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Platanista gangetica, Ganges River Dolphin

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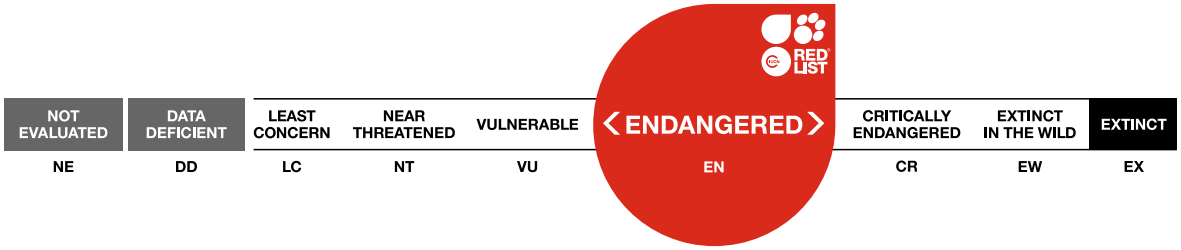

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Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Chordata	Mammalia	Cetartiodactyla	Platanistidae

Scientific Name: *Platanista gangetica* (Lebeck, 1801)

Synonym(s):

- *Delphinorhynchus gangeticus* (Lebeck, 1801)
- *Delphinus gangeticus* Lebeck, 1801
- *Platanista gangetica* ssp. *gangetica* (Lebeck, 1801)
- *Platanista gangetica* (Lebeck, 1801)
- *Soosoo gangeticus* (Lebeck, 1801)
- *Susu platanista* (Lesson, 1828)

Common Name(s):

- English: Ganges River Dolphin, Ganges Dolphin, Gangetic Dolphin
- French: Plataniste du Gange, Sousou
- Spanish; Castilian: Delfín del Ganges
- Afro-Asiatic (Other): Pani Suar, Shishumar
- Assamese: Hiho, Hihu
- Bengali: Hurchum, Hush, Shush, Shushuk
- Hindi: Bhagirath, Soans, Socho, Soons, Soos
- Nepali: Shus, Suongsu

Taxonomic Source(s):

Committee on Taxonomy. 2017. List of marine mammal species and subspecies. Available at: www.marinemammalscience.org. (Accessed: 31 August 2018).

Taxonomic Notes:

The Ganges River Dolphin, *Platanista gangetica* (Lebeck, 1801), is one of two recognized species in the family Platanistidae (Braulik *et al.* 2014a, 2021). From the late 1990s until 2021 the Ganges River Dolphin, and its sister species the Indus River Dolphin (*Platanista minor* Owen, 1853), were recognized and listed on the Red List as subspecies *P. g. gangetica* and *P. g. minor*, respectively (Rice 1998, Society for Marine Mammalogy 2020). In early 2021 evidence from a comparison of mtDNA control regions together with external and skeletal morphology was published, indicating that Indus and Ganges dolphins are substantially different and warrant a change in taxonomy to classify them as separate species (Braulik *et al.* 2014a, 2021). This taxonomic change was approved by the cetacean taxonomic authority the Committee on Taxonomy of the Society for Marine Mammalogy, in mid-2021 (Committee of Taxonomy 2021). Details on the taxonomic history of the two species are summarized in Braulik *et al.* (2021).

Assessment Information

Red List Category & Criteria: Endangered A2abcde+3bcde+4abcde ver 3.1

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Year Published: 2022

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Justification:

Baseline data on population size and distribution across the range of Ganges River Dolphins has increased significantly since previous assessments. However, many surveys have lacked sufficient rigor for comparing estimates between different areas, calculating detection bias, and robust estimation of trends. Based on the sum of all dolphin counts and abundance estimates across the range in India, Nepal, and Bangladesh, about 5,200 individuals, with a range of 4,700 to 5,920 animals of all ages can be accounted for based on surveys conducted from 2008 to date. The lower and upper bounds of the sum of counts and estimates were determined from the ranges provided in different survey reports cited in the Population section. Due to the lack of standardization and rigor and considering that large areas in Bangladesh remain unsurveyed, uncertainty remains about the relationship between the sum of all dolphin counts/abundance estimates and actual abundance. However, the total of 5,200 individuals serves as a useful baseline for a minimum population estimate. Note that the name Ganges is used for the Ganga/Padma/Ganges River throughout this document. The name Brahmaputra or Jamuna is used for the Brahmaputra/Jamuna River according to its mention for India and Bangladesh, respectively. We estimate that the historical linear range of Ganges River Dolphins in the late 1800s (Anderson 1879) was approximately 16,830 km, and that the current range is *ca* 13,500 km, corresponding to a 20% decline in 150 years. The current range corresponds with an estimated area of occupancy for Ganges River Dolphins of approximately 13,500 x 2 = 27,000 km². A width of two km is used as the minimum to measure area of occupancy, as per the IUCN Guidelines v14 for linear habitats. The overall population is fragmented by dams and barrages into at least seven subpopulations. The diversity and scale of threats facing this species—recent, ongoing, and projected—are vast. They include storage dams, barrages, and 'run-of-river' hydropower projects that divert river waters and reduce in-stream flow, habitat availability and longitudinal connectivity, unsustainable mortality from fishery interactions, hunting in some areas, pollution, industrial development of inland waterways and plans for river-interlinking in India. Maintenance dredging and underwater noise from increased vessel traffic may also be negatively affecting Ganges River Dolphins (Kelkar 2017, Dey *et al.* 2019). The Ganges River Dolphin (then defined as a subspecies) was classified as Endangered in the previous assessment (Braulik and Smith 2019) and here it is again assigned to this category, but now as a species rather than a subspecies.

Criterion A. Only limited data are available on the life history of dolphins in the genus *Platanista* (reviewed by Brownell 1984). Age at first reproduction is thought to be around 10 years and maximum lifespan to be above 30 years, however the sample size of aged adult animals is very small (Kasuya 1972, Lockyer and Braulik, 2014, Braulik *et al*. 2021). Ohsumi (1979) estimated the maximum lifespan of the Ganges susu as 33-35 years. Following the method of calculation provided by the IUCN Red List Guidelines (version 14), we estimated the reproductive phase of the lifespan for Ganges dolphins at approximately 25 years, and generation time at around 17 years. This means that three generations equal 51 years (i.e. from 1970 counting backwards or until 2072 counting forwards).

Subcriterion A2 can be applied with the assumption that a population size reduction of more than 50% from 1970 to 2020 is suspected, given that much of the dam and barrage construction associated with large-scale declines in the area of occupancy has occurred since that time. The large-scale introduction

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of monofilament gillnets from the 1970s in India and Bangladesh, coupled with increasing fishing intensity in many regions, means that fishing-related mortality of these dolphins has also increased significantly since that time. Increases in riverine pollution, especially in the Ganges, have occurred within the last forty years following industrialization and intensification of irrigated agriculture and reduction in sediment-flushing ability of rivers after dam construction. The suspected reduction in dolphin population size continues, and the main causes have not ceased (habitat fragmentation and water diversion are ongoing, mortality from fishing gear entanglement and targeted hunting is common, and pollution levels remain high). The causes of the past decline are not fully understood and may not be reversible. The basis for listing could rest on any or all of (a) to (e).

Subcriterion A3 (future decline) and subcriterion A4 (decline spanning the past and the future) can also be applied because a population size reduction of more than 50% could reasonably be projected over the next 30-60 years into the future (A3), or inferred, projected, or suspected over a time period spanning the past and into the future (A4), given the huge scale of threats, and the predicted massive negative impacts, if major future developments such as India's inland waterways and river-interlinking projects are realized. The cumulative effects of these projects could easily cause a population size reduction of 50% (or more) from 2020-2080, with exact causes uncertain, continuing, and possibly irreversible; in both instances based on any or all of (a) to (e). Evidence for subcriterion A4c is probably the strongest since a precautionary interpretation of life history data indicates a period of 51 years for three generations, which encompasses the effects of over 20 barrages and 17 high dams constructed in the Ganges-Brahmaputra-Meghna (GBM) system since the 1960s-1970s, and the projected declines in the area of occupancy, and/or quality of habitat that will undoubtedly occur if the Ganges-Brahmaputra basin inter-link canals and dam projects are constructed.

Criteria B, C, D, and E are not applied due to the population of mature individuals and area of occupancy being greater than needed for the species to qualify for a threatened category under these criteria. It is therefore concluded that the species qualifies as EN under criterion A, subcriteria A2abcde+3bcde+4abcde, with available evidence strongest for subcriterion A4c.

Subpopulations

Some of the small populations of Ganges dolphins isolated or semi-isolated upstream of, or between, barrages (low gated dams) could be assessed separately as subpopulations, assuming that there are conservation benefits of such assessments. There is limited information on the degree of isolation of these populations. Among sub-populations that are priorities for assessments, due to their small size, are those located between Bijnor and Narora barrages in India, and upstream of the Girija barrage in the Karnali/Ghaghra River in Nepal and India.

For further information about this species, see Supplementary Material.

Previously Published Red List Assessments

2012 – Endangered (EN)
https://dx.doi.org/10.2305/IUCN.UK.2012.RLTS.T41756A17627639.en

2004 – Endangered (EN)

1996 – Endangered (EN)

1996 – Endangered (EN)

1994 – Vulnerable (V)

1990 – Vulnerable (V)

1988 – Vulnerable (V)

Geographic Range

Range Description:

Ganges River Dolphins historically occurred throughout the GBM and Karnaphuli-Sangu (KS) river basins from their tidal deltas in India and Bangladesh, to the plains at the Himalayan foothills, where rocky barriers, shallow water, and fast currents prevented upstream movement (Nepal, Arunachal Pradesh in India). Ganges River Dolphins usually do not occur in coastal waters with salinity above 10–12 ppt (Smith *et al.* 2009), but they have been observed occasionally in waters with salinity up to 23 ppt (Smith *et al.* 2010). Although there may be occasional demographic interaction in the high-water season if the freshwater plumes of the two river systems meet, the GBM and KS systems are disjunct and so are their respective dolphin populations (Richman 2014, Smith *et al.* 2001). The metapopulation of the species has been fragmented by numerous man-made barriers in the form of dams and barrages (gated water diversion structures) constructed within the last 150 years, which completely, or partially, isolate populations. Isolated, or partially isolated, dolphin populations occur between the barrages on the upper Ganges (Bijnor, Narora, Kanpur barrages), above and below the Girija barrage near the India-Nepal border in the Karnali-Ghaghra River, and above and below the Farakka barrage (located approximately at the geographic centre of the overall range) close to the India-Bangladesh border (Sinha 2000, Qureshi *et al.* 2018). Importantly, Ganges River Dolphin populations do not appear to be extant or number more than a few individuals upstream of the Birpur (Koshi) barrage on the Kosi River, and the Triveni barrage on the Narayani-Gandak River, both of which are located along the India-Nepal border. Depending on dam or barrage operations and the altered local channel hydraulic and geomorphologic features, the degree of isolation of dolphins between barrages likely varies. However, upstream and downstream movements through barrage gates are possible, as reported for a radio-tagged Indus dolphin (Toosy *et al.* 2009). The current west-east distribution extends from the Chambal River in north-central India, to the eastern end of the Brahmaputra River in Assam (India). The south-north extent is from the Budhabalanga River in Odisha (India; Ura *et al.* 2007) and the Karnaphuli-Sangu river basins in Bangladesh in the south; and below the Bijnor barrage in the Ganges in Uttar Pradesh (India) and Karnali River (Nepal) in the north. Refer to Supplementary Information Table 1 and Map 1 for more details.

Range declines

Anderson (1879) produced the first map of the range of *Platanista* from sighting data contributed by colonial officials posted in different provinces of the Indian subcontinent. We measured river channel lengths where the species currently occurs versus the historical baseline from Anderson's map. This approach was used by Reeves *et al.* (1991) and Braulik *et al.* (2014b) to estimate the range decline of Indus River Dolphins. We calculate that the historical range of Ganges River Dolphins in 1879 was about 16,830 km of river length. The current range of the species is about 13,500 km, indicating a decline in their distribution of about 20%. About 35% of the upstream range is only occupied during the high-water monsoon season (July-October), based on seasonal movements of dolphins. The remaining 65% (c. 8,700 km) of the current range supports dolphins year-round. Of the total current distribution, about

