

“Migration of birds and their flyways in India”

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ABSTRACT

Every year in most parts of the Northern Hemisphere, a large number of avian species move toward the south for wintering and after spending the winter season at their respective destinations they return back using the same migratory routes. This phenomenon is known as bird migration and routes followed by migratory birds are known as flyways of migration. Over 2000 species of birds are known to participate in migration. Some species exhibit longitudinal movements and/or local migration, relatively covering a short distance. Due to multiple factors, most migratory birds face a number of threats and their species diversity and populations are declining worldwide. To ensure the conservation and sustainability of migratory birds a number of measures have been adopted by United Nations at the global level and multi-lateral treaties/cooperation have been enforced. India is a party to the Convention on Migratory Species and is playing a crucial role in the conservation of migratory birds in India. A total of 128 avian species are listed in the appendices of the convention. A total of 7 species are covered in appendix-I and 103 species in appendix-II, while 18 species are covered by both appendices. The Central Asian Flyway encompasses several important bird migration routes between Eurasia and the Indian Ocean including India. Over 180 migratory birds including some globally threatened species are known to use this flyway. Studies carried out in India, provide rich information on migratory birds and their habitats.

KEYWORDS: Migratory birds, Flyways for migration, Endangered species, Ramsar sites, Conservation.

INTRODUCTION

Every year, after the onset of the winter season in most parts of the Northern Hemisphere, a large number of avian species move towards the south for wintering. After spending the winter season at their respective destinations, they return back to their native ground in the spring season (Alerstam, 1990; Berthold, 2001; Newton, 2003; Somveille *et al.*, 2013). This regular two-way seasonal movement is termed as bird migration and over 2000 species of birds are known to participate in this worldwide phenomenon (BNHS, 2020). These birds are known as migratory birds. It has been observed that migratory birds use certain routes due to some natural barriers such as the Mediterranean Sea, Caribbean Sea, and high-altitude Himalayan peaks, and these movements are known as migratory flyways (Stroud *et al.*, 2006). Most migratory birds are aquatic species, and their wintering destinations are comprised of terrestrial water bodies ranging from small ponds to large-sized lakes and wetlands (Figure 1).

Due to various anthropogenic factors like habitat destruction and degradation, pollution and climate change, illegal and unsustainable hunting, infrastructure development, and disease, most migratory birds are facing a number of threats, and their species diversity and populations are declining in most parts of the world (Biber and Salathé, 1991; Baker *et al.*, 2004; Trouwborst, 2012). Their conservation depends on coordinated efforts on a multi-lateral, international scale. To ensure the sustainability of migratory birds, a large number of conservation measures have been adopted at the intergovernmental level, and multi-lateral treaties/cooperation have been enforced, such as Convention on Migratory Species (<https://www.cms.int/en/legalinstrument/cms>), Ramsar Convention (<https://www.ramsar.org>), Convention for the Protection of Migratory Birds, State of the World's Birds, and Neotropical Migratory Bird Conservation Act (<https://www.fws.gov/law/migratorybird-treaty-act-1918>). Flyways provide a framework that can help forge international collaboration and focus attention on the strategic needs of migratory birds. Bird migration and migratory species were highlighted by Shri Narendra Modi, Honourable Prime Minister of India, in 'Mann Ki Baat' in Feb. 2020, which motivated and encouraged a number of behavioural biologists and conservationists to take up the subject for further studies and exploration. It prompted us to review the subject, especially in the Indian context and consolidate the information in the form of an article. Present review is based on the survey of literature and studies conducted by authors and other scientists of the Zoological Survey of India on migratory birds and their habitats in India.

What is bird migration?

