Expanding the Protected Area System to Incorporate Important Aquatic Ecosystems Project

Final Report

ATLAS ON GANGES RIVER DOLPHIN AND IRRAWADDY DOLPHIN OF BANGLADESH



Prepared by

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Cover photo: Ganges river dolphin in Pankhali, Khulna

Bangladesh Forest Department
Ministry of Environment, Forests and Climate Change

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Executive Summary

Cetaceans are one of the most remarkable aquatic animals on earth. They constitute an important component of aquatic biodiversity in the vast wetlands of Bangladesh. Of the 10 cetacean species reported to occur in the country, the Ganges river dolphin and Irrawaddy dolphin are two significant aquatic mammals – an ideal indicator species to monitor our river's health. To conserve the remaining cetaceans in the country, updated information on their status and distribution are urgently needed. Taking this into account, the Bangladesh Forest Department has initiated the 'Expanding the Protected Areas System to Incorporate Important Aquatic Ecosystems (EPASIIAE)' project with support from the Global Environment Facility through United Nations Development Programme. Under this project, the present study has focused to identify critical winter habitats of the Ganges river dolphin and Irrawaddy dolphin across the country, in order to depict their distribution in the form of an atlas for Bangladesh.

The Ganges river dolphins are found in all of our major river systems including the rivers Padma, Jamuna, Meghna, Halda-Karnafuli and the Sundarbans. In particular, the identified critical winter habitats include Paikerchhara at Dud Kumar river, Gorgachh of Chilmari at Brahmaputra in Kurigram; Silonda-Nagderma in Boral, Nagarbari-Mohonganj in Jamuna; Nazirgonj, Rajshahi T-band, Godagari and Bakorali in Padma river; Bhairab bridge in Meghna river; Halda and Karnafuli rivers; Rupsha-Bhairab-Atai in Khulna and the Sundarbans. Using our survey data, a series of maps have been prepared and presented with geographical information and threats to these species. Our observations suggest that although all of the major river systems support the Ganges river dolphins, some of the tributaries might no longer be suitable for dolphins in winter months, which include Dorla, Teesta, Sangu and Kushiyara rivers among the others. On the contrary, Irrawaddy dolphins are restricted to moderate and high saline zones of the Sundarbans and coastal areas of Bangladesh.

The dolphins are flagship species for river conservation which can benefit not only other aquatic and threatened species sustained in rivers but also will ensure better health of our river ecosystem that will ultimately benefit millions of local communities who survive on aquatic resources. The conservation importance of these species is therefore paramount and our greater efforts are needed on the ground to save these charismatic aquatic mammals of Bangladesh.

CHAPTER I: BACKGROUND

1.1. Introduction

Biodiversity conservation has been an important global issue over decades due to its rapid depletion worldwide. Consequently, the Convention of Biological Diversity (CBD) adopted in 1992 categorically warned about the loss of biodiversity that would affect directly the poorest people of the developing countries who entirely rely upon local ecosystems for their livelihoods. Therefore, aligned with the CBD guidelines as a signatory and recognising the importance of biodiversity as a fundamental natural resource, Bangladesh government have been working with best efforts to conserve the threatened animal species through different programs and strategies as well as adopting various policies, legislations and innovative approaches. As part of these initiatives, Bangladesh has established a network of protected areas under the Wildlife (Protection and Security) Act, 2012 across the country to conserve the rich diversity of wild animals and their habitats. The core protected area (PA) networks encompass 17 national parks and 20 wildlife sanctuaries comprising mostly forests alongside the Swatch of No-ground Marine Protected Area (MPA) in the Bay of Bengal (Fig. 1). Of these, six wildlife sanctuaries have been established specifically for dolphin conservation in the Sundarbans and Padma-Jamuna confluence which altogether cover 1648 ha (BFD, 2017). However, beyond the Swatch of No-ground MPA, the wetland-based protected area coverage including these six 'dolphin' sanctuaries is largely insignificant compare to total PA networks in the country.

The fundamental principle of conserving biodiversity lies with ensuring *in-situ* protection of ecosystems, and the maintenance of viable populations of species in their habitats. Although Bangladesh is a populous country, it still supports a rich biodiversity in its natural habitats. On its aquatic ecosystem, Bangladesh is known to harbour 10 species of cetaceans (IUCN Bangladesh, 2015), including the freshwater Ganges river dolphin surviving on its vast freshwater river systems. The Ganges river dolphin is one of the most beautiful and significant aquatic mammalian species – an ideal candidate of indicator species for our river's health. Although a number of studies have been done on cetaceans in Bangladesh (Smith et al., 2010, 2006, 2001), countrywide status and distribution of dolphins are largely lacking. In order to conserve the remaining cetacean populations and their habitats, field-based population and habitat information are urgently needed. Taking this into account, the United Nations Development Programme (UNDP Bangladesh office) in partnership with the Government of Bangladesh (through the Bangladesh Forest Department) has initiated a project titled 'Expanding the Protected Areas System to Incorporate Important Aquatic Ecosystems

(EPASIIAE)' with support from the Global Environment Facility. Under this project, the present study has focused to identify critical winter habitats in the form of an atlas on the Ganges river dolphin and Irrawaddy dolphin of Bangladesh.

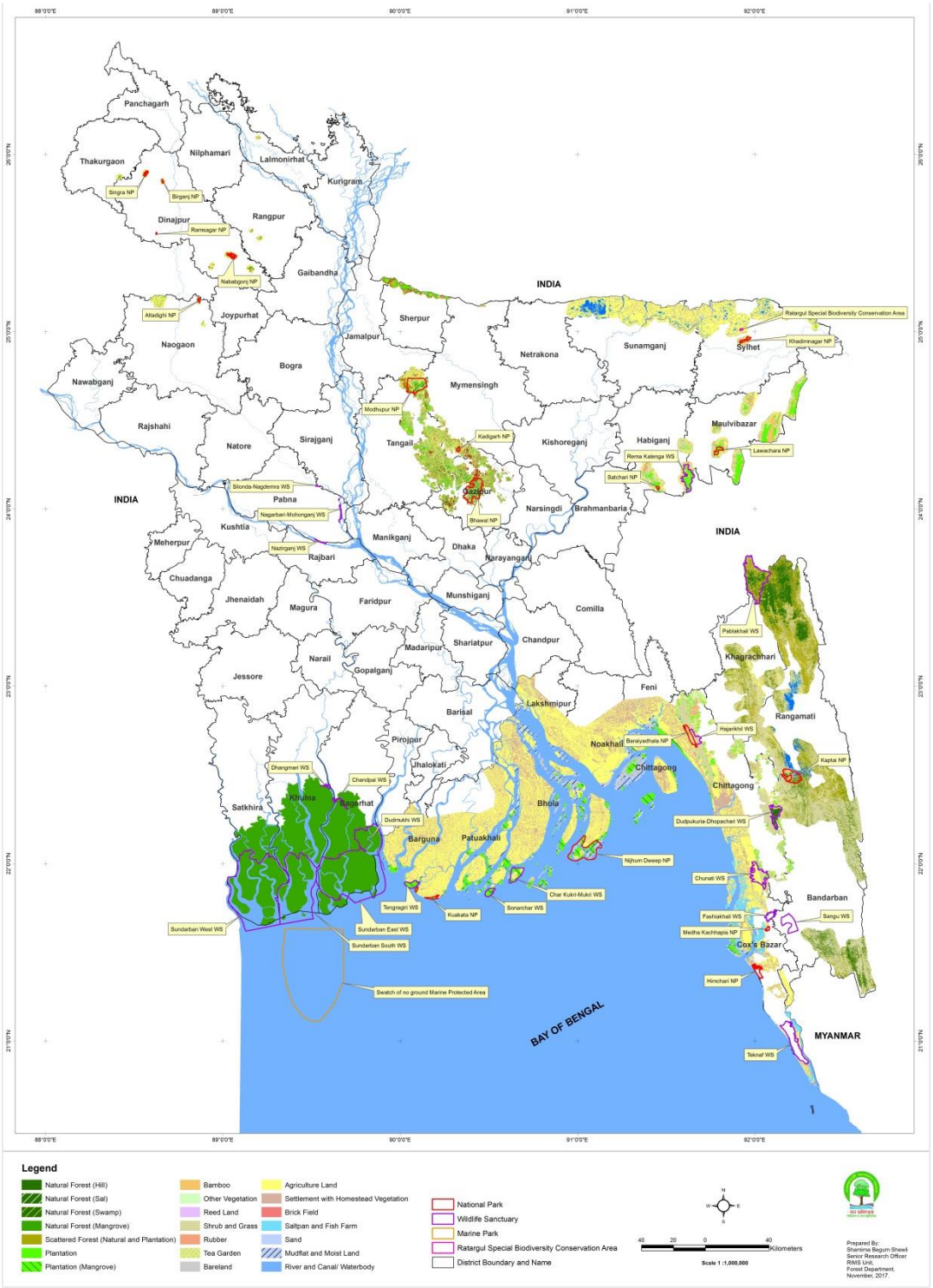


Fig. 1. Protected areas of Bangladesh (BFD, 2017).

1.2. Focal species

The cetaceans constitute an important component of aquatic biodiversity in the vast wetlands of Bangladesh. Bangladesh supports 10 species of cetaceans, of which Ganges river dolphin and Irrawaddy dolphin are two important aquatic mammals. Considering the overall status of biodiversity and unregulated use of natural resources in the country, the abundance of Ganges river dolphin and Irrawaddy dolphin in the remaining habitats are still fascinating. Although there were some levels of previous research and conservation initiatives being done on country's cetaceans, they were mostly confined to the Sundarbans and adjacent coast of Bangladesh, resulting in a major lack of national stocktaking of the cetaceans. To formulate the conservation strategy of any species, the foremost priority is assessing the critical habitat, distribution, population hotspots and anthropogenic pressures. The scientific data on these parameters are critical to *in-situ* conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of the species.

The Ganges river dolphin is an endemic aquatic mammal found only in the Indian subcontinent including the vast waters of Bangladesh. It is a tertiary organism in the food chain and is an important indicator species of our river ecosystem. Although the species is found in almost all major rivers of Bangladesh, north-eastern regions of the Bangladesh Sundarbans have been an important stronghold of this species. This creates a hope of future for this species' survival in Bangladesh. The Ganges river dolphin is a flagship species for river conservation and its conservation can benefit other aquatic species to be conserved as well as wider local communities for their subsistence (Sinha et al., 2010). At the end, protection and maintenance of this species will ensure better health of our river ecosystem that will ultimately benefit millions of local communities who survive on aquatic resources. The conservation importance of these species is therefore paramount and our greater efforts are needed on the ground to save this charismatic aquatic mammal of Bangladesh before it is upgraded on to the IUCN Red List of threatened species.

Two species of dolphins, namely the Ganges river dolphin *Platanista gangetica gangetica* and Irrawaddy dolphin have been considered as focal species for this atlas. The former species is known to occur in freshwater rivers and estuaries whilst the later in the brackish and saline waters, generally across the coast of Bangladesh. A brief account on these cetaceans is given below.

1.2.1. Ganges river dolphin

Ganges river dolphin was discovered in 1801 (Roxburgh, 1801). There were four obligate freshwater dolphin species existed globally, which include the

Ganges river dolphin (*Platanista gangetica gangetica*), Amazon River Dolphin (*Inia geoffrensis*), Indus River Dolphin (*Platanista gangetica minor*) and Yangtze River Dolphin (*Lipotes vexillifer*) (Fig. 2). In 2006, the Yangtze River Dolphin was declared functionally extinct in the Yangtze River of China where the species once occurred (Hopkin, 2006). The Ganges river dolphin is believed to be closely related to the now extinct, but once widespread, shark-toothed dolphins. One of its remarkable features is that this species moves and feeds in a murky riverine environment using echolocation. Their eyes, which are only capable of distinguishing light from dark, are tiny and effectively non-functional, giving also a name of blind-river dolphin (Rice, 1998). This dolphin is almost identical to its closest living relative, Indus River Dolphin (*Platanista platanista minor*) (Grill, 2000). Although several marine dolphin species are commonly found in rivers far upstream of freshwater ecosystems, Ganges river dolphins are morphologically and phylogenetically distinct from marine dolphins (Sinha et al., 2010).

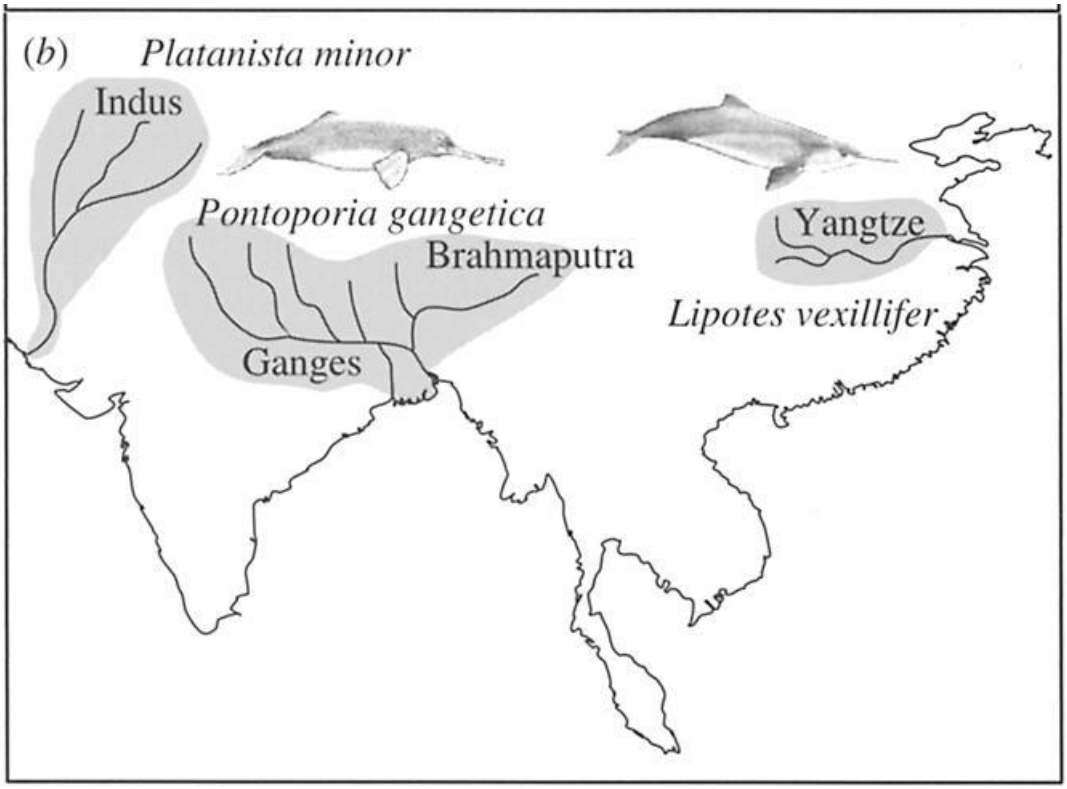


Fig. 2. Geographical distribution of river dolphins in Asian countries (adapted from Hamilton et al. 2001).

