could not be counted accurately. In December 2018, over 5000 individuals of Lesser Sandplover were recorded in several flocks, along with 650 Little Stint,



Figure IV.3: Map showing Alibaug Jetty, Akshi Beach and Nagaon Beach

600 Kentish Plover, a few individuals of Ruddy Turnstone, Terek Sandpiper, Broad-billed Sandpiper, and Dunlin. A mixed flock of over 900 gulls and terns, majorly comprising Lesser Black-backed Gull, Pallas's Gull *Larus ichthyaetus*, Brown-headed Gull, Gull-billed Tern, and Lesser Crested Tern, was seen. In January 2019, the number of shorebirds declined. The Lesser Sandplover remained high, with over 2000 individuals recorded along with over 400 individuals of Kentish Plover and over 100 Ruddy Turnstone. A total of 220 Little Tern were also recorded in January 2018, along with 420 individuals of Black-headed Gull. During both the migratory seasons studied, in February, the numbers of waterbirds recorded was similar to that recorded in January. During the survey in March 2018, the Lesser Sandplover numbers had declined to 650 individuals, which influenced the overall number recorded in this area.

During the study period, Eurasian Oysercatcher (uncommon to the Maharashtra coast) was recorded in October 2017 (7 individuals), December 2017 (3 individuals), and September 2019. One individual was



Figure IV.4: Ruddy Turnstone Arenaria interpres at Akshi beach



Figure IV.5: Congregation of gulls and terns at Akshi Beach



Figure IV.6: Congregation of Lesser Sandplover Charadrius mongolus at Akshi Beach



Figure IV.7: Endangered Great Knot Calidris tenuirostris recorded at Akshi Beach

ringed and tagged in September 2019. An individual of Sanderling was recorded in October 2017, and a couple of individuals were recorded subsequently in January, March, October, and December 2018. One individual was ringed in September 2019. Three individuals of Great Knot *Calidris tenuirostris* were recorded in January 2018 and 12 individuals in December 2018. An individual of Bar-tailed Godwit *Limosa lapponica* was ringed in September 2019.

In September 2019, while banding the birds, it was observed that the juveniles of Lesser Sandplover and Ruddy Turnstone arrived early in the month, and the adult numbers increased from late September. The Ruddy Turnstone was seen scavenging the trash on the beach, and at times feeding on coconut shells, flowers, organic waste, and even human waste.

# Nandgaon Beach

During the study, insignificant anthropogenic disturbance was recorded at this beach. A flock of 25 Lesser Sandplover and a couple of Kentish Plover were seen at this site.

# **Murud Beach**

This is a tourist beach and a few shorebirds were recorded here despite heavy anthropogenic disturbance during all the surveys. In April 2018, 190 Lesser Sandplover, 70 Kentish Plover, and 20 Terek Sandpiper were recorded. In December 2018, 30 Gull-billed Tern along with a few Lesser Crested Tern and Greater Crested Tern were seen roosting at this beach.



Figure IV.8: Shorebirds feeding at Murud Beach at dawn, before the tourists arrive

# Agardanda

The mudflat near to Agardanda Ferry is exposed during low tide where terns (Whiskered Tern and Gull-billed Tern) were seen roosting. In April 2018, two individuals of Near Threatened Black-headed Ibis were recorded and in December 2018, a few individuals of Eurasian Curlew, Whimbrel *Numenius phaeopus*, Bar-tailed Godwit, and Curlew Sandpiper were seen at this site.

# Velas Agar-Diveagar Beach

Velas Agar and Diveagar Beach are adjacent sandy shores. The local fishermen informed that the congregation of gulls and terns increases as the summer approaches, suggesting that this area could be used as a staging site during northward migration. During early mornings, the gulls and terns were seen moving from Diveagar Beach to Velas Agar, when disturbed. During the survey in December 2018,



Figure IV.9: Map showing Diveagar Beach and Velas Agar



Figure IV.10: Flock of gulls recorded at Velas Agar in December 2018

over 4,000 individuals of gulls and terns were recorded at Velas Agar. The flock composition was majorly Lesser Black-backed Gull, Brown-headed Gull, and Black-headed Gull. Few individuals of Lesser Crested Tern and Caspian Tern were also seen. One Lesser Black-backed Gull was found dead on this beach during December 2018. Due to tourist disturbance with ATV and bikes on the beach, no waterbirds were recorded at Diveagar. During high tide, roosting and feeding waders were seen at a mangrove and saltpan area, which is located in the outskirts of Diveagar. A small flock of 70 Little Stint, 30 Black-winged Stilt, 20 Common Redshank, along with a few individuals of Pacific Golden Plover, Temminck's Stint, Wood Sandpiper, and Common Sandpiper, was recorded at this site. As this site is only partially approachable, the survey could be done only on a portion of this area. The remaining area had a good potential of being a high-tide roosting site. During April 2018 when the tourist disturbance was comparatively low at Diveagar Beach, a congregation of 130 Lesser Sandplover was seen, along with a few Ruddy Turnstone, Whimbrel, and Common Redshank. A flock of 150 individuals of Brown-headed Gull, Lesser Crested Tern, Greater Crested Tern *Thalasseus bergii*, Caspian Tern, and Gull-billed Tern was recorded at this site.

# **Bharadkhol**

The rocky shore between Diveagar Beach and Bharadkhol Fishing Jetty was a roosting site for the gulls. During the high tide in January 2018, a total of 530 Lesser Black-backed Gull were recorded roosting at this site. According to the local fishermen, these rocky patches are used by gulls as night roost for the



Figure IV.11: Map showing Bharadkhol

entire winter. In April 2018, the roosting flock of Gull-billed Tern (47), Black-headed Gull (29), Whiskered Tern (28), Lesser Sandplover (19), and Caspian Tern (10) was observed at this rocky site. The locals informed that intermittently about 500 roosting birds were recorded at this site in April 2018. In December 2018, a flock of 220 Lesser Black-backed Gull 50 Gull-billed Tern, and 30 Brown-headed Gull was recorded at this site. Further south, at a rocky beach at Kondvili, a flock of 800 gulls (Lesser Black-backed Gull and Brownheaded Gull) was seen. It could be understood that there was a possibility of movement of the roosting gulls and terns between Kondvili, Bharadkhol, Diveagar, and Velas Agar.

# Srivardhan Beach

In April 2018, Brown-headed Gull and Black-headed Gull were recorded at this site along with 20 individuals of Grey Plover, several of which had already attained breeding plumage. In December 2018, a flock of 110 Lesser Sandplover and 40 Kentish Plover were seen roosting here early in the morning, but were chased by the tourists soon after. Srivardhan Beach is a tourist site and tourist recreation activities such as speed boating and sand bikes caused much disturbance to the birds.

# Kalinje Mangrove and Mudflats

This site was used as a roosting site by gulls and terns. During January 2018, a flock of 3,000 Lesser Black-backed Gull was recorded at the mudflat that was exposed during low tide. In December 2018 a flock of 4,000 gulls and terns, predominantly comprising Lesser Black-backed Gull and Brown-headed Gull, was seen arriving to roost in the evening. Very few birds were recorded during the low tide in the next day. This site was used by the locals for fishing during the day, which caused disturbance to the birds. The mangroves and mudflats at Kalinje are not directly accessible by road, and that could be a reason for fewer tourist activities and huge congregation of the gulls and terns in this area.



Figure IV.12: A flock of gulls arriving at Kalinje mudflats to roost

# Harnai Beach-Palande Beach

This coast is adjacent to a fishing jetty. Gulls and terns were seen following the fishing boats during the day and roosting at the beach in the evening. In January 2018, a roosting flock of 400 gulls and terns comprising nine species *viz*. Lesser Black-backed Gull, Black-headed Gull, Brown-headed Gull, Slenderbilled Gull, Gull-billed Tern, Sandwich Tern *Thalasseus sandvicensis*, Lesser Crested Tern, Greater Crested Tern, and Caspian Tern were recorded. In December 2018, a flock of 490 Brown-headed Gull, 85 Lesser Black-backed Gull and 21 Gull-billed Tern was recorded along with a congregation of shorebirds *viz*. Kentish Plover (91), Lesser Sandplover (42), and Little Stint (11).

# **Malgund Beach**

In January 2018, a flock of over 500 gulls and terns, predominantly comprising Lesser Crested Tern, Black-headed Gull and Greater Crested Tern, was recorded at this site. A small congregation of Lesser Sandplover, along with three individuals of the uncommon Sanderling and a single individual of Endangered Great Knot, was seen here. In April 2018, only a few individuals of Lesser Crested Tern were roosting at this site. This beach is adjacent to Ganpatipule, which is a tourist destination. In the course of the study, the tourism activities at this beach were on rise.



Figure IV.13: Great Knot Calidris tenuirostris recorded at Malgund Beach in January 2018

# Aare Ware Beach

A roosting congregation comprising Lesser Black-backed Gull (2000), Brown-headed Gull (720), Blackheaded Gull (100) was recorded, along with a few individuals of Lesser Crested Tern, Common Greenshank, Lesser Sandplover, Kentish Plover, and Whimbrel. No disturbance to the birds were recorded, even though few tourists were present here.



Figure IV.14: Congregation of gulls seen at Ware Beach in December 2018

#### **Bhayte Beach-Mandavi Beach**

During the surveys, gulls and terns were seen roosting on exposed sand bars and at the beach. In January 2018, a small flock of 170 gulls and terns, mainly composed of Black-headed Gull, Lesser Black-backed Gull, Brown-headed Gull, and Lesser Crested Tern, was recorded. A few shorebird species such as Eurasian Curlew, Common Sandpiper and Little Stint were seen scattered along the beach. In December 2018, 350 Lesser Black-backed Gull, and 160 Black-headed Gull were recorded. It was also observed that they were moving between the open sandbars near Mandavi and Bhatye Beach. Mandavi and Bhatye beaches are sites within Ratnagiri city, and are subjected to considerable disturbance. Disturbance by stray dogs to the roosting gulls and terns were recorded during the surveys.

#### **Ambolgad Beach**

This is a tourist beach where accommodation facilities are available along the shore. Due to which, tourist movement was present on the beach at the time of our surveys. Despite the disturbance, birds were recorded here. In May 2018, a flock of 400 gulls and terns was recorded in one end of the beach, but they could not be identified as they were chased before being identified. During the survey in December 2018, a flock of 554 gulls dominated by Lesser Black-backed Gull, and Brown-headed Gull were recorded.

# **Dande Beach**

The open mudflats at this beach and the adjoining sandbars were potentially good habitats for shorebirds. But, during the first three of the four coastal surveys, very few birds were recorded at these sites. In December 2018, a total of 1700 Lesser Sandplover, 50 Kentish Plover, and a few individuals of Little Stint and Terek Sandpiper were recorded in this beach.

#### Mithmumbri

The mangrove and mudflat habitat at the creek in Mithmumbri was a roosting site for waders, gulls and terns. During the survey in December 2018, 230 Brown-headed Gull, and 30 Black-headed Gull were seen roosting along with 80 Kentish Plover and a few individuals of Common Redshank and Common Sandpiper. According to the locals, the birds have been frequenting to these sites in good numbers between November and March. The birds roost in the patches between the mangroves during high tide. It needs further continuous monthly surveys to confirm the fact.



Figure IV.15: Roosting flock of gulls and terns recorded at Mithmumbri in December 2018

# Devbag (Tsunami Island & Seagull Island) and Bhogave Beach

In January 2018, a large flock of gulls was recorded, mainly comprising Black-headed Gull (800), Brownheaded Gull (420), Lesser Black-backed Gull (150), and Pallas's Gull (30). In May 2018 there were no bird congregations in this area. According to the locals, the maximum number of birds are recorded between November and January each year, which also coincides with the peak tourist season. In December 2018, a large flock of gulls and terns comprising Lesser Black-backed Gull (600), Black-headed Gull (100), Brownheaded Gull (60), and Lesser Crested Tern (45) was recorded. Along with the gulls and terns, 130 Kentish Plover and 30 Lesser Sandplover were also recorded from this area. After the beginning of the tourist activity, the gulls were seen shifting between the sandbars before they settled at Bhogave Beach, and some of the individuals moved towards the rocks in the sea. The waders were seen roosting at Devbag Beach.



Figure IV.16: Map showing Devbag Beach, Tsunami Island, Seagull Island and Bhogave Beach



Figure IV.17: Flock of Lesser Sandplover Charadris mongolus sighted at Devbag Beach



Figure IV.18: Flock of gulls recorded near Tsunami Island

Devbag and Tarkarli are famous tourist destinations, the highlights here being water sports and scuba diving tours. The tourist disturbance in this area is evident from the movement of birds. Bhogave beach is south to Devbag and disturbance by tourists is lesser. There are two large sandbars, Tsunami Island and Seagull Island, located between these two beaches, which support waterbirds. A small sandbar is also present parallel to Bhogave Beach. Early morning, gulls are seen roosting at Tsunami Island. When the tourists started arriving at this site, the gulls moved to Seagull Island. In the forenoon, when the boats started frequenting the Seagull Island, the birds moved to Bhogave Beach.

# **Pat Parule Lake**

This is a freshwater lake with floating vegetation. It is surrounded by agricultural patches and wooded vegetation. The lake adjoins Parule village. During the surveys in January, May and December 2018, more than ten species of waterbirds were recorded. In January 2018, over 150 individuals of Northern Pintail were recorded, most of which were females. A total of 40 Common Coot and a few individuals of Garganey, Asian Openbill, and Indian Cormorant were also seen. The other major species recorded at this site during the surveys were Lesser Whistling Duck Dendrocygna javanica (100), Cotton Pygmy-goose Nettapus coromandelianus (90), Purple Swamphen Porphyrio porphyrio (36), Common Moorhen Gallinula chloropus (20), a few individuals of Bronze-winged Jacana Metopidius indicus, and River Tern Sterna aurantia. The locals reported that the numbers had noticeably reduced to half of what they had observed five years back. A few individuals of Wood Sandpiper, Common Sandpiper, and Common Coot were recorded in May 2018. The major species recorded were local breeding species such as Lesser Whistling Duck (160), Little Cormorant (67), Cotton Pygmy-goose (65), Intermediate Egret (42), and Bronze-winged Jacana (40). From the survey in summer, it was evident that this site is important for local breeding waterbird species. During the survey in December 2018, Lesser Whistling Teal was recorded in maximum number (330), followed by Northern Pintail (110) and Cotton Pygmy-goose (75). Other species found in good numbers include Common Coot (20), Purple Swamphen (70), Bronze-winged Jacana (40), and Pheasant-tailed Jacana Hydrophasianus chirurgus (20).



Figure IV.19: Northern Pintail Anas acuta recorded in the reedbeds at Pat Parule Lake

# Taak Marsh

This marsh has inflow of water from the sea and the Mochemad River. The wooded vegetation in this site was used by Black-headed Ibis and egrets as a roosting site. During the survey in January 2018, Black-headed Ibis (48), Intermediate Egret (25), and Little Cormorant (12) were seen roosting on the trees, and species such as Lesser Whistling Duck (20), Pheasant-tailed Jacana (15), Bronze-winged Jacana (12) were seen feeding in the wetland. In the survey in December 2018, a total of 25 Black-headed Ibis, 14 Little Cormorant, and 12 Little Egret were seen roosting on the tree.



Figure IV.20: Roosting flock of Black-headed Ibis *Threskiornis melanocephalus* at Taak

# **Mochemad Beach-Tank Beach**

During the survey in January 2018, no birds were recorded at this site. But the local fishermen reported that the birds were frequently seen here during the day and found roosting on the rocky outcrops at sea by night. The locals at Flayefondewadi Beach, Kondura Beach, Kelus Beach, Wayangani Beach, and Vengurla Beach also informed the same. They also reported that the roosting gulls, if disturbed, would fly away but return to the same site immediately. They also reported that gulls were frequently seen (though not every day) at the beach during the day. From the gathered information, it could be inferred that the seagulls feeding at the sea were using the network of beaches to roost, and there was a chance that the recorded gulls were from the same flock. During the survey, gulls were recorded from Vengurla Bandar and the sandbars between Mochemad Beach and Tank Beach. In December 2018, a flock of 1000 gulls



Figure IV.21: Gulls and terns recorded at the sandbar between Mochemad and Tank Beach



Figure IV.22: Map showing Mochemad Beach and Tank Beach

and terns were seen at Tank Beach. Though very few tourists were at the beach, they caused enough disturbance and were seen chasing birds using bikes. When the flock was disturbed, they moved to the sandbars between Tank and Mochemad Beaches. Lesser Black-backed Gull (270), Black-headed Gull (140), Lesser Crested Tern (63), and Pallas's Gull were seen moving between these the two beaches when the flock was disturbed. Also, a roosting flock of Little Pratincole *Glareola lactea* (230), Lesser Sandplover (73), Terek Sandpiper (7), Eurasian Curlew (5), and Grey Plover (3) was recorded at Mochemad Beach.

# **Shiroda Saltpans**

During our surveys, we observed that the saltpans at Shiroda adjacent to the Tiroda Creek functioned as feeding sites for shorebirds. The shorebirds were seen scattered across the saltpans. In January 2018, a total of 86 Common Redshank, 78 Pacific Golden Plover, 60 Marsh Sandpiper, 43 Wood Sandpiper, 35 Temminck's Stint, 20 Little Stint, 20 Little Ringed Plover, and a few individuals of Common Sandpiper, Lesser Sandplover, Grey Heron *Ardea cinerea*, and Purple Heron *Ardea purpurea* were seen. As access to some of the saltpans was restricted, surveys could not be carried out in the sites. In May 2018, salt production was in process and birds were seen only in one of the saltpans. Black-winged Stilt (17), Wood Sandpiper (14), and a few individuals of Common Redshank, Temminck's Stint, Little Stint, Common Greenshank,



Figure IV.23: Ringed Lesser Sandplover Charadrius mongolus sighted at Shiroda Saltpans



Figure IV.24: Roosting and feeding shorebirds recorded at Shiroda Saltpans

Marsh Sandpiper, and Pacific Golden Plover were counted. In December 2018, 418 individuals of 14 migratory waterbird species were recorded which mainly comprised species belonging to Scolopacidae and Charadriidae families, along with the Near Threatened Black-headed Ibis. The species recorded in maximum number was Pacific Golden Plover (140) followed by Common Redshank (43), Black-winged Stilt (37), Common Greenshank (36), Lesser Sandplover (33), Little Stint (28), Common Sandpiper (16), Grey Plover (15), and a few individuals of Terek Sandpiper, Wood Sandpiper, and Gull-billed Tern. One ringed Lesser Sandplover was also seen during this survey. The scientific staff of SACON had ringed a few species at the site during the previous years, and it was interesting to know that the same individuals had returned back to the same site, thus highlighting the importance of this site. This site is a crucial high-tide roosting and feeding site.

It is crucial to mention here that though many sites along the Maharashtra coast support small congregations of migratory birds, the importance of these sites for the survival of the species could be well assessed only through bird banding exercises at these sites. The details are covered in the Bird Banding Chapter.

# V THREATENED SPECIES RECORDED ALONG THE MAHARASHTRA COAST

The health of an ecosystem is maintained by its flora and fauna. When species become endangered, it is the sign of an ecosystem's imbalance. The conservation of these endangered species is important for humans as well. A well-balanced ecosystem purifies the environment.

During the study, in order to assess the quality of the ecosystem along Maharashtra's coastline, besides focusing on waterbird species in the designated sites, greater emphasis was laid on recording the status of the threatened species. Totally nine threatened waterbird species were recorded, which included one Endangered, two Vulnerable and six Near Threatened species. This section provides a brief note on the threatened waterbird species recorded.

#### **ENDANGERED**

# Great Knot Calidris tenuirostris

# IUCN Status: Endangered CAF NAP Priority Species

#### **Species description**

Great knot *Calidris tenuirostris*, a medium sized (26–28 cm) wader, is a long-distance migrant. The breast and flanks are heavily spotted black. Scapulars have large chestnut spots and blackish tips. Non-breeding adult has paler grey upperparts and breast. Upperparts, head and neck are finely streaked dark grey; breast streaked, flanks lightly streaked; faint white wing-bar; white rump and uppertail-coverts with longer bill. At rest, wings project beyond tail (del Hoyo et al. 2018).

It is a winter migrant to the Indian Subcontinent, and occurs along the coast and tidal mudflats (Balachandran et al. 2018). It has also been reported from Lakshadweep and Andamans. (Ali and Ripley 1987). It is listed as Endangered in the IUCN Red List of threatened species.

#### **Distribution Range**

Breeding range of Great Knot is northeastern Siberia from Verkhoyansk Mountains east to Magadan, Koryak Highlands, and South Chukotskiy Peninsula, but the distribution is poorly known. Wintering grounds are mainly in the Indian Subcontinent, Arabia, South East Asia, and south to Australia (del Hoyo et al. 2018).

In India it is a regular winter visitor to the Gulf of Mannar, Tamil Nadu (Balachandran 2012) and was regularly seen in the early 1980s at Great Vedaranyam Swamp near Point Calimere, Tamil Nadu (Balachandran 1998).

#### Population

Its latest population size, as of 2007, is estimated to be between 2,92,000 and 2,95,000 individuals. Wintering population including Southeast Asia and Australia is estimated to be 2,90,000 individuals. In India, Balachandran (2012) reported over 200 birds at Gulf of Mannar, Tamil Nadu. Ganpule et al. (2011) reported sighting 125 Great Knot in Gujarat's Gulf of Kachchh. There are records from the coast of Goa, Maharashtra, Karnataka, Kerala, Andhra Pradesh, Odisha, and West Bengal (Bhavanarayeni and Bayani 2020; eBird 2020; Ganpule et al. 2011). It has also been reported from Lakshadweep and the Andamans (Ali and Ripley 1987).



Figure V.1: Sites along Maharashtra coast where Great Knot Calidris tenuirostris was recorded

The 1% population threshold of Great Knot for South Asia is 2,900 individuals (Wetlands Internationals 2019).

# **Major Threats**

Loss of intertidal stopover habitats in the Yellow Sea region is thought to be a key driver in the population declines of shorebirds. In the Philippines, India, and Australia, threats may include mangrove afforestation, habitat degradation caused by intense fishing activities and harvesting of molluscs and bivalves, infrastructure projects, aquaculture, oil spills, and invasive alien plant species (BirdLife International 2020).



Figure V.2: Great Knot Calidris tenuirostris sighted at Malgund Beach, Ratnagiri district in January 2018

The extension of salt-based industries, diminishing rainfall and disturbance caused by fishermen have altered the habitats. Habitat degradation coupled with poaching (at unprotected buffer zone) form the major threats. Unregulated agricultural practices, disturbance from humans, climatic and environmental changes are also causing population decline at many sites (Balachandran 2012).