20% of the length of major large rivers has not been fully surveyed (c. 3,280 km), of which about 2,300 km lie in Bangladesh, and c. 980 km is within India (see Table 1 for details). Paudel and Koprowski (2020a) reported a range decline of 18%, but their estimates excluded some river stretches where dolphins are known to be locally extirpated (e.g. Yamuna, Barak, Ramganga rivers), and included some areas (e.g. between Narora and Kanpur barrages) where small populations persist (WWF-UPFD 2015).The main known range declines have been in the Son, Sind, Ken, and Betwa Rivers, which are peninsula-origin rivers, and in Himalaya-origin rivers such as the Yamuna, Ramganga, and Sharda, and upstream reaches of the Ganges River in the north Indian plains (Sinha *et al.* 2000, Sinha and Sharma 2003, Sinha and Kannan 2014, Singh *et al.* 2014). These southern tributaries have multiple dams, and dry-season flows have been reduced to almost zero. A range reduction of about 15% for the Ganges River main stem (in the Haridwar-Bijnor and the Narora-Kanpur segment) is evident. No dolphins have been reported in recent years between the Madhya Ganga Barrage at Bijnor and the Bhimgoda Barrage near Haridwar (100 km), thought to be the upstream limit of their historical range in the Ganges in the late 1800s (Sinha *et al*. 2000). The 345 km stretch between the Narora and Kanpur barrages on the Ganges supports only 15-20 individuals. (Behera *et al.* 2013, 2014; WWF-UPFD 2015, WII-GACMC 2017). In major northern tributaries of the Ganges (Ghaghra (Karnali in Nepal), Gandak (India), Kosi (Koshi in Nepal), and Mahananda (India)), dolphin populations are still extant, although minor range reductions have occurred upstream and downstream of barrages. Anderson (1879) mapped the possible range of Ganges River Dolphins to include the Yamuna River until Delhi. The dolphin population in the Yamuna River has undergone a range reduction of 40% (from Delhi to Firozabad) and the remaining population is small (estimated at 40 animals from Etawah to Allahabad: Behera *et al*. 2014, Taigor 2020), and seriously threatened by poor flows and pollution especially upstream of Etawah. In the Karnaphuli-Sangu basin, a range reduction of about 40% is estimated to have occurred after the construction of the Kaptai Dam (Smith *et al*. 2001). In the Buriganga and Turag Rivers in Bangladesh, a population reduction of about 70% is estimated to have occurred during the last 40 years due to habitat loss from industrial pollution and vessel traffic (Alom, unpublished). The smallest range decline is in the Brahmaputra River and its undammed tributaries in India. Wakid (2005) reported dolphins only from the Kulsi and Subansiri tributaries of the Brahmaputra, and no dolphins were recorded in ten others. Of these ten, Anderson (1879) had included the Manas, Kameng or Jia Bhareli, Dhansiri, and Kopili in the inhabited range shown in his map. Choudhury *et al.* (2019) reported the extirpation of dolphins in the Barak River (90 km) in Assam (India), a tributary of the Meghna River, which they attributed to a combination of bycatch in fishing nets, and water pollution. No range reductions have been reliably documented in Bangladesh, except for the upper Karnaphuli above the Kaptai Dam (Smith *et al.* 2001). In Nepal's rivers, range reductions have been reported for the naturally range-restricted (due to the Himalayan foothills) populations in the Karnali and Narayani rivers (Paudel *et al.* 2015a, Khanal *et al.* 2016). In Nepal's Narayani River, the population is fewer than 2 or 3 animals, and dolphins are extirpated from the Mahakali (Sharada) River (Paudel *et al.* 2015a).

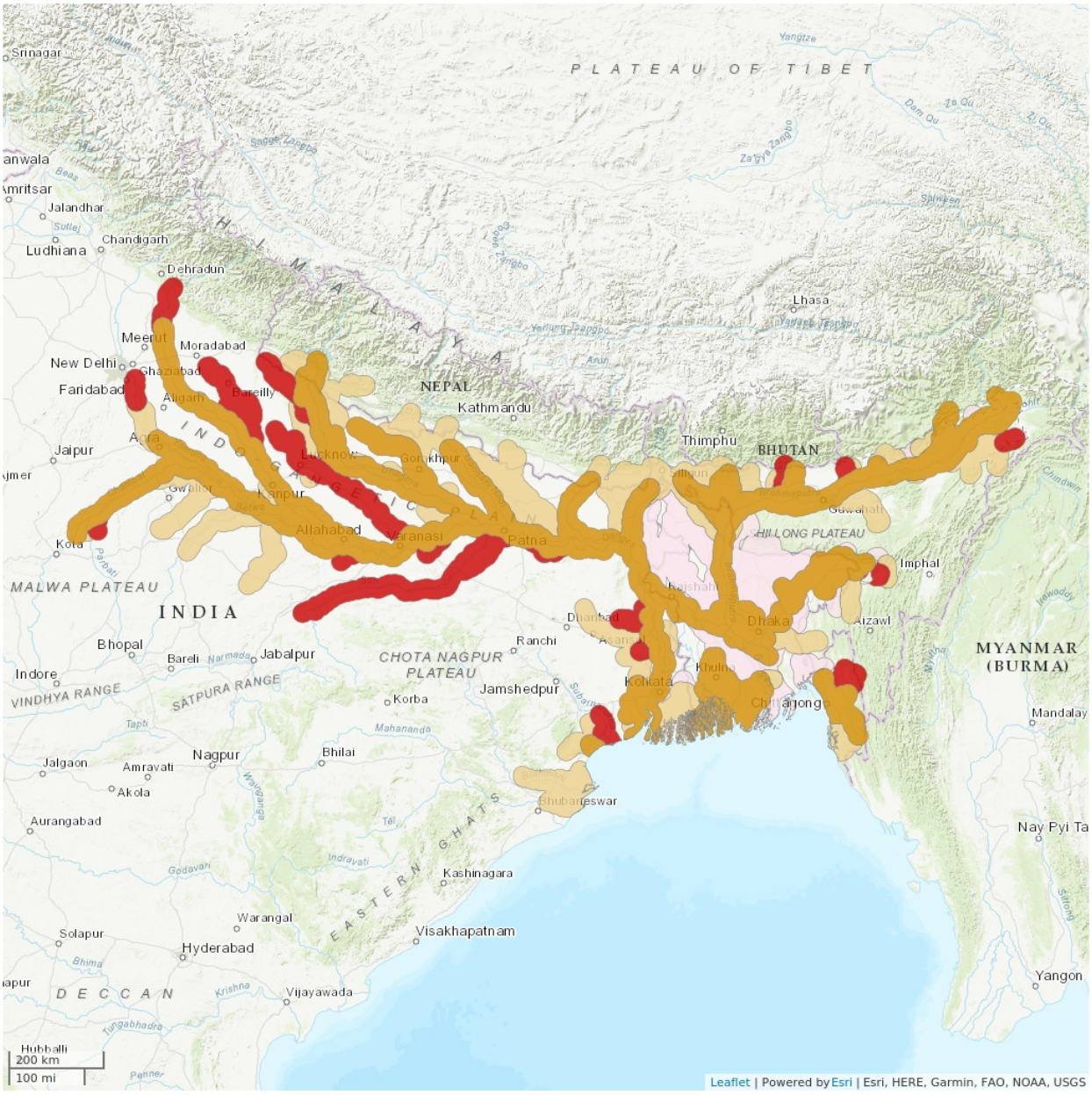
For further information about this species, see Supplementary Material.

Country Occurrence:

Native, Extant (resident): Bangladesh; India; Nepal

Presence Uncertain & Origin Uncertain: Bhutan

Distribution Map



Legend

- EXTANT (RESIDENT)
- EXTANT (PASSAGE)
- POSSIBLY EXTANT (SEASONALITY UNCERTAIN)
- EXTINCT

Compiled by:

Kelkar, N., Smith, B.D., Alom, M., Dey, S., Paudel, S. & Braulik, G.T. 2022

The boundaries and names shown and the designations used on this map do not imply any official endorsement, acceptance or opinion by IUCN.

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Population

Historical estimates of abundance

The aggregate range-wide abundance of Ganges River Dolphins was suggested by Jones (1982) to be 4,000–5,000 individuals and later by Mohan *et al*. (1997) as fewer than 2,000, but these were just guesses. The previous IUCN Red List Assessment for Ganges River Dolphins in 2008 conducted a rough accounting and arrived at a conservative total of about 1,200–1,800 animals as a reasonable lower range for the total metapopulation. However, that assessment also acknowledged that the true number could be several times higher, considering that areas with potentially large numbers of animals had not been surveyed, and because direct counts generally underestimate abundance due to availability and perception bias (Smith and Reeves, 2000; Richman *et al*. 2014). More recently, Sinha and Kannan (2014) estimated a population of around 3,520 dolphins from available survey data in the rivers of India.

Current estimates of abundance

Most surveys have used direct counts (based on Smith and Reeves 2000) conducted within discrete portions of riverine and deltaic habitat. Since 2000, concurrent counts by independent teams (double-observer surveys) and paired visual-acoustic surveys have been used in some river stretches in India and Bangladesh. These methods provide more rigorous estimates of absolute abundance that correct for detection bias, and have accompanying estimates of precision (e.g. Smith *et al*. 2006, Kelkar *et al*. 2010, Akamatsu *et al*. 2013, Richman *et al*. 2014).

Metapopulation estimate: The sum of available survey data as of 2021 indicated that at least 5,200 Ganges River Dolphins of all ages occur across the range in India, Nepal, and Bangladesh with a lower bound at 4,700 individuals. Due to the lack of widespread survey data analyses that correct for detection bias (missed dolphins), and considering that large areas in Bangladesh remain unsurveyed, uncertainty persists about the relationship between the sum of all dolphin counts/abundance estimates and actual abundance (see Supplementary Information Table 1 for full details).

The largest numbers of dolphins documented are in the main stem of the Ganges (Ganga in India and Padma in Bangladesh: ~2,000 individuals in c. 1,925 km), and the Brahmaputra main stem in India (877 individuals CV=2% in c. 884 km) (WWF-UPFD 2015, CMS 2020). However, significant gaps in survey coverage remain, especially in the main stem of the Ganges and Brahmaputra (Padma and Jamuna) in Bangladesh, Teesta, and Meghna Rivers and associated tributaries/distributaries in Bangladesh, and in some channels of the Sundarbans delta in India. The unsurveyed river segments of Bangladesh might support Ganges River Dolphin populations that would significantly increase the minimum estimated population size noted above.

Ganges River system: The Ganges River in Uttar Pradesh supported an estimated 712 dolphins in 1,300 km of river surveyed in 2015 (WWF-UPFD 2015). In March 2018, the Ganges River from the Uttar Pradesh-Bihar border to the Farakka barrage (625 km) supported a population of about 1,340 (CV=3.5%) animals of all ages (Qureshi *et al*. 2018), making the estimated abundance for the Ganges River in India around 2,050. Among the major tributaries, the Kosi in India and Nepal (c.270 km) supported about 350 (CV 7%) animals as of 2019 (Dey *et al*., unpublished). The Ghaghra River (505 km) in Uttar Pradesh supported 300-320 dolphins in 2015 (WWF-UPFD 2015), and in Bihar about 125 dolphins in 100 km in 2018 (Bihar Dolphin Survey, unpublished). A population of about 40 dolphins was estimated for the Ghaghra (Karnali in Nepal) River and section of the Giruwa channel within India, upstream of the

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Ghaghra barrage (Basu 2012, Khanal, G., pers. comm.). Thus, the Karnali-Ghaghra River from about 10 km below Chisapani in Nepal to its confluence with the Ganges at Doriganj (in Bihar, India) likely supports a population of 480-490 dolphins. A survey conducted by the Uttar Pradesh Forest Department and World Wildlife Fund-India (WWF-UPFD 2015) counted 40 dolphins in the Rapti River in India's Uttar Pradesh in 2015. In the Gandak River (324 km), 155 dolphins were recorded in 2018 (Bihar Dolphin Survey, unpublished), a clear reduction from the 250-270 counted dolphins in 2010 (Choudhary *et al*. 2012). The Mahananda River (250 km) within the Indian states of Bihar and West Bengal supported 190-232 dolphins in 2021 (Kelkar and Dey 2021). The Chambal River (356 km) supported 90-120 dolphins in 2014-2015 (Behera *et al*. 2014; WWF-UPFD 2015; Singh *et al.* 2014). Sharma and Singh (2014) reported counts fluctuating between 60 and 90 dolphins, with no clear trends in the Chambal River from 1985 to 2014. Dey *et al*. (unpubl.) did not find any dolphins in 150 km of the Parman, Mechi, Kankai, and Bakra tributaries of the Mahananda, although there were regular reports of strandings during the high-water season. Kelkar and Dey (2021) recorded 190-232 dolphins in 250 km of the Mahananda River in 2021. A few dolphins (<5) are likely to occur during the monsoon season in other rivers such as the Budhi Gandak and Bagmati (Bihar) and the rivers of North Bengal (Raza, R., pers. comm.; Chatterjee *et al*. 2015).

Rivers in West Bengal: Qureshi *et al*. (2018) conducted double-observer surveys in March 2018 and estimated 236 (CV 10%) dolphins in 500 km of the Hooghly River in West Bengal from the Farakka feeder canal to the Hooghly delta mouth near Ganga Sagar/Kakdwip. Dolphins persist in this waterway with heavy shipping traffic, urbanized riverfronts, and high pollution loads. Sharma (2010) found 140-170 dolphins in 222 km of the Hooghly River from Farakka to Calcutta (Kolkata) in 2009, similar to the count of 152 in 1996 (Sinha 1997). A single stranded dolphin was rescued from a deep pool in the Damodar after its flow was diverted by an upstream barrage (Smith *et al*. 2000). Dolphins are now probably extirpated, barring occasional sightings, from the Damodar and Jalangi Rivers, and a few individuals regularly encountered near their confluence with the Hooghly River (Mallick 2011, Chowdhury *et al*. 2016, Qureshi *et al*. 2018). Other rivers in which such occasional dolphin sightings have been recorded include the Ichhamati, Ajay, Shilabati, Matla, and Bidyadhari rivers in Southern West Bengal (Mallick 2011). Ganges River Dolphins were previously reported from the Indian Sundarbans (Anderson 1879, Jones 1982). However, recent surveys by the Wildlife Institute of India (2014-2016) recorded no sightings in over 300 km of survey effort (CMS 2020). In an earlier opportunistic survey, Manjrekar and Prabhu (2015) reported one individual sighted during 238 km of survey effort in the delta. No dolphin sightings were reported from the Matla, Gomor, and Bidya tidal rivers of the central and eastern Sundarbans of West Bengal (Mitra and Chowdhury 2018). Dolphins were reported to occur in river segments with less than 10 ppt salinity in the Muriganga, a tidal river in the western Sundarbans (Mitra and Chowdhury 2018). Samad (2021) recorded 6-13 dolphins in a 14 km section of the Ganges River within India downstream of the Farakka barrage.