The Ganges river dolphin has been imprinted in the history of the region over centuries. Historically, the Ganges river dolphin occurred across the entire Ganga and Brahmaputra rivers, and all their tributaries from the delta at the

Bay of Bengal till the Himalayan foothills. On the distribution of Ganges river dolphin across the Indian Subcontinent, an impression could be found in the *Baburnama* (ca. 1500 AD) where Babur said, "The 'water-hog' is in all Hindustan rivers" (Sinha et al., 2010), implying its ubiquitous occurrence in the region. Cuvier goes even further saying that the 'susu' ascended the Ganges in great numbers to the limit of their navigability (Cuvier, 1836).

1.2.2. Irrawaddy dolphin

Named after the Irrawaddy River of Myanmar, the Irrawaddy dolphin has many characteristics that place it in the family of oceanic dolphins. Irrawaddy dolphin has a blunt rounded head but no beak. Its body is pale in appearance which closely resembles the beluga whale. However, while the beluga gradually turns white, the Irrawaddy dolphin remains grey – darker above, and paler below. It also possesses a small dorsal fin which lies behind the midpoint of the body. Some unfused neck vertebrae allow the head free movement.

Biology of the Irrawaddy dolphin is poorly known. The evidence from captivity suggests that mating occurs in spring and early summer. Gestation period seems to be about 14 months. The size of the dolphin at birth is about 1 m while weigh 90-150 kg. They live in small groups, up to 6; however groups of 15 individuals have been observed. Their diet includes mainly the crustaceans, fishes and other invertebrates (Grill, 2000).

The brackish water-loving Irrawaddy dolphin occurs in in coastal areas in South and Southeast Asia, and in three rivers, namely the Ayeyarwady (Myanmar), the Mahakam (Indonesian Borneo) and the Mekong. They are more localized in the coastal as well as estuarine regions around South and Southeast Asia. Recent investigations suggest that the marine distribution of the species in South and South-east Asia is generally limited to estuarine waters (Minton et al., 2017).

The Irrawaddy dolphin is one of the most endangered among all cetacean species occurring globally. It is facultative freshwater species given its range near shore marine waters of the Indo-Pacific regions. The Irrawaddy dolphins are categorized as *Vulnerable* globally and *Near Threatened* in Bangladesh.

1.3. Bangladesh – a land of rivers for dolphins

Bangladesh lies in the largest delta of the world, the Bengal Basin, formed by the several river systems of the mighty Ganges, Brahmaputra, and Meghna along with their tributaries. The Bengal Basin is a vast lowland, therefore,



almost half of the country's land surface can be considered as wetlands which include complex networks of rivers and streams, freshwater lakes and marshes, fish ponds, flooded cultivated fields and estuarine systems with extensive mangrove swamps (Hughes et al., 1994). These wetlands have a wide range of ecological, socio-cultural and economic significance that have a broader implication on lives and livelihoods of our 'ecosystem people'. A large chunk of the country's 160 million people depend on rivers for a living and for transportation (Fig. 3).



Fig. 3. Boat plying in rivers – has been an important activity of local people where dolphins live (12/11/2014).

Bangladesh is popularly known as land of rivers, where the entire delta is formed by the deposits of the three major river systems of the Ganges, Brahmaputra-Jamuna, and Meghna Rivers (Fig. 4). There are around 700 rivers in Bangladesh stretching over 24,140 km, thousands of smaller channels, floodplain depressions and extensive seasonally flooded lands that collectively form the floodplain ecosystems (Akonda, 1989). These rivers generally flowing from north to south have significantly influenced the overall physiography of the country. The total wetland area of Bangladesh is estimated to be from 7 to 8 million hectares. These wetlands encompass a wide variety of dynamic ecosystems, including rivers (7,497 km^2), estuaries and mangrove swamps (6,102 km^2), *beels* and *haors* (1,142 km^2), floodplains

(45,866 km^2), Kaptai Lake (artificial reservoir, 688 km^2), ponds (1,469 km^2), baors (oxbow lakes, 55 km^2), and brackish-water farms (72,899 km^2) (Khan et al., 1994). Estimates of the area of floodplain range up to 80% (Brammer, 1990), and about 25% to 33% of the country remains under water every year for four to six months during the monsoon (rainy season). The country's rivers can be described briefly by the following major river systems:

(a) The Jamuna-Brahmaputra river system extends from northern Bangladesh to its confluence with the Padma. The Brahmaputra ('Son of Brahma') receives waters from five major tributaries and at the point where the Brahmaputra meets the Teesta River in Bangladesh, it becomes known as the Jamuna. The Jamuna is a very dynamic and notorious river due to its subchannel characteristics and for the formation of fertile silt islands across its courses.

(b) The Padma-Ganges, which is divided into two sections: a 258-kilometer segment, the Ganges, which extends from the western border with India to its confluence with the Jamuna some 72 km west of Dhaka, and a 126-kilometer segment, the Padma, which runs from the Ganges-Jamuna confluence to where it joins the Meghna River at Chandpur.

(c) The Surma-Meghna system, which courses from the north-eastern border with India to Chandpur, where it joins the Padma.

(d) Padma-Meghna system: When the Padma and Meghna join together, they form the fourth river system – the Padma-Meghna – which flows 145 km to the way of Bay of Bengal.

(e) A relatively minor river system, unconnected to the other four, is the Karnaphuli-Sangu system. Flowing through the region of Chittagong and the Chittagong Hills, it cuts across the hills and runs rapidly downhill to the west and southwest and then to the sea. The Feni, Karnaphuli, Sangu, Halda and Matamuhari—an aggregate of some 420 km – are the main rivers in the region. The Kaptai reservoir and dam are located in this area.

The last population census suggests that up to 120 million people lived in the country's floodplains which provide a range of ecosystem services. A large proportion of the rural poor depend on natural water bodies in the floodplains for their livelihoods. Their subsistence is based on food production, fishing, harvesting wetland plants, plying country boats, and other activities that depend on healthy aquatic ecosystems (Sultana and Thompson, 2017).



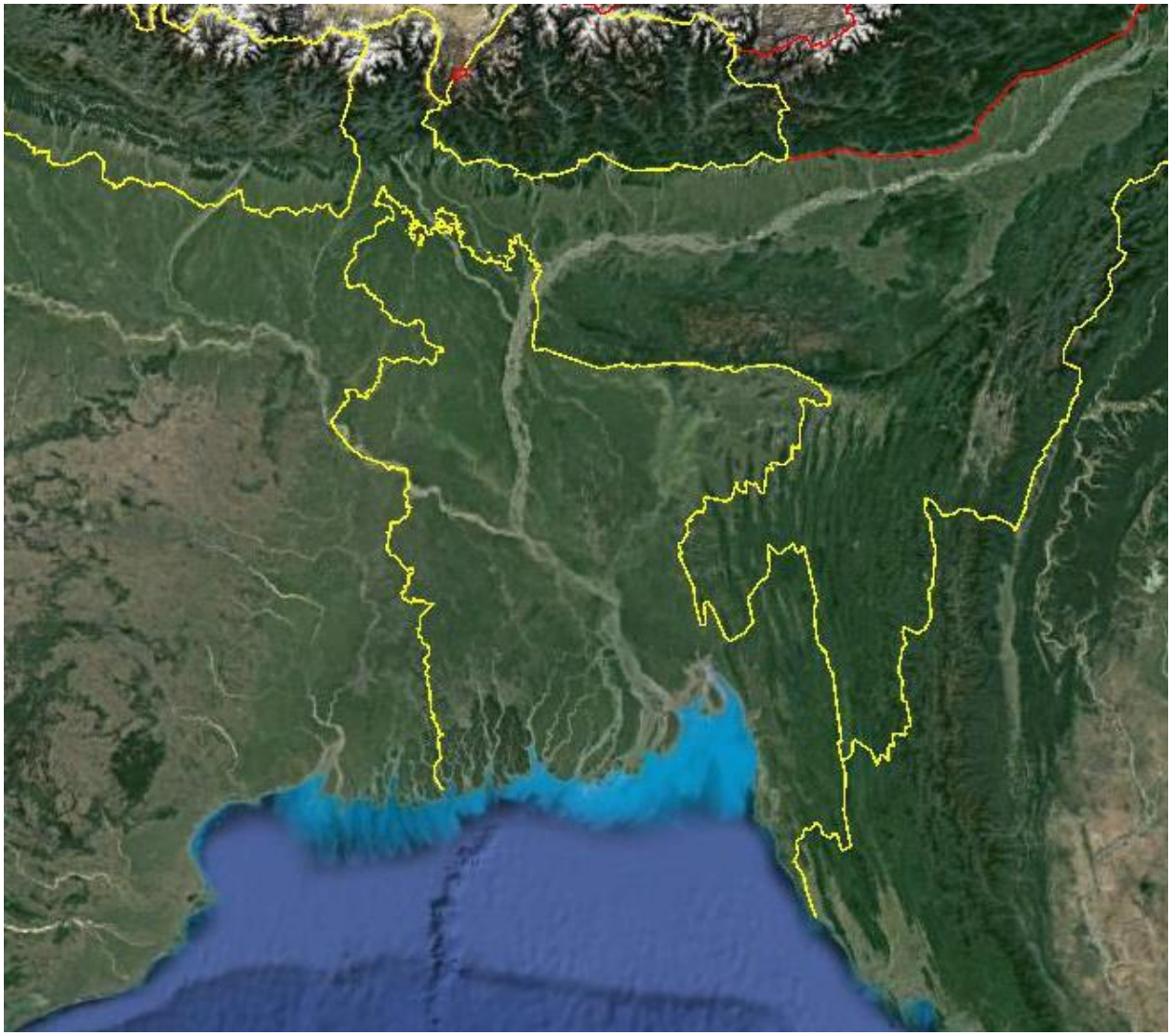


Fig. 4. Google Earth image showing the vast river networks in the Indian Subcontinent, ultimately find their ways to the Bay of Bengal through the land of Bangladesh.

Apart from these river systems, the intricate river networks of the Sundarbans and the vast coastal waters of Bangladesh have the important habitats for dolphins. The coast of Bangladesh is about 700 km long that can be characterized by a vast network of rivers (24,000 km in length), covering an area of 9380 km^2, a large number of islands between channels, a submarine canyon of the Swatch of no-Ground. The Ganges, Brahmaputra and Meghna estuaries in the south and the Karnaphuli, Halda and Sangu rivers and Arakan ranges shoreline in the southeast have given a distinct feature of the whole coastal zones of Bangladesh. Besides, the Kaptai Lake is the largest man-made freshwater body in Bangladesh which was created by damming the river Karnaphuli near Kaptai town in the Chittagong Hill Tracts (Fig. 5).

