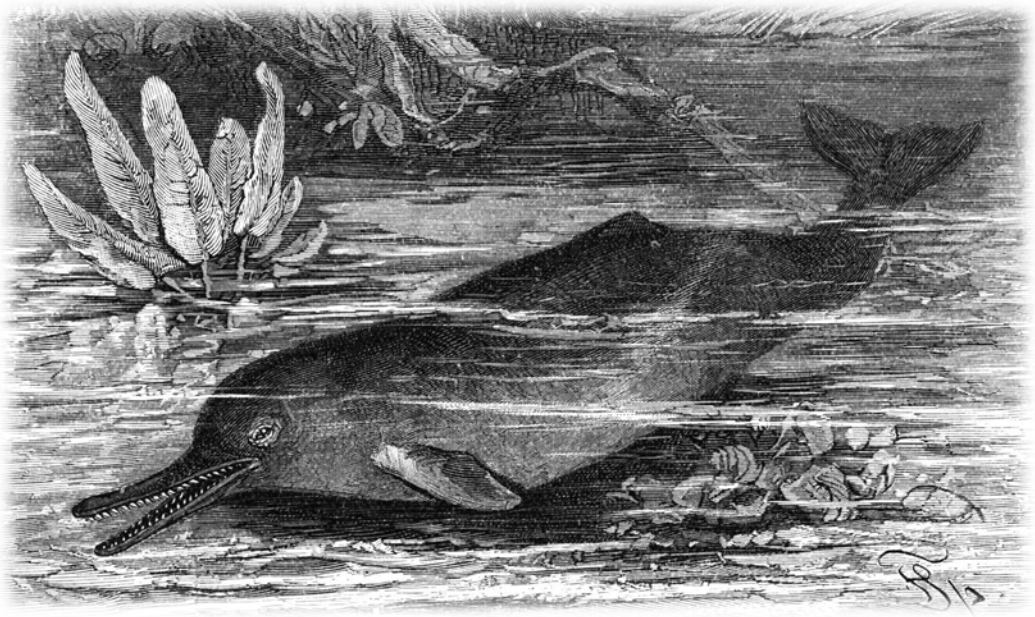
Indus River Dolphin
(Platanista gangetica minor)



Drawing by Friedrich Specht - Brehm

5-Year Review:
Summary and Evaluation
September 2016

National Marine Fisheries Service
Office of Protected Resources
Silver Spring, MD

5-YEAR REVIEW
Indus River Dolphin
(Platanista gangetica minor)

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional or Headquarters Office:

Therese Conant, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, Silver Spring, MD (301) 427-8456.

1.2 Methodology used to complete the review:

A 5-year review is a periodic analysis of a species' status conducted to ensure that the listing classification of a species as threatened or endangered on the List of Endangered and Threatened Wildlife and Plants (List) (50 CFR 17.11 – 17.12) is accurate. The 5-year review is required by section 4(c)(2) of the Endangered Species Act of 1973, as amended (ESA) and was prepared pursuant to the joint National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife 5-year Review Guidance and template (NMFS and USFWS 2010). The NMFS Office of Protected Resources led the 5-year review with input from NMFS regional offices and science centers. We relied on peer-reviewed publications, government and technical reports, conference papers, dissertations, and theses. Information was gathered *through May 2016*. The information on the Indus River dolphin (*Platanista gangetica minor)* biology and habitat, threats, and conservation efforts were summarized and analyzed in light of the ESA section 4(a)(1) factors (see Section 2.3.2.1) to determine whether a reclassification or delisting may be warranted (see Section 3.0). NMFS initiated a 5-year review of the Indus River dolphin (*Platanista gangetica minor)* and solicited information from the public on February 23, 2016 (81 FR 8923). NMFS received information on the species biology and conservation from the Marine Mammal Commission and from one researcher.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review:

81 FR 8923, February 23, 2016

1.3.2 Listing history

Original Listing
FR notice: 56 FR 1463
Date listed: January 11, 1991
Entity listed: Species
Classification: Endangered

1.3.3 Associated rulemakings: Not Applicable

1.3.4 Review History:
September 2016 (this document): Recommendation—No change in classification

1.3.5 Species' Recovery Priority Number at start of 5-year review: Not Applicable

1.3.6 Recovery Plan or Outline

Name of plan or outline: Not Applicable– It was determined that a plan will not promote the conservation of the species because it exists solely in foreign waters.

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy[1]

2.1.1 Is the species under review a vertebrate?

_X___***Yes***
_____***No***

2.1.2 Is the species under review listed as a DPS?

____ ***Yes***

[1] To be considered for listing under the ESA, a group of organisms must constitute a "species," which is defined in section 3 of the ESA to include "any subspecies of fish or wildlife or plants, and any distinct population segment (DPS) of any species of vertebrate fish or wildlife which interbreeds when mature." NMFS and USFWS jointly published a policy regarding the recognition of DPSs of vertebrate species under the Endangered Species Act (DPS Policy, 61 FR 4722; February 7, 1996).

"DPS" is not a scientifically defined term; it is a term of art that is used in the context of ESA law and policy. Furthermore, when passing the provisions of the ESA that give us authority to list DPSs, Congress indicated that this provision should be used sparingly. We have discretion with regard to listing DPSs and, in order to be consistent with the directive of the Congressional report that followed the introduction of the DPS language in the ESA to identify DPSs sparingly, we will generally not, on our own accord, evaluate listings below the taxonomic species or subspecies level if the best available information indicates that the species or subspecies is in danger of extinction throughout all or a significant portion of its range. We should only identify DPSs if there is an overriding conservation benefit to the species.

_X_ ***No***

2.1.3 Was the DPS listed prior to 1996?

____ ***Yes***
____ ***No***

2.1.3.1 Prior to this 5-year review, was the DPS classification reviewed to ensure it meets the 1996 policy standards?

____ ***Yes***
____ ***No***

2.1.3.2 Does the DPS listing meet the discreteness and significance elements of the 1996 DPS policy?

____ ***Yes***
____ ***No***

2.1.4 Is there relevant new information for this species regarding the application of the DPS policy?

____ ***Yes***
_*X*__ ***No***

2.2 Recovery Criteria

N/A

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

____ ***Yes***
_X_ ***No***

2.2.2 Adequacy of recovery criteria.

N/A

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?

