Rescuing Ganges river dolphins (*Platanista gangetica*) from irrigation canals in Uttar Pradesh, North India, 2013–2020

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ABSTRACT

The Ganges river dolphin (*Platanista gangetica*) is an endangered freshwater species found in the rivers of India, Nepal and Bangladesh. The development of dams and barrages have severely affected this habitat as dolphins move into irrigation canals where they are at risk of injury or death due to a range of factors, such as rapidly receding waters, heat stroke, drowning and human interference. Between 2013–20, the TSA Foundation India and the Environment, Forest and Climate Change Department, Uttar Pradesh, rescued 24 dolphins in 18 entrapment events. While 19 dolphins were rescued, five died during capture or transportation. Here we describe our capture and transportation methods to raise awareness of the issue and improve survival rates in future entrapment events.

KEYWORDS: GANGES RIVER DOLPHINS; IRRIGATION; ENTRAPMENT; RESCUE OPERATIONS

INTRODUCTION

Ganges and Indus river dolphins were formerly recognised as two subspecies (*Platanista gangetica* and *P. g. minor*) until recent mtDNA analysis, alongside comparisons of skeletal and external morphology, led to distinct species status (Braulik *et al*., 2021a). The Ganges river dolphin is distributed throughout the Ganges-Brahmaputra-Meghna and Karnaphuli-Sangu (GBMK) river systems of Nepal, India and Bangladesh (Kelkar *et al*., 2022). The species has been extirpated from some parts of this river system due to habitat fragmentation, caused by irrigation barrages, diversions, low water flow and pollution. According to a recent assessment, the total population is estimated to be between 4,700–5,920 individuals of all age classes across its entire distribution range (Kelkar *et al*., 2022).

This species is included in Schedule 1 of the Indian Wildlife (Protection) Act 1972, Appendix 1 of the Convention on International Trade in Endangered Species (CITES) and Appendix 1 of the Convention on Migratory Species (CMS). It is also 'Endangered' on the IUCN Red List (Kelkar *et al*., 2022). In 2020, the CMS recommended concerted action between India, Nepal and Bangladesh to 'strengthen rescue response and release efforts' and 'prioritise outreach and capacity building efforts to secure river dolphin habitats and population connectivity' (CMS, 2020). The CMS also highlighted the need to better understand the impact of hydro-development projects on habitat loss and movement ecology among the wider risks to South Asian river dolphins.

In 2016, the International Whaling Commission's (IWC) Scientific Committee recognised that both Ganges and Indus river dolphins require prompt and coordinated action to protect them from imminent threats (IWC, 2018). In 2017, the IWC created the Asian River Dolphin Task Team (AR-TT) to identify information gaps, research priorities and develop concerted action for the protection of the Ganges and Indus river species in their range

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habitat. The AR-TT recognised the issue of canal stranding and recommended a focused study should be conducted to understand the movement of dolphins across barrages in all countries (IWC, 2020).

The Ganges river dolphin faces numerous threats across its range habitat, including impacts from hydro-development projects where high dams have led to extreme water flow alterations. Irrigation barrages on major river systems have also impeded the movement of river dolphins, leading to population fragmentation, restricting prey fish, affecting foraging patterns and eventually depleting downstream flow in the main channel. More than 20 barrages and 17 high dams have been built on the GBMK river system since 1950. Further projects are either planned or already under construction in the main channel and tributaries.

The Ganga river basin includes a vast network of irrigation canals that draw water from the surrounding rivers (Reeves *et al.*, 2000; Sinha *et al.*, 2010; 2014). When the barrage gates close, water is diverted into these irrigation canals. Dolphins occasionally pass through canal regulator gates and become trapped as these gates prevent re-entry into the main river channel. It is possible for dolphins to survive within the canal for some months, if not injured or harmed but water depth and water flow are not regulated, so that as the temperatures start to rise in summer and the water levels start to fall, all trapped dolphins will eventually die unless removed. Habitat fragmentation is therefore considered the primary factor responsible for the species' estimated 20–30% distributional range decline (Braulik *et al.*, 2021b).

A dolphin rescue programme was initiated in 1992 by Sindh Wildlife Department and WWF-Pakistan to rescue river dolphins from irrigation canals (Braulik *et al.*, 2015; Waqas *et al.*, 2012). No rescue attempts were made in the Ghaghara basin. Many instances of entrapment were not even reported. There is clearly a need to address this entrapment issue for both Ganges and Indus river dolphins. In this article, we describe our efforts to rescue Ganges river dolphins and release them into adjacent rivers. Our objectives are to: 1) describe our capture and relocation methods; 2) describe the behavioural and demographic details of rescued animals; 3) describe the locations of these canals, which might help to explain how these dolphins become trapped in the first place. See Appendix 1 for specific details of each rescue operation. A detailed guide based on our recent experience can be found here.

