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Analysis on Urban Impacts on Ranganathittu Bird Sanctuary: Biodiversity, Conservation, and Eco-Tourism

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Abstract:

Bird sanctuaries serve as critical habitats for avian biodiversity, facilitating both resident and migratory species and maintaining the ecological balance of wetland ecosystems. In India, many such sanctuaries are increasingly threatened by urban expansion. Ranganathittu Bird Sanctuary, also known as the Pakshi Kashi of Karnataka, is situated along the Cauvery River and is one of the most significant wetlands in southern India, recognised as a Ramsar Site. This study examines the urban-induced impacts on the sanctuary's biodiversity, habitat structure, and water systems. Recent urban development, particularly from the Mysuru region, combined with rising tourism pressures, led to increased habitat disturbance, pollution, and noise impacts. Water level fluctuations resulting from KRS Dam operations further impact breeding and foraging grounds. Field surveys, photographic documentation, and interviews with forest staff reveal a gradual decline in bird populations, fragmentation of habitat zones, and shifts in migratory behaviours. The findings underscore the urgent need for sustainable tourism management, integrated urban planning, and enhanced conservation measures to preserve Ranganathittu's ecological integrity. The study helps identify immediate actions to balance human use with habitat protection, ensuring the sanctuary's survival for future generations.

Keywords – Urban Impact, Bird Sanctuary, Ranganathitthu Bird Sanctuary, Riverine ecosystem

1. Introduction

Among India's notable bird sanctuaries, Ranganathittu Bird Sanctuary in Karnataka holds significant importance. Established in 1940 at the behest of renowned ornithologist Dr. Salim Ali, the sanctuary encompasses a cluster of six islets on the Cauvery River, near Srirangapatna. Despite its modest area of approximately 0.67 square kilometres, Ranganathittu is recognized as the largest bird sanctuary in Karnataka and has been designated as a Ramsar site, highlighting its international importance as a wetland habitat. (Hindu, 2022). The sanctuary supports a rich diversity of avian fauna, with over 225 bird species recorded, including the painted stork (*Mycteria leucocephala*), Asian openbill stork (*Anastomus oscitans*), and spot-billed pelican (*Pelecanus philippensis*), among others. Additionally, it provides habitat for various mammals and reptiles, such as the marsh crocodile (*Crocodylus palustris*) and smooth-coated otter (*Lutrogale perspicillata*).

The sanctuary's proximity to urban centres, particularly the city of Mysuru, has made it a popular ecotourism destination, attracting numerous visitors annually. While tourism contributes to local economies and raises awareness about conservation, it also introduces challenges, including habitat disturbance and increased pollution. Furthermore, the expanding urban footprint poses threats such as habitat fragmentation and environmental degradation. Recognising these pressures, the Indian government has declared an Eco-Sensitive Zone (ESZ) around Ranganathittu, imposing regulations to mitigate adverse impacts from developmental activities.

2. Aim and Objective:

This research aims to investigate the multifaceted impacts of urbanisation and tourism on Ranganathittu Bird Sanctuary. The study's objectives are to:

2.1. *Assess Biodiversity Trends:* Evaluate changes in bird populations and diversity over recent years, identifying patterns and potential declines.
2.2. *Analyse Ecological Significance:* Examine the sanctuary's role in regional and global biodiversity conservation, considering its status as a Ramsar site and its support for significant populations of various species.
2.3. *Evaluate Tourism Impacts*: Investigate how tourism activities affect the sanctuary's ecological health, with a focus on habitat disturbance and pollution levels.
2.4. *Review Conservation Efforts*: Analyse the effectiveness of existing conservation measures, including the establishment of the ESZ and Ramsar designation, in preserving the sanctuary's ecological integrity. (Express, 2022)

By integrating ecological data, spatial analysis, and policy evaluation, this study seeks to provide comprehensive insights into the challenges facing Ranganathittu Bird Sanctuary. The findings aim to inform sustainable management strategies that balance conservation objectives with the pressures of urban development and tourism, ensuring the long-term preservation of this vital avian habitat. (Gopi, 2022)

Image 1: Pelican bird nesting colonies. Source: Author

3. Location and Geography:

Ranganathittu Bird Sanctuary, often referred to as the "Pakshi Kashi of Karnataka," is situated in the Mandya district of Karnataka, India. It lies approximately 4.5 kilometres from the historic town of Srirangapatna and about 19 kilometres north of Mysuru. The sanctuary spans around 40 acres (0.67 square kilometres) and comprises six islets along the banks of the Cauvery River.