____ ***Yes***
____ ***No***

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?

____ ***Yes***
____ ***No***

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information

N/A

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

The Indus River dolphin (*Platanista gangetica minor*), locally referred to as bhulan, is characterized by a long beak and rounded, stocky body. The species lives exclusively in rivers. The Indus River dolphin is functionally blind and depends on a sophisticated auditory sense, including echolocation, to navigate, avoid obstacles, and capture prey (Smith and Reeves 2012). It is reported to swim on its side near the bottom of muddy rivers, while echolocating more or less continuously to find prey (Herald et al. 1969). Diet includes a large variety of bottom-dwelling fish and prawns (Braulik 2012; Braulik et al. 2015b). The Indus River dolphin's unique side swimming behavior is only observed in the Ganges River dolphin (*Platanista gangetica ganetica*) in India (Waqas et al. 2012).

The maximum lifespan for the Indus River dolphin is thought to be 33-35 years (Ohsumi 1979 as cited in Braulik et al. 2015b). Estimated age at first birth was 9 years, and oldest age of a reproducing female was estimated at 28 years. The smallest known length at sexual maturity is 200 cm and 199 cm for females and males, respectively. Body length at birth is about 80 cm or greater; however a free-swimming female calf was reported as 67.4 cm in length. Calf-survival was estimated at 0.798 and non-calf survival at 0.950 (Taylor et al. 2007). Gestation is unknown, but may be 10-11 months, and females may give birth to approximately 11 calves over their lifespan (Brownell 1984). Adults weigh between 155-245 pounds (70-110 kg) with a maximum size at approximately 8.2 ft. (2.5m) (Waqas et al. 2012). Females are larger than males (Brownell 1984).

Data are lacking on behavior and movement because the dolphin lives in turbid water, rarely approaches boats, and lacks unique features making photograph identification of individuals impossible (Braulik 2012). Unlike many marine dolphins which form social groups, the Indus River dolphin is frequently observed in loose and small aggregations with little apparent interaction, except for mating purposes (Braulik 2006; Braulik et al. 2015b; Smith and Reeves 2012).

2.3.1.2 Abundance, population trends

The current distribution of the Indus River Dolphin falls entirely within three Pakistan provinces; Sindh, Punjab, and Khyber Pakhtunkhwa (Figure 1 *Source*: Braulik et al. 2015b).

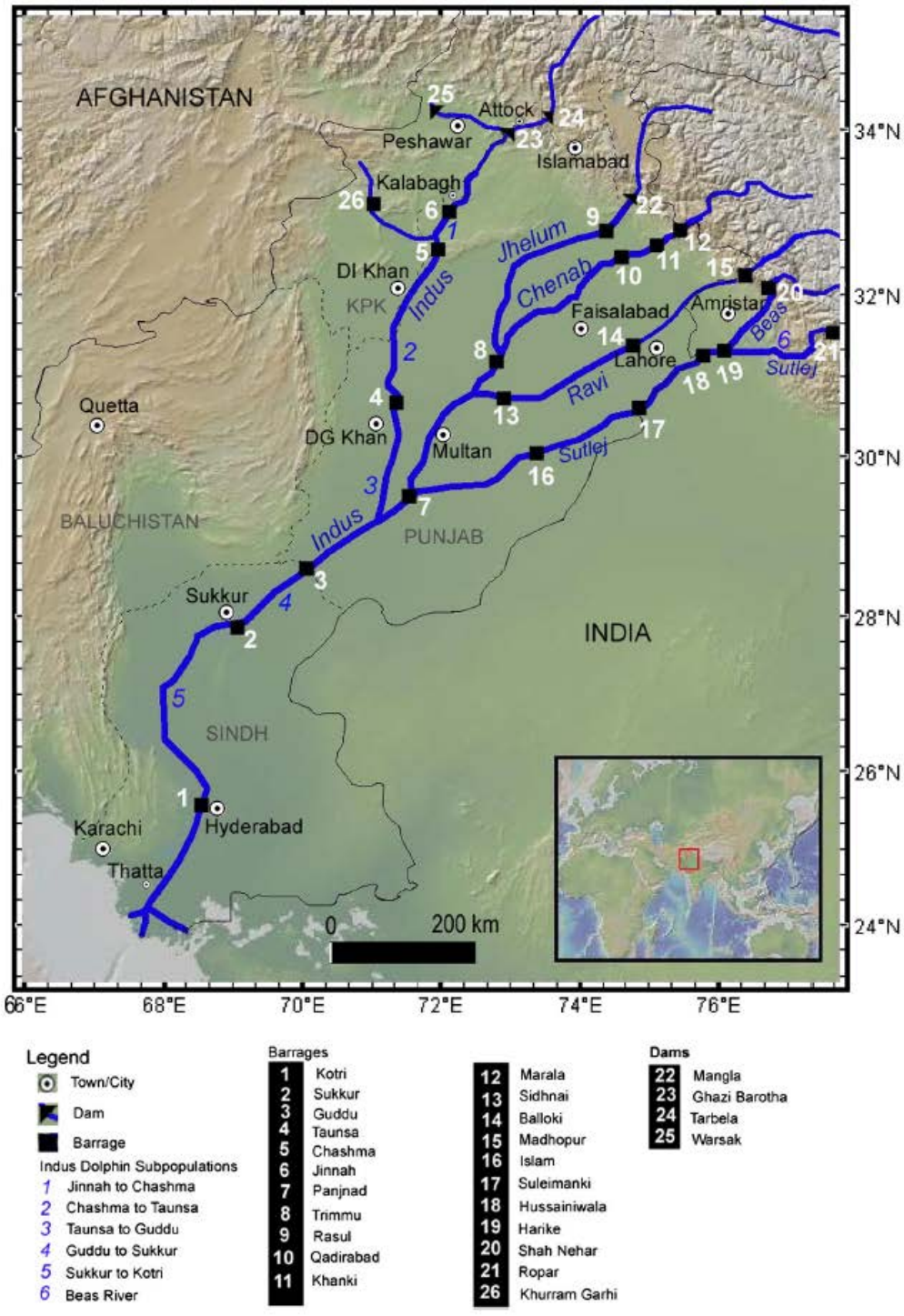


Figure 1. Distribution of Indus River dolphin subpopulations and locations of barrages (source: Braulik et al. 2015b)