#### Status along Maharashtra coast during the study period

Great Knot was recorded on three occasions during the study period. During January 2018 survey (conducted as part of 2017-2018 migratory season study), three individuals were recorded at Akshi Beach in Raigad district, and 12 individuals were recorded at the same site during the subsequent migratory season in December 2018. An individual was sighted at Malgund Beach in Ratnagiri district in January 2018. Prasad (2003) mentions the Great Knot to be a rare winter visitor to the Maharashtra coast, probably under-recorded (because of difficulty in identification). Several other recent records of the species prove that it is a regular winter visitor to the coastal areas of Maharashtra (Gole 1994, Pittie 2000). As it is one of the prioritized species in India's National Action Plan Plan for the conservation of Migratory Birds and their Habitats along Central Asian Flyway (2018-2023), a focused monthly monitoring along the Maharashtra coast is needed to document the status of this species.

#### **VULNERABLE**

#### Asian Woollyneck Ciconia episcopus

# IUCN Status: Vulnerable Species description

Asian Woollyneck or Woolly-necked Stork *Ciconia episcopus* is a large size (86 –95cm) stork. It has a distinctive gleaming white, almost fluffy neck; white lower belly and tail and orange-red legs. The face is bald, with bluish-grey skin and the glossy black cap is in contrast to the white neck feathers. It has a long and sharp bill, mostly black with a reddish tip (BirdLife International 2020).

Asian Woollyneck is a resident bird found along rivers, lakes, floodplains, marshes, jheels, paddyfields, drying ponds, flooded pastures, waterholes, lagoons, freshwater, and peat-swamp forest; it prefers waterlogged ground in India (del Hoyo et al. 2018). It has been listed as Vulnerable in 'IUCN Red List of threatened species' because it is suspected to be undergoing a rapid population decline (IUCN 2020).

# **Distribution Range**

Subspecies *episcopus* is found patchily across South Asia and Southeast Asia. Its range extends from Pakistan through India, the lowland of Sri Lanka, Nepal, Bhutan, Bangladesh, and south-east through Myanmar, Thailand, Laos, Cambodia, Vietnam, Peninsular Malaysia, the Philippines, and Indonesia (del Hoyo et al. 2018; BirdLife International 2020). In India, it is a widespread resident but not recorded in northwestern and eastern India (Grimmett et al. 2011).



Figure V.3: Sites along Maharashtra coast where Asian Woollyneck Ciconia episcopus was recorded

# Population

The global population of Asian Woollyneck is estimated at 35,000 individuals (Wetlands International 2019). The 1% population threshold of the bird is estimated at 250 individuals (Wetlands International 2019).

The Tungabhadra Reservoir in Karnataka holds much greater numbers than their 1% population threshold (Rahmani et al. 2016). Santharam (1996) recorded 25 birds at Vazhani Reservoir in the Trichur district of Kerala in 1993.

# Movement

Based on the ringing studies carried out by BNHS, seven birds ringed in Thailand between 1965 and 1971 were recovered in Bangladesh along the Brahmaputra delta. A bird ringed in Bharatpur in 1956 was recovered in 1958 from Rampur Karkhana, Uttar Pradesh.

# **Major Threats**

A major threat to Asian Woollyneck is hunting. The species is also threatened by severe habitat loss and fragmentation, the habitat loss mainly being nesting trees. (BirdLife International 2020).

# Status along Maharashtra coast during the study period

During the surveys, a total of three individuals were recorded at Shiroda Saltpans, Sindhudurg district in January 2018, two at Belpada, Raigad district in November 2018, one near Padavne bridge, Ratnagiri district and one at Malgund Beach, both in December 2018.



Figure V.4: Asian Woollyneck Ciconia episcopus recorded from Shiroda Saltpans in January 2018

# Indian Skimmer Rynchops albicollis

# **IUCN Status: Vulnerable**

# **CAF NAP Priority Species**

# **Species description**

The Indian Skimmer *Rynchops albicollis* is generally black above and white below, with broad white forehead and broad white trailing edge to secondaries and inner primaries, visible in flight. The size ranges from 38–43 cm. It has long yellow-tipped red bill, with much longer lower mandible; comparatively short red legs (del Hoyo et al. 2018).

It is a resident that occurs primarily on larger, sandy, lowland rivers, around lakes, and adjacent marshes and, during the non-breeding season, along estuaries and coasts. It breeds colonially on large, exposed sand-bars and islands (BirdLife International 2020). It has been listed as Vulnerable in 'IUCN Red List of threatened species' because its population is undergoing a rapid decline (IUCN 2020).

# **Distribution Range**

Indian Skimmer is confined to Pakistan, India and Bangladesh, where a large proportion of the population winters, principally in the Padma-Meghna delta and Myanmar.

In India, National Chambal Sanctuary (NCS), which comes under 3 States namely Madhya Pradesh, Rajasthan and Uttar Pradesh, is known to host a significant breeding population of Indian Skimmer (Shaikh et al. 2018). Along with NCS, Son Gharial Wildlife Sanctuary in Sidhi district of Madhya Pradesh (Dilawar and Sharma, 2016) the Turtle Wild Life Sanctuary in Varanasi, Uttar Pradesh (Mital et al. 2019), Mundali Dam area on Mahanadi in Cuttack district, Odisha, India (Debata et al. 2017) hold a few populations of breeding pairs.

# Population

According to BirdLife International (2020), Indian Skimmer population is at 6,000 to 10,000 individuals, roughly equating to about 4,000–6,700 mature individuals. The 1% population threshold of the bird is estimated as 75 individuals (Wetlands International 2019).



Figure V.5: Indian Skimmer Rynchops albicollis recorded at Panje, Uran in October 2018



Figure V.6: Sites along Maharashtra coast where Indian Skimmer Rynchops albicollis was recorded

The estimated Indian population in 2001 was 2,500 individuals (BirdLife International 2020). However, Shaikh et al. (2018) observed 412 Indian Skimmer in February 2017; Dilawar and Sharma (2016) reported a colony with 14 individuals at Son Gharial Sanctuary; Mital et al. (2019) reported 13 individuals from Turtle Wild Life Sanctuary and Rahmani et al. (2016) reported that Vikramshila Gangetic Dolphin Sanctuary in Bihar holds an excess of 1% biogeographic population. From Mahanadi in Odisha, 153 birds were recorded by Debata et al. (2017). A total of 256 individuals were reported from the Kakinada coast recently (Mahesh Babu *per. comm.*)

# **Major Threats**

Its decline could be owing to widespread increase in human disturbance, exploitation and domestic use of its habitat, degradation of rivers and lakes through fishing, transportation cutting through the habitat, irrigation schemes, and pollution from agricultural and industrial chemicals. An emerging threat

for breeding colonies is from sand mining, which reduces reproductive and foraging success (BirdLife International 2020). Cattle grazing and predation of nests by free ranging dogs also hamper the breeding success of Indian Skimmers (Shaikh et al. 2018).

# Status along Maharashtra coast during the study period

During the study period, four individuals of Indian Skimmer were reported in Panje, Uran in October 2017 and one each individual each at the same site in November 2017 and September 2018. The Government of India has included Indian Skimmer as one of the priority species in the CAF National Action Plan and species specific plan is being prepared to promote the specific conservation activities to be carried out for this species.

# **NEAR THREATENED**

# Black-tailed Godwit Limosa limosa

# **IUCN Status: Near-Threatened**

# **CAF NAP Priority Species**

# **Species description**

The Black-tailed Godwit *Limosa limosa* is one of the largest waders (40–44 cm) found in India with a distinctive long bill on a relatively small head, long neck and long legs. During winter, the color of its frontal body part is pale grey-brown, which becomes dull chestnut-pink by about end March when it begins its migration journey to its breeding grounds (del Hoyo et al. 2018).

Black-tailed Godwit is a long-distance migratory bird species and a fairly common winter migrant in India. It visits marshes and estuaries along the east and west coasts of the mainland, Andaman and Nicobar Islands and Lakshdweep in India, Sri Lanka and the Maldives (Balachandran et al. 2018). It is listed as Near Threatened in the IUCN Red List of threatened species (IUCN 2020).

There are currently three subspecies of Black-tailed Godwit namely *L.l.limosa*, *L.l.islandica* and *L.l.melanuroides*. Out of those three, *L.l.limosa* and *L.l.melanuroides* are found in India and the Indian subcontinent (del Hoyo et al. 2018).

# **Distribution Range**

The subspecies *islandica* breeds predominantly in Iceland and winters in the Republic of Ireland, United Kingdom, France, Spain, and Portugal and in the Netherlands. Subspecies *limosa* breeds in western and central Europe and Russia to the upper Yenisey River and winters in Sub-Saharan Africa, east through the middle east to western India. Another race *melanuroides* has disjunct breeding population in Siberia, east to the Yenisey River, East Mongolia, Northeast China, and Russian Far East, and winters in India, Indochina, Taiwan and the Philippines, south to Indonesia, New Guinea and Australia (del Hoyo et al. 2018).

Black-tailed Godwit is a fairly common winter migrant to the Indian subcontinent (Ali and Ripley 1987). It can be seen between August and April in different coastal and freshwater habitats throughout the country. It is a common winter visitor along the coastal mudflats of Gujarat, Maharashtra, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, and Odisha. Also there are records of the species from the inland wetlands of Maharashtra, Rajasthan, Bihar, and Karnataka (Kumar and Choudhary 2010; Rahmani 2012).



Figure V.7: Sites along Maharashtra coast where Black-tailed Godwit *Limosa limosa* was recorded

# Population

Although the Black-tailed Godwit is a widespread species and has a large global population, its numbers have declined rapidly over the past few years throughout its range. As per the population estimates, there are 1,02,000–1,49,000 pairs in Europe, 25,000–1,00, 000 in West Central Asia, 1,50,000 in Central Asia and Siberia, and 1,60,000 in the rest of Asia and Australia (BirdLife International 2020).

According to Wetlands International (2019), the 1% population threshold is 1, 500 for the subspecies *L*. *I. limosa* and 1, 400 for subspecies *L. I. melanuroides*.

Balachandran (2012) reported 55,000–65,000 Black-tailed Godwit between 2010–2012 at Chilika lake in Odisha. Kolleru lake in Andhra Pradesh (AP) had a record of more than 20,000 birds in 2014. Kaj Wetland in Gujarat reported 7000 birds in 2003 (Rahmani et al. 2016).

Veeranam Lake, Tamil Nadu had a record of 10,000 Black-tailed Godwit in 2003 (Rahmani et al. 2016). Balachandran et al. (2014) observed 12,000 birds at Point Calimere in 2013.

# Movement

Of the long-distance movement records, one bird ringed in Bharatpur in 1969 was recovered after ten years, from Balyktykol Lake, Kazakhstan.

## **Major Threats**

Throughout India, wintering sites of Black-tailed Godwit are particularly disappearing outside the protected areas. This habitat loss is caused by several infrastructure development activities and fragmentation of the remaining wetlands by the construction of roads, flyovers and jetties. Loss of freshwater ponds and lakes, intertidal mudflats, estuarine habitat due to the urban development is one of the major threats to its wintering population. Afforestation in open areas or open grasslands is also leading to the loss of their foraging grounds in India, resulting in a decrease in the wintering population. Destruction of mangroves along their habitats in India is a cause for concern as mangroves act as nurseries for small arthropods and fishes in the intertidal areas and hence serve as important food sources for these birds.

Illegal hunting and trapping are factors that cause direct and severe damage to the wintering Blacktailed Godwit population in India. In several wintering grounds throughout the country, the species is poached and trapped in large numbers along with other waders. The Black-tailed Godwit has been recorded in trade by Daniel et al. (1999) and also during bird trade survey by Ahmed (1997). Industrial effluents, untreated sewage, oil spills that pollute the river and ocean systems destroy the ecosystem of the habitat, thus resulting in less amount of food supply to the species.

#### Status along Maharashtra coast during the study period

Black-tailed Godwit was recorded in the wetlands around Mumbai during the study period. Large congregations were seen feeding during low tide in Thane Creek and Sewri mudflats. The highest count of 750 individuals was recorded at Bhandup Pumping Station in December 2018. Earlier in November 2018, 740 individuals were recorded at Panje wetlands. More than 200 individuals were recorded regularly in the inland wetland sites Jasai, Bhandup Pumping Station, and Panje. Black-tailed Godwit is also one of the priority species in India's National Action Plan.

### Curlew Sandpiper Calidris ferruginea

# **IUCN Status: Near-Threatened**

#### **CAF NAP Priority Species**

#### **Species description**

The Curlew Sandpiper *Calidris ferruginea* is a medium sized (18–23 cm) wader. It has a drawn-out neck and legs and long down-curved bill. In breeding plumage, its head, neck and all upperparts are rusty rufus to deep chestnut-red in colour, with dark streaks on the crown. Non-breeding adult is plain grey above, white below, with contrasting white supercilium; sides of the breast are washed grey (del Hoyo et al. 2018).

This species is listed as 'Near Threatened' in 'IUCN Red List of threatened species' due to its recent global population decline (IUCN 2020). It is also listed as 'Arctic Migratory Bird Initiative Priority species' in the 2019–2023 work plan under the *Conservation of Arctic Flora and Fauna* initiative.


Figure V.8: Sites along Maharashtra coast where Curlew Sandpiper Calidris ferruginea was recorded

## **Distribution Range**

Curlew Sandpiper breeds in Arctic Siberia from Yamal Peninsula to Kolyuchinskaya Gulf (North Chukotskiy Peninsula) and spend its winters in the region extending from sub-Saharan Africa through Middle East and South and South East Asia to Australasia. It is a winter migrant to the Indian Subcontinent frequenting seashore, mudflats, and marshes in the mainland, and in Andaman and Nicobar Islands, Sri Lanka and Maldives (del Hoyo et al 2018).

Curlew Sandpiper is a common winter visitor to the entire coastline of India. It has also been recorded in some inland wetlands and marshes such as Bharatpur in Rajasthan (Balachandran et al. 2018) for a short period of time during its passage migration. The species has been reported regularly

from the coast of Gujarat, Maharashtra, Karnataka, Kerala Tamil Nadu, West Bengal, Andhra Pradesh, and Odisha (eBird 2020). It is also recorded in small numbers in Andaman and Nicobar Islands (Ali and Ripley 1989).

#### Population

The global population of Curlew Sandpiper is estimated to be about 10,85,000–12,85,000 birds. Wintering population in Europe 1,000–1,800 individuals, West African population 3,50,000–4,50,000 individuals and East Asian-Australasian Flyway population 90,000 individuals of which the South Asian non-breeding population estimation at 2,00,000–3,00,000 (BirdLife International 2020). According to Wetlands International (2019), the 1% population threshold for South Asia is 2,400.

Major congregation sites from the east coast are Point Calimere, Gulf of Mannar and Pulicat in Tamil Nadu, Chilika and Bhitarkanika in Odisha, and Coringa in Andhra Pradesh. Along with Mumbai and its adjacent areas, Khijadia and Gulf of Kachchh in Gujarat support a significant population of the species that winters in the west coast (Balachandran 2006; Balachandran et al. 2006; Balachandran 2012; Narwade et al. 2017; Sathiyaselvam et al. 2018).

#### Movement

As a result of the Bird Migration studies conducted by BNHS, several recoveries have been reported for this species. Based on the multiple recoveries thrown up during the studies, habitat connectivity has been established between Tianjin along Yellow Sea and Chilika Lake in Odisha and Point Calimere in Tamil Nadu. Also, birds ringed in Victoria, Australia were recovered from these two sites. Birds ringed in Point Calimere, Chilika Lake and Bharatpur were recovered from wetlands in Russia and Kazakhstan. One bird ringed in Kazakhstan in 1971 was recovered from Mumbai in 1973.

#### **Major Threats**

The key threat in the East Asian-Australasian Flyway population is thought to be the loss of stopover habitats in the Yellow Sea. It is estimated that up to 65% of tidal flats in the Yellow Sea region have been lost over the past five decades, with an annual loss of 1.2% per year since the 1980s.

In Tamil Nadu, illegal hunting (for food purpose), reservoir and marshland habitat alteration by salt industries, and habitat degradation owing to diminishing rainfall are major threats reported (Balachandran 2006; Sandilyan et al. 2010a; Sandilyan et al. 2010b; Kannan and Pandiyan 2012).

Estuarine waders such as Curlew Sandpiper are particularly threatened by land reclamation and the consequent changes in natural habitats due to urbanisation, dyke construction and conversion of semi-natural habitats as saltpans and aquacultures (Van de Kam et al. 2004). Shrimp farms have steadily increased in South Asian countries in the past few decades, and several countries have virtually lost all their natural coastal wetland habitats. These changes have led to losses in the numbers and diversity of waterbirds (Sandilyan et al. 2010a). Large developmental infrastructure such as ports, harbours, or jetties destroy tidal areas in a great scale. However, these structures have often been built without a full understanding of the littoral drift patterns and have resulted in changes in adjacent shorelines, especially erosion (Lakshmi et al. 2012).

India is both the largest manufacturer and consumer of inorganic pesticides in South Asia (Rahmani 2012). The use of deadly pesticides is increasing day by day in proportion to the growing demand and agricultural production. Higher accumulations of life-threatening Organochlorine (OC) pesticides in resident and migratory birds were reported from South India (Tanabe et al. 1998).

The depletion of groundwater and saltwater intrusion into the coastal mudflats has become a serious threat to the Curlew Sandpiper population and other similar species. The flushing of highly saline water stored in reservoirs, condensers and salt-pans has been hampered by embankments constructed in the swamps by chemical companies and other salt works. The hyper-saline conditions not only alter the texture of the mudflats, but also affect the adjacent habitats for the wintering migratory birds (Balachandran 2006).

#### Status along Maharashtra coast during the study period

This species was primarily recorded in the wetlands around Mumbai Bay. Its occurrence was recorded in Thane, Mumbai, and Raigad districts along the Konkan region during the study

period. The maximum count of 5000 individuals were recorded at the TSC wetland in Navi Mumbai in November 2018. In Panje wetlands, a total of about 1040 and 1140 individuals were counted in September 2018 and January 2019 respectively. Apart from Mumbai, very small numbers were recorded at Arnala Beach, Akshi Beach, and Agardanda jetty. Of the birds ringed during the previous seasons, six individuals of Curlew Sandpiper with rings/flags were resignted during the study period at Panje wetlands covering August 2018, September 2018, January 2019 and February 2019. Details are covered in the Bird Banding section of this report.

## Black-headed Ibis Threskiornis melanocephalus

#### **IUCN Status: Near-Threatened**

#### **Species description**

Black-headed Ibis *Threskiornis melanocephalus* is a resident bird about 65–76 cm in height, with a black head with an overall white body. The ornamental feathers are grey, with a little black on the tips of the primaries. The non-breeding adult largely lacks grey scapulars and neck plumes (del Hoyo et al. 2018).

Usually seen in coastal wetlands or extreme lowlands, the species inhabits freshwater marshes, lakes, rivers, flooded grasslands, paddy fields, tidal creeks, intertidal mudflats, mangroves, saltmarshes, and coastal lagoons. However, in some areas, agricultural land may be an important habitat for the species (BirdLife International 2020). It has been listed as Near Threatened in IUCN Red List of threatened species (IUCN 2020).

#### **Distribution Range**

The Black-headed Ibis breeds from Pakistan and Nepal through India to Sri Lanka; probably north east China (Heilongjiang), Cambodia, south Vietnam, Java and possibly Sumatra. Winters in south China, Myanmar, Thailand, Sumatra and Philippines (del Hoyo et al. 2018).

It is widespread in India and locally common in the west, scarce in the east; possibly increasing locally due to the spread of artificial wetlands. It has seen rapid increases in Kerala (BirdLife International 2020). Very few nesting colonies of Black-headed Ibis are known from India. In the western region, nests have been reported from Gujarat, Rajasthan, Uttar Pradesh in North India, and Karnataka and Kerala in South India (Chaudhury and Koli 2018; Rahmani et al. 2016).

## Population

The population is estimated to number up to 10,000 individuals in South Asia, plus up to another 10,000 in South East Asia and up to 100 in east Asia. This is likely to total fewer than 20,000 mature individuals, and so the population is placed in the band 10,000–19,999 mature individuals. This equates to 15,000–29,999



Figure V.9: Sites along Maharashtra coast where Black-headed Ibis Threskiornis melanocephalus was recorded

individuals in total, rounded here to 15,000–30,000 individuals globally (BirdLife International 2020). The 1% population threshold for Southeast Asia of the bird is estimated as 100 individuals (Wetlands International 2019).

Chaudhury and Koli (2018) recorded 643 individuals in 2017 in Southern Rajasthan. As per the old data, 80 pairs were recorded at Kutch (now Kachchh), Gujarat in 1994 (Tiwari and Rahmani 1998). 168 nests of Black-headed Ibis were present in August 2014 at Bhitarkanika Wildlife Sanctuary, Odisha. During 2003-04, Balachandran et al. (2009) recorded about 850 Black-headed Ibis from Chilika Lake. Chaurs of North Bihar, Goga Beel Pakshi Vihar (IBA) is likely to hold more than 1% geographic population of the (Rahmani et al. 2016).

From Karnataka, Gudavi Wildlife Sanctuary is a traditional nesting sites for more than 5,000 Black-headed Ibis every year and it still breeds in thousands. More than 700 Black-headed Ibis have been recorded breeding at Karanji Tank in Mysore during monsoon. Narasambudhi Lake along Kabini river is known to hold population more than 1% threshold and Tungabhadra Reservoir also holds much greater numbers than their 1% population threshold (Rahmani et al. 2016). 208 nests were observed at Kumarakom heronry, Kerala (Narayanan et al. 2006). Sashikumar et al. (2015) counted 201 nests at Panamaram in 2014. Nearly 1,800 Black-headed Ibis have been sighted in Big Tank (Peria Kanmai) and Sakkarakotai Kanmai, Tamil Nadu (Rahmani et al. 2016). More than 2,000 were sighted in this place Odiyur Lagoon, Tamil Nadu (Manakadan 2014).

# **Major Threats**

It is vulnerable to drainage, disturbance, pollution, agricultural conversion, destruction of roosting and nesting sites, hunting and collection of eggs and nestlings from colonies. A combination of these factors has probably caused the decline (BirdLife International 2020).

## Status along Maharashtra coast during the study period

During the study, this species was recorded regularly in 10 sites of four districts along the Maharashtra coast. The details of the maximum number recorded in each site are given in the Table.V.1

Month	Site District		Maximum Count at site
January 2018	Thane Flamingo Sanctuary	Thane	48
October 2018	NRI Wetland	Thane	8
April 2018	T.S. Chanakya	Thane	24
December 2018	Bhandup Pumping Station	Mumbai	4
November 2018	Belpada	Raigad	10
April 2018	Agandanda Jetty	Raigad	2
December 2018	Diveagar environs	Raigad	6
April 2018	Dighi Jetty	Raigad	6
April 2018	Achra Crab Culture	Sindhudurg	2
January 2018	Taak Marsh	Sindhudurg	48

Table V.1: List of maximum number of individuals of Black-headed Ibis recorded site-wise

## Eurasian Curlew Numenius arquata

## **IUCN Status: Near-Threatened**

## **CAF NAP Priority Species**

#### **Species description**

The Eurasian Curlew *Numenius arquata* is a large size (50–60 cm) wader. It is greyish-brown in colour with long bill and plain head pattern. Head, neck, breast, and upperparts buffy brown with dark streaking, although plumage is variable. Underwing is pale, rump and lower back are white. Belly is white and flanks are streaked. Non-breeding adult has grey-brown breast and upperparts and whiter underparts (del Hoyo et al. 2018).