Study area

This study focuses on the Ghaghara basin of the Ganges river in Uttar Pradesh, Northern India (Figure 1). The Ghaghara is the largest tributary of the Ganga. It originates in Tibet and flows through Nepal before entering

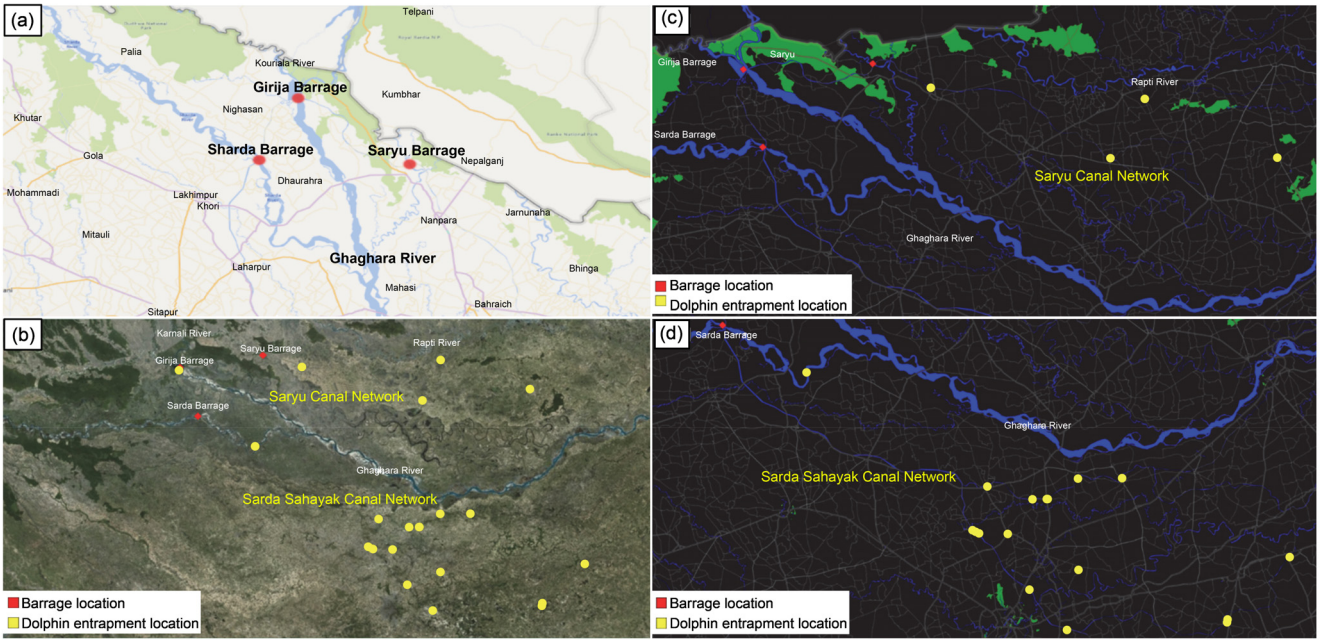

Fig. 1: A) Map showing the location of barrages; B) map showing all canal entrapment location in the Ghaghara; C) closer view of dolphins stranded in Saryu canal network; D) closer view of dolphins stranded in the Sharda Sahayak canal network.

India near Bardiya National Park. The total catchment area of the Ghaghara river is c.127,000km^2 – 45% of which flows through India.

Irrigation in the Ghaghara basin is provided by the Sharda-Sahayak and Saryu canal systems. The Sharda-Sahayak Project (SSP) began in 1968 to provide irrigation for 16 districts of central Uttar Pradesh. A 28km link canal starts at the Girija barrage and diverts 480 cumecs of water from the Ghaghara to the Sharda river which connects Barabanki, Jaunpur, Raebareli, Ayodhya and Lucknow (PEO, 2007). The Saryu Canal was designed to irrigate multiple districts of eastern Uttar Pradesh, including Bahraich, Gonda, Balrampur, Srawasti and Basti.

Most rescue attempts between 2013–20 occurred in the Sharda Sahayak canal system (n = 19), followed by the Saryu Canal System (n = 5) (Figure 1). Total stranding incidents in the region between 2013–20 are as follows: Barabanki (11), Lucknow (3), Amethi (3), Bahraich (2), Shravasti (2), Gonda (1), Raebareli (1) and Jaunpur (1). These incidents were recorded at distances between 88–384km upstream from the barrage.

METHODS

Observation and planning

Ganges and Indus river dolphins are sensitive freshwater species. Several rescue attempts have previously resulted in heart failure (Pilleri, 1970; Braulik *et al*., 2020). It is therefore important to observe each individual and plan a sensitive rescue operation to minimise additional stress. Limited resources and infrastructure mean that CMS guidelines for safe and humane handling of cetaceans cannot always be replicated in rural India (Hamer *et al*., 2020). Here we describe methods safely used to rescue Ganges river dolphins from the canal systems of Uttar Pradesh.

Each rescue operation began when members of the local community reported sightings to the Forest and Wildlife Department (UPFD) who in turn passed relevant information to the Turtle Survival Alliance Foundation India (TSAFI). Permit requests were made to the Principal Chief Conservator of Forests or Chief Wildlife Warden via the relevant Divisional Forest Officer (DFO).

The rescue team began by making careful observations to determine the number and behaviour of trapped individual(s). These observations were quick and noninvasive but provided critical information to assess each dolphin's stress levels. For example, one dolphin was seen swimming on its side with very little surfacing. These observations continued throughout each rescue and operations were suspended where the team observed a rise in stress levels. In a second case, the dolphin began moving frantically once the nets were deployed. Ample time was given after each unsuccessful attempt to allow the dolphin's condition to stabilise. Most operations therefore began early in the morning to maximise daylight hours and take advantage of low temperatures to avoid heat stress. Where a rescue attempt had to be suspended overnight, all equipment was removed from the water to minimise stress and avoid the risk of entanglement and/or drowning. The rescue team continued to monitor the animal every four to six hours throughout the night.