Three comprehensive surveys were conducted in 2001, 2006, and 2011 to estimate abundance of Indus River dolphins throughout their current range (Braulik et al. 2015b). Minimum population estimates were 1,200 in 2001, 1,550-1,750 in 2006, and 1,452 in 2011 (see Table 1 in Braulik et al. 2015b). Abundance and encounter rates increased with survey sites further downstream. The Indus River dolphin consists of six subpopulations. The three largest subpopulations were between Chashma and Taunsa Barrages (84 dolphins; 0.28/km), Taunsa and Guddu Barrages (259 dolphins; 0.74/km) and Guddu and Sukkur Barrages (602 dolphins; 3.60/km) (Braulik 2006). Remnant subpopulations occur up and downstream of these primary populations. Including the only surviving Indus River dolphin subpopulation (approximately 10 dolphins) in India between Beas city and Harike Barrage (Behera et al. 2008 cited in Khan 2013).

Approximately 99% of the population occurs in 690 km of river length (from Taunsa Barrage downstream to Sukkur Barrage), of which the greatest concentration occurs in a 190 km river section between Guddu and Sukkur Barrages in the Sindh Province, Pakistan (Braulik 2006; Braulik et al. 2012a). The Guddu-Sukkar population appears to have increased approximately 5.65% each year between 1974 and 2008 (Braulik et al. 2012a). The apparent increase may be due to several factors: (a) differences in survey methods and not a true trend; (b) high carrying capacity; (c) a ban on hunting instituted in 1972 resulting in a population increase in the area; (d) immigration from other populations (i.e., dolphins from populations upstream may pass through irrigation barrages when gates are fully open); and (e) or some combination of these factors (Braulik et al. 2012a, 2012b).

Surveys were conducted in 2009 and 2012 in the upper reaches of the in the Indus River in the Himalayan foothills from Saggu to Ramak in the Kyber Pakhtunkhwa Province, Pakistan. Estimated abundance in 2009 was 54 dolphins (Perveen et al. 2011) and 35 dolphins in 2012 (Awan and Shah 2012). The 2012 survey was conducted during a period of extended drought in Pakistan, and dry season river discharge was lower than average. Awan and Shah (2012) reported anecdotal extirpations near Miran Spur based on personal communications with crane hunters and staff from the Wildlife department of Dera Ismail Khan. A subpopulation near Dera Ismail Khan Bridge was also reported to be extirpated (Chaudhry and Khalid 1989 cited by Awan and Shah 2012).

2.3.1.3 Genetics, genetic variation, or trends in genetic variation:

Of the Indus River dolphin's six subpopulations, the smallest two populations are 18 dolphins between Sukkur–Kotri Barrages and two dolphins between Jinnah–Chashma Barrages (Braulik 2006). A third subpopulation between Chashma and Taunsa Barrages was reported to have only 84 dolphins. The smaller populations would not be resilient to stochastic events due to the effects of inbreeding and loss of genetic diversity. Loss of genetic diversity has been documented in the Indus River dolphin. Braulik et al. (2015a) examined mitochondrial deoxyribonucleic acid (mtDNA) samples mainly extracted from skeletal specimens stored in museums. Age of samples ranged from approximately 30 to 160 years. A total of 26 Indus River dolphin samples were successfully analyzed. The authors found an absence of variability in 458 base pairs of the partial control region and a significant expansion signal from the genetic diversity and neutrality tests, suggesting the Indus River dolphin expanded after passing through

a bottleneck (i.e., loss of genetic variation when a population is dramatically reduced for at least one generation) in the past. In addition to the partial control region uniformity in the Indus dolphin, Braulik et al. (2015a) found extremely low mtDNA genetic variation in both the Indus River dolphin and Ganges River dolphin. The authors suggest the low genetic variation may be due to a restricted habitat and naturally low abundance.

2.3.1.4 Taxonomic classification or changes in nomenclature:

There are no changes in the taxonomic classification or nomenclature.

Kingdom:	Animalia
Phylum:	Chordata
Class:	Mammalia
Order:	Cetacea
Suborder:	Odontoceti
Family:	Platanistidae
Genus:	*Platanista*
Species:	*gangetica*
Subspecies:	*minor*

The family, Platanistidae, has one genus, *Platanista,* and species, *gangetica,* consisting of two subspecies--the Indus River dolphin (*P.g. minor*) and the Ganges River dolphin (*P. g. gangetica*). The Indus and Ganges River dolphins were considered a single species until the 1970s when they were separated based on differences in craniology, vertebrae, and lipid composition (Pilleri *et al.*, 1982 cited in Waqua et al. 2012). However, in the late 1990s, the separation was re-examined and the classification reverted to a single species containing two subspecies (Waqas et al. 2012).

The Indus River dolphin and Ganges River dolphin diverged about 0.51 (McGowen et al. 2009) to 0.55 (Braulik et al. 2015a) million years ago likely due to changes in drainage patterns that re-routed major tributaries of the Ganges into the Indus River and isolated the populations (Braulik et al. 2015a). The genus *Platanista* is one of four extant genera of river dolphins. Hamilton et al. (2001) hypothesized that river dolphins diverged from marine dolphins beginning in the Middle Miocene (approximately 11.6-15.97 million years ago) when sea levels increased and inundated foreland basins such as the Indo-Gangetic basin. River dolphins likely remained in these shallow epicontinental seas and adapted to freshwater when sea levels receded during the Pliocene.