Brahmaputra and Meghna River systems: Approximately 900 dolphins were estimated in 884 km of the main stem of the Brahmaputra, 37 dolphins were counted in the Kulsi, and 48 (CV 12.5%) were estimated in the Subansiri tributaries (69 and 93 km respectively) in 2018 (Qureshi *et al*. 2018). From a population of 10-15 dolphins in 1999-2000, dolphins had disappeared from the Barak River (Southern Assam, India) in 2014 (Choudhury *et al*. 2019). In the Surma and Kushiyara rivers in India north of the Bangladesh border, six dolphins were seen in 2013 (Mazumder *et al*. 2014). An adult dolphin killed in fishing gear is known from July 2010 (S. Reddy, pers. comm.) in the Gumti River at Udaipur, Tripura, India (part of the upper Meghna basin) and this is the only known documentation of the species from this

area.

Karnaphuli-Sangu River system: In 1999 about 125 dolphins were counted in 165 km of the Karnaphuli-Sangu River system (Smith *et al.* 2001). Using a paired visual and acoustic survey, in the same area, Richman *et al*. (2014) estimated 203 dolphins (CV=3%). There were occasional reports of dolphins in the reservoir behind the Kaptai dam (built in 1961) in the Karnaphuli-Sangu system until the mid-1990s (Ahmed 2000), but surveys in the late 1990s found no evidence that Ganges River Dolphins survive there (Smith *et al.* 2001).

Rivers in the Bangladesh Sundarbans and delta: Using double-concurrent counts made by independent observers, Smith *et al*. (2006) estimated 225 (CV=12.6%) Ganges River Dolphins in all navigable channels (1,510 km) of the Bangladesh side of the Sundarbans mangrove forest, with the species occurring primarily in the northeast low-salinity portion of the forest and then replaced by Irrawaddy dolphins (*Orcaella brevirostris*) in the southwest high-salinity portion of the forest (Smith *et al*. 2009, 2010). Aziz (2019) recently reported a count of 159 dolphins in 1,340 km of the Bangladesh Sundarbans. However, no details were provided on the sampling design and bias in counting or coverage, so this is likely to be just a minimum count of dolphins in that area.

Nepal: Paudel *et al*. (2015a) reported two dolphins from the Narayani River upstream of the Gandak barrage on the India-Nepal border. The Mahakali population is extirpated probably due to an upstream barrage (Smith *et al*. 1994). Downstream of the Birpur barrage on the Kosi River within Nepal, dolphins persist at a population of 20-25 animals in the low-water season (Smith *et al*. 1994, Paudel *et al*. 2015a,b). In the Karnali River, only 6-10 animals survive in the Nepal stretch of the river (Paudel *et al*. 2015a,b; Khanal *et al*. 2016) but this population's low-water season range is connected with the 20-30 animals surviving upstream of the Girijapuri barrage on the Ghaghra River in India (downstream of the India-Nepal border). Recently, Shah *et al*. (2020) conducted dolphin surveys in the monsoon season (July-August) in the Karnali, Mohana, Narayani, and Sapta Koshi rivers. They reported a best estimate of 52 (range 50-61) dolphins, 43 from the Mohana River and tributaries associated with the Karnali-Ghaghra drainage, and the rest from the Koshi. Individuals moving from India to Nepal during the high-water season must have contributed to these counts.

Canals: Three small populations warrant mention as they occur in manmade feeder/link canals used for irrigation and navigation. These are in the Karnaphuli-Sangu (Sikalbaha-Chandkhali) link canal in Bangladesh with 20-30 dolphins in 29 km (Smith *et al*. 2001), the Farakka feeder canal in West Bengal, India, with a seasonally changing abundance of between 3 and 36 animals in 43 km (Sinha 1997, 2000; Samad 2021), and the Ghaghra-Sharda link canal in Uttar Pradesh, India, with 5-6 dolphins in 28 km (Prajapati 2018, 2021). In the Farakka feeder canal, gillnet fishing and resulting bycatch of river dolphins is likely to have a significant impact on the local population size (Samad *et al.* 2022).

Relative Abundance

The highest encounter rates of Ganges River Dolphins have been observed in the Ganges main stem between Patna and Rajmahal (2-2.5 dolphins/linear km along the river) (Sinha *et al*. 2000, 2010; Sinha and Kannan 2014, Kelkar *et al*. 2010). Within this stretch, encounter rates were particularly high from Sultanganj to Rajmahal (2.5-3 dolphins/km), peaking downstream of Kahalgaon and Maniharighat (3-3.2 dolphins/km), based on surveys carried out from 2000 to 2015 (Kelkar 2015). The Vikramshila Gangetic Dolphin Sanctuary from Sultanganj to Kahalgaon (65-70 km) in Bihar lies in this segment (Choudhary *et*

al. 2006). Encounter rates in the Brahmaputra are almost 1 dolphin/km and in the lower Sangu river 1.4 dolphins/km (Smith *et al*. 2001), and around 1.4 dolphins/km in the Kosi River in India. In other stretches, densities are usually lower than 1 dolphin/km (e.g. Hooghly, Chambal, Ghaghra, Gandak, Mahananda, Bangladesh Sundarbans and other rivers; see Table 1 for details of data sources). In Bangladesh, encounter rates of Ganges River Dolphins were estimated at 0.29 individuals/km during 2003-2004 in the Buriganga River (Alam and Sarker 2012) and 0.48 dolphins/km in that river in 2013 (Alam *et al*. 2015, Hossain *et al*. 2016). An encounter rate of 0.49 dolphins/km was estimated in an 18.5 km long and highly polluted stretch of the Turag River, Bangladesh, in 2013 (Baki *el al.* 2017).

Population Trends

Few credible time series of abundance estimates are available that allow inferences about population trends. In the Vikramshila Sanctuary in Bihar, India, and neighboring river stretches, dolphin population numbers appear to have been stable from 2000 onwards (150–190 dolphins in 67 km; Choudhary *et al*. 2006, Kelkar 2015). In Assam's Barak River, numbers declined from 10–15 dolphins in 2000 to zero in 2014 (Choudhury *et al*. 2019). In Nepal, Ganges River Dolphins in the Karnali River were monitored from 1982 to 2006, but the reported numbers have fluctuated greatly due to differences in distances surveyed and in the rigour of past survey methods, major hydrological changes (channel course shifts), as well as possible changes in the number of dolphins using the area (WWF-Nepal 2006, Smith 1993, Smith *et al*. 1994). Recently, Khanal *et al*. (2016) reported a decline from 11 to six animals from 2009 to 2015 in the Karnali River. A decline is probable in the Gandak River, with 257 dolphins recorded in 2010 and only 155 recorded in 2018 (Choudhary *et al.* 2012, Sharma 2013, Bihar Dolphin Survey, unpublished). In the Ganges in Bihar and Brahmaputra in Assam (India), either population declines have been small or local population abundance has remained stable (Kelkar 2015, Qureshi *et al*. 2019). However, the apparent stability of these populations could change substantially if current plans for waterway development and river interlinking projects proceed, or if bycatch is not reduced. Cumulative and increasing threats, including habitat loss from dams and diversions and bycatch in fisheries, make a "continuing decline" the most plausible trend in abundance in the absence of conservation action.

For further information about this species, see Supplementary Material.

Current Population Trend: Decreasing

Habitat and Ecology (see Appendix for additional information)

Ganges River Dolphins are generally concentrated in counter-current pools below channel convergences and sharp meanders (Kasuya and Haque 1972, Smith 1993, Smith *et al*. 1998, 2000) and above and below mid-channel islands, bridge pilings, and other engineering structures that cause scouring (Smith *et al*. 1998, Smith and Reeves 2012). Dolphins appear to prefer river sections with thalweg depths of 5–12 m in larger river channels (Kelkar *et al*. 2010). In shallower tributaries, dolphins were found in river channels with depths from 2.5 to 5 m (Choudhary *et al.* 2012). River dolphin site-fidelity to counter-current pools is probably the greatest in fast-flowing channels (Smith *et al*. 1998). Annual monsoon-driven floods cause great variability in the amount of available habitat. The dolphins generally expand their distribution to include small tributaries or braided channels in the high-water season and then shrink their distribution to larger channels during the dry season (Haque *et al*. 1977, Mohan and Kelkar 2015). Isolation in seasonal lakes sometimes occurs (especially in the Brahmaputra basin), as does "escapement" into artificial water bodies such as canals and reservoirs. Deltaic (brackish) waters are a major component of the total range, but Ganges River Dolphins do not usually occur in coastal waters,

except occasionally in river mouths during low tide and during the monsoonal flooding or high-water season when salinity declines (Smith *et al*. 2009, 2010). Information on the physiology, anatomy, behaviour, and sensory ecology of the species is mainly available from field specimen collections and captive studies from the 1970s (e.g. Herald 1969, Pilleri 1971, Kasuya 1972). Ganges River Dolphins use high-frequency echolocation clicks, with relatively low sound source levels compared to marine dolphins. Ganges River Dolphins forage on small fish and shrimp (Ura *et al*. 2007, Jensen *et al*. 2013, Kelkar *et al.* 2018). The dolphins are largely solitary, with mother-calf pairs as the only obvious social grouping, and little is known about social interactions (Sutaria *et al*. 2019, Braulik *et al*. 2020).

Systems: Freshwater (=Inland waters)

Threats (see Appendix for additional information)

Major threats to Ganges River Dolphins include 1) flow regulation and habitat fragmentation by water development projects (dams, barrages, canals, and embankment construction projects), 2) mortality from entanglement in fishing nets, 3) targeted hunting of dolphins for oil and flesh, 4) river pollution, and 5) disturbance from human activities related to boat traffic, underwater noise, and shoreline/riverfront development (Smith and Smith 1998, Reeves *et al*. 2000, Sinha *et al*. 2010, Sinha and Kannan 2014, Dey *et al*. 2018, Braulik and Smith 2019, Kelkar and Dey 2020). Other emerging threats include river bottom sediment dredging, saline ingress from sea level rise (in the Sundarbans Delta), and the impacts of climate change on basin-scale hydrological dynamics.

Although it is possible that there have been undetected declines in abundance, higher-density dolphin populations in the Ganges and Brahmaputra basins have generally persisted despite continuing threats. Threats from reduction of dry-season flow, fishing-related mortality, and possibly, pollution, are likely having cumulative and synergistic effects on population persistence (e.g. Choudhury *et al*. 2019, Khanal *et al*. 2016, Paudel *et al*. 2020c). At least in the short term, Ganges River Dolphins have persisted in some highly degraded and polluted stretches, e.g., Turag River near Dhaka, Bangladesh, and the Hooghly River at Kolkata, India.

1. Flow regulation and habitat fragmentation by water development projects

Reduction in dry-season river flows due to diversion of water for irrigation- by dams and barrages and groundwater/surface water abstraction from tube wells and surface pumps has significantly compromised river dolphin habitat in many areas (e.g. Lapworth *et al*. 2021). In many rivers, depths and river width have declined, and in some, dry-season flows have been modified by sudden and erratic flows released by upstream barrages (Sonkar and Gaurav 2020). In general, water development projects have caused (a) fragmentation of the meta-population, (b) reduction or elimination of habitat in the dry season, (c) "escapement" of dolphins into canals where they are exposed to high risk of injury and mortality, (d) possible cascading effects from interrupted migrations of fish/shrimp prey and degradation of fish spawning habitat (e) chronic and/or acute exposure to toxins and pollutants in reservoir areas, (f) loss of habitat complexity and productivity (due to channelization, sediment entrapment upstream of dams), and (g) downstream effects on the ecology of deltas including saline encroachment and increased sedimentation.

In India, construction of at least 50 dams and barrages within the known or suspected historical range of Ganges River Dolphins has significantly affected habitat, abundance, and population structure (Reeves *et al.* 2000, Smith *et al*. 2000). Apart from habitat and population fragmentation, dams and barrages

have degraded downstream and upstream habitat. Reservoirs and pondages upstream of dams and barrages can cause significant backwater effects, leading to altered assemblages of fish and invertebrate species, and luxuriant growth of macrophytes, which could affect dolphin habitat use (Sinha 2000, Sonkar and Gaurav 2020). Between the Narora and Kanpur barrages, low flows and high pollution levels appear to have caused a population decline and made the habitat unviable in the last two decades. Diversion of dry season flows by the Kanpur Barrage on the Ganges, constructed in 2000, has also fragmented river habitat. However, small populations are still extant upstream of barrages on the Ghaghra and Kosi Rivers. A small population is still extant upstream of the barrage on the Ghaghra River. The Brahmaputra River in India has no dams, but planned hydropower development in headwater catchments have implications for future flows in the basin. The Lower Subansiri project on the Subansiri River was almost 50% complete in 2013, and with its eventual completion, extensive flow alterations are likely, which could cause severe loss of dolphin habitat (Baruah *et al*. 2012). The Tipaimukh dam and another high dam proposed for the Surma River in Cachar, India, will likely affect dolphins downstream in the Kalni-Kushiyara distributary in Bangladesh (Smith *et al*. 2000, Choudhury *et al*. 2019). Freshwater influx into the Sundarbans Delta has been reduced by barrage and dam projects since the 1950s (e.g. Farakka barrage on the Ganges, the Teesta projects). The downstream effects of at least ten dams and barrages constructed on the Damodar main stem and tributaries has severely reduced and fragmented dolphin habitat in this river system (Smith *et al*. 2000). From the 1980s, momentum has continued in India for large-scale inter-basin water transfer (or river-interlinking) projects, involving the construction of many additional dams and canals for water diversion from the Gangetic basin to rivers in peninsular India. Although proposed river-interlinking projects are expected to take longer than the next 10 years to implement, these interventions, if pursued, are likely to cause major declines in river dolphin populations.

