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Skin Marks on the Indus River Dolphin (*Platanista minor*) and their Implications for Conservation

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ABSTRACT

The Indus River dolphin (*Platanista minor*) is an endangered species found in the Indus River system of Pakistan including Beas River in India which is a part of Indus River system, enlisted in Appendix I of CITES Red List of threatened species. Currently, the whole population across the Indus River in Pakistan is divided into four subpopulations. Although photo-identification efforts on freshwater dolphins were successfully made on the Irrawady dolphin (*Orcaella brevirostris*) in South Asia, Baiji (*Lipotes vexillifer*) in the Yangtze River of China, and the Amazon River dolphin (*Inia geoffrensis*) in South America, it is very difficult to take photographs of Indus river dolphin. From March 1 to 9 in 2019, a survey was conducted in the area covered in a branch of approximately 70 km of the Indus River from Taunsa barrage (District Muzaffargarh, Tehsil Kott Addu) to just downstream of Ghazi Ghat near Samina (District Dera Ghazi Khan) in Punjab, Pakistan. We successfully photographed and first reported seven types of skin marks originated from their natural or social interactions and anthropogenic activities. Dead bodies of five calves were collected from two different subpopulations in the Punjab river section, two from the Chashma-Taunsa and three from the Taunsa-Guddu barrage. Illegal hunting of Indus river dolphin and utilization of blubber in upstream areas of Punjab is still in practice. Anthropogenic threats are needed to be evaluated for long-term conservation of this endangered species to reduce conflict and mortality in areas where fishing is under practice.

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Key words
Anthropogenic effect, Calves, Indus river dolphin, Intraspecific interaction, Photo-identification

INTRODUCTION

Freshwater ecosystems of Indian subcontinent are inhabited by two species of river dolphins, the Ganges river dolphin (*Platanista gangetica*) and the Indus river dolphin (*P. minor*) (Braulik *et al*., 2021). Both river dolphins are endangered species enlisted in Appendix I of CITES Red List of threatened species. The Indus river dolphin is distributed in the Indus River system of Pakistan including Beas River in India which is a tributary of the Indus River system, and legally protected by all wildlife legislations of Pakistan. Its distributional range has declined by 80%, and the habitat is severely fragmented by diversion of water, construction of dams and barrages for irrigation purposes (Braulik *et al*., 2004, 2014c; Smith *et al*., 2012). Currently, in Pakistan the whole population (n=1816) across the Indus river has been divided into four subpopulations, i.e., two subpopulations in the Punjab river section (n=741), one subpopulation (n=170) from Chashma Taunsa (C-T) barrage and another subpopulation (n=571) from Taunsa-Guddu (T-G) barrage (WWF, 2017). Freshwater dolphins are least known among cetaceans, although recent studies have provided valuable information such as abundance, distribution, habitat selection and phylogenetics of Indus river dolphin (Braulik *et al*., 2004).

Efforts are still needed to understand the basic ecological aspects of dolphin's life, to evaluate the potential threats in the habitat for long term conservation of this endangered species (Braulik *et al*., 2004). All the freshwater cetaceans occur in developing countries. In the advancement of technology, a non-invasive process of photographic technique and tracking of individuals is helpful in providing explanation for a large range of basic ecological questions regarding social interaction, distribution, population size, migration, critical habitat, conflict with fisheries and negative anthropogenic effects (Whitehead *et al*., 1992).

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Photo-identification efforts on freshwater dolphins were successfully made on the Irrawady dolphin (*Orcaella brevirostris*) (Smith *et al*.,1997), Baiji (*Lipotes vexillifer*) in the Yangtze river of China in South East Asia (Hua *et al*., 1990; Zhou *et al*., 1998), and the Amazon river dolphin (*Inia geoffrensis*) in South America (Parra and Corkeron, 2001; Kreb and Rahadi, 2004) targeted the natural marks such as nicks, scars, notches, white marks, distinctive shape of dorsal fin, white spots on the dorsal ridge and behind the blowhole.