2.3.1.5 Spatial distribution, trends in spatial distribution, or historic range:

The Indus River dolphin's range has declined by 80% over the last century. In the 1870s, the species' linear range was over 3,500 km expanding from the Himalayan foothills to the river deltas (Anderson 1879 cited in Braulik et al. 2015b). By 2001, the dolphin occurred in only 1,000 km with approximately 99% of the population in 690 km of river (Braulik 2006). The species' historical range has been fragmented into 17 river sections by barrages (diversion dams) used for agriculture. A total of 22 barrages and 4 dams are located on the Indus River (Figure 1).

Based on dolphin sightings and interview surveys, the species has been extirpated from ten river sections, they persist in six, and are of unknown status in one section (Braulik et al. 2014). Extirpations occurred between 20 and 80 years ago, mainly in upstream populations and include the Indus River mainstem upstream of Jinnah Barrage and downstream of Kotri Barrage and populations in five Indus River tributaries. Thus, the range of the Indus River dolphin has contracted inwards, and dolphins persist primarily in what may have been their former core, high density range or populations have been extirpated due to water extraction on the periphery (Braulik et al. 2014).

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

The Indus River dolphin inhabits freshwater of the Indus River and its tributaries. The Indus River originates on the Tibetan Plateau and flows through northwest India entering Pakistan in the north and flows to the Arabian Sea (Braulik et al. 2015b). The river's gradient is gentle as it leaves the Himalayan foothills and runs through desert, semi-desert, and scrub lands. The Indus River is turbid and its banks are constantly eroded. Dry and wet seasons change the river by forming and reforming channels, islands, and sand bars (referred to as braiding). River discharge peaks (20–22,500 m3/s) between June and August fed by Himalayan melt-water and monsoon run-off and subsides (300 m3/s) between December and April (Braulik 2006). The Himalayan foothills receive up to 71 inches of rainfall annually, which declines rapidly to about 8 inches annually in the lower reaches of the Indus River (Archer et al. 2010). River water temperatures vary depending on the season and ranged from 0°C in October to 36.67°C in July (Tassaduque et al. 2003), with an annual temperature range of almost 30 °C (Braulik unpublished cited in Braulik et al. 2015b).

River cetaceans need sufficient river flows, freshwater of adequate depth, and appropriate current speed and temperature to survive and reproduce (Reeves et al. 2000). Depth, width, and water flow influence the distribution of the Indus River Dolphin. The dolphin prefers river widths of 0.5-2.0 km and depths ranging between 2.4 – 5.1 m (Akbar et al. 2004). Dolphins prefer confluence areas with counter-current eddies (Khan and Niazi 1989; Braulik et al. 2012c). Within confluence areas, counter-current eddies 'trap' fish and concentrate prey for the river dolphins (Kreb 2004), but these areas may also provide dolphins a respite from the energetically demanding act of swimming against the downstream current (Smith and Reeves 2012). Dolphins also prefer areas with less braiding and avoid channels with a cross-sectional area less than 700 m^2 (Braulik et al. 2012c).

The Indus River was identified as one or 11 irreplaceable sites because of the presence of endemic species (including the Indus River dolphin), species richness, and biodiversity (Pompa et al. 2011).

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

Water Extraction

The Indus Basin Irrigation System (IBIS) consists of 19 barrages, 12 inter-river link canals, and two million kilometers of tertiary watercourses and is considered to be the largest integrated irrigation system in the world (Hassan et al. 1999 cited in Braulik 2006). The vast majority of the diverted water is used for agriculture (95%) followed by drinking, sanitation, and industry (Kamal 2008). Pakistan's demands for freshwater are predicted to outstrip availability before 2025 (Siddiqi & Tahir-Kheli 2004 as cited in Braulik et al. 2012b).

Two main storage dams, Mangla on the Jhelum and Tarbela on the Indus River, were completed in 1967 and 1978, respectively (Archer et al. 2010). Dams, impoundments, and barrages comprised of a series of gates are designed to divert water into lateral canals (Figure 2). Only a small opening is left in the barrage gates to ensure that water is diverted into canals. These gates are fully open for only a few days or weeks to allow for floods and for three weeks during low flows when the canals are closed for maintenance (Braulik et al. 2015b). The system irrigates approximately 18 million hectares, which represents 78% of Pakistan's total cultivated area (Habib 2004 cited in Archer et al. 2010). Over 67% of the Indus River is diverted into irrigation canals, which results in substantial population and habitat fragmentation (Reeves and Leatherwood 1994 cited in Dudgeon 2010). Several early estimates indicate the IBIS has reduced the annual freshwater flow downstream from greater than 150 billion m^3 to less than 45 billion m^3 (Keerio and Bhatti 1999 cited in Inam et al. 2007). The IBIS influences the Indus River natural discharge to such an extent that the river virtually ceases to flow during the dry season (Postel and Richter 2003; Dudgeon 2005). Water extraction has resulted in substantial seawater intrusion up to 100 km upstream in the lower Indus River (Archer et al. 2010). Low river discharge due to water abstraction at these irrigation barrages was found to be a principal factor in the Indus River dolphin's decline in range (Braulik et al. 2014).

