Review Article
Volume 10:4, 2022

Journal of Biodiversity & Endangered Species

ISSN: 2332-2543 Open Access

Recent Scientific Advances on the Indus River Dolphin (*Platanista minor*)

Aamir Ibrahim[1], Bingyao Chen[1], Hassan Ali[2], Imran Khaliq[3], Carolina S. Gutstein[4], Sajjad Hussain[1,2] and Guang Yang[1*]

[1]*Jiangsu Key Laboratory for Biodiversity and Biotechnology, College of Life Sciences, Nanjing Normal University, Nanjing, P.R China*
[2]*Punjab Wildlife and Parks Department, Punjab, Pakistan*
[3]*Department of Zoology, Ghazi University, Dera Ghazi Khan (Punjab), Pakistan*
[4]*Departamento de Biología, University de Chile, Santiago, Chile*

Abstract

The family Platanistidae is most basal position among the Odontoceti lineages, all members has been extinct except two the Ganges river dolphin (*Platanista gangetica*) and the Indus river dolphin (*P. minor*). Their ancestors were deep marine dwelling and moved to the freshwater ecosystem of the Indian subcontinent and thrived in the Ganges river system, later invaded the Indus river system by following the shifting flow pattern of the tributaries. The development of dams and barrages has severe negative impact, habitat destruction; isolation and extirpation of several subpopulations, there were only few hundred individuals in Pakistan. In 1974, conservation efforts were carried out in Pakistan, now are highly appraised and available data reflects an increasing population trend across the Indus River in Pakistan. During dry season dolphins prefer to stay in deep water pools, which increase group sizes, and intraspecific interactions which can be predicted from different skin marks. These marks are promising marks for the Capture-mark-recapture (CMR) and to assess the underwater threats. The conflict between fisheries and dolphins may also reach at intense level during dry season, when predator and fisheries target the same species which may lead to injuries among adults and high mortalities among the calves (1-2 years age). There is still, a big gap on the information of any disease and on identification of the parasites at species level. Future studies should be focused on the preference prey and the prey abundance and density across the habitat. The prevalence of microplastics from the Punjab river section and the intensive use of pesticides in the agriculture bed on the immediate banks of both sides in Sindh and Punjab indicated rise in water pollution. It is necessary to monitor water quality around the year for the long term conservation of this endangered species.

Keywords: Anthropogenic activities • Freshwater • Indus river dolphin • Indus River • Pakistan

Introduction

The Indus river dolphin (Platanista minor) and the Ganges river dolphin (P. gangetica) are freshwater dolphins endemic to the freshwater ecosystems of the indian subcontinent. Both species are protected under CITES Appendix I enlisted in the Red List of threatened species. Based on historic record, once the Indus river dolphin occupied the entire Indus river system and gradually declined its distributional range due to negative impact of dams and barrages. Surveys were conducted to assess the population abundance by WWF-P, IUCN and Volkart Foundation reported severe decline in population size and distributional range. The Government of Pakistan officially declared as protected species and stretch between Guddu-Sukkur (G-S) barrages was designated as the Indus river dolphin sanctuary. Over the course of 50 years, the population of this endangered species has been revived from few hundred to >2000 individuals in the main-stretch of the Indus River in Pakistan and in the Beas River (tributary of the Indus River system) in India [1-10].

Although, historic studies provided baseline information on the basic biology and behavioral ecology of the Indus river dolphin and recent studies have contributed to evaluate the causes and the pattern of extirpation of several subpopulations, how dry season pose threat in habitat selection, skin marks to assess under water threat, cranial anatomy, soft nasofacial tissues of echolocation and cochlear adaptation for hearing in extreme turbid river water. However, the taxonomic status, phylogenetic position and phylogeography of the extant Platanista lineage still under debate. Recent studies found the prevalence of microplastics, conflict between fisheries and dolphins which induce mortalities among calves. This review has compiled recent scientific published studies in local and international scientific journals with aim to summarize the up to date scientific information as well as the possibilities of future studies to fill gap for the effective conservation of this freshwater endangered species in Pakistan [11-15].

***Address for Correspondence:** Guang Yang, Jiangsu Key Laboratory for Biodiversity and Biotechnology, College of Life Sciences, Nanjing Normal University, Nanjing, P.R China; Tel. +86-2585891163; E-mail: gyang@njnu.edu.cn*

Received: 08 April, 2022, Manuscript No. jbes-22-60082; **Editor assigned:** 10 April, 2022, PreQC No. P-60082; **Reviewed:** 15 April, 2022, QC No. Q-60082; **Revised:** 20 April, 2022, Manuscript No. R-22-60082; **Published:** 30 April, 2022, DOI:10.37421/2332-2543.2022.10.418

Methods

We have collected more recent information of scientific literatures published in local and international journals, reports presented in international meetings and seminars, master and doctoral theses of local and international universities, and unpublished reports of NGOs. This review is organized as follows:

- Studies covered taxonomy, systematic and evolution of Platanista
- Basic biology and life history of the Indus river dolphin
- Population biology and genetics, and direct and indirect anthropogenic threats highly focused to promote conservation

Systematics of platansita and evolution of Indus river dolphin

Several independent descriptive anatomies were provided for the Ganges and the Indus river dolphins. However, the comparative anatomy identified some cranial variations and suggested might be living in different geographic range. Subsequent studies reported additional variations in facial region, differences in cervical vertebrae, sizes of fluke's composition of blubbers and blood to assign them as different species [16-20].