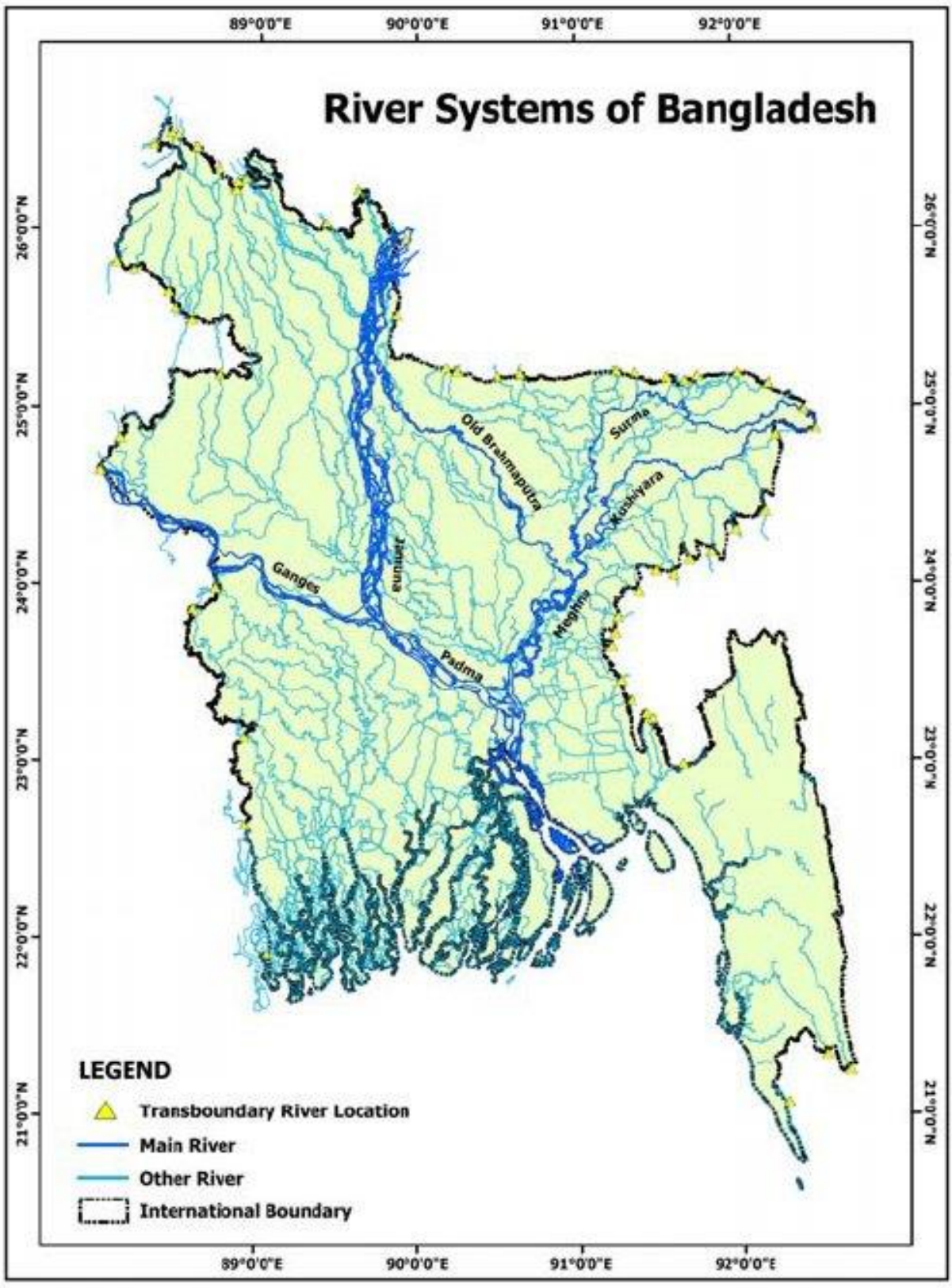


Fig. 5. River networks in Bangladesh (adapted from WARPO).

All these river systems and associated wetlands/rivers and coastal waters are the important habitats for a large variety of flora and fauna of local, national and regional significance. In particular, the major river systems and coastal

waters of Bangladesh have been known to support a high diversity of cetaceans (Smith et al., 2010, 2006). A number of hotspots have already been identified across the river channels of the Sundarbans and adjacent coasts which are considered as the critical habitats for Ganges river dolphin and Irrawaddy dolphin, including the relatively rare Indo-Pacific Humpback Dolphin in Bangladesh (Khan and Aziz, 2018; Smith et al., 2010).

1.4. Dolphin conservation in Bangladesh

A decade of research and conservation works by the Bangladesh Cetacean Diversity Project (BCDP) of the Wildlife Conservation Society alongside other conservation NGOs and individuals produced a wealth of knowledge on the status and distribution of cetaceans in and around the Sundarbans of Bangladesh. Afterwards, Bangladesh Forest Department has initiated the "Expanding the Protected Areas System to Incorporate Important Aquatic Ecosystems (EPASIIAE)" project with support from United Nations Development Programme. In the meantime, the Government of Bangladesh established six wildlife sanctuaries specifically for the protection of the Ganges river dolphin and their habitats. Alongside the Swatch of No-ground located about 100 km from the coast of Sundarbans has been established for protecting a diversity of cetaceans and other aquatic resources.

Three wildlife sanctuaries (WS) within the Sundarbans (Chandpai, 560 ha; Dudhmukhi, 170 ha; Dhangmari, 340 ha) established in 2012 for the protection of freshwater dolphins are particularly effective at encompassing priority habitat for Ganges river dolphins but only marginally effective in encompassing high priority habitat of Irrawaddy dolphins (Smith et al., 2010). The WS established outside of the Sundarbans include the Silonda-Nagderma WS at Boral River (24.17 ha), Nagarbari-Mohonganj WS at Jamuna River (408.11 ha) and Nazirgonj WS at Padma River (146 ha) (BFD, 2017) (Fig. 6). These sanctuaries were established for protecting the Ganges river dolphins in the Padma-Jamuna river systems.

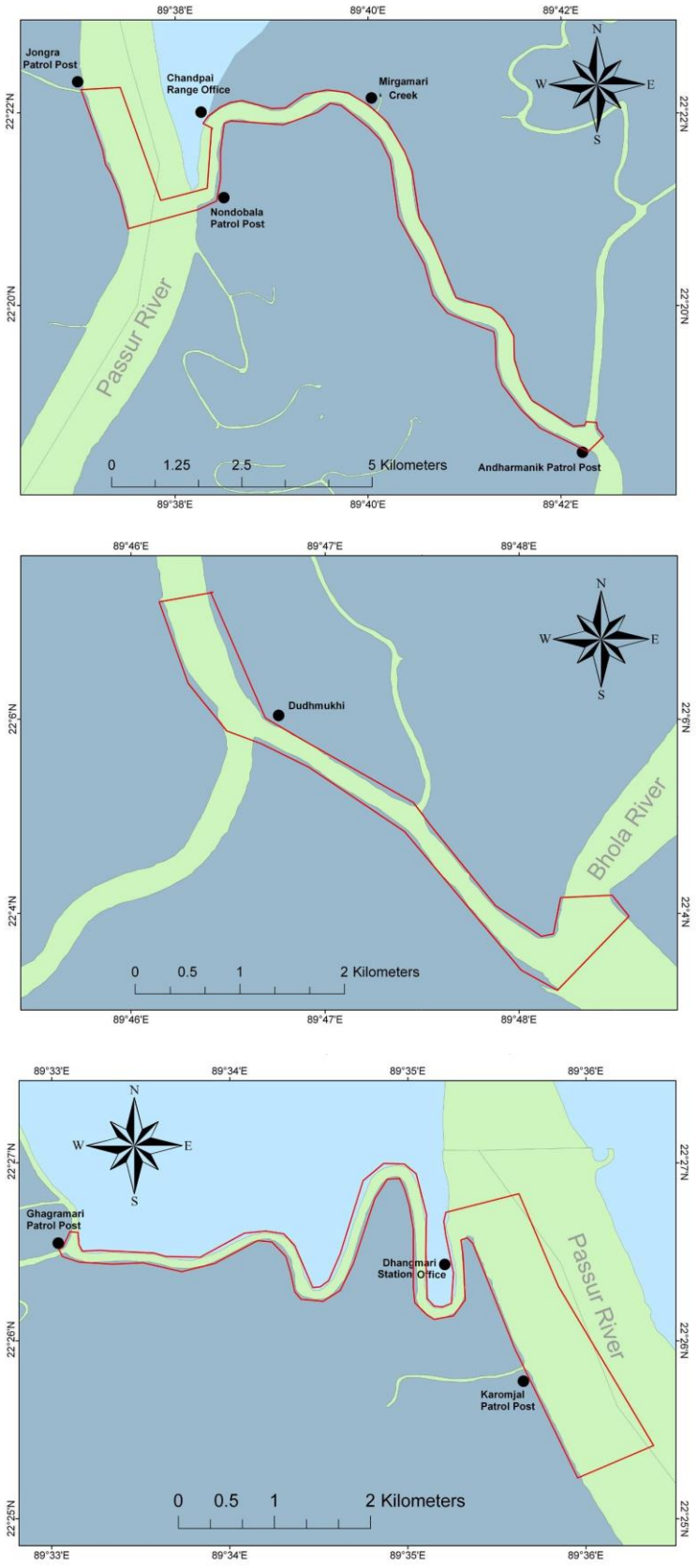


Fig. 6. Three wildlife sanctuaries within the Sundarbans (from top: Chandpai, Dudhmukhi, and Dhangmari) established for the protection of dolphins (BFD, 2017).

CHAPTER II: METHODS AND APPROACHES

Dolphin surveys, community meetings, consultations and key informant interviews across all major rivers have been conducted to collect and collate information on presence/absence of dolphins, abundance of fish and threats to dolphins (Fig. 7). All these efforts were put in place for understanding the population distribution, delineating their range and identifying their threats. This information was then used to outline GIS-based distributional and range maps across Bangladesh on the Ganges river dolphin and Irrawaddy dolphin. This study has been conducted between 23 September 2018 and 28 February 2019. The survey results in the form of a draft atlas were presented in a national seminar held on 25th April 2019 with all relevant stakeholders, NGO professionals and forest department officials. Valuable comments and suggestions came from the discussants in the seminar were incorporated which further improve this document.



Fig. 7. Information was also obtained by meeting officials of the Bangladesh Forest Department (3/1/2019).

2.1. Literature review

Literature review includes collection and collation of relevant literature focusing on published and unpublished information from different government and non-government organizations/agencies, and universities working on national and regional levels. Dolphin location data generated through the hotspot identification study by Khan and Aziz (2018) carried out under the EPASIIAE project were also used to prepare dolphin distribution map for Sundarbans and adjacent coastal areas of Bangladesh.



Fig. 8. Interviewing local fishermen at Godagari on the bank of Padma River (26/12/2018).

2.2. Community meeting and key informant interview

Given limited time and resources but vast scope of this study, secondary information was collected to describe the best possible picture of dolphin distribution across the country. To this end, community-based meeting targeting local fishers and interviewing key informants were conducted to identify the range of dolphins in the country. From each of the major survey sites, at least one community meeting and several key informant interviews was organized (Fig. 8, 9).



Fig. 9. Meeting with community fishermen in Bera, Pabna in presence of Divisional Forest Officer (DFO) of the region (2/1/2019).

2.3. Field surveys

Cetacean survey methods have generally been applied on need-basis which is often tailored to suit to the characteristics of the water courses as well as the nature of study. Given the scope of this assignment, a team comprising the National Consultant of this study including Prof. Monirul Khan from the Department of Zoology, Jahangirnagar University, and officials from UNDP and BFD has conducted the field surveys. Several regionally posted wildlife scouts of Chattogram, Khulna and Rajshahi including other field staffs have joined our field surveys. Assistance regarding the organization of meetings and interviews as well as local logistics were drawn from local BFD and related authorities. During the survey using local engine-driven boat, sightings of the dolphins recorded from a mechanized boat, running an average speed of 7-10 km per hour (Fig. 9). The team actively searched for dolphins using handheld binoculars (10x42) and naked eyes. The observer team recorded data on dolphin species observed, locations and GPS coordinates using handheld *Garmin GPSMAP 64s*. The GPS database was imported onto the Geographic Information System platform using ArcGIS v10.3 and Google Earth Pro for spatial analysis and generation of maps.



Fig. 10. Dolphin survey at Padma River in Rajshahi, accompanied with local FD officials (25/12/2018).



Fig. 11. National seminar on findings of the study in the Bangladesh Forest Department with presence of Chief Conservator of Forests, forest officials and consultants of the study (24/4/2019).

CHAPTER III: DISTRIBUTION OF DOLPHINS

3.1. Global distribution

The Ganges river dolphin is endemic to the Indian Subcontinent. In the region, the distribution of this species had been restricted to Bangladesh, India, Nepal, and possibly Sikkim and Bhutan, below an elevation of about 250 m (Rice, 1998). Currently the species survives in the Ganges-Brahmaputra-Meghna and Karnaphuli-Sangu river systems, while a few individuals may survive in the Karnali, and the Sapta Kosi Rivers in Nepal (Sinha et al., 2010) (Fig. 12).

The global population estimates are about 3500 individuals throughout its distribution range (Sinha et al. 2014). The Ganges river dolphin was officially declared as the National Aquatic Animal of India in 2010 to highlight the importance of this species in the river ecology and to ensure long term survival in the rivers of India (Sinha et al., 2010)



Fig. 12. Distribution of Ganges river dolphin in the Indian Subcontinent (adapted from IUCN 2019).

3.2. Ganges river dolphin in Bangladesh

The Ganges river dolphin is named Shushuk (শুশুক) in Bengali by the wider local communities across Bangladesh. However, it is also named differently in different regions in the country, such as Shishu (শিশু) and Thus (ঠুস) in the Sundarbans, Houmach (হউমাছ) in Bhairab, Shishuk (শিশুক) in Sirajgonj, Shishu (শিশু) in Sylhet, Shushu (শুশু) in Rajshahi, Hochchum (হোচ্চুম) in Chattogram, etc. Although the Ganges river dolphin is wrongly believed to be a fish among many communities as well, it is however widely recognized inedible. There are lots of stories and myths associated with this 'strange' animal among communities where many people believe this animal as a friend of fishermen in many ways including, forcing fishes to congregate in a particular location, indicating the presence of large fishes where it lives, etc.

The rivers Padma, Jamuna, Meghna, Brahmaputra and Karnaphuli including their tributaries are the principal habitats of this species in Bangladesh. The Ganges river dolphin is endangered globally as well as in Bangladesh (IUCN Bangladesh, 2015). This species is included in the First Schedule of Bangladesh Wildlife (Protection & Security) Act, 2012 to ensure higher level of protection for their *in situ* conservation.

Kasuya and Hoque (1972) led the first scientific expedition about a half century ago for documenting the Ganges river dolphins in the present day territory of Bangladesh. They made significant observations on dolphin populations in several points of the Brahmaputra, Meghna and Jamuna, and the upper and lower regions of the Sundarbans. Afterwards, observations were made by several workers on the population abundance across Bangladesh (Ahmed, 2000; Smith et al., 2001, 1998), and on assessment of dolphin hotspot and habitat preference in and around the Sundarbans of Bangladesh (Smith et al., 2010, 2006). In other parts of the country, information on population status appeared from segments of the rivers Jamuna-Padma (Khan and Rahman, 2013; Rashid et al., 2015), Bhairab-Atai (IUCN Bangladesh, 2018a), Turag (Baki et al., 2017) and Burigonga (Alam and Sarker, 2012).

