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Distribution, Population, Habitat, Feeding, Roosting, and Breeding Biology of Black-headed Ibis (*Threskiornis melanocephalus*): A Review

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Abstract: The Black-headed Ibis (BHI) *Threskiornis melanocephalus* is a large white-water bird with a long, downcurved black bill and a prominently exposed black head and neck. It is sporadically distributed in the oriental region of Earth. Waterbirds are key indicators of the quality and importance of wetlands. They preferred a wide variety of habitats, including freshwater and salt-water marshes, lakes, and ponds, as also rice fields, freshly ploughed crop fields, irrigation canals, riversides, reservoirs, urban lakes, open sewage gutters, grazing lots, and garbage dumping sites, etc. for both feeding and non-feeding activities. BHI diets are extremely diverse; they typically consume invertebrates, small fishes, amphibians, reptiles, animal carcasses, mammals, vegetable materials, and domestic waste. The breeding season of BHI is from June to October. BHI built 'platform nests', which consisted of an irregularly placed, loose assemblage of twigs and sticks but sometimes they also use threads and pieces of plastic bags, grass, and Green plant material and built on top of *Acacia*, *Prosopis*, and *Ficus* trees in or near wetlands. The major threats are hunting by stray dogs, disturbance by human settlement, agricultural conversion, collection of eggs and nestlings, and cutting down of trees used for breeding and roosting. Habitat destruction, urbanization, artificial lightning and noise, bird-vehicle collision, pollution, invasion of exotic species, tourism, and eutrophication cause negative impacts on water bird's survival, including the BHI.

Keywords: Black-headed Ibis, Waterbird, Microhabitats, Diet, Breeding, Threats

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Introduction

Ciconiiformes order of class Aves includes 29 families comprising 1027 species of Herons, Storks, Spoonbills, Shoebills, and New World

vultures (Including the Andean Condor). Threskiornithidae, a family of big wading birds, has 34 species. The family is divided into two

subfamilies: ibises and spoonbills. Before, it was thought that spoonbills were related to Ibises and other long-legged wading birds in the order Ciconiiformes. Ibises, long-legged wading birds possess a long, downward curving beak (del Hoyo *et al.*, 1992). Black-headed Ibis *Threskiornis melanocephalus* Latham, 1790 is commonly known as Oriental White Ibis, Black-necked Ibis and Oriental Black-necked Ibis. Based on locality and language, many names of Black-headed Ibis (BHI) are used in India such as, Sapheda bajha (in Hindi), Bujja (in Rajasthani) and Saratika (in Sanskrit) (Ali and Ripley, 2007). The BHI is a large (65–75 cm long), wading, nomadic, and white-water bird. It has a long, downward-curving black bill and a prominently exposed black head and neck. The species has a strong and extended body. Both the male and female BHI are identical in size and appearance and both have grey decorative feathers on their tails. During the breeding season, bare regions under the wings turn into brighter red colour (Hancock *et al.*, 2001). Juveniles differ from adults in their plumage, size, coloration of naked body regions (such as the legs, head, neck, and underwing), and morphological features (Ali and Ripley, 2007). In mature Ibis, the top of the head and throat are completely black and have no feathers (Beckmann *et al.*, 2015). Few individuals of BHI were seen with red-colored patches on their hindneck in Nelapattu Bird Sanctuary Nellore (Andhra Pradesh, India) (Kannan *et al.*, 2010; Gupta *et al.*, 2012). A total six individuals of BHI were sighted with red patches, three with large patches covering the hind neck, and others with reduced patches from the Vadodara district of Gujarat, India. A detailed study on the availability of food makes a carotenoid-rich diet of birds and other factors causing such colour development during the breeding season (Tere, 2023). The IUCN conservation category of BHI was Least Concerned (LC) till 2000 but from 2004 it became Near Threatened (NT) (Kumar, 2006). The species is included in the Near Threatened (NT) category by IUCN (BirdLife International, 2017). State of India's Birds (SoIB) report- a brief review. Black-headed Ibis and Oriental Darter *Anhinga*

melanogaster are categorized as 'Globally Near Threatened Species'. In SoIB both the bird species are categorized as 'Low priority' species (Maitreyi, 2024).

