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First successful satellite tagging of a river dolphin in Asia: movements of Indus River dolphin Platanista minor in the Indus River, Sindh Province, Pakistan

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First successful satellite tagging of a river dolphin in Asia: movements of Indus River dolphin *Platanista minor* in the Indus River, Sindh Province, Pakistan

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ABSTRACT

This study reports the preliminary findings of the first successful satellite telemetry of any freshwater cetacean in Asia. Three Indus River dolphins, *Platanista minor* were tagged with ARGOS satellite tags from Wildlife Computers in the Indus River, Sindh, Pakistan. These dolphins were rescued from an Dadu canal (1♂) and a disconnected side channel (2♀) on 11th and 15th January 2022, respectively and were released just above the Sukkur barrage in the Indus Dolphin Reserve, a 190 km protected area between Guddu (28°25'07.74"N, 69°42'46.95"E) and Sukkur barrages (27°40'45.68"N, 68°50'45.55"E). The two adult females have been transmitting locations since 15th Jan 2022, 97 days so far, while after a few messages the tag on the young male did not transmit any data. The preliminary data from satellite tracking has helped in providing some insights into ranging patterns and spatial overlap. It also helped in determining different uses of the riverine features; confluence, side channels and main channel. Both dolphins spent equal percentage (42% recorded locations) in the main channel of the Indus River, 221535 had 41% and 17% and 221436 with 21% and 36% locations in confluences and side channels respectively. The longest distance a dolphin (221536) travelled from the release point was 44.8 km upstream Sukkur barrage, while the farthest the other female (221535) travelled from the release point was 11 km and this movement is regular over this study duration in the area. These initial results look promising for a large-scale telemetry study in Pakistan, prospecting for other dolphin species in the freshwater ecosystem in Asia and cross learning within region and with South America. This will be extremely useful in understanding the movement patterns in relation to water flow variations in this highly managed river system, while providing insights into habitat use and preferences. These will also help in monitoring post release survival of the rescued dolphins and associated conservation planning such as monitoring long distance translocations planned in future.

Keywords: Pakistan, satellite tags, Indus River dolphin, confluences, rescued

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INTRODUCTION:

Freshwater biodiversity is declining far faster than in any other ecosystem, almost one the three species are threatened with extinction (Collen et al. 2014). Based on available data, we know that almost 90% of global wetlands have been lost since 1700 (WWF, 2020). We also see impacts on freshwater cetaceans and all the six species are now categorized as endangered or critically endangered (IUCN Red List). Freshwater cetaceans face many threats and some of the most important ones are water infrastructure, fishing activities and pollution (Khan, 2018). Freshwater biodiversity is also exploited by illegal fishing activities such as electrofishing are also becoming more frequent, is illegal because it may kill dolphins and reduce the abundance of their prey (Thomas et al. 2019).

The Indus River dolphin *Platanista minor*, one of the most endangered cetaceans and is also one of the only four obligate freshwater dolphin species (Braulik & Smith, 2019). It was recently spilt into a separate species (Braulik, 2021). The current population of the species in 1987 individuals from surveys in 2017 and 2018 (Aisha and Khan 2021). The comprehensive range surveys in Pakistan started in 2001 (Braulik 2006) and are now conducted every five years (Braulik et al. 2012, Noureen 2013, Aisha and Khan 2021), the fifth survey is underway 2022. There has a population increase from 1100 in 2001 (Braulik 2006) to 1987 (Aisha & Khan 2021).

These dolphins regularly get stranded in the irrigation canals, especially at two of six barrages on the Indus River: Guddu and Sukkur. After 1998, there have been regular and concrete efforts to rescue these dolphins and translocate them back to the mainstream river. There is an emergency rescue programme led by the Sindh Wildlife Department, so far 177 dolphins have been successfully rescued (Malik & Khan 2022, updated rescue data, unpublished WWF - Pakistan). The rescue protocols were developed including an illustrative guide (Khan, 2006), these were adapted from Geraci et al 2005. Each year on average eight dolphins are rescued, this provides a unique opportunity to understand the species through telemetry studies.