The term 'migration' is derived from the Latin word 'migrara' which means movement from one place to

another. In birds, many species have evolved to move from one place to another (two-way seasonal journeys) to gain the benefits of favourable conditions in terms of food and shelter. Due to the scarcity of food and unfavourable seasonal conditions such as low temperatures and snowfall (onset of winter season) at home grounds, birds move to other warmer places (known as wintering ground) for better survival conditions, and after spending a few months, once the conditions become favourable for life (due to seasonal changes and the onset of spring season), they return back to home grounds (Kirby *et al.*, 2008). It is interesting to note that all

species of birds do not migrate, but most species are subject to seasonal movements of varying extents. This seasonal movement of birds is known as 'bird migration' and it can be categorised into several types mostly based on the season and distance of migration



Figure. 1. Large congregations of migratory birds at Patna Bird Sanctuary, Uttar Pradesh

Sandpiper *Tringa stagnatilis*, Common Greenshank *Tringa nebularia*, Ruddy Turnstone *Arenaria interpres*, Eurasian Whimbrel *Numenius phaeopus*, and Pallas's Gull *Ichthyaeetus ichthyaeetus*, are known to cover a long distance (Rasmussen and Anderton, 2005). However, some species migrate over short latitudinal distances, such as Himalaya to peninsular India and vice versa (Figure 2).



Figure 2. Some examples of local/short-distance migrants in India. (A) Blue Whistling Thrush *Myophonus caeruleus* (above left) and Himalayan Black Bulbul *Hypsipetes leucocephalus* (above right); (B) Grey-headed Canary-Flycatcher *Culicicapa ceylonensis* (below left) and Grey Bush Chat *Saxicola ferreus* (below right)

A less frequent opposite movement also occurs in the southern hemisphere. For example, cuckoos breed in India and spend the summer at South-east Africa (Thorup *et al.*, 2020). Some tropical birds are known to migrate during the rainy season to the outer tropics to breed and return to the central tropics after breeding. Many marine avian species also make considerable migrations. The Arctic Tern *Sterna paradisaea* breeds in the northern temperate region and migrates to the Antarctic zone along the Atlantic, covering a distance of 22,500 km (Duffy *et al.* 2013; Fijn *et al.* 2013). The Bar-headed Goose *Anser indicus* is one of the world's highest-flying birds (Hawkes *et al.*, 2011), and winters in many wetlands of India (Figure 3). Some species of birds are known to possess longitudinal migration, occurring when they migrate from east to west and vice-versa (Figure 4). The Starlings *Sturnus vulgaris*, a resident of East Europe and West Asia has been reported to migrate towards the Atlantic coast. Another notable example is the Hooded Pitta *Pitta sordida*, which is common and widespread in Eastern and Southeast Asia, where it lives in various types of habitats. During the

summer months, it migrates to the Himalayan foothills. Some scientists consider the daily movements of birds as 'daily migration'. Based on the time of travel, migratory birds can further be classified as diurnal migrants and nocturnal migrants.



Figure 3. A flock of Bar-headed Goose *Anser indicus* at Pong Dam wetland, Himachal Pradesh. This species migrates over the Himalaya to spend the winter in parts of South Asia from Assam to as far south as Tamil Nadu in India.

Problems faced by birds during migration Birds face a number of threats during migration (Kirby et al., 2008), ranging from natural disasters (such as thunderstorms, sandstorms, diseases and predation) to anthropogenic activities (such as wind farms, pollution, oil spills, radiation, electric lights, degradation of habitats, and hunting). Due to these factors, many populations of migratory bird species are on the decline. In most cases, the decline is the consequence of multiple interlinked factors. In India, some of the major problems to migratory birds are as follows.

- 1. Harvesting of fishes:** The locals from the adjoining areas of wetlands often harvest fish from the wetlands. Fish harvesting creates a disturbance to birds and often birds feel terrified.
- 2. Human disturbance:** It is seen that often herders and visitors roam in adjoining areas of wetlands. Their livestock not only grazes over natural resources but also creates a disturbance to birds. Such grazing causes soil erosion in the lands surrounding the lakes, which enhances the siltation of lakes.
- 3. Agricultural encroachment:** The surrounding areas of wetlands often encroach. They remove the surrounding vegetation cover of wetlands. Often the water from the lakes is used for irrigation in these fields.

The exploitation of aquatic reeds/ vegetation:

The residents commonly harvest the aquatic reeds from wetland areas, leading to habitat degradation. On the other hand, some plants namely *Ipomoea carnea* and *Eichhornia*



Figure 4. Common Cuckoo *Cuculus canorus* (left) and Red-breasted Flycatcher *Ficedula parva* (right) are widespread longitudinal winter migrants in India. *crassipes* spread very fast, resulting in decreasing surface area being used by most migratory birds. Some of the plants such as *Eichhornia crassipes*, *Lemna perpusilla*, *Marsilea quadrifolia*, and *Wolffia globosa* are known as common surface-covering plants, and form a dense greencovering on the surface.