Figure V.10: Sites along Maharashtra coast where Eurasian Curlew Numenius arquata was recorded

Eurasian Curlew is a winter visitor to India, frequenting the seashore and mudflats in the mainland, Lakshadweep, Andaman and Nicobar Islands (Balachandran et al. 2018). This species is listed as 'Near Threatened' in 'IUCN Red List of threatened species' due to its declining population (IUCN 2020).

There are three subspecies found across the globe. Except *N. a. suschkini* other two viz. *N. a. arquata* & *N. a. orientalis* occur in India.

## **Distribution Range**

Subspecies *N. a. arquata* breeds from British Islands and France across West Europe (North to Arctic Circle) and East to the Volga River and Urals. It winters from Iceland and British Island South to Mediterranean and north west Africa, and East to Persian Gulf and Western India.



Figure V.11: Eurasian Curlew Numenius arquata recorded at Ware Beach in December 2018

*N. a. orientalis* breeds from central Siberia east through Central Russia to Northeast China; winters in East and South Africa, Madagascar, and from South Caspian Sea South to Persian Gulf, east through South Asia to East China and South Japan, and south to the Philippines and Greater Sundas.

*N. a. suschkini* breeds lower Volga River and Urals east to South West Siberia and North Kazakhstan; winters along the coasts of Sub-Saharan Africa and South West Asia.

It is recorded from Odisha (Gopi and Pandav 2007), Andhra Pradesh (Kannan and Pandiyan 2012), Point Calimere and Gulf of Mannar in Tamil Nadu from the east coast, and Gujarat, Maharashtra (Pachpande and Pejaver 2016), and Kerala (Aarif et al. 2017; Sivaperuman and Jayson 2012) from the west coast. There are also few records from inland wetlands (Pfister 2001; Paliwal and Bhandarkar 2014).

## Population

The global population is estimated to number 8,35,000–1,310,000 individuals. The 1% population threshold for South Asia is 1,000 individuals (Wetlands International 2019).

Balachandran (2012) recorded 55 individuals from the Gulf of Mannar between 2005–2007. 369 individuals were observed at Pulicat lake on the east coast of India (Kannan and Pandiyan, 2012). Around 700 birds were recorded at Kole Wetlands (Sivaperuman and Jayson 2012) and 350 at Kadalundi Vallikkunnu Community Reserve in Kerala (Aarif et al. 2017).

## Movement

One bird ringed at Point Calimere in 1971 was recorded from Jaffna coast in Sri Lanka in 1973.

## **Major Threats**

Wintering populations are threatened by disturbance on intertidal mudflats such as construction work and foot traffic, development work on high-tide roosting sites, pollution and flooding of estuarine mudflats and saltmarshes as a result of tidal barrage construction. The species is also threatened by the degradation of migrational staging areas owing to land reclamation, pollution, human disturbance and reduced river flows. Local populations of this species have also declined owing to hunting pressures (BirdLife International 2020).

#### Status along Maharashtra coast during the study period

During the study, this species was recorded in 21 sites along the coast. The maximum numbers recorded in each site are given in the Table V.2 and the locations are shown in the Fig. V.10 T.S. Chanakya and N.R.I pond near Mumbai supported large numbers; over 115 and 50 individuals were recorded in these sites respectively.

Month	Site	District	Maximum Count at site
November 2017	Panje, Uran	Raigad	51
September 2018	Arnala beach	Thane	1
November 2018	Akshi	Raigad	3
November 2018	T.S. Chanakya Ponds	Thane	153
May 2018	NRI Pond	Thane	51
November 2018	Mahul-Sewri Creek	Mumbai	2
December 2018	Bhandup pumping station	Mumbai	3
December 2018	Belpada	Raigad	20
December 2018	Aaravi Beach	Raigad	1
December 2018	Agardanda Jetty	Raigad	1
December 2018	Harihareshwar beach	Raigad	1
January 2018	Harnai Beach	Ratnagiri	3
April 2018	Bhatye Beach	Ratnagiri	3
April 2018	Jaigad Beach	Ratnagiri	8
January 2018	Achra Crab Culture	Sindhudurg	3
December 2018	Malgund Beach	Ratnagiri	1
December 2018	Mochemad Beach	Sindhudurg	5
December 2018	Padale Beach	Ratnagiri	2
December 2018	Palande Beach	Ratnagiri	1
December 2018	Taramumbrai Creek	Ratnagiri	7
December 2018	Ware Beach	Ratnagiri	1

Table V.2: List of maximum number of individuals of Eurasian Curlew recorded site-wise

#### Eurasian Oystercatcher Haematopus ostralegus

# **IUCN Status: Near-Threatened**

## **Species description**

Eurasian Oystercatcher *Haematopus ostralegus* is a large size (40–47.5 cm) wader. Breeding adult has black head, neck, upper breast, scapulars, upperwing-coverts, and tail. Broad white wingbar present from inner secondaries to middle primaries, which becomes narrower and more broken distally. Middle and lower back, rump, uppertail-coverts, lower breast, and belly are white; eye and eyering are red, bill is orange-red and legs are pink in colour (del Hoyo et al. 2018).

It is a winter visitor in India mostly found on estuarine mudflats, but also saltmarshes and sandy and rocky shores (Hockey et al. 2020). This species is listed as 'Near Threatened' in 'IUCN Red List of threatened species' due to its declining population (IUCN 2020).



Figure V.12: Sites along Maharashtra coast where Eurasian Oystercatcher Haematopus ostralegus was recorded

There are four subspecies normally recognized. *H. o. ostralegus, H. o. osculans, H. o. finschi* and the one which occurs in India is *H. o. longipes*.

# **Distribution Range**

*Longipes* breeds in West & North Central Russia (mouth of the river Ob) south to the Black, Caspian and Aral Seas and Lake Balkhash, and east to western Siberia. It winters on the coast from East Africa through Arabia to India.

Eurasian Oystercatcher is mainly a passage migrant on the Indian coast as per the distribution map of BirdLife International (2020). It is reported from the coast of Maharashtra, Odisha and Tamil Nadu (Gopi and Pandav 2007; Sandilyan et al. 2010b; Balachandran 2006).

It could be wintering in Gujarat; Urfi (2002) recorded a few in winter.

# Population

The global population is estimated to number 9,25,000–10,30,000 individuals (Wetlands International 2019). The 1% population threshold of *Longipes* subspecies is 1,400 individuals.

Two birds were sighted in October 2016 at Sindhudurg district in Maharashtra (Babu et al. 2017; Kurve, 2017). Urfi (2002) recorded 20 birds from Byet Dwarka, Gujarat in February 2000.

# **Major Threats**

This species is majorly threatened by habitat degradation on its wintering grounds due to land reclamation, pollution, human disturbance, coastal barrage construction, industrial development including development of ports and oil extraction, oil spills and wind farms (BirdLife International 2020).

# Status along Maharashtra coast during the study period

During the study, this species was recorded twice in Akshi. A total of seven individuals were sighted in September 2017 and three were recorded in December 2017. Also three individuals were recorded at Arnala Beach in September 2018. During the ringing session in September 2019, one individual was seen, which was also banded.

# Lesser Flamingo Phoeniconaias minor

# **IUCN Status: Near-Threatened**

# **CAF NAP Priority Species**

# **Species description**

Lesser Flamingo *Phoeniconaias minor* is the smallest (80–90 cm) flamingo. It has long bill which is very dark. Female is slightly smaller. Juvenile is grey brown, slightly darker overall, with browner head and neck than the adult (del Hoyo et al. 2018).



Figure V.13: Lesser Flamingo Phoeniconaias minor congregation recorded NRI Pond in January 2019



Figure V.14: Sites along Maharashtra coast where Lesser Flamingo Phoeniconaias minor was recorded

It is a local migrant in India and breeds on extensive mudflats usually far out from shore in large lakes or pans. It spends winter in inland saline and alkaline lakes, and also coastal lagoons. It tolerates or actively seeks out more alkaline water than Greater Flamingo due to specialized diet (del Hoyo et al. 2018). This species is listed as 'Near Threatened' in 'IUCN Red List of threatened species' as the populations appear to be undergoing a moderately rapid decline (IUCN 2020).

# **Distribution Range**

Bulk of population in Rift Valley of East Africa; with discrete populations in Namibia, Botswana, South Africa, Mauritania, Senegal, Pakistan and India (del Hoyo et al. 2018).

One of the largest breeding populations, it occurs on coastal wetlands in Rann of Kachchh in Gujarat, India (Parasharya et al. 2015). Wintering places in Gujarat are Gulf of Kachchh, Gulf of Khambhat, and other coastal sites in Gujarat including saltpans (Jadhav and Parasharya 2004). Along Maharashtra coast, Lesser Flamingo occurs at Thane Creek and Mahul-Sewri Mudflats. There are also records from Tamil Nadu (Manakadan 1992), Andhra Pradesh, Haryana, Odisha, Rajasthan, and Uttar Pradesh (Rahmani et al. 2016).

# Population

The global population has been estimated at 2,220,000–3,240,000 individuals. Regional estimates include 15,000–25,000 individuals in West Africa, 1,500,000–2,500,000 in East Africa, 55,000–65,000 in South Africa and Madagascar, and 650,000 in South Asia (BirdLife International 2020). The 1% population threshold of Lesser Flamingo for South Asia is 3,600 individuals (Wetlands International 2019).

In January 2003, Jadhav and Parasharya (2004) made a preliminary survey of selected coastal sites and inland freshwater wetlands in Gujarat. About 2,97,366 birds were recorded at Gulf of Khambhat, 31,381 at Gulf of Kachchh and 41,141 at other coastal sites of Gujarat. At least 80,000 to 100,000 flamingos were recorded foraging at the inundated Little Rann of Kachchh (Shah and Qureshi 2013)

From Maharashtra, 20,000 Lesser Flamingo were sighted in January 2014 at Mahul-Sewri Mudflats and 10,000 in Thane Creek in March 2013. In September 2001, 10,000 Lesser Flamingos were observed at Sambhar Lake, Rajasthan (Rahmani et al. 2016). During the recent coordinated flamingo count conducted by BNHS, a total of 1,20,000 flamingos were counted in January 2019.

# **Major Threats**

All the breeding sites of Lesser Flamingo face threats and require protection. Other threats include land claim, water pollution, and collisions with electric wires.

Inflow of industrial effluents into the Mahul-Sewri Mudflats is a cause for concern, as untreated waste results in the contamination of water. The area receives high loads of sewage, effluents, and bacteria. The water is highly contaminated with oil and grease due to its proximity to two ports (Rahmani et al. 2016).

# Status along Maharashtra coast during the study period

Lesser Flamingo was the most abundant species found in the wetlands near Mumbai and Navi Mumbai region. A maximum number of over 10,000 individuals were recorded at Bhandup Pumping Station in February 2018 (Table V.3). An estimated 900 individuals were recorded at Sewri in June 2018. A total of 8,200 and 7000 individuals in Sewri mudflats and NRI Pond respectively in January 2019. Over 2700 individuals were also recorded in Thane Creek, Vashi Creek and TSC during the study period. During the coordinated Flamingo counts conducted by BNHS, a maximum count of 1,07,000 individuals of Lesser Flamingo was recorded in Mumbai region during January 2019.

Month	Site	Maximum Count at site
February 2018	Bhandup Pumping Station	10000
May 2018	T. S. Chanakya	3521
December 2018	DPS Pond	853
June 2018	Sewri Mudflat	9000
January 2019	NRI Pond	7000
January 2018	Jasai Pond	43
December 2018	Panje	1110

Table V.3: List of maximum number of individuals of Lesser Flamingo recorded site-wise

# **Painted Stork**

# **IUCN Status: Near-Threatened**

# **Species description**

Painted Stork is large size (93–102 cm) Ibis-like stork. It has long, tapering, drooping bill. Breeding adult is mainly white with black breast-band, black tail, and black-and-white wings tinged pinkish on the greater coverts and tertials; head and legs bright reddish. Non-breeding adult has plumage and bare parts duller, e.g. naked orange-red head, and dull red legs (del Hoyo et al. 2018).

Painted Stork is widespread and a locally common resident bird in India. It frequents freshwater marshes, lakes and reservoirs, flooded fields, rice paddies, irrigation canals, freshwater swamp forest, river banks, intertidal mudflats, and saltpans (BirdLife International 2020). This species is listed as 'Near Threatened' in 'IUCN Red List of threatened species' because it is thought to be undergoing a moderately rapid population decline owing primarily to hunting, wetland drainage, and pollution (IUCN 2020).

# **Distribution Range**

It is distributed globally in southwest Pakistan (Sind), India and Sri Lanka east to China (del Hoyo et al. 2018).

The southern part of Rajasthan, Madhya Pradesh, Maharashtra, Uttar Pradesh, and all the states from South India hold significant population of Painted Stork (Koli et al. 2013; Kushwaha and Kumar 2018; Rajashekara and Venkatesha 2010; Narawde et al. 2012; Rahmani et al. 2016)

# Population

The 1% population threshold of Painted Stork is 250 individuals, with the global population estimated at 25,000 (Wetlands International 2019).



Figure V.15: Painted Stork Mycteria leucocephala congregation roosting at NRI Pond

In Andhra Pradesh, Ramesh and Philip (2015) recorded 2560 birds from the heronry at Veerapuram Village. Another heronry at Andhra Pradesh named Telineelapuram heronry has a record of 304 and 290 nests of Painted Stork in December 2013 and 2014 respectively. Kolleru lake has a record of 1,700 Painted Storks in 2014 (Rahmani et al. 2016). Taher (2007) reported 2,500 Painted Stork from Uppalapadu. As many as 120 individuals were observed from Madurai, Tamil Nadu in May 2013 (Thangalakshmi and Eswaran 2016). Kannan et al. (2008) recorded the highest count of 645 birds at Pulicat Lake during August 2006. Nearly 1,500 Painted Storks have been sighted in Big Tank (Peria Kanmai) and Sakkarakotai Kanmai, Tamil Nadu (Rahmani et al. 2016). Also, Tungabhadra Reservoir in Karnataka holds much greater numbers than their 1% population threshold (Rahmani et al. 2016).

Keoladeo National Park in Rajasthan also holds significant number of Painted Stork from North India. More than 300 nests of Painted Stork were reported from Nikol, Gujarat in the period 2012–2013 (Rahmani et al. 2016). Urfi et al. (2007) observed 79 nests at Sultanpur National Park, Haryana in 2005. Koli et al. (2013) counted 650 individuals in 2009. Delhi Zoo held 250 birds in 2011. In 2002, Balachandran et al. (2009) estimated about 5,000 birds at Chilika Lake.

# **Major Threats**

The increasing impacts of habitat loss, disturbance, pollution, wetland drainage and the hunting of adults are cause for concern. In northern India conversion of wetland habitats into fishing ponds has reduced their value as waterbird habitats, affecting waterbirds including Painted Stork. Eggs of the species are collected for food in parts of the range (BirdLife International 2020).

# Status along Maharashtra coast during the study period

During the study, this species was sighted from Thane Creek, Sewri Mudflats, Bhandup Pumping Station, NRI Pond, T.S. Chanakya Pond, Jasai, Panje, Belpada and Madhuban wetlands (Table V.4).

Month	Site	Maximum Count at site
January 2018	T.S. Chanakya Ponds	150
November 2018	Belpada	31
March 2018	Madhuban	4
December 2018	Bhandup pumping station	9
November 2018	NRI Wetlands	419
November 2018	Panje, Uran	166
October 2017	Jasai Pond	170
January 2019	Sewri Mudflat	18
November 2018	Thane Creek	25

#### Table V.4: List of maximum number of individuals of Painted Stork recorded site-wise

# VI. THREATS TO MIGRATORY WATERBIRDS AND THEIR HABITATS

Migratory waterbirds face an array of threats in their global range, including both short-term and longterm. On a study carried out on shorebirds, a team of experts identified a total of 45 issues (Sutherland et al. 2012) and categorized them into:

- a. Natural (tsunamis, volcanos, regional climate change, cyclones etc.)
- b. Anthropogenic pressures (agricultural intensification, conversion of tidal and coastal wetlands, developmental activities, eutrophication etc.)
- c. Future issues (microplastic, new means of recreation, infectious diseases etc.)

Studies have also shown that changes in the timing and extent of precipitation, temperature and weather patterns have had different responses on the shorebird populations regionally. The effects of global warming and habitat change are presumed to be especially severe in wetlands due to increased water demands for domestic, industrial and agricultural use, thus affecting the water table and in turn the productivity of these wetlands (Robinson 2009). Natural and human-induced habitat changes impact prey availability, prey dynamics, as well as predation pressure at each site (Boere et al. 2006). With changing habitats, levels of connectivity, anthropogenic impact, hydrology, and climate, there are many potential threats that we may still be unaware of. In the research to follow, it will become critical to identify all the micro- and macro-level threats to formulate effective mitigation measures before it is too late. Long-term monitoring has played a key role in providing a baseline data for understanding the trends and identifying the stress factors, which have led to prioritizing conservation activities.

Major threats to the coastal biodiversity along the Maharashtra coast are related to factors like coastal erosion, siltation, pollution, destruction of mangrove swamps, salt marshes, sea-level rise, landslides and slope failure, pressure of population, industrialization, and road transport (Apte and Bhave 2010; Ahana Lakshmi et al. 2012).

During the study, the threats observed at each site were recorded. Some pressures to the areas in the recent times narrated by the locals were also noted. They are:

## Plastic and solid waste

Plastic litter by locals and tourists was recorded at the beaches of Alibaug, Akshi, Kashid, Murud, Diveagar, Harne, Dabhol, Ganpatipule, Bhatye, Achra, Malwan, and Tarkarli. Solid waste with plastic garbage was seen dumped near Alibaug beach, Alibaug fishing jetty, and Bhatye beach. During the survey and ringing session, a large quantity of plastic waste was recorded scattered across Akshi beach. Several of these beaches are important feeding site for shorebirds and other waterbirds, and they are at a risk of ingesting the plastic. In studies carried out worldwide, plastic waste on the beaches and in the sea has been a cause of death for several waterbird species.

Plastic pollution is one of the growing threats not just for the terrestrial ecosystem, but also coastal and marine. Mismanaged waste and marine debris have presented an evident threat to the marine and coastal birds, with almost 2,50,000 tonnes of plastic waste afloat (Roman et al. 2019). A study in Marine Pollution Bulletin discusses about the study carried out along the coast of Brazil, where 24 American Oystercatchers were dissected and plastic and glass was recorded in each of the individual's stomach (Cirino 2018).



Figure VI.1: Solid waste dumped at a mangrove near Alibaug

Plastic waste was recorded in three major forms: i) Plastic litter strewn by public (locals and tourists) ii) Dumped solid waste iii) Plastic debris deposited by the sea.

The fishermen at Alibaug and Ratnagiri jetty informed that the plastic debris at the sea has greatly hampered their active fishing time and fishing efficiency, causing a cascading impact on their livelihood. With every fishing trip, they spend hours cleaning the plastic waste stuck in the fishing nets and the propellers of the motor boats. Much of their time was spent removing the waste from the nets, and as a consequence, they had experienced reduced catch of fishes in recent years. They attributed the root cause of the problem to the plastic litter dumped in and around Mumbai City. The quantity of marine debris being entangled in fishermen's nets along the Maharashtra coast needs to be studied season-wise and location-wise, along with the socio-economic impact caused by the marine debris.

The fishermen were found dumping the marine debris cleaned from their nets along the boat landing areas. As there was no waste disposal mechanism in place, the removed plastic wastes made their way back into the sea.

In addition to the solid and plastic wastes on the beaches, the resultant pressure due to free ranging dogs at these sites also posed a threat to the foraging and roosting shorebirds. This was recorded at beaches with plastic and other solid waste litter, which also happened to be areas of high tourist footfall. Free ranging dogs were recorded at Alibaug, Akshi, Nandgaon, Kashid, Murud, Anjarle, Savane, Harne, Dabhol, Ganpatipule, Bhatye, Tondavali, and Vengurla beaches. The threat would be true for other unrecorded sites as well. One injured gull each was recovered from Akshi and Velas Beach. The dogs were seen chasing birds in the observed sites, but there were no direct records of them hunting down the birds. A study would be useful to assess the extent of threat to waterbirds from free ranging dogs.





Figure VI.2: Plastic and other solid waste debris deposited by sea at Akshi beach

Figure VI.3: Plastic litter stuck in fishing net



Figure VI.5: Dogs chasing a flock of gulls at Akshi Beach

It is critical to restrict the littering and dumping of waste on the beaches. Not only is there a danger of the birds ingesting plastic particles and infected organic material, but the waste would attract scavenging animals, which would then pose a threat to the waterbirds feeding and roosting at these coastal areas. Awareness programmes on the safe disposal of litter should be conducted for various stakeholders.

## **Tourist Activities**

Several of the sites surveyed along the coast of Maharashtra are frequented by tourists. Some sites face more pressure due to the negligent behaviour and disturbing activities of the tourists. The sites closer to urban areas face this kind of disturbances than those located far away. At Bhuigaon and Akshi, the visitors were repeatedly seen chasing the birds using two-wheeler and four-wheel vehicles. Though such recreational chasing does not cause mortality, it was observed that they impacted the feeding time of



Figure VI.4: Tourist chasing feeding birds on two-wheeler

the birds. Also birds were seen moving from one place to other than feeding at a single site. During the survey in December 2018, this activity was reported in high numbers at the beaches between Mochemad and Terekhol. The locals of the area informed that it was due to the influx of tourists from Goa. It has been documented elsewhere in the world that outdoor recreation results in interactions between humans and wildlife. These interactions can have deleterious effects on the foraging efficiency of avian species. Disturbances can be energetically costly due to loss of feeding time and increased escape activities (Schummer and Eddleman 2003). Disturbance during the non-breeding season may increase energy demands and/or delay migration (Fredrickson and Drobney 1979). Therefore, disturbance to rapid moving birds could result in decreased nutrient reserves, late arrival to breeding grounds, and ultimately, reduced reproductive success.

The bird banding and resighting of ringed birds through this study indicated that many migratory species stayed for a long time in these areas, and they were important foraging and roasting sites for the migratory birds. Increased escape activities may impact the body condition of the migratory waterbirds. Further, the loss of energy levels in the wintering areas will have adverse impact on the breeding success of the migratory species. However, long-term site specific waterbird monitoring and behavioural studies are important to ascertain the same.