The rescue team also made careful observations of the location and water conditions, such as the gradient, vegetation and presence of submerged rocks/debris which might have posed a risk to the dolphin(s), equipment or rescue team. In fast flowing and/or deep waters, the large capture net wasn't able to reach the canal bottom, which meant the dolphin(s) could escape underneath. In these conditions, the rescue team asked the local irrigation department to reduce the level of water discharge to ensure the dolphin could be maintained in the same section of canal.

The rescue team also planned for possible interference from members of the public. For example, the rescue team requested a Forest Department unit remain in situ. Temporary notices were put in place to inform local communities from interfering with the animal(s). Assistance from local police and Gram Panchayat (village leaders) helped keep the curious crowds of onlookers under control.

Response team

Composition of the rescue team depended on the size and location of each stranded dolphin. Each rescue operation required rescue and medical expertise alongside members who could engage with the public, media, police and Forest Department staff. The rescue team began by formulating an initial plan based on each dolphin's

Table 1
Structure of the rescue team.

Team	Sub team	Role
Lead Rescuer		Supervise rescue operation.
Net Team (15 fishermen familiar with fishing gear and river flow characteristics who are able swimmers and divers)	Sub Team A (five members)	Responsible for sealing off the upstream end of canal with silk drag net to restrict movement of the dolphin. When the canal was deep and/or wide, a boat was used to deploy the nets from bank to bank.
	Sub Team B (five members)	Responsible for sealing off the downstream end of canal with silk drag net to restrict movement of the dolphin.
	Sub Team C (five members)	Corral the dolphin with mosquito net. Enter water to manually capture the dolphin as soon as it is restricted to a small area of the canal.
Rescue Team (six members with experience of dolphin rescue)	Capture Team (four members)	Secure dolphin and place on stretcher before transferring to the cot and rescue vehicle.
	Transport Team (five members) including members of the capture team	Fill water drum and ensure sprinklers are in place. Assist with lifting cot onto vehicle.
	Vehicle Team (two members)	A driver and navigator will plan the best route to release site.
	Veterinarian	In charge of diagnostics and urgent clinical treatment.
Ground Support Team	Includes members of forest department, police and local village council.	Responsible for managing crowds, clearing rescue area and guiding rescue vehicle.

size, location and the wider environmental conditions. A Lead Rescuer was nominated at the outset to manage the operation, delegating responsibilities and ensuring the team had access to necessary resources. Before the operation, the rescue team was given a briefing on the roles and responsibilities of each team member:

Equipment

These rescue operations required a range of equipment. Some items were easily sourced from local stores. Specialised equipment was custom made. One team member was responsible for ensuring that all necessary equipment reached the rescue location and was returned afterwards.

General items included:

1. Water drum of at least 100l. capacity that could fit in the rescue vehicle. The drum was filled with canal water at the rescue site to maintain the dolphin's temperature. Additional containers were used to sprinkle water on the dolphin to ensure the skin didn't dry out.
2. Knives and scissors were used to cut the net if the snout became entangled.
3. Fleece, foam, mattresses and pillows were used to provide support and avoid irritation. Wet fleeces were used to cover the dolphin's body to avoid dryness. Pillows and rolled towels were used to stabilise the dolphin while on the move.
4. Two-way radios were essential during rescue operations, especially in remote areas where mobile communications weren't reliable.
5. First-aid kits were kept onboard to ensure the safety of the rescue team.
6. A stethoscope was kept onboard to monitor the dolphin's heart rate. A bag valve mask was used to address any breathing abnormalities.

Custom-made items included:

1. Silk nets (*chhanta*), 60–100m × 3m deep, with 10 finger gaps (local term), equivalent to 15cm mesh size. Two initial attempts to rescue dolphins failed as monofilament nylon gill nets were easily torn.
2. Mosquito nets (*fardi*), 50m × 2m deep, were used where canals had shallow water levels to secure the dolphin and corral it towards the capture team.

3. Stretchers were extremely important to ensure each dolphin was safely handled. The stretchers were made according to each dolphin's size. The base was made of non-abrasive, stretchable double-layered canvas or nylon with reinforced edges. The pole along the side was made of sturdy iron rods with at least four hand holds.

4. A specialised iron cot was used to transport each dolphin in the vehicle. The cot was made of a metal frame that could hold approx. 1,000lbs. The frame was woven using jute rope to provide a soft base. The legs of the cot were fixed with shock absorbers to minimise jerks while traveling across land. An additional foam cushion (approx. four to eight inches) was used to absorb shock and retain water to prevent the skin drying out.

Capture methods

First, the Net Team ensured the nets were properly deployed. Sub-teams A and B restricted the movement of the dolphin both up- and downstream by passing the silk net between the banks. The sub-teams then extended the mosquito net between the positions of the silk net. The sub-teams slowly moved these nets towards the dolphin in an arching motion to enclose it within a small area (Figure 2).

The Rescue Team captured the dolphin and transferred it to the vehicle. This part of the operation posed a high risk of further stress and injury to the dolphin. As the Net Team corralled the dolphin, the Capture Team secured it in a small section of the canal. One member secured the snout by hand while a second member secured the dolphin's lower half. The third and fourth members embraced the dolphin to keep the blowhole upright. The dolphin was then slowly positioned on the stretcher (Figure 3).