4. Poaching of birds: Often some local poachers harvest migratory birds from wetlands. However, forest officials are very prompt to prevent such activities.

5. Pollution: Wetlands are the most complex and fragile ecosystems and do not have a self-cleaning ability and thus readily accumulate pollution. Dispose of water bottles, plastic wrappers, and bags can be seen frequently near the banks of the wetlands. It is often observed that the people living nearby wetlands are dumping wastes near wetland areas thus making the water and surroundings more polluted. Recently, it has been investigated that nocturnally migrating passerines are more strongly affected by light pollution (Burt *et al.* 2023).

International strategies for migratory bird conservation

For the conservation of migratory birds and their habitats, a number of strategies have been adopted and these are framed, networked and enforced at the international level by United Nations.

- 1. Convention on Migratory Species:** It is a treaty of the United Nations that provides a global platform for the conservation and sustainable use of migratory animals, their habitats, and migration routes. It is also known as 'Convention on the Conservation of Migratory Species of Wild Animals' or 'Bonn Convention' (<https://www.cms.int/en/legalinstrument/cms>). It was signed in 1979 in Bonn, West Germany, and became effective in 1983. So far total 133 countries are the parties to this convention. It works with a number of international organizations, NGOs and partners. It is a legal foundation for internationally coordinated conservation measures throughout a migratory range. It is mainly focused on migratory birds as the largest proportion of migratory animals is birds. The convention brings together the countries through which migratory animals pass. The appendices of the convention include mammals, birds, fish, reptiles and one insect. Migratory species threatened with extinction are covered in Appendix I of the convention. The parties of the convention adopt a legal framework to protect these animals through the conservation and restoration of their habitats, mitigating threats to migration and controlling other factors. Migratory species that are likely to be significantly benefited from international cooperation are listed in Appendix II of the Convention. On the basis of information collected from various sources, in India, a total of 128 species are listed in the appendices of the convention. A total of 7 species are covered in appendix-I and 103 species in appendix-II, while 18 species are covered by both appendices.
- 2. World Migratory Bird Day:** It is an annual awareness-oriented campaign to publicise the need for the conservation of migratory birds and their habitats. It is a global instrument to support the conservation of migratory birds, to address the threats faced by migratory birds, their ecological importance, and the need for a joint venture and cooperation at the international level. Every year people around the world actively participate and organize various outreach activities such as bird festivals, awareness events, exhibitions and bird-watching excursions (<https://www.worldmigratorybirdday.org>). World Migratory Bird Day was initiated in 2006 by the Secretariat of the Agreement on the Conservation of African-Eurasian Migratory Waterbirds in collaboration with the Secretariat of the Convention on the Migratory Species. The idea to designate a day for migratory birds was initiated in the United States in 1993, when the US Fish and Wildlife Service, the Smithsonian Migratory Bird Center and the Cornell Laboratory of Ornithology celebrated 'International Migratory Bird Day'. Later on, this event was adopted in the African-Eurasian region, and it was decided to expand the scope into an honouring day that celebrates all migrating birds at the international level. In 2018, the joint campaign adopts the single name of 'World Migratory Bird Day' and major events to celebrate the day will be organized twice a year, on the second Saturday in May and in October.
- 3. Convention on Wetlands:** Management and protection of wetland habitats is a prerequisite to the conservation of migratory birds. Wetlands are among the most diverse and productive ecosystems, known to provide a wide range of ecosystem services. However, they continue to be degraded and converted extensively for other uses. The 'Convention on Wetlands' is one of the oldest intergovernmental environmental agreements. The treaty was negotiated through the 1960s by countries and non-governmental organizations and was adopted in the Iranian city of Ramsar in 1971 and came into force in 1975 (<https://www.ramsar.org>). The major mission of the convention is the 'wise use' of wetlands. It defines the wise use of wetlands as 'the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the