Distribution and Population status:

Avian population densities can be influenced by the singular or interactive influences of predation, intra- and inter-specific resource competition, parasites, diseases, habitat availability, and weather conditions (Andrewartha *et al.*, 1954; Begon and Mortimer, 1986). The birds can be found in terrestrial as well as aquatic habitats, both marine and fresh waters. The Indian subcontinent has 1300 avian species and around 22% are dependent on wetlands.

Black-headed Ibis is a widespread resident throughout India (Grimmett *et al.*, 2011) and has a wide global range extending from Pakistan to Myanmar and sporadically to China and Japan (Ali and Ripley, 1987; Soothill and Soothill, 1989; Hancock *et al.*, 2001). In eastern India, it is relatively rare while farther east in Bangladesh and northeastern India, it is known only from sporadic records (Kazmierczak, 2000). Its distribution in India depends on the availability of water and food (Ali and Ripley, 2007).

On December 6, 2007, there were two flocks (20+ and 18+) of Oriental White Ibis sighted at Kaziranga, Assam (Choudhary, 2012). At the 40 wetlands in southern Rajasthan, India, total 288 adults BHI and 15 juveniles in 2008 and 286 adults BHI and 10 juveniles were counted in 2009 (Koli *et al.*, 2013).

Approximately 580 individuals (496 adults and 84 juveniles) and 643 individuals (547 adults and 96 juveniles) were counted in six districts of southern Rajasthan in 2016 and 2017, respectively (Choudhary and Koli, 2018). The first observation of the BHI was in Virar, Taluka Vasai, Palghar, Maharashtra, India (Gautam and Aras, 2020). At three villages (Dighal, Gochhi, and Chhochhi) in Jhajjar district, Haryana, India, 60 flocks consisting of 248 individuals (adults and

juveniles) of BHI were observed (Anjali and Rana, 2022).

Habitat preference:

This species prefers large marshes and jheels with wide areas of water covered with bushes and trees (Whistler, 1949). The BHI is very versatile being able to use a large variety of natural and man-made habitats. These include freshwater and salt-water marshes, lakes and ponds, as also rice fields, freshly ploughed crop fields, irrigation canals, riversides, reservoirs, urban lakes, open sewage gutters, grazing lots, and garbage dumping sites. Wetlands saw the majority of sightings during the summer and winter, while the rainy season saw the greatest aggregation in sewage pipes and grazing regions (Choudhary and Koli, 2018).

Feeding ecology:

Generally, food availability is the single most important factor governing different aspects of the ecology, distribution, and breeding biology of the birds. They are primarily carnivorous birds that eat aquatic invertebrates, small fishes, amphibians, reptiles, and mammals as food (Carrick, 1959; Morris, 1973; Vestjens, 1973; Cowling, 1974). Sometimes they also eat vegetables and domestic wastes.

The time it takes for them to ingest a food item indicates how long it takes them to handle their prey successfully without losing a substantial quantity of energy (Krebs *et al.*, 1972). Colony nesting birds follow other birds of the colony to the feeding grounds to find prospective feeding places (Ward and Zahavi, 1973).

The Black-headed Ibis (BHI) was primarily recognized for probing. Depending on the type of prey, the type of hard or soft substrate, the depth of the prey available, and the movement and density of the prey, several probing strategies were used. However, the Animal Dead Bodies Dumping Station (ADBDS) produces a visual feeding niche as a result of the high density of prey on the surface of the substratum, which may help adopt different foraging grounds (Kahl, 1964; Kushlan and Kushlan, 1975).

A study on the feeding ecology and foraging behaviour of BHI will provide the necessary information about the availability of prey and quality of foraging sites to develop a long-term conservation strategy (Choudhary, 2012).

BHI feeding on carcasses:

In the Udaipur district of Rajasthan, on February 24, 2016 at Ekling or Kailashpuri Lake, three BHI were eating the carcass. In another instance, three BHI feeding on the carcass of a cow on 11 March 2016 at Udaisagar Lake, Udaipur, along with Cattle Egrets *Bubulcus ibis* (Chaudhury and Koli, 2016).

The maximum number of BHI uses the aquatic foraging microhabitats. BHI is a wetland bird; it remains on the feeding site throughout the daytime. The BHIs arrived half an hour after sunrise and left the site half an hour after sunset. During foraging, the BHI is engaged in various activities; mainly feeding, resting, preening, and scanning for predators (vigilance) (Senma and Acharya, 2018).

