

# Colonial Status, Feeding and Nesting ecology of near Threatened Oriental Darter (*Anhinga melanogaster*) across the world –A Review

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**Abstract**—One significant family of water birds is the Anhingidae. The feathers of large Anhingidae birds are sexually dimorphic. They are between 80 and 100 cm (2.6 to 3.3 ft) length, weigh between 1,050 and 1,350 grammes (37 to 48 oz), and have a wingspan of around 120 cm (3.9 ft). The males have a larger bill than the females, black and dark-brown feathers, and a small erectile crest on the nape. The females have somewhat darker plumage, especially on the neck and underparts, and are marginally larger. Grey stippling appears on long scapulars and the upper wing coverts of both. The bill lacks an external nose, has a desmognathous palate, and serrated borders. According to Brodkorb et al. (1982), the darters have small legs that are completely webbed. The focus of this paper review is on bird species that are near threatened and require future conservation efforts.

**Index Terms**—Anhingidae, Sexually Dimorphic, Desmognathous

## I. INTRODUCTION

The Oriental darter for the most part, Oriental Darters inhabit shallow inland wetlands like lakes, rivers, swamps, village ponds, and reservoirs, as well as estuaries, tidal inlets, mangroves, and coastal lagoons. According to Rahmani, Darters need larger, deeper, clean water bodies. As a diving waterbird, they mostly eat fish, though they have occasionally been observed eating larger fish than their gullet and thin bill can hold. In addition, they could exhibit local motions, depending on the water conditions.

Distribution of Oriental Darter (*Anhinga melanogaster*) across the world viz Sri Lanka, Jakarta, Khata Corridor Forest, Ernakulum Kerala, Kumar Akom Heronry Kerala, Bihar, New Delhi, Gujarat and

Bundh Baretha Bharatpur Rajasthan with different habitat and behaviour is included in this Review Paper.

## II. POPULATION STATUS

This taxon is near threatened as it has been evaluated against the criteria but does not qualify for critically endangered, endangered or vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future. The International Union for Conservation of Nature and Natural Resources (IUCN) Red List system was created in 1963 and has been promoting species conservation for more than 30 years. It established a standard for species listing and conservation status of species (IUCN,1963).

Table: Species of Darter present all over the world.

S.N.	Common name	Scientific name	Local status
1	American darter	<i>Anhinga anhinga</i>	Least concern
2	African darter	<i>Anhinga rufa</i>	Least concern
3	Australian darter	<i>Anhinga navaehollandiae</i>	Least concern
4	Oriental darter	<i>Anhinga melanogaster</i>	Near threatened

The study of biodiversity of water birds in the Suruwila lake region of Anawilundawa Tank Sanctuary (Ramsar Convention), Sri Lanka A taxonomy of the avianfauna in a genus wise method, yields 24 genera of birds, which, belong to 13 different families. The majority of species are members of the Ardeidae family, which is followed by the Anatidae

and Rallidae. Purple-moor chickens were the most prevalent of the Rallidae, although cotton-pygmy of the Anatidae family were more conspicuously abundant. The only member of its family, the Anhingidae, was an Oriental darter. Black-headed ibis, spot-billed pelicans, and oriental darters are among the breeding residents of Suruwila Lake that are considered internationally threatened, although they are also among the least threatened species in the nation. Among the breeding residents, the Great Cormorant is considered a national menace. The gadwall is one of the migrant species whose existence is nationally threatened. However, these species' conservation condition is of the least significance on a worldwide scale (Begum,2015).

During the study in and around an urbanized lake at Peralanda –Ragama, North Colombo, Sri Lanka, sixty-three species from thirty-seven families and fourteen orders were identified. These comprise three near-threatened species worldwide. Three species that are locally near threatened are the Spot-billed Pelican (*Pelecanus Philippoussis*), Oriental Darter (*Anhinga melanogaster*), and Black-headed Ibis (*Threskiornis melanocephalus*) (Silva et al,2017)

Drastic change was seen in Pulau Rambut Wildlife Sanctuary, Jakarta Bay in three decades. In 1990's there were 15 species listed but later on two species Black headed ibis and little Pied cormorant are no more found and thus the species remain 13. Deepness of waterbody plays principal role for bird as mainly birds prefer shallow wetland. In order to wade or peck food. Oriental darter and cormorant require deep waterbody as they actively pursue fish, and dive for it (Mardiastuti,2022).