Two freshwater ecosystems the Indus and Ganges Rivers are separate since 40 MYA figure 1. The genetic analysis based on mitochondrial genome, growth patterns, sexual dimorphism, cranial morphological features such as protuberance and plane frontal bone, symmetry of maxillary crests, and apparent body colors were recognized as diagnostic features to identify them as separate species the Ganges river dolphin as (*P. gangetica*) and the Indus river dolphin (*P. minor*).

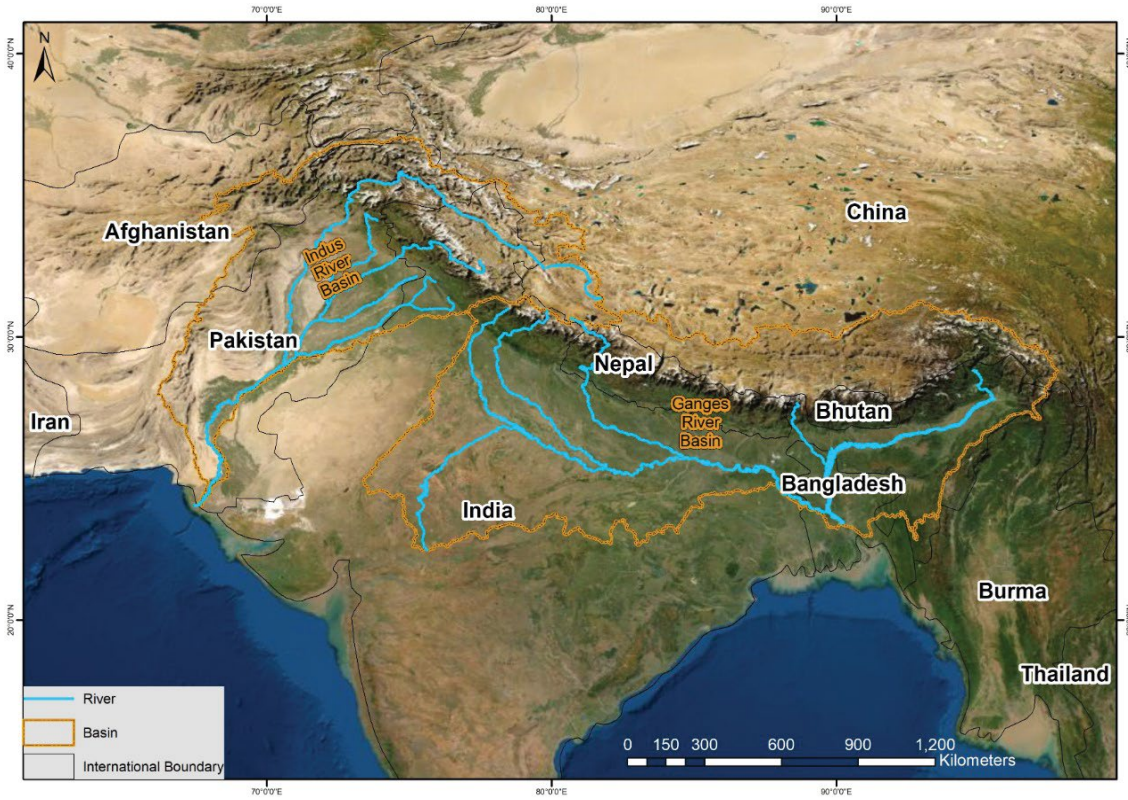

Figure 1. The Indus, Ganges and Brahmaputra river systems in the indian subcontinent.

A phylogenetic analysis based on and extinct and extant families of Odontoceti have concluded that the river dolphins are paraphyletic. The proposed grouping of three family systems for the extant river dolphins. The genus Platanista into Platanistidae, two genera Inia and Ponotoporia into a single family "Inioidea" while Lipotes into family "Lipotidae" proposed that the Platanista has no affinity with other river dolphins and separated the Platanista from the remaining river dolphins and proposed a clade link among (Inia, Pontoporia and Lipotes) with family Delphinoidea. Meanwhile proposed close link among two genera (Inia and Pontoporia) to Delphinoidea and Lipotes as the sister group of (Inia, Pontoporia and Delphinoidea). It was highly accepted for the phylogenetic position of the Platanista, but the position of other three genera (Inia, Lipotes and Pontoporia) remained were unresolved.