The BHI was eating molluscs, crustaceans, insects, and worms (Jerdon, 1864; Mason, 1911) but also eating fish (Mano, 2023), turtles (Jayamoorthy, 2023), Common Smooth-scaled Water-snake *Enhydris* (Khan and Patnaik, 2018; Dawn, 2023; Roy, 2023), frogs (Roy, 2023) and animal carcass (Choudhary and Koli, 2016; Sadiwala, 2023).

Roosting ecology:

The Ibis is a large large-sized water bird, and easy to count individuals at roost sites when the species aggregates as per its communal roosting habitat (Salimkumar, 1982). Some birds use communal roosts to get protection from predators, while others use them to learn about the availability of food (Weatherhead, 1983). Aggregation of the Ibis is larger and more stable at the roost than on the feeding grounds (Chavda, 1988).

In Bhavnagar (Rajkot), the morning departure of the Ibises from the roost was mainly biased towards exploiting foraging ground, which

resulted in a clump of birds leaving the roost site in a particular direction in a shorter period. However, during the evening, the arrival of the Ibises at intervals happened to take a longer period to fill the roost with almost an equal number of birds (Gadhvi, 2001). BHI roosting and breeding colonies are known as “heronries or egretries” and are located in and near wetlands, frequently in combination with other Ciconiiform and Pelecaniform wetland birds (Balakrishnan and Thomas, 2004).

A total of 50 roosting sites were observed in six districts of southern Rajasthan, wherein 26 were in rural and 24 were in urban areas. About 336 Black-headed Ibis (BHI) and 328 BHI were found in urban and rural areas respectively. BHI was roosting with other birds such as egrets, herons, other Ibis species, and storks (Choudhary, 2018; Koli *et al.*, 2019).

Nesting and Breeding Biology:

Of the three populations of the BHI found globally, the East Asian population is alarmingly small, with an estimate of less than 100 individuals. The Southeast Asian and South Asian population of this species is estimated at 10,000 and 25,000 individuals each (Rose and Scott, 1997).

The breeding of BHI at the Pulau Dua Nature Reserve (Banten Bay, West Java). On *Rhizophora apiculata* and *Avicennia marina* trees, there were a total of 11 and 26, nests, respectively (Noor and Hasudunpn, 2000). The number of Oriental White Ibis (OWI) in zoological collections should be increased for several reasons, including the diminishing population of OWI in the wild, the tiny number of OWI under human care, and the paucity of information regarding this Ibis. Experience gained over 33 years (since 1882) at Opel-Zoo Kronberg has demonstrated that OWI is extremely adaptable, even to the climate of central Europe. OWI is reproducing successfully and can produce multiple broods of parent-reared offspring each year, even in tiny groups, if appropriate nesting locations and food are available. For instance, during a single season at Opel-Zoo, the females in

a group of 7.3 OWI laid at least 14 eggs in seven nests. From the eggs, twelve chicks hatched (Beckmann *et al.*, 2015).

Only a few nesting colonies of BHI are known from India. Only the Gujarat state in the western half of India (Tiwari and Rahmani, 1998; Gadhvi and Soni, 2006; Senma and Acharya, 2010) recorded nesting. A total of 50 pairs of White Ibis were seen constructing and repairing nests at the Bhavnagar, Gujarat, India. The sexes may be distinguished from one another and identified during the nidification based on differences in body size, particularly the bills' size (Gadhvi and Soni, 2006).

The nest sharing between two ‘near threatened’ heronry species Painted stork *Mycteria leucocephala* and BHI at the Indroda Nature Park (Gandhinagar, Gujarat, India). The nest was built by Painted stork on a neem tree (*Azadirachta indica*). The eggs were first laid by the Painted Stork and then after a gap of 6 days, egg-laying was done by the BHI. The incubation was done by both species alternatively. However, BHI could incubate the eggs only in the absence of the Painted Stork (when it was away for feeding) and could spend only 20–30 min (in the evening) for incubation, as it was chased away by the Painted Stork on its arrival back to the nest. However, the nest was vigorously monitored by both species. The nest was monitored for 40 days, till the hatchlings emerged from the eggs. The Painted Stork had successful nesting as both the eggs were incubated successfully after 29 days. The eggs of BHI did not hatch, may be due to insufficient time spent by it for incubation. Later, the eggs of BHI were damaged by the Painted Stork nestlings and were eaten (Theba and Vyas, 2013).

