Impact of Anthropogenic disturbances on Thattekkad Bird Sanctuary, Kerala, India – A Review

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Abstract

Thattekkad bird sanctuary is the premier bird sanctuary in Kerala, India, which was constituted in 1983 by the recommendation of Dr. Salim Ali, an internationally known Indian ornithologist. Now here exist a wetland ecosystem that emerged by replacing the riparian forest existed earlier. This review study tries to cover various anthropogenic activities that occurred in Thattekkad over a long time. Major man made activities can be recognised as Construction of roads and buildings, Establishment of plantations, Human inhabitation and Hydrological changes that include construction of Bhoothathankettu barrage, checkdams. earthen bunds and waterholes. Being blessed with the presence of natural water sources like Edamalayar, Periyar, several streams and about 14 check dams, 13 earthen bunds and seven waterholes the sanctuary is managing to maintain a wetland ecosystem. The sanctuary has rich biodiverse area, the rich flora and fauna of which are affected by human interferences. Management strategies have been adapted to retain the habitat.

Key words: Thattekkad Bird Sanctuary, anthropogenic activities, inhabitation, Bhoothathankettu barrage, wetland

A brief history of Thattekkad Bird Sanctuary

Thattekkad bird sanctuary is the first bird sanctuary in Kerala, located in Kothamangalam Taluk in Ernakulam District, Kerala, India. It falls between $10^0$7' and 11^0N latitudes and $76^0$40' and $76^0$45'E longitudes. The word "Thattekkad" literally means low land flat forest. From the literature available, the history of the sanctuary can be traced back from the date 1st July 1895 when the area including the sanctuary had been declared as a Reserve Forest, "The Malayattoor and Idayar Reserve". In 1946 through a Government order, the Old Northern Division was bifurcated into two Forest Divisions, Malayattoor and Movattupuzha. (Sreedharan,N.W. 1954). In the working plan prepared by N. Sreedharan, there is a well detailed mentioning about the area covered by the Sanctuary. Earlier the sanctuary was a part of Kuttampuzha Forest Section of Kuttampuzha Forest Range coming under the administration of Malayattoor Forest Division. After the declaration of the area as a Bird Sanctuary, it is coming under the administration of Idukki Wildlife Division.

Dr. Salim Ali and Thattekkad Bird Sanctuary

An important milestone towards the establishment of the Sanctuary was the visit of Dr. Salim Ali, the Bird man of India, for the ornithological surveys of Travancore and Cochin during 1930's. As a part of ornithological expeditions carried out by Dr. Ali in association with Bomaby Natural History Society, he visited Travancore and Cochin in 1933 for systematic field studies. Particularly, Thattekkad area was covered during 2 to 13 February 1933 and was deeply impressed by the avian diversity he observed here. He commented about Thattekkad in his book "The Fall of a Sparrow" as: "*For richness and diversity of birdlife, Kerala stands, in my estimation as undisputed No.1. There were certain localities in particular, for example Thattekkad on the Periyar river in northern Travancore, which linger in my memory as the richest bird habitat in peninsular India. I have known - comparable only with the Eastern Himalayas"* (Ali, S. 1985). Understanding these facts Dr. Ali suggested the Thattekkad area to get established and managed as a Bird Sanctuary and sent a letter to the Government, on the basis of which 25.16 km^2 area on northern bank of Periyar was declared as a Bird Sanctuary in 1983 through the Governement Order notification no. 35743/FM3/AD dated 27- 8-1983.

Geographical features of Thattekkad Bird Sanctuary

The sanctuary is located towards the Northern bank of Periyar river and covers an area of 25.16 km^2. The sanctuary is bordered by Neriamangalam reserve forest in South, and Teak plantations of Thundathil and Edaamalayar in

North. The Eastern border is continuous with the Teak plantation of Kuttampuzha Forest Range and Western border is shared with Kothamangalam Reserve Forest. The area of the Sanctuary is almost in the foothills of Western slopes of Western Ghat and the higher peak of Western Ghat the Anamudi (2695m) is directly uphill of Thattekkad. The terrain is undulating, with marshy lands and vayals. The altitude ranges from 30m to 523m with highest peaks at Njayappillimudi (523m) and Thoppimudi (488m).