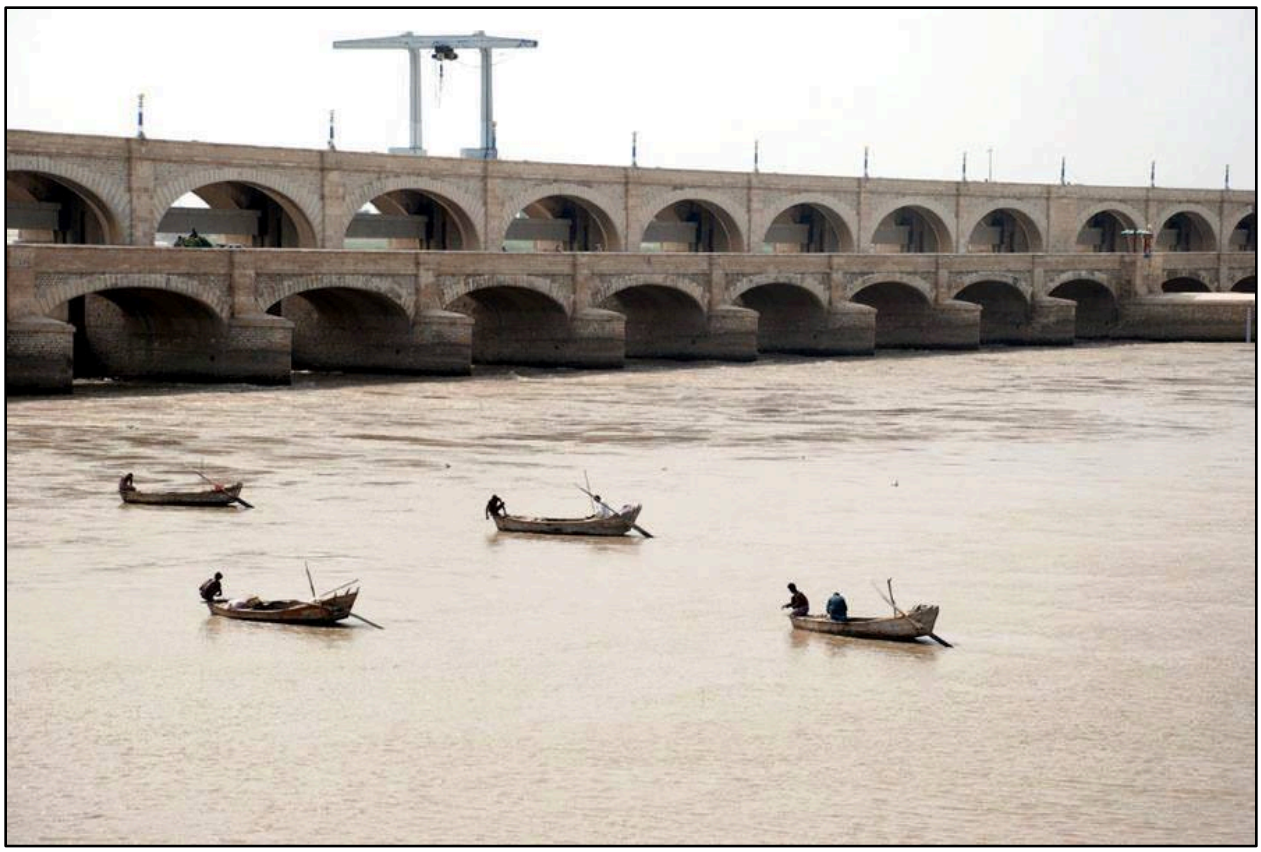


Figure 2. Sukkar Barrage, Pakistan: Source: Hafeezullah, WikiMedia Commons.

Barrages restrict the movement of river dolphins and separate them into subpopulations (Braulik 2006). Dolphins in the Indus mainstem were isolated from those in the five Punjab tributaries in 1932 when Sukkur and Panjnad Barrages were completed. Barrages further fragmented the Indus mainstem population into four subpopulations, resulting in extirpation in the Indus mainstem and tributaries (see Section 2.3.1.5). One radio-tracked dolphin passed up and downstream through a barrage while the gates were open, but became trapped downstream of its subpopulation once the gates were closed (WWF Pakistan unpublished data cited in Braulik et al. 2015b). This example supports that passage across barrages may be limited with most dolphins being stranded downstream once they have passed through the open gates (Braulik et al. 2015b). The ability for a dolphin to pass through a barrage would depend upon differences in engineering design, operational cycle, diversion capacity and location of the barrage. Impassable barrages would result in downstream migration with attrition from upstream populations (Braulik 2006). Sukkur Barrage, which is downstream from the Guddu Barrage, diverts more water than other barrages and its gates are therefore lowered, or closed, for a large part of the year. High dolphin abundance between Guddu and Sukkur Barrages may therefore be the result of immigration through the more permeable Guddu Barrage and low emigration through the mostly closed Sukkur Barrage, resulting in an overall augmentation of the subpopulation between the barrages by downstream migration (Braulik 2006).

Indus River dolphins become trapped in the irrigation canals. A total of 137 dolphin strandings were reported from 1992 to 2012, of which 34 dolphins died during the rescue (Waqas et al.

2012). In 2010, a flood resulted in high dolphin mortality and the highest mortality was reported in 2011 with a total of 45 dead dolphins found along the river banks or impinged on the barrages. Other rescue operations reported 34 dolphins trapped in canals near the Sukkur Barrage between January 2000 and December 2002. Ten of the dolphins died and 24 were successfully returned to the Indus River (WWF-Pakistan unpublished data cited in Braulik et al. 2012a).

Development and Pollution

Cities and towns are sparse along the Indus River, but increase with proximity to the delta area. Only three relatively large towns are located along the Indus River—Dera Ismail Khan in Khyber Pakhtunkhwa Province and Sukkur and Hyderabad in Sindh Province (Awan and Shah 2012). In Pakistan, the urban population has grown from 20 million in 1980 to 70 million in 2000 with an associated growth in manufacturing industry, which places increasing demands on the aquifers and rivers including the Indus River (Archer et al. 2010).

Pakistan uses approximately 25,000 tons of chemical compounds and pesticides in a year (Memon 2004). Pesticide use has increased at an annual rate of about 6% (World Bank 2005 cited in Braulik et al. 2015b). Insecticides used in agriculture and chemical discharge from factories enter the rivers, especially the Punjab River which flows through industrial and agriculture areas (Braulik et al. 2015b). Above the Panjnad River confluence (Figure 1—approximately at Panjnad Barrage no. 7), the habitat is less polluted, but becomes more so downstream due to lack of treatment for industrial and municipal waste from cities (e.g., Lahore, Sheikpura, Faisalabad and Multan) located in the Punjab Province (Braulik 2006; Braulik et al. 2012a). In Pakistan, more than 90% of industrial and municipal effluents are not treated prior to entering water resources (Braulik et al. 2014). Approximately 75% of the dolphin populations are located downstream of the Panjnad River confluence and are vulnerable to acute and long-term chronic effects of unregulated upstream pollutant discharges from the Punjab Province (Braulik 2006).