The breeding of a near-threatened BHI in Karnal (Haryana, India). The colony contained 425 nests including Little Egrets *Egretta garzetta* and Cattle Egrets. The second known breeding place in the state is the village pond in Jhanjhari (Dwevedi *et al.*, 2018).

In two districts of southern Rajasthan (India), Udaipur and Dungarpur, seasonal wetlands were found to have the greatest number of nests, along with eight other species of waterbirds. The most preferred nesting tree species were “Vilayati babul *Prosopis juliflora*” and “Babul *Acacia nilotica*”, with Cattle Egrets being the most frequently associated nesting species (Choudhary and Koli, 2018).

Eight prospective locations in the Bhavnagar (Gujarat, India) metropolitan area offer multi-species heronries the finest ecological circumstances, protection, and climatic conditions for breeding. Five heronry bird species namely Painted stork, Little Cormorant *Phalacrocorax niger*, Black-headed Ibis, Eurasian Spoonbill *Platalea leucordia*, and Red-naped Ibis *Pseudibis papillosa* breeds at these sites (Gohel *et al.*, 2021).

The first BHI nesting site in Kerala state, India discovered in 2002 is the Panamaram. The nests were composed of sticks and twigs and located on top of bamboo trees (7 + 0.45 m in height) (Balakrishnan and Thomas, 2004).

The second nesting report of BHI in Kerala, India about 64 nests were recorded in this heronry from June to September 2004. Nests situated on the *Flagellaria indica* and *Sonneratia caseolaris* mangrove trees (Narayanan *et al.*, 2006). The breeding of BHI has been reported at Mavoor marsh, Kozhikode (Kerala, India). During September, there were 10 nests, two with two chicks each, and 3-4 nests were under construction (Shifa, 2021).

A new breeding site record of Oriental White Ibis (Aves: Threskiornithidae) is at Thirunavaya wetland, Malappuram (Kerala, India). This wetland is primarily an uncultivated paddy field and is located near Bharathappuzha (Kerala's second-largest river). In October 2021, four nests of Oriental White Ibis, three nests of Asian openbill Stork *Anastomus oscitans* and one nest of Oriental Darter situated on the freshwater mangrove *Barringtonia acutangula* trees (Chullakattil, 2022).

At Naxalbari, foothills of Darjeeling, (West

Bengal, India), about 120 nests of BHI were situated on the Mango (*Mangifera indica*), White Fig (*Ficus citrifolia*), and Banyan (*Ficus benghalensis*) trees. All these trees were situated close to the human habitation. There were approximately 465 adults, sub-adults, and juveniles in total in 2020. Around 350 individuals were counted overall in 2021. In contrast, roughly 400 individuals were counted overall in 2022 (Pal *et al.*, 2023).

The breeding success of Oriental White Ibis observed in captivity at Arignar Anna Zoological Park (Vandalur, Tamil Nadu, India) (Devkar *et al.* 2006). In each nest of Oriental White Ibis contain 2-4 eggs. The typical incubation period in captivity was found to be between 27 and 29 days. Considering that egg-laying took place during all four study phases, observations suggest that the breeding season of Oriental White Ibis in captivity lasts the entire year. A protracted breeding season that lasts practically the entire year may be caused by the absence of natural predators in captivity environments and an abundance of food and water. It is recognized that extrinsic factors, such as adequate rainfall and familiarity with foraging sites, favor reproduction in its natural habitat (Devkar *et al.* 2006).

Total 145, 143, and 138 nests of BHI were observed in 2004, 2005 and 2006, respectively in Bhitarkanika mangroves, Odisha. BHI was observed to nest away from most of the species within the heronry, forming sub-colonies on their own. The Ibis, though it arrives last in the heronry, tends to nest in the central location by displacing established nests of smaller birds like Great Egret *Casmerodius albus*, Intermediate Egret *Ardea intermedia*, and Little Egret (Gopi and Pandav, 2013).