context of sustainable development'. Wetlands are indispensable for the wide range of benefits that they provide such as freshwater supply, food and building materials, biodiversity, flood control, groundwater recharge, and climate change mitigation. To achieve the targets of the convention, it was decided that each party (to the convention) must designate at least one wetland site within their territory for inclusion in the List of Wetlands of International Importance (known as Ramsar Sites). These 'Ramsar Sites' attain a new national and international status. They are recognized as being of significant value for humanity as a whole. There are currently over 2,400 Ramsar sites around the world. There are 75 Ramsar sites in India (<https://ramsar.org/wetland/india>). Till 2014 there were 26 Ramsar sites across India. Since 2014 till date 49 new Ramsar sites have been added across the country. The largest number (14 wetlands) of these sites are located in Tamil Nadu.

Government of India initiatives

India is a signatory to the conventions of IUCN pertaining to environment and biodiversity conservation, and plays a major role for nature conservation. For the conservation of migratory birds and their wetland habitats, the remarkable steps and measures adopted by the Government of India (MoEFCC, 2020) are highly appreciable. Ministry of Environment, Forest and Climate Change (MoEFCC) has adopted a wide framework and implemented a large number of programmes. India is a Party to the Convention on Biological Diversity (CBD). The MoEFCC is the nodal Ministry for the implementation of CBD in India. India is recognized as a leader on biodiversity conservation in developing and implementing relevant legal and policy regimes. Two Protocols have been adopted so far under the aegis of CBD, namely the Cartagena Protocol on Biosafety (2000) and the Nagoya Protocol on Access and Benefit Sharing (2010). India became a party to the 'Convention on Wetlands', also known as the Ramsar Convention on 1st February 1982 and has since then designated 75 wetlands covering an area of 13,26,677 hectares under the List of Wetlands of International Importance which includes 5 sites designated during FY 2020-2021. India has successfully implemented the National Action Plan for Conservation of Migratory Birds and their Habitats along the Central Asian Flyway (2018-2023). The overall goal of the plan is to reduce the population decline of migratory birds and to secure their habitats (https://moef.gov.in/wp-content/uploads/2018/03/CAF_NAP_Final-with-CL.pdf). The short-term goal of the plan is to stop the decline in population by 2027. Apart from this, over the years a large number of research projects have been executed by various organizations/ institutions in the country, providing rich information on the migratory birds in India.

Flyways of bird migration

Migratory birds use loosely fixed routes for their migration. Globally, certain routes have been identified that connect both the northern and southern hemispheres. Every year, millions of waterbirds follow these routes to reach their destinations and return journeys.

"The geographical area covered by a migratory bird over the course of its annual cycle, encompassing breeding and non-breeding grounds and the connecting migration route, is known as a flyway" -Kirby et al. (2008).



Figure 6. Pangong Tso is a high-altitude trans-Himalayan lake for the breeding of Bar-headed Goose *Anser indicus*.

Usually, migratory birds follow a north-south axis to spend the duration of their non-breeding winter season. The energetic costs of migration act as a driving force to adopt the shortest possible route. However, some other factors such as weather patterns, en route resources and the geographical features of the destination are also involved. Migrants mostly follow the mountain ranges, rivers, watercourses and coastlines for navigation. Large-sized water bodies and high-altitude mountains are often avoided. As a result, a number of species having similar biological/ ecological traits and requirements often share similar routes. These routes are known as 'flyways of bird migration' used by the world's 2,274 migratory species. However, contrary to this, some migratory routes are not in accordance with a north-south axis. For example, in the southern hemisphere, it has been investigated that avian movements are often linked to patterns of rainfall. That's why some migratory species are often less latitudinal than northern migrants. Most species utilize only the partial extent of flyway used such as wagtails and wheatears. While a few species utilise the full extent of

any flyway such as Whimbrel *Numenius phaeopus*, Ruddy Turnstone *Arenaria interpres*, and Sanderling *Calidris alba*. The International Wader Study Group identified eight multiple-species flyways such as Pacific Americas Flyway, Central Americas Flyway, Atlantic Americas Flyway, East Atlantic Flyway, Mediterranean/Black Sea Flyway, East Asia/East Africa Flyway, Central Asian Flyway, and East Asia/Australasia Flyway. However, East Asian-Australasian Flyway Partnership (EAAFP) consider a total of nine bird flyways after adding West-Pacific Flyway.