Transport and release

The stretcher was transferred to the cot lined with foam (Figure 4). Pillows were positioned along the dolphin's body to reduce impact and pressure. The dolphin was immediately covered with wet fleeces, avoiding the blowhole. This entire structure was transferred to the rescue vehicle – usually a modified minivan large enough

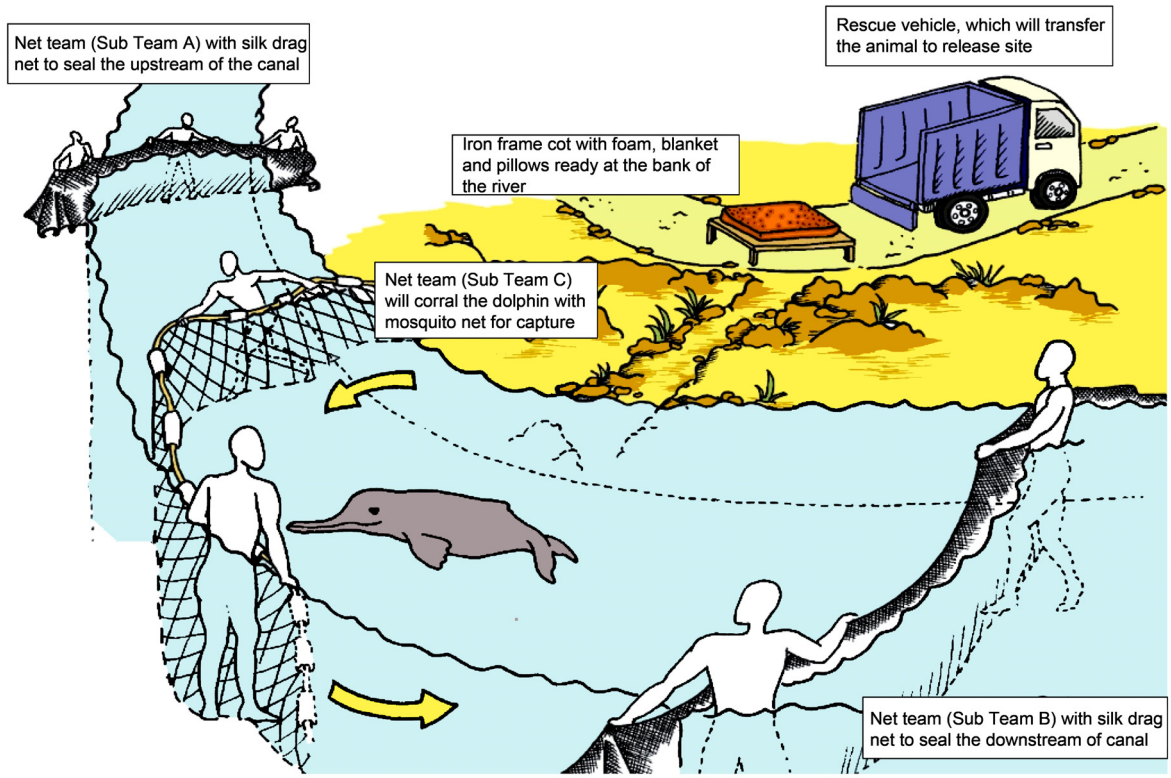

Fig. 2: Silk drag nets are passed between banks to block the canal while a large mosquito net surrounds the stranded animal.

Fig. 3: A stretcher made using foam, tent cloth and sturdy iron rods with handholds.

Fig. 4: A sturdy iron cot cushioned with foam is designed to hold the stretcher during translocation.

to accommodate the rescue team and equipment. In 2016, a Ganges river dolphin was rescued from the Donk river in Bihar District where the stretcher was suspended from the inside roof to reduce jerks (Sen *et al*., 2016).

The land journeys took between 40–150 minutes (70–100km). Dolphins of *Platanista* genus have been shown to survive long journeys when handled properly and efforts were made to reduce stress (Braulik *et al*., 2020; Pilleri, 1970a). In the 1970s, dolphins were captured and transported thousands of kilometers across India, Bangladesh and Pakistan, using trucks, trains, motorboats, even rickshaws and air transport, for up to 70 hours, albeit with significant deterioration in the dolphin's condition. Suspected myopathy occurred in several of these operations (Braulik *et al*., 2015; Haque *et al*., 1977; Pilleri, 1970b; Herald *et al*., 1969).

While in transit, the rescue team monitored the dolphin's vital rates. If the respiration rate either dropped to one breathe per minute or rose to 10 breaths per minute, air was pumped into the mouth via a soft pipe attached to an AMBU bag. This method helped three dolphins that had stopped breathing for at least four minutes return to a normal breathing rate (one breath per 40–50 seconds). Haque *et al*. (1977) have suggested the minimum breathing rate can fall to 40 breaths per hour and that placing one hand below the throat can encourage the dolphin to calm down and stop struggling. We further observe that this breathing rate tended to relax when a member of the rescue team gently rubbed the stomach area.

The rescue team ensured the dolphin's skin was continually moist while also recording useful information, such as total body length (TBL) and rostrum length. Sex was determined based on the overall size, rostrum shape and dental structure, as it was not always possible to observe the ventral orifices. Before release, the veterinarian also treated any minor injuries.

