Breeding ecology of the Little Cormorant *Microcarbo niger* in northern Bangladesh

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Abstract

From 2017 to 2023, we conducted a study on the breeding ecology of the Little Cormorant *Microcarbo niger* across north and northeast Bangladesh. Employing direct observations and passive camera-trapping, we identified 186 active colony sites: 147 breeding and 39 night-roosting colonies. The breeding colonies were primarily observed in heavy human-use wetlands, with the highest colony concentrations around the Ganges Tributaries (56 colonies) and the Haor Basin (46 colonies). Of the 22,892 nests we counted, 42.12 % were in the Haor Basin and 26.69 % in the Ganges Tributaries. Nest construction took place between May and August, while breeding occurred between May and October. Nest diameters, for 42 nests, ranged between 23–31 cm, and each held 3–5 eggs. Of these, 27 nests produced at least one fledgling. The average length of eggs, for 83 eggs, was 4.35 cm (± 0.18) and the average breadth was 2.84 cm (± 0.07) on average. The incubation period lasted 24–29 days, with fledging occurring after 35–45 days. Nest counts exhibited a strong positive association with both tree numbers and average tree height per colony site. However, there was no significant regional differentiation nor did cormorants show any preference for native trees. The study highlights the species' adaptive plasticity in semi-natural and peri-urban wetlands. The findings emphasize the importance of tree height, proximity to water, and nesting site integrity for breeding success, underscoring the role of preserving groves in Bangladesh's human-modified wetlands.

Introduction

The Little Cormorant *Microcarbo niger* is a small waterbird of the cormorant family Phalacrocoracidae. Spread across South and Southeast Asia, it is one of three cormorant species in Bangladesh (Siddiqui et al. 2008; IUCN Bangladesh 2015). Little Cormorants are highly versatile and can thrive in various aquatic habitats. Despite having a widespread distribution and being classified as Least Concern (Billerman et al. 2020). According to Grimmett et al. (2011), Little Cormorants are colonial nesters that frequently build shared or single colonies at village edges. These colonies are typically developed in trees or big shrubs near or above water bodies, protecting them from terrestrial predators and providing access to feeding places (Kazmierczak 2000). The Little Cormorant typically breeds during the monsoon season, generally between June and October. During the breeding period, males approach females with courtship actions such as wing fluttering, neck stretching, and vocalizations (Naher et al. 2009). Nests are constructed of simple plant materials, such as twigs, leaves and other plant materials (Ali & Ripley 1983). Females usually lay 3–5 eggs per clutch. The bluish-white eggs are incubated by both parents for 15 to 21 days (Naher et al. 2009. The timing of breeding ensures abundant food for the offspring's survival and growth (Naher 2014). Food supply, predation pressure are reported to impact the Little Cormorants' breeding success. Human activities like habitat degradation, pollution, and hunting threaten breeding colonies. Conservation is vital for protecting these areas and ensuring the species' survival (Naher 2014).

Old-World cormorants, such as Great Cormorants *Phalacrocorax carbo* and Socotra Cormorants *P. nigrogularis*, have been studied for a long time in other locations (Lorentsen et al. 2022). In Bangladesh, there are studies on the Little Cormorant's population and breeding biology (Naher & Sarker 2004; Naher et al. 2009). According to Naher and Sarker (2004), in the Brahmaputra-Ganges-Meghna confluence, breeding activity spans between May and October. The major nesting trees include exotic and native trees, such as *Albizzia procera*, *Mangifera indica*, *Ficus spp.*, *Strebulus asper*, and *Cocos nucifera*. Naher et al. (2009) mentioned bamboo groves (*Bambusa spp.*) to be the highly preferred nesting sites of Little Cormorants in northern Bangladesh, adjacent to North Bengal, India (Fig. 1).

However, no comprehensive study has been carried out in the country regarding the spatial distribution of colony sites and the plant species association with the species' nesting activity. The more-than-decade-old findings in Bangladesh however warrant an update. Understanding the Little Cormorant's breeding ecology might help address knowledge gaps on understudied species and provide critical information for wetland conservation efforts. To that end, in this study, we examined the spatial distribution of Little Cormorants and their nest-site association with plants. We further provided a detailed account of its breeding biology based on observations carried out in northern and north-eastern Bangladesh.

