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Global Dynamics of Bird Migration: Trends, Mechanisms and Conservation Challenges

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ABSTRACT

Global bird migration is a complex phenomenon influenced by a multitude of factors, including climate change, habitat loss, and human activities. This paper explores the trends in migratory patterns observed over recent decades, highlighting shifts in timing, routes, and species distributions Bird migrations are behavioural occurrences, exemplifying intricate spatiotemporal tactics to optimise living expenses while enhancing fitness. Birds express a range of migratory patterns, from highly predictable obligate migration, to less predictable nomadic and fugitive migrations. Despite significant advancements in bird migration studies, still certain essential gaps remain. Due to technological advancement, bird migration studies have uncovered significant insights into the behavioural, cognitive, physiological, and evolutionary underpinnings. The seasonal variability of bird populations presents an intriguing phenomenon for avid observers to

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discern their origins, migratory routes, and return patterns. Among the remarkable migrations executed by several species of fish, animals, and insects, birds exemplify the highest degree of mobility among all living forms on Earth. This paper gives reasons for all Bird migration strategies with a view toward the preservation of Bird ecosystems and assurance of Environmental sustainability.

Keywords: Bird migration; species; bonn convention; conservation of migratory species; environmental sustainability; international migratory bird day.

1. INTRODUCTION

The dynamic fluctuations of bird populations throughout the seasons are inevitable for those who are observant and desire to grasp the source and destinations of these birds. Though many species of aquatic life, terrestrial mammals, and various insects make migratory voyages, birds collectively form the most versatile organism living on earth which migrates a lot (Lehikoinen and Sparks, 2010). Even human beings, with their transportation mode on, cannot equate birds in terms of their mobility. No human population travels each year as far as the Arctic to the Antarctic, and then back, but Arctic Terns do. Birds are designed in their anatomy and physiology to survive in air (McWilliams et al., 2021). Their feathered wings and tails, bones, lungs, air sacs, and metabolic powers all contribute to their tendency to migration (Newton, 2023). These enable bird species fly high to find habitats that are most suited to their needs at different seasons. The result is only known as migration, or the systematic, periodic, seasonal movement of populations from one geographic area to another and their return (Bell and Ward, 2000).

Throughout the course of human history, migratory avifauna have played a significant role as a vital food resource following harsh winters, as well as serving as indicators of seasonal transitions. The emergence of particular species has been celebrated with corresponding rituals in numerous cultures. Within the Eskimo communities and other indigenous groups, this occurrence is widely recognized as a reliable indication of the approach of spring, the advent of warmer climatic conditions, and relief from winter-related food scarcities. European traders, who sold furs in Alaska and Canada, prompted the Native populations who could see the first wave of geese during the spring season, and made common cause over the arrival of these newcomers with much fanfare (Lincoln and Peterson, 1979).

With the more crowded occupation of North America, the large flocks of ducks and geese, as well as migratory rails, doves, and woodcock, which had all been hunted for food, of course, were of intense interest to a rapidly growing number of sportsmen (Ford et al., 2009). Furthermore, it was discovered that many nongame species were also important allies for farmers in their perennial fight against insects pests and weed seeds. To say the least, all species have acquired an increasingly higher value in terms of recreational and aesthetic worth to millions of people who derive recreation from bird watching. It was realized that the migratory bird resources are a world heritage that could not be satisfactorily managed by a single state or country alone but rather with collective responsibility from all countries. The need for laws concerning both game and nongame avian species coincided with the requirement to regulate the hunting of declining game populations. Investigations have been found necessary as part of wildlife administration to determine the habits, environmental needs, and migratory habits of these species. The U.S. Department of the Interior realized the significance of this resource and has made commitments toward efforts on initiatives countering the effects of changes in land use, habitat destruction, and pollutants born from our technological society (Vig et al., 2012). Hence, avian research is funded by the U.S. The Fish and Wildlife Service falls under the Department of the Interior. Congress, in the Migratory Bird Treaty Act, has also entrusted this with the responsibility of protecting those bird species that annually migrate between the United States and foreign countries (Vencil, 1986). The federal government, through the Biological Resources Division of the U.S. Geological Survey, also supports fundamental research on avian migration (National Research Council, 2001). Federal agencies collaborate with their international counterparts, as well with state entities, institutions of learning, and non-governmental organizations, to enhance understanding and the preservation of migratory

species through efforts such as Partners in Flight, a broad international cooperative effort across the Western Hemisphere (Smith, 2013).