Figure 2: Location of Ranganathittu Bird Sanctuary w.r.t cities in proximity. Source: Author

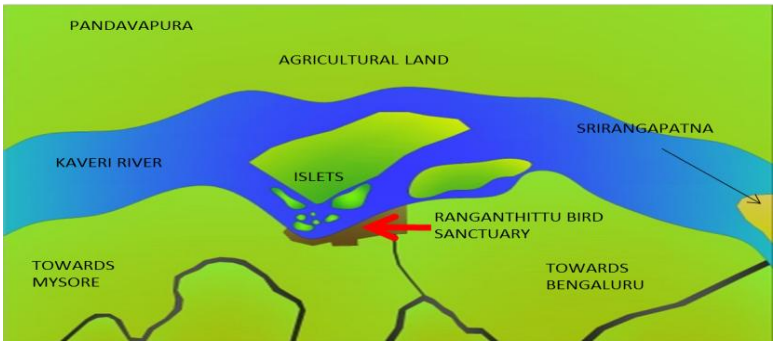

Figure 3: Location of Ranganathittu Bird Sanctuary and its context. Image Source: Author

These islets were formed in the 17th century when an embankment was constructed across the Cauvery River by the then king of Mysore, Kanteerava Narasimharaja Wadiyar. The islands are primarily covered with broadleaf forests, featuring dominant species such as Terminalia arjuna (Arjun tree), bamboo groves, and Pandanus trees. Riverine reed beds line the banks, providing essential nesting sites for various bird species. The sanctuary experiences a tropical climate with distinct wet and dry seasons. The monsoon season, typically from June to September, brings heavy rainfall, resulting in increased water levels in the Cauvery River and occasional flooding of the islands. These climatic conditions, combined with the diverse vegetation and the presence of the river, create an ideal habitat for a wide variety of bird species. The islands offer secluded nesting grounds, while the surrounding waters provide abundant food resources, making Ranganathittu a critical breeding and roosting site for both resident and migratory birds.

The unique geographical features of Ranganathittu Bird Sanctuary, characterized by its riverine islands, diverse vegetation, and favourable climate, collectively contribute to its status as a haven for numerous bird species, underscoring its importance in avian conservation efforts. There are 6 small islets which act as the habitat for the birds, and they are:

- Neeranji Island
- Rain Tree Island
- Mathi Tree Islan
- Whistling Teel Island
- Stone Plover Island
- River Tern Island

The placement of the islets and the boating route around the bird sanctuary which is around the Neeranji islet are shown in Figure 4.

Figure 4: Plan of Ranganathittu Bird Sanctuary with the Islands and river edge activities. Source: Author

4. Avian Biodiversity:

Ranganathittu Bird Sanctuary supports a rich diversity of bird species, making it one of the most important avian habitats in southern India. The sanctuary offers ideal conditions for both resident and migratory birds, thanks to its riverine islands, dense vegetation, and abundant aquatic life.

Table 1 -Prominent Birds at Ranganathittu Bird Sanctuary.

Sl No	Common Name	Scientific Name	Status	IUCN Red List	Image of Birds
1	Painted Stork	Mycteria leucocephala	Resident Breeder	Near Threatened	
2	Asian Openbill Stork	Anastomus oscitans	Resident	Least Concern	
3	Spot-billed Pelican	Pelecanus philippensis	Resident Breeder	Near Threatened	
4	Black-headed Ibis	Threskiornis melanocephalus	Resident	Near Threatened	
5	Little Egret	Egretta garzetta	Resident	Least Concern	
6	Woolly-necked Stork	Ciconia episcopus	Resident	Vulnerable	

7	River Tern	Sterna aurantia	Resident	Near Threatened	
8	Bar-headed Goose	Anser indicus	Migratory	Least Concern	
9	Common Teal	Anas crecca	Migratory	Least Concern	
10	Great Stone-curlew	Esacus recurvirostris	Resident	Least Concern	

Image Source: e-Bird (University, 2025)

4.1. Migratory and Resident Birds: Resident birds such as the painted stork, Asian openbill, and black-headed ibis nest and breed within the sanctuary throughout the year.Migratory birds visit primarily between November and March, coinciding with winter in Central Asia and Siberia. These include the bar-headed goose, common teal, and various species of ducks and waders.

Table 2 - Resident Birds at Ranganathittu Bird Sanctuary.

Common Name	Scientific Name	IUCN Status	Bird Images
Indian Cormorant	*Phalacrocorax fuscicollis*	Least Concern	

Little Cormorant	*Microcarbo niger*	Least Concern	
Darter (Snakebird)	*Anhinga melanogaster*	Near Threatened	
Black-crowned Night Heron	*Nycticorax nycticorax*	Least Concern	
Intermediate Egret	*Ardea intermedia*	Least Concern	
Great Egret	*Ardea alba*	Least Concern	
Indian Pond Heron	*Ardeola grayii*	Least Concern	

Brahminy Kite	*Haliastur indus*	Least Concern	
Common Kingfisher	*Alcedo atthis*	Least Concern	
White-throated Kingfisher	*Halcyon smyrnensis*	Least Concern	
Pied Kingfisher	*Ceryle rudis*	Least Concern	
Red-wattled Lapwing	*Vanellus indicus*	Least Concern	
Purple Heron	*Ardea purpurea*	Least Concern	

Image Source: e-Bird (University)