The Sanctuary is located in the Western Ghats foothills and the area falls in the biodiversity hotspot, Serial number 21 – Western Ghats. On the northern side, it is part of a large ecological unit that includes the Malayattoor, Sholayar, and Parambikulam hill ranges. On the eastern side, Munnar, Eravikulam, and Chinnar landscapes support various vegetation types, allowing bird species to migrate seasonally. The altitudinal gradients, the topographical position in the western slope of Western Ghats, and the high ranges' foothills make TBS and its adjoining areas a hub of migratory birds and its track (Management plan, 2022-23)

Biodiversity of Thattekkad

Thattekkad bird Sanctuary holds unique and richest biodiversity. The phytogeography of Thattekkad supports the existence and survival of a wide variety of flora and fauna. The natural forests of the Sanctuary falls under seven types: viz. 1. Riparian Forests mostly seen along the river banks (Periyar and Edamalayar), 2. Tropical Evergreen Forests characterized by tall trees with massive plank buttresses (eg: *Vateria indica*, *Dipterocarpus indicus*), 3. Semi –Evergreen Forests dominated by the characters of evergreen and deciduous forests trees (*Artocarpus hirsuta, Hopea parviflora* etc). 4. Moist deciduous Forests dominated by trees like *Cassia fistula, Lagerstroemia lanceolata* etc. 5. Scrub jungle with hardwood trees, thorny shrubs, cacti and climbers, 6. Grasslands, 7. Plantations (Teak and Mahogony). (Management plan 2022-23)

The massive flood of 2018 in Periyar and Kuttampuzha rivers seriously affected the normal situation of TBS. The natural water bodies, check dams and waterholes were all inundated by the flood. Sedimentation and accumulation of plastic waste occurred in the water bodies. Eleven of the fourteen check dams got damaged. Moreover, mud and silt deposition has decreased water depth and disturbed the aquatic ecosystem. The flood significantly impacted 26 bird species and 51 fish species (S.C. Joshi *et al*., 2018). The grasslands along the river bank were also eroded. There have been no major adverse effects inside the Sanctuary (PDNA, 2018).

Floristic diversity

728 plant species belonging to 109 families have been documented in Thattekkad Bird Sanctuary of which 28% are endemic. Fabaceae is the dominant family represented by 58 members, followed by Poaceae (50) and Rubiaceae (38 species) (Balasubramanian and Veeramani, 2011). A review study entitled Diversity and checklist of tree species in Thattekkad Bird sanctuary enlisted 168 tree species (Rijuraj M. *et al*, 2015). Nikesh (2010) identified 17 species of mosses, 19 species of liverworts and 2 species of hornworts, thus a total of 30 species of mosses. The study reported the occurence of two new species *Jungermania hyalina* and *Porella compylophlla* var. *ligulifera*. 30 species of Pteridophytes were reported by Joseph *et al*., (2017). A study on Desmid diversity in Thattekkad revealed a high level of diversification that is 74 taxa were obtained in which the genus Cosmarium (21 species) dominated, followed by Euastrum (12) (P.B Bibina *et al.*, 2024). According to a report by Ambili C.B. and Mohandas A, (2023) 98 species of aquatic macrophytes belonging to 42 families with 44 and 54 species belonging to aquatic and non aquatic taxa are present in Thattekkad Bird Sanctuary. The growth of macrophytes was adversely affected by change in water level or dewatering. Most of the macrophytes did not achieve or complete their life cycle due to the fluctuations of habitat

Faunal diversity

The rich biogeographic features of Thattekkad Bird Sanctuary supports a wide range of fauna also. A rapid Biodiversity Assessment conducted by Balasubramanian and Veeramani in 2011 resulted in the documentation of 39 mammals, 282 bird species, 34 reptiles and 52 species of fishes. 25 species of amphibians were also been reported by Sandeep and Rajkumar (2016). They also documented 20 reptile species including 17 sanke species. Sevaral ecologically important species of animals like Flying squirrel (Rina Chakraborty, 2008, Nandini , *et al*., 2001), Malabar spiny dormouse, a rodent species endemic to the Westerrn Ghats (E.A Jayson 2006) etc were also reported in Thattekkad. Mumthaz *et al*., 2018 reported 9 species of anurans from Sanctuary's human inhabited areas. Dinesh *et al* (2021) conducted a study entitled Morphological groupings within Euphlyctis (Anura: Dicroglossidae) and description of a new species from the surroundings of Thattekkad Bird Sanctuary. Another survey by A.P Varghese *et al* (2014) recorded 82 species of Odonata (Insects) f which 21 species are endemic to Western Ghats. 89 species of spider species were documented from TBS by Minu *et al*., 2022.

Microbial Diversity

Soil microbial diversity studies conducted by Reshma S. *et al.*, 2018 revealed the presence of 42 bacteria isolated and identified using nutrient agar method and 1275 bacterial species belonging to 478 genera were identified by metagenomic analysis. This reveals rich diversity of bacteria in the sanctuary.