Material and Methods

The research was conducted in 24 districts (second-order administrative units) (Fig. 1). The study area includes a vast expanse of cultivated lands and wetlands. It also contains two Ramsar sites (the Tanguar and the Hakaluki Haor), two major rivers (the Ganges and the Brahmaputra), and eight Important Bird Areas. Data collection was carried out between March 2017 and December 2023, totalling 345 field days (13–15 days per district). In addition to field visits and semi-structured focus-grouped discussions, media reports (print, electronic, and social media), eBird checklists, and networking with various citizen scientists were also attempted to identify colony locations. All field visits were conducted by the first author between 2017 and 2023.

Upon identifying a colony, the number of nesting sites, nesting adults, number of nests, stage of nesting, and nesting trees were counted. Independent colonies were defined if they were distinct from neighbouring nest clusters for at least 400 m or separated from other groups by a significant habitat discontinuity (Watts & Watts 2018). Field observations were made using a pair of binoculars, a spotting scope, GPS, measuring tape, scale, and digital slide calipers. Tree height was measured with a laser rangefinder (Trupulse 200x laser). Breeding activity of certain pairs was monitored with close circuit cameras (Tapo C310 129E) upon the availability of electricity, otherwise with passive infrared camera traps (GardePro and Scout guard). If any young/chicks or at least one adult were in the nest, the nest was categorized as active or occupied (Bibby 2000). Population estimates were done on the total count of active nests during a breeding season (May–October). A census was conducted during the peak of their nesting period to determine the number and distribution of nests (N pairs). Active nests were counted by a team of observers who moved systematically through the colony, recording the tree number, tree species, nest height, and number of nests. Each tree containing a nest was marked with a unique number tag. Every tree examined was marked with tree marking paint to avoid repeated counts. The coordinates of all nesting sites are mapped with ArcGIS 10.5 software.

Fig. 1. Distribution map of the colony sites and key habitats of colonial waterbirds in the study area i.e., 24 districts of Rajshahi (Ganges Tributaries), Rangpur (Teesta Tributaries), Mymensingh (Northern Bangladesh), and Sylhet Divisions (Haor Basin).

Morphometric measurement of nest building, clutch size, nesting successes, and breeding successes followed (Katuwal et al. 2022). Barve et al. (2020) was used as the guideline for visiting the cormorant nests. These were extracted at 42 marked nests located in the districts of Naogaon, Sylhet, Sunamganj, and Moulvibazar. We installed a total of 14 camera traps but got detailed information on nest building, incubation, hatching, fledgling, etc., from six camera traps. We did not get information from the rest due to camera thefts and camera malfunctions.

To assess the association between cormorant nests colony size and various habitat variables, we fit a regression model with the number of nests per colony site (No. of Nest) as the response variable, and 1) trees per colony site (No. of Trees), 2) the average height of trees per colony site (Average Height), 3) tree type (categorical, Exotic or Native), and 4) region (categorical, Teesta Tributaries, Chalan Beel, Haor Basin, northern Bangladesh near south-central Meghalaya (India), and Ganges Tributaries; based on the distribution of waterbodies) as explanatory variables. When plotted for visualization, and tested for variance-to-mean ratio, the response variable appeared extremely right-tailed and over-dispersed (score 1.6) respectively. Following Zuur & Ieno (2016) we fit the regression with a negative binomial error structure. According to Zuur & Ieno (2016) we first checked the Pearson's correlation coefficient (cutoff value, $r = |0.7|$) and the Variance Inflation Factor ($VIF > |3|$) for correlation between our numerical explanatory variables. To avoid plugging in outliers in the modelling, we used 136 colonies that had up to 100 nests. We hypothesized that there would be a positive association between colony size and the number and height of nesting trees (indicators of healthy village and/or peri-urban groves). We also hypothesized that colony size would be negatively associated with exotic trees and positively associated with native tree species and a positive relationship with density of waterbodies. The full model was No. of Nests ~ No. of Trees + Average Height + Tree Type + Region (https://github.com/lynx025/Little-Cormorant-Breeding-Biology.git).

Results

Status, distribution and abundance

A total of 247 colony sites were identified, of which 186 were active colony sites and the rest were abandoned (Fig. 1). Of the active colony sites, 79.03% (n =147) were breeding colonies, but the remaining colony sites, 20.96% (n = 39), were used for roosting. The age of the active nesting sites ranged from 2 to 150 years old (19.78 ± 27.99, n = 147), except for one colony site at Nilphamari District which was reported to be up to 200 years old by the locals.