Table 3 - Migratory Birds found majorly at Ranganathittu Bird Sanctuary

Common Name	Scientific Name	IUCN Status	
Northern Pintail	*Anas acuta*	Least Concern	
Garganey	*Spatula querquedula*	Least Concern	
Eurasian Wigeon	*Mareca penelope*	Least Concern	
Northern Shoveler	*Spatula clypeata*	Least Concern	
Rosy Starling	*Pastor roseus*	Least Concern	
Marsh Sandpiper	*Tringa stagnatilis*	Least Concern	

Wood Sandpiper	*Tringa glareola*	Least Concern	
Common Greenshank	*Tringa nebularia*	Least Concern	
Black-tailed Godwit	*Limosa limosa*	Near Threatened	
Common Redshank	*Tringa totanus*	Least Concern	

Image Source: e-Bird (University)

4.2. Breeding Patterns: Breeding season for many resident species typically begins with the onset of the monsoon (June to September), when water levels rise and vegetation flourishes. Birds build nests in the trees overhanging the river islets or among the reeds and bamboo groves. Species such as painted storks and pelicans breed colonially, forming large, noisy nesting colonies, which are a major attraction for tourists and bird watchers.

4.3. Importance as a Nesting Ground: Ranganathittu is considered one of the most important nesting grounds in southern India due to its isolated river islands, which provide predator-free, undisturbed sites for breeding. The combination of aquatic and terrestrial resources, along with minimal human interference (especially on certain protected islets), creates ideal conditions for successful nesting and chick rearing.

Figure 5: Nests are found at various heights on Neeranji Island. Image Source: Author

5. **Ecosystem and Flora:** Ranganathittu Bird Sanctuary, located along the Cauvery River, is dominated by a lush riverine and wetland ecosystem. The sanctuary's vegetation plays a crucial role in maintaining ecological balance and supporting a diverse array of fauna, particularly birds.

5.1. Major flora along the Cauvery River belt include Riparian and Riverine Vegetation: Terminalia arjuna (Arjun tree) – Common along the banks; supports nesting birds like painted storks and pelicans. Bamboo species – Provide dense thickets ideal for perching and roosting. Ficus spp. – Large-canopied trees offering shaded, stable nesting platforms. (Venkatesh, 2021).

Aquatic and Semi-aquatic Plants: Water hyacinth (*Eichhornia crassipes*) – Though invasive, often found floating in calm stretches of the river. Water lilies (*Nymphaea spp.*) and Lotus (*Nelumbo nucifera*) – Offer habitat for insects, frogs, and aquatic birds. Reed beds and grasses – Provide cover for waders and ground-nesting birds.

5.2. Interaction Between Flora and Fauna: The sanctuary's flora forms the structural foundation of its food web and nesting network. Canopy and mid-layer trees support arboreal nesting for species like pelicans, storks, and cormorants, which nest colonially on tall riverbank trees. Aquatic vegetation supports populations of invertebrates, frogs, and small fish, which in turn feed herons, egrets, kingfishers, and darters. Dense underbrush and reeds near the water's edge serve as cover and breeding zones for smaller birds like warblers and bitterns, and mammals like smooth-coated otters. Fallen leaves, branches, and decaying plant matter also support detritivores, enriching soil and water nutrients—fuelling plant and animal growth.

Figure 6: Edge condition of the islands with Marsh Land Crocodile around. Image Source: Author

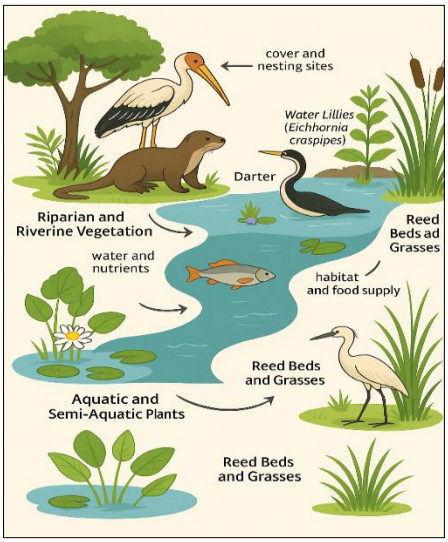

Figure 7: The interdependency of Flora and Fauna in the riverine ecosystem. Source – Created by ChatGPT as per the information by Author on Ecosystem data.

6. **Role of the Local Ecosystem in Supporting Birdlife:** The unique wetland-riverine mosaic of Ranganathittu makes it a biodiversity hotspot. The Cauvery River maintains water levels year-round, ensuring consistent food supply of fish, insects, amphibians and birds. Seasonal flooding during the monsoon regenerates aquatic plant life and opens up new breeding niches for colonial nesters. Vegetation diversity provides vertical habitat zoning, enabling co-existence of multiple bird species with varying nesting and feeding preferences. The sanctuary acts as a safe breeding haven, especially for threatened and near threatened species like spot-billed pelicans, black-headed ibis, and darters, because of the isolation of river islands and minimal human intrusion.