For nearly a century, the Fish and Wildlife Service and its predecessor, the Biological Survey, have been collecting data on the important details of bird migration. Scientists have compiled information regarding the distribution and seasonal movements of many species throughout the Western Hemisphere (Bridge et al., 2011).

Complementing these studies is the effort of numerous university staff and volunteer ornithologists from the United States, Latin America, and Canada, who document the migration patterns and statuses of avian species noted in their specific regions.

Data preserved in field notes, electronic records, and scientific publications form a vast storehouse of knowledge on the distribution and migration patterns of avian species in North America. By drawing all this data together with supplementary information from a wide global source, this publication articulates the findings that speak to our present comprehension of the intriguing phenomenon of bird migration (Apitzsch and Siouti, 2007).

2. TECHNIQUES FOR ANALYSING MIGRATION

2.1 Direct Observation

The oldest, most simple, and most commonly used approach to the study of migration is direct observation. Size, color, song and flight of different species help both the amateur and the professional to determine when birds are on migration (Pedersen et al., 2016). Some studies done by Wells W. Cooke and his fellow workers from 1888 through 1915 and continued by succeeding workers in U.S. They were of especial importance in the earlier years of these investigations in North America. Bureau of Biological Survey (later U.S. Fish and Wildlife Service) (Sauer et al., 2013).

Some of the largest and most interesting routes and patterns were sorted out by tediously compiling and comparing literally thousands of observations of species in a given locality at a particular time of year. More recently, the National Audubon Society and many state Audubon and ornithological societies publish information in their bulletins and newsletters on direct observation of migration. Direct observation has collectively contributed much to our knowledge of migration, but this method is limited by its being largely restricted to daytime, ground-based data on birds either before or after a period of actual migratory flight.

Migratory birds often migrate at night.

It was apparent just how extensive nocturnal migration actually was obvious and challenging.

Information has been obtained by observing migrating birds flow across the face of a full moon through telescopes, as well as by making density and direction of birds. Since the percentage of the sky that is accessible to view through a telescope while looking at the moon is very small-about one-hundred thousandth of the observable sky-the volume of birds recorded is very small. On a night of heavy migration, some 30 birds per hour can be seen. That any birds are seen at all is a tribute to the large numbers passing overhead. A large-scale cooperative moon watch was conducted and interpreted by George H. Lowery, Jr. of Louisiana State University during the 1960's (Howell and O'Neill, 1981).

2.2 Aural

Another night observation method that is feasible for species identification during the study was using a parabolic reflector with an attached microphone to amplify call (chip) notes. Using a tape recorder, this device can record night migrants up to 11,000 feet on nights both with and without a full moon. The major drawback is that one cannot determine the direction a bird is traveling. In addition, it may not be easy to identify the chip notes at night during migration because such calls tend to be variable, and the same is very rarely heard from the notes during the day. The bird may not call when directly over the reflector and hence would not be recorded (Graber and Cochran, 1960).

2.3 Preserved Specimens

Reference material in the form of preserved bird skins with time and data collection locality are included in many natural history museums. The key requirement in studying migration by this technique is to have an appropriate series of specimens collected during the breeding season so that differences in appearance between

geographically separate breeding populations of the same species can be distinguished. Such properly identified breeding specimens would be used to compare with individuals that could be captured during migration with a view to associating such individuals with their breeding areas. This provides a convenient method of identifying and referencing individual's representative of known populations anywhere they may have encountered (Wiley et al., 2017).

2.4 Marking

Capturing, marking, and then releasing birds without causing them injury can reveal extensive information about migratory patterns. Techniques for marking have been developed to permit detection of particular birds when they are seen or re-captured later. The United States regulates the practice of marking birds with leg bands bearing numbers in North America since 1920. Fish and Wildlife Service (and more recently the Biological Resources Division of the U.S. Geological Survey) in cooperation with the Canadian Wildlife Service. Each year professional biologists and volunteers, working under permit, attach bands to thousands of game and nongame birds, from the largest to the smallest, migratory and non-migratory species. Each band is labeled with a serial number on its outside and has an address on its inside for return of recovered bands. If a bird that has been banded is reported from another location, real information regarding its movements is established.