In Bangladesh, the insufficiency of water released by India downstream of the Farakka barrage has significantly reduced dry-season habitat in the Ganges River (Padma) until the Brahmaputra/Jamuna confluence in Bangladesh (Smith *et al*. 1998, Reeves and Smith 1999, Sinha 2000, Gain and Giupponi 2014). Reduced river discharge below the Farakka barrage, along with sea level rise and saline intrusion into the Sundarbans Delta (Rahman 1986), have already decreased the amount of suitable habitat for this obligate freshwater species (Reeves *et al*. 1993, Smith *et al*. 2009). Regulation of Teesta River basin waters by India might have also caused habitat reduction in downstream reaches. In the upper Karnaphuli basin, dolphins have been extirpated from the reservoir behind the Kaptai dam (Smith *et al*. 2001), presumably because of the change in habitat (from flowing water to a static lake environment), or because the population isolated above the high dam was too small to be viable.

In Nepal, the proposed Karnali dam project (for hydropower and irrigation), if constructed, could eliminate dolphin habitats downstream (Smith and Reeves 2000, Khanal *et al*. 2016). Barrages on the India-Nepal border have already constrained movements and caused population declines in the large rivers of Nepal's plains (Smith 1993, Smith *et al*. 1994; Paudel *et al*. 2015a,b). Recently, Paudel *et al*. (2020b) estimated that low dry-season river flow (January-April) in the Karnali River could be constraining the availability of habitat to river dolphins.

Embankments built along riverbanks for flood control also affect dolphin habitat. Embankments cause sediments to be deposited in the riverbed instead of on the floodplain, thereby reducing eddy-counter current habitat preferred by dolphins (Smith *et al*. 1998, Sinha *et al*. 2019). They also restrict access to floodplain habitat critical to the reproduction and growth of riverine fish species (Boyce 1990, Hossain

and Sakai 2008). Approximately 3,500 km of embankments have been constructed in the Ganges mainstem and the Kosi, Gandak, Burhi Gandak, Bagmati, Kamala, Yamuna, and Son tributaries (Agarwal and Narain 1996, Mishra 2008, Sinha 2008). Dolphins were apparently extirpated from about 35 km of the Punpun tributary of the Ganges after embankment construction in 1975 (Sinha *et al*. 2000). In Bangladesh, plans for constructing extensive embankments along rivers under the Flood Action Plan (FAP) coordinated by the World Bank (World Bank 1990) were significantly scaled down. However, multiple smaller projects may have adverse effects on dolphin habitat. Other sources of habitat degradation in the GBM system include the removal of stones (Shrestha 1989), sand (Mohan *et al*. 1998), and woody debris (Smith 1993), especially in smaller tributaries where suitable habitat is limited and more vulnerable to local disturbance.

The threat of canal entrapment of dolphins appears to be localized to the Ghaghra-Sharda and upper Ganges canal networks of India. Since 2008-09, twenty-six Ganges River Dolphins (mostly adults) were reported to be entrapped in secondary and tertiary canals of the Ghaghra-Sharada canal network in Uttar Pradesh (U.P.) (Prajapati 2021). Since 2013, sustained efforts by the Turtle Survival Alliance-India and U.P. forest department have been successful in translocating 19 out of 24 dolphins rescued from canals back into the Ghaghra River (Singh, S., pers. comm.), but monitoring the fates of released dolphins is needed. Other cases of canal entrapment or getting isolated in minor tributaries during flood-recession are known from the upper Ganges canal system in U.P., Hooghly and Damodar canal systems of West Bengal, tributaries of the Mahananda in Bihar, and tributaries of the Teesta and Brahmaputra in northern West Bengal (Behera *et al*. 2014, Chatterjee *et al*. 2015, authors' observations and reports).

2. Mortality from entanglement in fishing gear

Many reports of dolphin mortality in fishing gear exist, but few numerical estimates by area or time are available. Dolphins are particularly vulnerable to mortality from bycatch in the dry season from November to May because, during this period, their preferred habitat near channel confluences and divergences overlaps with fishing grounds which become crowded with nets that bycatch dolphins and reduce space available for accessing prey (Kelkar *et al*. 2010, Kelkar 2015). Bycatch mortality during the flood season is also poorly reported. Because dolphin oil is highly valued as a fish attractant, fishermen have incentive to kill animals found alive in their nets or even to set their nets strategically in the hope of capturing dolphins (described by Sinha 2002 as "assisted incidental capture").

Mortality in fishing gear, especially gillnets with larger mesh sizes (>= 100 mm) is not uncommon for Ganges River Dolphins across their range (Mohan 1995, Smith and Reeves 2000, Dewhurst-Richman *et al*. 2019, Kelkar and Dey 2020). River dolphin bycatch is highest in gillnets with large mesh sizes (Mansur *et al*. 2014, Dewhurst-Richman *et al*. 2019). Kelkar and Dey (2020) estimated that nearly two-thirds of known bycatch mortality occurs in gillnets with mesh sizes that are considered "legal" according to regional or national fishery laws and regulations in all range countries of *Platanista*. Kelkar and Dey (2020) estimated a range-wide population-weighted mean of bycatch mortality at 5% of the total known all-age abundance, but there can be significant variation in this owing to local anthropogenic impacts and dolphin population size.

In Bangladesh, between February 2007 and May 2021, 134 deaths of Ganges River Dolphins were recorded by the Wildlife Conservation Society's (WCS's) dolphin mortality monitoring network. Most of these deaths (64.9%) occurred in waterways inside and around the Sundarbans mangrove forest in

Bangladesh where a large portion of research activities are concentrated. This means that reporting rates were higher in this area than in rivers farther upstream. The cause of death was known for slightly more than half of the deaths (68) of which 82.4% were due to entanglement in fishing gear. Dolphins were beaten to death (probably in retaliation for depredation) in 8.8% of cases, hunted by harpoon in 2.9%, and fatally injured by boat strikes in 5.9% of the remaining cases with a known cause of death. Of the total number of fishing-related deaths when the gear type was known (45), 77.8% involved gillnets, 11.1% set bag nets, and 11.1% long lines (WCS, unpublished). In the Karnaphuli-Sangu basin, Dewhurst-Richman *et al*. (2019) used interview surveys to document a minimum of 14 dolphin deaths from October 2010-October 2011, with 89% occurring in gillnets, especially those with large mesh-sizes and where water depths declined during the dry-season. The authors considered that the mortality rate (~7%) was unsustainable.

Systematically collected data on river dolphin mortality are available from two sites in the Ganga and Barak Rivers in India. In a 67 km river segment including the Vikramshila Gangetic dolphin sanctuary, Bihar, India, Kelkar (2015) estimated the mortality rate of by-caught animals at 6 to 12 dolphins per year, which equals about 5% of the local population, and this could be an underestimate. In this area, about 79 dolphin deaths in fishing nets (most in large gillnets) were recorded between 1999 and 2020 (Kelkar *et al*., unpublished).

In the Ganges, although targeted hunting has declined and harpooning is now rare, mortality in fishing nets remains widespread (Sinha 2002) and related to high fishing activity (Bashir *et al*. 2010). Extensive use and the high value of dolphin oil along the Brahmaputra and Hooghly Rivers in eastern India drive an illegal market for dolphins found dead or alive in fishing nets (Kolipakam *et al*. 2020). Mortality in fishing nets was recorded previously in the National Chambal Sanctuary on the Chambal River (Hussain 1993) but reports of such mortality are now rare. In Nepal, Khanal *et al*. (2016) found that irrigation water diversions in the Karnali could have increased the risk of bycatch in gillnets. In Nepal, four dolphin deaths were attributed to bycatch in gillnets from 2016-2020. Paudel and Koprowski (2020a) reported the deaths of one adult and two calves in the Karnali and Sapta Koshi rivers, respectively.

3. Targeted hunting

In the past, dolphins were killed by tribal people and fishing communities in the upper Brahmaputra for their meat and by fishers in the middle reaches of the Ganges for their oil, used as a fish bait or attractant (Motwani and Srivastava 1961, Mohan 1995, Mohan and Kunhi 1996). Deliberate killing of river dolphins is believed to have declined in most areas. This has probably been due to a combination of increasing awareness among fishers about the protected status of dolphins and local efforts to conserve them (Kelkar 2018). Nevertheless, targeted hunting of dolphins with harpoons still occurs in some parts of India (Bengal and Assam), and probably in Bangladesh. Between 1975 and 2015, about 30 cases of mortality from targeted hunting and bycatch in gillnets and seine nets were recorded from the Barak River, where dolphins are now extirpated (Choudhury *et al*. 2019).

As fishers are usually aware that hunting is illegal, such activities are almost never reported for fear of penalties and fines, and no reliable numbers are available. Hunting might still occur occasionally in the middle Ganges near Patna, India (Smith and Reeves 2000, Sinha 2002, Sinha *et al*. 2010), the Kalni-Kushiyara River of Bangladesh (Smith *et al*. 1998), the Gandak River, Bihar (Dey, S., pers. obs.), the Ganges and Hooghly Rivers in West Bengal (Qureshi *et al*. 2018, Samad 2021), and the upper reaches of the Brahmaputra River in Assam, India (Mohan *et al*. 1997).

4. River pollution

Levels of pollution in many of the rivers inhabited by, or formerly inhabited by Ganges River Dolphins are exceptionally high. Organochlorine and butyltin concentrations in samples from the tissues of Ganges River Dolphins have been high enough to cause concern (Kannan *et al*. 1993, 1994, 1997; Senthilkumar *et al*. 1999; Sinha and Kannan 2014). River dolphins in Asia may be particularly vulnerable to urban and agricultural pollution, because they often use deep channels close to point sources along urban areas (e.g., Allahabad, Varanasi, Patna, Calcutta, Guwahati and Dhaka), and their range overlaps extensively with intensively cultivated agricultural landscapes (Reeves *et al*. 1993, 2000). The capacity of rivers to dilute pollutants has been reduced by upstream water extraction, diversion, and impoundment.

5. Impacts of disturbance from inland navigation

In 2016, the Indian Government passed the National Waterways Act to develop 111 rivers in the country as commercial and industrial waterways for shipping and transport of cargo goods, industrial machinery, coal, and people (Government of India 2016). The projected extent of waterways targeted for inland navigation (over 3600 km in India) overlaps with about 90% of the Ganges River Dolphin habitat within India (Kelkar 2017). Being almost blind, *Platanista* are continuous emitters of high-frequency echolocation clicks at relatively low sound source levels, an adaptation to shallow river habitat (Jensen *et al*. 2013, Kelkar *et al*. 2018). Negative impacts of waterways on Ganges River Dolphins from underwater noise, vessel strikes, propeller-strikes, pollution, dredging, port construction, etc., have not yet been well studied. Dey *et al*. (2019) found that Ganges River Dolphins altered their acoustic activity in the presence of underwater noise from propeller cavitation in the range of 40 to 80 kHz. Dolphin carcasses with propeller-strike injuries have been reported from the Hooghly River near Kolkata City in West Bengal, India (Mallick 2011). Harwood (2001) suggested that river dolphins could be susceptible to dredging-induced disturbances to river sediment. The impacts on Ganges River Dolphins from dredging and high vessel traffic are likely to increase.

Other threats

A seismic survey planned in the Brahmaputra River in 2005-06, which could have had serious consequences for dolphins, was eventually cancelled (Wakid 2009). Recently, an oil well blowout at the Baghjan oil field near the Lohit-Dibru tributary sections of the Brahmaputra River in Assam, India, led to temporary loss of habitat for Ganges River Dolphins and other wildlife in the vicinity (Wildlife Institute of India 2020). The effects of climate change on hydrological dynamics may lead to negative impacts on river dolphins in the long term, through extreme rain events, weakening monsoon rainfall, rapid glacial melt, and increased saline ingress through sea-level rise in delta regions in the Ganges-Brahmaputra basins (Wijngaard *et al*. 2017, Krishnaswamy *et al*. 2018).

Stochastic demographic shifts and inbreeding depression could be significant problems for small, isolated populations. However, existing anthropogenic impacts, especially fishery bycatch and the impacts of future water development, will very likely overwhelm these intrinsic problems faced by small populations.

Conservation Actions **(see Appendix for additional information)**

Ganges River Dolphins are legally protected from hunting and deliberate injury/disturbance in all range-states where they occur. India's Wildlife Protection Act, 1972, Nepal's National Parks and Wildlife Conservation Act 2029 (1973) and Aquatic Animal Protection Act 1960, and Bangladesh's Wildlife

(Conservation and Security) Act, 2012, afford the highest level of protection to the species. Protected areas where Ganges River Dolphins occur cover only a minor part of their range. Dolphin conservation in legally protected areas is often ineffective, because of poor or limited law enforcement, lack of community engagement, and financial and technical constraints on sustained monitoring. Existing protected areas where Ganges River Dolphins occur include the 1) Vikramshila Gangetic Dolphin Sanctuary, Bihar, India (70 km, designated in 1991); 2) National Chambal Sanctuary, Rajasthan-Madhya Pradesh-Uttar Pradesh, India (425 km); 3) Kaziranga National Park (NP), Dibru-Saikhowa NP and Orang NP in Assam, India, 4) Bardia NP in Nepal (although no dolphins are reported in the Geruwa river channel at present) and Katerniaghat Wildlife Sanctuary (WLS) in India on the Ghaghra (Karnali in Nepal) River; 5) Hastinapur Wildlife Sanctuary (Uttar Pradesh, India), 6) Sundarbans Tiger Reserve (West Bengal-India), and 7) three dolphin sanctuaries or conservation areas in the Bangladesh Sundarbans. The degree of effectiveness varies with respect to the level of active monitoring and management. Qureshi *et al*. (2019) found greater calf abundance and recruitment in the Kaziranga National Park stretch as compared to upstream sections of the Brahmaputra River in India. Kelkar (2015) did not find differences in river dolphin densities upstream and downstream of the Vikramshila Sanctuary. The Vikramshila Sanctuary covers a 65-70 km segment of the Ganges River. Dolphin sanctuaries in the Bangladesh Sundarbans focus on protecting deep pool habitat where river dolphins aggregate (Smith *et al*. 2010). Some smaller tributaries that flow through protected areas for terrestrial wildlife might also have small populations of Ganges River Dolphins. Increasingly, community-based protected areas and reserves are being considered in all range countries (Sinha *et al*. 2010). Such approaches have had mixed success (see Choudhary *et al*. 2015, Kelkar 2015, 2018).