Figure 8: Smaller rocky patches around the islands enable sunbasking for birds and crocodiles. Image Source: Author

7. **Tourism Activities:** Visitors to Ranganathittu can engage in various activities designed to enhance their understanding and appreciation of the area's rich biodiversity, which include – Boat Tours, Nature Interpretation Centre, Bird Watch Tower, and Kids Play Area.

7.1. *Guided Boat Tours:* These tours provide close-up views of the sanctuary's avian inhabitants and other wildlife, including marsh crocodiles. Trained guides offer insights into the ecology and behaviour of the species encountered. Nests of birds can be viewed at close proximity, and their behavioural pattern can be observed.

7.2. *Nature Interpretation Centre*: An educational facility is provided at the entrance where visitors can learn about the sanctuary's ecosystem, conservation initiatives, and the importance of preserving such habitats.

7.3. *Bird Watching*: With around 170 bird species recorded, the sanctuary is a haven for bird watchers, especially during the nesting season from June to November. Watchtowers are provided for visitors at distant locations for a wider view of the islands.

Figure 9: Guided Boating for visitors. Image Source: Author

Figure 10: Interpretation Centre the entrance of the Sanctuary

7.4. Pros and Cons of Eco-Tourism:

The advantages of tourism include –

- Conservation Funding: Revenue generated from tourism activities supports conservation projects and maintenance of the sanctuary.
- Environmental Awareness: Educational programs and guided tours raise awareness about wildlife conservation among visitors.
- Local Economy Boost: Tourism creates employment opportunities for local communities, including roles such as guides, boatmen, and staff at the sanctuary.

The disadvantages of visitors/ tourists around the sanctuary and during boating include –

- Disturbance to Wildlife: Increased human presence can disrupt natural behaviours of animals, especially during breeding seasons.
- Pollution: Littering and waste generated by tourists can degrade the habitat if not properly managed.
- Resource Strain: High visitor numbers may strain local resources and infrastructure, leading to potential environmental degradation.

Figure 11: Boating facility at the riverbed. Image Source: Author

7.5. Visitor Statistics: The sanctuary has witnessed fluctuating visitor numbers over the years:Pre-Pandemic: Over 340,000 visitors annually. During the Pandemic, there was a significant drop to approximately 45,000 visitors. *(Ranganathittu Bird Sanctuary adopts additional safety measures as tourists increase; Tuesday, April 12, 2022).* Post-Pandemic Recovery: Numbers have rebounded to over 170,000 visitors in the past year, indicating a resurgence in eco-tourism activities.

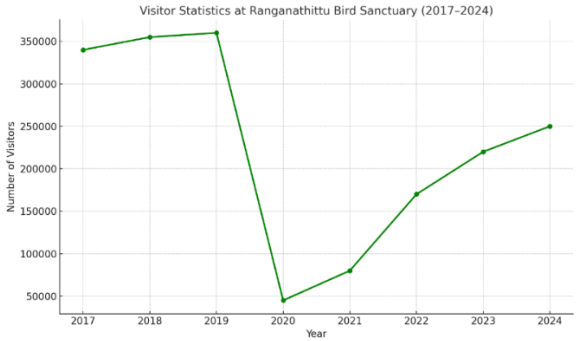

Figure 12: The graph showing the visitor statistics at Ranganathittu Bird Sanctuary from 2017 to 2024. It highlights the significant drop during the COVID-19 pandemic and the gradual recovery in recent years. Source – Created by ChatGPT as per the information by the Author

To accommodate and manage the influx of tourists, the sanctuary offers several facilities. Boating Facilities: Guided boat rides are available, allowing visitors to explore the river and its islets. Options include group tours and private boat hires. Amenities: The sanctuary is equipped with a nature interpretation centre, landscaped gardens, a food court, drinking water facilities, a souvenir shop, themed gardens, sanitation zones, watchtowers, and child care rooms.

Figure 13: Souvenir shop as viewed from the boating entrance. Image Source: Author

8. Threats due to Human interference:

The eco-tourism helps in understanding nature and its ecosystem and brings humans close to nature, but it also poses challenges such as:

8.1. *Pollution:* Improper waste disposal by visitors can lead to habitat degradation, affecting both flora and fauna. The shops and eating spots pave the way for more plastic and waste disposal. Any of this littered around would affect the terrestrial animals and birds. Air pollution in the immediate vicinity of the river edge is possible due to vehicular movement, which can impact the atmospheric conditions around the sanctuary.

8.2. *Disturbance to Wildlife:* Noise and close human interaction, especially during boat rides, can stress animals and disrupt their natural behaviours. Children's play areas without age restrictions can be challenging to manage in terms of noise levels.

8.3. *Infrastructure Impact:* The development of tourist facilities can lead to habitat fragmentation if not carefully planned and managed. Trees and plants are destroyed to make way for parking, and built structures such as canteens, interpretation centres and shops. Balancing eco-tourism with conservation requires continuous efforts to minimise human impact while promoting environmental education and sustainable practices. (India G. o., 2025)

Figure 14: Parking Facility at the sanctuary. Image Source: Author

9. **Conservation Efforts at Ranganathittu Bird Sanctuary:** The government and its departments play a major role in implementing the conservation policies and plans. The Karnataka Forest Department plays a central role in the management, protection, and development of Ranganathittu Bird Sanctuary. Established as a protected area in 1940, when it was identified by ornithologist Dr Salim Ali, the sanctuary is currently governed under the Wildlife Protection Act, 1972.