The highest number of active breeding colonies was identified in the Rajshahi Division or the Ganges Tributaries (n = 56), followed by the Sylhet Division or the Haor Basin (n = 46), the Rangpur Division or the Teesta Tributaries (n = 32), and very few colonies in the Mymensingh Division or northern Bangladesh bordering Meghalaya, India (n = 20) (Fig. 1). Among the four divisions, the highest percentage of nests was found in the Sylhet Division (42.12%, n = 9,641), followed by Rajshahi (26.69%, n = 6,111), Mymensingh (19.43%, n = 4,447), Rangpur (11.76%, n = 2,693) (Fig. 2A).

A total of 22,892 nests were counted in 147 colonies, and all of them were associated with human settlement and surrounding human-dominated wetlands. The colony size exhibited significant variation, ranging from 3 to 2,005 nests (155.72 ± 276.40) per colony (Fig. 2B).

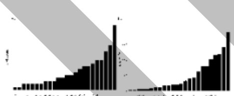

Fig. 2. No. of active breeding colonies (A) and total nests (B) observed in the districts of four regions surveyed during the study period.

Nesting site characteristics

The highest number of nesting sites and nests was counted in paddy field-dominated habitats (91 colonies and 10,400 nests) and wetland habitats (30 colonies and 9,777 nests). Of 147 colonies, only ten were in a single-species colony, and the rest of them were in mixed-species colonies associated with egrets, herons *Egretta/Ardea sp*., darters *Anhinga sp.*, and storks *Anastomus sp.* A total of 22,892 nests were counted in 147 colonies, and all of them were associated with human settlement.

Inferences from modelling

Results indicate that the number of trees per colony site significantly and positively correlates with the number of nests (β = 0.08, SE = 0.02, $p < 0.001$, Fig. 3A), as does the average tree height per colony site (β = 0.10, SE = 0.03, $p < 0.01$ Fig. 3B). The effect of exotic tree types was negative but nonsignificant (β = -0.10, SE = 0.17, $p = 0.548$). Among regions, none showed significant associations with nest numbers, although the Ganges region showed a trend toward fewer nests compared to the reference region (β = -1.09, SE = 0.44, $p = 0.14$). These findings highlight structural tree characteristics as key predictors of Little Cormorant nesting, while regional differences and tree type appear less influential (Table 1). Fig. 3 shows the relationship between the number of nests per colony and the variables with significant effects.

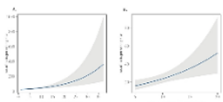

Fig. 3. Inferred positive and significant relationship between the no. of nests per colony site and the no. of trees (A), and the average tree height (m) per colony site (B)

Table 1. Summary of the negative binomial regression to test for an association between the number of nests per colony and colony site characteristics. The modelling was based on the nest counts of 136 colonies observed between 2017 and 2023 in Bangladesh.

Parameter	Coefficients (log scale)	Standard error	95% confidence interval		Z-value	P-value
			lower	upper		
Intercept	2.51	0.34	1.85	3.20	7.43	< 0.001
No. of trees per colony site	0.08	0.02	0.04	0.12	5.02	< 0.001
Tree type [exotic]	-0.10	0.17	-0.43	0.23	-0.60	0.548
Average tree height per colony site	0.10	0.03	0.02	0.13	2.81	0.005
Region [Ganges]	-1.09	0.44	-1.95	-0.20	-2.47	0.14
Region [Haor]	-0.28	0.28	-0.84	0.22	-1.03	0.304
Region [North Bangladesh]	-0.14	0.36	-0.83	0.53	-0.41	0.684
Region [Teesta]	-0.20	0.29	-0.78	0.34	-0.69	0.491

