Bioscene

Bioscene
Volume- 21 Number- 03
ISSN: 1539-2422 (P) 2055-1583 (O)
www.explorebioscene.com

Risk of Migration: Limb Deformities in Avian Migrants at Kaipad Rice Fields Ezhome, Kerala

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Abstract: Migration is an innate adaptive behavior in birds, allowing them to cope with environmental scarcity. During migration, birds follow specific flyways supported by various stopover sites, though they often face injuries and mortality. Many wetland migratory birds use rice fields as foraging sites. Kaipad, an indigenous saline-prone organic rice field associated with mangroves along the riverbanks of North Kerala, serves as a refueling center for these migrants. Over five years, eight species of wetland migratory birds with amputated legs were observed in the Ezhome Kaipad using direct observation methods with binoculars and cameras. Contributing factors to these injuries include natural predators such as birds of prey, mammals, and crustaceans, as well as anthropogenic factors like fishing gear and electric power lines.

Key words: Bird Migration, flyway, stopover site, Kaipad, amputated legs

Introduction

Migration is an innate adaptive behavior in birds that enables them to cope with food scarcity and adverse climatic conditions (Beauchamp, 2011; Watts et al., 2018). Migratory birds follow specific flyways, utilizing stopover sites along their routes (Boere & Stroud, 2006; Choi et al., 2009; Warnock, 2010; Battley et al., 2012; Hua et al., 2013). The Central Asian Flyway, a major migratory route, crosses the Indian subcontinent (Balachandran, 2006; Aarif & Prasadan, 2014; Anilkumar & Imran Alam, 2023). Wetlands are crucial as breeding, staging, and wintering grounds for migratory waterbirds (Amezaga et al., 2002; Fernandez & Lank, 2008), with many species depends on rice fields for foraging (Elphick et al., 2010; Sicemore & Maine, 2012; Nam et al., 2015; Marco-Mendez et al., 2015).

India, the world's second-largest rice producer, cultivates rice across 3.85 million hectares (Agristat, 2016). Rice fields, dynamic ecosystems influenced by crop cycles, significantly impact bird communities (Bambaradeniya et al., 2004; Jayasimhan & Pramod, 2019). Over 351 bird species in India forage in these fields, some even using them for breeding (Sundar & Subramanya, 2010). The paddy fields not only provide habitat services but also as greeninfrastructure (Osawa et al., 2022;

Takeshi Osawa, 2023). In particular, Kaipad, an indigenous organic rice field system associated with mangroves in North Kerala, is a crucial foraging site for waterbirds (Cheruvat, 2004; Vanaja, 2013).

Migration is costly and risky for birds, as they encounter unfamiliar and unpredictable conditions that lead to energy loss, physical trauma, and mortality (Newton, 2006; Klaassen et al., 2013; Loss et al., 2015; Conklin et al., 2017). The longer the distance traveled, the higher the risks and costs (Reneerkens et al., 2019). Anthropogenic threats, such as power lines, wind turbines, oil spills, and chemicalsexacerbate injury and mortality risks during migration (Newton, 2007; Camphuysen, 2010; Leighton, 2011; Jessica et al., 2012; Loss et al., 2015). Pesticides, for instance, have far-reaching effects on reproductive health, behavior, and physiology, including organ deformities in wetland bird migrants (Hampton et al., 2003; Varagiya et al., 2016; Moreau et al., 2022). Additionally, fishing net entanglement is a significant cause of mortality for migratory shorebirds along the Indian coasts (Kannan & Pandiyan, 2012; Aarif & Prasadan, 2014; Aarif et al., 2021), leading to reduced foraging efficiency and reproductive success (McNeil et al., 1994; Vieira, 2016; Wang et al., 2018).
The conservation of man-managed ecosystems, like rice fields, is critical to maintaining the biodiversity. Rice fields should be viewed through a conservation lens, as they serve as vital refueling and foraging grounds for migratory birds (Bambaradeniya et al., 2004; Edirisinghe & Bambaradeniya, 2008; Elphick et al., 2010; Huang et al., 2022). This study focuses on the occurrence of limb deformities in waterbird migrants in the Kaipad rice fields of Ezhome, investigating their causative factors.