Now it's widely accepted that four genera of river dolphins make two groups. The genera Platanista belong to the superfamily "Platanistoidea" (an early divergent Odontoceti), while another group called the non-platanistoid river dolphins (Lipotes, Inia and Pontoporia) are monophyletic and have close phylogenetic relationship to superfamily Delphinoidea (Figure 2).

The Indo-Gangetica foreland was broad flat plane turned into a shallow estuarine habitat during the middle Miocene. The members of the Platanistidae were vast distributed during this time; many fossils were discovered from the epicontinantal seas of North America. However, still not any recovered fossil from the subcontinent. The major fluvial system of Ganges, Brahamaputra and Indus River are separate since (~55-45) (MA) and flowing in constant pattern. Over the past the major tributaries of the Indus River system were former tributaries of the Ganges river system. Approximately 5 MA these tributaries started to shift their flow pattern and became the part of Indus river system. The Platanista flourished in the Ganges river system and entered into the Indus river system by following the shifting pattern of tributaries which is corroborated to molecular data and studies reported both species were diverged nearly 0.5-0.51 MYA.

Life history and biology

Recent review suggested the Indus river dolphin exhibit no any sexual dimorphism male and female have similar growth pattern, body sizes, weight, and length of the rostrum and skull growth. The more pronounced disparity male get sexual maturity at the age of 10 year with body length of 170 cm, and female get sexual maturity two years earlier but larger in body size (170 to 200 cm). The Indus river dolphin gives birth in the start of winter (December-January) or in the early summer. At birth the size of calf usually 60-70 cm in length, which may increase 65.7% in body length at the age of 1 year. A calf may start predation at the age of 1-2 months, while weaning lasted for one year. The female produces an average of 9-11 calves in its life.

The Indus river dolphin use wide band low frequency with unusual double beam echolocation. The echolocation beam usually stronger and continuous from 15-25°, while weaker from 0-15° and beyond 60° on dorsal and ventral planes of the rostrum. The pneumatic maxillary crest assisted structural support to the entire melon, and pterygoid sinuses which may work as an acoustic mirror to produce more focusing echolocation beam.

Several historic studies documented the seasonal migration of the Indus river dolphins; they were observed to use upstream sections in dry season and returned back to the downstream areas during peak flow or flood season. Construction of dams and barrages may restrict their seasonal movements, however, the increase group sizes in dry season preferred to stay in the deep water pools. The permanent movement of the entire subpopulation from (J-C) to the downstream section, and documented smooth movement of one radio tagged Indus river dolphin to cross the gates of barrages. Recently, radio tagged on three individuals were mounted in Sindh river section, the data from this study will be helpful to provide new biological aspects of the Indus river dolphin in Pakistan.

There is no available published record of any disease in Indus river dolphin in Pakistan. Three female calves were captured and kept them in captivity, they were died shortly. The cause of death of one individual was injury while capturing, and other two were died of pneumonia. Parasites are important biological indicator to provide health status of the host, characterization and identification of threats for the conservation and management of species in their natural environment. The parasites in the mouth of one female calf (Figure 3) were not identified at species level (unpublished data), future studies should be focused to evaluate their negative impact on the dolphin's health figure 3.