Khata Corridor Forest which connects Bardia National Park of Nepal with Katarina hat Wildlife Sanctuary of India. It provides shelter to many birds' native as well as migratory it's a common way for passage of migrants. 2 individuals of Oriental darter were recorded during the study period. Khata corridor favours maximum biodiversity. 2 parameters used for study were species evenness and species abundance. Species found in all type of habitat is Generalist and species restricted to a particular type of habitat is Specialist.

Distribution map of Oriental darter was drawn, 2 individuals one in middle of river and one on bank were recorded. And in whole study 141 bird species

from 12 orders and 43 families were listed (Chaudhari, et al,2009).

Oriental darters are active throughout the day so it's simple to study them. (Surya and Raju,2023).

In the investigation, ten species were discovered breeding in the Kumarakom heronry; nine of them had previously been documented to breed there (Sreekumar 2003), while the Black-headed Ibis was discovered breeding for the first time. According to BirdLife International (2001), two of the ten species—the Oriental Darter and Black-headed Ibis—are considered to be near threatened worldwide. Throughout the whole study period, the numbers of Little Cormorants and Indian Cormorants surpassed the previous maximum counts, making the congregations of Little Cormorants, Indian Cormorants, and Oriental Darters the largest ever observed in the area (B. Sreekumar, pers. comm.). The Thanneermukkom Saltwater Barrier's construction across Vembanad Lake and the ensuing changes in the ecology of the southern part of the lake may be the cause of the rise in populations of the two cormorant species and Oriental Darter and the decline in the Black-crowned Night Heron. The southern portion of the lake has turned into a freshwater body after the barrier was built. The area has seen an increase in the population of freshwater fish species, which are likely the main source of food for Oriental Darters and cormorants, even though no research has been done to support this. On the other hand, habitat loss in other places might be the cause. The Periyar Tiger Reserve's Oriental Darter population has decreased recently, presumably due to competition with the Great Cormorant *Phalacrocorax carbo* for nesting locations (Sashikumar & Palot 2002).

This could be one of the causes of the growing number of Oriental Darters at Vembanad Lake. According to Rahmani et al. (2002), 83 Great Cormorants were spotted in Kerala in the winter of 2001–2002, while Vembanad Lake and its environs have previously been known to have Great Cormorants (Sreekumar 2003). This could have an impact on the Oriental Darter breeding population in the Kumarakom heronry in the future. The Waterbird Census report from 2002 states that there were just 489 Oriental Darters in whole of India (Rahmani et al. 2002). According to Zacharias & Gaston (2003), Kerala's Oriental Darter population has decreased during the previous thirty years. According to Kottayam Nature Society's January mid-winter

waterbird counts from 2001 to 2004, which were assisted by the Kerala State Forest and Wildlife Department, the numbers of Oriental Darters at Kumarakom Heronry were 65, 10, 23, and 42, respectively (Sreekumar 2001, 2002, 2003, 2004; Sreekumar & Narayanan 2004).

It is possible that birds from other regions also gather here to breed because of the significantly higher numbers of Oriental Darters that are present during the breeding season. It is obvious that this significant breeding population needs to be safeguarded and observed.

Wetlands International (2002) estimates that there are 4,000 Oriental Darter in the South Asian biogeographical population.

The entire breeding population was predicted to be 314 individuals based on the number of nests reported, with the highest number of darters recorded during the current study being 276 in a single count in July. As a result, roughly 8% of South Asians are Oriental Darters, who live in the Kumarakom district. Throughout the investigation, the number of Oriental Darters stayed quite constant (Narayanan & Vijayan, 2007).