Gachal and Slater (2003) observed streams of raw sewage entering the Indus River just upstream of the Sukkur Barrage. Large quantities of refuse were boated to the center of the river and dumped. Use of pesticides in the agricultural fields along the river banks and industrial discharge has resulted in mass fish kills (Reeves and Chaudhry 1998 cited in Braulik et al. 2012a). To evaluate the pollution status of the Indus River, water samples, fish muscle, and sediments were collected midstream between Sukkar, Rohri, and Guddu from April to November 1999 (Gachal et al. 2006a, 2006b). Water samples revealed high chemical and biological oxygen demand values, indicating the presence of high organic pollutants. High levels of trace metals were found in all samples indicating industrial pollutants and fertilizer loads in the river. Mercury and arsenic concentrations in the muscle of fish from above the Guddu Barrage were high at 3.920 and 3.072 μg·g–1, respectively (Tariq et al. 1996 cited in Smith and Smith 1998). High concentrations of volatile solids have been reported in June and July in the Indus River. These solids may have contained fertilizers from agricultural runoff (Khan and Ali 2003). The Indus River carries high sediment loads, which has been exacerbated by human activities such as agriculture and development erosion. Increased river turbidity has the potential to adversely impact the Indus River dolphin (Khan and Ali 2003). However, sediment loads may have decreased in the later-half of the 1900s due to dryer conditions and excessive water extraction, but reliable data on Indus River sediment runoff are difficult to obtain (Kravtsova et al. 2009).

Data are sparse on toxicology of Indus River dolphins. Pesticides (dichlorodiphenyltrichloroethane, Cypermethrin, Deltamethrin and Endosulfan) were found in the tissue of three Indus dolphins that died in Sukkur in January 2011 (WWF-Pakistan 2011 cited in Braulik et al. 2015b). However, more information is available on the accumulation and biomagnification of toxins have found in the Ganges River dolphin (e.g., Kannan et al. 1993, 1997; Kumar et al. 1999).

Summary
The Indus River dolphin's habitat has and continues to be severely modified and fragmented through water extraction systems. The species has responded by contracting its range. In addition, water quality has been degraded due to lack of treatment of municipal, agricultural, and industrial waste. This may have long-term consequences on the health of the Indus River dolphin and viability of its subpopulations. For these reasons, we conclude that the Indus River dolphin continues to be threatened with the present or threatened destruction, modification or curtailment of its habitat or range.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

The Indus River Dolphin was hunted for its meat and oil (for medicinal and domestic use) up through 1970s in the Sindh Province, when hunting was banned by the Sindh Wildlife Act of 1972 (Braulik et al. 2015b). Within a few years of enactment, dolphin hunting ceased in the Sindh Province, but poaching was reported upstream in the Punjab Province, where enforcement was more lax, and was thought to occur through the early 1980s. Although there is no evidence the Indus River dolphin is currently hunted (Braulik et al. 2015b), some sources report poaching occurs occasionally (Reeves et al. 2010). Adequate enforcement of existing regulations is lacking (see 2.3.2.4 Inadequacy of existing regulatory mechanisms).

Data on threats from recreational, scientific, or education purposes were not found.

Summary
Given systematic hunting occurred through the early 1980s within the maximum lifespan for the Indus River dolphin and poaching may still occur on depleted populations, we conclude that the Indus River dolphin continues to be threatened by directed take.

2.3.2.3 Disease or predation:

There are no records of disease or predation of the species. Thus, we conclude the Indus River Dolphin is not threatened by disease or predation.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

General

In Pakistan, responsibility for natural resources management occurs mainly at the provincial level (International Union for Conservation of Nature and Natural Resources (IUCN) 2005; Awan and Shah 2012; Ahsan and Khawaja 2013). Over one third of Pakistan's natural resource laws were enacted prior to 1947 and are predicated on commercial objectives of sustainable use, rather than conservation and protection (IUCN 2005). Braulik et al. (2015b) stated that national oversight of environmental protection is weak and large parts of the Indus River fall within control of tribal landlords. According to Chaudhry (2010), the management of natural resources is usually ineffective and penalties for illegal activities are not prohibitive. Pakistan legislative process does not allow citizens to participate or have access to information in developing and implement natural resources laws (IUCN 2005).

No federal legislation exists to control freshwater pollution except for a few provisions under the Pakistan Environmental Protection Act of 1997 (PEPA). PEPA prohibits discharges and emissions in excess of national standards that may cause or likely cause an adverse environmental effect. Ahsan and Khawaja (2013) stated the administrative structure of agencies responsible for the PEPA are inefficient because decisions lie within one position at both the federal and provincial level, resulting in delays in enforcement of laws and rendering decisions subjective and 'devoid of collective wisdom.' Further, PEPA provisions do not override other statutes, review of environmental impacts is limited to new projects, and there are no provisions to analyze cumulative effects (IUCN 2005).

Federal laws pertaining to the agriculture sector provide no measures to mitigate the impact of agriculture on the natural environment. In 1960, the Indus Waters Treaty gave Pakistan the exclusive use of waters of the three western tributaries, the Indus, Jhelum and Chenab Rivers, and India has rights to the eastern rivers, Sutlej, Beas and Ravi Rivers to their entry point to Pakistan (Archer et al. 2010). The Treaty enabled Pakistan to irrigate areas on the eastern rivers, which included the construction of dams and canals (see Section 2.3.2.1). In 1991, Punjab, Sindh, and Blochistan Provinces signed the Water Apportionment Accord, which established quotas on water allotment from the Indus River. The Accord established a threshold of 12.3 km^3 annual water volume entering the river delta downstream of Kotri Barrage. Kravtsova et al. (2009) report the Accord threshold has not been fulfilled and the runoff downstream of the Kotri Barrage is much less than 12 km3/year.