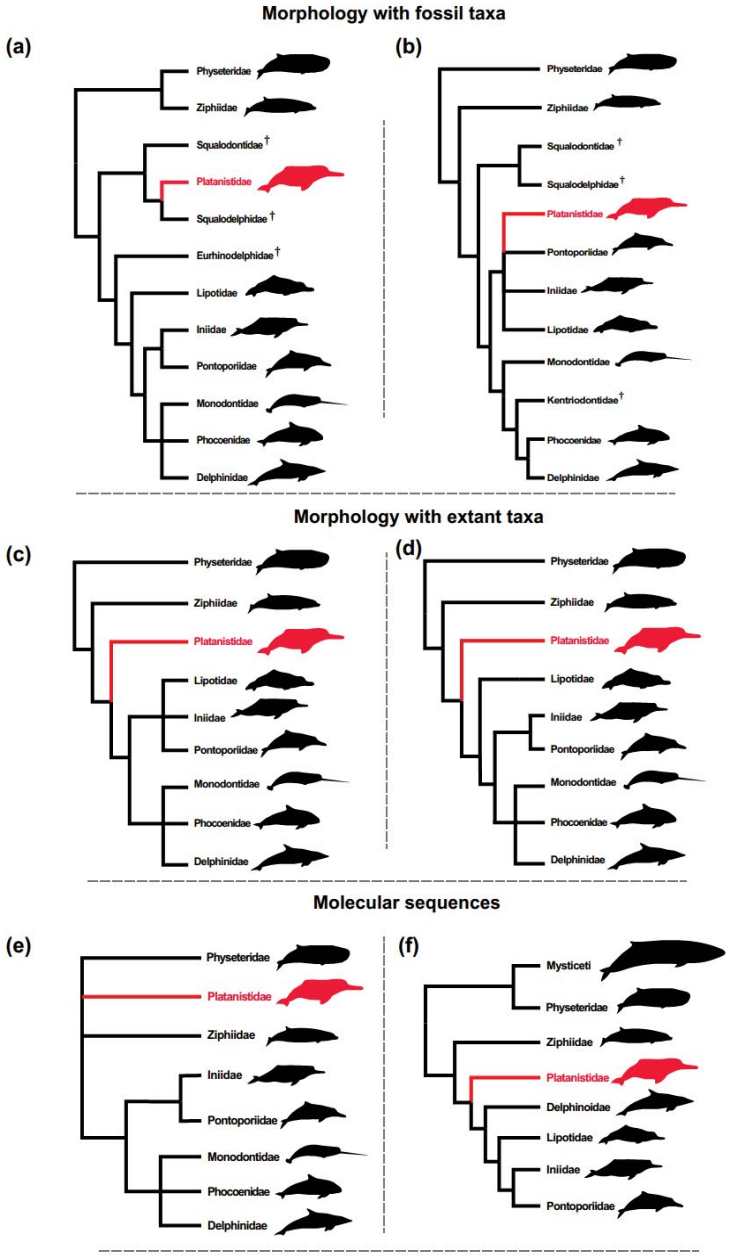

Figure 2. Selected phylogenetic trees of toothed whales from different studies.

The lacks of detailed Information on the prey selection and preference, which may vary from season to season, geographic location, age and gender of the individuals. The Indus river dolphin preyed upon the bottom dwelling fishes and variety of other aquatic invertebrates, all prey species are summarized in Table 1. The behavior of Indus river dolphin in natural habitat has never been focused except Herald ES, et al. [11] reported side swimming behavior in captivity, flippers edges periodically touched the bottom while head move continuously side to side. This study reported body remained at an angle of 10° to the surface and tail position remains slightly higher than the whole body. It approach prey by right angle and engulf head first. Indus river dolphin break the surface very rapidly, unpredictable and continuous changes its direction and location first the appearance of the rostrum in upward direction following the head and back and immediately take downward direction to make curve for quick diving and disappear before the visibility of flukes. The sequence of one surfacing, the appearance and body positions are shown in Figure 4.

The Indus river dolphin are not social animals, in dry season the low water force them to aggregate in similar patches of habitats which may lead to conflict for suitable habitat and food. The Indus river dolphins has very high site fidelity and use similar habitat over the years and very sensitive to any change in the surrounding environment. It leave permanent habitat for short time and return back in absence of any threat. In the summer season, the adult and calves of the Indus river dolphins attracted towards bathing buffaloes' herds in river water, they followed those fishes which feed upon the dung of buffaloes (data unpublished) table 1 and figure 4.

The appendicular anatomy of Indus river dolphin is poorly understood. Three different types of carpals schemes has been identified so far, first type described in which carpals (scaphoid and intermedium) pisiform stippled in mature individual reported by Zhou (1982), other two schemes were identified by recent study (Figure 5). The ossification of carpals (scaphoid and intermedium) to pisiform stippled start asymmetrically from the left flipper after at the age of 1 year in the Indus river dolphin (Figure 5).

Negative impacts of dams and barrages

Pakistan is an agriculture country, the Indus Basin Irrigation System (IBIS) is a network of 19 dams and barrages, 12 inter-river link canals and two million kilometers of tertiary watercourses was constructed to irrigate 180,000 km^2 of arid, semi-arid land and production of electricity to raise economy FBSP 2003; CIA 2004) (Figure 6).

Figure 3. (1) The arrow signs represent of parasites in Indus river dolphin; (2) all were collected and stored in the absolute alcohol; (3) one parasite and (4) microscopic view of parasite.

Table 1. The list of the fishes reported as the prey of Indus river dolphin.

S. No	Scientific Name	Order	Family	Common Name in Pakistan
1	*Labeo rohita*	Cypriniformes	Cyprinidae	Pall
2	*Catla catla*			Palli
3	*Punitus sophore*			Bupri
4	*Notopterus notopterus*	Osteoglossiformes	Notopteridae	Sopher
5	*Bagarius bagarius*	Siluriformes	Sisoridae	Fouji Khaga
6	*Wallago attu*			Malhi
7	*Ompok sinctensis*			Sindhi paphta
8	*Heterpheustes fossilis*		Heteropneustidae	Sanghi
9	*Chana marulias*	Anabantiformes	Channidae	Soll
10	*Colisa lalia*		Osphronemidae	Kungi
11	*Chanda nama*	Ovalentaria	Ambassiade	Nama shisha
12	*Glossobius giurius*	Gobiiformes	Gobiidae	Golo
13	*Maslacembelus armatus*	Synbranchiformes	Mastacembelidae	Bam

Figure 4. Different sequences of one surfacing behaviour of Indus river dolphin (Photo by A. Ibrahim).