Located on the 45.3-hectare KTDC Tourist Complex, 14 km west of Kottayam, is the Kumarakom Heronry. The heronry is bordered to the south by the Kerala Agricultural University Regional Agricultural Research Station farm, to the east by the Kumarakom-Vechoor road, to the north by the Kavanar River, and to the west by the Vembanad estuary. The prominent trees in the heronry include *Sonneratia caseolaris*, *Rhizophora mucronata*, *Bruguiera gymnorrhiza*, *Avicennia officinalis*, and *Terminalia catappa* (Greeshma & Jayson, 2020).

Pokkali is a salt replent type of rice grown in Ernakulum district. Pokkali lakes are named for well-known Pokkali rice variety which is recognised globally as a gene donor for rice ability to withstand. The current farming method used in Pokkali territory is widely recognized as sustainable. The rotational integration of rice and prawns with the shift in salinity of the field water bodes well for natural system. One of the most environment friendly agriculture method in the world is the organic cultivation of Pokkali, a special type of rice grown along the seashore. Chemical pesticides, fertilizers are not required for a good yield. According to Rahmani (2012), 153 globally threatened bird species occurs in India and 3

of them are found here. Oriental darter (*Anhinga melanogaster*), 495 individuals reported during this study. 4% of South Asian population of near threatened Oriental darter lives in Pokkali wetland in all seasons of the year. This species also reported from Thatteked Bird Sanctuary (seema et al, 2004), Kole wetland (Tomy, 2014), Kuttanad wetland (Prasanth et al, 2014) and pokkali wetland during the present study. Kole wetland favoured by 2% of geographical population of Darter (Tomy, 2014). (Prasanth et al 2014) found Kumarakom heronary alone supported by near threatened Oriental darter. Darters may be more prevalent since they reproduce in a variety of location close to the Pokkali wetland the kuzhippily location which was (500m) extremely near to the sea, had the highest number of darters. The Darter's closest breeding records were from the Kumarakom heronary about (60km.) away. The prawn cultivation season had the highest number of darters (329) while the transitory time show the low population (Deepa & John, 2017).

Bihar's Valmiki Nagar Tiger Reserve is a comparatively unknown birdwatching destination. 246 species recorded in one-year observation. Oriental darter alone bird was sighted flying close to Valmiki Nagar along the Gandak River. (Choudhury, 2015)

Since 2006, Darters have been recorded breeding on trees in a 2.5ha wetlands with depths ranging from 2.4m (dry season) to 4m (post-monsoon). The restored wetland now has abundant aquatic flora, insects (Niangthianhoi & Khudsar 2009), planktons (Ramaswami 2006), and fish, surrounded by trees, grasses, and sedges. In 2011, the Darter had a cumulative nest-occupancy time of 189 days, spanning 10-14 weeks for each nest (YBP). Nine nests were incubated, but only eight produced hatchlings. The nests (n=9) were finished in  $5.33 \pm 1.65$  days. Nests were found in *Acacia nilotica* and *Eucalyptus tereticornis* trees, with an average GBH of  $92.2 \pm 24.47$  cm (n=4). Nest components included dried and fresh twigs, *Eucalyptus* leaves, and some *Acacia* twigs. Nest heights on *Acacia* trees were  $670 \pm 44.72$  cm (n=2), while *Eucalyptus* trees averaged  $1344 \pm 127.45$  cm (n=7). A total of 23 chicks hatched, however only 19 survived until fledging. Nesting success was 82.6%, with 2.37 chicks per nest (n=8). Only four chicks died, making up 17.39% of the total hatchlings (Niangthianhoi & khudsar, 2015).

8179 waterbirds with 2000 unidentified were recorded from Bundh Baretha Reservoir, Bharatpur during 4-year research work. Globally near threatened Oriental darter mostly sighted in autumn season viz 30 (Verma, 2008).

### III. PREFERRED HABITAT

KCF has great biodiversity which we can see great Avian diversity.

Area with maximum vegetated area which is Khauraha river was favoured habitat of Oriental darter and other water birds. (Chaudhari, et al, 2009).