Anthropogenic disturbances occurred in Thattekkad

Thattekad had been declared as a Bird Sanctuary in 1983 on the recommendation of Dr. Salim Ali. The major anthropogenic activities that had impacted the topography of Thattekkad can be described under four heads viz. (i) Construction of roads and buildings (ii) Establishment of plantations (iii) Human inhabitation (iv) Hydrological changes (construction of Bhoothathankettu Barrage, checkdams, earthen bunds and waterholes).

i) Construction of roads and buildings

This can be traced back to 18th century when Europeans established a large scale rubber plantation at Palamattam, on the southern bank of the river Periyar near Thattekkad. This area was identified as one of the best rubber yielding estate and established large scale rubber plantations along the banks of Periyar. Construction of roads for this purpose through the forest changed the ecosystem very much. Another important targerr of British was the tea plantations of Kannan Devan Hills, also known as Munnar Hills. The road built to connect Kannan Devan Hills to Kochi passing through the dense forests on the Western slopes of Western Ghats included the nearby areas of Thattekkad. (Rahul B, 2023). Several private and Government buildings also exist inside the Sanctuary area The construction activities inside the natural forest negatively impacted the ecosystem structure.

ii) Establishment of plantations

After establishing large scale rubber plantations along the banks of the river Periyar, in 19th century there occurred a shortage of food supply. The fertile forest area on the northern side of the river was given to the locals for cultivation. In the same period British established various types of plantations. Teak plantations were established in this area beginning in 1927. The sanctuary contains nine teak plantations covering an area of 2.16 sq.km. Rosewood plantations established in 1974 was a failure, and the area was replanted with natural species in 1996. Another plantation established within the sanctuary was Mahogany, covering an area of about 0.0667 sq.km. in 1974 (Fig 1). These planting activities negatively impacted the forest area and altered the canopy structure and vegetation characteristics, making the area less suitable to birds with very specific feeding and nesting requirements, thus resulting in their extinction locally. Gradual displacement of bird species resulting from man-made alterations of the habitats was reported. Approximately one tenth of the sanctuary (2.22 km^2) along the western side of the natural forest consists of teak and mahogany plantations. After the declaration of Thattekkad as a Bird Sanctuary, timber extraction and plantation activities came to an end. Hence by this time almost all the areas of the Sanctuary including plantations have very thick undergrowth. The natural growth of plants and trees has made it more or less a natural forest. (Rahul B, 2023).

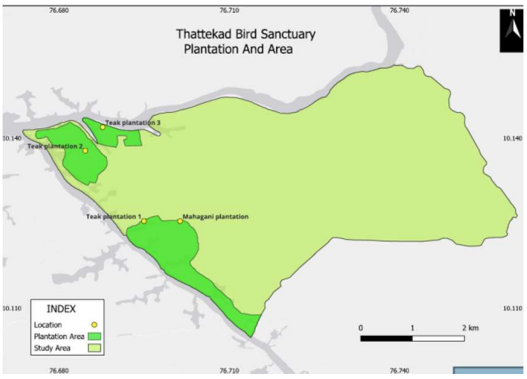

Fig 1: Map of Thattekkad Bird Sanctuary showing teak and mahogany plantations

iii) Human inhabitation

Human inhabitation started possibly during the 19th century when the fertile forest area on the northern side of the river was given to the locals for cultivation. For many years forests were cleared and the land was cultivated. After obtaining independence large areas on Pooyamkutty river bank were given to locals. The system of giving 'Patta' in exchange of the land resulted in the formation a human population belt stretching from Thattekkad to Kuttampuzha.

Now the people are occupying a total of 9 km^2 of the sanctuary in Kuttampuzha village (Fig 2). There are no tribal settlements within the sanctuary.

The Eco development activities were first launched in the sanctuary in 2002. The main objectives of which are strengthening the People-PA interface, improving participatory forest conservation and to enhance livelihood opportunites for forest-dependent people. Proposal for adding the avifauna-rich area (10 km^2) from the adjacent area of Neriyamangalam Range of the Sanctuary's eastern side is under consideration of the Government. As per the management plan, timely assessments are done to ensure people are not violating the forest area; also proper demarcation is made between agricultural areas and forest land that are not permitted for cultivation.