The analysis of many such cases brings to the fore a much more complete understanding of the dynamics of migration (Silvy et al., 2012).

Other significant information regarding migrations has been derived from the records of banded birds, including arrival and departure dates, the duration of breaks for feeding and resting, the correlation between weather conditions and migration initiation times, the travel rates of individual birds, and the frequency with which individual birds return to their summer or winter quarters from previous years. The methodical operation of several banding stations throughout the year provides valuable information on the migration patterns of birds that were previously solely based on speculation. The banding studies that provide the most relevant results are those that specifically target certain bird populations.

2.5 Radio Tracking

The process of radio tracking, also known as telemetry, involves the attachment of a compact radio transmitter that emits regular signals or "beeps" from a bird in flight. By equipping a radio receiver kit on a vehicle or aircraft, it becomes feasible to monitor these radio signals and track the advancement of the migratory bird. A particularly striking illustration of this approach was documented by Richard Graber in 1965. A Gray-cheeked Thrush was apprehended on the University of Illinois campus, and a 2.5-gram transmitter was affixed to it (equivalent to a coin weighing 3 grammes). The bird was successfully tracked for more than 8 hours on a straight north trajectory from Urbana, passing through Chicago and along Lake Michigan. It carried on a continuous flight of around 400 miles at an average speed of 50 mph, with the assistance of a 27 mph tail wind. It is noteworthy that while the small thrush navigated up the centre of Lake Michigan, the chasing aircraft followed the lake's shore and stopped tracking at the northern end due to depletion of fuel, but the bird persisted in flying. The constraints of radio telemetry are the transmitter's size that can be positioned on birds without disrupting flight and the receiving vehicle's capacity to maintain sufficient proximity to the flying bird for signal detection purpose (Fiedler, 2009). Notwithstanding this challenge, there has been significant advancement in the technology, and the promising outcomes so far augur well for the future, especially when birds can be monitored by orbiting satellites. However, its usage should be exercised with caution, since many studies have shown that birds fitted with transmitters had much reduced survival rates.

2.6 Radar Observation

The development of radar with the purpose of electronically identifying and tracking aircraft played a crucial role in England's triumph in the Battle of Britain in the early stages of the Second World War. The first radar watchers observed, however, that they obtained dynamic returns that were not correlated with aircraft. Initially referred to as "angels" by observers in England, these radar reflections were quickly identified as avian species. Post-war, scholars of migration took use of the ability to track bird flight using radar to gather data on bird migrations over vast geographical regions, both during the day and at night (Nilsson et al., 2018).

Three types of radar have been employed in the study of birds: 1) general surveillance radar, akin to those found at airports, which covers a wide area and provides information on the overall time and direction of aerial movements of birds; 2) tracking radar, which records the trajectory of an airplane (or bird) in the sky by focussing on a specific "target" and consistently following that object; and 3) Doppler radar, akin to those used by law enforcement agencies to measure the speed of a passing automobile. In the absence of a human observer, radar data may be electronically recorded and then linked with meteorological data sets (Gauthreaux et al., 2003).

In migration research, radar has proved very useful in establishing the direction and speed of large bird movements, the dates and times of departure, the height of transit, and the overall volume, particularly at night time. An intriguing revelation resulting from ongoing radar research is the identification of very substantial migrations of warblers and other diminutive terrestrial avian species, which occur across seas instead of along coasts and in directions that were previously unknown to airborne observers.

2.7 When Birds Migrate

Individual birds exhibit a rather stationary behaviour throughout two distinct times annually, namely during breeding season and winter. When analysing the whole bird population of a continent, it is evident that birds undertake latitudinal excursions during almost all time periods. Every individual species, or a collection of species, undertakes migration at a certain period of the year and some during a precise period of the day. Migratory behaviour in other species is characterised by greater irregularity (Robinson et al., 2010). Red Crossbills, for instance, are typic migratory birds that will establish themselves and reproduce during any month of the year, provided there is a sufficient abundance of conifer seeds.