It normally selects the place with plentiful water. It chooses the habitat with ample food and less disturbance. Prefers sunny areas over shady. Passes more time in vegetated areas (Surya and Raju, 2023).

Oriental darter which mostly uncommon elsewhere was considered common in shravathy landscape, Karnataka due to its vegetated habitat and less disturbance (Barwe & warrier, 2013).

### IV. FORAGING ECOLOGY

Majorly chooses fishes for eating and are carnivores. They are quick swimmers and while swimming whole body remains underwater except neck. It tosses the prey upside in air and then engulf it. Mostly eats the head first and then rest of the part and sometimes can eat the prey as a whole. Preening and sunbathing activities noticed after feeding and even can rest on nearby trees or poles (Surya and Raju, 2023).

Feeding rate of Oriental Darter were recorded as 0.1/min. It was noted active throughout the whole day but less feeding in noon time. From two different year observation morning time 6-7 and 7-9 a.m. were active feeding noted and in previous year 15-16 and 17-18 pm were mostly active feeding recorded. Highest feeding rate in month of June and start reducing from July. Darters can forage even 18.45 hours or more than that. Average time noted was 21.7 sec. (ranges from 6-73 sec.) This is the time when Darter remains submerged in water for feeding, it's a part of preying strategy. Considerable element of their food is fishes. From investigation and their vomits concluded that it consumes different species of cyprinidae family & stolporus species. Mean length of fishes eaten by Oriental darter in kuttanad waterbody was 7.53+-2.89 cm. within a range of 2.4 to 25.4 cm. The biggest

fish swallowed by Darter was a catfish *Heteropneustes fossilis* and tiniest was *Puntius vittatus*. Prey upon slow moving benthic rather than fast moving.

According to Kamsuk's study on ecology of Oriental Darter at Phiu Khieo Wildlife sanctuary of Thailand shows its feeding time before 7 am during 10-12 and 12-13:30 pm but this study shows feeding time in early morning and late evening hours. (Narayanan, 2016).

### V. NESTING

With 168 and 157 nests, respectively, the Indian Cormorant and Oriental Darter were the second and third most numerous species in Kumarakom, making them the largest colonies of these two species in Kerala (Narayanan & Vijayan, 2007).

Of all the Keralan heronries, Kumarakom is the largest. From a four years investigation a survey of the Oriental darter breeding population at this heronry showed that there were 442 nests in this heronry. In 2007, 73.5% of nests were observed. Following this, the number of nests in the Kumarakom heronry drastically decreased.

The Oriental darter (*Anhinga melanogaster*), a heronry nesting species that is primarily piscivorous and near threatened, is a member of the Anhingidae family. haunts estuaries, tidal inlets, mangroves, and coastal lagoons in addition to shallow inland wetlands such as lakes, rivers, swamps, and reservoirs. It can be seen alone, in pairs, or in small flocks, but seldom in big ones. It is a common resident species in Assam and rare elsewhere in India. Its current status is unknown; however, it appears to be declining. According to Zacharias and Gaston, Kerala's population of Oriental darters has decreased during the previous thirty years. In Kerala, darter nests at barely over ten locations. Thus, the long-term existence of the near-threatened Oriental darters depends on the Kumarakom heronry. Throughout the study period, 442 nests from the Kumarakom heronry were counted. During the 2007 breeding season, 325 nests, or 73.5% of these, were observed. The breeding population in the 2004 breeding season, which included 157 Oriental darter nests, accounted for roughly 8% of the South Asian biogeographic population. (Narayanan et al, 2012).