But for the Indus river dolphin, it was very difficult to take photographs. The anomalous surfacing behavior of Indus river dolphin breaks surface unpredictably in different directions every time and surfaces alone without any synchronization in groups, they appear on the surface only for fraction of seconds and does not approach the boats. Further, only rudimentary dorsal fin is present and lack of any identifiable features for individual identification (Herald *et al*., 1969; Braulik *et al*., 2012a). Sporadic efforts were made in Pakistan however, without any success in identifying individuals. Concerted efforts were made to take photos of Ganges river dolphin in Nepal, out of 1200 photographs, not a single individual could be identified (Smith and Reeves, 2000). In 2012, another attempt was made on the Ganges river dolphin in river Ganges in the vicinity of Farakka barrage, India. Out of 1000 photographs, only three individuals were identified, two with lower broken jaws and one with a deep cut on dorsal fin (Sinha and Kannan, 2014).

Interactions with fisheries and mortality of cetaceans has been increasing in frequency and intensity during the last decades. This interaction occurs when fisheries and predators exploit the same areas to target the same species (Beverton, 1985; DeMaster *et al*., 2001). The photographs could provide some information on intraspecific interactions, such as an affiliated behavior (Herzing, 1997), copulation (Payne and Dorsey, 1983; Reynolds *et al*., 2000), aggression (Herzing, 1997; Connor *et al*., 1992), negative anthropogenic effects and fisheries interactions, such as visible marks of wounds or injuries, scarring due to entanglement in nets (Friedlaender *et al*., 2001; Robbins and Mattila, 2001; Romanov, 2001; Baird *et al*., 2002; Baird and Gorgone, 2005).

The present study was conducted with the following objectives: (1) photographical identification of Indus river dolphin based on natural marks such as tooth rakes, linear wounds or injuries, (2) analysis of different marks to highlight the social interaction, interaction with fisheries and negative anthropogenic effects. It was a successful attempt to prove the possibility of photo-ID in Indus river dolphin and unveil the new different aspects of Indus river dolphin's life. Such information would be valuable for the conservation and management of Indus river dolphin.

MATERIALS AND METHODS

The study was conducted from March 1 to 9 in 2019, 70 km from Taunsa barrage (District, Muzaffargarh, Tehsil Kott Addu) to just downstream of Ghazi Ghat near Samina (District, Dera Ghazi Khan) in Punjab, Pakistan (Fig. 1). Weather permitting, a four m long, wooden boat equipped with 8 Horsepower (HP) engine was used for field survey. The boat moved downstream slowly (switched off engine) relying on the current flow of river. When a dolphin was sighted, boat moved and approached slowly; attempt was made to take photographs by Camera (Canon, EOS 70d) equipped with tele-photolens (Canon, 400 mm), and geographic positions were recorded with GPS Garmin 62s. We focused on taking photographs with visible marks of different types from various sources (Scott *et al*., 2005). All photographs were optically analyzed, any visible marks were identified, and classified in different categories (Fig. 2, Table I).

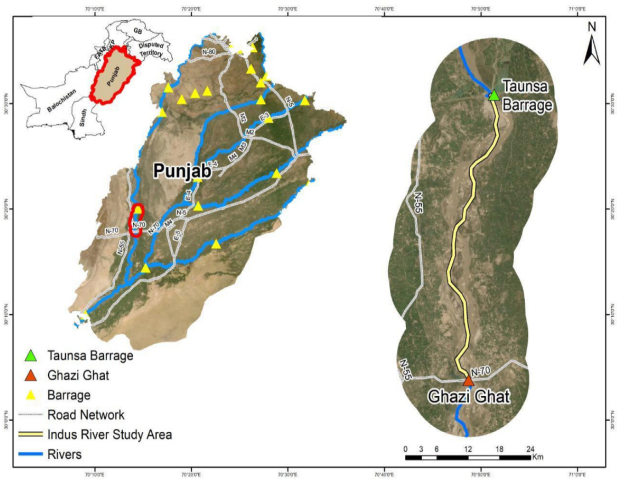

Fig. 1. Study area covered from just downstream of Taunsa barrage (District, Muzaffar garh, Tehsil, Kot Addu) to near Samina Ghazi Ghat (District Dera Ghazi Khan), Punjab.