In 1947, the subcontinent was divided into two independent states India and Pakistan. The dispute on water was resolved and Indus treaty was signed in 1960's. According to the agreement, India has right to use of 25% water of the Indus, Jhelum and Chenab Rivers and Pakistan will receive 75% water of these rivers. Other three rivers (Ravi, Beas and Sutlej) will remain completely use under the India. The Ravi, Beas and Sutlej Rivers controlled in upstream section by India and almost dry in the downstream section of Pakistan. To manage water shortage the western water resource were linked via irrigation canals to support agriculture land in the eastern part. Currently the Indus River accommodating 90% freshwater supply in Pakistan When we compare the historic 3500 km distributional range of Indus river dolphin (Anderson 1879), it has lost 80% of its former distribution range, and currently, confined to the 690 km in the linear stretch of the main Indus River. There could be the role of multiple anthropogenic activities in the spatial and temporal dynamics of range decline and extirpation of the Indus river dolphins. However, due to lack of sufficient historic data of other threats, recent study has only ruled out the IBIS.

Recent study explained that the progressive constructions of barrages were fragmented and turned open habitat into closed (bounded between two gated barrages) variable sizes of river sections. The water storage in upstream sections (India), which reduced the flow pattern and water availability in downstream sections and lowering the carrying capacity of dolphin's natural habitat in (Pakistan).The downstream sections turned into shallow stagnant pools of water, reduced the physical spaces for dolphins and their prey.

Furthermore, high surface area to volume ratio increased the risk of exposure to high temperature, destructions of breeding and nursery grounds for dolphins and scarcity of their prey caused the Indus river dolphin to extirpate from those downstream sections.

The recent extirpation of a far upstream subpopulation between Jinnah-Chashma barrages is hypothesized that the individuals were migrated in downstream section. This freshwater species facing severe negative impact of IBIS. So far, the extant distribution in the Indus River (Pakistan) and Beas River (India) has survived due to optimum water flow across the seasons. This study has also suggested the Indus river dolphin distribution has been contracted inward, and strongly recommended to maintain sufficient water discharge in those sections which are occupied by the Indus river dolphin (Figure 6).

Population biology

The assessment of population abundance was primarily focused to evaluate the effective measurements for the conservation and management of this endangered species. From 1974-2017, population assessment surveys were conducted across the habitat of Indus river dolphin in Pakistan. The subpopulation from the upstream Punjab river section Jinnah-Chashma (J-C) barrage believed to be extirpated, while the subpopulation from the extreme downstream of Sindh river section between Sukkur-Kotri (S-K) barrages has no any updated information since 2006. The extant population has been revived from few hundred individuals to >2000 individuals, currently, two subpopulation in Punjab river section Chashma-Taunsa (C-T) barrage and Taunsa-Guddu (T-G) barrage, and largest subpopulation in Sindh river section Guddu-Sukkur

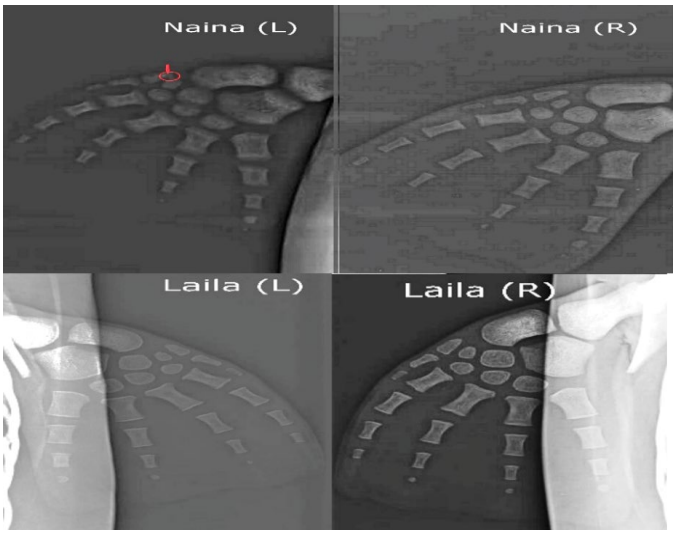

Figure 5. Flipper anatomy of two calves. Laila (R); right flipper, Laila (L) left flipper of specimen named Laila age <Year, Naina (R); right flipper, Naina (L) left flipper and ossification of carpals marked with red circle and sign of arrow.