A population of 225 Ganges river dolphin has been reported from the less saline zones of the Sundarbans whilst a population comprising 125 individuals from the Karnafuli and Sangu river systems (Smith et al., 2001).

Although all of the major river systems still have supported the Ganges river dolphins, some of the tributaries of these rivers might have no longer been suitable as their habitat, at least in winter months. These rivers include Dorla, Teesta and Kushiyara (Fig. 13).

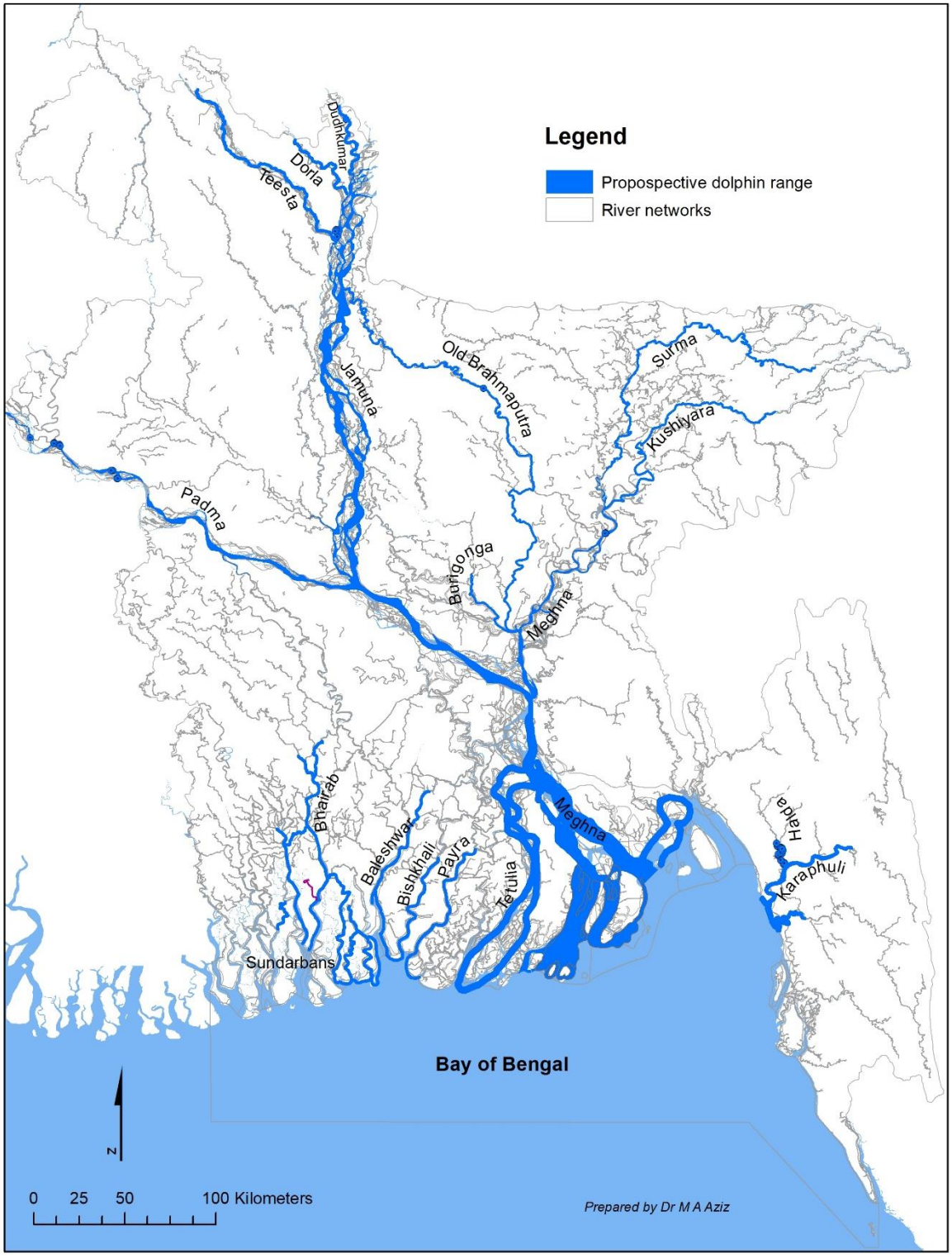


Fig. 13. Range of Ganges river dolphin at monsoon season in Bangladesh.

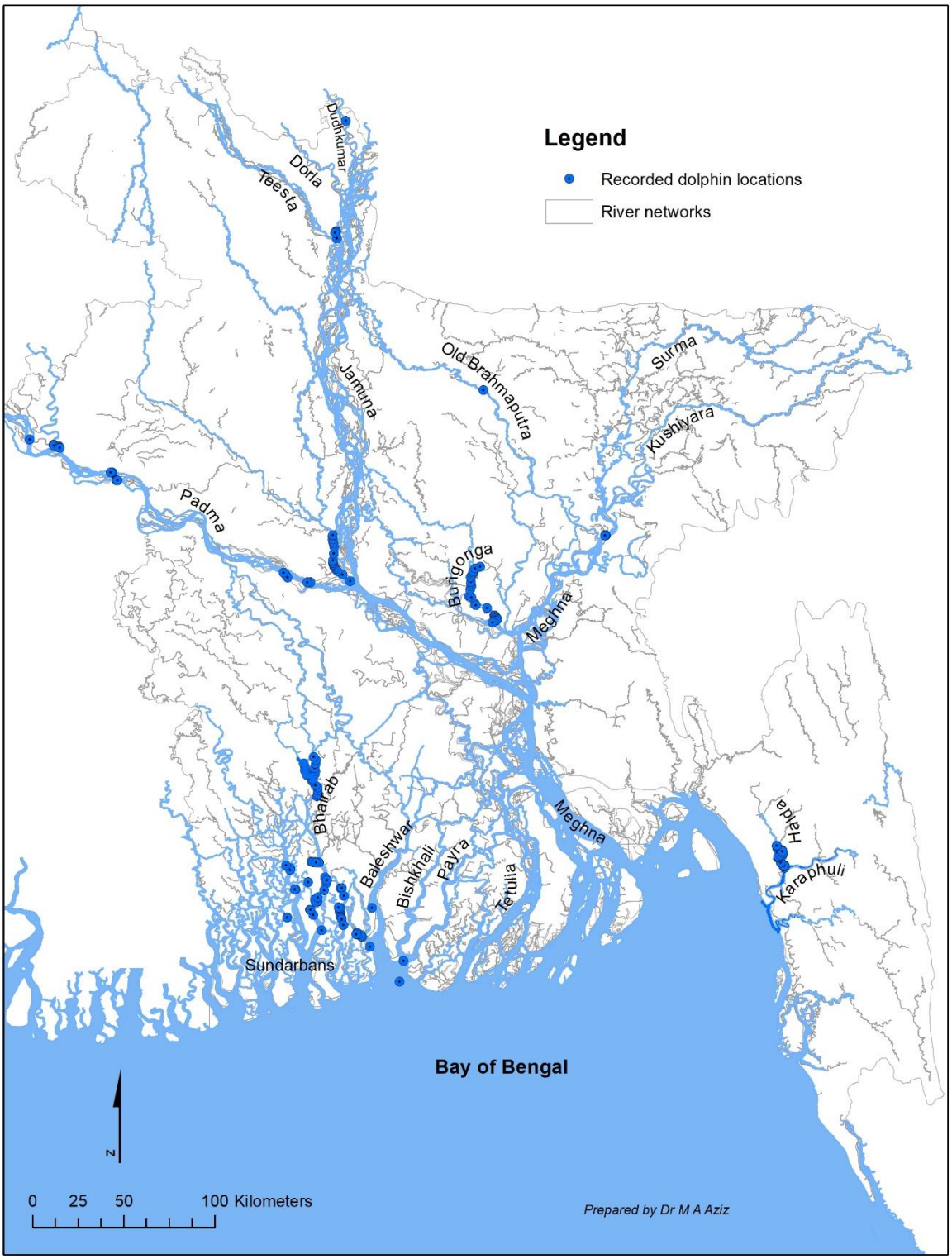


Fig. 14. Recorded locations of Ganges river dolphin at winter season in Bangladesh. Some previous data referred in text were also used here.

3.2.1. Ganges river dolphins in Jamuna-Brahmaputra system

Two of the three wetland-based wildlife sanctuaries, specifically established for protection of Ganges river dolphin outside the Sundarbans, are located in the Jamuna-Brahmaputra river system: Silonda-Nagderma WS at Boral River, Nagarbari-Mohonganj WS at Jamuna River. These sanctuaries were known to support a good population of dolphins in these regions (Fig. 14). In the recent past, a monitoring program conducted between 2015 and 2016 recorded a total of 206 sightings, comprising 87 in Nagarbari, 96 in Mohongonj and 23 in Boral locations (IUCN Bangladesh, 2018b). A number of deep waterpools (kum) was identified based on the high level of dolphin sightings in winter months, most of which already have fallen under the jurisdiction of these sanctuaries (Rashid et al., 2015). Subsequent monitoring of dolphins in the same area recommended to declare the entire Y-shaped confluence of Padma and Jamuna rivers (approx. 200 km of Jamuna River and 100 km of Padma River) as 'Padma-Jamuna dolphin sanctuary' (Khan and Rahman, 2013) (Fig. 15).



Fig. 14. Ganges river dolphin in the Padma River (24/12/2018).

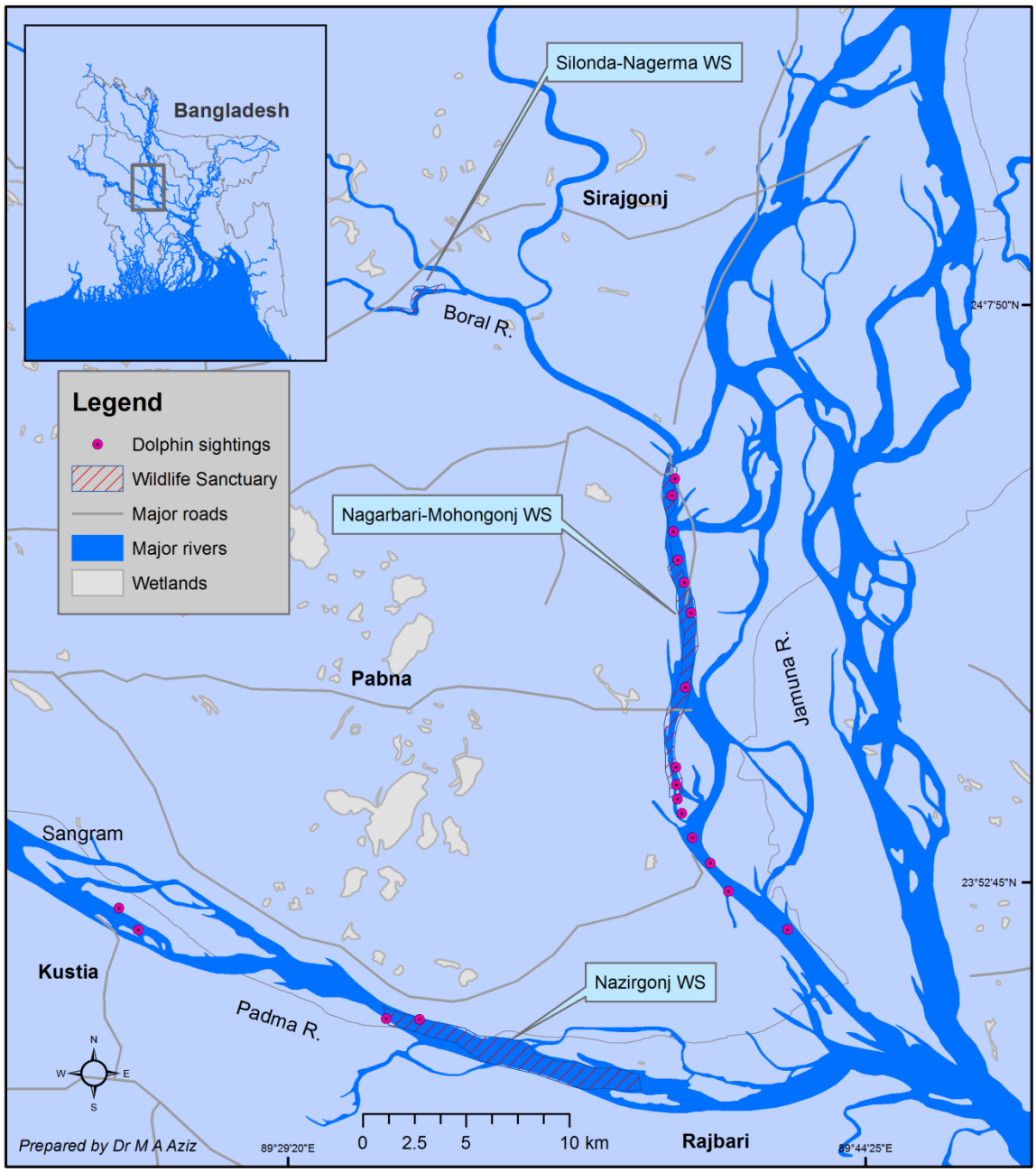


Fig. 15. Dolphin sightings in sanctuaries of the Padma and Jamuna rivers.