Tracking data of freshwater dolphins in Asia is very limited. This is primarily because tracking of freshwater dolphins or porpoise has three major hurdles: 1. how to fix tags where there is no fin or a very small dorsal fin 2) how to get accurate locations or reliable data when the animal surfaces for a short time for example in case of the Indus and Ganges river dolphins 3) water is murky because of silt therefore satellite connection is not possible while the dolphin in still underwater. Tracking can provide valuable information about behaviours, habitat preferences, seasonal changes and movement patterns etc. There are only two examples of telemetry of freshwater cetacean species in Asia. One Indus dolphin was placed with a VHF tag in 2009, a male dolphin (118 cm length, weighing 18kg) rescued from an irrigation canal (Toosy et al 2006). The analysis had shown that the dolphin moved through the Sukkur barrage in both upstream and downstream between 14th Jan and 7th Feb 2009, it went 5 km upstream the release point and then swam 6 km downstream the barrage (Khan, WWF unpublished) and then the dolphin was not found. China designed a vest to attach the tags on the Yangtze finless porpoise in an attempt to attach tags from the wildlife computer, but the devices could not get the accurate location (average 0.8s surface time). Then the Chinese Academy of Science developed a radio tracking systems and successfully tested to deploy a VHF tag on two male porpoises in the Poyang Lake in June 2018. The results of total tracking time of 22940 minutes with 1000980 surfacing showed that the Yangtze finless porpoise was more active at night, probably because of more frequent predation. They were less active in the afternoon which was attributed to the higher water temperature. Habitat with countercurrents appeared to be the preferred habitat during the dry season (Zhigang et al 2018).

MATERIAL AND METHODS

Study Area:

The study area was vicinity of the Sukkur Barrage, Indus River, Sindh Province, Pakistan. (Figure 1). The Sukkur Barrage is one the oldest barrages on the Indus river which was constructed in 1932 (Sindh Irrigation Department). There are seven canals that emanate from this barrage (Table 1). The upstream river stretch of about 190 km is a protected area, Indus Dolphin Reserve managed by the Sindh Wildlife Department, however, fishing licenses are awarded by the Sindh Fisheries Department. This stretch is also a Ramsar wetland.

Table 1: Sukkur Barrage canals data

#	Canals information	Right Bank Canals			Left Bank Canals			
		NW Kirthar	Rice	Dadu	K.F.W	Rohri	K.F.E	E.Nara
1	No. of Bays	6	13	4	2	12	2	16
2	Canal Length (miles)	36.1	82.0	131.5	41.9	208.0	58.6	226.0
3	No. of distributaries	127	90	120	68	283	55	163
4	Designed Discharge (Cusecs)	5,125	10,658	3,150	2,000	14,000-15,000	2,094	13,602 – 15000
5	Discharge in high flow (Cusecs)	3,000- 6,000	3,000 – 11,000	1,200 – 3,000	1,000 – 2,000	10,000-14,000	1,000 – 2,100	800-1500
6	Discharge in low flow (Cusecs)	2,000 – 2,500	5,00-1,950	1,500 - 2,000	200-1,000	4,000-5,500	400-1,000	4,000-5,000
7	Closing period[1]	5th Jan. – 22nd Jan	Oct.-March	5th Jan. – 22nd Jan	5th Jan. – 22nd Jan	5th Jan. – 22nd Jan	5th Jan. – 22nd Jan	5th Jan. – 22nd Jan - Aug.