A total of 2,276 plants of 48 plant species were identified at 147 cormorant colonies (Table 2). Plant species were both exotic and native. The most preferred exotic species were Mahagoni *Swietenia mahagoni* (30.04%, n = 6,876), False Ashoka *Polyalthia longifolia* (4.83%, n = 1,107), Raintree *Brunfelsia sp.* (3.23%, n = 740), Silk Tree *Albizia* sp. (2.54%, n = 581). Of the native trees, the Burflower-tree *Anthocephalus indicus* (4.12%, n = 945), Indian Tamarind *Tamarindus indica* (2.17%, n = 498), Bamboo *Bambusa* spp. cluster (21.14%, n = 4,840), Mango *Mangifera indica*, (9.48%, n 2,171), Kures *Dalbergia reniformis* (7.57%, n = 1,734), Sacred Barna *Crateva religiosa* (1.07%, n = 451) were most preferred by cormorants the least used tree was Coconut *Cocos nucifera* 0.01%, n = 3). Generally, cormorants preferred tall trees for their nests, with an average height of 5–15.28 m (mean 9.85 ± 2.28 SD, n = 2,276). The lowest height of the cormorant nesting site was 3.6 m observed for a colony at a Bamboo *Bambusa* spp. cluster, and the highest height was 22 m observed for the colony at an Indian Tamarind tree. Table 2 provides a detailed account of colony per tree species.

Table 2: Nesting tree/plant species preferences based on the total count of nests and tree species

Plant species	No. trees/plants	No. of nests
Akashmoni *Acacia auriculiformis*	40	384
Arjan *Terminalia arjuna*	39	288
Ata *Annona squamosa*	2	18
Babla *Acacia nilotica*	8	13
Bakul *Mimusops elengi*	2	37
Bamboos *Bambusa* sp.	464	4840
Barun *Crateva religiosa*	21	451
Boroi *Ziziphus mauritiana*	2	22
Bot *Ficus* sp	11	274
Chalta *Dillenia indica*	4	50
Coconut *Cocos nucifera*	3	3
Debdaru *Polyalthia longifolia*	65	1107
Domur *Ficus glomerata*	3	41

Khajur *Phoenix dactylifera*	10	27
Kodbel *Limonia acidissima*	1	19
Koroch *Dalbergia reniformis*	196	1734
Koroi *Albizai* sp	29	581
Kuma *Lepisanthes senegalensis*	3	44
Lichu *Litchi chinensis*	1	14
Mahagoni *Swietenia mahagoni*	556	6876
Mahua *Madhuca longifolia*	1	3
Mango *Mangifera indica*	339	2171
Minzium *Acacia mangium*	12	56
Neem *Azadirachta indica*	7	65
Epil *Leucaena leucocephala*	3	45
Eucalyptus *Eucalyptus* sp	12	74
Gab *Diospyros discolor*	1	7
Ghora Neem *Azadirachta indica*	1	6
Ghoraneem *Melia azedarach*	3	27
Hijal *Barringtonia acutangula*	4	30
Jackfruit *Artocarpus heterophyllus*	36	170
Jalpai *Elaeocarpus serratus*	1	4
Jam *Syzygium cumini*	33	258
Jarul *Lagerstroemia* sp	8	34
Jiga *Lannea coromandelica*	2	11
Joytun *Olea europaea*	1	10
Kadam *Anthocephalus indicus*	137	945
Pakur *Ficus rumphii*	24	330
Pitali *Trewia nudiflora*	40	358
Pitraj *Aphanamixis polystachya*	2	17
Raintree *Brunfelsia* sp	48	740
Shatim *Alstonia scholaris*	2	19
Shegun *Tectona grandis*	1	14
Shimul *Bombax ceiba*	2	16
Showra *Streblus asper*	9	67
Supari *Areca catechu*	28	29
Tal *Borassus flabellifer*	7	65
Tetul *Tamarindus indica*	52	498

Breeding ecology

Nest construction began in May and continued until August. Breeding occurred between May and October. The nest size was about 27.2 cm (± 2.11, N=42), but the inner part or cup size was 14.1 cm (± 0.97, N=42). Male and female cormorants, upon formation of pairs, participated in copulation and together built rather simple oval nests composed of twigs, grasses, and different plant materials in trees or shrubs.

The Little Cormorant, during the survey period, laid 3–5 eggs, with the interval of laying being 1–3 days. Table 3 details the clutch size observed in these 42 nests. The oval to elongated eggs were white or bluish-white but became brownish when incubated for some days. The length and diameter of the egg varied from 3.46–4.67 cm and 2.71–3.02 cm, respectively. The egg was incubated by both parents, which took around 24–29 days. This shared incubation allowed one parent to guard the nest while the other foraged for food. The incubation/hatching success was 74.85% and 61.07% of the eggs laid resulted in successful fledging (Table 3) .