Braulik *et al*. (2020) recently reviewed prospects for ex situ conservation and translocations for *Platanista,* which are currently not held in captivity anywhere. They noted that while ex situ conservation is not an urgent need for either Indus or Ganges Dolphins, both species face significant and immediate threats. There is a definite need to build technical capacity towards rescue, translocation, and captive holding of these cetaceans (in case of need) in all range countries, where such capacity is at present almost non-existent. In the present range, the potential for creating semi-natural reserves to have insurance populations, as in the case for Yangtze Finless Porpoises, is limited. The Ganges-Brahmaputra river basins do not have many large ox-bow lakes in the river floodplains as in the Yangtze basin. On rare occasions, Ganges Dolphins may occupy such ox-bow lakes for short periods during the flood season (e.g. Pilleri 1970). Dam reservoirs, due to their deepwater habitat features and operations for multiple human demands, are not appropriate habitat to be able to establish insurance populations of Ganges River Dolphins. Preservation of in-river populations thus remains of critical importance and topmost priority.

Earlier studies proposed alternatives to the use of dolphin oil as a fish attractant including oil from fish scraps and sharks (Mohan and Kunhi 1996, Smith *et al*. 1998, Mohan *et al*. 1999, Bairagi 1999, Sinha 2002). Fishers have also tried using palm oil and vegetable oil along with fish oils (Dey, S., pers. obs.), with trials attempted in the Vikramshila Sanctuary (Dey *et al.*, unpublished), and in the Brahmaputra River (Qureshi *et al*. 2018). Reports on the effectiveness of these oils as compared to dolphin oil have been equivocal, and the uptake of alternatives by fishers remains limited.

Quantitative data on the magnitude of catches, either deliberate or incidental (bycatch), are needed as a matter of priority. Such data are unlikely to become available in the absence of well organized, adequately funded, and transparent fishery/wildlife management systems. For bycatch reduction, the

use of pingers has been attempted for various cetacean species. From 61.8 hours of theodolite tracking data recorded during 75 sightings of Ganges River dolphins in the Bangladesh Sundarbans, Smith (2013) found that 70 kHz, 145 decibel pingers had limited effectiveness in displacing dolphins from the device.

In 2010, India declared the Ganges River Dolphin its "National Aquatic Animal", and a Conservation Action Plan (2010-2020) was prepared (Sinha *et al*. 2010b). However, only some recommendations have been implemented. In 2015–2016, the Compensatory Afforestation Fund Management and Planning Authority (CAMPA), Government of India, funded the Wildlife Institute of India to conduct a five-year species recovery project on Ganges River Dolphins. Statewide dolphin surveys have been completed in many areas with the participation of state forest departments and conservation agencies (WWF-UPFD 2015, Qureshi *et al*. 2018, CMS 2020). Recently, the Ministry of Environment, Forests, and Climate Change, Government of India has announced "Project Dolphin" for the conservation of marine and river dolphins.

A Concerted Action Plan for Ganges River Dolphins was approved at the Convention on Migratory Species 13th Conference of Parties in Gandhinagar, India (2020), which aims to promote conservation and research activities on dolphins in trans-boundary regions.

Credits

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Bibliography

Agarwal, A. and Narain, S. 1996. Floods, Floodplains and Environmental Myths. State of India's Environment: A Citizen Report. Centre for Science and Environment, New Delhi.

Ahmed, B. 2000. Water development and the status of the shushuk (*Platanista gangetica*) in southeast Bangladesh. In R.R. Reeves, B.D. Smith and T. Kasuya (eds) *Biology and Conservation of Freshwater Cetaceans in Asia*, pp. 62-66. IUCN Species Survival Commission Occasional Paper 23, Gland, Switzerland and Cambridge, UK.

Akamatsu T., Ura T., Sugimatsu H., Bahl R., Behera S., Panda S., Khan M., Kar S.K., Kar C.S., Kimura S., & Sasaki-Yamamoto Y. 2013. A multimodal detection model of dolphins to estimate abundance validated by field experiments Key Topics. *Journal of the Acoustical Society of America* 134: 2418–2422.

Anderson J. 1879. *Anatomical and Zoological Researches: Comprising an Account of Zoological Results of the Two Expeditions to Western Yunnan in 1868 and 1875; and a Monograph of the Two Cetacean Genera,* Platanista *and* Orcella*[sic]*. Bernard Quaritch, London. Two Volumes.

Anonymous. 2002. Proceedings of Regional Seminar on Environmental Laws: Violations and Regulations in Vikramshila Gangetic Sanctuary (November 30, 2002). Unpublished report available from the Vikramshila Biodiversity Research & Education Centre, University Department of Botany, T.M. Bhagalpur University, Bhagalpur (Bihar).

Aziz, M.A. 2019. Expanding the Protected Area System to Incorporate Important Aquatic Ecosystems. Atlas on Ganges River Dolphin and Irrawaddy Dolphin of Bangladesh. Final Report to Bangladesh Forest Department, Ministry of Environment, Forests, and Climate Change, Govt. of Bangladesh.

Bairagi, S.P. 1999. Oil bait fishery of catfishes in Brahmaputra River affecting river dolphin populations in Assam, India. *Journal of the Bombay Natural History Society* 96: 424-426.

Baki M.A., Bhouiyan N.A., Islam M.S., Alam S.M.I., Shil S., & Hossain M.M. 2017. Present Status of Ganges River Dolphins *Platanista gangetica gangetica* (Roxburgh, 1801) in the Turag River, Dhaka, Bangladesh. *International Journal of Zoology* 2017: 8964821.

Baruah, D., Hazarika, L.P., Bakalial, B., Borah, S., Dutta R., and Biswas S.P. 2012. A grave danger for the Ganges dolphin (*Platanista gangetica*, Roxburgh) in the Subansiri River due to a large hydroelectric project. *Environmentalist* 32: 85-90.

Bashir, T., Khan, A., Behera S.K., and Gautam, P. 2012. Factors determining occupancy of Ganges River dolphin (*Platanista gangetica gangetica*) during differing river discharges in the upper Ganges, India. *Mammalia* 76(4): 417-426.

Bashir T., Khan A., Behera S.K., & Gautam P. 2010. Socio-economic factors threatening the survival of Ganges River Dolphin *Platanista gangetica gangetica* in the upper Ganges River, India. *Journal of Threatened Taxa* 2: 1087–1091.

Basu, D. 2012. The abundance and distribution of the Ganges River Dolphin, susu, in the Geruwa and Ghagra rivers of Uttar Pradesh, India. WWF-India & The Uttar Pradesh Forest Department, India.

Behera, S.K., Singh, H. and Sagar, V. 2013. Status of Ganges River Dolphin (*Platanista gangetica gangetica*) in the Ganga River Basin, India: a review. *Aquatic Ecosystem Health and Management* 2: 425-432.

Behera, S.K., Singh, H., Sagar, V. and De, R. 2014. Current status of Ganges river dolphin *Platanista gangetica gangetica* in the rivers of Uttar Pradesh, India. *Rivers for Life. Proceedings of the International Symposium on river biodiversity: Ganges-Brahmaputra-Meghna river systems, Patna, India*.

Bihar Dolphin Survey. Report on Ganges River Dolphin populations in Bihar, India. Govt. of Bihar, India.

Boyce, J.K. 1990. Birth of a megaproject: political economy of flood control in Bangladesh. *Environmental Management* 14:158-165.

Braulik, G.T. and Smith, B.D. 2017. *Platanista gangetica*. The IUCN Red List of Threatened Species 2017. Available at: http://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS. T41758A50383612.en.

Braulik, G.T., Archer, F., Khan, U., Imran, M., Sinha, R.K., Jefferson, T.A., Donovan, C. and Graves, J.A. 2021. Taxonomic revision of the South Asian River dolphins (Platanista): Indus and Ganges River dolphins are separate species. *Marine Mammal Science* 37(3): https://onlinelibrary.wiley.com/doi/10.1111/mms.12801.

Braulik, G.T., Arshad, M. Noureen, U., and Northridge, S. 2014. Habitat fragmentation and species extirpation in freshwater ecosystems: causes of range decline of the Indus River dolphin (Platanista gangetica minor). *PloS one* 9(7): p.e.101657.

Braulik, G.T., Barnett, R., Odon, V., Islas-Villanueva, V., Hoelzel A.R., and Graves J.A. 2014a. One Species or Two? Vicariance, Lineage Divergence and Low mtDNA Diversity in Geographically Isolated Populations of South Asian River Dolphin. *Journal of Mammalian Evolution* 22(1): 111-120.

Braulik, G.T., Barnett, R., Odon, V., Islas-Villanueva, V., Hoelzel A.R., and Graves J.A. 2014. One Species or Two? Vicariance, Lineage Divergence and Low mtDNA Diversity in Geographically Isolated Populations of South Asian River Dolphin. *Journal of Mammalian Evolution* 22(1): 111-120.

Braulik, G.T., Bhatti, Z.I., Ehsan, T., Hussain, B., Khan, A.R., Khan, A., Khan, U., Kundi, K., Rajput, R., Reichert, A.P., Northridge, S.P., Bhaagat H.B., and Garstang R. 2012a. Robust abundance estimate for endangered river dolphin subspecies in South Asia. *Endangered Species Research* 17: 201-215.

Braulik, G.T., Kelkar, N., Khan, U., Paudel, S., Brownell Jr., R.L., Abel, G. 2020. Indus and Ganges river dolphins (*Platanista gangetica*): ex situ options for conservation. In: B.L. Taylor, G. Abel, P. Miller, F. Gomez, L. von Fersen, D. DeMaster, R.R. Reeves, L. Rojas-Bracho, D. Wang, Y. Hao, F. Cipriano (ed.), *Ex situ options for cetacean conservation. Report of the 2018 workshop, Nuremberg, Germany*, pp. 79-96. Occasional Paper of the IUCN Species Survival Commission No.66. Gland, Switzerland: IUCN. https://doi.org/10.2305/IUCN.CH.2020.SSC-OP.66.en.

Brownell Jr., R.L. 1984. Review of reproduction in platanistoid dolphins. *Report of the International Whaling Commission* (Special Issue) 6: 149-158.

Butler, C., Rest, M. 2017. Calculating risk, denying uncertainty: seismicity and hydropower development in Nepal. *Himalaya: the Journal of the Association for Nepal and Himalayan Studies* 37: 2-6.

Chatterjee A., Sen A., Das D., & Mitra P. 2015. The status of the Ganges River Dolphin, *Platanista gangetica gangetica* (Roxburgh, 1801) in Coochbehar district of West Bengal, India. *International Research Journal of Natural and Applied Sciences* 2: 86-96.

Chaudhary, S., Dey, S., Sagar, V., Nair T., and Kelkar, N. 2012. River dolphin distribution in regulated river systems: implications for dry-season flow regimes in the Gangetic basin. *Aquatic Conservation: Marine and Freshwater Ecosystems* 22: 11-25.

Choudhary, S.K., Dey, S., Kelkar, N. 2015. Locating fisheries and livelihood issues in river biodiversity conservation: Insights from long-term engagement with fisheries in the Vikramshila Gangetic Dolphin Sanctuary riverscape, Bihar, India. *Proceedings of the IUCN Symposium on Riverine Biodiversity, Patna, India (April 2014)*: 30.

Choudhary, S. K., Smith, B. D., Dey, S., Dey, S. & Prakash, S. 2006. Conservation and biomonitoring in the

Vikramshila Gangetic Dolphin Sanctuary, Bihar, India. *Oryx* 40: 189-197.

Choudhury, N.B., Mazumder, M.K., Chakravarty, H., Choudhury, A.S., Boro, F., & Choudhury, I.B. 2019. The endangered Ganges river dolphin heads towards local extinction in the Barak river system of Assam, India: Plea for conservation. *Mammalian Biology* 95: 102-111.

Chowdhury, M.R., Mitra, S., Sen, S. 2016. On the behaviour, abundance, habitat use and potential threats of the Gangetic Dolphin *Platanista gangetica* in southern West Bengal, India. *Journal of Threatened Taxa* 8: 9131-9137.

Committee on Taxonomy. 2017. List of marine mammal species and subspecies. Available at: www.marinemammalscience.org. (Accessed: 31 August 2018).

Committee on Taxonomy. 2020. List of marine mammal species and subspecies. Society for Marine Mammalogy. Available at: www.marinemammalscience.org. (Accessed: 7 July, 2020).

Convention on Migratory Species (CMS). 2020. Proposal for a Concerted Action for the Ganges River Dolphin (*Platanista gangetica gangetica*) already listed on Appendix I and II of the Convention. Prepared by the Government of India. Agenda Item 28.2 UNEP/CMS/COP13/Doc.28.2.6/Rev.2. *presented at the 13th Meeting of the Conference of the Parties, Gandhinagar, India, 17-22 February 2020*.

Dewhurst-Richman, N.I., Jones, J.P., Northridge, S., Ahmed, B., Brook, S., Freeman, R., Jepson, P., Mashood, S.P. & Turvey, S.T. 2019. Fishing for the facts: river dolphin bycatch in a small-scale freshwater fishery in Bangladesh. *Animal Conservation*: doi:10.1111/acv.12523.