The Great Cormorant in Kumarakom Heronry, *Phalacrocorax carbo* is a common breed. Two nests were recorded in 2005 and ten nests in 2006 by Narayanan et al. (2006). During the 2014 Heronry

Census, five nests were identified (Sashikumar et al. 2015). From December 2016 to March 2017, we conducted a study of the Kumarakom heronry to determine the species' current nesting status. During that time, kept records on the Oriental Darter (*Anhinga melanogaster*) nesting. There were 21 Great Cormorant nests total, with an average of 59 birds. Additionally, there were seven broken nests that could have belonged to an Oriental Darter or Great Cormorant. During the study, 34 Oriental Darter individuals and two nests were also noted. Six *Terminalia catappa* trees, each more than 13 meters above the ground, housed all of these two species' nests. In every instance, nests of Great Cormorants were observed in the uppermost canopy, whilst those of Oriental Darters were found along the middle branches. According to Neelakantan (1996) and Sashikumar and Palot (2002), the "invasion" of Great Cormorant into the heronry caused the numbers of Little Cormorant and Oriental Darter in Periyar Tiger Reserve to drop. Narayanan et al. (2006) documented comparable instance of Great Cormorant displacement of other species from Kumarakom heronry (Greeshma & Jayson, 2020).

## VI. BIRDS AS ECOLOGICAL INDICATOR

Big mammals are not great for the evaluation of any ecosystem as they have high range of tolerance but birds can be very great indicator as they are very sensitive to a very small change in ecosystem. As Orai river comprise of only 5 species and the reason is over fishing, poisoning and blasting on the other hand 78 species were listed from Geruwa –karnali River which was free from such activities (Chaudhari, et al, 2009). Birds are bioindicators, its presence shows good health of an ecosystem with no disturbance (Surya and Raju, 2023).

## VII. THREATS

In July 2019, a crude oil spill hampered mangrove rehabilitation efforts. The mangrove forest was the primary nesting area for waterbirds on Pulau Rambut. The reduction in size and quality of the mangrove would have a substantial negative impact on waterbirds, since fewer nesting places would result in more intense competition for space and nesting supplies. In addition to oil contamination, the island

has received a significant amount of marine debris. Domestic wastes in Java are capable of impeding the regeneration of essential mangrove species. The loss of wetland regions, such as marshes, mudflats, mangrove forest areas, rice fields, fish/shrimp ponds, estuaries, lakes, and dams, has significantly contributed to the fall of waterbird populations. Each species has its own preferred wetland type for foraging. The Jakarta Greater Area (Jabodetabek), also known as Jakarta, Bogor, Depok, Tangerang, and Bekasi, has experienced fast land-use changes, including the conversion of wetlands for various purposes. Rice fields, a key foraging ground for waterbirds, have reduced in Java, particularly in the northern coastal area of Jakarta Bay and adjoining inland areas. (Mardiastuti, 2022).

Pollution drainage, hunting and the gathering of eggs and nestlings causing its population to reduce considering it as Near threatened (Birdlife International, 2011). Population of this bird in Kumarakom heronry may have been caused by the increased tourism on Darter's feeding ground (Deepa & John, 2017).

Vargiya et al. (2016) cite the loss of connectivity between the Chhaya Rann wetland complex and the parent wetland, the influx of factory effluents, the fast urbanization and encroachment within the wetlands, the absence of conservation initiatives, and the absence of a wetland management authority as part of the findings of the Asian Waterbird Census that was carried out in the area in January 2016. Images of birds being hit by power lines, impacted by fire crackers, and sprayed with DDT are also included. It was noted that the Chhaya wetlands were threatened by a number of things, such as the disposal of rubbish, household sewage, and solid waste. Every year, DDT is sprayed around the edge of the wetland to keep mosquitoes away. These wetlands' primary hazards are comparable to those noted for other wetlands in the Indian subcontinent. For instance, the principal risks to wetlands and waterbirds of Kashmir's Shallabug Wetland were siltation, eutrophication, the risk of DDT and pesticide intoxication, severe weed infestation and water quality degradation, encroachment by agriculture, and urbanization (Dar & Dar 2009). (Kafe et al. 2008) Threats of habitat destruction at Rupa Lake in Pokhara, Nepal, include human disturbance, sedimentation, agricultural conversion, soil erosion, water pollution,

eutrophication, trapping/hunting, and net-based fish farming (Vargiya & Chakraborty ,2019).