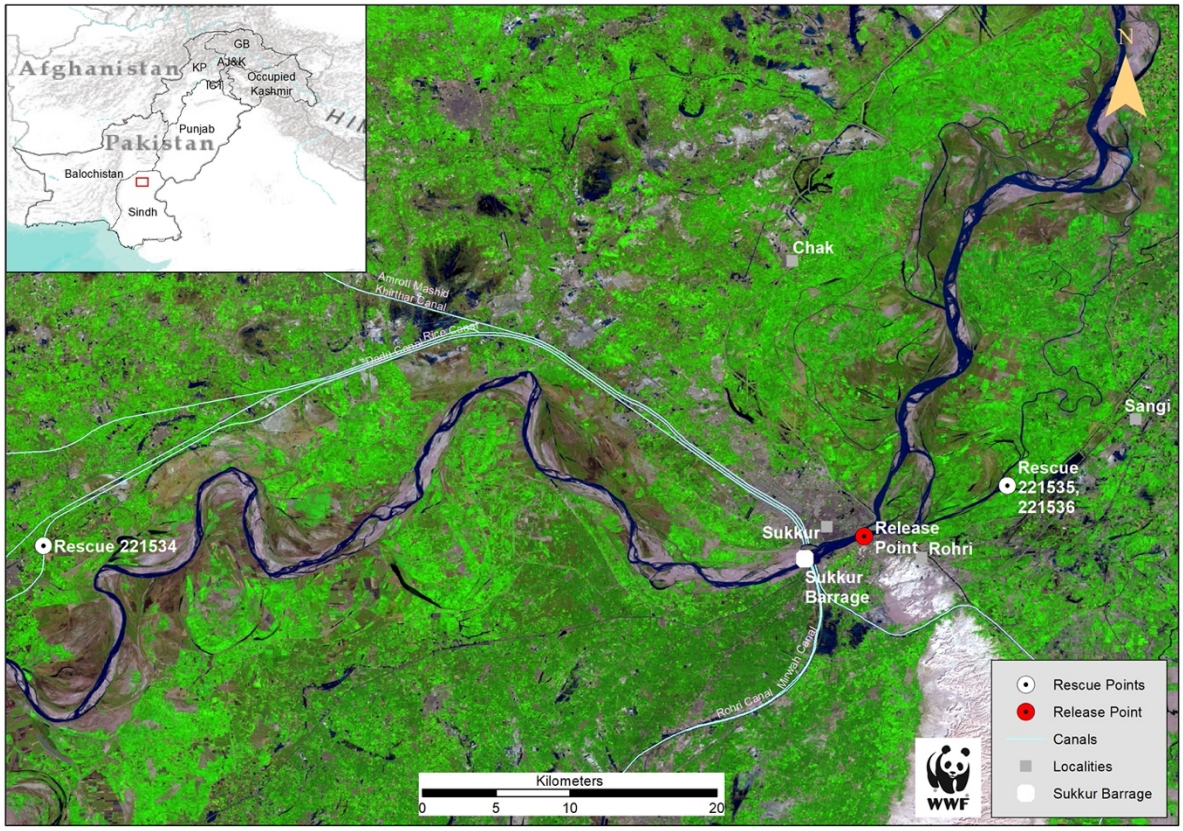

Figure 1: Study area with rescue and release locations of the Indus river dolphins

[1] The canal closure is also depends on the water; may close for some days due to heavy rains or breach in the canals embankments.

Capture, tagging and release:
The rescue protocols were developed covering including an illustrative guide (Khan, 2006), these were adapted from Geraci et al 2005. The dolphins were captured from canals or disconnected side channels. The process involves 3-5 boats with Sindh Wildlife Department and WWF-Pakistan trained field staff and local fishermen, after checking the depth of the pond the dolphin is steered to the shallower side and then nets are used to encircle dolphins while monitoring it closely and once it swam into the net, divers lift it and cut the net to remove it and place on a stretcher and translocated in purpose built vehicle, while covering the body below the blowhole onwards with a moist towel and kept moist with the Indus river water using sponges during translocation. The dolphins breathing was monitored and any signs of stress were checked before beginning the tagging procedure. The tagging hardly took five minutes.