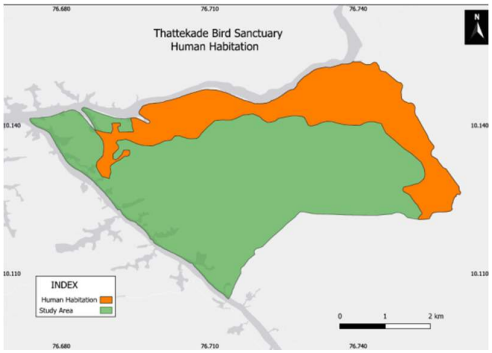

Fig 2: Map of Thattekkad Bird Sanctuary showing areas of human inhabitation

(iv) Construction of Bhoothathankettu Barrage

As a part of commissioning Periyar Valley Irrigation Project (PVIP) in 1964, Bhoothathankettu Barrage was constructed in Periyar river which flows through the south western side of Thattekkad. This caused the submergence of all low lying forest and land areas near the river. The flow of the river was prevented by the barrage and led to the destruction of riparian forest ecosystem that existed earlier. The interesting consequence occured was that the newly created water bodies became new habitats and niches for a variety of wetland and aquatic birds, which were not found during the survey of the area by Dr. Salim Ali. Bhoothathankettu barrage plays a significant role in maintaining the water cycle of TBS. Every year from June to October the shutters of the dam are kept open to allow the free flow of water to Periyar. From November to May the shutters are kept closed to retain enough water for irrigation and this floods the area. This caused several aquatic birds to left the area as they lost their feeding and breeding environment (Rahul B, 2023). The periodic cycle of flooding and draining of plains causes ecological variations in the habitat. Ambili C.B. and Mohandas A. (2024) studied the avian flora especially the wetland birds of Thattekkad Bird Sanctuary and observed 40 such species of which there are 7 migrants, 20 local migrants, and 13 residents. The study examined how habitat changes due to the Barrage's operation affected bird populations, revealing significant fluctuations in species numbers. The closing of the Barrage created favorable conditions for wetland birds

Other major anthropogenic activities that impacted the hydrological changes in Thattekkad are the construction of check dams and water holes. The sanctuary now have a more or less wetland ecosystem created by several natural and artificial water bodies those include Edamalayar, Periyar rivers and about 14 checkdams alongwith 7 waterholes and about 13 earthen bunds. Out of the seven waterholes two are natural and five are artificially created. All these are the steps towards establishing perennial water bodies to facilitate the habitat for aquatic water birds and several flora and fauna that depend on water to complete their life cycle. Such approaches were found to be effective in attracting the water birds that left the area once. Ambili C. B and Mohandas A (2023) investigated the impact of hydrological changes on water bird populations and biodiversity in Thattekkad Bird Sanctuary, highlighting the need for improved wetland management. The findings emphasize the urgent need for a scientifically updated wetland management plan to address ecological crises and ensure the habitat requirements of endemic macrophytes, macro invertebrates, fishes, and birds.

Discussion

All these man-made activities affected the topography of Thattekkad Bird Sanctuary in one way or other. Construction of roads through the area of sanctuary was the foremost notable activity. This caused the disturbance of the lush forest and paved way for direct human interference. Also establishment of plantations interrupted the canopy and vegetation pattern of the area though it helped to generate revenue. After the declaration of the area as a Bird Sanctuary in 1983, the system recognized the importance of maintaining the natural habitat and blocked

plantation activities, the aftermath of which was the regeneration of forest. The teak and mahogany planted areas are now with the regenerated secondary forest. Establishment of rubber and tea plantations in nearby areas along with developmental activities like construction of roads induced human inhabitation in and around the areas of Sanctuary. This accelerated the exploitation of forest areas and products. Since 2002, through the launching of Eco development activities people –PA interference strengthening steps have been taken. Most significant anthropogenic activity contributed to the change in the topography of the Sanctuary was the construction of Bhoothathankettu barrage in 1964, by replacing the riparian forest ecosystems on either sides of the river Periyar with wetland habitat. Since then started the annual cyclic flooding and draining of the area that resulted in the loss of endemic characteristics and diversity of flora and fauna (Ambily, C B and Mohandas, A, 2023). In order to overcome the instability created by the barrage constructions like checkdams, earthenbunds and waterholes have been created to maintain the wetland ecosystem which was found to be fruitful towards attracting the aquatic flora and fauna that left the area once (Rahul B, 2023).

Conclusion

This review study gives an insight into various anthropogenic activities that impacted the ecosystem evolution in Thattekkad bird sanctuary. It gives an idea about the role of anthropogenic agencies towards such changes. The sanctuary now has a more or less wetland ecosystem created by several natural and artificial water bodies including Edamalayar and Periyar, 14 checkdams, about 13 earthen bunds and 7 waterholes. By the effective management of these the sanctuary is in a successful path towards achieving its conservation goals.

Conflicts of Interest

The authors declare no conflicts of Interest.

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