Paikerchhara

The Dud Kumar River, a tributary of the Brahmaputra, enters Bangladesh from West Bengal state of India through Shilikuri union of Bhurungamari Upazila of Kurigram district. There is an old railway bridge over this river at Paikerchhara point that connects Bhurungamari-Kachakata road, where there is a small depression (*kum*) in the river (26.09793°E, 89.72089°N). During this survey, an individual of the Ganges river dolphin was sighted under the bridge area (Fig. 16, 18), although key informant interview suggest

that a good number of dolphins might be surviving there in winter season when water level goes down remarkably. The depth of the *kum* was estimated as deep as 12 m. The river segment stretches approximately 800 m in length. Similar to other areas across country, people reported several incidental killings of dolphins by entanglement in the past. Few years ago, a calf was caught in a fisherman's net that was then transferred to his pond for rearing but it died in the next day.



Fig. 16. Paikerchhara kum in Dud Kumar River of Kurigram district (15/10/2018).

Jorgachh

Jorgachh (25.54487°E, 89.66862°N) is located on the eroded bank at Ramna thana of Chilmari Upazila, Kurigram. The *kum* comprises the Jorgachh ghat which is one of the main points that connect Raumari Upzaila though country-boat on the southeastern side of the Brahmaputra River. Once renowned river port, the Chilmari has now eroded to the Brahmaputra River, which was once the major river port engaged in business with Assam region of India today. The remaining area of the proposed Chilmari river port has a moderate *kum* spanning over 800 m segment of the Brahmaputra River where eight individuals of the Ganges river dolphin were sighted on 14 November

2018. The area remains busy with trading and passenger boats for communication between Chilmari and Raumari upazilas. Given the frequent movement of boats, the area was free from setting fishing nets that has created a fishing net-free habitat for dolphins. Of the sighted dolphins, five individuals were found in one group while the rest were found individually. Few individuals were quite large in size (Fig. 17, 18). No calves were detected in the group. Interviews with local fishermen suggest that dolphins caught incidentally in fishing nets were processed for extraction of oil for traditional medicinal use.



Fig. 17. A large individual of Ganges river dolphin in Bramaputra river at Chilmari of Kurigram district (14/10/2018).

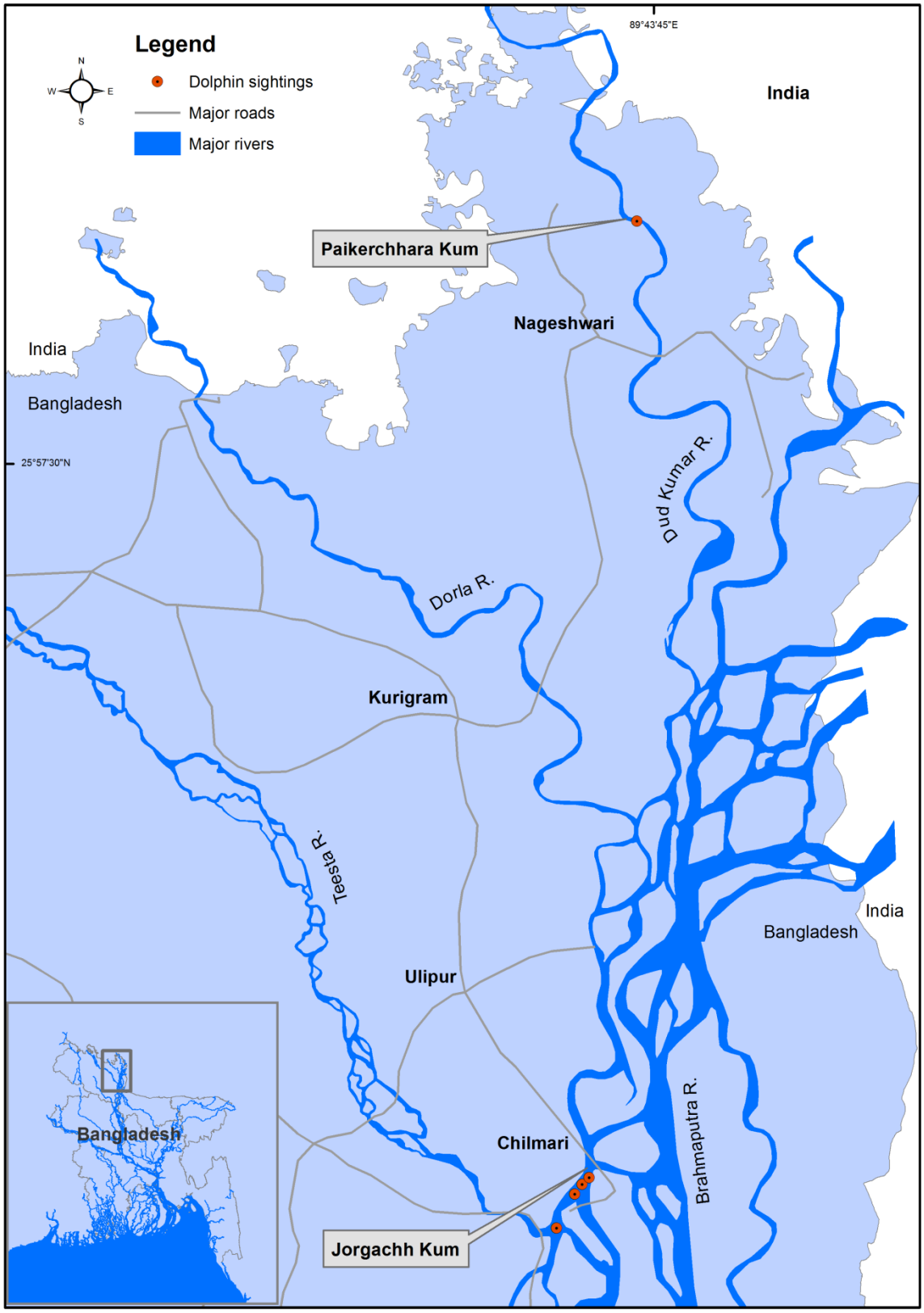


Fig. 18. Map showing the dolphin sighting locations at Bramaputra River in Kurigram district.

3.2.2. Ganges river dolphin in Padma-Ganges River System

Nazirganj

Located on bank of Padma River, Nazirganj falls under Sujanagar Upazila of the district Pabna. One of the three river-based wildlife (dolphin) sanctuaries in Padma-Jamuna confluence is the Nazirganj WS at Padma River, which is a dolphin hotspot in this region (Fig. 13). A number of deep water-pool was identified based on the high level of dolphin sightings in winter months, most of which already have fallen under the jurisdiction of sanctuaries (Rashid et al., 2015). Subsequent monitoring study in the same area has recorded high abundance of dolphins that recommended an extended area for including into the wildlife sanctuary already established (Khan and Rahman, 2013).

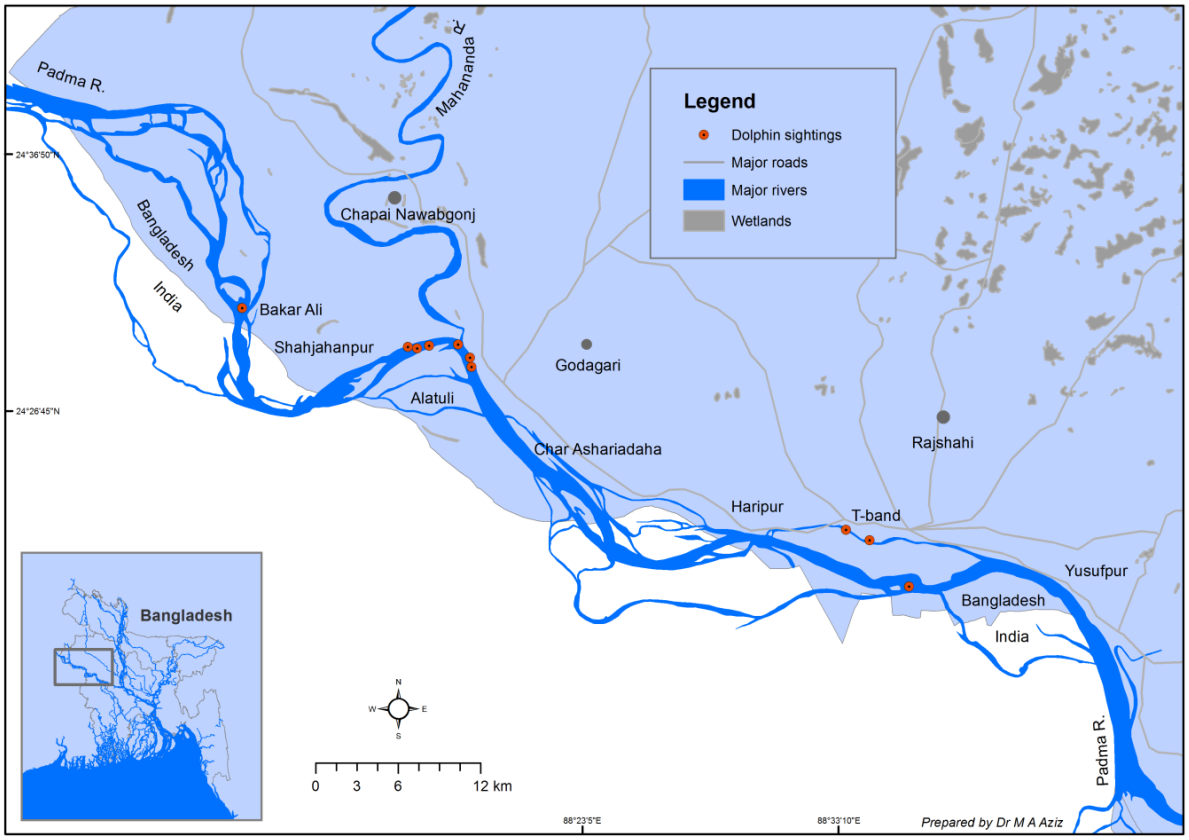


Fig. 19. Map showing the dolphin sighting locations in the Padma River.

Rajshahi T-band

The T-band section of the Padma River lies on immediate vicinity of the Rajshahi city (Fig. 19). The upstream and downstream of T-band of the river segment appears to be an important habitat for dolphins in the dry season. The potential area extends from south-western Bangladesh-India border across the river in Haripur to the south-eastern border in Yousufpur. Although there are several large charlands within the section of river, some *kums* can potentially harbor dolphins even in the dry season. During our visit in December 2018, several individuals were sighted from the T-band area. In particular, a *kum* next to the T-band and Bot Tola ghat of the river bank have been a good winter habitat for dolphins when water level even goes down to critical level.

Godagari

In Godagari upazila of Rajshahi, the river section of the Padma extending from Hakimpur Tokpara in Durlavpur to Prmetali Bazar in Kathalbari is a good winter habitat for dolphins (Fig. 19). In particular, the segment between Ashariya to Hakimpur appears to be potential for supporting dolphins in the region in winter months. Additionally, the Mahananda confluence in Foridpur Roadpara is also a good habitat for dolphins. During our visit in December 2018, we sighted a good number of dolphins in these areas. While talking to local villagers people of Horma village (24.50163, 88.28631) under Debinagar Union, it appears that they are familiar with the traditional medicinal use of dolphin oil but ignorant about the importance of dolphins in their neighbourhood and national law relating to the protection of dolphins.

Bakorali

Bakorali is situated on the north-western corner of Chapai Nawabganj District where the Padma River first enters the Bangladesh territory (Fig. 19, 20). Bakorali is one of the busiest locations on this border areas and remains as one of the most important hub for livestock import from India. Having relatively less gillnets due to heavy boat traffics, the area appears to be important dolphin habitat in winter months. Although we could not detect any dolphins during our visit, previous observations and key informant interview suggest that the area supports a good number of dolphins in winter season.



Fig. 20. Padma River at Bakorali point having deep water-pool that is used as dolphin's winter habitat. The area also used extensively for livestock trade between India and Bangladesh (13/12/2018).

3.2.3. Ganges river dolphin in Meghna-Surma River System

Meghna is the major river in this river system which appears to support Ganges river dolphin in northeastern region of Bangladesh. The major distributaries and associated river system of Meghna at the downstream, notably the Tetulia, Kirthonkhola, Galachipa, Dakatia, Arial Khan, Payra and Bishkhali rivers remain as important habitats during summer as well as winter months. On the contrary, the water depth at Surma and Kushiyara rivers remaining critically low on the upstream in winter season thereby unlikely to support dolphins. We could not find any dolphins in our February 2019 visit in Surma and Kushiyara rivers. Although a previous study conducted back in 1995-1996 reported 34-43 dolphins from the Kushiyara Rivers (Smith et al., 1998). However information provided by the key informant suggests that the Surma might have been a habitat for dolphins during summer, but the Kushiyara may no longer be used by dolphins.

Bhairab Bridge

The immediate upstream from the Bhairab bridge on the Meghna River is an important dolphin habitat on the northeast region of Bangladesh. During our

visit in February 2019, we have spotted a good number of dolphins, within approximately 400 m on the north of Bhairab bridge (Fig. 21, 22). The area appears to be a busiest river-based trading hub loaded with coal-based boats coming down all the way through the Surma River. The depth of water appears to be relatively high in winter months in the dolphin hotspot (Fig. xx). The area also remains gillnet-free due to river traffic, although other small fishing gears were found.