The availability of food and protection in captivity may have contributed to the summer breeding season. Midway through January, the Ibises in the aviary engaged in courtship rituals and mating activities. During the nesting season, there were enough sticks and twigs available in the aviary. Due to the aviary's inhabitants

increased energy requirements during the nesting season and to assure the survival of hatchlings, more food (namely freshwater fish) was offered inside. Moving about the aviary was also restricted for zookeepers and keepers were assigned specifically to keep an eye on the birds and give them the attention they needed (Bindya *et al.*, 2019).

The nest of the BHI is a platform made of twigs and sticks that are covered in grass and threads and built on top of *Acacia*, *Prosopis*, and different types of *Ficus* in wetlands and nearby wetlands. It typically gathers resources for nesting from trees, although threads and fragments of plastic bags have also been observed (Senma and Acharya, 2010).

Throughout the whole copulatory process in Oriental White Ibis, the male maintained a bill lock with the female. When the male and female were in the proper posture, they both expanded their wings horizontally and the female shifted her tail laterally to reveal her cloaca. The male gave the female a "cloacal kiss" by pressing its cloaca against theirs. The copulatory period lasted for roughly 5 min and six cloacal kisses, each lasting between 4-12 sec. Additionally, it was observed that the male bird needed a longer time to balance on the female back than it did to make cloacal contact (Roshnath *et al.*, 2013).

During the breeding season of BHI at Nehru Talai (Bhilwara, Rajasthan), four different cases of Lek-based polygyny were observed in which older males forcefully mate with younger females (Sharma and Tripathi, 2024).

Black-headed Ibis breeds in or during rainy seasons (Ali and Ripley, 2007). Breeding season of Black-headed ibises usually ranges between November and March in India (Ali and Ripley, 2007). However, the breeding season of Black-headed ibises also varies based on the geographical location and local climatic conditions. Numerous of study has been carried out on the various breeding aspects of black-headed ibis including the breeding seasons; for

example Kerala, in July to September (Balakrishnan and Thomas, 2004; Narayanan *et al.*, 2006; Aarif and Basheer, 2012; Roshnath *et al.*, 2013; Shifa, 2021); January to March (Bindya *et al.*, 2019) and June to September (Chullakattil, 2022); in West Bengal March to October (Pal *et al.*, 2023); in northern India, June to August (Ali and Ripley, 2007); and late June to October in Saurashtra region (Gujarat), depending on the onset of monsoon (Sinhji, 1955); January to September (Devkar *et al.*, 2006); June to October in Rajasthan state (Theba and Vyas, 2013; Choudhary and Koli, 2018).

The Black-headed Ibis took less than one week from the nest initiation date to egg laying. Black-headed Ibis had the largest clutch size (n=4) and had the smallest clutch size with less than 2 eggs per nest. Incubation started soon after the first egg laying. Black-headed Ibis incubation duration is 25-29 days. Productivity in terms of hatching and fledgling success was very low (<50%) for most species, especially for the Black-headed Ibis in the breeding colony since it was established that centre and edge nests differed in terms of breeding success (Coulson, 1968; Balda and Bateman, 1972; Brown and Brown, 1987).

Green plant material was also recorded in active nests. Under harsh conditions, green material is expected to shield eggs and nestlings (Newton, 1979; Collias, 1997; Mertens, 1980). In 2019 and 2020, a total of 296 and 202 nests of BHI were observed, respectively in six different wetlands of Bhilwara district, Rajasthan, India. Nests were primarily on the top canopy of *Acacia nilotica*, *Prosopis julliflora*, *Ziziphus mauritiana*, and *Salvadora persica* trees (Sharma *et al.*, 2021).

The delayed pairing was observed in only one abnormal morph out of sixteen abnormal morphs. Two eggs were laid by this female which formed pair with normal morph. Two offsprings were developed in due course of time (Sharma and Tripathi, 2023).

The impact of redneck patterns on its breeding was observed. The males with these patterns

attract the females soon through their courtship or the males were more attractive to the females with the patterns. In BHI, the pair formation was done within 2-3 days but red-neck individuals started nest building by making pairs in less time than normal individuals. The redneck patterns were dark before/during pair formation, but the darkness gradually decreased from nest building to further events. So, after that, the patterns become light-coloured (Sharma and Tripathi, 2024).