During the holiday season, with the already added tourist disturbance, at some beaches, activities such as horse riding, camel rides, All Terrain Vehicle (ATV) rides and speed boats were seen. At Devbaug Beach, when the speed boat rides were started during high tide, the gulls used the sites between Tsunami Island and Seagull Island and further moved southwards to Nivti Beach. The ATVs were seen disturbing birds at Alibaug, Kashid Diveagar, and Dabhol beaches. Though these activities do provide financial benefit to the people, efforts should be made towards promoting environmentally conscious tourism and boosting eco-tourism activities.

'Conservation' does not mean non-use but wise use, which contributes to sustainable utilization. It

could be understood during the field surveys that the behaviour of chasing birds for enjoyment was due to lack of awareness among the tourists. It is therefore very important to create awareness about birds and their behaviour among common people, especially tourists. There could be informative signboards put up at vantage points on the beach, stating the importance of these sites for the long distance migratory waterbirds. This would at least discourage some of the activities and promote responsible tourism in such bird areas. Awareness programmes need to be conducted for the local people so that they can play a proactive role in controlling disturbances to migratory birds.

# **Reclamation of wetland**

It was observed during the August 2017 survey, right at the onset of the study, that landfilling activity had commenced in Jasai (Dastan Phata). During the survey, nearly 900 waterbirds were recorded at Jasai wetland despite the disturbance. But, by the end of the study in July 2019, the wetland was drained and reclaimed and only a few birds were seen in the patches of water at the southern side.

For many coastal areas, land reclamation is a daunting challenge for migrating waterbirds because the areas that are most suitable for these migratory shorebirds also happen to be prioritized for development. Despite the relatively small size of the wetlands, the loss of these biologically productive areas negatively impacts several migratory bird species (WMBD 2011). With the loss of such wetlands, the migratory birds must look for other potential areas for roosting and refuelling for their journey. The wetlands around Mumbai face threats from land use change. BNHS recently conducted a study assessing the land use land cover change in the wetlands of Navi Mumbai using Landsat images of 1973, 1987, 2002 and 2018. The analysis highlighted that though the mangrove cover had shown an increase, the wetlands and saltpans had shown a substantial decline. As assessed from the landuse change from the 1990s to 2019, there has been an increase of 47 sq. km in the mangrove cover around Mumbai, of which 24 sq. km is covered within Thane Creek alone. Land accretion has also resulted in land use change from surface water to land (majority of which has been mangroves and mudflats). Though the feeding area along the creek has seen an increase, the high-tide roosting sites have been under threat. These inland wetlands are still in grave threat from unsustainable developmental activities, especially landfilling for residential, recreational and commercial purpose (Bajaru et al. 2019, Bhave and Apte 2020).

#### **Disturbance from fishing and boats**

Disturbance caused by fishing activities was recorded in NRI Complex Ponds, T. S. Chanakya Pond, DPS Pond, and wetland at Bhandup Pumping Station. The birds were disturbed when the fishermen entered into the ponds, but the consequences of the temporary disturbance were difficult to evaluate. Similarly, the birds were disturbed with the approaching boats at Bhandup Pumping Station. At Alibaug, Murud, Agardanda, and Harne beaches, seagulls were seen following the fishing boats for potential feed. As the maintenance of boats is carried out just after the monsoons, a large amount of grease, machine oil and synthetic waste from ship mending was seen on the beach. And cases of birds covered in oil were also recorded during the September survey.

#### Other threats reported

Sand mining activity at Malai and Palshet created disturbance, and no roosting or feeding birds were recorded at these sites.

Disturbance due to cattle was recorded at several beaches and inland wetlands along the coast.

# VII. BIRD BANDING

The capture and banding of birds can provide information about sex, age, morphology, plumage, physical condition, and even the diet of the individuals concerned. The subsequent recapture, alive or recovered as dead, of ringed birds provides further information on survival, movement, and changes in some of the attributes mentioned above. When pooled over large samples of birds, the data yield the estimates of demographic parameters (age and sex ratios, survival rates), which characterize whole populations of birds and can be monitored over time. The monitoring of survival rates is one of the most important conservation functions of ringing since it can alert the conservationists to incipient population declines and indicate their demographic cause (Greenwood et al. 1993, DeSante 1993).

Bird banding is carried out across the globe for various purposes (Balachandran et al. 2018, Bayly et al. 2018; Norris et al. 2005; Wilson et al. 2007; Sillet and Holmes 2002; Frederiksen 2002). The applications of bird banding studies are as follows:

- 1. To understand the linkage between spatially distant habitats and the seasonality of use through band recoveries and tagged bird sighting records.
- 2. To understand the habitat requirement and spatial needs in the network of sites used during breeding, non-breeding and staging during the migratory season.
- 3. To understand the non-breeding displacement patterns of birds breeding in different biogeographic areas.
- 4. To investigate the habitat quality during each migratory stage based on the moult pattern, fat reserve and period of commencing migratory journey.
- 5. To estimate juvenile survival rate and annual survival of adults in migratory birds by capture-recapture/resighting.
- 6. To calculate the annual recruitment success based on the age data collected and collated from the entire region. The results of the age proportion obtained from the ringing studies have been communicated to the flyway organizations, which has in turn helped in understanding the recruitment rate and fecundity.
- 7. To have a better understanding of the physiology that helps in the long-distance migration of birds through energy usage and hormones.
- 8. To understand the effect of climate change and landscape change on the migration pattern of birds, made possible through long-term bird ringing.

It was proposed to study the movement and dispersal pattern of short- and long-distance migrants and to document the existence of important staging/wintering areas along the coast of Maharashtra by using bird ringing and colour marking.

# Methodology

# **Bird Trapping**

Birds were trapped using modified indigenous traps, i.e. Mesh Net and Noose Trap for waterbirds and the standard Mist-Net for trapping landbirds. These nets were operated by trained trappers and ringing staff.

- 1. **Mesh net**: It is used to catch waders of all sizes from Little Stint *Calidris minuta* to the Greater Flamingo *Phoenicopterus roseus*. This fine cotton thread net has a mesh size of 10 x 10 cm, height of 1.2 m and a length of 60 m. Shorebirds were caught using mesh nets by professional bird trappers. Mesh netting was done at night along the flight path from the foraging places to the roost sites.
- 2. **Noose Trap:** This trap is used to catch various species of birds including storks, ducks and waders. Noose Traps are made from mono-filament nylon twine. The size of the nylon twine and the noose vary for different species. Long-legged wading birds were caught by legs mostly with the noose, which was operated during daytime in the foraging and roosting areas.
- 3. **Mist Net:** This method was primarily targeted towards landbirds. Dark-coloured nylon net is inconspicuously mounted on poles. The nets have a series of 3–4 shelves or pockets running horizontally along the length of the net into which the bird drops when it strikes the net.

# **Bird banding**

All the captured birds were immediately marked with an engraved metal ring. The shorebirds were also marked with colour leg flags as per the 'East Asian-Australasian Shorebird colour flagging protocol' for northern India (white flag with red engraving along with a plain white flag).

# Morphometry

*Measurements*: The birds were further examined for morphological measurements viz. wing length, bill length, tarsus length etc.; they were weighed and plumages were checked. The measurements, especially bill and tarsus, help in identifying different geographical populations of a particular species as well as subspecies variations. These also help in sexing the birds in certain species.

**Ageing and sexing:** The birds were aged on the criteria described in the British Trust for Ornithology Guide number 17 (Prater et al. 1977). Based on the plumage of waders, first year birds were separated from adult birds. Sexing was done in certain species on the basis of bill measurements (e.g. Curlew Sandpiper *Calidris ferruginea*).

**Moult Scoring:** Moult is an important phenomenon in a bird's life as it helps keep the plumage fresh for flight, especially just before undertaking migration. But it is also an energy consuming activity, just like the breeding process. The wintering waterbirds have to renew their feathers by moulting in order to effectively undertake the onward and return migration. Since moult is directly connected with migration, considerable emphasis was laid on collecting data on the moult pattern of all the migratory bird species that were ringed during the study.

The birds caught were scored for the condition of moult in flight feathers as per the following method. Primary feathers were numbered from inward (1) to outward (10). The moult was recorded by giving an integral score to each primary between "0" and "5". Old feathers were given a value of "0" and new feathers '5', and growing feathers were scored between 1 to 4. The symbols used were "1" for an old missing feather or new feather completely in pin, "2" for a new feather just emerging from the sheath up to one third grown, "3" for a new feather between one and two-thirds growth, "4" for a new feather more than two thirds growth and with the remains of waxy sheath at its base. The scores for all the ten primaries of one wing were added to get a primary moult score with a maximum of 50 (Balachandran 2002).

## **Results and discussion**

There was a delay in getting permission for the ringing. The permission was granted to BNHS for capturing/ banding of different migratory bird species of either sex from October 30, 2018 to September 30, 2019.

During bird monitoring along the coast of Maharashtra, bird trapping feasibilities based on the water condition, access to the site and bird congregation were found in a few wetland sites near Mumbai. Bird banding was carried out in September 2019 at Akshi Beach (18°.62.8881 N: 072°.88.4203 E), Raigad district.

During the study period, a total of 105 individuals belonging to 15 species of seven families were ringed. Of these, 97 were also colour flagged. Lesser Sandplover was the predominant among the captured species, followed by Kentish Plover, Ruddy Turnstone and Terek Sandpiper (Table VII.1). Only one individual each of Near Threatened Bar-tailed Godwit and Eurasian Oystercatcher were recorded at the site during the ringing period, both of these individuals were ringed. During the ringing session, nine individuals were re-trapped during the subsequent days, eight of which were Lesser Sandplover and one Bar-tailed Godwit.

Sr. No.	Scientific Name	Common Name	IUCN Status	Total		
	Family: Scolopacidae					
1	Actitis hypoleucos	Common Sandpiper	LC	1		
2	Arenaria interpres	Ruddy Turnstone	LC	7		
3	Calidris alba	Sanderling	LC	1		
4	Limosa lapponica	Bar-tailed Godwit	NT	1		
5	Xenus cinereus	Terek Sandpiper	LC	6		
		Family: Charadriidae	-			
6	Charadrius alexandrines	Kentish Plover	LC	10		
7	Charadrius leschenaultia	Greater Sandplover	LC	4		
8	Charadrius mongolus	Lesser Sandplover	LC	65		
9	Pluvialis squatarola	Grey Plover	LC	1		
Family: Haematopodidae						
10	Haematopus ostralegus	Eurasian Oystercatcher	NT	1		
Family: Muscicapidae						
11	Copsychus saularis	Oriental Magpie Robin	LC	2		
Family: Laniidae						
12	Lanius schach	Long-tailed Shrike	LC	1		
Family: Nectariniidae						
13	Leptocoma zeylonica	Purple-rumped Sunbird	LC	1		
Family: Pycnonotidae						
14	Pycnonotus cafer	Red-vented Bulbul	LC	3		
15	Pycnonotus jocosus	Red-whiskered Bulbul	LC	1		
			Total	105		

Table VII.1: Details of bird species ringed at Akshi in September 2019

## Age composition

Data on age composition collected over time at a particular site will be helpful in estimating the recruitment success in the breeding ground. Though generating a robust standard for a good recruitment rate takes a long time, a baseline can be generated for month-wise juvenile composition to understand the preference shown by the first year birds towards certain habitats. During the study, a total of 65 Lesser Sandplover were ringed, juvenile (first-year) birds outnumbered the adults. During the field observations, more juvenile Lesser Sandplover were recorded than adults from September 17 to 24. After that, a rise was recorded in the number of adults. In the ringing studies carried out at Point Calimere along the southeast coast of India, the juvenile composition has been comparatively lower. Of the 33 Lesser Sandplover ringed in the second half of September, only two were juveniles, and in 2014 during the same period, one juvenile was ringed along with seven adults. A total of 10 Kentish Plover were ringed. Of which, six were adults and four were juveniles. It was interesting that from September 18 to 21, only juveniles were captured and the first adult was trapped only on September 22.

Of the seven Ruddy Turnstone ringed, two were juvenile and five of the six Terek Sandpiper ringed were juvenile.

An individual each of Common Sandpiper, Sanderling and Bar-tailed Godwit ringed were also juveniles. The age composition observed in the dominant wader species ringed in Akshi Beach led to the speculation that during the time of arrival, the juveniles arrive first to this area. However, long-term and year-round ringing studies are necessary for further confirmation.

In landbirds, two each individuals of Oriental Magpie Robin *Copsychus saularis* and Red-vented Bulbul *Pycnonotus cafer* ringed were juveniles. Details of the adult and juveniles ringed are given in the Table VII.2.



Figure VII.1: Ringed Lesser Sandplover Charadrius mongolus in juvenile plumage

Sr. No.	Scientific Name	Common Name	Juvenile	Adult
1	Actitis hypoleucos	Common Sandpiper	1	0
2	Arenaria interpres	Ruddy Turnstone	2	5
3	Calidris alba	Sanderling	1	0
4	Limosa lapponica	Bar-tailed Godwit	1	0
5	Xenus cinereus	Terek Sandpiper	5	1
6	Charadrius alexandrines	Kentish Plover	4	6
7	Charadrius leschenaultia	Greater Sandplover	4	0
8	Charadrius mongolus	Lesser Sandplover	39	26
9	Pluvialis squatarola	Grey Plover	0	1
10	Haematopus ostralegus	Eurasian Oystercatcher	0	1
11	Copsychus saularis	Oriental Magpie Robin	0	2
12	Lanius schach	Long-tailed Shrike	1	0
13	Leptocoma zeylonica	Purple-rumped Sunbird	0	1
14	Pycnonotus cafer	Red-vented Bulbul	2	1
15	Pycnonotus jocosus	Red-whiskered Bulbul	0	1

Table VII.2: Age composition of birds ringed in Akshi Beach

## Weight

Some species of local migratory birds cover less than 100 kilometres between their breeding and wintering ground, while the long-distance migratory species may travel thousands of kilometres, crossing geographical barriers and unfavourable sites where they cannot stop to rest or feed. In such cases they need to accumulate large energy reserves in the form of fat adipose tissue (Newton 2007, Alerstam et al. 2003). The weight range of the population sample will also be useful to determine if the population will stay back the entire winter or will be using the site as a stopover and move further in the migratory path to reach the final wintering ground.

Of the adult Lesser Sandplover individuals ringed, the weight range was between 44 and 59 gm with mean of 55.1 gm. As many as 50% of the records were in the range of 52.5 and 56.6 gm. Among the juvenile Lesser Sandplover numbers ringed, the overall weight recorded was lower than adults. The weight range was 41.1 gm to 55.4 gm with 50% of the records in





the range of 43.4 and 48.7. From Fig VII.2 it can be seen that variation in the weight of an adult and juvenile Lesser Sandplover was not very high. This could suggest that the individuals captured were from the same geographical population. In case individuals from different populations were present, a wider variation in the weight would have been evident. The weights of adult Kentish Plover were recorded in the range of 35–38 gm and the juvenile in the range of 33–39 gm. The weight range of Ruddy Turnstone showed wide variation. The adult ranged between 76 and 101 gm and juvenile between 92 and 131 gm. The weight range in juvenile Terek Sandpiper was 52–65 gm. Juveniles of Greater Sandplover were recorded with weight range of 67–73 gm.

## **Primary moult**

Moult is one of the energy expensive events in the life cycle of migratory birds. It is an unavoidable event that a migratory bird must undergo and the species has to ensure that moult does not completely overlap with the other two major energy consuming events, namely breeding and migration (Jackson 2017). Moult is a cyclic process and not a continuous one, and it requires significant amount of energy to generate new feather material. The loss of primary remiges creates blank space in the flight feathers, which reduce the flight efficiency. Hence the birds have to strategize the timing and duration of moult (Underhill and Joubert 1995). The success of an efficient and timely moult will depend on the feeding potential provided by the habitat. The time of initiation and duration of moult will be different for different species. Even in a single species, the moult strategy would differ based on the breeding origin and migratory route taken by the population.

During the ringing session, all the juveniles of Lesser Sandplover had the fresh juvenile primaries. None of them were recorded moulting (Fig. VII.3). In adults, of the 25 individuals, three were recorded with old worn out feathers and were yet to initiate the moult. It was noteworthy to mention here that the weight of these individuals was lesser than that of the other adults (44–49 gm). Totally four adults were recorded



Figure VII.3: Moult score of Lesser Sandplover Charadrius mongolus recorded in September

with moult score less than 20. Of these, three had fresh three inner feathers that had completed moult. Other ten individuals were recorded with moult score between 21 and 30. These birds had renewed five inner primaries. Of the rest, seven individuals had score between 31 and 35. One individual had almost completed moult with the score of 49.

The adult as well as juvenile individuals of Kentish Plover and Terek Sandpiper were yet to start the moult. Among Ruddy Turnstone, two juvenile and four adults were recorded without the moult.



Figure VII.4: Primary remiges moult in Lesser Sandplover Charadrius mongolus

One adult was in the late stages of moult with a moult score of 45. One Grey Plover ringed was recorded in moult where the inner five primaries were replaced and the remaining moult was in progress.

In the landbirds ringed, primary moult was recorded in one each individual of Oriental Magpie Robin *Copsychus saularis*, Red-whiskered Bulbul *Pycnonotus jocosus* and Red-vented Bulbul *Pycnonotus cafer*.

# **Ring/Flag resighting**

Along with the conventional method of banding birds with engraved metal rings, the colour tagging method has gained significant popularity in the bird migration study. The movement of the tagged birds can be traced through a series of sighting records reported by birdwatchers, ornithologists and photographers.

Of the 105 individuals belonging to 15 species ringed and tagged in Akshi during September 2019, 31 individuals of five species were resighted subsequently. A Kentish Plover ringed in Akshi on September 24 was recorded on Merces Beach in Vasai on October 17, 2019 which showed the local movement.

The resighting records proved that using colour rings with individual codes facilitated repeated resighting records in waders, which is not possible using metal rings alone. The development of a network of birdwatchers through a series of trainings as part of this project (details are covered under the chapter Bird Band) and fast internet communications lead to favourable conditions for the resighting of colour-tagged birds. Moreover, resightings of colour-tagged birds at the ringing site produced more accurate evidences needed for ascertaining the role play by the particular sites for the migratory waterbirds. The resighting of individuals observed after 60 days (two months) in the same site indicated that these individuals were wintering in the location. Details of the resighted colour tagged birds are given in the Table VII.3.

Tag Ringing Date		Re-sighting Date/s	Re-sighting Date/s Time Lapse		
		Lesser Sandplover			
X15	19 September 2019	• 02 October 2019	- 13 days	Akshi Beach	
		13 November 2019	52 days		
		• 13 November 2019	• 52 days		
X22	22 September 2019	<ul> <li>15 December 2019</li> </ul>	• 84 days	Akshi Beach	
X27	23 September 2019	• 1 December 2019	• 69 days	Akshi Beach	
		• 13 November 2019	- 51 days		
X29	23 September 2019	• 30 November 2019	• 68 days	Akshi Beach	
X30	23 September 2019	• 17 November 2019	• 55 days	Akshi Beach	
X34	23 September 2019	• 30 November 2019	• 68 days	Akshi Beach	
7.51		17 November 2019	53 days		
X45	25 September 2019	• 30 November 2019	• 66 days	Akshi Beach	
X49	26 September 2019	- 30 November 2019	- 65 days	Akshi Beach	
	20 September 2010	17 November 2010	• 09 days	Akshi Boach	
X01	29 September 2019	• 17 November 2019	• 49 days	Akshi Deach	
881	29 September 2019	nber 2019     • 30 November 2019     • 62 days     Akshi Beach			
		Kenti	ish Plover		
X10	18 September 2019	• 21 November 2019	• 64 days	Akshi Beach	
		• 29 November 2019	• 68 days		
X25	22 September 2019	• 30 November 2019	• 69 days	Akshi Beach	
X40	24 September 2019	• 17 November 2014	• 54 days	Merces beach, Vasai	
		• 21 November 2019	• 58 days		
X43	24 September 2019	• 30 November 2019	• 67 days	Akshi Beach	
		• 13 November 2019	• 49 days		
X47	25 September 2019	• 16 December 2019	• 82 days	Akshi Beach	
		• 30 November 2019	• 63 days		
X70	28 September 2019	• 15 December 2019	• 78 days	Akshi Beach	
		Ruddy	Turnstone	T	
		• 2 October 2019	• 11 days		
0V3	21 September 2019	• 30 November 2019	• 70 days	Akshi Beach	
		• 13 November 2019	• 49 days		
		• 17 November 2019	• 53 days		
X46	25 September 2019	• 08 December 2019	• 74 days	Akshi Beach	
		Greater	Sandplover		
X54	27 September 2019	• 30 November 2019	• 64 days	Akshi Beach	
		Bar-tai	iled Godwit		
		• 02 October 2019	• 13 days		
2B7	19 September 2019	• 13 November 2019	• 55 days	Akshi Beach	

# Table VII.3: Details of the resighted colour tagged birds ringed in Akshi till 31 December 2019

A glimpse of the resighting records of the birds colour tagged in Akshi in September 2019



Figure VII.5: Bar-tailed Godwit P.C.: Awadh Agarwal



Figure VII.6: Kentish Plover P.C:. Capt. Bhalachandra Shirolkar





Figure VII.7: Kentish Plover P.C:. Roozbeh Gazdar





Figure VII.9: Ruddy Turnstone P.C:. Awadh Agarwal



Figure VII.10: Lesser Sand Plover P.C:. Dr. Dilip Verma

# VIII. 'BIRD BAND' MOBILE APPLICATION

hough bird ringing is a fairly economical and easy method to tag birds, the information on the movement of birds can only be obtained when the ringed individual is either recaptured (captured at the ringing site) or recovered (captured at a site other than the ringing location). The recapture data gives us information on the longevity of the bird, moult pattern, feeding success based on the fat deposition, site fidelity and flock fidelity. The recovery data helps to establish a connection between two distant sites the bird has visited and seasonality of movement pattern. BNHS has been able to establish information on connectivity between sites based on the recovery data. Since the beginning of ringing in India, 3000 recoveries were obtained till date from sites in 29 countries spanning five continents. The recoveries were helpful to delineate the three Asian Flyways and initiate global-level conservation of migratory birds.

The major drawback of this method, though, is that there is a need for the bird to be recaptured (dead or alive) at the same or different location in order to obtain any data. As a result of which the data obtained is very scarce. In the recent years,



colour tagging of birds (marking birds with coloured leg bands, leg sflags, nasal saddles, neck collars or colour rings) has become prevalent globally. These tags can be spotted on field from a distance and the information on the ringing site and the movement can be obtained. The colour tagging is done in concurrence with the ringing schemes in each flyway to avoid any overlap in the colour combinations that could lead to confusion. In case of shorebirds, we follow the shorebird colour flagging protocol agreed upon by the East Asian-Australasian Flyway. In southern India, the shorebirds are marked with a single black band with white alpha-numeric engraving, and in central and northern India, shorebirds are marked with two white flags, one of which is engraved with red alpha numericals (Fig. VIII.2). For geese, red neck colar with white engraving is being used in India.