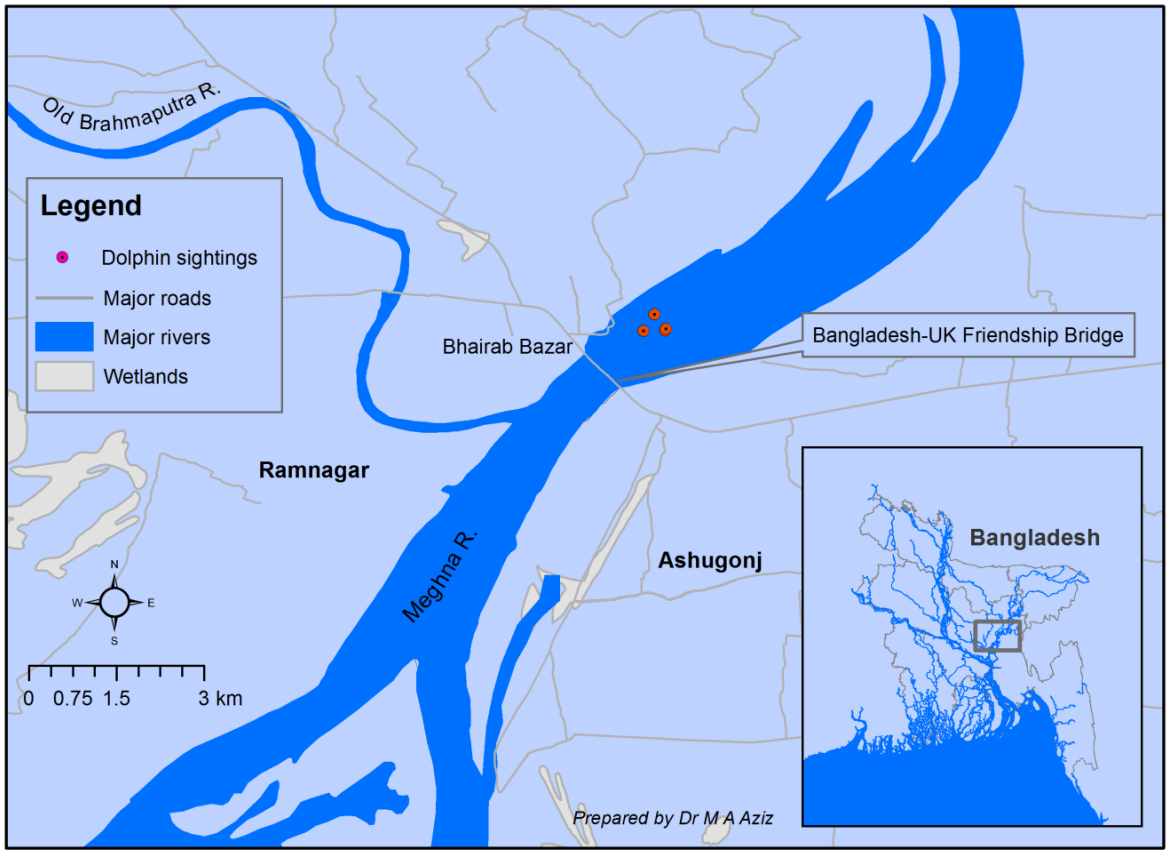


Fig. 21. Map showing dolphin sightings at Bhairab of Meghna River.



Fig. 22. A large individual of Ganges river dolphin in Meghna River (6/1/2019).

3.2.4. Ganges river dolphin in Karnafuli-Sangu River System

The presence of Ganges river dolphin in the Karnaphuli River and Halda tributary was first reported by Anderson (1879), with subsequent sightings at Karnaphuli (Pelletier and Pelletier, 1986). Two dolphins were sighted in 1992 (Reeves et al., 1993) and a dead individual in 1994 were reported from the Kapatai lake (Ahmed, 2000). A population of about 125 individuals were reported from the Karnafuli-Sangu river system (Smith et al., 2001).

Halda

Halda River appears to be the most significant stronghold for Ganges river dolphin in the southeast region of Bangladesh. We recorded a population of about 50 dolphins during our surveys between November, 2018 and January, 2019 with winter distribution from Halda-Karnafuli confluence to Sattarghat. However, secondary information confirmed that dolphins move up to Nazirhat during summer season when water depths remain relatively higher (Fig. 23, 25).

Halda is the major tributary of Karnafuli River. Originating from the Badnatali Hill Ranges in the Chittagong Hill Tracts, Halda enters Chattogram district through Fatikchhari upazila. It then flows southwest keeping off the higher regions to the north passing Bibirhat, Nazirhat, Sattarghat, Madunaghat and other important places of Fatikchhari. It falls into the Karnafuli at Kalurghat. Total length is about 81 km, of which 29 km up to Nazirhat are navigable by engine-driven boats throughout the year; small country boats can ply further up for 16 to 24 km to Narayanhat.

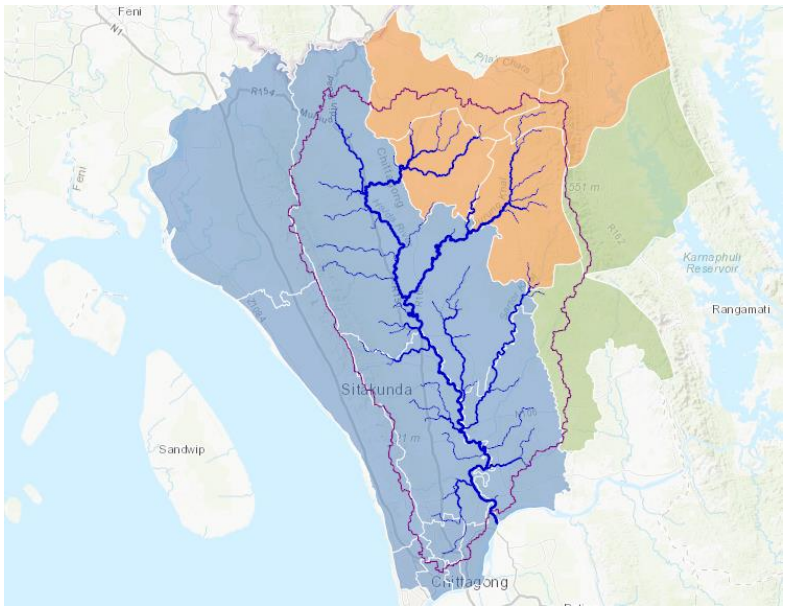
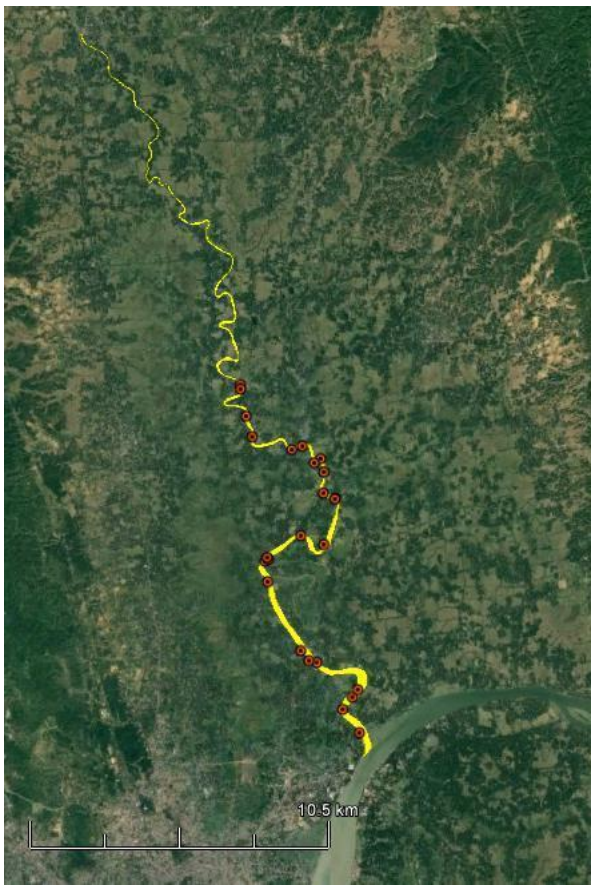


Fig. 23. Halda River with its tributaries has a profound impact on the overall physiography of the region (adapted from ESRI database).



Having connection with the coast of the Bay of Bengal through Karnafuli River, Halda is characterized with tidal waters and some mangrove vegetation (e.g., Chaila, *Sonneratia caseolaris*) on the downstream river banks. It is the only natural breeding ground for major carps in Bangladesh, perhaps in Southeast Asia. The geomorphology of Halda is unique, characterized with 34 major and minor canals that joined Halda in different points throughout its courses. There are 12 sluice gates, mostly on the downstream tributaries, and 11 excavated oxbow bends on its courses. All these physiographic attributes have profound influence on creating a unique hydro-ecological condition, suitable for spawning by carps as well as ideal habitat for Ganges river dolphins (Fig. 24).

Fig. 24. Halda River on the Google Earth.

Karnafuli

The Karnafuli is the principal river in southeast region of Bangladesh. From the confluence of Halda River up to the downstream point of Kaptai dam, dolphins appears to be absent in winder season. However, we observed five individuals of dolphins from the new Karnafuli bridge to the Halda confluence during February 2019 (Fig. 25). Originating from the Lushai Hills of Mizoram (India), it flows through Rangamati and Chittagong and finally discharges into the Bay of Bengal near Patenga. The river is flashy and its length is about 131 km. The construction of a dam on this river at Kaptai has blocked the river and the downstream therefore receives a very little water in the dry season. As a result, dolphins were rarely sighted in the Karnafuli River in the dry season these days, except few sightings at the upper reaches and the confluences of the Halda River. Although no dolphins were sighted in the Sangu Rivers, it appears to believe that some individuals may survive in the upper reaches of the river.

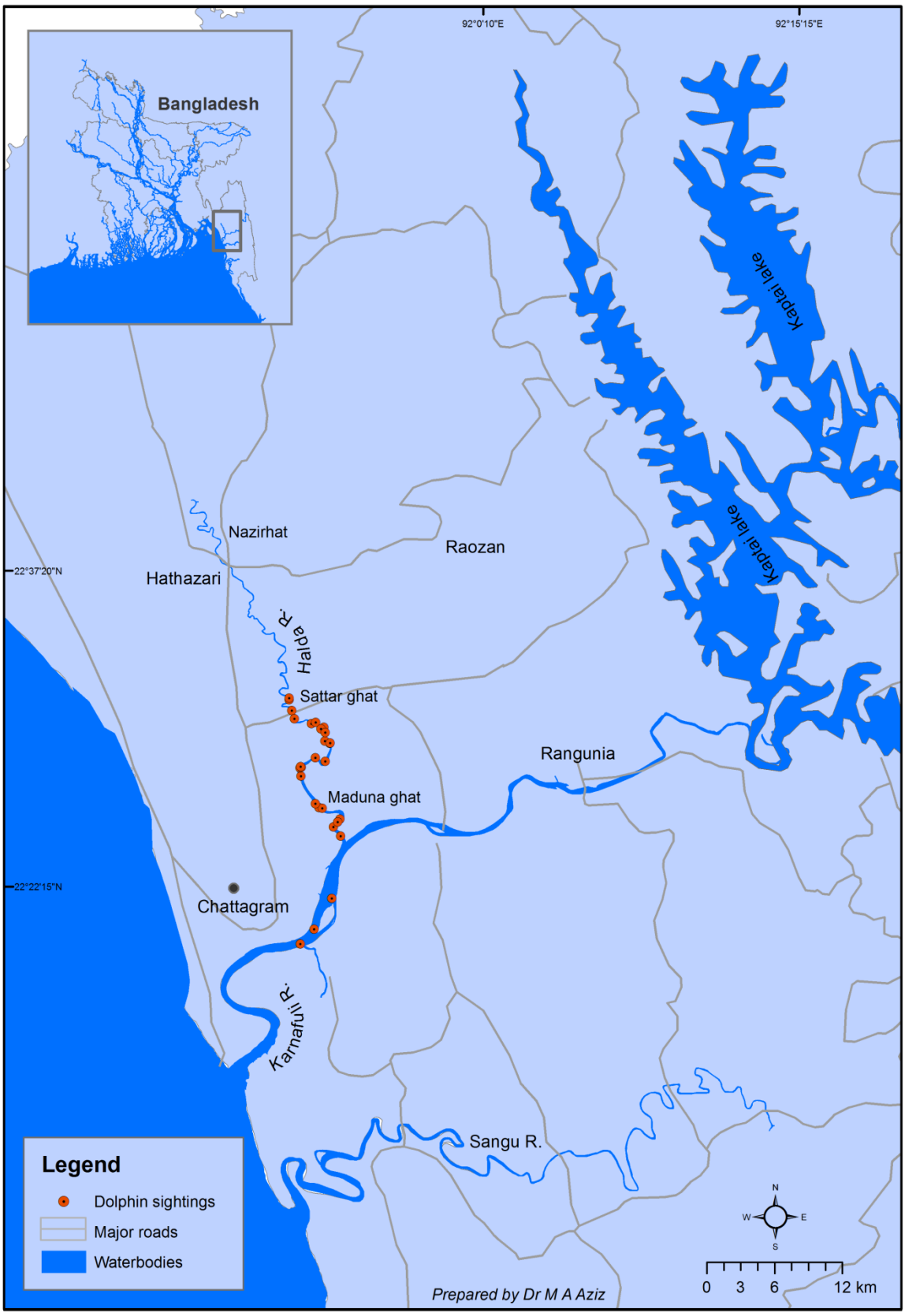


Fig. 25. Dolphin sightings in Halda and Karnafuli rivers.

3.2.5. Ganges river dolphin in the Bangladesh Sundarbans

The Sundarbans river systems have been a stronghold for dolphins in the southwest region of Bangladesh (Smith et al., 2010, 2006). In particular, this freshwater-loving dolphin was spatially distributed to the northeastern part of the Sundarbans, with some sightings on the estuarine region of the Baleshwar, Bishkhali and Payra Rivers (Fig. 26). This pattern of distribution suggests that this dolphin prefers more freshwater habitats than saline areas of the Sundarbans and adjoining coasts. Notably, the major groups of the population were found along the upstream channels of the Passur, Sela and Sibsa Rivers (Khan and Aziz, 2018).