Threats and Conservation Issues:

Their populations have been predicted to be declining across their range due to drainage, disturbance, pollution, agricultural conversion, hunting, and collection of eggs and nestlings (del Hoyo, 1992). The research on birds has demonstrated that there is a decrease in bird existence, abundance, and species richness in the vicinity of roadways. Comparatively, this reduction is greater close to busy highways than less busy ones (Spellerberg, 1998).

According to conservation biology, bigger animals are more vulnerable to endangerment than smaller ones. Large, fleshy wading birds like herons, ibises, storks, and flamingos can be easily spotted in the suitable areas and are therefore typically well-liked by people (Hancock *et al.*, 2001).

Numerous birds, largely native, died in collisions with moving vehicles, and this number has been steadily rising over time (Erritzoe *et al.*, 2003).

Around 58.4 million hectares of India come under wetlands and most problems in India's wetlands are related to the human population. One of such groups whose population is declining at a fast rate is storks and ibises. Waterbirds are key indicators of the quality and importance of wetlands (Erwin and Custer, 2000) but anthropogenic activities in wetlands and surrounding areas also harmed waterbirds distribution. The rapid decline of BHI population

occurs due to hunting habitat destruction and degradation and agricultural pollution (Pattanaik *et al.*, 2008; Choudhary, 2012).

Bird species richness and abundance are reduced close to roadways. Various engineering measures to lessen traffic noise disruption on people, such as noise-reducing tires, engines, and pavements, may not lessen the effects of roads on birds. If the traffic fatality hypothesis is true, preventing bird deaths by vehicles will be necessary to mitigate the consequences of roads on birds. Such methods would entail the installation of devices that require birds to fly above the level of traffic when they cross highways, as an alternative to removing roads and/or reducing traffic volumes (Summers *et al.*, 2011).

The conservation of ornithofauna is being done in the Kuttanad Wetlands, which are located in the southern part of the Vembanad-Kole Ramsar Site. Tourism, sewage and industrial pollution, eutrophication, cutting down of trees used for breeding and roosting, hunting and alien plant overgrowth etc. are the main risks to wetland birds (Narayanan *et al.*, 2011).

Rapidly declining populations of BHI in Indonesia:

In the Indonesian province of Southern Sumatra, there were 735, 607, 244, 103, 10, and 11 BHI in 1984, 1985, 1986, 2001, 2002, and 2003, respectively. On October 31, 2008, only one BHI was seen on the Banyuasin Peninsula in South Sumatra. In 2008-2009, no birds were spotted in the provinces of Aceh, North Sumatra, Riau, and Lampung. This means that the BHI exclusively exists historically and currently on Sumatra's east coast. Hunting, drainage-related disturbance of breeding colonies, and agricultural alteration of foraging habitats were major factors into the decline of the population of BHI in southern Sumatra (Iqbal and Hasudungan, 2012).

Artificial light and noise have indirect effects on the biorhythms of birds, affecting their development, singing, mating, breeding, and

migration (De Molenaar *et al.*, 2006; Morelli *et al.*, 2014).

Urbanization, habitat fragmentation, habitat destruction and agriculture intensification for rising population demands are the main threats to birds in Pakistan. The use of fertilizers, pesticides, and insecticides to boost crop protection, eutrophication, animal grazing, illicit hunting, and pollution, among other things are accelerating the extinction of bird species in Punjab, Pakistan's tropical thorn forest (Altaf *et al.*, 2018).

The greatest risks to the BHI colony are human encroachment on the village pond, garbage disposal, eutrophication, and road expansion. For the protection of this colony, a community-based conservation and monitoring system is recommended. Blue-green algae and water hyacinth (*Eichhornia sp.*) were eutrophicated and polybags were observed floating in the pond (Dwevedi *et al.*, 2018).

Urbanization affects the patterns of the association between avian species and area; insights from the breeding birds of Rome. C-values, or the number of species per unit area, decline as urbanization increases. This suggests that urbanization reduces avian diversity. Urbanization slows species accumulation from rural to suburban areas, while urban areas had a greater α than suburban ones, may be because of the lack of green space in inner cities. Their method of representing urbanization levels as the percentage of impervious surface from remote sensing imagery is straightforward and may be applied to almost any metropolitan region (Di Pietro *et al.*, 2021).