During release, each dolphin was encouraged to swim from the stretcher by submerging it in water between one to 1.5m deep. Dolphins were monitored visually but not tagged or marked for future tracking.

RESULTS & DISCUSSION

Rescued dolphins

There were 19 successful rescue operations. 14 dolphins were identified as female and 10 as male. The TBL of these dolphins was found to be between 128–275cm. Male dolphin body size ranged from 128–195cm, whereas female body size ranged from 190–274cm (Figure 5). Of the five dolphins that died, three had a TBL over 243cm.

The Ganges river dolphin is not known to be a gregarious species (Sinha *et al*., 2010), but we observed and handled at least one adult male and female together on five occasions. Furthermore, adult females have been seen with a calf on two occasions. These observations suggest that Ganges river dolphins may prefer to live and/or hunt in the pod. The dolphins may either stray into the canal while following prey upstream or get flushed into the canal by a sudden discharge of water from the barrage gates. We have limited information to confirm whether these adults are related or whether they entered the canal at different times and became trapped in the same section due to environmental conditions, such as water level and physical barriers. But this range of size and sex suggests the species may have different social structures at various stages of life.

Occurrence of male and female dolphins along the same stretch of canal also warrants further investigation to understand if dolphins deliberately enter these canals. The higher proportion of females (n = 14) to males (n = 10) suggests that straying may occur because either larger animals or pregnant female dolphins look for an easier prey base in the canal system. The movement of dolphins to low current areas also seems to be associated with the migration and dispersal of prey (Reeves *et al*., 1989; Mallick, 2016). In one incident, a female dolphin and juvenile were found trapped in a deep pool in the Damodar (Randhia). It is presumed that the dolphins travelled upstream in search of food during the spawning season of Hilsa (*Tenulosa ilisha*), before becoming trapped due to water shortages (Mallick, 2010). Further investigation is required to determine whether instances of multiple-individual stranding involve related individuals.

Seasonality

Over 70% of entrapments events were reported either post-monsoon or during peak winter (Figure 6). This suggests straying incidents are directly related to the release of water into canals during or after monsoons. The other 30% of dolphins were rescued during peak summer when water levels fall and the minimum water flow is maintained. Among the rescued dolphins, females were found trapped between Sep–May with maximum occurrence during peak winter (Dec–Feb). In contrast, males were mostly recorded post monsoon and during the summer season, with least occurrence in peak winter.

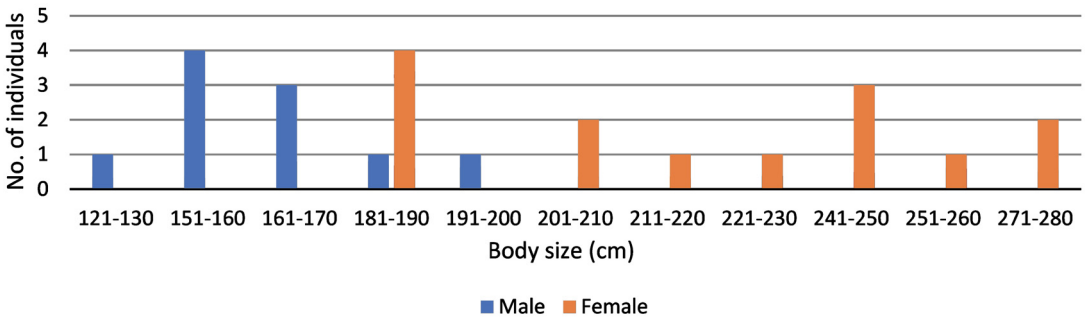

Fig. 5: Occurrence of dolphins according to size.

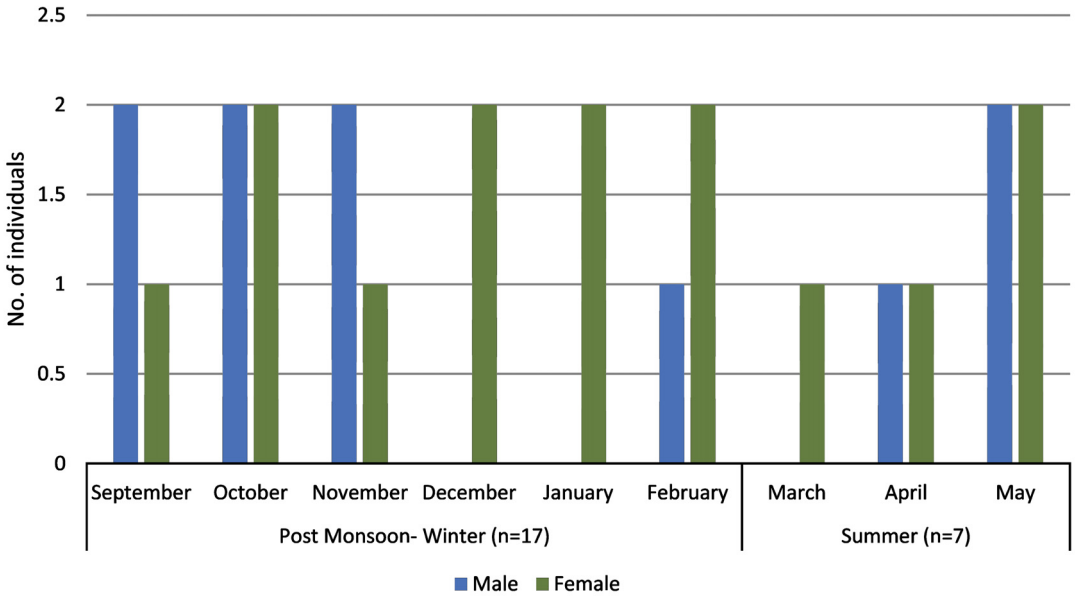

Fig. 6: Occurrence of dolphins across months and seasons.