The tags were placed on three rescued dolphins, one male and two females. The emergency rescues and translocations of stranded dolphins from the irrigation canals or cut off water side channels is a regular programme in the Sindh Province. The male was rescued from the right bank Dadu canal 27°41'9" N, 68°22'46" of the Sukkur barrage, Larkana District, Sindh, on 11th Jan 2022, with a body length of 1.12 m (tag number 221534) and two adult females were rescued on 15th Jan 2022 from a disconnected side channel at Mando Dero, District Sukkur, 27°43'21" N, 68°58'8" (Figure 1). These two adult females; body length 2.2 metres (tag number 221535) and 1.85 m (tag number 221536).

Single attachment tags from Wildlife Computers (https://wildlifecomputers.com) were selected, considering that those were least invasive and also because the dorsal fin is small. Wildlife Computer SPOT6 model 399 tags, with the dimensions of 180x19x26mm, weighing 65g and the battery life of 243 days, offered horizontal movement with Argos location quality (not GPS resolution) and temperature data including attachment kits. This model SPOT6-399 tag and the vast majority are for the sea, while this tag was built as a version for fresh/brackish water dolphins with different resistors to work optimally in the different conductivity waters. The conductivity and pH level of the Indus River (Ghachal et al 2006) were taken into consideration for these tags.

The tags were attached using the attachment protocol provided by the wildlife computers which is based on the method used by the Chicago Zoological Society's Sarasota Dolphin Research Program. The only adaptation made was we used a 5mm gauge punch biopsy, which was very efficient in making a hole in the dorsal fin. All equipment was sterilised prior as prescribed and recommended drugs were used for local anesthesia. A qualified and experience veterinarian with the specialization in surgery was part of the team for this purpose, we had also arranged an experience sharing session with the veterinarians who were involved in tagging of the Amazon River dolphin in Brazil. Samples from the dorsal fins were preserved for further studies.

Data Analysis:
Argos data was received using Wildlife Computers data portal. Locations are categorized on the basis of accuracy into 1-6 Location Error radius in the following location classes: 3 (accurate <250m), 2 (accurate 250-500 m), 1 (accurate 500-1500 m), and A and B indicating the messages received but no accuracy estimation). In this analysis only the higher accuracy location were used from classes 3 and 2. The data in categories 1, A and B were not used. Spatial data was exported from WILDLIFE Computers data portal into ArcMap. The spatial data was processed in ESRI ArcMap 10.x and was cleaned and exported in the .shp format for further processing and analysis. ArcMap was used for and development of distribution and project area maps. The location points of the tagged individuals were presented on the Landset 9 satellite image with the capture date of 17th February 2022. This helped in identifying different river features (mainstream, side channels and confluences) with more reliability.

RESULTS

Tracking effort

Satellite-tagged locations were analysed for two adult females for 97 days from 15th Jan to 21st April 2022. Till the time of the data analysis i.e 22nd of April 2022 there were 88 accuracy 2 and 3 locations for 221535 and 33 for 221536. The third tag 221534 placed on the young male did not transmit any location and send a few messages for two days before stopping altogether.

Movement pattern

The longest distance travelled by the dolphin 221536 from the point of release was 44.8 km around which was on the 20th of Jan 2022 and at that time the upstream discharge at Sukkur Barrage was 20020 cu, while the other female 221535 travelled 11 km from the point of release. At the time of the release on the 15th of Jan 2022 the water discharge at Sukkur Barrage at both downstream and upstream was only 3050 cu while at the time of data analysis i.e. 22nd April 2022, the upstream discharge at Sukkur Barrage was 25670 cs and downstream was 7985 cu, 17685 cu diverted to irrigation canals (Indus River System Authority IRSA).