With the use of colour tags that can be recorded by binoculars and photographs, it became possible to get information of the location of these individuals from students, birdwatchers and ornithologists. These sighting records have yielded interesting results on the movement of waterbirds and established links between migratory birds wintering in India. In the past years, 37 color tag sighting records sent by birdwatchers from wetlands near Jamnagar have shed light on the seasonality of movement of the migratory birds. Interestingly, two Greater Flamingo color banded in Khijadiya, Gujarat, were



Figure VIII.1: Neck collar colour combination used in India



Figure VIII.2: East Asian-Australasian Flyway Protocol for colour flagging shorebirds http://www.shorebird-network.net/PDFs/EAAF-Flagging-Protocol-EAAF-1Nov2010Review.pdf

recorded dispersing to other sites in the following season, presumably owing to the drought conditions at the tagging site. One of these individuals was recorded in a wetland in Mumbai. Additionally, the birds colour banded around the wetlands of Mumbai in the previous seasons were resighted at the same sites by several birdwatchers and photographers (Annexure VI).

In order to collate this sighting records to give detailed information on the health and ecology of the bird as well as the state of the habitat, a bird band sighting form (Fig. VIII.5) was designed and circulated in the birdwatcher groups during the study period. It was added as one of the curricula in the training programmes organized for stakeholders, which were carried out through this project.

This form collected information on the date and location of the sighting, species, type and placement of the tag, information on the flock that the individual was observed in. The template of the form is given in Fig. VIII.5.



Figure VIII.3: Shorebird colour flag used in southern India

Figure VIII.4: Shorebird colour flag used in central and northern India

# **BAND SIGHTING DETAILS**



Please complete all the important (#) details below. If any are missed the details may be cleared when submitting and will need to be re-entered. If the bird had any colour rings please fill them into the correct positions (# important column). If you have trouble filling this for please email the ring details to bands@bnhs.org along with the photos

Bird Name / Species #	Enter C	Enter Common/Scientific Name			
Location Name #	Click or	Click or tap here to enter text			
Latitute Click o	r tap here	to enter text Longi	tute	Click or tap here to enter text	
Landmark#	Click or	tap here to enter te	xt		
Date Obsereved	Click or	tap to enter a date			
State?Province#	Click or	Click or tap here to enter text			
Metal Ring on # :	Righ	t Leg			
Ring Position # :	Above knee	e (Tibia)			
E	Below knee (Tarsus)				
Numbers / Letters / Inscribed Click or tap here to enter text			er text		
Bird Statu (Alive/Dead/Injured/Trapp		ped) #		Click or tap here to enter text	
Further Information		Click or tap here t	o ent	er text	

#### Figure VIII.5: Bird Band Sighting Details Form

Further Information on tag

Click or tap here to entet text

# Any additional tags/flags



( $\checkmark$ )Please select the appropriate box						
Leg flag	Neck Collar	Wing Tag	Geolocator			
Leg band	Nasal Saddle	Satellite transmi	tter			
Tag Colour Cl	Tag Colour Click or ta here to enter text					
Tag Inscription Click or tap here to enter text						
Leg tag on Right Leg Left Leg						
Additional Information Click or tap here to enter text on Bird sighting						
Contact Details #	Name/s: e	email address, contact nur	nber of observer(s)			

Apart from traditional monitoring methods, advancement in science and technology has aided the development of a wide range of modern tools to monitor wildlife and also to manage them. Some examples are the use of wireless image sensor networks (Zhang et al. 2014), drones (Verschoor 2016), Internet of Things (IoT; Sheela et al. 2016), mobile applications (Bateman et al. 2013; Jepson and Ladle 2015), and popular citizen science mobile applications to gather bird data (https://play.google.com/ store/apps/details?id=edu.cornell.birds.ebird&hl=en\_IN). The smart phone usage in India is very high and phones are available in very nominal prices now. A need was felt to develop a platform for all the enthusiastic birdwatchers, volunteers, students and photographers to share information on tagged birds via a dedicated mobile application, and was executed through this project.

The mobile application was designed and developed with adequate field testing. It was officially launched on June 05, 2019 by Mangrove Foundation as a part of the World Environment Day Celebration.

A total of 296 users have registered to this application from June to December 2019. Efforts are being made to popularize this application among the birdwatcher forums, students and wildlife photographers. The information from all records reported from across India with this citizen science initiative will be compiled as a database, which will help in the conservation actions for important bird habitats across the country.



Figure VIII.6: Bird Band application being launched on 05 June 2019

The Mangrove Foundation can access the data of the users and entered tagged bird sighting records. The login ID and Password is provided separately. A brief about the mobile application is given below.

This mobile application can be downloaded from the BNHS website.

The mobile application has been designed to collect information in three stages:

I. Profile of the birdwatcher: The mobile phone users (observers) have to register themselves after downloading the mobile application by providing the following simple information

Name

Profession

**Contact Details** 



53.3KB/s 📶 😤 🔳

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Figure VIII. 8: Bird Band Tag Details section

Based on the information provided, the tagged bird is categorized as one tagged in India or tagged outside India. In case it is tagged in India, the ringing information is selected from the bird ringing database and shared with the user on the application. If it is ringed outside India, the sighting details are communicated with the ringing agencies to get the ringing information. This information is then shared with the user.

In their specific accounts, the observers can report current sighting details while on field, or even old sighting records. Once they save their records, they can access all the tagged bird sighting records at any given point. They can segregate the available data based on the type of the tag, species and location.

# IX. TRAINING FOR FOREST DEPARTMENT STAFF AND OTHER STAKEHOLDERS

The success of any scientific approach to conservation is when the local communities and other stakeholders understand and undertake efforts towards it. Managing wetlands requires diverse capacities to make various stakeholders aware of the wide-ranging ecosystem services and biodiversity values of these waterbodies. Most of the wetlands that support the migratory birds along the coast of Maharashtra lie close to human dominated landscapes. Their effective management and protection requires the involvement of personnel from the Forest Department, conservation agencies and local communities. Hence it was felt necessary to provide an orientation to the local communities and other stakeholders on the importance of coastal habitats and the role they play in supporting migratory birds.

# **Compiling a Training Manual**

In order to fulfil this objective, a concise bi-lingual training manual on bird monitoring, handling and marking was compiled highlighting the standardized methods and protocols for bird monitoring, bird migration, collection of data on ringed bird sighting, and identification of important wetlands. Information on bird migration and flyways were also given in the manual. Site-specific long-term monitoring and data collection, which are crucial for carrying out effective management measures and conservation activities, were also emphasized in the manual.



Figure IX.1: Bird Monitoring, handling and marking training manual

A brief overview of some of the topics covered in the manual:

# **Bird Migration**

Migration of waterbirds and the need for wetland connectivity during the migratory cycle was introduced. The topic on flyways highlights the need for collaborative efforts from local management agencies and international scientific communities for the conservation of important sites in the migratory pathway of waterbirds.

# **Central Asian Flyway (CAF)**

A majority of the birds wintering in India use the CAF. So it is important to obtain up-to-date data on habitat quality, population size and seasonal trends in order to formulate management activities across the flyway. As India lies in the heart of CAF, the knowledge gap needs to be filled efficiently to be relevant for conservation of the important sites and critical species.

# Asian Waterbird Count (AWC)

It is one of the long-term citizen science databases available in the Asian Region. The major objective of AWC was to obtain regional information on waterbird population during the non-breeding time. This is part of an international initiative. Standardized protocols are followed for maintaining uniformity in the AWC data format. The basic protocols followed in the AWC like site selection, time, duration and repeatability have been discussed in this section. Bird counting and estimation techniques, and precautions to be taken while counting birds were also covered. Specialised methods such as roost count and colonially nesting species count have been discussed in brief. The procedure of compiling and reporting AWC data has also been explained.

#### **Bird Handling Techniques and Protocol**

One might encounter a situation where one is forced to handle or restrain a wild bird for scientific studies, disease surveillance or rescue. Specific protocols have to be followed while handling wild birds of different sizes and temperament. The safety of the bird as well as the handler is of primal importance. Considering this, handling and restraining instructions applicable to small-, medium- and large-sized birds have been explained.

#### **Bird Migration Study Techniques**

Bird marking studies have been useful in understanding the dispersal, migration, behaviour, social structure, life-span, survival rate and population structure of birds. Some conventional and modern bird-marking techniques, each with certain merits and demerits, have been mentioned. Bird Ringing is the most widely used marking technique in India, in practice for nine decades and has provided tremendous data on bird movement. In the past few years, Satellite Tracking studies have helped to map a detailed network of wetlands used by various migratory species in their migratory pathways. Colour marking has been a favoured technique to study the movement patterns of the migratory species in recent years. The colour marking protocol co-ordinated by the flyway range countries for different species has also been illustrated in this section.

#### **Way Forward**

Information on knowledge gaps in the bird migration studies, identification of critical and crucial wetlands in the CAF, science-based conservation activities to be carried out in the wetlands of international importance and implementation strategies of the CAF National Action Plan have been discussed in this section.

#### **Training Workshops**

A total of seven workshops were conducted in five coastal districts of Maharashtraviz. Palghar, Mumbai Suburban, Mumbai, Thane, Raigad and Sindhudurg. Details of the training workshops, date and topics covered are given in the Annexure IV.

A total of 151 members consisting of Forest Officials, Forest Department front-line staff, local students, researchers, birdwatchers, ornithologists, self-help group members and members of local non-governmental organizations were trained. Apart from these workshops, one workshop was conducted specifically for researchers, birdwatchers and photographers who have been monitoring the coastal wetlands as well as reporting tagged bird sightings during the study period. This workshop was aimed to train the participants in the use of the 'Bird Band' mobile application. Details of the trained people are given in the Annexure V.

The priority during the training was to help training participants to improve their knowledge and understandings with respect to wild birds, their movements and conservation. Totally eight modules
were taught to various stakeholders during the trainings. Brief about the modules covered during the training are given below:

## Module 1: Bird Identification

It was intended to provide an orientation to the participants in bird identification. Identifying birds is the first and necessary step during bird monitoring. Hence it was important to train the participants in bird identification of species commonly occurring around Mumbai. A bird guide was provided to the participants as part of the course materials. The following were taught to the participants both during classroom sessions and in the field.

- Understanding the morphology of a bird, scientific terms and different keys for identifying various bird groups and species
- Using behaviour and habits as tools to identify birds
- Identifying birds in different habitats using beak and feet modifications
- Differentiating between similar looking species
- Bird calls to identify birds as well as to differentiate similar looking species
- Ethics to be followed during bird surveys
- Equipment that can be used for effective bird surveys

## Module 2: Introduction to Bird Migration

Introduction on bird migration, types and patterns of bird migration, threats and barriers faced by the long-distance migratory species during their annual journey, life-history strategies and the ecological factors that govern the success of migration were covered. Wetlands connectivity and habitats necessary for birds to complete their annual migration was also emphasized. Topics that were dealt under the module included:

- Resident, local migrant and migratory species
- Reasons for migration
- Patterns of migration
- Orientation and navigation during migration
- Concept of Flyway and major flyways around the world

## Module 3: Bird Monitoring Programmes

Several monitoring programmes such as Common Bird Monitoring Programme, Sálim Ali Bird Count, Great Backyard Count have been developed to involve the general public in common bird monitoring programme and to collect data sets scientifically for establishing site / location / area specific long-term bird monitoring databases though citizen science. The data collected by locals and people from multi-disciplinary fields over the period of time have been helpful in understanding the trend of species occurring in an area. This module gave an orientation into the objectives of each count, the methodology

to be followed while counting birds and the network of entities involved in these monitoring programmes. The module was taught with the following additional information:

- Importance of long-term bird monitoring programmes for understanding the trends of bird population
- Role of scientifically collected citizen science data in conservation management activities
- Identifying threats and pressures faced by the birds wintering in particular site with the help of longterm bird data
- Standardized methodology to be followed while collecting data
- Common Bird Monitoring Programme
- Baya Weaver Count
- Sálim Ali Bird Count

## Module 4: Waterbird Counting Techniques

Bird counting has been crucial in monitoring the numerical size of waterbird populations and understanding the changes occurring in population size. The counts also help to identify wetlands of importance and species of concern. Total count method is used to count waterbirds, with accurate count of species less than 3000 and estimation of species more than 3000 in number. Pictorial examples were taught on block count, foraging bird count and roost site count. Some topics covered:

- Need to count waterbirds
- Field equipment to be carried while counting
- Workforce/assistants needed while scientifically counting waterbirds
- Methods of accurate counting
- Conditions for estimating waterbird numbers
- Method of estimating birds
- Roost Site Count
- Foraging bird count

## Module 5: Asian Waterbird Count (AWC); Recording and reporting

AWC is basically a citizen science programme, which has played an important role in the conservation of waterbirds and their habitats at the national as well as international levels. The objectives of AWC were explained and the strategy for site selection was discussed. Using counting techniques explained in the previous module, the details to be filled in the AWC datasheet were explained. State, regional, national and international co-ordinators were listed as contact points. Topics covered included:

- Objectives and importance of AWC
- Sites to be monitored
- Sites in Maharashtra periodically monitored for AWC
- How to count
- How to fill AWC data sheet
- Reporting data

## Module 6: Bird Migration Study Techniques

This module described the different bird migration study tools in use, along with the merits and limitations of each tool. This also spelt out the need for the use of multiple tools for a better understanding of the migratory routes of birds. With the use of colour marking tools for migratory birds, birdwatchers, ornithologists and site managers can play a crucial role by reporting tagged and banded birds and helping to understand the movements of colour banded birds. The different colour marking protocols were explained and the participants were urged to look for tagged birds while monitoring. The banded bird data reporting procedure was also explained. Topics covered included:

- History of Bird Migration Studies in India
- Outcomes of long-term bird marking
- Ring recoveries and boundary marking of Central Asian flyway
- Conventional Bird banding techniques
- Data collected while marking birds and its significance
- Data from Colour Marking
- Migratory range from GPS marking
- Satellite Tagging to obtain wetland connectivity data
- Reporting marked birds
- Wetland connectivity and threats to migratory birds

## Module 7: Wild bird handling techniques and disease monitoring

The site managers as well as researchers might encounter a situation when they will need to handle a wild bird during disease surveillance, bird marking, zoo purpose, sample collection or restraining an injured bird. The safety and well-being of the bird as well as the handler are of primal importance, hence safe methods of restraining the birds were demonstrated. Some important handling protocols and necessary precautions were explained. Symptoms of major diseases were listed and the impact of avian influenza on the local bird community and local economy were explained.

- Situations to capture and handle wild birds
- Wild bird health concerns
- Handling protocol
- Different handling techniques for small-, medium- and large-sized birds
- Dos and Don'ts of handling wild birds
- Avian Diseases and symptoms
- Avian Influenza and its impact
- Avian Influenza surveillance

## Module 8: Central Asian Flyway (CAF) and conventions for migratory birds

A majority of the migratory species recorded in India use the CAF, and they are threatened due to loss of habitat, unsustainable water management, land-use change and anthropogenic impact. The reason for the implementation of CAF Action Plan is to work with international co-operation towards better wetland management, undertake species-specific action plan and promote sustainable use of the wetlands. The scope of migration studies in better management of wetlands was highlighted in the module. Information on the following subjects were taught to the trainees:

- CAF and eight other major flyways of the world
- Challenges faced by migratory birds in the CAF
- Central Asian Flyway to conserve migratory waterbirds and their habitats
- Scope of Application
- Priority species and single species conservation
- Habitat conservation and management
- Management of human activities
- Important wetlands in India in view of migratory birds



Figure IX.2: Training workshop in progress for local stakeholders from Mumbai city and Mumbai Suburban district in January 2018



Figure IX.3: Participants at a training conducted in April 2018 for researchers, students and birdwatchers in Thane and Raigad districts



Figure IX.4: Forest Officials from Mumbai city, Mumbai Suburban, Thane and Raigad districts at one of the training workshops held in Mumbai in April 2018



Figure IX.5: Local stakeholders from Palghar district at a training workshop conducted in Virar in June 2018



Figure IX.6: Local community members and eco-club members of Malwan, Sindhudurg district at the training workshop conducted in February 2019



Figure IX.7: Students, researchers and local birdwatchers of Sindhudurg District at a training programme conducted in Malwan in February 2019



Figure IX.8: Participants and resource persons at the Bird Band Sighting Mobile Application Tutorial and Training workshop for researchers and birdwatchers held in Mumbai in May 2019

## X. CONCLUSION AND WAY FORWARD

During the study, all the stipulated objectives were achieved. However, the following activities envisaged during the course of the project need to be further studied in order to achieve a deeper understanding of the role of the wetlands, impact of threats, and the movement patterns of the migratory waterbirds. This understanding will help to better implement effective conservation actions.

- Totally 99 sites were surveyed along the Maharashtra coast through the course of the study. Continuous monitoring is needed at prominent sites that have shown to support more than 500 waterbirds (feeding and roosting sites) in order to understand the seasonality of use of these sites. Baseline data has been collected during the present study regarding the role played by each coastal wetland for the waterbirds. Further long-term monthly monitoring is necessary to understand the population fluctuation of waterbirds in each of these sites.
- 2. Threat assessments across the migratory season are needed to know the level of impact that these threats pose to the bird congregations.
- 3. It was noticed marine debris was the major threat and also the major concern of the local fishermen along the northern Maharashtra coast. As observed at the major fish landing sites along the coast, the detrimental effects of marine debris in fishing nets needs to be quantified along with the socio-economic impact of these debris.
- 4. From the bird monitoring, ringing and resighting studies, it was realized that Akshi is a very important site for staging and wintering migratory shorebirds along the coast of Maharashtra. Shorebird counts also exceeded over 5000 individuals at this site. Such large congregations were not recorded south of Akshi along Maharashtra coast. The ringing and recovery studies will reveal more information on the role played by this wetland and the connectivity it affords in the migratory route.
- 5. Bird ringing needs to be carried out at several sites along the coast at major congregation sites to understand the movements of the birds.
- 6. Local level biodiversity registers can be prepared for important sites along Maharashtra coast, discussing the status and long-term trends of waterbirds based on traditional knowledge.
- 7. The Bird Band mobile application was launched as part of the outcome of the project, to record the resighting of ringed/banded birds. Its successful implementation is required to build the database, achieve the targets of disseminating the mobile application to a wider audience and involve stakeholders in bird migration studies.
- 8. Furthermore, India has launched the Central Asian Flyway (CAF) National Action Plan. Maharashtra is one of the states having overlapping flyways (Central Asian and East African Eurasian Flyways). Mumbai Bay (Sewri, Thane, Alibaug), which is one of the regular monitoring sites of this study, has also been selected as one of the crucial sites in India and CAF for the migratory waterbirds, and hence needs to be monitored. The proposed activities will help to achieve the targets envisaged in the CAF National Action Plan, including the single species action plan (Table X.1). Moreover, the continuation of the study would be helpful to also build the national database.

- 9. National Single Species Action Plan (SSAP) is an instrument for implementing coordinated measures to conserve some important migratory species and render them to a favourable conservation status. A total of 20 priority species have been selected including Eurasian Curlew Numenius arquata, Crab Plover Dromasardeola, Black-tailed Godwit Limosa limosa, Bartailed Godwit Limosa lapponica, Red Knot Calidris canutus, Long-toed Stint Calidris subminuta, Indian Skimmer Rynchops albicollis, Greater Flamingo Phoenicopterus roseus, Lesser Flamingo Phoeniconaias minor, Curlew Sandpiper Calidris ferruginea, Little Stint Calidris tenuirostris, Common Pochard Aythya farina, Yellow-breasted Bunting Emberiza aureola, White-headed Duck Oxyura leucocephala, Ferruginous Duck Aythya nyroca, European Roller Coracias garrulous, and Sociable Lapwing Vanellus gregarius. Many of the above species occur in the coastal wetlands of Maharashtra. Though the status of some of the species has been reported through this study, further monitoring is required to ascertain the status of the species, the threats faced by them and the management action needed for their conservation.
- 10. Many forest officers, Forest Department frontline staff and Mangrove Foundation staff have been trained through the project. As some of the trained staff have been transferred and Mangrove Foundation has further recruited new staff, it is important to organize fresh training sessions on the importance of flyways, CAF National Action Plan, its implementation and Bird Migration (using advance technologies like mobile app).