Materials and Methods

Study Area:

The Ezhome Kaipad rice fields (12°13' N – 12°31' N, 75°14' E – 75°16' E) are located in Ezhome Village, Kannur District, Kerala, India (Figure 1a and 1 b). This 9 km^2 area extends from Ezhome to Payangadi along the southwest border and from Ezhome to Narikot in the northeast. The wetland is a low-lying area, with an average mean sea level (AMSL) of 3.5 meters. The Pattuvam River and its tributaries, which flow from the base of Madayipara, provide ample water to the region. The Kaipad is subject to tidal variations, and the exposed mudflats during low tide serve as key foraging sites for birds.

Methodology:

The study was conducted from 2020 to 2024 using the direct observation method (Hoves and Bakewell, 1989). with the aid of binoculars (Olympus 10x50 DPS) and camera (Canon EFS 55-250mm). Bird identification and systematic classification were carried out with the help of reference guides (Grimmet et al., 1999; Ali, 2002; Kumar et al., 2005; Sasikumar et al., 2011; Praveen et al., 2016). Observations were conducted intermittently during early morning (7:00 AM to 9:00 AM) and late evening (5:00 PM to 6:30 PM), preferably during low tide periods.

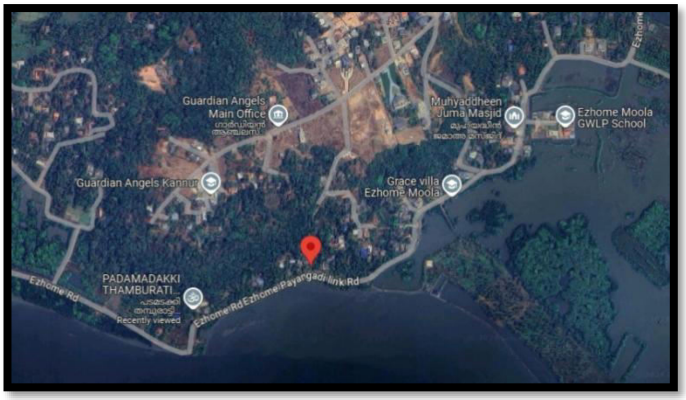

Fig 1 a. Study area **Fig. 1 b.Ezhome Kaipad rice fields**

Result

The Kaipad is an excellent wintering area for migratory water birds. Migrants use the intertidal mudflat for foraging, and many species utilize this area as a stopover site for short periods or as a staging site for months. Observations in the Ezhome Kaipad rice fields reveal that the area is rich in water bird diversity, comprising 30 transcontinental migrants, 10 local migrants, and 19 resident species.

The transcontinental migrants sighted include eight species of Plovers, seven species of Sandpipers, three species of Stints and Shanks, two species of Snipes, and one representative each of the Garganey Teal, Northern Shoveller, Woolly-necked Stork, Black-tailed Godwit, Ruff, Glossy Ibis, and Whimbrel. Local migrants observed are the Ruddy-breasted Crake, Slaty-breasted Rail, Watercock, Blackwinged Stilt, Common Coot, Baillon's Crake, Yellow Bittern, Chestnut Bittern, Indian Spot-billed Duck, and Painted Snipe. Resident birds comprise three species of Egrets and Herons, and one species each of the Openbill Stork, Purple Swamphen, White-breasted Waterhen, and White Ibis.

The migrants typically arrive in July and return by the end of May. Some bird species, such as the Lesser Sand Plover, Pacific Golden Plover, Black-tailed Godwit, and Glossy Ibis, are found to oversummer in this habitat.