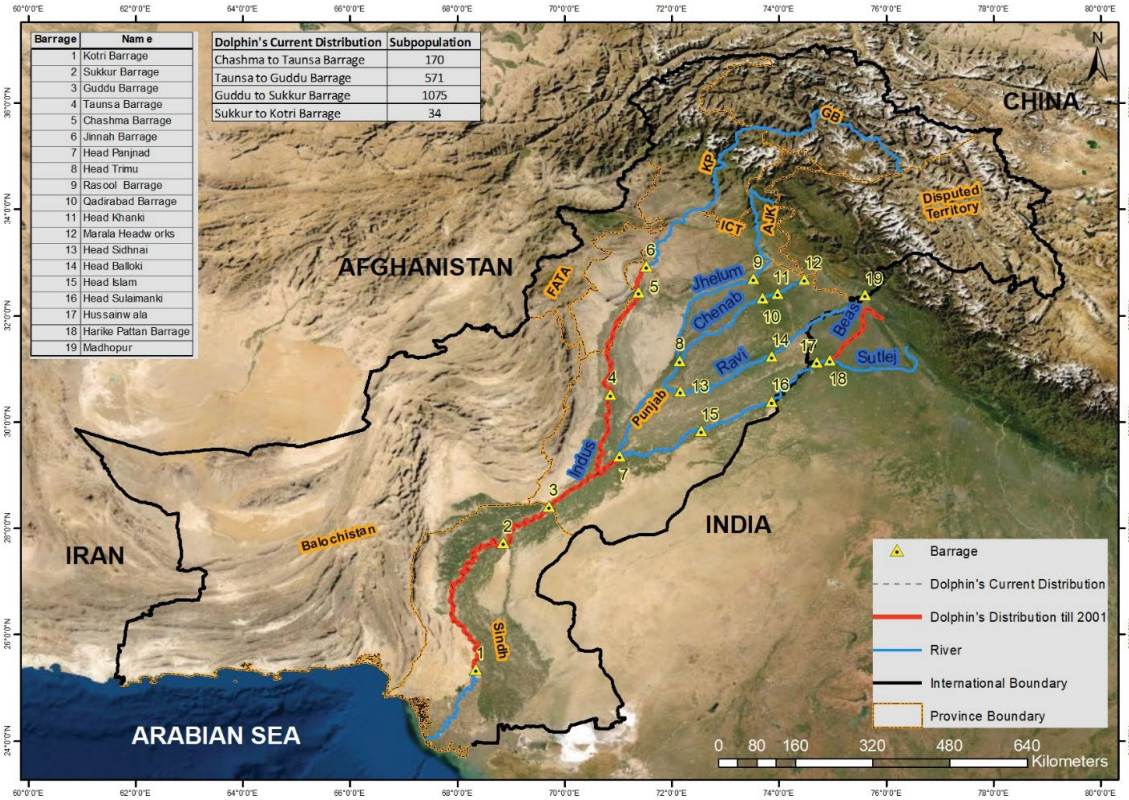

Figure 6. The IBIS system, historic and extant distribution of Indus river dolphin in the Indus river system in Pakistan and India. Population data source from Aishaa H, et al. [9].

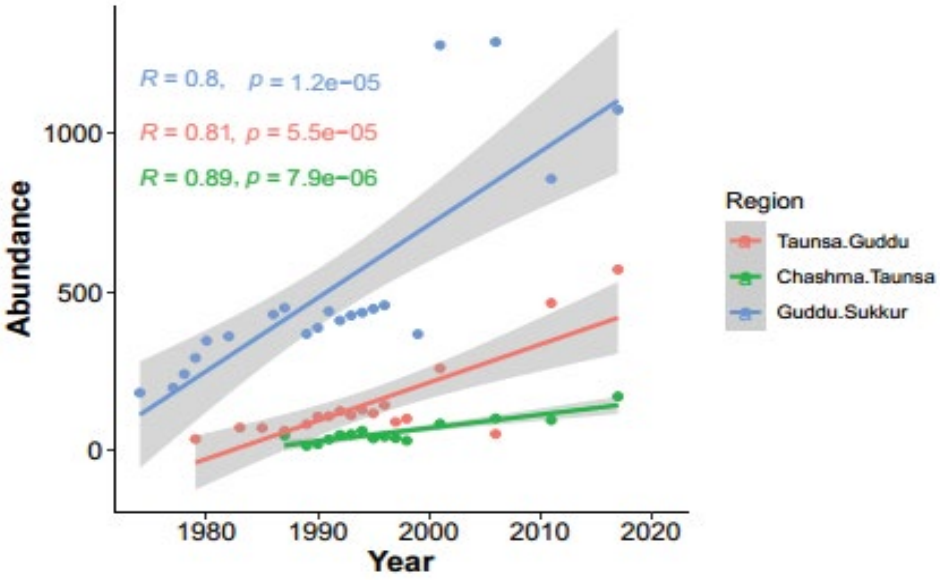

Figure 7. The subpopulations abundance record of Indus river dolphin in Pakistan from 1974-2017.