Necropsy methods

Necropsies were performed by a panel which included government veterinarians as stipulated in Schedule 1 of the Indian Wildlife (Protection) Act 1972 where a team of three veterinarians must include at least one appointed by the State. Necropsies were conducted on the five dolphins that died during capture or transportation to examine gender, age, nutrition and parasitic load in gastrointestinal and respiratory tracts. It is also advised under Schedule 1 to have a representative of the forest department present at the time of necropsy and carcass disposal.

Suspected causes of death

One dolphin died immediately after capture. Four dolphins died during transport, within 10–30 minutes of capture. One was identified as male, four as female. This suggests female dolphins may be more prone to stress and shock than male dolphins. Females are also much larger than males (Kelkar *et al*., 2022) which poses difficulties for capture and handling. These heavier female dolphins also risk higher pressure being applied to internal organs during transport, which could lead to respiratory discomfort. The stomachs of three dolphins were found to be mostly empty. This lack of recent feeding may be due to stress, lack of prey or other impediments to successful foraging. See Appendix 2 for specific details on cause of death.

Local beliefs

There were several cases where dolphins had been killed by villagers because of local folklore and beliefs. Local communities refer to these dolphins as ‘Soons’ – an onomatopoeic title based in part on the sound they make when blowing air through their blowholes. There are local myths and legends which present these dolphins as a threat to human life and livestock. Rescue teams often encountered these stories when engaging with members of the public. The following examples indicate some of the beliefs which exacerbate the risk of injury and death. In 2008, a male dolphin stranded in the Sharda Shayak Canal (Lucknow) was stoned to death by villagers. In 2016, a male dolphin stranded in the Sharda Shayak Canal (Barabanki) was injured by a spear thrown from the crowd. The Rescue Team was able to remove the spear and provide primary medical treatment before release. The Rescue Team also received anecdotal evidence. In 2013, local people in Gonda district blamed the disappearance of livestock on a stranded dolphin in a nearby canal. In 2015, local people in Tiloi, Amethi told our team about a ruler (*Raja*) who ordered stranded dolphins to be shot out of fear for the village.

RECOMMENDATIONS

Here we list our research and resource priorities to improve future rescue operations and wider conservation strategies.

Deterrents

The IWC AR-TT recognised the issue of canal entrapment and suggested a focused study should be conducted to understand the movements of dolphins across barrages in all countries (IWC, 2020).

The AR-TT also suggested assessing the efficacy of pingers or bubble curtains on canal gates to minimise the risk of dolphin strandings (IWC, 2020). We recommend a pilot scheme using sonic devices or 'pingers' at all three barrages (Girijapuri, Lower Sharda and Saryu) in the Ghaghara subbasin to test their efficacy as deterrents, with a view to expanding their use across the range of present species.

Water supplies

We encourage local water authorities to monitor water levels in the Geruwa-Sharda link canal where there are isolated dolphin populations and to allocate additional water supplies when needed. Local irrigation departments can maintain a minimum depth of six feet in the section of canal where the dolphin(s) is trapped. This allows the rescue team to stabilise the dolphin's condition, make the necessary observations and provide sufficient time to prepare for rescue operations. This is a careful balance: increasing water levels too much may cause or enable the dolphin(s) to move between sections of the canal. Water depth and flow should therefore be regulated to increase the likelihood of success, including cases where the operation must be suspended overnight. We recommend the Irrigation Department alert the local forest and wildlife departments before opening barrage gates to help target monitoring efforts. We further encourage water authorities to remove construction debris close to the barrage gates to minimise the risk of additional harm to the dolphins.

Monitoring and reporting

Monitoring and reporting are key to timely rescue operations, particularly as water levels reduce throughout the summer season. In 2020, a male dolphin was found dead in a shallow canal, possibly due to heat stroke. As the water temperature reached 40 degrees Celsius, the dolphin began to turn red with blisters (see Appendix 3).

Frontline Forest Department officers passed information regarding 80% of cases to the TSA rescue team, but newspaper reports indicate an additional four to eight dolphins die annually in canal strandings which are not reported to local authorities. Due to the lack of monitoring, these estimates are likely to be conservative. See Appendix 3 for details of unreported strandings.

We recommend foot patrols monitoring 50km stretches of main, linking and branch canals every year post monsoon. We also recommend mapping the canal network downstream of each barrage to better understand the routes dolphins take before becoming trapped. All monitoring efforts should follow IUCN Guidelines for Reintroductions and Other Conservation Translocations (2013).

Equipment

Small trucks are currently used as rescue vehicles, but we recommend upgrading to sound-proofed vehicles with strong suspension to absorb the shock and impact on unpaved roads. The vehicle should have a rear ramp door to improve access with either a large load capacity or reinforced base. The vehicle should ideally be customised to include an overhead water-tank, drainage system and adequate storage to accommodate all rescue equipment.