Over five years, eight species of migrants were found injured, with amputated legs. This includes seven species of transcontinental migrants and one local migrant. The injured migrants sighted are the Common Greenshank, Wood Sandpiper, Terek Sandpiper, Lesser Sand Plover, Pacific Golden Plover, Black-tailed Godwit, and Glossy Ibis (Figure 3 a,b,c &d). Among the injured, the Black-tailed Godwit is listed as Near Threatened by the IUCN. The Ruddy-breasted Crake is the only local migrant found injured.

In terms of species abundance, the Lesser Sand Plover (*Charadrius mongolus*) was the most frequently sighted, with 6,077 sightings, while the Terek Sandpiper (*Xenus cinereus*) had the fewest, with 34 sightings (Table 1). Systematic analysis shows that the family Scolopacidae was most affected, with four species, followed by Charadriidae with two species, and Threskiornithidae with one species. The order Charadriiformes had the highest number of species with deformities (six species), while Pelecaniformes and Gruiformes represent one species each (Table 1, Figure 2).

Regarding the abundance of injured individuals, the Pacific Golden Plover and Black-tailed Godwit were most affected, with three sightings each, followed by the Lesser Sand Plover and Terek Sandpiper, with two sightings while other species had one injured sighting. The leg-injured Lesser Sand Plover, Pacific Golden Plover, Black-tailed Godwit, and Terek Sandpiper were sighted twice in a year. Furthermore, the injured Black-tailed Godwit and Pacific Golden Plover were observed in two consecutive years. Injured birds were often isolated from their flocks and showed the signs of feeding deficiency.

The major threats to the avian fauna of Kaipad are natural enemies and anthropogenic factors. The natural enemies observed include birds of prey ;the Black Kite, Brahminy Kite, Besra Sparrowhawk, Shikra, Osprey, Western Marsh Harrier, White-bellied Sea Eagle, and Crested Serpent Eagle and the predatory mammals; stray dogs, jackals, jungle cats, and mongooses, as well as the crustacean

Giant Mud Crab (*Scylla serrata*) (Figure 4). Anthropogenic threat factors include fishing gears; gill nets, cast nets, hook lines, box traps and also electric power lines.

Discussion

Rice fields serve as essential foraging and stopover sites for many wetland bird migrants (Elphick et al., 2010; Sicemore & Maine, 2012; Nam et al., 2015; Marco-Mendez et al., 2015). The diversity and abundance of migratory water birds in Kaipad indicate that this habitat serves as an attractive foraging site. However, the occurrence of injured migrants in Kaipad shows that the birds are under severe threat in this habitat, supporting the notion that migration is expensive and risky, often leading to physical injuries and mortality (Klaassen et al., 2013; Loss et al., 2015; Conklin et al., 2017; Reneerkens et al., 2019).

The presence of both predators and anthropogenic factors in Kaipad indicates that this habitat contributes to trauma in migrants. This aligns with the view that natural enemies and human-related factors such as power lines, wind turbines, oil spills, discarded fishing nets, and agrochemicals are major causes of injuries and mortality in migratory shorebirds (West et al., 2002; Hampton et al., 2003; Newton, 2007; Camphuysen, 2010; Leighton, 2011; Kannan & Pandiyan, 2012; Jessica et al., 2012; Loss et al., 2015; Varagiya et al., 2016; Aarif & Prasadan, 2014; Aarif et al., 2021).

According to present observations, the injured birds are often isolated from their flocks and exhibit reduced feeding behavior. This supports the view that physical injuries diminish the foraging ability and reproductive success of avian migrants (McNeil et al., 1994; Vieira, 2016; Wang et al., 2018). The repeated appearance of injured Black-tailed Godwits and Pacific Golden Plovers in consecutive years suggests that these migrants may fail to complete their course of migration.Resident birds in Kaipad appear to be free from trauma, likely due to their familiarity with local risk factors. This reinforces the view that exposure to unfamiliar and unpredictable conditions at various stopover sites during migration increases the risk of injuries and mortality (Newton, 2006; Klaassen et al., 2013; Loss et al., 2015; Conklin et al., 2017). The fitness of resident birds to avoid injury may also be attributed to their physical characteristics, such as longer legs and larger body size.