2.8 Geographic Patterns of Migration

2.8.1 Short-distance migration

Certain species have wide summer habitats (such as the Pine Warbler, Rock Wren, Field Sparrow, Loggerhead Shrike, and Black-headed Grosbeak) and specialise in the southern region of their breeding range during the winter season or occupy extra land only a little distance to the south. The whole species may thus be limited to a tight region during winter, but with the resurgence of warmer weather, the species expands to re-establish distribution throughout the much broader summer range (Lehikoinen et al., 2010).

Numerous species, such as American Tree Sparrows, Snow Buntings, and Lapland Longspurs, establish their nests in the northern regions of the United States and spend the winter in the eastern parts. Conversely, other species, including Vesper and Chipping sparrows, Common Grackle, Red-winged Blackbird, Eastern Bluebird, American Woodcock, and various species of ducks, nest in the southern regions of the United States and Canada and migrate a relatively short distance south for the winter to areas along the Gulf of Mexico. Within some hardy species, individuals may persist in sheltered areas even in regions of extreme cold (George, 1952).

For instance, the Common Snipe often inhabits areas of the Rocky Mountain region that experience very cold weather, since the presence of warm springs ensures a reliable food source.

2.8.2 Long-distance migration

Over 300 distinct breeding species migrate from the United States and Canada to the West Indies, Central America, or South America during the winter season.

Specifically, the Cape May Warbler reproduces in the northern regions of New England, Michigan, and Minnesota, extending northward to New Brunswick, Nova Scotia, and almost reaching Great Slave Lake. Its concentration during winter is mostly seen in the West Indies, especially on the island of Hispaniola. A portion of the typical summer inhabitants of North America undertake a more extensive migration, crossing the Equator and ultimately settling in the Argentine pampas or Patagonia for the winter season (Lincoln and Peterson, 1979). While Common Nighthawks, Barn Swallows, Cliff Swallows, and thrushes may share similar winter habitats in Brazil, the Bar Swallows and other nighthawks migrate to more southern regions. These species are perhaps the most migratory of all land birds in North America. They migrate northward to the Yukon Territory and Alaska during the summer, then southward to Argentina, which is 7,000 miles distant during the winter.

However, the extraordinary migrations of certain shorebird species, such as White-Rumped and Baird's sandpipers, Greater Yellowlegs, Ruddy Turnstones, Red Knots, and Sanderlings, surpass the duration of these periodic flights. Within this category, there are 19 species that reproduce in the northern regions of the Arctic Circle and spend the winter in South America. Out of these species, six migrate as far south as Patagonia, covering a distance of almost 8,000 miles (Wells and Blancher, 2011).

2.9 International Strategies for Migratory Bird Conservation

2.9.1 World migratory bird day

World Migratory Bird Day is a yearly campaign aimed at raising awareness about the essentiality of conserving migratory birds and their habitats.

The instrument serves as a worldwide tool to promote the preservation of migrating birds, mitigating the challenges they encounter, recognising their ecological significance, and advocating for international collaboration and partnership. Each year, individuals worldwide actively engage in and coordinate a range of outreach initiatives, including bird festivals, awareness events, exhibits, and bird-watching trips. In 2006, the Secretariat of the Agreement for the Conservation of African-Eurasian Migratory Waterbirds, in partnership with the Secretariat of the Convention on the Migratory Species, established World Migratory Bird Day. "International Migratory Bird Day" was established in 1993 in the United States by the US Fish and Wildlife Service, the Smithsonian Migratory Bird Centre, and the Cornell Laboratory of Ornithology to commemorate migrating birds (Conservation, 1996-2000). Subsequently, this occasion was embraced throughout the African-Eurasian area, and it was determined to broaden its parameters to become a commemorative day that acknowledges all migratory birds on a global scale. The collaborative effort in 2018 officially establishes the single name 'World Migratory Bird Day' and will host significant activities to commemorate the day twice a year, namely on the second Saturday in May and in October.

2.9.2 Convention on wetlands

The International Convention on Wetlands emphasises that the management and maintenance of wetland ecosystems are essential for the conservation of migratory birds. Wetlands are highly varied and productive ecosystems, renowned for their provision of a broad spectrum of ecological services.