The Central Asian Flyway covers large parts of Eurasia located between the Arctic and the Indian Ocean. It encompasses several important bird migration routes, initiated from the northernmost breeding grounds of migratory ducks and waders in Siberia to the southernmost wintering grounds of West Asia, India and the Maldives (<https://wildlifesos.org/conservation-awareness/central-asian-flyway-an-overview>). Over 180 migratory bird including some globally threatened and near-threatened species are known to use the flyway. These include the critically endangered White-bellied Heron *Ardea insignis* and Northern Bald Ibis *Geronticus eremita*, the endangered Greater Adjutant Stork *Leptoptilos dubius*, the vulnerable Lesser Adjutant Stork *Leptoptilos javanicus* and Black-necked Crane *Grus nigricollis*, and the near-threatened Lesser Flamingo *Phoeniconaias minor* and Pygmy Cormorant *Microcarbo pygmaeus*, to name a few.

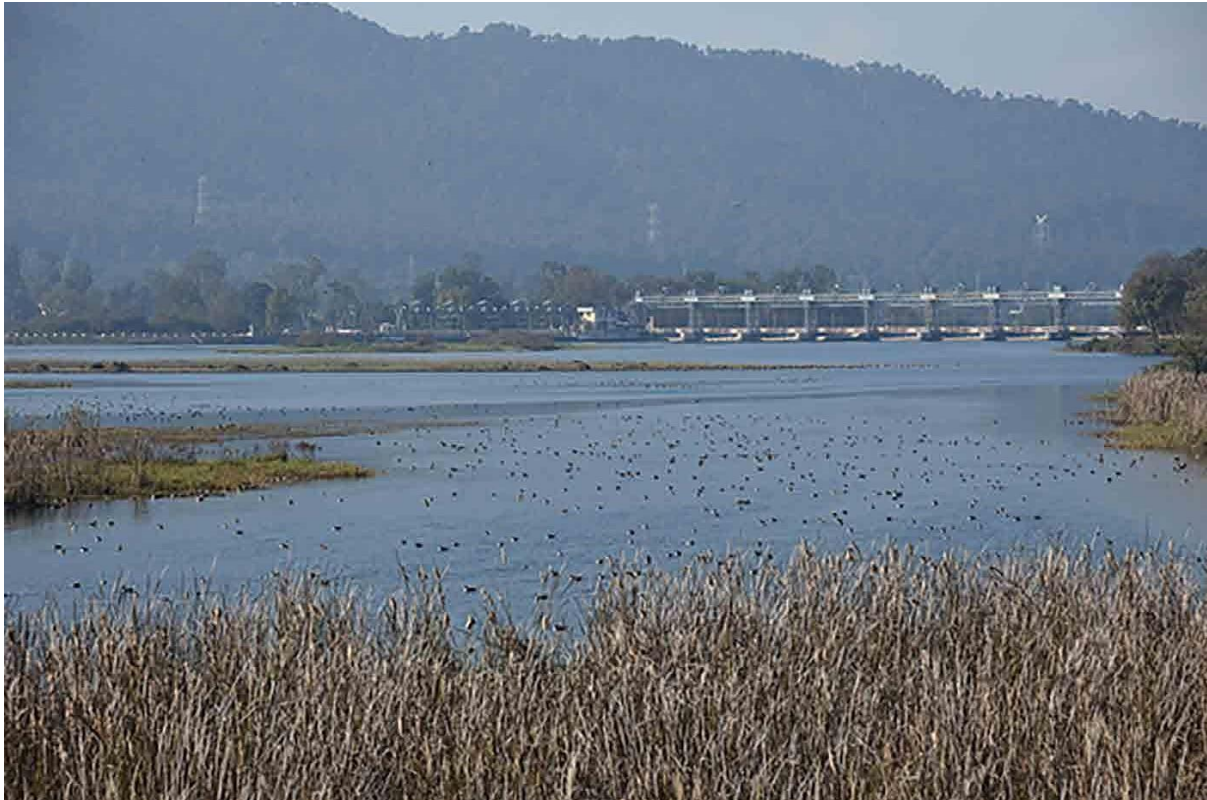


Figure 7. A panoramic view of Asan Conservation Reserve, Dehradun, Uttarakhand.

