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Population Size, Behavior and Threats to Indian Skimmers (*Rynchops albicollis*) at their Largest Known Wintering Site

DELIP K. DAS^{1*}, NAIM KHANDAKAR¹, IRIN SULTANA^{1,2}, MOHAMMAD SHAMSUDDOHA³,
ASHIK JAHAN GALIB³, FARHANA AKHTAR⁴ AND THEUNIS PIERSMA^{5,6,7}

¹Department of Zoology, Faculty of Life and Earth Sciences, Jagannath University, Dhaka-1100, Bangladesh

²National Center for Biological Sciences, Bangalore, India

³Wildlife Conservation Society, Bangladesh

⁴428/B, Khilgaon Chowdhury Para, Dhaka-1219, Bangladesh

⁵Rudi Drent Chair in Global Flyway Ecology, Conservation Ecology Group, Groningen Institute for Evolutionary Life Sciences, University of Groningen, PO Box 11103, 9700 CC, Groningen, The Netherlands

⁶NIOZ Royal Netherlands Institute for Sea Research, Department of Coastal Systems, PO Box 59, 1790 AB Den Burg, Texel, The Netherlands

⁷Global Flyway Network, PO Box 3089, Broome, Western Australia 6725

*Corresponding author; E-mail: bisharga1095@gmail.com

Abstract.—Bangladesh hosts most of what is left of Indian Skimmer (*Rynchops albicollis*) populations, a globally endangered species. Each October–March from 2015–2020, 21 surveys of nonbreeding birds were made in Nijhum Dweep National Park, Bangladesh. High tide or evening roosts were counted from vantage points whenever a build-up or breakdown of skimmer concentrations was noticed, and site use noted by marking all observations of presence and activity on maps. The largest single count was 3,108 skimmers on 18 February 2020, constituting 30–50% of the known global population. Indian Skimmers mostly occurred in Damar Char West and at the tip of the Majher Char. Throughout the day with incoming tide, skimmers moved between preferred roosting areas to forage in the shallows. We describe a unique group-foraging strategy in which skimmers chase fish from deep water to shallow water along the shoreline. Circling high over the tidal channel, the flock of skimmers dives down in unison to just above the water surface, then spreading like a net towards the shore. Raptors caused disturbances to roosting skimmers, and we observed one instance of predation of a skimmer by a White-bellied Sea Eagle (*Haliaeetus leucogaster*). Human fishing activities disturbed nearshore foraging and shoreline roosting skimmers. We suggest protecting Damar Char West by regulating human activities to minimize disturbance from December to March. *Received 13 September 2020, accepted 3 October 2021.*

Key words.—Bay of Bengal, Central Asian Flyway, East Asian–Australasian Flyway, Important Bird Area, Indian Skimmer, Marine Protected Area, Meghna Estuary, *Rynchops albicollis*.

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Only three species of skimmers are found worldwide. All of them occur in large, sandy, slow-flowing lowland rivers, lakes, and marshes during the breeding season and in estuaries and coasts during the non-breeding season. Indian Skimmers (*Rynchops albicollis*) have been listed as a Globally Endangered species by IUCN Redlist (BirdLife International 2020), once widespread in the major river systems of Pakistan, India, Bangladesh, Myanmar, and South-East Asia along the Mekong River, but now mostly confined to Bangladesh and India (Das 2015; Mundkur *et al.* 2017; BirdLife International 2020). This is a consequence of habitat fragmentation and degradation of lowland river and lake sys-

tems throughout much of their range (BirdLife International 2020).

At present, India is the last remaining breeding ground for Indian Skimmers, where they mainly breed in Ganges (Ankit *et al.* 2018; Mital *et al.* 2019), Chambal (Das 2015), Son (Dilwar and Sharma 2016) and Mahanadi rivers (Debata *et al.* 2017). Bangladesh is the last remaining stronghold for nonbreeding Indian Skimmers in winter, and > 1,000 skimmers can still be seen in Nijhum Dweep National Park in the south-central coast of the country annually (Islam and Khan 2005; Das 2015; Das *et al.* 2020a). In Nijhum Dweep, 5,400 skimmers were reported in 2001 (Li *et al.* 2009) and

3,200 skimmers in 2008 (Thompson *et al.* 2018), the highest counts across its range in the last 20 years. Yet, Mohsanin (2014) reported a 90 % decrease of Indian skimmers in Bangladesh between 2000 and 2013, and the species is now considered Critically Endangered by IUCN Bangladesh (2015). Any form of protection or management, however, is hindered by specific ecological knowledge (Rahmani 2012; Debata *et al.* 2017; Das *et al.* 2020a).