Dey, M., Krishnaswamy, J., Morisaka, T., & Kelkar, N. 2019. Interacting effects of vessel noise and shallow river depth elevate metabolic stress in Ganges river dolphins. *Scientific Reports* 9: 15426.

Dey, S., Choudhary, S.K., Goyal, N., Nair, T. & Kelkar, N. in review. Sustaining dry-season flow availability and habitat connectivity for Ganges river dolphins in the regulated Kosi River, India. *Aquatic Conservation: Marine and Freshwater Ecosystems*.

Gain, A.K. and Giupponi, C. 2014. Impact of the Farakka Dam on Thresholds of the Hydrologic Flow Regime in the Lower Ganges River Basin (Bangladesh). *Water* 6(8): 2501-2518.

Gomez-Salazar, C., Coll, M., Whitehead, H. 2014. River dolphins as indicators of ecosystem degradation in large tropical rivers. *Ecological Indicators* 23: 19-23.

Government of India. 2016. *National Waterways Act (No. 17 of 2016). Registered No. Dl-(N) 04/0007/2003-16. March 26, 2016*.

Harwood, J. 2001. Marine mammals and their environment in the twenty-first century. *Journal of Mammalogy* 82: 630-640.

Herald, E.S. 1969. Field and Aquarium Study of the Blind River Dolphin *Platanista Gangetica*. Steinhart Aquarium, California Academy of Sciences, San Francisco, California, USA.

Hossain, M.Z., & T. Sakai. 2008. Severity of Flood Embankments in Bangladesh and Its Remedial Approach. *Agricultural Engineering International: the CIGR e-journal* 10: Manuscript LW 08 004.

Hussain, S.A. 1993. A note on the morphometry of the Ganges river dolphin with comments on its mortality in fishing nets. *Journal of the Bombay Natural History Society* 90: 501-505.

IUCN. 2022. The IUCN Red List of Threatened Species. Version 2022-1. Available at: www.iucnredlist.org. (Accessed: 21 July 2022).

Jain, V. and Sinha, R. 2000. Monitoring fluvial hazard from space: a case study from north-Bihar plains,

India. In: Muralikrishna, I. (ed.), *Proceeding, International Conference on Remote Sensing and GIS*, pp. 11-16. Hyderabad, India.

Jelil S. N. 2015. Conservation threats of the Gangetic Dolphin *Platanista gangetica gangetica* in River Kulsi, a tributary of Brahmaputra, Assam, India. *Northeast Journal of Contemporary Research* 2: 6-11.

Jensen, F.H., Rocco, A, Mansur, RM, Smith, BD, Janik, VM & Madsen, P.T. 2013. Clicking in shallow rivers: short-range echolocation of Irrawaddy and Ganges river dolphins in a shallow, acoustically complex habitat. *PloS One* 8: e59284.

Jones, S. 1982. The present status of the gangetic susu, *Platanista gangetica* (Roxburgh), with comments on the Indus susu, *P. minor* Owen. FAO Advisory Committee on Marine Resources Research, Working Party on Marine Mammals. *FAO Fisheries Series* 5(4): 97-115.

Kannan, K., Senthilkumar, K. and Sinha, R.K. 1997. Sources and accumulation of butyltin compounds in Ganges River Dolphin, *Platanista gangetica*. *Applied Organometallic Chemistry* 11: 223–230.

Kannan, K., Sinha, R.K., Tanabe, S., Ichihashi, H. and Tatsukawa, R. 1993. Heavy metals and organochlorine residues in Ganges rRver Dolphins from India. *Marine Pollution Bulletin* 26: 159–162.

Kannan, K., Tanabe, S., Tatsukawa, R. and Sinha, R.K. 1994. Biodegradation capacity and residue pattern of organochlorines in the Ganges River Dolphins from India. *Toxicological and Environmental Chemistry* 42: 249– 261.

Kasuya, T. 1972. Some informations on the growth of the Ganges dolphin with a comment on the Indus dolphin. *Scientific Reports of the Whales Research Institute* 24: 87-108.

Kasuya, T. and Haque, A.K.M. 1972. Some informations on the distribution and seasonable movement of the Ganges dolphin. Scientific Reports of the Whales Research Institute (Tokyo) 24: 109-115.

Kelkar, N. 2014. River Fisheries of the Gangetic basin, India: a Primer. *Dams, Rivers & People Newsletter* 13: 3-5.

Kelkar, N. 2015. Strengthening the meaning of a freshwater protected area for the Ganges River Dolphin: looking within and beyond the Vikramshila Gangetic Dolphin Sanctuary, Bihar, India. Final report submitted to the Small Cetacean Fund, International Whaling Commission (IWC), Cambridge, United Kingdom.

Kelkar, N. 2016. Digging Our Rivers' Graves? A summary analysis of the ecological impacts of the National Waterways Bill (2015). *Dams, Rivers, and People Newsletter, South Asia Network for Dams, Rivers, and People (SANDRP)* 14: 1-6.

Kelkar, N. 2017. A river dolphin's ear-view of India's waterways development plans. *Sanctuary Asia* XXXVII (4): 58-61.

Kelkar, N. 2018. The resource of tradition: changing identities and conservation conflicts in Gangetic fisheries. In: Srinivasan, U. and Velho, N. (eds), *Conservation from the Margins*, Orient Black Swan, India.

Kelkar, N. and Dey, S. 2021. Ganges river dolphins and other biodiversity in the Mahananda River in Bihar and West Bengal: A report on the first complete survey, November 2021. Report for the Department of Environment, Forests, and Climate Change, Government of Bihar. Wildlife Conservation Trust, Mumbai, India.

Kelkar, N. & Dey, S. 2020. Mesh mash: legal fishing nets cause most bycatch mortality of endangered South Asian river dolphins. *Biological Conservation* 252: 1008844.

Kelkar, N., Dey, S., Deshpande, K., Choudhary, S.K., Dey, S., Morisaka, T. 2018. Foraging and feeding

ecology of Platanista: an integrative review. *Mammal Review* 48(3): 194-208.

Kelkar, N., Krishnaswamy, J. 2014. Restoring the Ganga for its fauna and fisheries. In: Madhusudan, M.D., Rangarajan, M., & Shahabuddin, G. (ed.), *Nature Without Borders*, Orient Black Swan, India.

Kelkar, N., Krishnaswamy, J., Choudhary S., and Sutaria D. 2010. Coexistence of fisheries with river dolphin conservation. *Conservation Biology* 24(4): 1130-1140.

Khanal, G., Suryawanshi, K.R., Awasthi, K.D., Dhakal, M., Subedi, N., Nath, D., Kandel, R.C. and Kelkar, N. 2016. Irrigation demands aggravate fishing threats to river dolphins in Nepal. *Biological Conservation* 204B: 386–393.

Kinze, C. C. 2000. Rehabilitation of *Platanista gangetica* (Lebeck, 1801) as the valid scientific name of the Ganges dolphin. *Zool. Med. Leiden* 74(11): 193-203.

Kolipakam, V., Singh, S., Ray, S., Prasad, L., Roy, K., Wakid, A., Qureshi, Q., 2020. Evidence for the continued use of river dolphin oil for bait fishing and traditional medicine: implications for conservation. *Heliyon* 6: e04690.

Kreb, D., Reeves, R.R., Thomas, P.O., Braulik, G.T. and Smith, B.D. (eds.). 2010. Establishing protected areas for Asian freshwater cetaceans: Freshwater cetaceans as flagship species for integrated river conservation management, Samarinda, 19-24 October 2009. Final Workshop Report, Yayasan Konservasi RASI, Samarinda, Indonesia.

Krishnaswamy, J., Kelkar, N., Aravind, N.A., Vaidyanathan, S. 2018. Climate change and aquatic biodiversity. In: Bhatt, J.R., Das, A., Shanker, K. (ed.), *Biodiversity and Climate Change: an Indian Perspective*, pp. 163-190. Ministry of Environment, Forest & Climate Change, Government of India, New Delhi.

Lapworth, D.J., Dochartaigh, B.Ó., Nair, T., O'Keeffe, J., Krishan, G., MacDonald, A.M., Khan, M., Kelkar, N., Choudhary, S., Krishnaswamy, J., Jackson, C.R. 2021. Characterising groundwater-surface water connectivity in the lower Gandak catchment, a barrage regulated biodiversity hotspot in the mid-Gangetic basin. *Journal of Hydrology* 594: 125923.

Lockyer, C. and Braulik, G. T. 2014. An evaluation of age estimation using teeth from South Asian River dolphins (Platanistidae). *NAMMCO Scientific Publications* 10.

Mallick J.K. 2011. Ecology and Status of the Ganges Dolphin (*Platanista gangetica gangetica*): India's National Aquatic Animal, in Southern West Bengal. *Animal Diversity, Natural History and Conservation* 1: 277–306.

Manjrekar, M.A., Prabhu, C. L. 2013. Status of Irrawaddy dolphin (Orcaella brevirostris Gray, 1866) and Ganges river dolphin (*Platanista gangetica* Roxburgh, 1801) in the water channels of Sundarban Tiger Reserve, India. *Journal of the Bombay Natural History Society* 110: 72-74.

Mansur R.M., Alom Z., Smith B.D., & Akhtar F. 2014. Monitoring the mortality of freshwater cetaceans in the Sundarbans, Bangladesh: progress, challenges, and potential. *Rivers for Life. Proceedings of the International Symposium on River Biodiversity: Ganges-Brahmaputra-Meghna River System*, pp. 214-128. IUCN, Patna, India.

Maurya K.K., Hasan D., & Gupta M. 2016. Endangered Ganges River Dolphin *Platanista gangetica gangetica* Sighted in Rapti River, Balrampur, Uttar Pradesh, India. *Journal of the Bombay Natural History Society* 111: 214-216.

Mazumder, M.K., Boro F., Barbhuiya, B., Singha, U. 2014. A study of the winter congregation sites of the Gangetic River dolphin in southern Assam, India, with reference to conservation. *Global Ecology and*

Conservation 2: 359–366.

Mishra, D.K. 2008. The Kosi and the Embankement Story. *Economic & Political Weekly* November: 47-52.

Mitra, S. & M.R. Chowdhury. 2018. Possible range decline of Ganges River Dolphin *Platanista gangetica* (Mammalia: Cetartiodactyla: Platanistidae) in Indian Sundarban. *Journal of Threatened Taxa* 10(13): 12738–12748.

Mitra S., Sultan S., & Sen S. 2015. Occurrence records of Ganges River Dolphin (Platanista gangetica) in Southern West Bengal and impact of anthropogenic interferences in its habitat. *IOSR-JPBS* 10: 76-83.

Mohan, R.S. 1995. Mortality of Ganges River dolphin, *Platanista gangetica*, in gillnets of Ganges and Brahmaputra in India. *Tiger Paper* 22(1): 11-13.

Mohan, R.S., Dey, S.C. and Bairagi, S.P. 1998. On a resident population of the Ganges River dolphin *Platanista gangetica* in the Kulsi River (Assam) a tributary of Brahmaputra. *Journal of the Bombay Natural History Society* 95: 1-7.

Mohan, R.S.L. and Kunhi, K.V.M. 1996. Fish oils as alternative to river dolphin, *Platanista gangetica* (Lebeck) oil for fishing catfish *Clupisoma garua* in the River Ganges, India. *Journal of the Bombay Natural History Society* 93: 86–88.

Mohan, R.S.L., Dey, S.C., and Bairagi, S.P. 1999. Ganges River Dolphin oil bait fishery in the river Brahmaputra and introduction of crude shark liver oil as a substitute. *Zoos' Print Journal* 14(8): 89-90.

Mohan, R.S.L., Dey, S.C., Bairagi, S.P. and Roy, S. 1997. On a survey of Ganges River Dolphin *Platanista gangetica* of Brahmaputra River, Assam. *Journal of the Bombay Natural History Society* 94: 483–495.

Mohan, R.S.L., Kelkar, N. 2015. Ganges River Dolphin. In: Johnsingh, A.J.T., and Manjrekar, N. (eds), *Mammals of South Asia – Vol. II*, University Press (India) Pvt Ltd.

Motwani, M.P. and Srivastava, C.B. 1961. A special method of fishing for *Clupisoma garua* (Hamilton) in the Ganges river system. *Journal of the Bombay Natural History Society* 58: 285–286.

Ohsumi, S. 1979. Interspecies relationships among some biological parameters in cetaceans and estimation of the natural mortality coefficient of the southern hemisphere minke whale. *Report of the International Whaling Commission* 29: 397-406.

Paudel, S., & Koprowski, J.L. 2020a. Factors affecting the persistence of endangered Ganges River dolphins (*Platanista gangetica gangetica*). *Ecology and Evolution*: https://doi.org/10.1002/ece3.6102.

Paudel, S., Koprowski, J.L. & Cove, M.V. 2020c. Seasonal flow dynamics exacerbate overlap between artisanal fisheries and imperiled Ganges River dolphins. *Scientific Reports* 10: 18798.

Paudel, S., Koprowski, J.L., Thakuri, U. Sigdel, R., & Gautam, R.C. 2020b. Ecological responses to flow variation inform river dolphin conservation. *Scientific Reports* 10: 22348.

Paudel, S., Levesque, J.C., Saavedra, C., Pita, C. and Pal, P. 2016. Characterization of the artisanal fishing communities in Nepal and potential implications for the conservation and management of Ganges River Dolphin (*Platanista gangetica gangetica*). *PeerJ*: 4:e1563 https://doi.org/10.7717/peerj.1563.

Paudel, S., Pal, P., Cove, M.V., Jnawali, S.R., Abel, G., Koprowski, J.L. and Ranabhat, R. 2015. The Endangered Ganges River dolphin *Platanista gangetica gangetica* in Nepal: abundance, habitat and conservation threats. *Endangered Species Research* 29(1): 59-68.