Hotspots for bird migration in India

The presence of a large number of water bodies, inland and coastal wetlands, marsh areas and ponds are the major attraction for migratory birds in India (Islam and Rahmani, 2004; Kumar, 2015). India is home to a varied number of wetlands ranging from high altitude trans-Himalaya lakes such as Tso Moriri, Pangong Tso (Figure 6), Tso Kar and Chander Taal to coastal wetland comprised of salt marshes, lagoons, bottomland hardwood swamps, fresh marshes, mangrove swamps, and shrubby depressions. Most of these wetlands are very rich in primary production and thus attract a large number of birds. Some of these wetlands are designated as 'Wetlands of International Importance' due to an incomparable ecosystem with immense conservation values and ecosystem services. At present, in India we have a total of 1243 wetlands further comprised of 75 Ramsar wetlands, 115 significant wetlands and 1053 other wetlands (<https://indianwetlands.in>). India became a party to the 'Convention on Wetlands', also known as the Ramsar Convention on 1st February 1982. Ramsar sites in India cover an area of 13266.77 km².

Presently, India holds the first position in South Asia and third in Asia in terms of Ramsar sites. Most of these sites are located in north-west Himalaya and Gangetic plains (<https://indianwetlands.in>). Some of the notable wetlands attract a large number of winter migratory birds are Pong Dam in Himachal Pradesh (Kumar, 2011; Kumar and Paliwal, 2015), Asan Conservation Reserve (Figure 7) in Uttarakhand, Wular Lake in Jammu & Kashmir, Tso Kar Wetland Complex in Ladakh, Harike Lake in Punjab, Bhindawas Wildlife Sanctuary and Sultanpur National Park in Haryana, Sur Sarovar Bird Sanctuary in Uttar Pradesh, Keoladeo National Park and Sambhar Lake in Rajasthan, Bhoj Wetland in Madhya Pradesh, Kabartal Wetland in Bihar, Deepor Beel in Assam, Loktak Lake in Manipur, Bhitarkanika Mangroves and Hirakud Reservoir in Odisha, East Kolkata Wetlands and Sunderbans Wetland in West Bengal, Kolleru Lake in Andhra Pradesh, Point Calimere Bird Sanctuary and Pichavaram Mangrove in Tamil Nadu, Ashtamudi Wetland and Sasthamkotta Lake in Kerala, Nanda Lake in Goa, Thane Creek in Maharashtra, Nalsarovar Bird Sanctuary, Khijadia Wildlife Sanctuary and Wadhvana Wetland in Gujarat. Apart from this, a number of bird sanctuaries have wetland habitats, known to host a sizable number of migratory birds such as Patna Bird Sanctuary, Nawabganj Bird Sanctuary, Lakh

Bahosi Sanctuary and Sandi Bird Sanctuary in Uttar Pradesh, Kanwar Lake Bird Sanctuary in Bihar, Khichan Bird Sanctuary, Pulicat Lake at the border of Tamil Nadu and Andhra Pradesh, D'Ering Wildlife Sanctuary in Arunachal Pradesh, Rann of Kutch in Gujarat, Kumarakom Bird Sanctuary in Kerala, and Ranganathittu Bird Sanctuary in Karnataka.

Conclusion

Studies showed that India is one of the most important destinations for migratory birds in South Asia, owing to the occurrence of wide array of wetlands ranging from coastal wetlands to inland lakes and dams. Strategic locations of some major wetlands such as Pong Dam, Asan Barrage, Harike Barrage and marshy depressions/ waterlogged areas in Gangetic plains are not only host a large number of migratory birds but also act as a stop-over for passage migrants going further southwards. A number of treaties have been enforced by United Nations for the conservation of water birds and India is a major contributor, is working for the conservation of migratory birds and their habitats in India mediated through the country-wide implementation of a number of programmes under the umbrella of Ministry of Environment Forest and Climate Change.

Acknowledgements

The authors are grateful to Dr. Dhriti Banerjee, Director, Zoological Survey of India, Kolkata, for the kind support and encouragement. We are grateful to Shri Tammay Kumar, Additional Secretary, MoEFCC, New Delhi, for the kind encouragement.

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