Based on the distribution across the Sundarbans and adjacent coasts, five dolphin hotspots were identified. These hotspots were identified based on high abundance of the species, sighting of calves and co-occurrence of the Ganges river dolphins and the Irrawaddy dolphins (Khan and Aziz, 2018).

By surveying 1,340 km of rivers within the Sundarbans, a total of 118 Ganges river dolphins were directly counted (based on sightings) between January and April 2018. Using the visibility correction factor of 1.35, the total populations (crude) of Ganges river dolphin in the Sundarbans were estimated 159. Also, 5 individuals were recorded from a survey of 290 km downstream channels of the Baleshwar, Bishkhali and Payra Rivers (Khan and Aziz, 2018).

The distribution of the Ganges river dolphin in the Bangladesh Sundarbans was restricted to the northeastern part of the Sundarbans, with some sightings on the estuarine region of the Baleshwar, Bishkhali and Payra Rivers. This pattern of distribution suggests that the Ganges river dolphin prefers more freshwater habitats than saline region of the Sundarbans. Notably, the majority of the population were found along the upstream channels of the Passur, Sela and Sibsa Rivers (Khan and Aziz, 2018).

A recent study has identified dolphin hotspots in the Bangladesh Sundarbans based on abundance, co-occurrence, encounter rate and presence of the calves in any particular area of Ganges river dolphin and Irrawaddy dolphin. A total of five hotspots were identified in Sela-Supati Rivers, Sibsa River, estuarine area around Putney Island, Passur River, and Baleshawr Estuary, which totally cover 334.5 km^2 stretching over 567.6 km of rivers (Fig. 27). Additionally, the semi-hotspots for dolphins were identified that totally cover 411.1 km^2 area and 397 km length, which are in the western Sundarbans (Khan and Aziz, 2018).

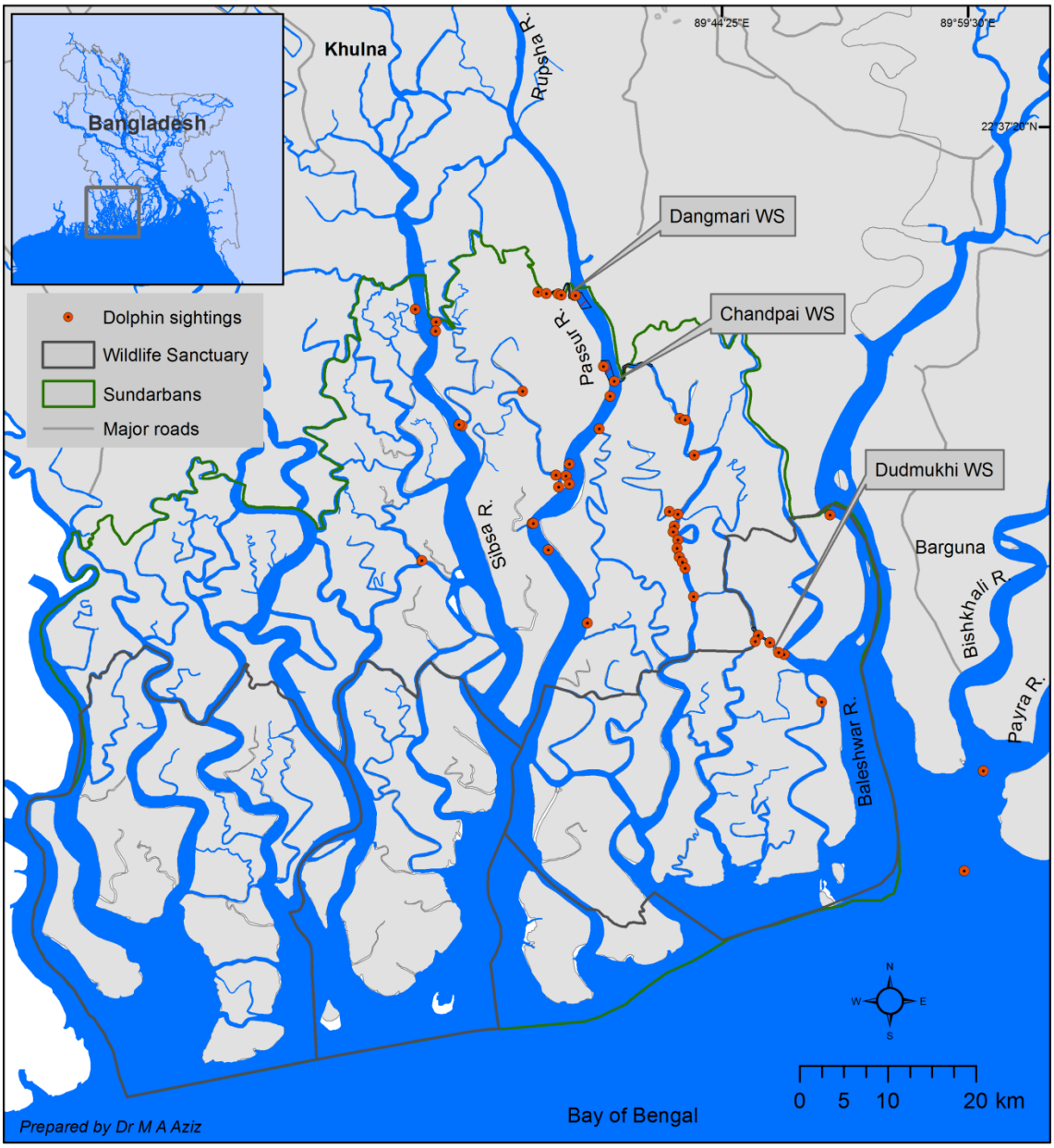


Fig. 26. Ganges river dolphin sightings in the Sundarbans and adjacent coast of Bangladesh.

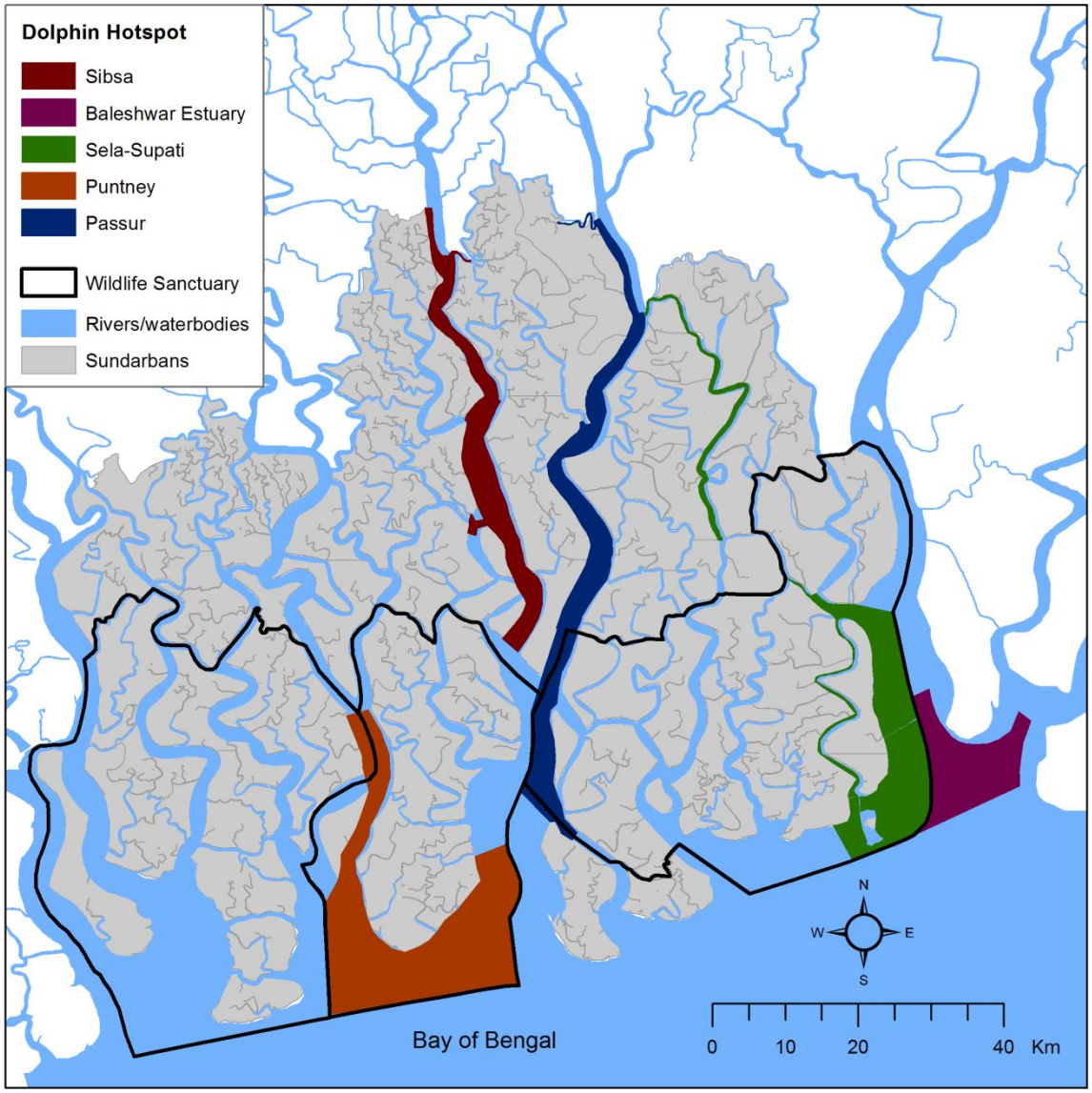


Fig. 27. Dolphin hotspots in the Sundarbans and adjacent coast of Bangladesh.

3.2.6. Ganges river dolphin in Rupsha-Bhairab River System

Rupsha-Bhairab-Atai

A high abundance of dolphin has been reported on the upstream of the eastern Sundarbans from the Rupsha bridge up to the Atai-Bhairab confluence. The most important area was delineated in and around the confluence of Atai-Bhairab-Rupsha rivers where a total of 284 sightings were made with an overall encounter rate of 1.18/ km. Using the mark-recapture method, the study estimated 34-47 dolphins from the areas during four

seasonal surveys (IUCN Bangladesh, 2018a). Our opportunistic observations also suggest that Bhairab-Atharobeki confluence is also an important dolphin habitat in the region (Fig. 28). It is also very likely that dolphins in the lower reaches of the rivers Bhairab and Baleshwar travel upstream in monsoon towards Madhumuti-Gorai-Chitra river systems.

Pankhali

Pankhali is located under Dacope upazila of Khulna district on the confluence of the Passur and Jhapjhapia rivers (22.21612, 89.68493) (Fig. 26, 27). The confluence is about 17 km from the northern boundary of the Sundarbans along Passur River and few km from the Rampal Coal Power Plant site. The confluence appears to be a potential hotspot for the Ganges river dolphin. The area comprises about 1.41 km^2 at the confluence of both rivers has been suggested to include within the protected area network of Bangladesh (Khan and Aziz, 2018).

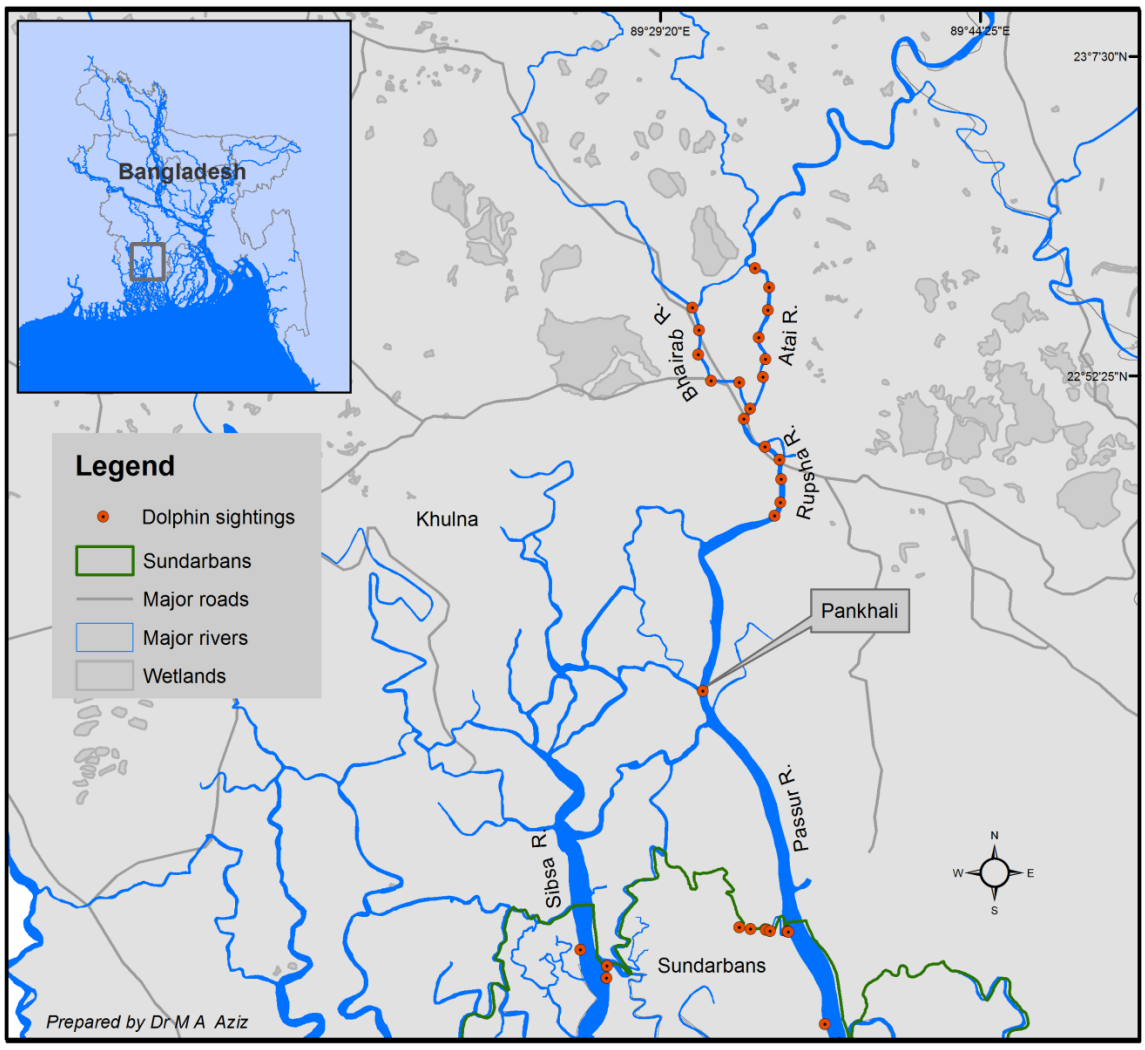


Fig. 28. Rupsha-Bhairab-Atai and Pankhali dolphin hotspots in Khulna.