Nevertheless, they persist in receiving degradation and undergoing substantial conversion for other use. The Convention on Wetlands is a longstanding global environmental accord. Through the 1960s, nations and non-governmental organisations negotiated the treaty, which was approved in the Iranian city of Ramsar in 1971 and became effective in 1975 (Halls, 1997). The primary objective of the treaty is to promote rational and prudent use of wetlands. The sensible use of wetlands is defined as the preservation of their natural nature, accomplished by using ecosystem management strategies, within the framework of sustainable development. Wetlands are essential for their significant contributions in many areas, including freshwater provision, food and construction resources, biodiversity, flood management, groundwater replenishment, and climate change resiliency.

2.9.3 Government of India initiatives

In the realm of environmental and biodiversity protection, India assumes a significant role as a signatory to the treaties of the International Union for Protection of Nature (IUCN). The efforts and strategies implemented by the Government of India (MoEFCC, 2020) to protect migrating birds and their wetland habitats are very commendable (Bhat, 2024). The Ministry of Environment, Forest and Climate Change (MoEFCC) has fully embraced a comprehensive framework and successfully executed a multitude of initiatives. Biological Diversity Convention (CBD) is a Convention to which India is a Party. In India, the MoEFCC serves as the central ministry responsible for implementing the CBD. The development and implementation of relevant legal and policy frameworks have positioned India as a prominent leader in the field of biodiversity protection. Two protocols have been implemented so far within the framework of the Convention on Biosafety (CBD), namely the Cartagena Protocol on Biosafety in 2000 and the Nagoya Protocol on Access and Benefit Sharing in 2010. India ratified the 'Convention on Wetlands', also referred to as the Ramsar Convention, on February 1, 1982 (Lakshmanan, 2018).

2.9.4 Bonn convention on the conservation of migratory species

The CMS (Conservation of Migratory Species) is often referred to as the Bonn Convention. It is the only convention that addresses the extraction or harvesting of species from their natural habitats. It now safeguards 173 migratory species worldwide (Caddell, 2005).

Enforcement Year: The Convention became effective on November 1, 1983. The Secretariat responsible for administering the Convention was formed in 1984.

As of November 1, 2019, there were 130 Parties to the Convention, including 129 nations and the European Union. The Maldives is the most recent nation to join it (November 2019).

Species Addressed: The Convention has two Appendices.

Appendix I enumerates migratory species that are endangered or at risk of extinction.

Appendix II enumerates migratory species that possess an unfavourable conservation status and need international agreements for their protection and management.

2.9.5 The Wildlife Protection Act, 1972

Rare and endangered species of birds, including migratory birds, are included in Schedule-I of the Wild Life (Protection) Act, 1972 thereby according to them highest degree of protection.

Stringent punishments have been provided for in the Wild Life (Protection) Act, 1972 for violation of the provisions of the Act.

Important habitats of birds, including migratory birds, have been notified as Protected Areas under the Wild Life (Protection) Act, 1972 for better conservation and protection of birds and their habitats (Thakur and Kumar, 2023).

Financial and technical assistance is provided to the State/UT Governments for the protection and management of Protected Areas (Mohan et al., 2018).

Wildlife Crime Control Bureau has been established for the control of illegal trade in wildlife and its parts and products.

3. CONCLUSION AND SUGGESTIONS

Global bird migration is a multifaceted and dynamic occurrence that entails the annual movement of billions of birds across continents and oceans. These movements are influenced by various reasons. A comprehensive understanding of the patterns and intensities of migratory migrations is crucial for effectively regulating hunting pressure on many species. Effective conservation of migratory bird populations, for which our society has acknowledged its obligation, must also depend on comprehending migratory patterns. Furthermore, there are explicit economic considerations. Research has shown that the rice damage in southern States is mostly caused by local, nonmigratory populations of different blackbirds, while the influx of blackbirds from the North has no impact on the losses (Orians et al., 1961). Furthermore, the transmission of arbor viruses by long-distance migrants has severe consequences for human health (Matteson, 2023).