As a first step toward gaining ecological knowledge, we here report our observations on the numbers, site use, and the occurrence of foraging and roosting as a function of tide and time of day in nonbreeding Indian Skimmers in the Nijhum Dweep National Park from the 2015-16 to the 2019-20 winters (Oct – March). Additionally, we describe a unique group-foraging behavior observed at the site, as well as existing threats to skimmers at the site to inform specific conservation actions.

METHODS

Study Area

Nijhum Dweep National Park (Fig. 1; 22° 03' 51" N, 91° 00' 03" E) encompasses an area of 16,358 ha and is located in the Meghna Estuary on the Bay of Bengal on the south-central coast of Bangladesh (See details in Das *et al.* 2020b). The park is within the Ganges-Brahmaputra-Meghna delta, which is recognized as an Important Bird and Biodiversity Area (IBA) for migratory birds using the East-Asian Australasian Flyway and the Central Asian Flyway (Islam and Khan 2005; BirdLife International 2020). Damar Char, within Nijhum Dweep National Park, is the only site in Bangladesh where large flocks of Indian Skimmer have regularly been observed during the last 10 years (Das *et al.* 2020a).

Even though Nijhum Dweep National Park is a protected area, > 12,000 people (BBS 2014) inhabit the park. Shoreline and mudflats are extensively used by people for subsistence, mainly for fishing and other wetland ecosystem services. Fishing with long seine nets set with poles along the shoreline is a common practice here, and setting nets demands heavy manpower and hours of work on the mudflat (see online supplement Appendix 1 with photos).