Table 3: The fate of nest, eggs and breeding success of the Little Cormorant observed during the survey period

Item/Criteria	Number	(%)

Number of nests examined	42	-
Number of eggs counted	167	-
Number of eggs lost to predation	7	4 %
Number of eggs to unhatched	16	10 %
Number of eggs lost by storm	19	11 %
Total egg mortality	42	25.0%
Total number of successfully hatched eggs (hatching success)	125 (eggs/chicks)	75 %
Nest with eggs destroyed by storm	2	5 %
Nest Predation	2	5 %
Nest with fledgling destroyed by storm	3	2 %
Total number of nests with viable fledgling	35 nests	83 %
Number of chicks/fledglings lost by storm/fallen from the nests	19 chicks/fledgling	15 %
Fledgling predation	4	3 %
Total fledgling mortality	23	18 %
Total number of survived fledglings	102	82 %
Overall/final breeding success (Number of individuals survived successfully in ratio to clutch size or total eggs laid)	-	61 %

After hatching, the chicks were altricial. Chicks remained in the nests until 19 to 23 days post hatching, at which time they began to move from the nest regularly for the next 9–12 days, returning to the nest for feeding. Both parents fed the chicks by regurgitating partially digested food into their mouths. The fledglings were given small fish for nourishment at the age of about 20 days, and as they grew, they were given larger prey items (Fig. 4). Fledglings became completely independent after about 31–40 days. Predation attempts by Rats *Bandicota sp.* and Fishing Cats *Prionailurus viverrinus* on cormorant eggs and chicks were observed during the study period (Fig. 5).

Fig. 4. Small (A, B, C and D) and large (E and F) food items of the chicks of Little Cormorant [observed in Sylhet Division (the Haor Basin Region)]

Fig. 5. Predation on Little Cormorant chicks captured in camera traps. Top Row (A and B): before and during predation by the Rat *Bandicota spp.* Bottom row (C and D): before and predation by the Fishing Cat *Prionailurus viverrinus*. Both events were captured in the Halla Haor, Barlekha, and Moulvibazar. The latter event was reported by Sadik & Akash (2024).

Discussion

Understanding the habitat preferences of common waterbirds such as the Little Cormorant is crucial for wetland conservation and management. Little Cormorants are known to be relatively tolerant of human presence and can often be seen in urban and rural water bodies. These anecdotes matched our field observations as well as inferences made from modelling. The cormorants did not show any regional-level differences in nest number per colony site or exhibit any dependence on native trees. However, we observed abandonment of breeding colonies between 2019 and 2023. The drivers behind these observations warrant further assessment.

Cormorants were frequently observed nesting in mixed-species colonies, usually in trees or big bushes (bamboo, palm) near or overhanging water. This behaviour was reported by Smythies (1953), Ali & Ripley (1987) and Begum (1997). Our investigation found 147 active nesting sites, 137 of which were mixed-species colonies associated with egrets, herons *Egretta/Ardea sp*., darters *Anhinga sp.*, and storks *Anastomus sp*. This colonial nesting, both mixed and mono-species, provides added protection from predators through the collective vigilance of the colony. Little Cormorants are known to use the same nesting sites repeatedly if the conditions remain favourable (Ali & Futehally 1967). We found seven colony sites that are said to have been used for more than 100 years. Nesting in colonies also helps predator deterrence due to the 'safety in numbers' effect. In our observation, the breeding season started in May and continued to October, but the peak breeding period occurred from July to August. Similar observations were observed by Whistler et al. (1949), Smythies (1953), Begum (1997), Siriwannichkul (1981) in India, Myanmar, Bangladesh, and Thailand respectively. The breeding season, however, may vary geographically but generally coincides with the monsoon season. In Kerala, India, for instance, the breeding season for Little Cormorants typically extends from February to July (Jayson 2001) with the peak breeding period between June to August (Roshnath & Sinu 2017; Girija et al. 2021).

We documented a large diversity of trees at colony sites compared to previous studies. This was likely due to the large spatial extent of our study area. Observing eight colony sites in Bangladesh, Naher (2014) reported ten different species used as a nesting substrate; all of the species were found to be used in this study as well. However, Naher (2014) found bamboo as the most preferred nesting tree, with nesting heights ranging from 8.84 to 10.66 m. In this study, the Mahagoni appeared to be the most preferred tree species. Furthermore, there is no significant effect of whether the tree species is native or exotic on the number of nest sites of cormorants.