Paudel, S., Timilsina, Y.P., Lewis, J., Ingersoll, T. & Jnawali, S.R. 2015b. Population status and habitat occupancy of endangered river dolphins in the Karnali River system of Nepal during the low water

season. *Marine Mammal Science* 31: 707-719.

Pilleri, G. 1970. Observation on the behavior of *Platanista gangetica* in the Indus and Brahmaputra rivers. *Investigations on Cetacea* 2: 27-60.

Pilleri, G. 1977. The Indian River Dolphin in the Babur Nama miniatures, the moral edicts of King Ashoka and ancient Indian literature. Legends and superstitions concerning the Amazon dolphin. *Investigations on Cetacea* 8: 351-360.

Pilleri, G. & Gihr, M. 1971. Differences observed in the skulls of Platanista gangetica [Roxburgh, 1801] and indi [Blyth, 1859]. *Investigations on Cetacea* 3: 13-21.

Pilleri, G., Gihr, M., Kraus, C. 1970. Feeding behavior of the Gangetic dolphin, *Platanista gangetica*, in captivity. *Investigations on Cetacea* 2: 69-74.

Pilleri, G., Kraus, C., Gihr, M. 1971. Further observations on the behavior of Platanista indi in captivity. *Investigations on Cetacea* 3: 34-42.

Prajapati, S. 2018. A study on straying incidences of Gangetic dolphins (*Platanista gangetica gangetica*) into irrigation canals along Ghaghara-Sarju river system. MSc thesis, Forest Research Institute.

Prajapati, S. 2021. Stranding cases of endangered Ganges river dolphins in the Ghaghara–Sharada irrigation canals, Ganges river basin, India: conservation implications. *Mammalia* 85: 39-46.

Qureshi, Q., Kolipakam, V., Wakid, A., Ray, S. & Hussain, S.A. 2019. Development of Conservation Action Plan for Ganges River Dolphins – Part II. Wildlife Institute of India, Dehradun.

Qureshi, Q., S.A. Hussain, V. Kolipakam, A. Wakid, R. Raza, S.K. Choudhury, V. Talukdar, S. Ray, V. Singh, S. Deori, R. Rastogi, A. Warudkar, N. Goyal, S. Sharma, M. Jacob, K. Roy, & G. Roy Choudhary. 2018. Development of Conservation Action Plan for Ganges River Dolphin. Annual Report 2017-18. Wildlife Institute of India, Dehradun.

Rahman, M.G. 1986. Reducing the flow of the Ganges: the consequences for agriculture in Bangladesh. In: E. Goldsmith and N. Hilyard (eds) *The Social and Environmental Effects of Large Dams*, Vol 2, Case Studies, pp. 267-275. Wadebridge Ecological Centre, Cornwall, UK.

Rashid S.M.A., Akonda A.W., & Ahmed B. 2015. Ganges River Dolphin (*Platanista gangetica gangetica*) in the Padma , Jamuna and Hurasagar-Baral rivers of Pabna District, Bangladesh. *International Journal of Current Science* 14: 107-124.

Reeves, R.R. and Smith, B.D. 1999. Interrupted migrations and dispersal of river dolphins: some ecological effects of riverine development. In: UNEP/CMS (eds) *Proceedings of the CMS Symposium on Animal Migration*, Gland, Switzerland, 13 April 1997, pp. 9-18. United Nations Environment Programme, Convention on Migratory Species, Technical Series Publication No. 2, Bonn/The Hague.

Reeves, R. R., Chaudhry, A. A. and Khalid, U. 1991. Competing for water on the Indus Plain: is there a future for Pakistan's river dolphins? *Environmental Conservation* 18: 341–350.

Reeves, R. R., Leatherwood, S. and Lal Mohan, R. S. 1993. A Future for Asian River Dolphins: Report from a Seminar on the Conservation of River Dolphins of the Indian Subcontinent, 18-19 August 1992, New Delhi, India. Whale and Dolphin Conservation Society, Bath, Avon, England.

Reeves, R.R., Leatherwood, S. and Lal Mohan, R.S. 1993. A Future for Asian River Dolphins: Report from a Seminar on the Conservation of River Dolphins of the Indian Subcontinent, 18-19 August 1992, New Delhi, India. Whale and Dolphin Conservation Society, Bath, Avon, England.

Reeves, R.R., Smith, B.D. and Kasuya, T. 2000. *Biology and conservation of freshwater Cetaceans in Asia*.

IUCN, Gland & Cambridge.

Rice, D.W. 1998. *Marine Mammals of the World: Systematics and Distribution*. Society for Marine Mammalogy, Special Publication Number 4, Lawrence, Kansas.

Richman, N. I. 2014. Using local informant data and boat-based surveys to improve knowledge on the status of the Ganges River Dolphin (*Platanista gangetica gangetica*). PhD Dissertation, Bangor University, United Kingdom.

Richman N.I., Gibbons J.M., Turvey S.T., Akamatsu T., Ahmed B., Mahabub E., Smith B.D., & Jones J.P.G. 2014. To see or not to see: investigating detectability of Ganges River Dolphins using a combined visual-acoustic survey. *PLoS ONE* 9: e96811.

Samad, I. 2021. Life under control? Understanding the distribution dynamics of the Ganges river dolphin in a flow regulated river-canal system. MSc (Wildlife Biology and Conservation) Thesis, National Centre for Biological Sciences-TIFR.

Samad, I., Kelkar, N. and Krishnaswamy, J. 2022. Life at the borderline: Responses of Ganges river dolphins to dry-season flow regulation of river and canal habitats by the Farakka barrage. *Aquatic Conservation: Marine and Freshwater Ecosystems* 32(2): 294– 308.

Sasaki-Yamamoto Y, Akamatsu T, Ura T, Sugimatsu H, Kojima J, Bahl R, Behera S, Kohshima S. 2013. Diel changes in the movement patterns of Ganges River Dolphins monitored using stationed stereoacoustic data loggers. *Marine Mammal Science* 29: 589–605.

Senthilkumar, K., Kannan, K., Sinha, R.K., Tanabe, S. and Giesy, J.P. 1999. Bioaccumulation profiles of polychlorinated biphenyle congeners and organochlorine pesticides in Ganges River Dolphins. *Environmental Toxicology and Chemistry* 18(7): 1511-1520.

Shah, D. N., Poudyal, A., Sharma, G., Levine, S., Subedi, N., & Dhakal, M. 2020. Status, distribution, threats, and conservation of the Ganges River Dolphin *Platanista gangetica* (Mammalia: Artiodactyla: Cetacea) in Nepal. *Journal of Threatened Taxa* 12(1): 15106-15113.

Shah, K.B., and Paudel, S. 2016. Ecology of crocodile and dolphin in the Koshi Basin. Chapter 11. In: Doody, T.M., Cuddy, S.M., Bhatta, L.D. (ed.), *Connecting flows and ecology in Nepal: current state of knowledge of the Koshi Basin. Sustainable Development Investment Portfolio (SDIP) project*, pp. 123 -128. CSIRO, Australia.

Sharma, G. 2010. Current status of susu (*Platanista gangetica gangetica*, Roxburgh, 1801) in River Hooghly in West Bengal, India. *Records of the Zoological Survey of India* 110: 61-69.

Sharma, G. 2013. Current status of susu (*Platanista gangetica gangetica*, Roxburgh, 1801) in River Gandak, a major tributary of the holy River Ganga in Bihar, India. *Records of the Zoological Survey of India* 113: 39-59.

Sharma, R.H., & Awal, R. 2013. Hydropower development in Nepal. *Renewable and Sustainable Energy Reviews* 21: 684-693.

Sharma, R.K. 1993. Annual gharial census in National Chambal Sanctuary (1992-1993). *Journal of Tropical Forests* 9(1): 90-93.

Sharma, R.K., Mathur, R. and Sharma, S. 1995. Status and distribution of fauna in National Chambal Sanctuary, Madhya Pradesh. *The Indian Forester* 121(10): 912-916.

Sharma, R.K. & Singh, L.A.K. 2014. Status of Gangetic dolphin *Platanista gangetica* in National Chambal Sanctuary after 30 years. *Zoos' Print* XXIX(7): 22-27.

Shrestha, T.K. 1989. Biology, status and conservation of the Ganges River dolphin, *Platanista gangetica*, in Nepal. In: W.F. Perrin, R.L. Brownell Jr., K. Zhou and J. Liu (eds. *Biology and Conservation of River Dolphins*, pp. 70-76. IUCN Species Survival Commission Occasional Paper 3, Gland, Switzerland and Cambridge, UK.

Singh C.P., Chauhan R.R.S., & Mishra S.B. 2014. Status, habitat and distribution pattern of the Gangetic dolphin (*Platanista gangetica*) in National Chambal sanctuary, Uttar Pradesh, India. *Journal of Entomology and Zoology Studies* 2: 179-181.

Singh H. & Rao R.J. 2012. Sighting frequency and group composition of the Ganges river dolphin (*Platanista gangetica gangetica*) in the National Chambal Sanctuary, India. *Zoos Print* XXVII: 18–23.

Singh, L.A.K. and Sharma, R.K. 1985. Gangetic dolphin, *Platanista gangetica*: Observations on the habits and distribution pattern in National Chambal Sanctuary. *Journal of the Bombay Naural History Society* 82: 648-653.

Sinha, R. 2008. Kosi: rising waters, dynamic channels, and human disasters. *Economic and Political Weekly* November: 42-46.

Sinha, R., and Kannan K. 2014. Ganges River Dolphin: An Overview of Biology, Ecology, and Conservation Status in India. *Ambio* 43(8): 1029-1046.

Sinha, R., Gupta, A., Mishra, K., Tripathi, S., Nepal, S., Wahid, S.M., Swarnkar, S. 2019. Basin-scale hydrology and sediment dynamics of the Kosi river in the Himalayan foreland. *Journal of Hydrology* 570: 156-166.

Sinha, R.K. 1997. Status and conservation of Ganges River dolphin in Bhagirathi-Hoogly river systems in India. *International Journal of Ecology and Environmental Sciences* 23: 343-355.

Sinha, R.K. 2000. Status of the Ganges River dolphin (*Platanista gangetica*) in the vicinity of Farakka Barrage, India. In: R.R. Reeves, B.D. Smith, and T. Kasuya (eds) *Biology and Conservation of Freshwater Cetaceans in Asia*, pp. 42-48. IUCN Species Survival Commission Occasional Paper 23, Gland, Switzerland and Cambridge, UK.

Sinha, R.K. 2002. An alternative to dolphin oil as a fish attractant in the Ganges River system: conservation of the Ganges River Dolphin. *Biological Conservation* 107: 253–257.

Sinha, R.K. and Sharma, G. 2003. Current status of the Ganges river dolphin in the rivers Kosi and Son. *Journal of the Bombay Natural History Society* 100(1): 27-37.

Sinha, R.K., Smith, B.D., Sharma, G., Prasad, K., Choudhury, B.C., Sapkota, K., Sharma, R.K. and Behera, S.K. 2000. Status and distribution of the Ganges Susu, *Platanista gangetica*, in the Ganges River system of India and Nepal. In: R.R. Reeves, B.D. Smith, and T. Kasuya (eds) *Biology and Conservation of Freshwater Cetaceans in Asia*, pp. 54–61. IUCN Species Survival Commission Occasional Paper No. 23, Gland, Switzerland and Cambridge, UK.

Sinha, R.K., Verma, S.K., Singh, L. 2010. Population status and conservation of the Ganges river dolphin (*Platanista gangetica gangetica*) in the Indian subcontinent. . In: Ruiz-Garcia, M., and Shostell, J. (eds), *Biology, evolution, and conservation of river dolphins within South America and Asia*, pp. 419-443. Wildlife Protection, Destruction and Extinction Series, Nova Publishers.

Smith, B.D. 1993. 1990 status and conservation of the Ganges River dolphin (*Platanista gangetica*) in the Karnali River Nepal. *Biological Conservation* 66: 159-169.

Smith, B.D. 2013. Final report to the New England Aquarium on pinger displacement trials for Ganges River Dolphins *Platanista gangetica* in the Sundarbans mangrove forest, Bangladesh. WCS-Bangladesh.

Smith, B.D., Ahmed, B., Edrise, M. and Braulik, G. 2001. Status of the Ganges River Dolphin or Shushuk *Platanista gangetica* in Kaptai Lake and the southern rivers of Bangladesh. *Oryx* 35: 61–72.

Smith, B.D., Aminul Haque, A.K.M., Hossain, M.S. and Khan, A. 1998. River dolphins in Bangladesh: conservation and the effects of water development. *Environmental Management* 22: 323–335.

Smith, B.D. and Reeves, R.R. 2000. Survey methods for population assessment of Asian River dolphins. In: Reeves, R.R., Smith, B.D. and Kasuya, T. (eds), *Biology and Conservation of Freshwater Cetaceans in Asia*, pp. 152. IUCN Species Survival Commission Occasional Paper No. 23. IUCN, Gland, Switzerland and Cambridge, UK.

Smith, B.D. and Reeves, R.R. 2012. River cetaceans and habitat change: generalist resilience or specialist vulnerability? *Journal of Marine Biology* 11: 718935.

Smith, B.D. and Reeves, R.R. (eds) 2000. Report of the second meeting of the Asian river dolphin committee, 22–24 February 1997, Rajendrapur, Bangladesh. In: R.R. Reeves, B.D. Smith and T. Kasuya (eds) *Biology and Conservation of Freshwater Cetaceans in Asia*, pp. 1–14. IUCN/SSC Occasional Paper No. 23, Gland, Switzerland and Cambridge, UK.