The Fisheries Act of 1897 operates at the provincial level and forbids the use of explosives of poison for the purpose of fishing, but allows local governments to modify the prohibitions in specific areas (IUCN 2005). The Fisheries Act also allows local governments to regulate construction of weirs, use of fishing gear, and prohibit fishing in an area for up to a period of 2-years. In Sindh Province, laws under the Fisheries Act have resulted in over harvest of fish and an increase in illegal fishing practices, such as overnight netting, pesticide poisoning, and fishing without a legal permit (Waqas et al. 2012). The Fisheries Act allows for enforcement of violations, but data on enforcement are lacking.

Specific to Indus River Dolphin

The Indus River dolphin has been listed as endangered in IUCN Red Data Book since 1976. The species is on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), meaning the species is threatened with extinction and trade of the species (whole or parts) is prohibited except in exceptional cases such as scientific research. There are 182 Parties to CITES, including Pakistan who joined in 1976.

The Sindh Wildlife Act of 1972 prohibited hunting of Indus River Dolphin in the Sindh Province. In 1974, the Punjab Wildlife (Protection, Preservation, Conservation, and Management) Act was passed prohibiting take of dolphins with exceptions to for scientific or public purposes in Punjab Province (Reeves et al. 1991), and the definition of public purposes is not defined. In 1975, the Khyber Pakhtunkhwa, Wildlife (Protection, Preservation, Conservation and Management) was passed prohibiting the take of dolphins. Also in 1974, the Indus Dolphin Reserve was established along a 190 km stretch of the Indus River between Guddu and Sukkur Barrages. The Indus River Dolphin population has increased in the Reserve, indicating the Reserve's establishment has been effective at protecting the dolphin from hunting. However, other human activities (e.g., fishing, pollution discharge) which impact the dolphin still occur within the Reserve (Braulik et al. 2015b). In 2014, part of the Indus River between Taunsa and Gudda Barrage in the Punjab Province was designated as a protected area for the Indus River dolphin, and there is interest in establishing protected areas in the Khyber Pakhtunkhwa Province (Braulik et al. 2015b). However, establishment of protected areas does not guarantee effective conservation. Of a total 25 protected areas in northern Pakistan, 22 do not have a management plan, and 19 lack management infrastructure (Nawaz 2007 cited in Braulik et al. 2015b). Also, funding and staff support for wildlife protection agencies in Pakistan is a chronic problem (Awan and Shah 2012). The Sindh Wildlife Department office in Sukkur lacks vessels to conduct enforcement patrols, and officers often must rely on their own means to travel the river. Thus, documentation of violations of the laws protecting the Indus River dolphin is essentially opportunistic. Although most citizens in Pakistan respect the Islamic injunction against consuming dolphin meat, other byproducts such as its oil is used for medicinal and domestic purposes (Gachal and Slater 2003).

Summary

Pakistan's federal laws are delegated to the province or tribal level. Few national standards apply, which may result in inconsistency in applying federal laws across jurisdictional boundaries. Federal laws are based on the premise of sustainable use and generally lack provisions to conserve and protect natural resources. Laws directly related to the Indus River dolphin may have resulted in benefits to the species (e.g., Indus Dolphin Reserve), but are limited to direct take and do not address broader threats (e.g., pollution, water extraction). Staff and funding resources are a chronic problem for wildlife agencies in the Sindh Province, which is where key populations of the Indus River dolphin occur. For these reasons, we conclude the Indus River dolphin continues to be threatened by the inadequacy of existing regulatory mechanisms.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Climate Change

Climate change is likely to negatively impact freshwater dependent cetaceans. For example, climate disruption is expected to cause dramatic changes in the ecosystems the Ganges and Irrawaddy dolphins in the Sundarbans of Bangladesh depend upon (see Smith et al. 2010). The Indus River dolphin ecosystem relies on glacier water, with melting of Himalayan glaciers accounting for 70-80% of its source water (Qureshi and Ali 2011). Himalayan glaciers have receded in the last century (e.g., Chaudhry 2010; Eriksson et al. 2009 cited in Archer et al 2010). However, some glaciers in the higher watersheds appear to be thickening and advancing in some areas (Hewitt 2007). In addition, the Indus River also depends on seasonal snowmelt and rainfall. Winter precipitation may have a greater impact than glacial melt on the Indus River flow (Archer et al 2010). Melting of seasonal snow at middle latitudes accumulated during the preceding winter and spring contributes substantially to the Indus River. Historical trends in winter participation show an increase between 1961 and 1999 (see Archer et al 2010). Precipitation in the summer months is predicted to increase in frequency and intensity across the Indian sub-continent (The Intergovernmental Panel on Climate Change (IPCC) 2007). Based on certain climate models, the Indus River discharge is predicted to increase 44.1% by 2050 (Palmer et al. 2008). According to Braulik et al. (2015b), the Indus River dolphin may benefit from the predicted flow increase as long as water conservation practices are implemented in the future. Water conservation practices are currently poor to nonexistent (see Sections 2.3.2.1 and 2.3.2.4). In addition, other processes including the El Nino Southern Oscillation affect precipitation in the region, which further contributes to uncertainty about climate change impacts on the Indus Basin (Archer et al 2010).

Temperatures across Southeast Asia have increased at a rate of 0.14°C to 0.20°C per decade since the 1960s, resulting in an increase in the number of hot days and warm nights (Hijioka et al. 2014). Braulik et al. (2015b) report the Indus River dolphin has evolved the capability to cope with temperature fluctuations and may be more resilient to increases in water temperature due to climate change. However, effects of climate change on their prey and ecosystem are unknown and remain a concern.

Given the diversity of sources of water for the Indus River and complex climate processes in the region, predicting the severity of impact climate change will have on the Indus River dolphin and its ecosystem may be difficult.