Because it disturbs the birds, commercial fishing during the winter months may be harmful to the survival of both resident and migratory waterbird species. There hasn't been any research done on how these activities affect the avifauna. Pesticides used by farmers on their crops unintentionally harm waterbirds that graze on agricultural grains and in rice paddies in nearby fields. The water is poisonous to waterbirds due to hydrochlorinated pesticides that are carried into the wetland from agricultural fields. The city of Bharatpur also gets its water from this spring. Waterbird survival is negatively impacted by winter wetland draining; hence a plan must be implemented to solve this pressing problem with regard to irrigation water use and biodiversity preservation. Additional research and data from both upstream and downstream of BBR, including the catchments, are needed to create an appropriate migratory species conservation plan for the area. A great way to keep an eye on the condition of many wetlands and the natural capital they represent is to regularly count the waterbirds. Local communities and non-governmental organizations could take the lead in conservation and monitoring efforts, supporting local government (Verma, 2008).

#### VIII. CONSERVATION

For implementation of conservation strategies, the study of Oriental darter is very helpful. A Waterbird Sanctuary could be established in the Kumarakom area because to its significance for waterbird breeding and other migratory bird populations.

The near-threatened Oriental Darter, *Anhinga melanogaster*, was found to have an average of 211 individuals, with a maximum single count of 276. There is still no protection for the Kumarakom Heronry and the surrounding regions. A protected wetland region, encompassing portions of Pathiramanal Island, Kerala Tourism Development Corporation's Tourist Complex, and the lake between these two sites, should be created along with suitable conservation plans. The participation of the Forest Department, NGOs, local Panchayaths, and other stakeholders could accomplish this. (Narayanan & Vijayan,2007).

It is extremely concerning that the breeding population at Kumarakom Heronry is declining. There are still a

lot of unanswered questions regarding Asia's waterbirds, and as new information and threats to the region's birds and their habitats become available, our opinions of the most important conservation measures will probably shift. The Kumarakom heronry and Oriental darter breeding population require careful protection, monitoring, and research to better understand the region's ecology and threats (Narayanan et al,2012).

Since Pokkali wetland are acting as a 'Stepping stone' for transcontinental migrants, immediate action is required to preserve this special wetland environment in order to conserve the waterbird. Farmers and locals should be made aware of the need to preserve the wetland Pokkali rice prawn culture. Since the growing method used is distinct and also to conserve the nature and the migratory birds (Deepa & John ,2017).

Understanding the habitat needs of Near Threatened species, such as the Darter, and using them as instruments to preserve wetlands of breeding and foraging significance are two reasons why this work is crucial for conservation. The study is clear that the YBP wetland restoration offers an excellent feeding and nesting environment. To determine the elements influencing nest-site selection and the reasons why the available habitat for nesting is unacceptable, these sites must be identified and thoroughly studied. This will aid in the creation of future policies for the management and conservation of wetlands and has a significant impact on any conservation measures that are put into place. Due to the abundance of prey species, vegetation for roosting and nesting, and minimal disturbance, the recently restored YBP in the River Yamuna floodplain offers appropriate habitat, maximizing Darters' nesting (Niangthianhoi & khudsar,2015).

#### IX. CONCLUSION

Oriental Darter (*Anhinga melanogaster*) which is globally near threatened is mostly found in area with more vegetation (Chaudhari et al,2009). Oriental darters are active throughout the day so it's simple to study the behaviour .It selects habitat with plentiful water (Surya &Raju,2023).The wetlands with less human interference have high biodiversity and large number of Oriental darter .Sometimes invasion of new species like Great Cormorant can be a national menace (Begum, 2015).Depth of the wetland plays an

important role for waterbirds as waterbird like Oriental Darter prefers deep waterbody which is a part of their preying strategy(Mardistuti ,2022). Area with more vegetation and less human interference like Kumarakom Heronry Kerala has more chances of being chosen by Oriental Darter as its habitat, nesting and breeding purposes (Greeshma &Jayson,2020). Pokkali Prawn cultivation is a sustainable, most eco-friendly, organic agriculture method. Chemical pesticides and fertilizers are not required for a good yield so this season of prawn cultivation had highest number of Waterbirds including Oriental Darter so awareness should be spreaded which will help to increase the population of globally near threatened Oriental Darter.