There are striking differences in the movement of the two dolphins, 221536 is ranging over a much larger area and regularly overlapping its range with the other female 221535. In the percentage terms there has not been any difference in their occurrences in main channel, while 221536 is exploring side channels more than 221535. Some side channels appear very narrow from the satellite images and it seemed apparent that the dolphin returned to the main channel. (Table 2, Figure 2)

Table 2: Habitat use by the two adult female Indus river dolphins

Uses of riverine habitat	**221535**		**221536**	
	Frequency of 2 & 3 class locations	**Percentage**	**Frequency of 2 & 3 class locations**	**Percentage**
Confluence	36	41	7	21.2
Side channels	15	17	12	36.3
Main channel	37	42	14`	42.2
Total 2 & 3 class locations	88		33	

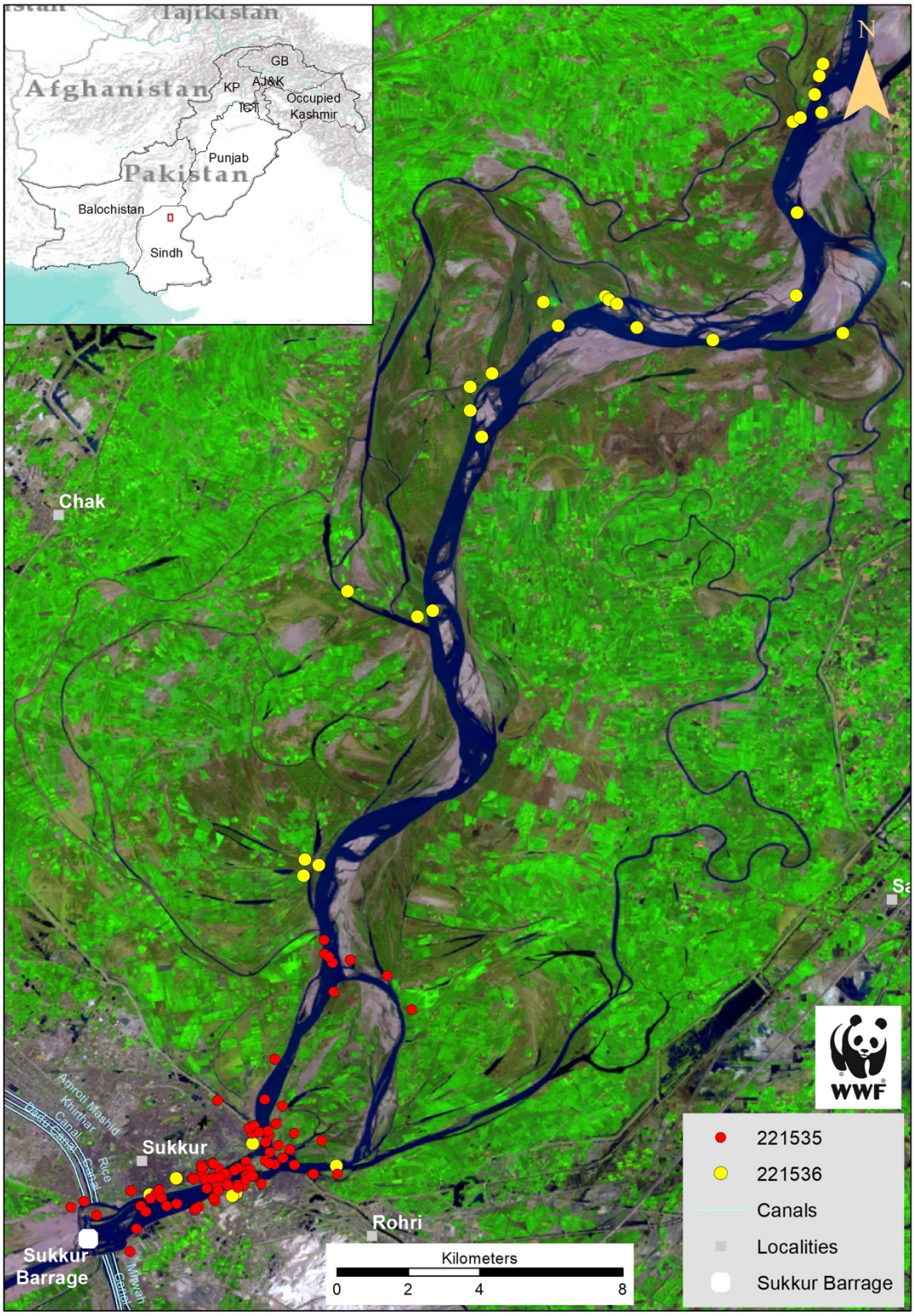

Figure 2: Satellite locations for the two Indus river dolphins tagged in the Indus River, Sukkur Barrage. Sindh, Pakistan

Discussion

These three tags were placed on experimental basis to investigate if they would work efficiently in this unique situation where Indus dolphins come out of the water for a very short time and live in the Indus River which is naturally high in silt. Further, we were concerned that these tags will be lost/migrate out of the dorsal fin very soon considering that the small size of the fin. This initial research has provided evidence that these SPOT tags can function well and help in answering many questions about the behaviour of the species by tracking the movement, understanding habitat use and to see how these dolphins move through barrages, how much do they travel, potentially understand when are they more active and if there is any difference between the movement patterns between males and females. We could not find the differences between movement patterns of males and females because the dolphins that are successfully transmitting locations are two females.

At the time of the release on the 15th of Jan. 2022 the water discharge at Sukkur Barrage was only 3,000 cu while at the time of the data analysis i.e. 22nd April 2022, the upstream discharge at Sukkur Barrage was 25,670 cs (Indus River System Authority IRSA). The water level was consistently increasing and it is likely that the movement will change as the water level increases further. The fact that dolphin 221536 travelled 44.8 km from the released point within the first week of tagging when the water upstream discharge at Sukkur Barrage had risen to about 20,000 cu which may suggest that