Some natural threats like stray dogs (3-5 dogs per site) and excessive growth of weeds like *Eichhornia sp.* (Water Hyacinth) and *Ipomoea aquatica* (Water Morning Glory) which reduces BHI feeding stations seem to be universal at all the three villages (Dighal, Gochhi, and Chhochhi) in Jhajjar district, Haryana, India (Anjali and Rana, 2022).

Conclusion

The Black-headed Ibis is a large white-waterbird with a long, downcurved black bill, a prominently exposed black head and neck and grey ornamental feathers on their tails. During the breeding season, bare patches under the wings turn into brighter red colour. Both the male and female BHI are similar in size and appearance.

The redneck pattern on the hindneck of BHI helps in the courtship of both males and females to promote quick pairing, resulting in increased breeding success of BHI. The abnormal morph of BHI failed to form a pair like normal morph during the breeding cycle due to its abnormal structure. Further genetical analysis suggested DNA Barcoding Method which can detect genetical changes between normal and abnormal morphs. These kinds of abnormal morphs are formed due to abnormal embryonic development.

The polygynous nature of BHI is advantageous for the male because he has a much higher chance of his progeny surviving, which means he is passing on his genes to more individuals.

The distribution of BHI in the oriental region depends on the availability of water and food. BHI used different microhabitats including freshwater and salt-water marshes, lakes and ponds, as also rice fields, freshly ploughed crop fields, irrigation canals, riversides, reservoirs, urban lakes, open sewage gutters, grazing lots, and garbage dumping sites, etc. for both feeding and non-feeding activities but varied in number. Seasonal wetlands were the most preferred site during the rainy season, while during the winter and summer seasons, perennial wetlands.

The species is primarily carnivorous and eats aquatic invertebrates (Molluscs, Crustaceans, Insects, Worms, Larvae from grass and ruminant fecal materials), small fishes, amphibians (frogs), reptiles (Indian flap-shell Turtles and Common Smooth-scaled Water-snake), animal carcasses, and small mammals as food. Sometimes they also eat vegetables (Cereal) and domestic waste.

BHI roosting colonies are located in and near wetlands, frequently in combination with other wetland birds such as Cattle egret, Glossy Ibis *Plegadis falcinellus*, Great egret, Little cormorant, Indian cormorant *Phalacrocorax fuscicollis*, Indian Pond heron *Ardeola grayii*, Painted stork, Oriental Darter, Asian openbill stork, and Eurasian Spoonbill.

The breeding of BHI was recorded in many states of India such as Kerala, Gujarat, Maharashtra, Andhra Pradesh, Tamil Nadu, Odisha, Karnataka, Rajasthan, Haryana, and West Bengal. The Black-headed Ibis start their nesting in mid-June and the peak time of nesting was found in the first week of August during which the maximum number of active nests were recorded. The end of nesting was observed in mid-October when the last nestlings left nests.

Both sexes are involved in nest building but males collect nesting material and offer it to females who build nests and built on top of *Acacia*, *Prosopis*, and *Ficus* trees in or near wetlands. The Black-headed Ibis built 'platform nests', which consisted of an irregularly placed, loose assemblage of twigs and sticks. The major portion of the nesting materials belonged to the tree on which the nest was located. The nesting materials other than twigs and sticks such as a small number of threads and pieces of plastic bags, grass and Green plant material were also recorded from the active nests in wetlands and nearby wetlands.

Several courtship behaviors like display preening, bill popping, head rolling, display shaking, head quiver, display flight, posture for balance, bowing display, bill shaking, and cloacal kissing were displayed after pairing. In the heronry of BHI, several waterbird species such as Little Cormorant, Great Egret, Cattle Egret, Night Heron *Nycticorax nycticorax*, Oriental Darter, Eurasian Spoonbill, Asian Openbill Stork, Little Egret, and Painted Stork form their nests.

Black-headed Ibis had the largest clutch size (n=4) and had the smallest clutch size with less than 4 chalky white eggs per nest. The average

timing per incubation was 20 sec to 4 min and the average duration of incubation was 20-22 days.

The major threats are hunting by stray dogs, disturbance by human settlement, agricultural conversion, collection of eggs and nestlings, and cutting down of trees used for breeding and roosting.

Conflict of Interest

The authors declare no conflicts of interest.

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