#### REFERENCE

- [1] Babu, S., Thomas,K. (2023). FEEDING ECOLOGY OF NEAR THREATENED ORIENTAL DARTER (*Anhinga melanogaster*) IN THE POKKALI WETLANDS OF ERNAKULAM DISTRICT, KERALA, INDIA, (2023). International Journal of Creative Research Thoughts (IJCRT),11(2).
- [2] Barve, S., &Warrier. R., (2013). Bird diversity of Sharavathy landscape Karnataka. *Indian BIRDS*, 8(3).
- [3] Begum, M., (2015). The study of biodiversity of water birds in the Suruwila lake region of Anawilundawa Tank Sanctuary (Ramsar Convention), Srilanka, *Species*, 12(36), 111-116.
- [4] Chaudhari, U.K., Kafle, G., and Baral, H.S. (2009). Avifaunal Diversity of Khata Corridor Forest. *Journal of Wetlands Ecology*, 2, 48-56.
- [5] Chaudhury, A. (2016). Bird observations from Valmiki Tiger Reserve, Bihar. *Indian Birds* ,11(3).
- [6] M., A. (2021). Waterbird community in Pulau Rambut Wildlife Sanctuary, Jakarta Bay: Review on species composition and population size after thirty years. *Earth and Environmental Science*.
- [7] M., D, M. John G. (2013). GLOBALLY THREATENED SPECIES OF BIRDS RECORDED FROM POKKALI WETLAND, KERALA, SOUTH INDIA. *Journal of Global Biosciences*, 6(9).
- [8] Narayanan, Prasanth, S., & Thomas, A. P. (2016). Feeding rate and diet of the near threatened Oriental darter *Anhinga melanogaster* in kuttanad wetlands of Kerala, India. *Global Biosciences*, 5 (1), 3450-3460.
- [9] Narayanan, S. P., & Vijayan, L. (2007). Status of the colonial breeding waterbirds in kumarakom heronry in Kerala, Southern India. *Podoces*, 2 (1), 22-29.
- [10] Narayanan, S. P., Sreekumar, B., Vijayan, L., & Thomas, A. P. (2012). Status of the nest of near threatened Oriental darter *Anhinga melanogaster* at kumarakom heronry. *Natl. Acad. Sci. Lett.*, 35 (2), 99-101.
- [11] Narayanan, S.P., Thomas, A.P., and Sreekumar, B., (2011). Ornithofauna and its conservation in the Kuttanad wetlands, southern portion of Vembanad-Kole Ramsar site, India. *Journal of Threatened Taxa*, 3(4), 1663–1676.
- [12] Niangthianhoi, S. L., & Khudsar, F. A. (2015). The nesting success of the Oriental darter *Anhinga melanogaster* (Aves: Suliformes:Anhingidae) in the Yamuna Biodiversity Park ,New Delhi ,India. *Threatened Taxa*, 7 (14), 8148-8153.
- [13] P, G., & Jayson, E. A. (2020). Great cormorant *Phalacrocorax carbo* in kumarakom heronry, Kerala, India, with observations on Oriental darter *Anhinga melanogaster*. *J.Bombay Natural His.Soc.*, 117.
- [14] Silva, E. I.P., Prabhath,M.C., and Sumanarathne, A.R.(2017). SPECIES DIVERSITY AND ABUNDANCE OF AVIFAUNA IN AND AROUND AN URBANIZED LAKE SITUATED AT PERALANDA - RAGAMA, NORTH COLOMBO - SRI LANKA. *WILDLANKA*, 5(2).
- [15] Vargiya, D.,Chakraborty A. (2019). The status of waterbird populations of Chhaya Rann Wetland Complex in Porbandar, Gujarat, India. *Journal of Threatened Taxa*, 11(10).
- [16] Verma, A. (2008). Occurrence and abundance of waterbirds at Bundh Baretha reservoir, Bharatpur, north-western India. *Indian Birds*, 4(5).