Component Number	Components
1.1	Population status
1.2	Single species action plan
2.5	Integrating CAF species and habitat conservation objectives in PA plans
3.2	Training material on population/habitat
3.3	Targeted training of enforcement officials
3.4	Ringing programme
5.1	Population status, migration pattern and connectivity along flyways
5.2	Monitoring population trends
5.3	Inventory assessment and monitoring of wetland habitats
5.6	Decision support system

# Table X.1: Project extension needed for achieving the activities envisaged in the CAF NationalAction Plan

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## ANNEXURE I List of waterbird species recorded at the study sites

Sr. no.	Common Name	Scientific Name	Site Name	IUCN status
		Family: Anatidae		
1	Common Teal	Anas crecca	Thane Flamingo Sanctuary	LC
			Bhendkal, Uran	
			Panje, Uran	
			Bhandup Pumping Station	
			NRI Pond	
			Panje, Uran	
			Thane Creek	
			Bakale Fatta	
			Delhi Public School	
2	Cotton Pygmy-goose	Nettapus coromandelianus	Pat Parule Lake	LC
			Taak Marsh	
3	Gadwall	Mareca strepera	Panje, Uran	LC
4	Garganey	Spatula querquedula	NRI Pond	LC
			Panje, Uran	
			Pat Parule Lake	
			Bhendkal, Uran	
			Bhandup Pumping Station	
5	Indian Spot-billed Duck	Anas poecilorhyncha	NRI Pond	LC
			Bhandup Pumping Station	
			Thane Creek	
			Pat Parule Lake	
			T S Chanakya	
			Panje, Uran	
			Belpada, Uran	
6	Lesser Whistling Duck	Dendrocygna javanica	Pat Parule Lake	LC
			Taak Marsh	
			Kasheli bandh	
			Akshi, Alibaug	
			Sewri Mudflat	
			Kuravde Jetty	
7	Northern Pintail	Anas acuta	NRI Pond	LC
			Jasai, Uran	
			Bhandup Pumping Station	
			Pat Parule Lake	
			Panje, Uran	
			Thane Creek	
8	Northern Shoveler	Spatula clypeata	NRI Pond	LC
			Bhandup Pumping Station	
			Arnala Beach	
			Thane Creek	
			Delhi Public School	

Sr. no.	Common Name	Scientific Name	Site Name	IUCN status
			Belpada,Uran	
			Jasai, Uran	
			Panje, Uran	
			Thane Flamingo Sanctuary	
9	Ruddy Shelduck	Tadorna ferruginea	Panje, Uran	LC
10	Tufted Duck	Aythya fuligula	NRI Pond	LC
		Family: Anhingidae		
11	Oriental Darter	Anhinga melanogaster	Pat Parule Lake	LC
		Family: Ardeidae		
12	Black-crowned Night-Heron	Nycticorax nycticorax	T S Chanakya	LC
			Achra Creek survey	
13	Cattle Egret	Bubulcus ibis	Delhi Public School	LC
			NRI Pond	
			Sewri Mudflat	
			Alibaug Jetty	
			Achra Crab Culture	
			Pat Parule Lake	
			Panje, Uran	
			Bhandup Pumping Station	
			Shiroda saltpan	
14	Great White Egret	Ardea alba	T S Chanakya	LC
			Delhi Public School	
			NRI Pond	
			Jasai, Uran	
			Akshi,Alibaug	
			Madhuban Wetlands	
			Alibaug Beach	
			Alibaug Jetty	
			Panje, Uran	
			Bhandup Pumping Station	
			Sewri Mudflat	
			Vashi Creek	
			Belpada,Uran	
			Taramumbrai creek	
			Bakale Fatta	
			Padavne Bridge	
			Baradkhol Rocky Beach	
			Diveagar outskirt	
15	Grey Heron	Ardea cinerea	Jasai, Uran	LC
			Panje, Uran	
			Bhandup Pumping Station	
			Delhi Public School	
			NRI Pond	
			Sewri Mudflat	
			Shiroda saltpan	
			Vashi Creek	

Image: state is a	Sr. no.	Common Name	Scientific Name	Site Name	IUCN status
Image: state in the state interpret of the state int				Kasari	
Image: style is a				Kasheli bandh	
Image: space of the synthetic				Belpada,Uran	
Achra Creek surveyAchra Creek surveyIndian Pond-heronArdeola grayiiPanje, UranILC16Indian Pond-heronArdeola grayiiPanje, UranILC11Indian Pond-heronArdeola grayiiPanje, UranILC11Indian Pond-heronIndian PondIndian PondIndian Pond12Indian PondIndian PondIndian PondIndian Pond12Indian PondIndian PondIndian PondIndian Pond13Indian PondIndian PondIndian PondIndian Pond14Indian PondIndian PondIndian PondIndian Pond14Indian PondIndian PondIndian PondIndian Pond14Indian PondIndian PondIndian PondIndian Pond15Indian PondIndian PondIndian PondIndian Pond15Indian PondIndian PondIndian PondIndian Pond16Indian PondIndian PondIndian PondIndian Pond17Indian PondIndian PondIndian PondIndian Pond16Indian PondIndian PondIndian PondIndian Pond17Intermediate EgretArdea IntermediaArshi,AlibangIndian Pond17Intermediate EgretArdea IntermediaArshi,AlibangIndian Pond17Intermediate EgretArdea IntermediaArshi,AlibangIndian Pond18Intermediate EgretArdea IntermediaArshi,AlibangIndian Pond19In				Pat Parule Lake	
Indian Pond-heronArdeola grayiiBhandup Pumping stationICC16Indian Pond-heronArdeola grayiiPanje, UranICC16Indian Pond-heronIndian Pond-heronIndian PondICC17Chanak Panie StancurayIndian PondIndian PondIndian Pond18Indian PondIndian PondIndian PondIndian Pond19Indian PondIndian PondIndian PondIndian Pond10Indian PondIndian PondIndian PondIndian Pond10Indian PondIndian PondIndian PondIndian Pond10Indian PondIndian PondIndian PondIndian Pond11Indian PondIndian PondIndian PondIndian Pond12Indian PondIndian PondIndian PondIndian Pond13Indian PondIndian PondIndian PondIndian Pond14Indian PondIndian PondIndian PondIndian Pond14Indian PondIndian PondIndian PondIndian Pond14Indian PondIndian PondIndian PondIndian Pond15Indian PondIndian PondIndian PondIndian Pond14Indian PondIndian PondIndian PondIndian Pond15Indian PondIndian PondIndian PondIndian Pond16Indian PondIndian PondIndian PondIndian Pond17Indian PondIndian PondIndian PondIndian Pond16I				Achra Creek survey	
16Indian Pond-heronArdeola grayiiPanje, UranLC1Indian Pond-heronThane Flamingo SoanctuaryIndiana1Delhi Public SchoolIndianaIndiana1IndianaIndianaIndiana1Indi				Bhandup Pumping station	
Image<	16	Indian Pond-heron	Ardeola grayii	Panje, Uran	LC
Image: state in the state in				Thane Flamingo Sanctuary	
Image: series of the series				Delhi Public School	
Image: series of the series				NRI Pond	
Sewri MudflatImage: Sewri Mudflat <td></td> <td></td> <td></td> <td>T S Chanakya</td> <td></td>				T S Chanakya	
Image: section of the section of th				Sewri Mudflat	
Image: second				Jasai, Uran	
Image: second				Harnai Beach	
Image: space of the systemImage: space of the				Kasari	
Achra Crab Culture      Taak Marsh      Jasai, Uran      Madhuban Wetlands      Agandanda Jetty      Undi beach      Dandi bridge      Pat Parule Lake      Redi Beach      Vashi Creek      Belpada, Uran      Bakale Fatta      Vetye Beach      Hegvi Beach      Hegvi Beach      Later Field      Achra Crab Culture      Agandanda Jetty      Later Field      Late				Bhatye Bridge	
Image: Section of the section of th				Achra Crab Culture	
Image: series of the series				Taak Marsh	
Image: second				Jasai, Uran	
Agandanda JettyImage: Image: Im				Madhuban Wetlands	
Image: Sector of the sector				Agandanda Jetty	
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Image: Second				Dandi bridge	
Image: section of the section of th				Pat Parule Lake	
Image: sector of the sector				Redi Beach	
Image: select				Vashi Creek	
Image: static				Belpada, Uran	
Parul rice field      Parul rice field      Bakale Fatta      Vetye Beach      Bhandarpule Beach      Hegvi Beach      Hegvi Beach      Intermediate Egret      Ardea intermedia      Akshi,Alibaug      LC      T S Chanakya      Delhi Public School      NRI Pond      Sewri Mudflat      Panje, Uran      Vashi Creek				Bhandup Pumping Station	
Image: sector of the sector				Parul rice field	
Image: sector of the sector				Bakale Fatta	
Image: Sector of the sector				Vetye Beach	
Image: Second				Bhandarpule Beach	
Intermediate Egret    Ardea intermedia    Akshi,Alibaug    LC      Intermediate Egret    Ardea intermedia    Intermediate    Intermediate      Intermediate Egret    Ardea intermedia    Akshi,Alibaug    LC      Intermediate Egret    Ardea intermedia    Intermediate    Intermediate      Intermediate Egret    Ardea intermedia    Intermediate    Intermediate      Intermediate Egret    Intermediate    Intermediate    Intermediate      Intermediate Egret    Intermediate    Intermediate    Intermediate      Intermediate    Intermediate    Intermediate    Intermediate      Intermediate    Intermediate    Intermediate    Intermediate      Intermediate    Intermediate    Intermediate    Intermediate      Intermediate    Intermediate    Intermediate    Intermediate      In				Hegyi Beach	
17  Intermediate Egret  Ardea intermedia  Akshi,Alibaug  LC    17  Intermediate Egret  Ardea intermedia  Akshi,Alibaug  LC    17  T S Chanakya  Delhi Public School  Image: School  Image: School    17  Image: School  NRI Pond  Image: School  Image: School    17  Image: School  Sewri Mudflat  Image: School  Image: School    17  Image: School  Image: School  Image: School  Image: School    17  Image: School  Sewri Mudflat  Image: School  Image: School    17  Image: School  Image: School  Image: School  Image: School    18  Image: School  Image: School  Image: School  Image: School    19  Image: School  Image: School  Image: School  Image: School    19  Image: School  Image: School  Image: School  Image: School    19  Image: School  Image: School  Image: School  Image: School    19  Image: School  Image: School  Image: School  Image: School    10  Image: School  Image: School  Image: School  Image: School    11  Image: School  Image: School  Image: School				Baradkhol Rocky Beach	
T S Chanakya    Delhi Public School    NRI Pond    Sewri Mudflat    Panje, Uran    Vashi Creek	17	Intermediate Egret	Ardea intermedia	Akshi, Alibaug	LC
Delhi Public School    NRI Pond    Sewri Mudflat    Panje, Uran    Vashi Creek		<b>J</b>		T S Chanakya	
NRI Pond    Sewri Mudflat    Panje, Uran    Vashi Creek				Delhi Public School	
Sewri Mudflat    Panje, Uran    Vashi Creek				NRI Pond	
Panje, Uran Vashi Creek				Sewri Mudflat	
Vashi Creek				Panje, Uran	
				Vashi Creek	
Belpada.Uran				Belpada,Uran	
Bhandup Pumping Station				Bhandup Pumping Station	
Shiroda saltnan				Shiroda saltpan	
Parul rice field				Parul rice field	
Dandi Bridge				Dandi Bridge	

Sr. no.	Common Name	Scientific Name	Site Name	IUCN status
			Anjarle Beach	
			Baramandla	
			Baradkhol Rocky Beach	
			Diveagar outskirt	
18	Little Egret	Egretta garzetta	T S Chanakya	LC
			Vashi Creek	
			Shiroda saltpan	
			Taak Marsh	
			Bakale Fatta	
			Baradkhol Rocky Beach	
			Belpada,Uran	
			NRI Pond	
			Bhandup Pumping station	
			Sewri Mudflat	
19	Purple Heron	Ardea purpurea	Jasai, Uran	LC
	-		Shiroda saltpan	
			Madhuban Wetlands	
			Belpada,Uran	
			Pat Parule Lake	
			Bakale Fatta	
			Padavne Bridge	
20	Green-backed Heron	Butorides striata	Thane Flamingo Sanctuary	LC
			T S Chanakya	
			Achra Crab Culture	
			Shiroda saltpan	
21	Western Reef-egret	Egretta gularis	Sewri Mudflat	LC
			Delhi Public School	
			Panje, Uran	
			Akshi,Alibaug	
			Alibaug Jetty	
			Kuravde Mangroves	
			NSPS Wetland	
			T S Chanakya	
			Jasai, Uran	
			Vashi Creek	
			Alibaug Beach	
			Agandanda Jetty	
			Dighi jetty	
			Diveagar Beach	
			Kelshi-Savare-Harnai beach	
			Bhuigaon Beach	
<u> </u>			Belpada,Uran	
			Taramumbrai creek	
<u> </u>			Dandi Bridge	
			Padavne Beach	
			Ware Beach	

Sr. no.	Common Name	Scientific Name	Site Name	IUCN status
			Malgund Beach	
			Undi Beach	
			Baramandla	
			Baradkhol Rocky Beach	
		Family: Charadriidae		
22	Greater Sandplover	Charadrius leschenaultii	Kelshi-Anjarle beach	LC
			Malgund Beach	
			Panje, Uran	
			Bhuigaon Beach	
			NRI Pond	
			Akshi,Alibaug	
			Belpada, Uran	
23	Grey Plover	Pluvialis squatarola	Bhuigaon Beach	LC
			Panje, Uran	
			Srivardhan Beach	
			Akshi,Alibaug	
			Arnala Beach	
			T S Chanakya	
			Shiroda saltpan	
			Mochemad Beach	
			Bhandup Pumping station	
			Sewri Mudflat	
			Belpada, Uran	
24	Kentish Plover	Charadrius alexandrinus	Jasai, Uran	LC
			Akshi,Alibaug	
			Alibaug Jetty	
			Murud Beach	
			Undi Beach	
			Panje, Uran	
			T S Chanakva	
			Arnala Beach	
			Tarkarli Beach	
			Munge Beach	
			Mithmumbra beach	
			Taramumbrai creek	
			Dandi Bridge	
25	Lesser Sandplover	Charadrius monaolus	Akshi,Alibaug	LC
			NBI Pond	
			Bhandup Pumping Station	
			Nandgaon beach	
			Murud Beach	
			Kelshi-Aniarle beach	
			Malgund Beach	
			Undi Beach	
			Bhatve Bridge	
			Shiroda saltnan	
				1

Sr. no.	Common Name	Scientific Name	Site Name	IUCN status
			Panje, Uran	
			Bhuigaon Beach	
			T S Chanakya	
			Sewri Mudflat	
			Vashi Creek	
			Nandgaon beach	
			Diveagar Beach	
			Bharadkhol Rocky Beach	
			Kelshi-Savare-Harnai beach	
			Arnala Beach	
			Thane Creek	
			Mochemad Beach	
			Tondivali Beach	
			Mithmumbra beach	
			Dandi Bridge	
			Madban Beach	
			Padavne Beach	
			Vetve Beach	
			Gaonkhadi Beach	
			Ware Beach	
			Bhandarpule Beach	
			Undi Beach	
			Nandivade Beach	
			Tondivali Beach	
			Naravan Beach	
			Palande Beach	
			Palande Beach	
			Aniarle Beach	
			Padale Beach	
			Baradkhol Rocky Beach	
			Diveagar outskirt	
			Nandgaon Beach	
26	Little Ringed Plover	Charadrius dubius	Bhandup Pumping Station	LC
			Shiroda saltpan	
			Bhendkal, Uran	
			Panie, Uran	
			Sewri Mudflat	
27	Pacific Golden Plover	Pluvialis fulva	TSChanakya	IC
			Shiroda saltpan	
			Kasheli bandh	
			Panie Uran	
			Bakale Fatta	
			Diveagar outskirt	
28	Red-wattled Lanwing	Vanellus indicus	NRI Pond	IC
			Panie Uran	
			Delhi Public School	

Sr. no.	Common Name	Scientific Name	Site Name	IUCN status
			T S Chanakya	
			Jasai, Uran	
			Bhatye Bridge	
			Shiroda saltpan	
			Madhuban Wetlands	
			Kasheli bandh	
			Pat Parule Lake	
			Shiroda saltpan	
			Parul rice field	
			Bakale Fatta	
			Padavne Bridge	
			Naravan Beach	
			Diveagar outskirt	
			Bhandup Pumping station	
		Family: Ciconiidae		
29	Asian Openbill	Anastomus oscitans	Jasai, Uran	LC
			Pat Parule Lake	
			Madhuban Wetlands	
			Belpada,Uran	
30	Painted Stork	Mycteria leucocephala	NRI Pond	NT
			Jasai, Uran	
			Delhi Public School	
			Panje, Uran	
			T S Chanakya	
			Madhuban Wetlands	
			Vashi Creek	
			Sewri Mudflat	
			Bhandup Pumping Station	
			Thane Creek	
			Belpada,Uran	
31	Green-backed Heron	Ciconia episcopus	Belpada,Uran	VU
			Padavne Bridge	
			Malgund Beach	
		Family: Glareolidae		
32	Little Pratincole	Glareola lactea	Mochemad Beach	LC
		Family: Haematopodidae		
33	Eurasian Oystercatcher	Haematopus ostralegus	Akshi, Alibaug	NT
			Arnala Beach	
		Family: Jacanidae		
34	Bronze-winged jacana	Metopidius indicus	Pat Parule Lake	LC
			Taak Marsh	
35	Pheasant-tailed Jacana	Hydrophasianus chirurgus	Pat Parule Lake	LC
			Taak Marsh	
		Family: Laridae		
36	Black-headed Gull	Larus ridibundus	Akshi, Alibaug	LC
			Panje, Uran	

Sr. no.	Common Name	Scientific Name	Site Name	IUCN status
			Vashi Bridge	
			Thane Flamingo Sanctuary	
			Delhi Public School	
			T S Chanakya	
			Alibaug Jetty	
			Harnai Beach	
			Malgund Beach	
			Bhatye Bridge	
			Tsunami Island, Tarkarli	
			Bhandup Pumping Station	
			NRI Pond	
			Vashi Creek	
			Murud Beach	
			Bharadkhol Rocky Beach	
			Srivardhan Beach	
			Kelshi-Savare-Harnai beach	
			Taramumbrai creek	
			Vetye Beach	
			Ware Beach	
			Baramandla	
			Velas Agar	
			Sewri Mudflat	
37	Brown-headed Gull	Larus brunnicephalus	Vashi Bridge	LC
			NRI Pond	
			T S Chanakya	
			Panje, Uran	
			Alibaug Jetty	
			Harnai Beach	
			Malgund Beach	
			Bhatye Bridge	
			Tsunami Island, Tarkarli	
			Navabaug Beach	
			Bhendkal, Uran	
			Bhandup Pumping Station	
			Delhi Public School	
38	Caspian Tern	Hydroprogne caspia	Akshi Beach	LC
			T S Chanakya	
			Belpada,Uran	
			Panje, Uran	
			Sewri Mudflat	
			Delhi Public School	
39	Common Tern	Sterna hirundo	Akshi Beach	LC
40	Greater Crested Tern	Thalasseus bergii	Akshi Beach	LC
			Harnai Beach	
			Malgund Beach	
			Bhatye Bridge	

Sr. no.	Common Name	Scientific Name	Site Name	IUCN status
			Murud Beach	
			Agardanda beach	
			Diveagar Beach	
			Panje, Uran	
			Terekhol Rocky Beach	
41	Gull-billed Tern	Gelochelidon nilotica	NRI Pond	LC
			Panje, Uran	
			Vashi Bridge	
			T S Chanakya	
			Sewri Mudflat	
			Alibaug Jetty	
			Nandgaon beach	
			Harnai Beach	
			Seagulls Islands, Tarkarli	
			Bhuigaon Beach	
			Delhi Public School	
			Alibaug Beach	
			Alibaug Jetty	
			Murud Beach	
			Agardanda beach	
			Diveagar Beach	
			Bharadkhol Rocky Beach	
			Srivardhan Beach	
			Kelshi-Savare-Harnai beach	
42	Indian Skimmer	Rynchops albicollis	Panje, Uran	VU
43	Lesser Black-backed Gull	Larus fuscus	Alibaug Jetty	LC
			Bharadkhol Rocky Beach	
			Harnai Beach	
			Bhatye Bridge	
			Bhandup Pumping Station	
			Bhuigaon Beach	
			Akshi, Alibaug	
			Panje, Uran	
			Arnala Beach	
			Mochemad Beach	
			Tsunami Island- Devgad	
			Vetye Beach	
			Ware Beach	
			Undi Beach	
			Tondivali Beach	
			Palande Beach	
			Baramandla	
			Kuravde Jetty	
			Pebbles beach	
			Velas Agar	
44	Lesser Crested Tern	Thalasseus bengalensis	Alibaug Jetty	LC

Sr. no.	Common Name	Scientific Name	Site Name	IUCN status
			Harnai Beach	
			Malgund Beach	
			Bhatye Bridge	
			Murud Beach	
			Agardanda beach	
			Diveagar Beach	
			Kelshi-Savare-Harnai beach	
			Panje, Uran	
			Akshi, Alibaug	
			NRI Pond	
			Mochemad Beach	
			Ware Beach	
			Palande Beach	
			Baramandla	
			Pebbles beach	
			Velas Agar	
45	Little Tern	Sternula albifrons	NRI Pond	LC
			Sewri Mudflat	
			Akshi,Alibaug	
46	Pallas's Gull	Larus ichthyaetus	Alibaug Jetty	LC
			Tsunami Island, Tarkarli	
			Bhandup Pumping Station	
			Akshi,Alibaug	
			Mochemad Beach	
			Ware Beach	
			Akshi Beach	
47	River Tern	Sterna aurantia	Pat Parule Lake	NT
			Bhandup Pumping Station	
48	Sandwich Tern	Thalasseus sandvicensis	Harnai Beach	LC
49	Slender-billed Gull	Larus genei	Akshi,Alibaug	LC
			Vashi Bridge	
			NRI Pond	
			Alibaug Jetty	
			Harnai Beach	
			Malgund Beach	
			Bhandup Pumping Station	
			T S Chanakya	
			Vashi Creek	
			Panje, Uran	
			Delhi Public School	
			Thane Creek	
			Thane Flamingo Sanctuary	
50	Whiskered Tern	Chlidonias hybrida	NRI Pond	LC
			Panje, Uran	
			Vashi Bridge	
			T S Chanakya	

Sr. no.	Common Name	Scientific Name	Site Name	IUCN status
			Sewri Mudflat	
			Jasai, Uran	
			Delhi Public School	
			Bhuigaon Beach	
			Akshi, Alibaug	
			Vashi Creek	
			Agardanda beach	
			Diveagar Beach	
			Bharadkhol Rocky Beach	
			Kelshi-Savare-Harnai beach	
			Bhandup Pumping Station	
			Belpada,Uran	
			Dighi Jetty	
			Alibaug jetty	
		Family: Phalacrocoracidae		
51	Great Cormorant	Phalacrocorax carbo	Delhi Public School	LC
			T S Chanakya	
52	Indian Cormorant	Phalacrocorax fuscicollis	Achra Crab Culture	LC
			T S Chanakya	
			Bhandup Pumping Station	
			Pat Parule Lake	
			Padavne Bridge	
53	Little Cormorant	Microcarbo niger	NRI Pond	LC
			T S Chanakya	
			Jasai, Uran	
			Panje, Uran	
			Bhandup Pumping Station	
			Vashi Bridge	
			Delhi Public School	
			Taak Marsh	
			Shiroda saltpan	
			Bhendkal, Uran	
			Madhuban Wetlands	
			Vashi Creek	
			Pat Parule Lake	
			Belpada, Uran	
			Parul rice field	
			Diveagar outskirt	
Familv:				
54	Greater Flamingo	Pheonicopterus roseus	Bhandup Pumping Station	LC
	<u>_</u>	,	NSPS Wetland	
			Jasai, Uran	
			T S Chanakya	
			Panje, Uran	
			Vashi Creek	
			NRI Pond	

Sr. no.	Common Name	Scientific Name	Site Name	IUCN status
			Arnala Beach	
			Sewri Mudflat	
			Thane Creek	
			Belpada,Uran	
			Delhi Public School	
55	Lesser Flamingo	Phoeniconaias minor	Thane Creek	NT
			Vashi Creek	
			Sewri Mudflat	
			T S Chanakya	
			NRI Pond	
			Panje, Uran	
			Thane Creek	
			Delhi Public School	
			Belpada,Uran	
			Bhandup Pumping station	
			Jasai, Uran	
			Thane Flamingo Sanctuary	
	·	Family: Podecipedidae		
56	Little Grebe	Tachybaptus ruficollis	NRI Pond	LC
			Panje, Uran	
			Pat Parule Lake	
			Delhi Public School	
			Bhandup Pumping Station	
		Family: Rallidae		
57	Common Coot	Fulica atra	Panje, Uran	LC
			NRI Pond	
			Jasai, Uran	
			Bhendkal, Uran	
			Madhuban Wetlands	
			Pat Parule Lake	
			Thane Creek	
			Bhandup Pumping Station	
			Taak Marsh	
			Pat Parule Lake	
58	Common Moorhen	Gallinula chloropus	Delhi Public School	LC
			NRI Pond	
			Pat Parule Lake	
			Shiroda saltpan	
59	Purple Swamphen	Porphyirio porphyrio	Pat Parule Lake	LC
			Panje, Uran	
			Taak Marsh	
60	White-breasted Waterhen	Amaurornis pheonicurus	Pat Parule Lake	LC
			NRI Pond	
			Taak Marsh	
		Family: Recurvirostridae		
61	Black-winged Stilt	Himantopus himantopus	T S Chanakya	LC