(G-S) barrage Figure 6. The subpopulation between (C-T) barrage remained stable until 2011. Since then, increasing population trend was recorded 0.58 dolphin/km, in a total of (n=61 groups, mean group size= 2.8 dolphins) with cumulative population of (n=170) individuals. In Punjab, the subpopulation between (T-G) barrage 1.62 dolphins/km, in a total of (n=189 groups, mean group size n=3.0) with cumulative population of n=571 individuals. The subpopulation between (G-S) barrage supporting the highest number of dolphins 6.65 dolphins/km, in a total of (n=152 groups, mean group size= 7.1 dolphins) with cumulative population of (n=1075) individuals. The overall three main subpopulation abundances are shown in Figure 7.

The partial and complete mitochondrial control region and cytochrome b of the Indus dolphin suggested homogeneity and low genetic diversity. Most probably the population of the Indus river dolphin was depleted due to hunting from centuries. Since 1970s, the population is being expanded only from few hundred individuals. Most of the samples included in this genetic analysis were collected dated back to >100 years old or after 1970s. Moreover, the origin of all genetic samples from only one subpopulation of Guddu-Sukkur barrage river section (Figure 6). If sufficient samples from other subpopulations are available, the future genetic analysis will be helpful to understand the current status of genetic diversity of each subpopulation and overall population of the Indus river dolphin in Pakistan.

Ecology and conservation

It has been 50 years since the different methodologies were adopted to assess the population abundance of the Indus river dolphin in Pakistan. A traditional single boat based methodology of direct count from 1979-2000 was adopted. This methodology was lack of any statistical approach to assess the missing dolphin underwater. In 2001, it was replaced by the double observer platform of two oar-powered boats based on capture-mark-recapture (CMR). Two survey boats maintain the temporal and spatial distance; collect the data independently while moving downstream. Recently, a successful study was conducted and reported different types of skin marks are promising marks to identify the dolphins, and CMR methodology based on photo identification is possible it should be adopted for the subsequent future surveys.

The physical characteristics of the habitats in the fluvial ecosystems such as the river morphology and hydrogeomophic characters from different river sections were compared and analyzed. The habitat patch between Guddu-Sukkur barrage sections is the hotspot area for the Indus river dolphins, due to narrow single channel, exhibited greater high cross section and depth than any other river sections. The Indus river dolphin become more susceptible particularly during dry season due to low water discharge, and preferred areas of high cross section 1050 m^2, with average depth of 1 m^2 along the constricted and confluences channels to avoid stranding.

There could be several undocumented potential threats to Indus river dolphin across its habitat in the Indus River in Pakistan. The increasing human population and industrialization might be contributing to the surface water pollution. Unfortunately, in Pakistan the negative impacts of water pollution on the Indus river dolphin has never been focused or considered as serious threat. Recent (unpublished) study by Ali (2019) reported different types of microplastics in the gut of dead specimen collected from the Punjab river section. Similarly, from the Sindh River section the prevalence of pesticides (Cypermethrin, Dicholoro-Diphenyl-Trichloroethane, Deltamethrin and Endosulfan) was reported in the tissues of three dead specimens (WWF-Pakistan 2011).

The Indus river dolphin is a protected species and has no any direct anthropogenic threat of intentional killing or hunting in Pakistan. However, the conflict with fisheries is most common during dry season, which may increase mortalities among young calves (1-2 years age) due to bycatch in fishing nets. Most probably there could be the difference to perform echolocation among calves and adults. Future studies should be focused on the ontogenetic development of biosonar capabilities will be helpful to take management decision to control mortalities among calves.

Conclusion and Future Research Directions

Recent studies have major contributions to explore the negative impacts on the distribution pattern, and the extirpation of the Indus river dolphin from various tributaries (Jhelum, Chenab, Ravi and Sutlej Rivers) including upstream and downstream sections of the main Indus River. As the Indus River is the perennial river, considerable differences of water availability and flow occur during dry and flood season. It is necessary to maintain the sufficient water flow during dry season in that section of barrages which are occupied by the Indus river dolphins. The dry season is the critical phase for the dolphin, which reduces the physical spaces, restricts their movement and reduces prey availability and conflict with fisheries to induce mortalities among calves. Group sizes of dolphins also increases and pushes to select those areas of high cross section with deep water pools. Implementation of strong conservation policies with improved laws and legislations and management efforts at national and

international levels population has been revived from few hundred to >2000 individuals. Strict monitoring and invigilation are necessary to avoid any stranding and other negative anthropogenic impacts in their hotspot areas. As the population is being expanded, it is necessary to evaluate prey density, prey availability across the habitat of Indus river dolphin. Still, there is a big gap of data on the basic biology and ecology of this species, the increasing human population and anthropogenic activities along the immediate bank side of the river has negative impact on the water quality as strong evidence by the prevalence of microplastics from Punjab river section and pesticides from Sindh river section. Although, recent study has identified the low genetic diversity in subpopulation between G-S barrage river section. The genetic status of the other subpopulations and overall population is still unclear. Capture-mark-recapture (CMR) based on photo-ID of Indus river dolphin should be carried out, this study will be helpful to identify each individual for robust population abundance of the Indus river dolphin. It will also provide the answers of wide range of biological questions such as behavior, health status, movement or any potential underwater threat.