Although extensive study has been conducted on the habitat preferences of migratory species in their breeding areas, as well as some attention given to the habitat selection of these species on their winter ranges, our understanding of the habitat requirements of these species during their migratory cycles remains limited (Alerstam and Högstedt, 1982). How well do the migratory routes outlined in this paper, represent continental habitat patterns that are responsible for providing the required resources at the stop-over locations needed during migration. Is the selection of habitat during migration determined by the same factors that the species utilises in its wintering range or breeding grounds? To what extent do wooded corridors along major river systems contribute to the reproductive success of migratory passerines? To what extent do the quantity and geographical distribution of wetlands directly influence the migratory patterns of waders and waterfowl? If significant, what is the necessary area size to support these species throughout the seasons of migration? While the magnitude and scope of environmental changes caused by human activities worldwide are well evident, our knowledge of how migrants are impacted by shifts in land use or degradation of habitats remains limited. Significant areas of woodlands have been incinerated or deforested. Rolling plains have been ploughed and then cultivated with monocultures of domesticated grasses and row crops. Urban expansion

persistently destroys natural environments. Air contaminants transported by high-altitude winds deposit acid rain on agricultural fields, mountains, lakes, and forests (Wei et al., 2022). Wetlands undergo drainage or filling. The degradation of riparian vegetation occurs when rivers are depleted due to the extensive extraction of groundwater by irrigators in the dry Western regions. The once gradual but now swiftly escalating levels of carbon dioxide, methane, and other greenhouse gases produced by human activities will modify world climates, but the specific paths these changes will follow cannot be reliably predicted. Over thousands of years, migratory routes developed in anticipation of a sufficiently stable environment with enough food and shelter along ideal corridors that linked winter ranges with acceptable breeding sites (Hilty et al., 2019).

Nevertheless, the environment has consistently undergone changes. With the exception of some catastrophic events that marked the course of recorded history, change took place at steady and progressive rates. This pace of change was sufficiently sluggish that the mechanisms of evolution enabled bird populations to establish compensating adaptations that guaranteed their ongoing survival. However, the effects of human activities on the ecosystem result in rates of change that surpass the capacity of many species to adjust. During the brief period between spring and autumn passages, a wetland that has been consistently used by shorebirds as a crucial feeding location on their extensive migration from South America to the northern tundra is drained and planted.

Warblers migrate from tropical regions to locate open-air mountain slopes devoid of any other viable environment for their nesting. The weedy fields that extended along the floodplains of major rivers and provided shelter and sustenance for populations of wintering sparrows migrating from the north now welcome their autumn arrival with well-organised rows of stubble or the tarmac and lawns seen in industrial parks. The inability of birds to use these modified habitats is well-documented, yet, the impact of these occurrences on migratory populations remains uncertain. To effectively mitigate the effects of these changes, it is important to first understand the repercussions of these changes.

Our environmental influence does not universally have a detrimental effect on all animals. Although the number of warblers and thrushes nesting in forest interiors may decline as forest fragmentation increases, species inhabiting the outlying areas may benefit from the more exposed environment and proliferate. With the formation of tree-dominated islands in the Great Plains, some eastern species like as the Baltimore Oriole extended their distribution towards the west. Before the establishment of a substantial cattle feedlot sector, feed-grains provided sustenance for a greater number of blackbirds than would have been possible without their inherent ability to withstand the winter stress.

Airports in the north-eastern region provide continuous grasslands for Upland Sandpipers, which formerly depended on small areas of land on the coastal plain or the temporary meadows of forest succession (DeGraaf and Rappole, 1995). Nevertheless, the overall pattern of human impact on the environment is towards homogeneity; we have diminished the diversity of the terrain. Consequently, this degradation diminishes the diversity of avian species that we encounter in our everyday existence. Given that our species has flourished upon the variety in our surroundings, our standard of living is adversely affected.

In light of these evolving circumstances, the Federal Government of the United States has acknowledged its obligation towards migratory birds. Enabling legislation facilitate the implementation of migratory bird treaty commitments in collaboration with other nations, and now the majority of species are legally safeguarded by laws overseen by the U.S. Fish and Wildlife Service (Cioc, 2009).

A major international accord, the Migratory Bird Treaty focusses on safeguarding and conserving migratory birds. The agreement was first negotiated between the United States and Canada in 1916 with the main objective of protecting migratory bird species that regularly migrate between the two nations. Later, the treaty was extended to include more agreements with Mexico (1936), Japan (1972), and Russia (1976), thereby establishing it as a fundamental structure for global collaboration in the field of bird conservation.

The pact encourages scientific study and monitoring to achieve a deeper understanding of migratory patterns, risks, and conservation requirements for migratory birds.

APPENDICES

Appendices I and II available in this ilnk:
https://mbimph.com/index.php/UPJOZ/libraryFiles/downloadPublic/26

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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