Veterinary expertise

These rescue attempts provide excellent opportunities to improve handling expertise, health assessment and veterinary care. Veterinarians in India do not generally have adequate training to handle and treat dolphins or understand necropsy findings. The Integrated Conservation Planning for Cetaceans (ICPC) identified the importance of 'strengthening the animal handling and veterinary capacity of local researchers to conduct health

assessment on rescued animals' (Braulik *et al*., 2020). We therefore recommend local veterinarians involved in rescue operations should receive training from international experts.

Genetics

It is important to understand the genetics of source populations and stranded individuals to improve transport and conservation strategies. We therefore recommend expanding genetic research of Ganges river dolphins. During each rescue event, genetic samples should be collected for analysis. A member of the team should therefore be trained to oversee sample collection and storage. A specialised institute should also be recognised before obtaining relevant permits under the Wildlife Protection Act 1972.

Survival studies

Rescued dolphins should be fitted with acoustic or satellite transmitters to better understand their survival following release (e.g., Toosy *et al*., 2009) and improve life chances in the event of a repeat stranding. These have been used successfully in Amazon and Bolivian river dolphins (WWF, 2017) and bottlenose dolphins in narrow river ecosystems (Hartel *et al*., 2020). We also recommend that dolphins are tagged with Passive Integrated Transponders (PIT tags) to ensure easy identification in future events and help determine whether strandings involve related individuals.

Outreach and education

Outreach and education for local communities should be expanded to prevent damaging and possibly fatal interference with animals. Young members of the local community could be trained to report sightings and assist with rescue operations. A dolphin rescue helpline has already been launched by TSA India and UPFD for local people to report sightings. We also recommend improving prosecution rates for anyone found to be involved in either injuring or attempting to kill stranded dolphins.

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Appendix 1

Results of rescue attempts following canal stranding in Uttar Pradesh, Northern India, 2007–20.

Sl. No.	Date	Sex	No. of individuals	TBL (cm)	Location	Release site	Distance transported	Details
1	2.10.2013	Female	1	213.5	Saryu Canal (156.41km from barrage)	Ghaghara River	40km (45 mins to 1hr)	Rescue initially planned for 29.9.13. Local people were throwing stones at the dolphin, which caused it to continue moving vigorously along a 30km stretch of canal between Mankapur and Maskanwa. The dolphin broke four traps during capture attempts on the first day, after that again netting was reinforced before a successful rescue on 2.10.13.
2	11.3.2015	Female	1	189.1	Barabanki branch of Sharda Shayak Canal (137.24km from barrage)	Ghaghara River	30km (45 mins)	Local people reported two sightings on 8.3.2015, but on reaching the site, the rescue team confirmed there was only one dolphin. The rescue team deployed nets in the Paniroli Canal. A tertiary canal was also connected and the dolphin was observed to be moving between both the canals.
3	21.9.2015	Female	1	183	Indira Canal, Amethi (230km from barrage)	Ghaghara River	70–80km (1.5hr to 2hr)	The female dolphin was rescued first and released the same day but the male dolphin died during relocation.
		Male	1	167.75		NA	NA	
4	15.11.2015	Male	1	158.6	Saryu Canal, Bahraich (150km from barrage)	Ghaghara River close to Sharda confluence	40km (45 mins to 1hr)	The male was rescued first and released but the female collapsed immediately after capture.
		Female	1	274.5		NA	NA	
5	20.11.2015	Male	1	167.75	Saryu Canal, Srawasti (98km from barrage)	Ghaghara River close to Sharda confluence	50km (1hr)	A large crowd of local people gathered at the rescue area, which led to confusion and delays during the rescue operation.
6	7.4.2016	Male	1	160.1	Sharda Canal, Barabanki (212km from barrage)	Ghaghara River	50km (1hr to 1.5hr)	The female was rescued first. The male was found with an injured harpoon attached. This was removed and the wound treated with Betadine-soaked cotton before release.
		Female	1	186.05				
7	25.10.2016	Male	1	152.5	Indira Canal, Lucknow (166.97km from barrage)	Ghaghara River	70km (1.5hr to 2hr)	Both the dolphin was stranded in the same canal however during the rescue process one animal moved further down. The first rescued dolphin (male) was released into the Ghaghara River, but during the overnight suspension of the operation, the female had moved over 50 km down from the original rescue location, and it proved more prudent to release this animal into the Ganges, which was closer to the rescue site.
8	27.10.2016	Female	1	228.75	Indira Canal, Raebareli (224.5km from barrage)	Ganga river, Lalganj	65km (1.5hr to 2hr)	
9	24.12.2017	Female	1	244	Sharda Canal, Lucknow (145km from barrage)	Ghaghara River	70km (1.5hr to 2hr)	Two initial failed rescue attempts as the female kept trying to escape.
10	22.1.2018	Female	1	242	Sharda Canal, Lucknow (147.68km from barrage)	NA	NA	The dolphin was moving along 200–300m stretches of the Canal. Local fishermen had already tried to rescue the dolphin which later died during relocation.
11	10.1.2019	Female	1	274.5	Sharda Canal, Amethi (127.64km from barrage)	Ghaghara River	100km (2.5hr to 3hr)	This dolphin continued to escape over a period of four days and a distance of 100km. Nick-named 'Maharani' (Queen) by the rescue team, this dolphin was finally caught and released.
12	3.2.2019	Female	1	244	Sharda Canal, Barabanki (114.36km from barrage)	Ghaghara River	40km (45 mins to 1hr)	The dolphin was sighted in Fatehpur tehsil by locals. After two initial rescue attempts by Forest Department officers, the rescue team was informed and the dolphin was finally rescued and released.
13	22.2.2019	Male	1	183	Sharda Canal, Jaunpur (384.72km from barrage)	Ganga River, Allahabad	100 km (2.5hr to 3hr)	Local people reported that this dolphin had been stranded for over a month in a small canal almost 400km from the barrage. The dolphin required respiratory assistance from an AMBU bag during transport.
14	30.12.2019	Female	1	256.2	Sharda Canal, Barabanki (246km from barrage)	NA	NA	The dolphin escaped during an initial failed attempt. Water levels increased overnight so that the Irrigation Department was asked to divert water from the canal. The dolphin was successfully captured but died during relocation.