The dolphin's carcasses were collected during routine patrolling by Punjab wildlife department staff. As corpses were recovered, initial examination such as morphometric measurements, gender identification was performed at the spot. Later these corpses were transported to nearby stations and stored at -20°Cuntil the necropsy was performed.

RESULTS

A total of 14 groups of 44 cumulated individuals were sighted, the group size ranged from one to eight (Fig. 3), the average group size being 3.14±2.14. Fifteen individuals 34.09% were successfully photographed. Based on the quality of photographs, seven individuals 46.66% were

categorized in class A, of good quality with higher visibility of identifiable marks, while eight individuals 53.33% in class B, of low quality with lower visibility of marks on their bodies. Based on the body marks on the dolphins, all photographs were divided into two categories, natural or intraspecific category (n=13) and anthropogenic category (n=2). All the marks were quantified as their origin and abundance details (Fig. 2, Table I).

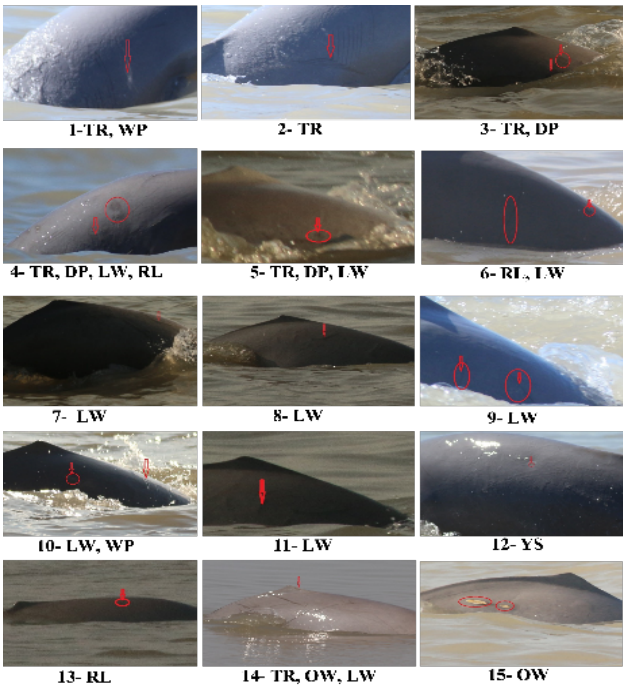

Fig. 2. Seven different types of skin marks on the body of Indus River dolphins. Photographs show majority of the dolphins have more than one type of skin marks on their bodies.

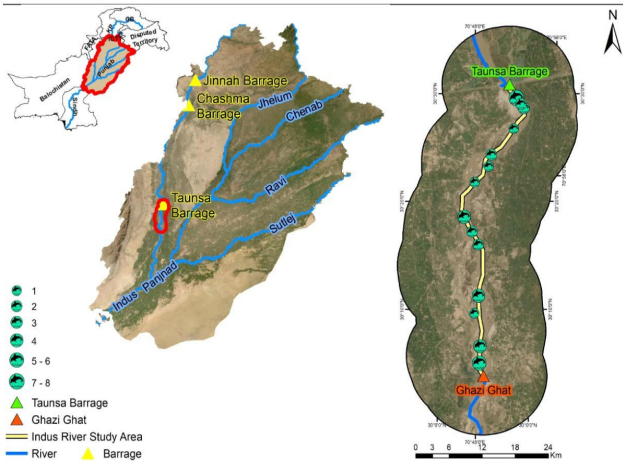

Fig. 3. Sighting of Indus River dolphins of groups in the study area.

Five dolphins were found dead from 2018 to 2020, two from Chashma-Taunsa (C-T) barrage were named as "Gabbar" and "Grey", while other three were named as "Laila", "Sultan" and "Naina" from Taunsa-Guddu (T-G) barrage sections (Figs. 4 and 6). The three dolphins from T-G barrage were transported to Lahore Zoo (Lahore, Punjab) and necropsy was performed there. A team of veterinarians confirmed the cause of death due to entanglement in nets (data will be published in a separate account).