The man-managed ecosystem is an integral component of wildlife, making the protection of biodiversity in rice fields imperative (Bambaradeniya et al., 2004; Edirisinghe & Bambaradeniya, 2008; Elphick et al., 2010). It is crucial to protect and regularly monitor the foraging grounds that serve as refueling centers for birds during migration (Huang et al., 2022). Special attention must be given to preserving the biodiversity of the Kaipad wetland, and public awareness should be raised regarding the significance of this habitat and the ecosystem services it provides.

Table 1: Checklist showing the migratory, conservation and population status of Injured birds

SL.No	Common name	Scientific name	Migratory status	Conservation status	Population Status	
					Total sightings	No. of Injured
	1.Order:Gruiformes					
	(i) Family:Rallidae					
1	Ruddy-breasted Crake	*Zapornia fusca* (Linnaeus, 1766)	LM	LC	81	1
	II.Order:Pelecaniformes			LC		
	(i)Family:Threskiornithidae					
2	Glossy Ibis	*Plegadis falcinellus* (Linnaeus, 1766)	M	LC	5082	1
	I. Order:Charadriformes					
	(i) Family:Charadridae					
3	Pacific Golden Plover	*Pluvialis fulva* (J.F.Gmelin, 1789)	M	LC	1528	3
4	Lesser Sand Plover	*Charadriusmongolus* (Pallas, 1776)	M	LC	6077	2
	(ii) Family:Scolopacidae					
5	Black-tailed Godwit	*Limosa limosa* (Linnaeus, 1758)	M	NT	1819	3
6	Terek Sandpiper	*Xenus cinereus* (Guldenstadt, 1775)	M	LC	34	2
7	Common Green Shank	*Tringa nebularia* (Gunnerus, 1767)	M	LC	1315	1
8	Wood Sandpiper	*Tringa glareola* (Linnaeus, 1758)	M	LC	2991	1

(M-Migrant, LM-Local Migrant, LC-Least Concern, NT-Nearly Threatened)

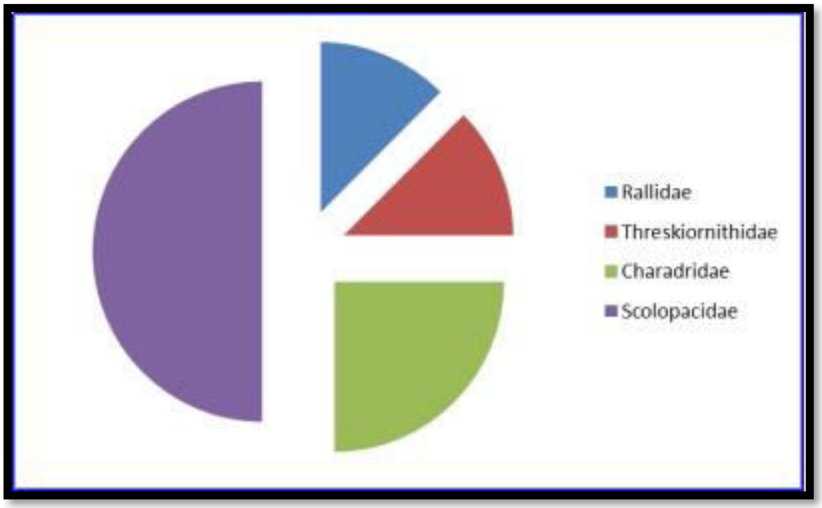

Fig.2. Family wise diversity of injured birds

a.

b.

c.

d.

Fig.3 Image showing injured birds with amputated legs a.Pacific Golden Plover b.Black-tailed Godwit c.Terek Sandpiper d.Lesser Sand Plover

Fig. 4 Giant mud crab, *Scylla serrata.*

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