Fig. 29. Ganges river dolphin at Pankhali of Dacope, Khulna (4/10/2018).

3.3. Global distribution of Irrawaddy dolphin

The Irrawaddy dolphins are discontinuously distributed to the coastal waters of the Indo-Pacific regions and principally occurred with freshwater zones (Smith, 2017; Stacey and Arnold, 1999). The coastal and estuarine populations occur from Borneo and the central islands of the Indonesian Archipelago north to Palawan, Philippines, and west to the Bay of Bengal, including the Gulf of Thailand (Fig. 28). Three well-reported subpopulations are known to occur in three relatively freshwater large rivers of the Ayeyarwady in Myanmar, Mahakam in Indonesia, and Mekong in Cambodia and Lao People's Democratic Republic. Three other subpopulations are found in brackish water bodies of the Chilika Lagoon in India, Songkhla Lagoon in Thailand, and Malampaya Sound in the Philippines (Minton et al., 2017). Interestingly, the largest population of the Irrawaddy dolphins have been reported from the open estuarine waters of Bangladesh coasts (Smith, 2017) with a relatively sizable population of 451 individuals from the waterways of the Sundarbans mangrove forest (continuous with the estuarine population) (Smith et al., 2006).

The Irrawaddy dolphins have a rounder head and shorted beak compared to the other saltwater dolphins. They live together in the relatively larger group while their principal food comprising the fish and crustaceans.



Fig. 30. Global range of Irrawaddy dolphin (adapted from IUCN).

3.3.1. Irrawaddy dolphin in the Bangladesh Sundarbans

The Sundarbans and the wide coastal belts have been the stronghold for Irrawaddy dolphins in Bangladesh. A study carried out in 2006 provided an estimates of 451 Irrawaddy dolphins in the Bangladesh Sundarbans (Smith et al., 2006). A recent study has found a relatively wide distribution patterns of this dolphin across the Sundarbans and estuarine areas of the rivers Baleshwar, Bishkhali and Payra (Khan and Aziz, 2018).

From the survey of 1,340 km of rivers within the Sundarbans, a total of 113 Irrawaddy dolphins were directly counted (based on sightings) between January and April 2018. Using the visibility correction factors of 1.75 the total populations (crude) of Irrawaddy dolphin in the Sundarbans were estimated at 198. Besides, 30 individuals of Irrawaddy dolphins were directly counted by surveying 290 km downstream channels of the Baleshwar, Bishkhali and

Payra Rivers in the adjacent area east to the Sundarbans (Khan and Aziz, 2018).

Unlike the Ganges river dolphin, the Irrawaddy dolphin population has a wide distribution across the Sundarbans and estuarine areas of the rivers Baleshwar, Bishkhali and Payra (Fig. 29). Although a relatively high abundance was observed along the Sibsa River, it was interesting to note that two individuals of this cetacean species was found further north of the Sundarbans, next to Mongla Port (Khan and Aziz, 2018) (Fig. 29).

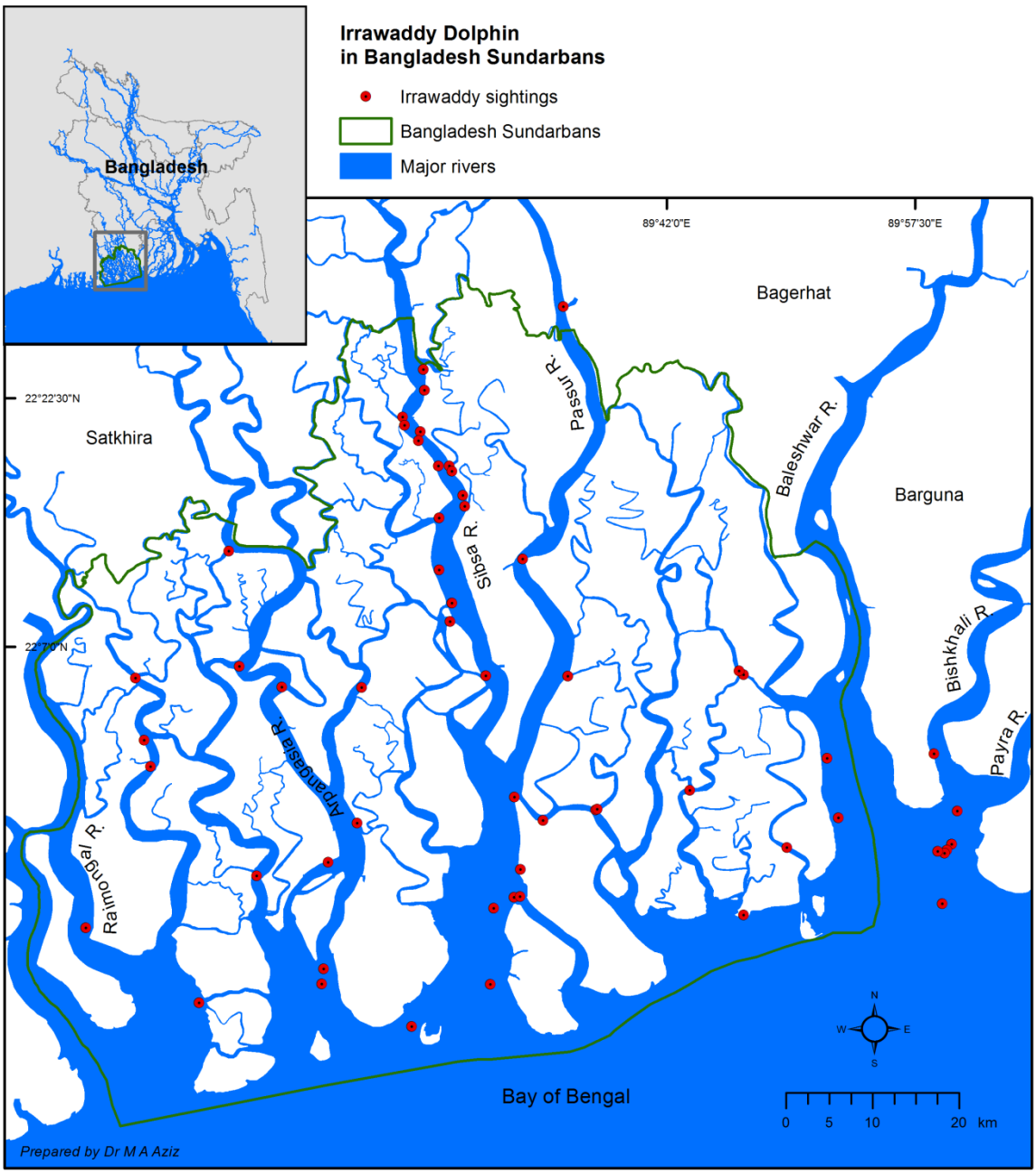


Fig. 31. Distribution of Irrawaddy sightings in the Sundarbans and adjacent coast of Bangladesh.

3.3.2. Irrawaddy dolphin in the Bangladesh coast

The wide long coast of Bangladesh from the Swatch of No-ground to the tip of the St. Martins Island on the southeast Bangladesh supports a larger population of the Irrawaddy dolphins. Additionally, an estimate of 451 Irrawaddy dolphins were reported from the river systems of the Bangladesh Sundarbans (Smith et al., 2006).

The estuarine open waters of Bangladesh appear to be the largest stronghold of Irrawaddy dolphins across its range (Fig. 30). A population estimate of 5,383 Irrawaddy dolphins was reported which appears to be the largest global population occurring in coastal waters of Bangladesh (Smith, 2017).

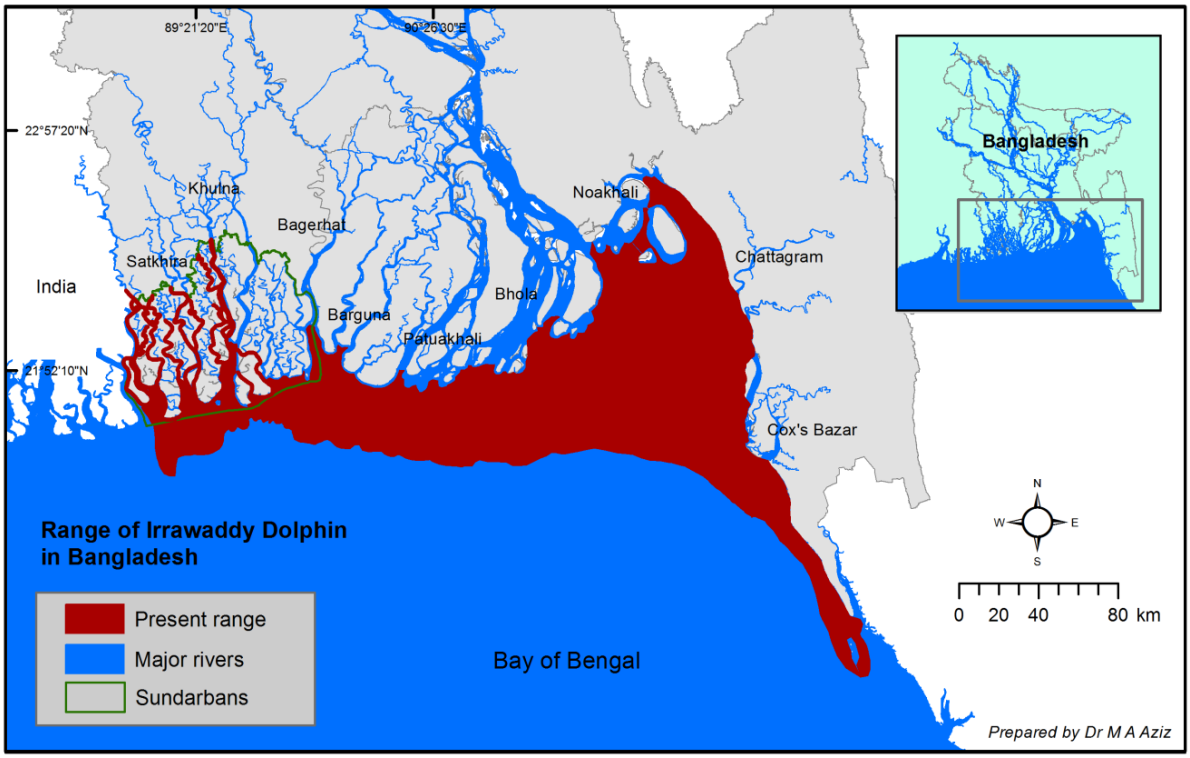


Fig. 32. Range of Irrawaddy dolphin in Bangladesh.

Way forward

The present study has been compromised by temporal and logistical constraints, therefore our survey coverage was not exhaustive. Many of the river stretches remain less or not explored. It is therefore imperative that a future endeavour is to be undertaken immediately to understand the fullest picture of the distribution of these dolphins during both seasons in Bangladesh. Also, spatial population status relating to seasonality is needed to be investigated as soon as possible.

Dolphins are at risk of extinction across their range. In particular, the Ganges river dolphin has experienced both population and range decline across its historical habitats in Bangladesh. Although Bangladesh has been an important habitat for dolphins across the region, it is feared that many of its former range might not support any dolphins today. For instance, occasional reports of dolphins in the reservoir behind Kaptai Dam (built in 1961) in southeastern Bangladesh occurred until the mid-1990s (Ahmed, 2000), but Smith et al. (2001) had found no individual left afterward.

However, Irrawaddy dolphins appear to be better in position than the former one due to their distributional patterns and relatively low level of human use of their habitats. However entanglements in fishing nets threaten the population being their ranges on the potential fishing ground.

There are fierce competition between dolphins and human communities for resources of river and coastal aquatic habitats. Because local communities are highly dependent on the aquatic resource of the country's river systems, Ganges river dolphins are particularly at high risk with myriad of threats and challenges. These issues deserve immediate conservation actions.

Dolphins cannot survive without waters. Even there are sufficient water but devoid of any aquatic organisms as well as their food due to high level of pollution (e.g., the Burrigonga), dolphins will not survive in the long-run or simply they will leave the area. The irrigation dam on the Feni river has forced the Ganges river dolphin to leave the downstream permanently. Similar situation prevails at upper reaches after hydroelectric dam of the Karnafuli river during winter months. Management actions are needed to increase upstream waterflow, and to stop pollutions in these river systems in order to restore these dolphin habitats.



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