Sr. no.	Common Name	Scientific Name	Site Name	IUCN status
			Thane Flamingo Sanctuary	
			Bhandup Pumping Station	
			Kuravde Mangroves	
			Bhatye Bridge	
			Bhendkal, Uran	
			NSPS Wetland	
			Madhuban Wetlands	
			NRI Pond	
			Belpada,Uran	
			Thane Creek	
			Shiroda saltpan	
			Bakale Fatta	
			Diveagar outskirt	
			Sewri Mudflat	
			Jasai, Uran	
			Panje, Uran	
			Delhi Public School	
62	Pied Avocet	Recurvirostra avosetta	Arnala Beach	LC
			Belpada,Uran	
			Panje, Uran	
			Thane Creek	
			Bhandup Pumping Station	
			NRI Pond	
			Delhi Public School	
			Jasai, Uran	
			Thane Flamingo Sanctuary	
	1	Family: Scolopacidae		
63	Bar-tailed Godwit	Limosa lapponica	Agardanda Jetty	LC
64	Black-tailed Godwit	Limosa limosa	Jasai, Uran	NT
			Thane Creek	
			Sewri Mudflat	
			Panje, Uran	
			Belpada, Uran	
			Bhandup Pumping Station	
			NRI Pond	
			T S Chanakya	
			Thane Flamingo Sanctuary	
65	Broad-billed Sandpiper	Calidris falcinellus	T S Chanakya	LC
			Panje, Uran	
			Bhandup Pumping Station	
			Akshi Beach	
			Belpada,Uran	
66	Common Greenshank	Tringa nebularia	T S Chanakva	LC
			Thane Flamingo Sanctuary	
			Vashi Bridge	
			Sewri Mudflat	

Sr. no.	Common Name	Scientific Name	Site Name	IUCN status
			Jasai, Uran	
			Kuravde Mangroves	
			Undi Beach	
			Bhatye Bridge	
			Achra Crab Culture	
			Panje, Uran	
			NSPS Wetland	
			Bhandup Pumping Station	
			Madhuban Wetlands	
			Delhi Public School	
			NRI Pond	
			Shiroda saltpan	
			Bakale Fatta	
			Ware Beach	
			Belpada,Uran	
67	Common Redshank	Tringa totanus	Jasai, Uran	LC
			Thane Flamingo Sanctuary	
			Vashi Bridge	
			Bhandup Pumping Station	
			Kasari	
			Bhatye Bridge	
			Achra Crab Culture	
			Madhuban Wetlands	
			Diveagar Beach	
			Arnala Beach	
			Thane Creek	
			T S Chanakya	
			Shiroda saltpan	
			Taramumbrai creek	
			Bakale Fatta	
			Ware Beach	
			Diveagar outskirt	
			NRI Pond	
			Sewri Mudflat	
			Belpada,Uran	
			Panje, Uran	
			Delhi Public School	
68	Common Sandpiper	Actitis hypoleucos	NRI Pond	LC
			Panje, Uran	
			Thane Flamingo Sanctuary	
			Bhandup Pumping Station	
			Vashi Bridge	
			T S Chanakya	
			Sewri Mudflat	
			Jasai, Uran	
			Kelshi-Anjarle beach	

Sr. no.	Common Name	Scientific Name	Site Name	IUCN status
			Harnai Beach	
			Bhatye Bridge	
			Bhendkal, Uran	
			Delhi Public School	
			Kelshi-Savare-Harnai beach	
			Harnai Beach	
			Undi beach	
			Kasari	
			Dandi bridge	
			Achra Crab Culture	
			Pat Parule Lake	
			Redi Beach	
			Belpada,Uran	
			Vashi Creek	
			Shiroda saltpan	
			Mochemad Beach	
			Achra Creek survey	
			Taramumbrai creek	
			Bakale Fatta	
			Madban Beach	
			Padavne Beach	
			Vetve Beach	
			Bhandarpule Beach	
			Malgund Beach	
			Nandivade Beach	
			Tondivali Beach	
			Naravan Beach	
			Hegyi Beach	
			Velneshwar Beach	
			Dabbol Beach	
			Aniarle Beach	
			Haribareshwar beach	
			Baradkhol Bocky Beach	
			Diveagar outskirt	
			Agardanda letty	
60	Common Spino	Callinago gallinago	NPL Pond	10
09			Bhondkal Uran	
70	Curlow Sandningr	Calidric formainoa		NT
70				INI
			Panje, Uran	
			Sewri Mudflat	

Sr. no.	Common Name	Scientific Name	Site Name	IUCN status
			Arnala Beach	
			Agardanda Jetty	
			Belpada,Uran	
			Jasai, Uran	
			Bhandup Pumping station	
71	Dunlin	Calidris alpina	Malgund Beach	LC
			Panje, Uran	
			Bhuigaon Beach	
			Akshi,Alibaug	
			Arnala Beach	
			Sewri Mudflat	
			T S Chanakya	
			Tarkarli Beach	
			Belpada,Uran	
			Bhandup Pumping station	
72	Eurasian Curlew	Numenius arquata	Panje, Uran	NT
			Thane Flamingo Sanctuary	
			Sewri Mudflat	
			NRI Pond	
			Kelshi-Anjarle beach	
			Harnai Beach	
			Jaigad Beach	
			Undi Beach	
			Bhatye Bridge	
			Achra Crab Culture	
			Tarkarli Beach	
			T S Chanakya	
			Alibaug Beach	
			Akshi, Alibaug	
			Agardanda beach	
			Diveagar Beach	
			Harihareshwar beach	
			Arnala Beach	
			Belpada,Uran	
			Mochemad Beach	
			Taramumbrai creek	
			Ware Beach	
			Malgund Beach	
			Palande Beach	
			Padale Beach	
			Harihareshwar beach	
			Aaravi Beach	
			Agardanda Jetty	
73	Great Knot	Calidris tenuirostris	Akshi,Alibaug	EN
			Malgund Beach	
74	Green Sandpiper	Tringa ochropus	Thane Flamingo Sanctuary	LC

Sr. no.	Common Name	Scientific Name	Site Name	IUCN status
			T S Chanakya	
			Sewri Mudflat	
			Panje, Uran	
75	Little Stint	Calidris minuta	Panje, Uran	LC
			Akshi,Alibaug	
			Vashi Bridge	
			Alibaug Jetty	
			Bhatye Bridge	
			Bhendkal, Uran	
			Panje, Uran	
			Bhuigaon Beach	
			T S Chanakya	
			NSPS Wetland	
			Jasai, Uran	
			Sewri Mudflat	
			Thane Creek	
			NRI Pond	
			Vashi Creek	
			Arnala Beach	
			Thane Creek	
			Shiroda saltpan	
			Dandi Bridge	
			Palande Beach	
			Diveagar outskirt	
			Belpada,Uran	
			Bhandup Pumping station	
			Thane Flamingo Sanctuary	
76	Marsh Sandpiper	Tringa stagnatilis	Jasai, Uran	LC
			Panje, Uran	
			Thane Flamingo Sanctuary	
			T S Chanakya	
			Kasari	
			Shiroda saltpan	
			Bhendkal, Uran	
			Delhi Public School	
			NRI Pond	
			NSPS Wetland	
			Madhuban Wetlands	
			Thane Creek	
			Sewri Mudflat	
77	Ruddy Turnstone	Arenaria interpres	Bhuigaon Beach	LC
			T S Chanakya	
			Akshi,Alibaug	
			Murud Beach	
			Diveagar Beach	
			Bharadkhol Rocky Beach	

Sr. no.	Common Name	Scientific Name	Site Name	IUCN status
			Sewri Mudflat	
			Panje, Uran	
			Arnala Beach	
			Delhi Public School	
78	Ruff	Calidris pugnax	Madhuban Wetlands	LC
			NRI Pond	
79	Sanderling	Calidris alba	Bhuigaon Beach	LC
			Akshi, Alibaug	
			Arnala Beach	
80	Temminck's Stint	Calidris temminckii	Bhatye Bridge	LC
			Shiroda saltpan	
			Sewri Mudflat	
			Panje, Uran	
			Akshi,Alibaug	
			Diveagar outskirt	
			Belpada,Uran	
81	Terek Sandpiper	Xenus cinereus	Murud Beach	LC
			Bhandup Pumping Station	
			Bhuigaon Beach	
			Akshi.Alibaug	
			Sewri Mudflat	
			Arnala Beach	
			Shiroda saltpan	
			Mochemad Beach	
			Mithmumbra beach	
			Dandi Bridge	
82	Whimbrel	Numenius phaeopus	Akshi Alibaug	IC
			Diveagar Beach	
			Bharadkhol Bocky Beach	
			Panie. Uran	
			NBLPond	
			Sewri Mudflat	
			Ware Beach	
			Baramandla	
			Agardanda letty	
			Bhandup Pumping station	
83	Wood Sandniner	Tripaa alareola	Thane Elamingo Sanctuary	
05			Panie Uran	
			NRI Pond	
			Shiroda saltnan	
			Bhandkal Uran	
			Bhandun Pumping Station	
			Madhuhan Watlanda	
			Pat Parula Laka	
			Polpada Uran	
			Belpada, Uran	

Sr. no.	Common Name	Scientific Name	Site Name	IUCN status
			Bakale Fatta	
			Diveagar outskirt	
			Sewri Mudflat	
		Family: Threskiornithida	e	
84	Black-headed Ibis	Threskiornis melanocephalus	Thane Flamingo Sanctuary	NT
			Vashi Bridge	
			T S Chanakya	
			Agandanda Jetty	
			Dighi jetty	
			Achra Crab Culture	
			Vashi Creek	
			NRI Pond	
			Belpada,Uran	
			Shiroda saltpan	
			Taak Marsh	
			Diveagar outskirt	
			Bhandup Pumping station	
			Sewri Mudflat	
			Delhi Public School	
85	Eurasian Spoonbill	Platalea leucorodia	NRI Pond	NT
			Panje, Uran	
			Delhi Public School	
			Belpada,Uran	
			Bhandup Pumping Station	
			Jasai, Uran	
86	Glossy Ibis	Plegadis falcinellus	NRI Pond	LC
	· ·		T S Chanakya	
			Jasai, Uran	
			Madhuban Wetlands	
			Panje, Uran	
			Achra Crab Culture	
			Bhandup Pumping Station	
			T S Chanakya	

#### **A**NNEXURE II

Common Name	Scientific Name	Site Recorded
	Endang	gered
Great knot	Calidris tenuirostris	Akshi, Malgund beach
	Vulner	rable
Asian Woollyneck	Ciconia episcopus	Shiroda saltpan, Belpada, Padavne, Malgund
Indian Skimmer	Rynchops albicollis	Panje
	Near Thre	eatened
Black-headed Ibis	Threskiornis melanocephalus	Sewri Mudflat, Bhandup Pumping station, Thane creek, Vashi Creek, Delhi Public School, NRI pond, T S Chanakya, Belpada, Agandanda Jetty, Dighi jetty, Diveagar outskirt, Achra Crab Culture, Taak Marsh, Shiroda saltpan
Black-tailed Godwit	Limosa limosa	Sewri Mudflat, Bhandup Pumping Station, Thane Flamingo Sanctuary, T S Chanakya, NRI pond, Jasai, Belpada, Panje
Curlew Sandpiper	Calidris ferruginea	Arnala Beach, Sewri Mudflat, Bhandup pumping station, Thane creek, Vashi Creek, T S Chanakya, NRI pond, Belpada, Jasai, Panje, Akshi, Agardanda Jetty
Eurasian Curlew	Numenius arquata	Sewri Jetty, Bhandup Pumping station, Thane Flamingo Sanctuary, T S Chanakya, NRI pond, Belpada, Panje, Arnala Beach, Alibaug Beach, Akshi, Agardanda Jetty, Agardanda beach, Harihareshwar beach, Diveagar Beach, Ware Beach, Malgund Beach, Taramumbrai creek, Palande Beach, Padale Beach, Aaravi Beach, Mochemad Beach, Achra crab culture, Bhayte beach, Harnai beach, Jaigad Beach, Arjarle Beach, Tarkarli Beach, Undi beach.
Eurasian Oystercatcher	Haematopus ostralegus	Akshi, Arnala Beach
Lesser Flamingo	Phoeniconaias minor	Sewri Mudflat, Bhandup Pumping Station, Thane Creek, Thane Flamingo Sanctuary, Vashi Creek, Delhi Public School, T S Chanakya, NRI pond,Belpada, Jasai, Panje,
Painted Stork	Mycteria leucocephala	Sewri Mudflat, Bhandup Pumping station, Delhi Public School pond, Thane creek, T S Chanakya, NRI pond, Belpada, Jasai, Panje, Vashi creek
River Tern	Sterna aurantia	Bhandup Pumping Station, Pat Parule Lake

## List of Threatened Waterbird species recorded during the study

#### **ANNEXURE III**

Site. No.	Site	Latitude	Longitude	Role of site	Total No. of bird species recorded	Maximum no. of birds recorded	Month
1	Alibaug mangrove	18.63969	72.89877	No Records	-	-	-
2	Alibaug beach	18.63965	72.87015	Potential Roosting site	6	16	Apr 18
3	Alibaug jetty	18.63849	72.88245	Feeding and Roosting site	7	1762	Dec 18
4	Akshi beach	18.62888	72.8842	Feeding site	17	6747	Dec 18
5	Sakharkhadi	18.62817	72.89729	No Records	-	-	-
6	Revdanda bridge	18.54181	72.92974	No Records	-	-	-
7	Nandgaon beach	18.38813	72.92642	Feeding site	1	24	Apr 18
8	Murud beach	18.32336	72.95715	Feeding site	5	336	Jan 18
9	Agardanda	18.32335	72.95715	Potential Roosting site	6	127	Apr 18
10	Dighi jetty	18.25385	72.96936	Potential Feeding site	3	68	Dec 18
11	Velas Agar	18.199315	72.977996	Roosting site	5	4003	Dec 18
12	Diveagar Creek	18.19204	72.98522	No Records	-	-	-
13	Diveagar beach	18.18936	72.98097	Potential Feeding site	12	291	Apr 18
14	Diveagar outskirts	18.18598	72.99156	Feeding site	17	133	Dec 18
15	Baradkhol beach	18.14451	72.9866	Roosting site	2	526	Jan 18
16	Pebbles beach	18.113668	72.979246	Roosting site	4	300	Dec 18
17	Aaravi beach	18.079031	72.997467	Potential Roosting site	2	5	Dec 18
18	Kanjili Srivardhan mudflats	18.03697	73.01882	Potential Feeding site	4	27	Apr 18
19	Kalanje mudflat	18.03312	73.03446	No Records	-	-	-
20	Kuravde jetty	18.02565	73.01884	Roosting site	2	4001	Dec 18
21	Harihareshwar beach	17.993993	73.020937	Potential Roosting site	2	2	Dec 18
22	Baramandla	17.99126	73.058576	Roosting site	6	2007	Dec 18
23	Velas beach	17.96151	73.02983	No Records	-	-	-
24	Padale beach	17.878633	73.075351	Potential Roosting site	3	7	Dec 18
25	Kelshi-Anjarle	17.8698	73.0794	Feeding site	4	153	Jan 18
26	Sawane beach	17.867537	73.080298	Potential Roosting site	1	34	Dec 18
27	Harnai beach	17.80224	73.10159	Feeding site	12	396	Jan 18
28	Palande beach	17.79653	73.103825	Roosting site	5	633	Dec 18
29	Murud-dapoli mudflats	17.79051	73.11068	Potential Roosting site	-	-	-
Site. No.	Site	Latitude	Longitude	Role of site	Total No. of bird species recorded	Maximum no. of birds recorded	Month
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30	Dabhol beach	17.58773	73.17215	Potential Roosting site	2	9	Dec 18
31	Undi beach	17.57865	73.17876	Potential Feeding site		14	Jan 18
32	Navanagar veldur	17.57374	73.17547	No records	-	-	-
33	Palshet	17.43742	73.19781	No Records	-	-	-
34	Velneshwar beach	17.380407	73.208869	Potential Roosting site	1	1	Dec 18
35	Hegvi beach	17.356287	73.219636	Potential Roosting site	2	2	Dec 18
36	Naravan beach	17.335518	73.225279	Potential Roosting site	3	18	Dec 18
37	Jaigad ferry point	17.29105	73.22382	Potential Feeding site	1	8	Jan 18
38	Kasari	17.28023	73.24928	Feeding site	3	7	Jan 18
39	Nandivade beach	17.267661	73.221059	Potential Roosting site	2	4	Dec 18
40	Undi beach	17.237456	73.233504	Potential Roosting site	4	14	Jan 18
41	Malgund beach	17.18421	73.25416	Feeding site	11	550	Jan 18
42	Ganpatipule beach	17.147614	73.265147	No Records	-	-	-
43	Bhandarpule beach	17.128765	73.270239	Potential Roosting site	4	18	Dec 18
44	Ware beach	17.085534	73.285903	Roosting site	12	2038	Dec 18
45	Shirgaon Mangroves	17.0365	73.288483	No Records	-	_	-
46	Ratnagiri Lighthouse	16.987862	73.272565	No Records	-	-	-
47	Bhayte bridge	16.98221	73.29585	Roosting site	2	508	Dec 18
48	Kasop beach	16.951495	73.287489	No Records	-	-	-
49	Wayangani beach	16.932857	73.287103	No Records	-	-	-
50	Mervi beach	16.823989	73.297107	No Records	-	-	-
51	Gaonkhadi bridge	16.80838	73.32145	Potential Feeding site	2	9	Dec 18
52	Kasheli bandh	16.74849	73.34203	Potential Feeding site	5	70	Apr 18
53	Vetye beach	16.688702	73.328444	Roosting site	7	447	Dec 18
54	Godavne beach	16.667309	73.331705	No Records	-	-	-
55	Maduban beach	16.577872	73.343554	Potential Roosting site	2	4	Decer 18
56	Bakale fata	16.57197	73.35927	Potential Feeding site	12	32	Dec 18

Site. No.	Site	Latitude	Longitude	Role of site	Total No. of bird species recorded	Maximum no. of birds recorded	Month
57	Vijaydurg beach	16.557623	73.332755	No Records	-	-	-
58	Dandi bridge	16.5554	73.35626	Feeding site	6	217	Dec 18
59	Girye beach	16.530142	73.316454	No Records	-	-	-
60	Parul beach	16.512368	73.32572	No Records	-	-	-
61	Pural rice field	16.4839	73.38555	Potential Feeding site	4	18	Dec 18
62	Padavne beach	16.41235	73.365291	Potential Roosting site	4	42	Dec 18
63	Malai	16.39373	73.39192	Potential Roosting site	-	-	-
64	Devgad beach	16.374197	73.371306	Potential Roosting site	0	0	
65	Taramumbrai	16.35905	73.39104	Feeding site	10	334	Dec 18
66	Mithmumbra beach	16.356954	73.386616	Roosting site	3	151	Dec 18
67	Mithbav beach	16.264844	73.412438	No records	-	-	-
68	Munge beach	16.236496	73.42166	Potential Roosting site	1	8	Dec 18
69	Achra Creek	16.204487	73.438512	Feeding site	5	38	Dec 18
70	Achra jetty	16.20154	73.43581	No records	-	-	-
71	Achra Crab Culture	16.20014	73.44423	Feeding site	9	78	Apr 18
72	Achra beach	16.19694	73.43763	Potential Feeding site	-	-	-
73	Tondivali beach	16.160501	73.44672	Potential Roosting site	7	144	Dec 18
74	Rock Garden	16.062752	73.455714	No records	-	-	-
75	Malwan beach	16.050035	73.468552	No records	-	-	-
76	Tarkarli beach	16.0076	73.49118	Roosting site	2	166	Jan 18
77	Devbaug	15.96971	73.50162	Roosting site	3	1360	Jan 18
78	Pat Parule Lake	15.96515	73.57287	Feeding site	13	673	Dec 18
79	Bhogave beach	15.942109	73.509027	No records	-	-	-
80	Nivati beach	15.937555	73.537109	No records	-	-	-
81	Vayangani Dabholi beach	15.872054	73.607685	No records	-	-	-
82	Vengurla bandar	15.85752	73.62353	Potential Roosting site		200	Dec 18
83	Navabaug beach	15.85599	73.62224	Feeding site	1	38	Jan 18
84	Sagareshwar Beach	15.851851	73.625967	No records	-	-	-
85	Vengurla beach	15.839424	73.631666	Potential Roosting site	2	176	Dec 18
86	Taak Marsh15.8048773.66608Feeding and Roosting site796		96	Jan 18			
87	Mochemad beach	Mochemad beach 15.797382 73.651713 Roosting site 11 801		Dec 18			

Site. No.	Site	Latitude	Longitude	Role of site	Total No. of bird species recorded	Maximum no. of birds recorded	Month
88	Vengurla taak	15.79415	73.66109	No records	-	-	-
89	Tank beach	15.790949	73.653816	No records	-	-	-
90	Aaravali beach	15.784259	73.656218	No records	-	-	-
91	Shiroda beach	15.756765	73.663597	No records	-	-	-
92	Shiroda Saltpans	15.75628	73.68427	Feeding site	18	479	Dec 18
93	Tiroda Creek	15.755692	73.665247	No records	-	-	-
94	Redi beach	15.753482	73.662802	No records	-	-	-
95	Redi bandh	15.74353	73.66905	Potential Roosting site	2	2	Apr 18
96	Rocky beach	15.7324	73.668943	No records	-	-	-
97	Terekhol Bridge	15.72565	73.720074	No records	-	-	-
98	Terkhol Jetty	15.721643	73.695837	No records	-	-	-
99	Terekhol Rocky beach	15.720498	73.68301	Potential Roosting site	1	20	Dec 18

#### **ANNEXURE IV**

### **Training Workshop Agenda**

### WORKSHOP FOR FOREST DEPARTMENT STAFF AND INSTITUTES ON BIRD MONITORING, BIRD MIGRATION AND CENTRAL ASIAN FLYWAY ACTION PLAN

### (UNDER THE PROJECT ELUCIDATING THE MIGRATORY ROUTES OF WATERBIRDS WINTERING ALONG THE MAHARASHTRA COAST)

Date: 09 January 2018 Venue: Interpretation Centre, Airoli

# Training Workshop Agenda

District: Thane, Mumbai

Duration: Full day

#### Day 1: 10 January 2018

Time	TOPICS		
09:15 – 09:30	REGISTRATION		
09:30 – 09:45	Welcome Address		
09:45 – 10:00	Introductory Speech		
10.00 10.50	Introduction to Bird Migration DR. P. SATHIYASELVAM, Senior Scientist, BNHS Wetlands		
10:00 - 10:50	Programme		
10:50 – 11:00	TEA BREAK		
11:00 – 12:15	Bird Identification Tools DR. RAJU KASAMBE, IBA Project Manager, Conservation Education		
	Centre In-charge		
	Bird Monitoring Programmes		
12.15 - 13.00	1. Common Bird Monitoring Programme		
12.15 15.00	2. Asian Waterbird Census by NANDAKISHOR DUDHE, Common Bird Monitoring Programme		
	In-charge		
13:00 – 13:45	LUNCH BREAK		
12.45 15.00	Bird Migration Study Techniques, Bird Banding and Reporting Bands by TUHINA KATTI,		
13:45 - 15:00	Scientist, BNHS Wetlands Programme		
15:00 – 15:15	TEA BREAK		
15.15 16.45	Wild Bird Monitoring Handling Techniques & Disease Monitoring Central Asian Flyway Action		
15:15 - 16:45	Plan and Way Forward by DR. P. SATHIYASELVAM		
15:45 – 16:15	INTERACTION SESSION		
16:15 – 16:30	VOTE OF THANKS		