9.1. The main role of the Forest Department includes:

- Protection of flora and fauna
- Regulating visitor access and eco-tourism
- Infrastructure development (e.g., watchtowers, interpretation centre)
- Anti-poaching and anti-encroachment patrols
- Collaborating with NGOs and research bodies on conservation strategies

9.2. Measures Taken for Habitat Protection: Several steps have been implemented to preserve the sanctuary's delicate riverine ecosystem, including:

- Regulation of boating activities during breeding seasons to avoid disturbing nesting birds.
- Erosion control measures on the riverbanks to protect tree cover and aquatic habitat.
- Restriction of human access to key nesting islands via physical barriers and patrols.
- Maintenance of native vegetation and removal of invasive species like water hyacinth to maintain ecological balance.
- Monitoring of water quality in the Cauvery River, which directly affects bird and aquatic life.

10. **Bird Census and Monitoring Programs:** Regular avian census surveys are conducted by the Karnataka Forest Department in collaboration with Salim Ali Centre for Ornithology and Natural History (SACON), Indian Institute of Science (IISc), and Local birdwatcher groups. These surveys help track Population trends, Breeding success, Migratory patterns, Health of bird species, including threatened ones like the spot-billed pelican and darter. As per the interview with the boating guide, the bird count in the recent 2 years, with species such as painted storks, black-headed ibis, and openbill storks, has shown stable breeding populations, a positive indicator of ecosystem health. (Ministry of Environment, 2025)

10.1. Awareness Programs for Locals and Tourists: Recognizing the importance of public participation in conservation, several education and outreach initiatives have been introduced. These include:

- Nature interpretation centre: Educates tourists on bird species, wetland importance, and responsible tourism.
- Eco-guides: Trained local youth act as naturalists and educators during guided tours.
- School-based awareness campaigns: Promote conservation through competitions, birdwatching camps, and nature trails.
- Local community involvement: Involves residents in eco-tourism as guides, boatmen, and forest staff, giving them a stake in protecting the sanctuary. (Department, 2025)

11. Challenges and Threats to Ranganathittu Bird Sanctuary: The threats and challenges include Environmental Threats, Illegal Fishing and Encroachment, Over-Tourism, and an increase in invasive Species. (Sundar, 2013).

11.1. Environmental Threats - Ranganathittu lies along the Cauvery River, making it highly susceptible to seasonal monsoon floods. In recent years, increased rainfall and the release of excess water from upstream dams (like Krishnaraja Sagar) have led to the submergence of nesting islands, disrupting the breeding cycle of key

species like painted storks and pelicans. Flooding events in 2019 and 2021 caused significant damage to vegetation and bird colonies, forcing temporary closure of the sanctuary.

Pollution- Littering by tourists, especially plastics and food waste, contaminates both terrestrial and aquatic habitats. Agricultural runoff from surrounding fields carries pesticides and fertilisers into the river, degrading water quality and affecting aquatic food chains.
Climate Change- Rising temperatures, erratic rainfall patterns, and altered migration timelines are affecting bird nesting and breeding behaviours. Reduced fish populations, due to changing river dynamics, pose a threat to piscivorous birds (e.g., cormorants, darters).

11.2. *Illegal Fishing and Encroachment* - Despite protection laws, illegal fishing continues to be reported, especially during the early morning or late evening hours. Use of fine nylon nets and chemicals threatens both birdlife and aquatic species. Encroachment on buffer zones by nearby settlements or agricultural expansion leads to habitat fragmentation and edge effects detrimental to sensitive species.

11.3. Over-Tourism- With over 340,000 visitors annually pre-pandemic, and recovery numbers growing again, Ranganathittu is facing the stress of high footfall. Impacts include Noise pollution from boating and crowds, Physical disturbance during breeding season, Increased infrastructure development near the sanctuary. The carrying capacity of the sanctuary is often exceeded during peak seasons, especially in holidays and weekends.

11.4. Invasive Species - The aquatic weed Water Hyacinth (*Eichhornia crassipes*), although partially controlled, remains a threat with respect to clogging waterways, reducing oxygen levels in water, and harbouring mosquitoes and pests. Invasive terrestrial plants like Lantana camara can alter understorey vegetation, outcompeting native flora essential for some ground-nesting birds and small mammals.