Sl. No.	Date	Sex	No. of individuals	TBL (cm)	Location	Release site	Distance transported	Details
15	10.2.2020	Female	1	209.84	Sharda Canal, Barabanki (166km from barrage)	NA	NA	Local people reported that the dolphin had been stranded here for several weeks. The rescue team found the snout was broken, probably due to the local people who had made repeated attempts to rescue the dolphin.
16	24.5.2020	Male	2	152.2 and 155.55	Sharda Canal, Barabanki (199km from barrage)	Ghaghara River	65km (1.5hr to 2hr)	A pod of four dolphins stranded in the same canal. The rescue team camped at the rescue site a day before to monitor the animals as May is one of the hottest months in northern India before conducting rescue operations early in the morning to take advantage of low temperatures. We formed three rescue teams with three sets of equipment. All dolphins were successfully rescued within 30 mins of capture.
		Female	2	201.3 and 190.01				
17	22.9.2020	Male	1	195.2	Saryu Canal, Srawasti (88km from barrage)	Rapti River	20km (30–45 mins)	High water flow and depth caused difficulty when deploying nets and meant the dolphin was able to move along a 7km stretch. The Irrigation Department was asked to reduce water flow which took two hours. The dolphin was then successfully released after a seven-hour operation.
18	21.10.2020	Male	1	128.1	Sharda Canal, Barabanki (136km from barrage)	Ghaghara River	65km (1.5hr to 2hr)	This dolphin was rescued after a difficult operation lasting over 5 hours and released safely in the Ghaghara River.

Appendix 2

Cause of death.

Sl. No.	Date	Sex and TBL (cm)	Condition when captured	Prior injury	Time to capture	Suspected cause of death	Other details
1	21.9.2015	Male (167.75)	Stressed	NA	3 days	Capture myopathy and stress could have led to death. The net team didn't remove the net after the successful rescue of a female dolphin, which caused the male dolphin to move in the opposite direction towards the canal gate. While trying to divert the dolphin, the fishermen set off fireworks, which caused further stress. The dolphin resisted capture for three days and died soon afterwards.	30cm snout and empty stomach
2	15.11.2015	Female (274.5)	Normal	NA	3 hours	Asphyxiation as the stretcher broke which meant the dolphin fell to the ground, causing the blow hole to shut.	89cm snout and empty stomach with gastroliths in stomach and parasites in gastrointestinal canal.
3	22.1.2018	Female (244)	Stressed	Injury caused by net as local fishermen had already tried to rescue the dolphin.		Parasite infection and capture myopathy; shock may also have led to death.	Pregnant female with 83cm snout. The foetus preserved. The gastrointestinal and respiratory tract infected with roundworms. Partially digested fish (c.25–30cm) with small fish and shrimp.
4	30.12.2019	Female (256.2)	Stressed	NA	4.5 hours	Capture myopathy and pain may have led to death. Dolphin rolled sideways twice during relocation. The tip of snout was also broken which suggests the dolphin was trying to jump canal gates.	86cm snout. Roundworms in gastrointestinal tract and mouth. Fish bones found in stomach which suggest dolphin still eating in the canal.
5	10.2.2020	Female (209.84)	Stressed	Broken snout and signs of injury all over body caused by fishing nets.	5 hours	Significant blood loss and trauma. The dolphin had been captured by villagers and manhandled before arrival of the Rescue Team. Lower mandible completely broken and upper mandible broken in multiple places. The dolphin eventually died of these injuries during transit.	73cm snout

Appendix 3

Additional information from the Forest Department and local media sources.

Sl. No.	Canal	District	Year	No. of individuals	Details
1	River in Haidergarh	Lucknow	2008	1	Dolphin rescued by UPFD staff (Telegraph India).
2	Sharda canal	Luckow	2008	2	Dolphins stoned by fishermen.
3	Sharda Canal	Barabanki	2015	1	Dolphin caught by fishermen and killed before Rescue Team arrived.
4	Sharda Canal, Ramnagar	Ramnagar	2020	1	Dolphin died due to low water levels and high temperature leading to blistered skin.
5	Indira Canal	Lucknow	2020	3	Local community reported three dolphins observed in canal.
6	Indira Canal	Ramnagar	2020	1	Dolphin stranded during COVID-19 lockdown.
7	Girija Barrage	Katarniaghat	2020	1	UPFD officers report putrefied dolphin body seen by barrage gate.