#### Day 2: 11 January 2018

#### FIELD SESSION

TIME	TOPICS
09:30 – 10:45	Bird handling and Ringing
10:45 – 11:00	Tea Break
11:00 - 12:30	Bird Identification and Estimation (Thane Creek)

# WORKSHOP FOR INTERNATIONAL BIRD CONSERVATION NETWORK (IBCN) MEMBERS AND OTHER STAKEHOLDERS ON BIRD MONITORING, BIRD MIGRATION AND CENTRAL ASIAN FLYWAY ACTION PLAN

# (UNDER THE PROJECT ELUCIDATING THE MIGRATORY ROUTES OF WATERBIRDS WINTERING ALONG THE MAHARASHTRA COAST)

Date: 8 April 2018

District: Thane, Mumbai city, Mumbai Suburban Duration: Full day

Venue: Marine and Coastal Biodiversity Centre, Airoli

#### AGENDA

Time	TOPICS & RESOURCE PERSON			
10:30 - 10:45	<b>REGISTRATION &amp; TEA BREAK</b>			
10.45 11.20	Introduction to Bird Migration and Central Asian Flyway by			
10:45 - 11:20	Dr. P. Sathiyaselvam, Senior Scientist, BNHS Wetlands Programme			
	Bird Identification Tools and Wetland IBAs and Potential Ramsar in Maharashtra by Dr. Raju			
11:20 - 12:10	Kasambe IBA Project Manager, Conservation			
	Education Centre In-charge			
	Bird Monitoring Programmes by Nandkishor Dudhe, (Common Bird Monitoring Programme			
12.10 12.00	In-charge)			
12:10-13:00	1. Common Bird Monitoring Programme			
	2. Asian Waterbird Census			
13:00 - 13:30	LUNCH BREAK			
12:20 14:20	Bird Migration Study Techniques, Bird Banding and Reporting Bands by Tuhina Katti,			
13:30 - 14: 30	Scientist, BNHS Wetlands Programme			
14:30- 14:45	TEA BREAK			
	Wild Bird Monitoring Handling Techniques & Disease Monitoring Central Asian Flyway			
14:45- 16:00	Action Plan & Way Forward by Dr. P. Sathiyaselvam, Senior Scientist			
16.00 - 16.15				
10.00 - 10:15				
16:15 - 16:30	VOTE OF THANKS			

# WORKSHOP FOR FOREST DEPARTMENT STAFF ON BIRD MIGRATION, CENTRAL ASIAN FLYWAY ACTION PLAN AND IMPLEMENTATION STRATEGIES

# (UNDER THE PROJECT ELUCIDATING THE MIGRATORY ROUTES OF WATERBIRDS WINTERING ALONG THE MAHARASHTRA COAST)

Date: 17 April 2018District: Thane, Mumbai Suburban, Mumbai city, RaigadVenue: Chief Conservator of Forest (CCF) Office,<br/>ThaneDuration: Full day

#### AGENDA

Time	TOPICS & RESOURCE PERSON
09:30 – 09:45	<b>REGISTRATION &amp; TEA</b>
09:45 – 10:00	Welcome Address & Introductory Speech
10:00 – 10:45	National and International Bird Monitoring programme

10:45 – 11:15	Global flyways, initiatives, Central Asian Flyway (CAF), CAF Action Plan and other CMS
	agreements related to birds
11.15 - 12.00	Wetlands Important Bird Areas, Ramsar criteria and Potential Ramsar Sites in
11.15 12.00	Maharashtra
12.00 13.00	Responsibilities of state governments for implementing the CAF Action Plan and other
12.00 - 15.00	CMS agreements
13:00 – 13:45	LUNCH
13:45-14:30	Legal Framework and Governance for migratory birds in India
14:30– 15:30	Role of Wetlands in conservation of Migratory Waterbirds
15:30 - 15:45	TEA BREAK
15:45 – 16:15	Disease Monitoring
16:15 – 16:45	INTERACTIONS AND FEEDBACK
16.45 – 17:00	VOTE OF THANKS

# WORKSHOP FOR INDIAN BIRD CONSERVATION NETWORK (IBCN) MEMBERS AND OTHER STAKEHOLDERS ON BIRD MONITORING, WETLAND IMPORTANT BIRD & BIODIVERSITY AREA (IBA'S), POTENTIAL RAMSAR SITES, BIRD MIGRATION AND CENTRAL ASIAN FLYWAY ACTION PLAN

### (UNDER THE PROJECT ELUCIDATING THE MIGRATORY ROUTES OF WATERBIRDS WINTERING ALONG THE MAHARASHTRA COAST)

Date: 24 June 2018 Venue: Viva college, Virar **District:** Palghar **Duration:** Full day

### AGENDA

Time	TOPICS TO BE COVERED
09:30 – 10:00	REGISTRATION
10:00 - 10:15	INTRODUCTION
10:15- 10:45	Introduction to Bird Migration
	Bird Monitoring Programmes
10:45 - 11:30	1. Common Bird Monitoring Programme
	2. Asian Waterbird Census
11:30 - 12:30	Bird Migration Study Techniques, Bird Banding and Reporting Bands
12:30 - 13: 30	LUNCH BREAK
13:30-14:30	Central Asian Flyway (CAF) and Central Asian Flyway Action Plan
14:30- 15:30	Wild Bird Disease Monitoring
15:30- 15:45	TEA BREAK
15:45- 16:00	Tie-ups and Way Forward
16:00 - 16:30	INTERACTION SESSION & VOTE OF THANKS

### WORKSHOP FOR LOCAL COMMUNITY ON BIRD IDENTIFICATION, MONITORING, POTENTIAL BIRD ECOTOURISM, BIRD MIGRATION AND CENTRAL ASIAN FLYWAY ACTION PLAN

# (UNDER THE PROJECT ELUCIDATING THE MIGRATORY ROUTES OF WATERBIRDS WINTERING ALONG THE MAHARASHTRA COAST)

Date: 16 February 2019

**District:** Sindhudurg **Duration:** Full day

Venue: Mangrove Foundation Centre, Sindhudurg

#### AGENDA

Time	TOPICS TO BE COVERED
09:30 – 10:00	REGISTRATION
10:00 - 10:15	INTRODUCTION
10:15- 10:45	Bird Identification and Birds of Sindhudurg
	Bird Monitoring Programmes- Hrishikesh Rane
10:45 - 11:30	1. Common Bird Monitoring Programme
	2. Asian Waterbird Census
11:30 - 12:30	Introduction to Bird Migration-Tuhina Katti
12:30 - 13: 30	LUNCH BREAK
13:30-14:30	Potential Bird Ecotourism in Sindhudurg- Ashwini Joshi
14:30- 15:30	Bird Migration Study Techniques, Bird Banding and Reporting Bands - Tuhina Katti
15:30- 15:45	TEA BREAK
15:45- 16:00	Tie-ups and Way Forward
16:00 - 16:30	INTERACTION SESSION & VOTE OF THANKS

# WORKSHOP FOR INDIAN BIRD CONSERVATION NETWORK (IBCN) MEMBERS AND OTHER STAKEHOLDERS ON BIRD IDENTIFICATION, MONITORING, WETLAND IMPORTANT BIRD & BIODIVERSITY AREA (IBAS), POTENTIAL RAMSAR SITES, BIRD MIGRATION AND CENTRAL ASIAN FLYWAY ACTION PLAN

(UNDER THE PROJECT ELUCIDATING THE MIGRATORY ROUTES OF WATERBIRDS WINTERING ALONG THE MAHARASHTRA COAST)

Date: 17 February 2019 Venue: Mangrove Foundation Centre, Sindhudurg **District:** Sindhudurg **Duration:** Full day

#### AGENDA

Time	TOPICS TO BE COVERED
09:30 – 10:00	REGISTRATION
10:00 - 10:15	INTRODUCTION
10:15- 10:45	Bird Identification and Birds of Sindhudurg
10:45 - 11:30	Important Wetland Bird Hotspots in Sindhudurg
	Bird Monitoring Programmes
11:30 - 12:30	1. Common Bird Monitoring Programme
	2. Asian Waterbird Census
12:30 - 13:00	Introduction to Bird Migration

13:00-14:00	LUNCH BREAK
14:00-15:00	Bird Migration Study Techniques, Bird Banding and Reporting Bands
15:00-15:45	Central Asian Flyway (CAF) and Central Asian Flyway Action Plan
15:45- 16:00	TEA BREAK
16:00- 16:25	INTERACTION SESSION, TIE-UPS AND WAY FORWARD
16:25 - 16:30	VOTE OF THANKS

# WORKSHOP FOR INDIAN BIRD CONSERVATION NETWORK (IBCN) MEMBERS AND OTHER STAKEHOLDERS ON BIRD BAND SIGHTING MOBILE APPLICATION TUTORIAL AND TRAINING

# (UNDER THE PROJECT ELUCIDATING THE MIGRATORY ROUTES OF WATERBIRDS WINTERING ALONG THE MAHARASHTRA COAST)

Date: 19 May 2019

Venue: Hornbill House, Colaba

Duration: Full day

### <u>AGENDA</u>

Time	TOPICS TO BE COVERED	RESOURCE PERSON	
10:00: 10:30	REGISTRATION & TEA		
10:30 - 10:45	INTRODUCTION		
	Introduction to Bird Migration study	Ms. Tuhina Katti, Scientist B- / Ms. Madhumita	
10:45- 11:30	techniques and Central Asian Flyway	Panigrahi, Scientist B- Wetlands Programme	
	(CAF)		
11:30 – 12:30	Sharing experience on Bird ringing	Dr. Raju Kasambe, Assistant Director-Education	
	and recovery		
12:30-13:30	LUNCH BREAK		
13:30-15:00	Bird Band Application Tutorial and	Mr. Hrishikesh Rane, JRF-Wetlands Programme	
	Training		
15:00- 15:15	Q/A session		
15:15- 15:30	VOTE OF THANKS		

#### **A**NNEXURE **V**

Sr. no.	Name	Designation/	Organisation/Institution
1	Abhishek Satam	Biologist	Zoological Survey of India (Kolkata)
2	Aditi Neema	Asst. Professor (Biodiversity/ wildlife)	B. N. Bandodkar college
3	Sagar G. Mahajan	Student	B. N. Bandodkar college
4	Prachi N. Jadhav	Student	B. N. Bandodkar college
5	Vrushali Mitter	Student	WWF-Mah. Volunteer Hub St. Xaviers College
6	Durgesh Patil	Student	WWF-Mah. Volunteer Hub Mithibai College
7	Priyanka Thakur	Student	WWF-Mah. Volunteer Hub
8	Toshal Raje	Student	K. J. Somiaya College of Science and Commerce
9	Prakriti Bagdi	Student	K. J. Somiaya College of Science and Commerce
10	Divesh P. Manchekar	Student	K. J. Somiaya College of Science and Commerce
11	Laxman P. Nagargoje	Forest Guard	Mah. Mangrove cell unit
12	Deepak L. Zugare	Forest Guard	Mah. Mangrove cell unit
13	Sachin V. More	Forest Guard	Mah. Mangrove cell unit
14	Yogesh P. Ringane	Forest Guard	Mah. Mangrove cell unit
15	Pandal V. L	Forest Guard	Mah. Mangrove cell unit
16	S. D. Gangurde	Forest Guard	Mah. Mangrove cell unit
17	N. T. Bhangae	Forest Guard	Mah. Mangrove cell unit
18	P. A. Gosavi	Forest Guard	Mah. Mangrove cell unit
19	P.K. Kamble	Forest Guard	Mah. Mangrove cell unit
20	Pradip Mali	Forester	
21	Daulat More	Forester	
22	Sunil Chikane	Forest Guard	
23	Subhash Shinde	Forest Guard	
35	Dr. Mahesh Sanzgiri	District Co-ordinator CBMP	The Golden Flacon Club
36	Ravindra Sathaye	Naturalist	Paryavaram Dakshata Mandal
37	Madan Tillu	Ornithologist	
38	NANDISH D. SONGIRE	Ornithologist	
39	Shubham Yadav	Ornithologist	
40	Vrinda A. Shringare	Ornithologist	
41	Hemlata Sagare	Ornithologist	ADITYA Birla

# Details of the participants of the Bird monitoring, migration and CAF workshops

Sr. no.	Name	Designation/	Organisation/Institution
42	Jaya Peter	Naturalist	
44	Roozbeh Gazdar	Naturalist	Tata Infrastructure
45	Hardeep Gazdar	Naturalist	
46	Shubham Tanpathak	Student	V.G. Vaze college
47	Sachin V. Rane	Naturalist	Naruralist Foundation
48	Yukti Joshi	Naturalist	Naruralist Foundation
49	Mr.Pravin Vishe	Naturalist	Greensteps
50	Divya Kalsi	Student	BVIEER
51	Prathamesh Amberkar	Student	K. J. Somaiya college
52	Masira Shaikh	Student	Ornithology Course
53	Shrikant Podwal	Student	Mithibhai college
54	Manish Zendekar	Boat Driver	Coastal & Marine Biodiversity centre
55	Shaheed Bamne	Boat master	Coastal & Marine Biodiversity centre
56	Satyawand Lavande		Coastal & Marine Biodiversity centre
57	Sachin Repal	DFO	
58	Sushant Salgaonkar	ACF	Thane Forest Division
50	M M Danditrao	DEO	Mumbai Mangrove Conservation
- 29			Unit
60	S. S. Kank	RFO	Thane Forest Division
61	Maneesh Kumar	DCF	Alibaug Forest Division
62	D. M. More	Forest Ranger	Forest Guard, Mumbai
63	R. B. Kumar	ACF	Thane Forest Division
64	D. C. Deshmukh	Forest Ranger	Thane Forest Division
65	A.M. Nichite	R O Thane	Thane Forest Division
66	Siddhesh Surve	Capacity Building Officer	Mangrove Foundation
67	Amol Lopes	Naturalist	NEST
68	Dr. Parag Nalawade	Naturalist	NEST
69	Dr. Ashirwad Thakur	Naturalist	NEST
70	Subhash Phadke	Naturalist	NEST
71	Subhangi Phadke	Naturalist	NEST
72	Girish Chonkar	Naturalist	NEST
73	Sachin Main	Naturalist	NEST
74	Pooja Pathak	Lecturer	Viva college
75	Swati Jaykar	Lecturer	Viva college
76	Arun Negi	Student	Viva college
77	Abhishek Mishra	Student	Viva college
78	Shubham Hadkar	Student	Viva college
79	Harsh Jadhav	Student	Viva college
80	Karmishtha Mhatre	Student	Viva college
81	Shivam Mishra	Student	Viva college

Sr. no.	Name	Designation/	Organisation/Institution
82	Monali Jethva	Student	Viva college
83	Sathyaprakash	Student	Viva college
84	Subham Dubey	Student	Viva college
85	Mansi Chaurasiya	Student	Viva college
86	Irshad Ali	Student	Viva college
87	Vrushabh A Khulatkar	Student	Viva college
88	Manish R. Singh	Student	Viva college
89	Sujeet Jagdale	Student	Viva college
90	Sailee Aras	Naturalist	Jungle Maniac
91	Anjali Mishra	Naturalist	Jungle Maniac
92	Vrushika Mistry	Naturalist	Jungle Maniac
93	Jayraj Nair	Naturalist	Jungle Maniac
94	Bruno Fernandes	Naturalist	Jungle Maniac
95	Abhijeet Mishra	Student	
96	Nikam Deepak	Livelihood specialist	Mangrove Foundation
97	Sai Satardekar	Eco-tourism self-help group member	Swamini shg, Vengurla
98	Ayesha Hule	Eco-tourism self-help group member	Swamini shg, Vengurla
99	Kasturi Dhoke	Eco-tourism self-help group member	Prasiddhi shg, Wadatar
100	Sejal Bhaval	Eco-tourism self-help group member	Siddhi shg.
101	Samidha G Chaugule	Eco-tourism self-help group member	Shivshankar shg. Achra
102	Laxmi Kubal	Eco-tourism self-help group member	Shivshankar shg. Achra
103	Anuja Appa Bandkar	Eco-tourism self-help group member	Utkarsh shg. Mithmumbra
104	Kishor Nare	Eco-tourism self-help group member	Gurudev Datta shg.
105	Rajan Arjun Surve	Eco-tourism self-help group member	Shri Mahapurush shg.
106	Bhushan K. Juwatkar	Eco-tourism self-help group member	Dive Master,Tarkarli
107	Aadesh M. Pednekar	Eco-tourism self-help group member	Karli
108	Kalidas Chipkar	Eco-tourism self-help group member	Karli
109	Sandip Arolkar	Eco-tourism self-help group member	Nivti

Sr. no.	Name	Designation/	Organisation/Institution
110	Dirember Negelker	Eco-tourism self-help group	N1:
110	Digamber Nagolkar	member	
111	Swapnil B Chavan	Project Assosicate	Mangrove Foundation
112	Digamber Toraskar	Project Assosicate	Mangrove Foundation, Nivti
113	Deepak Jadhav	Project Associate	Mangrove Foundation
114	Lavesh U Kargutkar	Project Associate	Mangrove Foundation
115	Ajaya A Bhatkar	Project Associate	Mangrove Foundation
116	Shruti V Ghag	Project Associate	Mangrove Foundation
117	Hemali Sawant	Project Associate	Mangrove Foundation
118	Mrunali S Dange	Project Associate	Mangrove Foundation
119	Sujata N Kankuntwar	Project Associate	Mangrove Foundation
120	Sanjeevan S. Shilavan	Forest Guard, Malvan	
121	Akshay Salunkhe	Project Associate	Mangrove Foundation
122	Sujata N Kankuntwar	Project Associate	Mangrove Foundation
123	Ratnadeep Prakash Kadam	Student	
124	Dr. Yogesh Koli	Assistant Professor	Sant. Rawool Maharaj college,Kudal
125	Pravin S Sawant	Student	Sant. Rawool Maharaj college,Kudal
126	Tushar G Pentar	Student	Sant. Rawool Maharaj college,Kudal
127	Sagar H Kudalkar	Student	Sant. Rawool Maharaj college,Kudal
128	Madhukar U. Shenai	Student	Sant. Rawool Maharaj college,Kudal
129	Namrata R Chauhan	Student	Sant. Rawool Maharaj college,Kudal
130	Harshada D. Mistry	Student	Sant. Rawool Maharaj college,Kudal
131	Pramod Wadekar	Boatman	Achra
132	Roshani D. Gawde	Student	S.H.Kelkar college, Devgad
133	Hiroji A Parab	Student	S.H.Kelkar college, Devgad
134	Bandu V. Rathod	Student	S.H.Kelkar college, Devgad
135	Dhanashri G. Koyande	Student	S.H.Kelkar college, Devgad
136	Lalit S. Naik	Student	S.H.Kelkar college, Devgad
137	Sahili Rajendra Ninave	Student	Br. Balasaheb Khardekar college, Vengurla
138	Komal S. Mayekar	Student	Br. Balasaheb Khardekar college, Vengurla
139	Neha M. Gawade	Student	Br. Balasaheb Khardekar college, Vengurla
140	Dr. Dhanashree S. Patil	Assistant Professor/ Green nature club coordinator	Br. Balasaheb Khardekar college, Vengurla
141	Yuvradni S. Patil	Student	DBSKKV, Dapoli
142	Guruprasad P. Chamankar	Student	S.P. college of Agriculture, Ratnagiri

Sr. no.	Name	Designation/	Organisation/Institution
143	Savala Sakharam Kamble	Forest Guard	Mah. Forest Department,
			Sawantwadi
144	Anteshwar N. Bhange	Forest Guard	Mangrove Cell, Maharashtra Forest
			dept
145	Manohar S. Teli	Professor (Biology)	Devgad college, Devgad
146	Ajay Nadkarni	Bird watcher/ Photographer	
147	Vedant Kasambe	Local birder	
148	Sankalp Bnadekar	Local birder	Patkar
149	Rinku R. Chaudhary	Local birder	Patkar
150	Raghav Gupta	Bird watcher/ Photographer	CEC-BNHS Course participant
151	Sagar Patankar	Student/ Birder	B N Bandodkar

ANNEXURE VI Images of the colour band resighting records submitted by birdwatchers



Lesser Flamingo with AFP colour flag sighted at Panje, Uran in November 2018



Common Redshank with A04 colour flag sighted at Panje, Uran in September 2018



Curlew Sandpiper with 2E\_ colour flag sighted at Panje, Uran in September 2018



Dunlin with 8B2 colour flag sighted at Panje, Uran in September 2018



Lesser Sandplover with 0E3 colour flag sighted at Panje, Uran in September 2018



Lesser Sandplover with 0E4 colour flag sighted at Panje, Uran in September 2018



Lesser Sandplover with 5D7 colour flag sighted at Panje, Uran in September 2018



Little Stint with leg ring sighted at Panje, Uran in December 2018



Lesser Sandplover with 7C4 colour flag sighted at Panje, Uran in September 2018



Little Stint with leg ring sighted at Panje, Uran in September 2018



Lesser Sandplover with 0E4 colour flag sighted at Panje, Uran in December 2018



Lesser Sandplover with 0E4 colour flag sighted at Panje, Uran in December 2018



Lesser Sandplover with 2E8 colour flag sighted at Panje, Uran in December 2018



Lesser Sandplover with 3D2 colour flag sighted at Panje, Uran in December 2018



Lesser Sandplover with leg ring sighted at Panje, Uran in December 2018



Little Stint with leg ring sighted at Panje, Uran in September 2018



Lesser Flamingo with colour flag sighted at Panje, Uran in January 2019



Lesser Flamingo with AGA Leg Band sighted at Seawood, Navi Mumbai in October 2018



Lesser Flamingo with colour flag sighted at Seawood, Navi Mumbai in January 2019



Broad-billed Sandpiper ringed in Mumbai and resighted in Jamnagar in November 2019



**Bombay Natural History Society** 

Hornbill House, Dr. Salim Ali Chowk, Shaheed Bhagat Singh Road, Mumbai – 400 001, India. **Tel**: (91-22) 2282 1811 **Fax**: (91-22) 2283 7615 **Email**: Office: info@bnhs.org **Director**: director@bnhs.org **Website**: www.bnhs.org