this quantity of water discharge upstream can facilitate the movement. As we receive more data, we will continue to relate these movements with water discharge. The use of telemetry for a species like the Indus River dolphin is critical, not only to understand the movement patterns but also to relate it to water flows. Especially considering that this species has shown the considerable decline in the range, in the 1870s, the historical distribution was mapped and it was determined to be approximately 3500km of river (Anderson 1879). In 1991 present distribution was determined from a combination of boat-based surveys and local knowledge and it was estimated that dolphins were only extant in approximately one fifth of their former range (Reeves et al. 1991). The habitat is highly managed to sustain agriculture and other anthropogenic requirements. Habitat fragmentation because of water infrastructure has already divided the species range into 17 river sections and interviews have shown that dolphins probably only exist in 6 river sections (Braulik et al. 2014).

Although the movement of the Amazon River dolphin and Indus River dolphin and their respective habitats cannot be compared because of evident differences. But there are some reflections from South America based on the tagging of 23 Amazon River dolphin *Inia geoffrensis* in the Amazon and Orinoco River basins (Mosquera-Guerra et al. 2021). In the 15 months study the average 2 & 3 class locations were 42 per month while the average per month for the two Indus river dolphins in this current study was 36 locations per month, which is not significantly different. However, the longest distance covered by the Amazon River dolphin was a lot more for example 297.9 km in Bolivia while the shortest distance was 7.5 km in Juruena River, Brazil. The tagging effort in Pakistan will continue as WWF-Pakistan has secured enough funding from the Engro Foundation to tag at least two dolphins per rescue season for the next five years and the Sindh Wildlife Department is also committed on furthering this research through their resources. As the tagging of more dolphins is undertaken, we will learn more about the habitat use and to apply this knowledge for the conservation and protected area management. There are plans to enhance existing effort to supplement populations in other river sections for example upstream Guddu barrage and these telemetry studies will be very useful in understanding the behaviour of translocated dolphins in future.

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