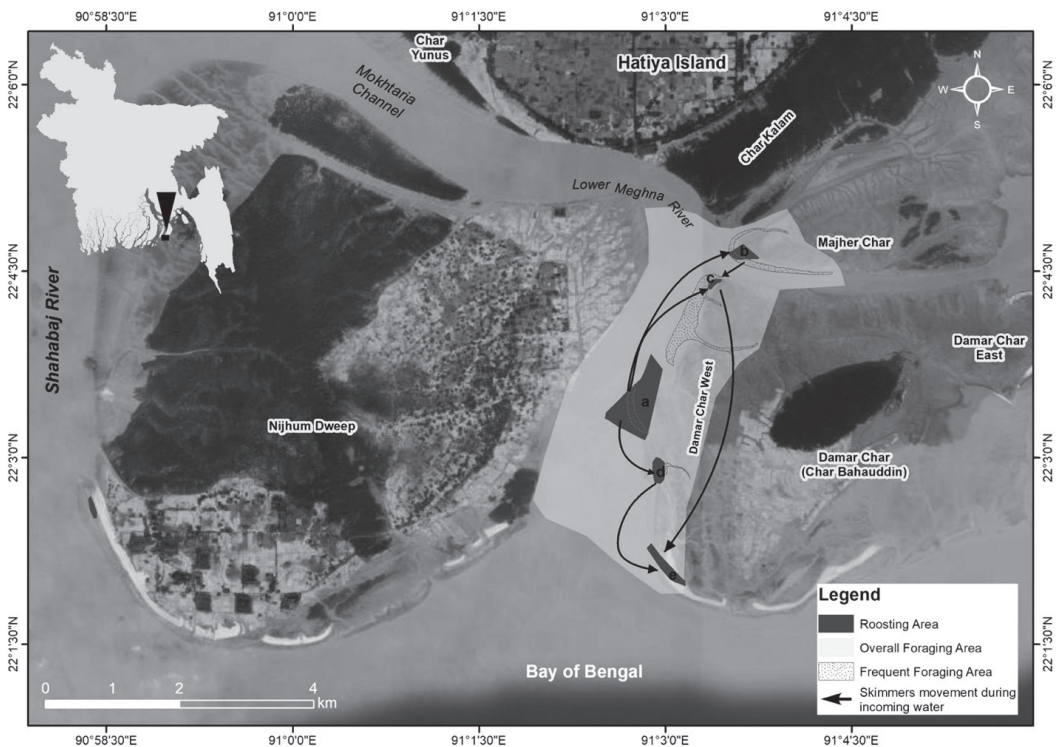


Figure 1. Locations of diurnal roosting and foraging areas of Indian Skimmers (*Rhynchops albicollis*) in the Nijhum Dweep National Park, Bangladesh, along with their general movement pattern during incoming water, from surveys and observations made during winters 2015-16 to 2019-20.

Survey Methods

We divided our study site into four subsites: Nijhum Dweep, Damar Char West, Damar Char East and Majher Char for convenience and conducted monthly surveys during the winter season (October-March) (Fig. 1). We conducted monthly surveys lasting three-five days and visited once per subsite for counting roosts and observing other activities. A motorboat was required for accessing the sites and to function as hides. Roosts were counted from vantage points on shore (Sutherland 1996; Bibby *et al.* 2000) as well as from the boat. Whenever a build-up of large aggregations or breakdown of a concentration of skimmers was noticed, a repeated count was made to determine the size of the roost and to check where they went for site use. To show the importance of the areas, we here report the maximum count per month.

The counts were simultaneously made by multiple observers (two-four persons) and then averaged to reduce individual bias. In total, we made 21 surveys from 2015-16 to 2019-20 winter seasons. Only one survey was conducted in 2016-17 and four counts in 2015-16 and 2017-18 due to lack of funding. However, we counted six times each in 2018-19 and 2019-20 winters. Trials were conducted together at the outset of the study to minimize inter-observer variation. To avoid any disturbances due to presence of observers, we did not approach the birds closer than 100 m. In most cases, we took cover in

a boat (observing from the water) or any other natural hide whenever possible during the data collection.

Behavioral observations were made using 60-80x spotting scope and Garmin eTrex10 GPS unit was used to record the locations of specific behaviors. Site use, foraging activities such as active foraging time, pattern, methods and potential threats such as presence and activities of people, cattle and raptors were recorded.

RESULTS

During the 21 surveys we counted an average of 479 Indian Skimmers (Fig. 2). The highest number of 3,108 skimmers was counted on 18 February 2020 (Table 1). Skimmers arrived in December, half of the population departed by March and the rest later. Most of the time they occurred in Damar Char West and at the tip of the Majher Char. They used these areas for diurnal roosting and crepuscular and nocturnal foraging (Figs. 1 and 2). On rare occasions, we encountered a few skimmers (< 3) on the west side of Nijhum Dweep and in Dama East.