Smith, B.D., Braulik, G., Strindberg, S., Ahmed B., and Mansur R. 2006. Abundance of Irrawaddy dolphins (*Orcaella brevirostris*) and Ganges River dolphin (*Platanista gangetica gangetica*) estimated using concurrent counts made by independent teams in waterways of the Sundarbans mangrove forest in Bangladesh. *Marine Mammal Science* 22(2): 527-547.

Smith, B.D., Braulik, G., Strindberg, S., Mansur, R., Diyan, M.A.A. and Ahmed, B. 2009. Habitat selection of freshwater-dependent cetaceans and the potential effects of declining freshwater flows and sea-level rise in waterways of the Sundarbans mangrove forest, Bangladesh. *Aquatic Conservation: Marine and Freshwater Ecosystems* 19: 209-225.

Smith, B.D., Diyan, M.A.A., Mansur, R.M., Mansur E.F., and Ahmed B. 2010. Identification and channel characteristics of cetacean hotspots in waterways of the eastern Sundarbans mangrove forest, Bangladesh. *Oryx* 44(2): 241-247.

Smith, B.D., Sinha, R.K., Regmi, U. and Sapkota, K. 1994. Status of Ganges River dolphins (*Platanista gangetica*) in the Karnali, Mahakali, Narayani and Sapta Kosi Rivers of Nepal and India in 1993. *Marine Mammal Science* 10: 368-375.

Smith, B.D., Sinha, R.K., Zhou, K., Chaudhry, A.A., Renjun, L., Wang, D., Ahmed, B., Haque, A.K.M. and Sapkota, K. 2000. Register of water development projects affecting Asian river cetaceans. In: R.R. Reeves, B.D. Smith, and T. Kasuya (eds) *Biology and Conservation of Freshwater Cetaceans in Asia*, pp. 22–39. IUCN/SSC Occasional Paper No. 23, Gland, Switzerland and Cambridge, UK.

Sonkar, G.K., Gaurav, K. 2020. Assessing the impact of large barrages on habitat of the Ganga River Dolphin. *River Research and Applications*: https://doi.org/10.1002/rra.3715.

Sutaria, D., Kelkar, N., Araujo-Wang, C., Santos, M. 2019. Cetacean Sociality in Rivers, Lagoons, and Estuaries. In: Wursig, B. (ed.), *Ethology and Behavioral Ecology of Toothed Whales and Dolphins*, pp. 413-434. Springer.

Taigor, S.R. 2020. Observation of fresh water Ganges dolphin (*Platanista gangetica*) in the Hamirpur and Ekdala stretches of Yamuna river, India. *Journal of Entomology and Zoology Studies* 8: 440-444.

Turvey, S.T., Risley, C.L., Barrett, L.A., Yujiang, H. & Ding, W. 2012. River dolphins can act as population trend indicators in degraded freshwater systems. *PloS One* 7(5): e37902.

Ura, T., Bahl, R., Sugimatsu, H., Kojima, J., Inoue, T., Fukuchi, T., Behera, S., Pattnaik, A., Khan, M., Kar, S.,

& Kar, C. S. 2007. Estimated beam pattern and echolocation characteristics of clicks recorded from a free-ranging Ganges river dolphin. *Proceedings of International Symposium on Underwater Technology 2007. Underwater Technology and Workshop on Scientific Use of Submarine Cables and Related Technologies*: 527–534.

Wakid, A. 2005. Studies on certain aspects of ecology and behaviour of river dolphin (*Platanista gangetica*) in Dibru-Saikhowa National Park, Assam. PhD Thesis, Dibrugarh University, Assam.

Wakid, A. 2006. Status and distribution of a newly documented residential Gangetic dolphin (*Platanista gangetica* Roxburgh 1801) population in Eastern Assam. *Journal of Bombay Natural History Society* 102(2): 158-161.

Wakid, A. 2009. Status and distribution of the endangered Gangetic dolphin (*Platanista gangetica gangetica*) in the Brahmaputra River within India in 2005. *Current Science* 97(8): 1143-1151.

WCS/BCDP. 2014. Educational outreach, training and consultations in the three wildlife sanctuaries for freshwater dolphins in the Eastern Sundarbans, Bangladesh. Background document prepared by the Wildlife Conservation Society's Bangladesh Cetacean Diversity Project, Khulna, Bangladesh.

Wijngaard, R.R., Lutz, A.F., Nepal, S., Khanal, S., Pradhananga, S., Shreshtha, A.B., & Immerzeel, W.A. 2017. Future changes in hydro-climatic extremes in the Upper Indus, Ganges, and Brahmaputra river basins. *PloS One* 12: e-0190224.

Wildlife Institute of India. 2017. Aquatic Fauna of the Ganga River: Status and Conservation. Wildlife Institute of India-Ganga Aqualife Conservation and Monitoring Centre. Wildlife Institute of India, Dehradun.

Wildlife Institute of India. 2020. Impact of oil well blowout at Baghjan oil field, Assam and resulting oil spill, on surrounding landscape. Assessment Report. Wildlife Institute of India, Dehradun.

World Bank. 1990. *Flood control in Bangladesh, a plan for action*. The World Bank, Washington D.C. 91 pp.

World Wildlife Fund-Nepal. 2006. Status, distribution and conservation threats of Ganges River Dolphin in Karnali River, Nepal. WWF-Nepal.

World Wildlife Fund (WWF) & Uttar Pradesh Forest Department (WWF-UPFD). 2015. Status and distribution of Ganges River Dolphin (*Platanista gangetica gangetica*) in Uttar Pradesh, India. Report submitted to the Department of Environment and Forests, Government of Uttar Pradesh.

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External Resources

For Supplementary Material, and for Images and External Links to Additional Information, please see the Red List website.

Appendix

Habitats

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Habitat	Season	Suitability	Major Importance?
5. Wetlands (inland) -> 5.1. Wetlands (inland) - Permanent Rivers/Streams/Creeks (includes waterfalls)	Resident	Suitable	Yes
5. Wetlands (inland) -> 5.6. Wetlands (inland) - Seasonal/Intermittent Freshwater Lakes (over 8ha)	Seasonal occurrence unknown	Marginal	-
9. Marine Neritic -> 9.10. Marine Neritic - Estuaries	Seasonal occurrence unknown	Suitable	No
15. Artificial/Aquatic & Marine -> 15.1. Artificial/Aquatic - Water Storage Areas (over 8ha)	Resident	Marginal	-

Threats

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Threat	Timing	Scope	Severity	Impact Score
1. Residential & commercial development -> 1.2. Commercial & industrial areas	Future	Majority (50-90%)	Slow, significant declines	Low impact: 4
1. Residential & commercial development -> 1.3. Tourism & recreation areas	Future	Majority (50-90%)	Slow, significant declines	Low impact: 4
2. Agriculture & aquaculture -> 2.4. Marine & freshwater aquaculture -> 2.4.1. Subsistence/artisinal aquaculture	Ongoing	Minority (50%)	Negligible declines	Low impact: 4
3. Energy production & mining -> 3.1. Oil & gas drilling	Future	Minority (50%)	Rapid declines	Low impact: 4
3. Energy production & mining -> 3.2. Mining & quarrying	Ongoing	Majority (50-90%)	Slow, significant declines	Medium impact: 6
4. Transportation & service corridors -> 4.1. Roads & railroads	Ongoing	Majority (50-90%)	Causing/could cause fluctuations	Medium impact: 6
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation		
4. Transportation & service corridors -> 4.3. Shipping lanes	Ongoing	Majority (50-90%)	Rapid declines	Medium impact: 7
5. Biological resource use -> 5.4. Fishing & harvesting aquatic resources -> 5.4.1. Intentional use: (subsistence/small scale) [harvest]	Ongoing	Majority (50-90%)	Rapid declines	Medium impact: 7
	Stresses:	2. Species Stresses -> 2.1. Species mortality		

5. Biological resource use -> 5.4. Fishing & harvesting aquatic resources -> 5.4.2. Intentional use: (large scale) [harvest]	Past, unlikely to return	Minority (50%)	Rapid declines	Past impact
5. Biological resource use -> 5.4. Fishing & harvesting aquatic resources -> 5.4.3. Unintentional effects: (subsistence/small scale) [harvest]	Ongoing	Majority (50-90%)	Rapid declines	Medium impact: 7
5. Biological resource use -> 5.4. Fishing & harvesting aquatic resources -> 5.4.4. Unintentional effects: (large scale) [harvest]	Ongoing	Whole (>90%)	Rapid declines	High impact: 8
	Stresses:	2. Species Stresses -> 2.1. Species mortality		
5. Biological resource use -> 5.4. Fishing & harvesting aquatic resources -> 5.4.5. Persecution/control	Ongoing	Minority (50%)	Slow, significant declines	Low impact: 5
5. Biological resource use -> 5.4. Fishing & harvesting aquatic resources -> 5.4.6. Motivation Unknown/Unrecorded	Ongoing	Minority (50%)	Slow, significant declines	Low impact: 5
6. Human intrusions & disturbance -> 6.1. Recreational activities	Ongoing	Minority (50%)	Negligible declines	Low impact: 4
7. Natural system modifications -> 7.2. Dams & water management/use -> 7.2.5. Abstraction of ground water (domestic use)	Ongoing	Majority (50-90%)	Causing/could cause fluctuations	Medium impact: 6
7. Natural system modifications -> 7.2. Dams & water management/use -> 7.2.10. Large dams	Ongoing	Majority (50-90%)	Rapid declines	Medium impact: 7
7. Natural system modifications -> 7.2. Dams & water management/use -> 7.2.11. Dams (size unknown)	Ongoing	Majority (50-90%)	Slow, significant declines	Medium impact: 6
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation		
9. Pollution -> 9.1. Domestic & urban waste water -> 9.1.1. Sewage	Ongoing	Majority (50-90%)	Slow, significant declines	Medium impact: 6
9. Pollution -> 9.1. Domestic & urban waste water -> 9.1.2. Run-off	Ongoing	Majority (50-90%)	Slow, significant declines	Medium impact: 6
9. Pollution -> 9.1. Domestic & urban waste water -> 9.1.3. Type Unknown/Unrecorded	Ongoing	Majority (50-90%)	Slow, significant declines	Medium impact: 6
9. Pollution -> 9.2. Industrial & military effluents -> 9.2.1. Oil spills	Ongoing	Minority (50%)	Negligible declines	Low impact: 4
9. Pollution -> 9.2. Industrial & military effluents -> 9.2.3. Type Unknown/Unrecorded	Ongoing	Majority (50-90%)	Slow, significant declines	Medium impact: 6
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation		
9. Pollution -> 9.3. Agricultural & forestry effluents -> 9.3.1. Nutrient loads	Ongoing	Majority (50-90%)	Slow, significant declines	Medium impact: 6
9. Pollution -> 9.3. Agricultural & forestry effluents -> 9.3.2. Soil erosion, sedimentation	Ongoing	Majority (50-90%)	Slow, significant declines	Medium impact: 6
9. Pollution -> 9.3. Agricultural & forestry effluents -> 9.3.3. Herbicides and pesticides	Ongoing	Majority (50-90%)	Slow, significant declines	Medium impact: 6

9. Pollution -> 9.3. Agricultural & forestry effluents -> 9.3.4. Type Unknown/Unrecorded	Ongoing	Majority (50-90%)	Slow, significant declines	Medium impact: 6
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation		
9. Pollution -> 9.4. Garbage & solid waste	Ongoing	Whole (>90%)	Slow, significant declines	Medium impact: 7
9. Pollution -> 9.6. Excess energy -> 9.6.3. Noise pollution	Ongoing	Minority (50%)	Slow, significant declines	Low impact: 5
11. Climate change & severe weather -> 11.1. Habitat shifting & alteration	Ongoing	Whole (>90%)	Rapid declines	High impact: 8
11. Climate change & severe weather -> 11.2. Droughts	Ongoing	Whole (>90%)	Rapid declines	High impact: 8
11. Climate change & severe weather -> 11.5. Other impacts	Ongoing	Whole (>90%)	Rapid declines	High impact: 8

Conservation Actions in Place

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Conservation Action in Place
In-place research and monitoring
Action Recovery Plan: No
Systematic monitoring scheme: No
In-place land/water protection
Occurs in at least one protected area: Yes

Conservation Actions Needed

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Conservation Action Needed
1. Land/water protection -> 1.1. Site/area protection
1. Land/water protection -> 1.2. Resource & habitat protection
2. Land/water management -> 2.1. Site/area management
3. Species management -> 3.1. Species management -> 3.1.1. Harvest management
4. Education & awareness -> 4.1. Formal education
4. Education & awareness -> 4.2. Training
4. Education & awareness -> 4.3. Awareness & communications
5. Law & policy -> 5.4. Compliance and enforcement -> 5.4.3. Sub-national level
6. Livelihood, economic & other incentives -> 6.2. Substitution

Research Needed

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Research Needed
1. Research -> 1.2. Population size, distribution & trends
1. Research -> 1.3. Life history & ecology
1. Research -> 1.4. Harvest, use & livelihoods
1. Research -> 1.5. Threats
1. Research -> 1.6. Actions
2. Conservation Planning -> 2.1. Species Action/Recovery Plan
2. Conservation Planning -> 2.2. Area-based Management Plan
2. Conservation Planning -> 2.3. Harvest & Trade Management Plan
3. Monitoring -> 3.1. Population trends
3. Monitoring -> 3.2. Harvest level trends
3. Monitoring -> 3.3. Trade trends
3. Monitoring -> 3.4. Habitat trends

Additional Data Fields

Population
Population severely fragmented: Yes
Extreme fluctuations in subpopulations: No
All individuals in one subpopulation: No
Habitats and Ecology
Generation Length (years): 17
Movement patterns: Full Migrant

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The IUCN Red List Partnership

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