Declaration

The author declares they have no conflict of interest.

Acknowledgement

We would like to thanks Dr. Abdul Qadir, Mr. Umer Waqas and Imran Ali provided valuable comments to complete this manuscript. This study was financially supported by the Natural Science Foundation of China (grant no. 32030011) to GY.

References

1. Braulik, Gillian T. "Status assessment of the Indus River dolphin, Platanista gangetica minor, March –April 2001." *Biol Conserv* 129 (2006):579-590.
2. Smith, B.D and R.R Reeves. "Report of the Second Meeting of the Asian River Dolphin Committee, 22-24 February 1997, Rajendrapur, Bangladesh." *Biology and Conservation of Freshwater Cetaceans in Asia* (2000a):1-14.
3. Anderson, John. "Anatomical and zoological researches: comprising an account of the zoological results of the two expeditions to western Yunnan in 1868 and 1875 and a monograph of the two cetacean genera Platanista and Orcella." *Bernard Quaritch, Piccadilly*, London. (1879).
4. Pilleri, G. "Pakistan Project 9229. Indus dolphin - Ecological Study. WWF Grant 1977." In WWF Yearbook. 1977-1978. (1977).
5. Braulik, Gill T., Masood Arshad, Uzma Noureen, and Simon P. Northridge "Habitat fragmentation and species extirpation in freshwater ecosystems ; Causes of Range decline of the Indus River Dolphin (Platanista gangetica minor)" (2014a).
6. Reeves, Randall R. "Conservation of the bhulan (blind river dolphin) in the Punjab." Natura (1991): 3-22.
7. Reeves, Randall R. The beleaguered *bhulans* of Pakistan." Sanctuary Asia XVII: 4(1997): 34-41.
8. Reeves, Randall R, and Leatherwood S. "Dams and river dolphins: can they co-exist?" *Ambio J Human Environment* 23 (1994): 172-175.
9. Aishaa, Hamera, Gill Barulik, Uzma Khana, Aimee Leslie, and Rab Nawaza. "Indus River Dolphin (Platanista gangetica minor) - An update on the current population assessment and conservation challenges." *IWC* 10 (2017).
10. Alamgir, Aamir, Moazzam Ali Khan, Janpeter Schilling, S. Shahid Shaukat, and Shoaib Shahab "Assessment of groundwater quality in the coastal area of Sindh province." *Pakistan Envir Monit Asses* 188 (2016): 78.
11. Herald, Earl S., Robert L. Brownell Jr and Fredric L. Frye. "Blind river dolphin: first side-swimming cetacean." *Sci* 166 (1969):1408-1410.
12. Kasuya, T. "some information's on distribution and seasonal movement of the Ganges Dolphin." *Sci Rep Whales Res Inst* 24 (1972): 109-115.
13. Pilleri, G. "Platanista gangetica, a dolphin that swims on its side." *Rev Suisse Zool* 77 (1970c):305-307.
14. Ibrahim, Aamir, and Hassan Ali BingyaoChen. "Skin Marks on the Indus River Dolphin (Platanista minor) and their Implications for Conservation." *Pakistan J Zool* (2021): 1-8.
15. Viglino, Mariana and Maximiliano Gaetan. "Hearing from the ocean and into the river: The evolution of the inner ear of Platanistoidea (Cetacea: Odontoceti)" *Paleobiol* (2021):1-21.
16. Lebeck, H.J. "Delphinus gangeticas beschrieben von Heinrich Julius Lebeckzu Trankenbar." *Der Gesellschaftnatur forschender Freundezu Berlin Neue Schriften* 3 (1801): 280-282.
17. Roxburgh, William. "An account of a new species of Delphinus, an inhabitant of the Ganges." *Asiat Res* 7 (1801): 170-174.
18. Owen, Richard. "Descriptive catalogue of the osteological series contained in the Museum of the Royal College of Surgeons. Volume II." *Mammalia Placentalia* (1853).
19. Blyth, E. "On the great rorqual of the Indian Ocean, with notices of other cetals, and of the Sirenia or marine pachyderms." *J Asiatic Soc Bengal* 28 (1859):481-498.
20. Rice, D.W. "Marine mammals of the world: Systematics and distribution." *Special Publication* 4 (1998).

How to cite this article: Ibrahim, Aamir, Bingyao Chen, Hassan Ali and Imran Khaliq, et al. "Recent Scientific Advances on the Indus River Dolphin (*Platanista minor*)." *J Biodivers Endanger Species* 10 (2022): 418