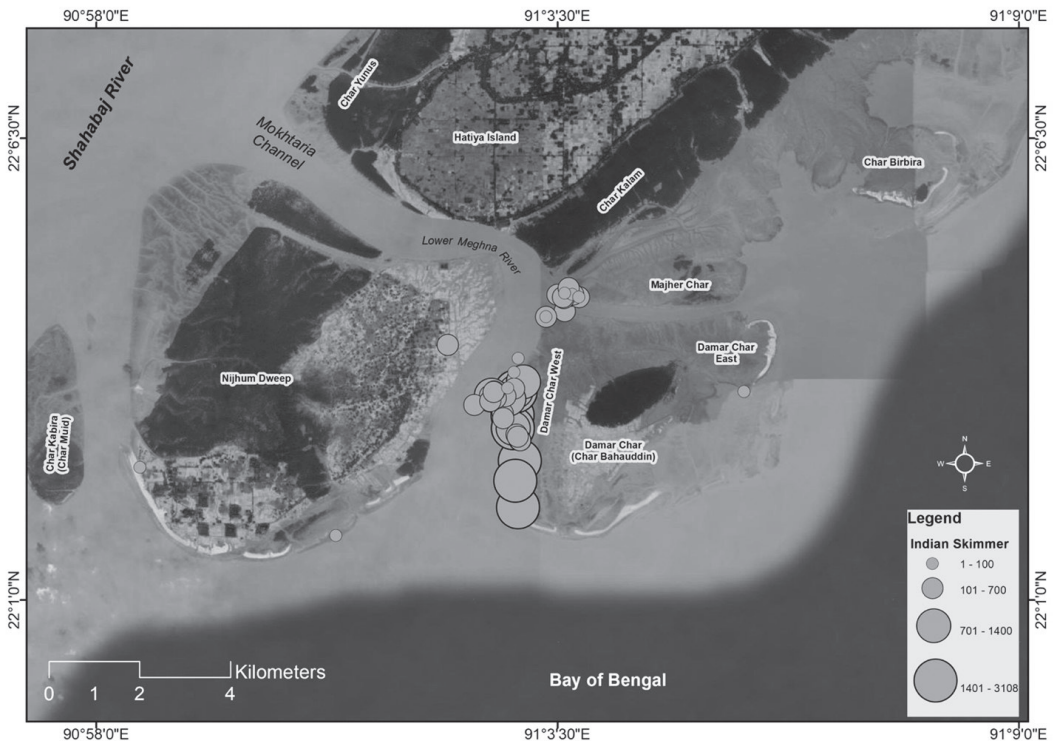


Figure 2. Distribution of Indian Skimmers (*Rhynchops albicollis*) counted as separate flocks during 21 surveys (grey circles) in winters of 2015-16 to 2019-20 in the Nijhum Dweep National Park, Bangladesh.

Table 1. Counts of Indian Skimmer (*Rhychoptis albicollis*) in Nijhum Dweep National Park, highlighting maximum counts in each season and across all seasons, as well as mean count at each site in five winter seasons 2015-2020 (X = area not surveyed).

Sites	2015-2016				2016-2017	2017-2018				2018-2019				2019-2020					Peak of all seasons	Mean								
	Dec-15	Jan-16	Feb-16	Mar-16	Max	Dec-17	Jan-18	Feb-18	Mar-18	Max	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Max	Oct-19			Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Max		
Majher Char	135	339	0	162	339	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	339	30
Nijhum Dweep	X	X	0	X	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	1
Damar Char West	X	X	1286	340	1286	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2200	3108	1600	3108	3108	3108	449
Damar Char East	0	0	X	X	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Total	135	339	1286	502	1625	4	1	0	0	5	0	0	2	0	0	0	0	0	0	0	1	2200	3108	1602	3110	3450	480	

Skimmers roosted on the edge of the waterline. During low water, when mudflats were exposed and there was no disturbance from fishermen, they roosted in the mid-west of Damar Char area near Kheyar Khal (“a” in Fig. 1). Skimmers were found at the south sandbar of Damar Char (“e” in Fig. 1) when other areas were covered by tidal water. Skimmers foraged in small flocks along shallow waters of the shoreline. They were frequently seen to forage in the shoreline water close to the tip of Majher Char (near to “b” in Fig. 1), corner of Dama north end (near to “c” in Fig. 1), and from mid-west to Dama north end shoreline (between “a” and “c” in Fig. 1).

They were also seen to skim along the small channels within the mudflat area, notably when it started to be covered by the incoming tide. Sometimes, skimmers used a group-foraging strategy. The entire flock first circled high over a large part of the channel and, after a couple of rounds, the flock dove to just above the water surface, then spreading like a virtual net and thus approaching the shoreline, catching the fish driven in front of them (Fig. 3). They would repeat this behavior several times. By this process, they chased fish from deep water to shallow water along the shoreline. When the entire mudflats and channels were inundated and water surface was calm, they skimmed up to 1 km from the waterline in the mid-west of Damar Char (shoreline to near “a” in Fig. 1).