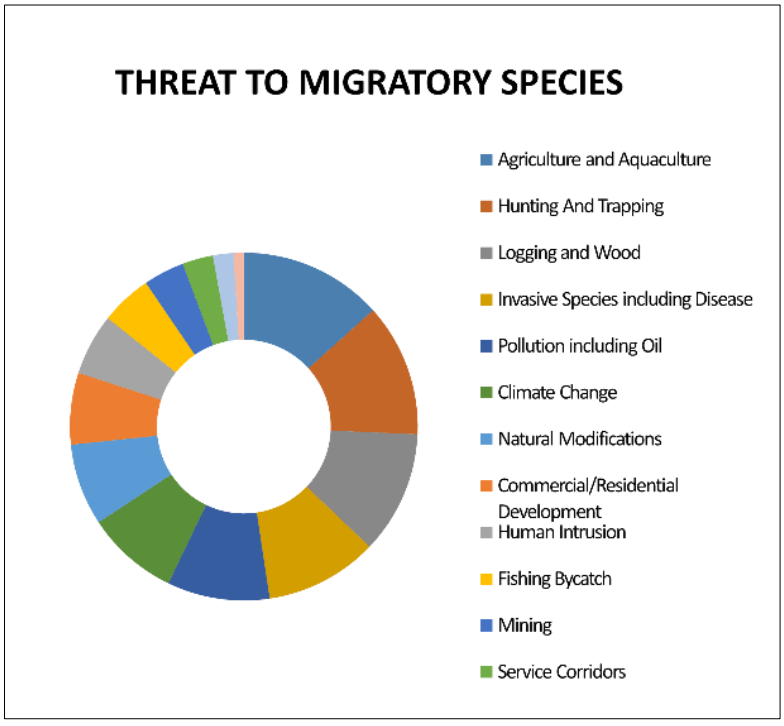

Figure 15: Threat faced by migratory birds. Source: Author

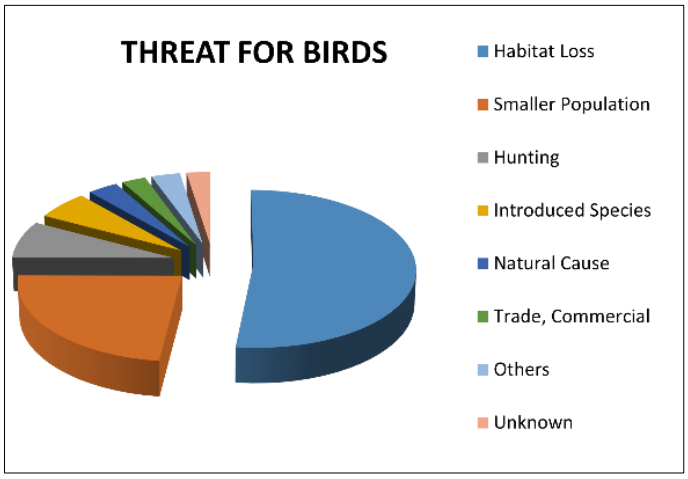

Figure 16: General threats faced by birds. Source: Author

Table 4: Summary of the threats faced in the Sanctuary:

Threat Type	**Specific Issues**	**Impact on Birds**
Flooding	Nesting island submersion	Breeding disruption, nest loss
Pollution	Plastics, chemical runoff	Habitat degradation, food chain impact
Illegal Fishing	Netting, poaching	Fish stock decline, accidental bird death
Over-tourism	Boating, littering, noise	Stress, habitat disturbance
Invasive Species	Hyacinth, lantana	Ecosystem imbalance

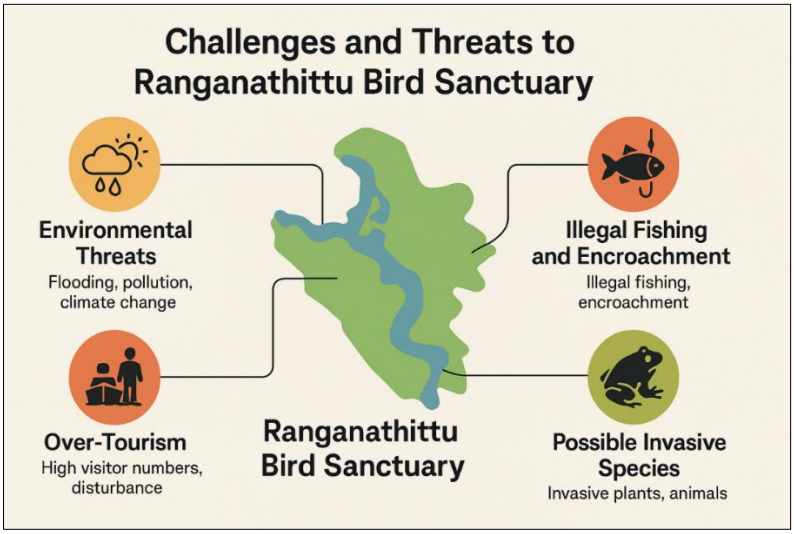

Figure 17: Graphical representation of threats faced at Rangnathittu Bird Sanctuary. Source – Created by ChatGPT as per the information provided by the Author

11. Comparative Study of Ranganathittu and Other Indian Bird Sanctuaries

Table 5: Major comparative points between a few literature studies of Keoladeo Ghana, Chilika Lake, and Vedanthagal Bird Sanctuary.