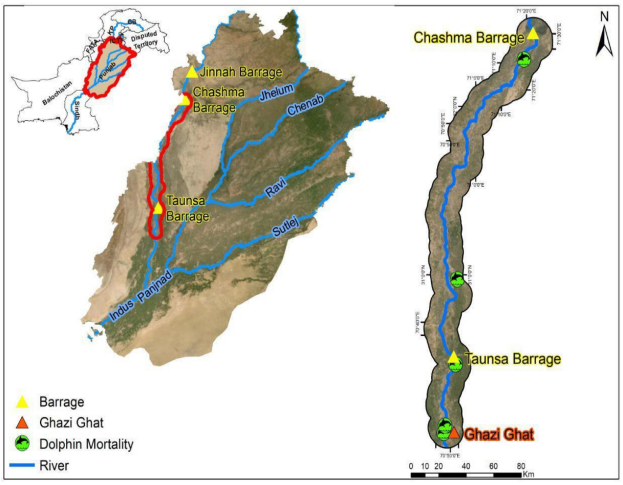

Fig. 4. Mortality of five dolphins in the area between C-T and T-G barrage.

Fig. 5. Side slapping behavior of Indus dolphin.

DISCUSSION

Different skin marks have been reported globally on the bodies of different species of cetaceans (Connor *et al.*, 2000). For Indus river dolphins, still no report is available to identify or analyze any skin marks. Here, for the first

time we are reporting seven types of skin marks originated from their natural or social interactions and anthropogenic activities. All these marks were classified according to their nature (Fig. 2, Table I). Among all the skin marks 86.66% were originated from the natural or social interactions. The highest prevalence marks were fresh linear wounds and tooth rakes, other marks such as ring lesions and dark patches were moderately prevalent, while white patches and yellow spots prevalence was low. Leone *et al.* (2019) reported similar skin marks on bottlenose dolphins (*Tursiops truncatus*), by comparing couple of other studies suggested that, these marks were directly associated with natural different behavioral activities during social interactions among the individuals.

Some marks such as ring lesion, dark and white patches are the combination of social interactions and negative environmental effects. These marks are the healing of older injuries caused by repeated social interactions, later these injuries might have been caused by microorganisms (Thompson and Hammond, 1992; Wilson *et al*., 1999; Van *et al*., 2007; Hart *et al*., 2012; Luksenburg, 2014; Mariani *et al*., 2016) or parasites, pollution in the water or other associated negative environmental conditions (Bloom and Jager, 1994; Harzen and Brunnick, 1997; Wilson *et al*., 1999; Rowe and Dawson, 2009; Hart *et al*., 2012; Mariani *et al*., 2016). The major cause, overfishing in the habitat may have reduced the availability of food resources, resulting in the increase of the foraging cost and intense competition among organisms (Blasi *et al*., 2015). Bottlenose dolphins in aggression have been found chasing, ramming, body slamming, sideswipes, tail slaps and biting (Tyack and Clark, 2000). In the current study a dolphin was found rapid swimming and chasing other dolphins, lateral side slapping (Fig. 5) of the same dolphin was spotted in a group of six individuals. This behavior might be an indicator of aggression as a threat to other dolphins in similar area of habitat. Leone *et al*. (2019) are of the view that further histological analysis in future could provide information regarding etiology of these marks for evaluating dolphin's health in the habitat.

Among all the skin marks 13.33% were originated by anthropogenic activities. In this study, 2 dolphins were found with traumatic injuries (open wounds), these wounds are characterized as clear sign of negative anthropogenic effects. During the dry season, water diverted into canals to support the agriculture, reduces the level of water in the river and the availability of space for dolphins and their prey. Conflict occurs when fishermen prefer to exploit areas for fishing in their habitat, resulting in negative anthropogenic outcome (Sinha *et al*., 2010; Braulik *et al*., 2012b) with most common external traumatic injuries such as parallel lines (entanglement in nets), deep wounds on skin, broken mandibles and teeth, lesions, notches and skin abrasions in different body regions (Kuiken *et al*., 1994; Siebert *et al*., 2001). These wounds make an individual more vulnerable to infection, which could limit the physiological activity, alter the behavior of dolphins, high energy demands, starvation and may lead to the death of the individual (Visser, 1999; Van *et al*., 2007; Bossart *et al*., 2017).