Fishing activities in the channels and on the mudflats frequently disturbed foraging and roosting migratory birds including Indian Skimmers. Fishing activities occurred by day and at night in all seasons, and the intensity increased during spring tides. During spring tides, > 50% of the shoreline of Dama West and 80-100% of the shoreline of Majher Char used by skimmers was covered with seine nets. Targeted fishing for mullet (*Rhinomugil corsula* and *Liza parsia*) was another common fishing practice. These nearshore activities were encountered 100% of survey days and were a major disturbance to roosting skimmers. The roosting birds were also disturbed



Figure 3. Illustration of the group-foraging strategy of Indian Skimmers (*Rhynchops albicollis*), during which they chase fish from deeper to shallower water on the shore. Drawing by Farhana Akhtar based on observations at Nijhum Dweep.

by grazing cattle, vessel movements, and people moving in and out of Damar Char. The average distance they allowed humans to approach before being alert and taking flight was 61 ± 16 m with a minimum distance of 49 m.

We recorded the skimmers being disturbed (alert and taking off) by Eastern Marsh Harrier (*Circus spilonotus*), White-bellied Sea Eagle (*Haliaeetus leucogaster*), Peregrine Falcon (*Falco peregrinus*), Greater Spotted Eagle (*Clanga clanga*), Brahminy Kite (*Haliastur indus*) and Black Kite (*Milvus migrans*). Brahminy and Black kites were very common. In our observation of all encounters between skimmers and kites, skimmers responded to flying kites (but not perching kites) by taking off from their roost. Also, some skimmers mobbed kites for distances of 0.5 km. Once we observed a White-bellied Sea Eagle eating a skimmer on the mudflat of Dama West. We did not see the chase but assumed it was actually captured by the eagle.

DISCUSSION

Nijhum Dweep National Park, Bangladesh is a regular wintering site for thousands of skimmers since 1980s (Thompson *et al.* 2018). However, large numbers of skimmers were absent for three consecutive winter seasons 2016-17 to 2018-19 of our study. With maximum counts of 3,000-5,000 skimmers, the study area may thus host up to 30-50% of their global population (Wetlands International 2020).

Skimmer foraging occurrence and roosting locations were predicted on the basis of tidal phase. However, the reasons for the skimmers to select specific areas will require systematic study of feeding opportunities, prey availability, and disturbance patterns. Skimmers are known for their crepuscular and nocturnal foraging (Bhatnagar and Bhatnagar 2009; Winkler *et al.* 2020). They have a unique bill structure and feeding method that restrict them in habitat use.

Black and Harris (1983) quantified feeding habitat in the Black Skimmer (*Rynchops niger*) and found that feeding occurred in shallow water (10-20 cm) far from land (Black and Harris 1983). The latter is reflected in Indian Skimmers foraging in shallow water up to 1 km from the waterline in the mid-west of Damar Char.

Skimmers select mullet (*Mugil* spp.) preferentially (Galib 2017). Although we did not quantify fishermen numbers and effort, in the course of our study we observed an increase both in numbers and intensity of fishing. This opens the potential for resource competition between skimmers and fisherman, which could force skimmers to change wintering sites due to depletion of prey and/or increased disturbance. Assuming that skimmers will eat much less than fisherman fish, we recommend new studies on the impact of mullet fishing on skimmers.

Human disturbances including fishing, walking, cattle grazing, and vessel movements were previously documented by Mohsanin (2014) and Thompson *et al.* (2018). Though we observed a flight response every time a raptor showed up, the only predation attempt was the one by a White-bellied Sea Eagle. White-bellied Sea Eagle feed on fish, aquatic birds and turtles and are also reported to hunt Silver Gull (*Chroicocephalus novaehollandiae*) in Australia (Mo *et al.* 2017). A nest of White-bellied Sea Eagle was present in nearby mangroves and they occasionally foraged in the areas used by skimmers.

Damar Char West is an important and preferred site within the national park for diurnal foraging and roosting skimmers. Disturbance due to humans, nearshore fishing in particular, is increasing, and existing protection in the park is insufficient. We suggest protecting Damar Char West by regulating human activities to minimize disturbance to skimmers from December to March, accompanied by monitoring of the effects of such regulations. We appreciate the socio-economic poverty of the local people and their high dependence on fishing, so recommend sustainable practices to be developed and implemented for vulnerable birds and people to coexist.

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