All breeding colonies were within or very near to a human settlement. Although since in the non-breeding season, these birds do spend the night outside of the human settlement, it is unclear whether their preference for nesting near human settlements is because of fewer predators or because of other habitat characteristics (Watts & Watts 2018). These observations, coupled with the modelling estimated effect of the number of trees and average height of trees per colony site demonstrates the importance of saving groves of tall trees in villages and peri-urban area for wetland birds.

Our observations on the nest-building period in Little Cormorants were similar to those of Ali & Ripley (1967) and Naher et al. (2009). However, Begum (1997) observed it to be 4 to 6 days. According to Naher et al. (2009), the outer diameter of the nests was 19–45 cm (mean 27.15 ± 5.8, n = 20), but the inner diameter of the cup ranged from 9–20 cm (mean 14.3 ± 2.8 SD, n = 20). The clutch size of 3–5 eggs (mean 3.97± 0.52, n = 42) matched the description of Siddiqui *et al*. (2008). However larger clutches of 2–6 (3.75± 0.8, n = 20) eggs was observed by Naher *et al*. (2009). The interval of laying eggs was 1–3 days, and the same observation was made by Naher et al. (2009) and Begum (1997). The clutch size is normally 2 to 5 eggs, sometimes up to 7 eggs (Whistler 1949; Ali and Ripley 1968; Ali 1977; Barnes 1981).

Several studies have mentioned egg-colour variation in Little Cormorants. Newly laid eggs are bluish-white and become brownish or yellowish as incubation continues (Naher et al. 2009); eggs have also been reported to be pale green (Jerdon 1862) or white or bluish-white (Barners 1981; Begum 1997). The mean dimension of eggs was reported to be 4.3x2.8 cm and 4.5x3.0 cm by Naher et al. (2009), 4.48x2.9 cm by Ali & Ripley (1968), 4.5x2.9 cm by Siddiqui *et al*. (2008), and 4.4x2.8 cm by Begum (1997). The same observations were made by Naher et al. (2009), Begum (1997), and Ali & Ripley (1987). Several studies reported the incubation period of Little Cormorants to be 22–26 days (Siriwannichkul 1981; Begum 1997; Kopciewicz et al. 1999). All of these findings matched with our observations. In contrast to Naher et al. (2009), who reported the incubation period of 14 to 21 days, our data showed that incubation generally took 24 to 25 days and in some cases 29 days.

We observed an egg mortality rate of 25.15% in ratio to clutch size. Earlier studies showed 13.74% egg mortality (Naher et al. 2009) and 36.82% (Begum 1997). In our study, the incubation/hatching success was 74.85% (n = 125). Hatching success was reported to be 86.26% by Naher et al. (2009), 63.15% by Begum (1997), and 80% by (Kopciewicz et al. 1999). The fledgling period was between 17–29 days in the study of Naher et al. (2009), 35–42 days in Siriwannichkul (1981)and 39–45 days (Begum 1997) in comparison to our observation of 31–40 days.

We documented a 15.2% mortality due to falls from the nest or food competition between young and 3.2% mortality due to predation by mammalian predators (Table 3). Fledgling mortality due to similar reasons was reported (Subramanya & Manu 1996; Kopciewicz et al. 1999; Jayson 2001). Naher et al. (2009) reported a mortality rate was about 23.3% due to destruction by locals. Begum (1997) reported 25% mortality due to predation (12.5%) and other natural causes (12.5%). Little Cormorants' nesting colonies are vulnerable to predation by aerial predators (crows, kites), snakes, and rats (Jayson 2001).

Little Cormorants are not considered globally threatened, although nesting habitat deterioration, poison baits, and commercial hunting are impacting their populations (IUCN Bangladesh 2015). These waterbirds, along with other ardeid species, are indicators of the health of human-dominated wetlands (Sarlin et al. 2022). Conservation measures, thus, may involve the protection of crucial breeding and foraging sites, as well as the prevention of hunting, chick theft, and poisoning. Conservation efforts should thus be directed at limiting disturbances in crucial breeding areas to avoid colony abandonment. To ensure shared space with humans, buffer zones can be established around major nesting places. Pollution reduction in water bodies is also essential for maintaining healthy fish populations and overall ecosystem health. Raising awareness in local communities is further recommended for the conservation and protection of habitats for the Little Cormorant and other waterbirds.

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