Feature / Site	Ranganathittu (Karnataka)	Keoladeo Ghana (Bharatpur) (Rajasthan)	Chilika Lake (Odisha)	Vedanthangal (Tamil Nadu)
Location	River Cauvery, near Srirangapatna	Wetland reserve in Bharatpur	Brackish water lagoon, Bay of Bengal coast	Inland freshwater wetland near Chennai
Habitat Type	Riverine islets, freshwater, dense vegetation	Seasonal wetland, grassland, woodland	Lagoon, mudflats, marshes, islands	Tank system, paddy fields, small water bodies
Area (Approx.)	~0.67 sq. km	~29 sq. km	~1,100 sq. km	~0.3 sq. km
No. of Bird Species	~170	~370	~230+	~115
Notable Species	Painted stork, Openbill, Spoonbill, Pelicans, Cormorants	Siberian crane (historically), Ducks, Herons, Raptors (UNESCO, 2025)	Flamingos, White-bellied sea eagle, Gulls, Terns (BNHS, 2021)	Night herons, Egrets, Cormorants, Painted storks (Raj, 2019)
Migratory Birds	Yes, especially from Siberia, Central Asia	High diversity of winter migrants from Central Asia & Europe	Major wintering ground for Eurasian birds	Mostly regional and short-distance migrants
UNESCO/ Ramsar Status	Ramsar Site	UNESCO World Heritage Site, Ramsar Site	Ramsar Site (Rsis, 2025)	No
Tourism Footfall	~170,000+ annually (post-pandemic)	High, due to historical and ecological significance	High, including boating and fishing communities	Moderate, mostly local and educational tourists
Conservation Challenges	Flooding, tourism pressure, pollution, invasive species	Water shortage due to diversion, invasive species	Salinity changes, fishery conflicts, and tourism impact	Habitat shrinkage, water scarcity during droughts
Management Body	Karnataka Forest Department	Rajasthan Forest Department, with UNESCO collaboration	Chilika Development Authority	Tamil Nadu Forest Department

11.1. *Unique Features of The Bird Sanctuary: A* Cluster of riverine islets, rare among Indian sanctuaries. Close proximity to urban areas (Mysuru) makes it accessible yet vulnerable. Compact but highly productive wetland – despite being small (~0.67 sq. km), it supports over 170 species. High nesting density for large waterbirds like painted storks and pelicans. Boat-based birdwatching offers a unique visitor engagement experience, unlike many walk-only sanctuaries. (India W. , 2025)

11.2. *Similarities with Others:* Shares wetland characteristics and seasonal migratory patterns with Chilika and Vedanthangal. Faces pressures from eco-tourism and water management, like those at Keoladeo. All sites play vital roles in migratory bird flyways, especially the Central Asian and East Asian–Australasian flyways. (A, 2022)

12. Methodology:

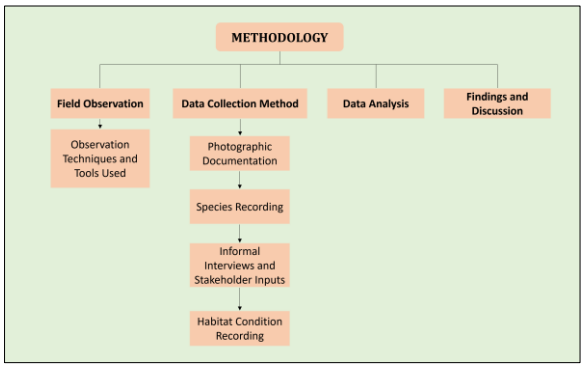

Figure 18: The pattern of methodology. Source: Author

12.1. Field Visit observations - A comprehensive field study was conducted at Ranganathittu Bird Sanctuary in March 2025, towards the end of the primary migratory season. The visit aimed to document avian diversity, ecological characteristics, and conservation challenges through direct observation and stakeholder interviews. During the visit, it was noted that many of the nesting islets had been reinforced with sandbags, a flood-mitigation strategy implemented by the Karnataka Forest Department to protect bird nesting zones. Compared to historical data, there was a noticeable reduction in the presence and density of bird species, potentially linked to the impacts of seasonal flooding and habitat disturbances.

12.2. Observation Techniques and Tools Used - Field observations were carried out using standard ornithological practices. Binoculars (10x50) were used for distant bird spotting and identification without causing disturbance. Field guides and local expertise: The official boat driver, trained as a bird guide by the Forest Department, helped in identifying key species and explaining local migratory trends and nesting behaviour. Observations were made from sanctioned boat paths during boat rides, designated watch points along the bank, and vegetation-rich zones where heronries were active.

12.3. Data Collection Method -

12.3.1. Photographic Documentation - A DSLR camera with a telephoto lens was used to capture images of bird species, nesting patterns, vegetation, and habitat conditions.

12.3.2. Species Recording - A bird species checklist was maintained using a standard wetland bird log format. Species were categorized as Resident or migratory, Water-dependent or canopy-dwelling, Breeding or non-breeding visitors.