Table I. The origin, type of marks and their description reported in different studies on Bottlenose dolphins (*Tursiops ssp.*), and similar marks found in this study on the body of Indus River dolphin and their abundance (%) during 1-9 March in 2019.

Origin	Type of marks	Descriptions	References	ID	Abundance (%)
Natural or social interaction	Tooth rakes (TR)	Parallel linear skin wounds or scars	Connor *et al*., 1992	1, 2, 3, 4, 5, 14	40
	Linear wounds (LW)	Laceration in the epidermis	Luksenburg, 2014	1, 4, 5, 6, 7, 8, 9, 10, 14	66.66
	White patches (WP)	Small white patches of irregular shape	Wilson *et al*., 1997	1, 10	13.33
	Ring lesion (RL)	Cream or white in center circled by normally colored skin		4, 6, 13	20
	Dark Patches (DP)	Irregular shape of dark grey blemish	Thompson and Hammond, 1992; Harzen and Johnson,1997; Wilson *et al*.,1997	3, 4, 5	20
	Yellow spot (YS)	Cluster of Cream or pale colored mass	Wilson *et al*.,1997	12	6.66
Anthropogenic	Open wounds (OW)	Deep cut-like wound, blubber visible	Lockyer and Morris, 1990	14, 15	13.33

Mortality in cetaceans is common due to incidental capture in fishing nets; this is a worldwide problem (Reeves *et al*., 2013). From 1993-2011, a total of 101 Indus dolphins were reported dead from Sindh Province due to incidental capture in fishing nets. While in the Punjab area only three dolphins (two mature and one calf) were reported dead in fishing nets in 2016 (WWF- Pakistan, 2011; Waqas *et al*., 2012; Braulik *et al*., 2015; Aisha *et al*., 2017). During 2018-2020, we have collected five dead bodies of calves from the two different subpopulations in the Punjab river section, two individuals from Chashma-Taunsa and three individuals from Taunsa-Guddu barrage (Fig. 6).

Fig. 6. Carcasses of Indus river dolphins from two subpopulations in Punjab.

Incidental capture and mortality data of two marine dolphin species viz., harbor porpoise (*Phocaena phocaena*) and bottlenose dolphin (*Tursiops truncatus*), emphasized 65% death of calves in the former and 41% death of calves in the latter. Major causes for the higher mortality in calves might be that calves echolocate with higher frequencies than adults, hence they may not be able to detect nets as rapidly as detected by adults. Calves are playful, careless, active, and agile which increases the chances of entrapment (Au *et al*., 1999; Siebert *et al*., 2001; Silva and Sequeira, 2003). Most of the body parts from one corpse of dolphin (Gabbar 5) were absent, and it seems that illegal hunting of Indus river dolphin and utilization of blubber in upstream area of Punjab is still in practice. The negative impacts of fisheries besides capture in nets include increasing water pollution and other associated anthropogenic impacts across the habitat of Indus river dolphin. Turvey *et al*. (2007) are of the view that freshwater dolphins are at higher risk of extinction due to habitat loss and anthropogenic pressures, as evidenced by a recent extinction of the Baiji (*Lipotes vexillifer*) freshwater dolphin in China.

CONCLUSION

The study demonstrated photographs as a new efficient and cost-effective methodology for photo identification of river dolphins to study the free ranging Indus dolphins in the wild. It is an easy approach to document the behavior of Indus river dolphin and threats to them by analyzing different skin marks. The analysis of these marks showed the combination of natural social interaction, negative environmental effects, and anthropogenic effects of fisheries. Indus river dolphins survive under multiple anthropogenic pressures, most important of which are overfishing and increasing pollution. Reduction in the mortality and conflict with fisheries, is important to evaluate the effects of increasing pollution on the dolphin's health and quality of the habitat. Capture-mark recapture (CMR) method is possible for population estimation of the Indus river dolphin. Some marks are short term such as tooth rakes and linear wounds, while some permanent marks such as ring lesion, dark patches, white patches and yellow spots are valuable for the CMR method.

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Statement of conflict of interest

The authors have declared no conflict of interest.

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