12.3.3. Informal Interviews and Stakeholder Inputs - Conversations with Forest Department staff and boatmen were conducted to gain insights into flooding patterns and seasonal changes, bird migration trends, infrastructure modifications (e.g., sandbag reinforcements, erosion control), and challenges in managing tourism vs. conservation

12.3.4. *Habitat Condition Recording* - Observations were made on vegetation type, presence of aquatic weeds, and shoreline erosion. Observations were made on how physical modifications (such as sandbags and barriers) may alter the natural sedimentation and hydrological behavior of the islets.

12.4. *Data Analysis* - Bird counts and sightings were compared with secondary sources such as published bird census reports and sanctuary checklists. Visual documentation was catalogued by species and location to identify patterns or anomalies in habitat usage. Interview transcripts were summarized to identify recurring themes around human impact and conservation practices.

12.5. *Findings and Discussion- Observed* Patterns in Avian Diversity: During the field visit in March 2025, a noticeable decline in bird species richness and abundance was recorded compared to earlier documented trends. Fewer migratory species were spotted, particularly among shoreline and ground-dwelling birds. The central islets continued to host large colonies of resident birds, such as the painted stork, Asian openbill, and Indian cormorant, although in slightly reduced numbers. The terrestrial zones along the riverbank, once frequented by foraging species, showed very limited bird activity. This pattern suggests a spatial disparity in species distribution, possibly influenced by habitat condition and human disturbance.

Figure 19: Sunset along the Neelkanji Island at Ranganathittu. Image Source: Author

13. Impacts of Conservation vs. Tourism:

13.1. *Positive Impacts* - Boating-based tourism, regulated by the Forest Department, had minimal ecological disturbance, with measures such as visitors being observed to maintain silence during boat rides. Bird colonies on islets remained undisturbed by the slow-moving, guided tours. Habitat reinforcement with sandbags has protected nesting sites from flood erosion. Native vegetation planting initiatives have begun to restore the stability of riverine habitats.

13.2. *Negative Impacts* - Tourism infrastructure on the riverbank, including food stalls, canteens, and children's play areas, contributes to Noise pollution, Vehicular movement disturbances, Waste accumulation, especially plastic and organic litter. These activities resulted in a significant decline in the presence of terrestrial birds at the river edge. Altered foraging behaviour of species like lapwings and egrets that prefer less disturbed habitats (Ramachandra T.V, 2020)

13.3. *Evaluation of Conservation Measures* – Island-focused conservation strategies appear to be largely successful, while terrestrial zones suffer from unmanaged tourist pressure and lack of spatial zoning.

Table 6: Measures taken and their impact in and around the islets

Initiative	Impact / Outcome
Sandbag reinforcement of islets	Prevented soil erosion during floods; improved nesting safety for waterbirds
Native tree and shrub planting	Enhanced vegetation cover, stabilized riverbanks, and improved microhabitats

Boating regulations and trained guides	Low-impact tourism model on water; raised awareness without disturbing birds
Commercial tourism along the riverbank	High disturbance to terrestrial and shoreline ecosystems
Lack of noise control zones on land	Deterred birds from roosting/feeding near banks; reduced species diversity

Figure 20: Sandbags alongside the island to prevent flooding. Image Source: Author

13.4. Steps to be taken further for balancing the urban effects on the ecosystem -Ecological Zoning: There's a need to create buffer zones that separate commercial tourism zones from core bird habitats. Integrated Management: Balancing eco-tourism with ecosystem conservation requires multi-stakeholder planning, involving forest officials, local vendors, and eco-tourism boards. Terrestrial Habitat Restoration: Currently under-prioritized, but essential for diversifying avian populations beyond island breeders.

14. Conclusion:

The study of Ranganathittu Bird Sanctuary reveals a nuanced interplay between ecological sensitivity and increasing human presence. This compact yet biologically rich wetland remains one of South India's most vital bird habitats, harbouring both resident and migratory avian species.

The main observations include a decline in species richness in certain areas, particularly terrestrial zones influenced by noise, pollution, and infrastructure development. Conservation efforts, such as sandbag-protected islets and the planting of native vegetation, have proven beneficial for nesting birds and riparian health. Eco-tourism via regulated boating remains a low-impact, successful model, but uncontrolled riverbank tourism has led to habitat degradation.

14.1. Conservation Imperatives: The findings emphasize the critical need for spatial zoning, visitor regulation, and continued habitat restoration. The sanctuary's resilience depends on adaptive management strategies that align with both ecological and visitor experience goals.

14.2. *Measures to be taken:* In order to safeguard Ranganathittu's unique biodiversity, authorities must enforce stricter limits on terrestrial development within the sanctuary's buffer zone. Awareness programs should be strengthened, engaging locals, tourists, and vendors as stakeholders in conservation. Researchers, planners, and students must continue to document changes, evaluate interventions, and promote sustainable design approaches in wetland landscapes.

Ultimately, Ranganathittu stands as a living classroom and ecological treasure—one that demands informed stewardship for future generations.

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16. Author's Biography –

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