Fisheries

Indus River dolphins are accidentally captured in fishing gear mainly in side channels and adjacent pools along the Indus River where fishing activity is greater due to higher densities of fish (Braulik et al. 2015b). However, entanglement is increasing in the main channel with an increase in the use of motorized boats that can better navigate the swift current. In addition, participants in the fishing industry increased after 2007 when an old fish contractor system was abolished and locals were allowed to obtain their own license to fish (Braulik et al. 2015b). In 2011 a total of 45 dead dolphins were found along the river banks or impinged on the barrages (Waqas et al. 2012). The data are not broken down by mortality source, but of the total strandings, at least 6 dolphins were killed within the Indus River Protected Area when insecticides were dumped into the river to increase fish catch (WWF-Pakistan 2011 cited in

Braulik et al. 2015b). The Sindh Wildlife Department recommended a ban on fishing from Guddu to Sukkur Barrage and submitted the proposal to the Sindh Chief Minister for approval (The Nation news article March 09, 2012), but it is unknown whether the ban was implemented. In 2015, the Express Tribune, Sunday Magazine, quoted the Chief conservator of the Sindh Wildlife Department, Javed Ahmed Mehar, "illegal nets and fish poisoning are the biggest threats to Indus river dolphin today." However, from 2013 to 2014, only six dolphin deaths have been reported. The decrease may be due to increased enforcement and community awareness (Braulik et al. 2015b).

Conservation Efforts

The World Wildlife Fund-Pakistan (WWF-Pakistan) in collaboration with the Sindh Wildlife Department began operations in 1992 to rescue dolphins stranded in irrigation canals, which has reduced dolphin mortality (Waqas et al. 2012). Animals have died during capture, which may have been due to stress related to the capture rather than the entanglement event. Dolphins that survived were transported and released, but post release monitoring was not conducted (Braulik et al. 2015b). WWF–Pakistan also participates in the global Better Cotton Initiative, which promotes best management practices for cotton farmers. The aim is to reduce water use in agricultural practices and improve water quality by reducing pesticide use in cotton farming (Kahn et al. 2010). WWF-Pakistan is also involved establishing community-based organizations to improve livelihoods of fishermen communities. Ten community-based organizations established in the Sindh and Punjab Provinces has raised awareness in local communities on the value of biodiversity. One of the communities, Indus Welfare Foundation, established on the west bank of Taunsa Barrage, is raising awareness among communities to conserve the Indus River dolphin (Express Tribune, Sunday Magazine, July 12th, 2015). In 2010, WWF-India established the River Watch Concept to survey and monitor biodiversity in several rivers including the Beas River where the small population of the Indus River dolphin occurs (Khan 2013).

In 1975, Pakistan joined the Ramsar Convention, and the Indus Dolphin Reserve between Guddu and Sukkur Barrages was designated Ramsar site in 2001 (Khan 2006). Conservation initiatives include rescue of dolphins, improved agricultural practices, and monitoring of water quality (Kahn et al. 2010). In 2006, Pakistan established the Pakistan Wetlands Programme to promote economic growth while protecting the nation's natural resources. Pakistan has been working with Punjab, Khyber Pakhtunkhwa, and Sindh Wildlife Departments in collaboration with communities on initiatives under the Pakistan Wetlands Programme to help conserve the Indus River dolphin in its entire range. Work has focused on causes of biodiversity loss, specifically linking the protection of the Indus River Dolphin with measures in the agricultural and fisheries sectors. The Programme works with key stakeholders and local communities along the main Indus River (Waqas et al. 2012).

Summary

Climate change is likely to result in adverse impacts to the Indus River dolphin. The species may benefit from a predicted increase in water flow, but the perceived benefit is contingent on adoption of adequate water conservation practices. The diverse sources of water that feed the Indus River and complex climate processes in the region, make it difficult to predict the degree of impact climate change will have on the Indus River dolphin and its ecosystem. Entanglement

in fishing nets and the use of poison for fishing remain a threat to the Indus River dolphin. Efforts to rescue dolphins have reduced mortality and community outreach programs have raised awareness of the value the Indus River dolphin contributes to biodiversity in the region. Information is lacking on whether these conservation efforts are sufficient to abate the threats to the Indus River dolphin. For these reasons, we conclude the Indus River dolphin continues to be threatened by other natural or manmade factors affecting its continued existence.

2.4 Synthesis

The Indus River dolphin population consists of about 1,400 dolphins distributed among six subpopulations. Only one subpopulation—Guddu-Sukkar—appears to have increased approximately 5.65% each year between 1974 and 2008. The apparent increase may be due to several factors: (a) differences in survey methods and not a true trend; (b) high carrying capacity; (c) a ban on hunting instituted in 1972 resulting in population increase in the area; (d) immigration from other populations (i.e., dolphins from populations upstream may pass through irrigation barrages when gates are fully open); and (e) or some combination of these factors. The Indus River dolphin's range has declined by 80% over the last century. Currently, approximately 99% of the population occurs in only 690 km of the Indus River. The species' historical range has been fragmented into 17 river sections by barrages used for agriculture. The Indus River dolphin has been extirpated from ten river sections, persists in six, and is of unknown status in one section. Extirpations occurred between 20 and 80 years ago, mainly in upstream populations. Remnant subpopulations are as small as two to 18 dolphins, which are less resilient to stochastic events due to the effects of inbreeding and loss of genetic diversity (see Section 2.3.1).

The Indus River dolphin's habitat has and continues to be severely modified and fragmented through water extraction systems (i.e., dams, canals, barrages). In addition, water quality has been degraded due to lack of treatment of municipal, agricultural, and industrial waste. This may have long-term consequences on the health of the Indus River dolphin and viability of its subpopulations, but data are currently lacking. The Indus River Dolphin was hunted for its meat and oil (for medicinal and domestic use) up through 1970s. Directed hunting is prohibited, but poaching may still occur in some provinces. Laws directly related to the Indus River dolphin may have resulted in benefits to the species (e.g., Indus Dolphin Reserve), but are limited to direct take and do not address broader threats (e.g., pollution, water extraction). Staff and funding resources are a chronic problem for wildlife agencies in the Sindh Province, which is where key populations of the Indus River dolphin occur. Climate change is likely to result in adverse impacts to the Indus River dolphin. The species may benefit from a predicted increase in water flow, but the perceived benefit is contingent on adoption of adequate water conservation practices. The diverse sources of water that feed the Indus River and complex climate processes in the region, make it difficult to predict the degree of impact climate change will have on the Indus River dolphin and its ecosystem. Entanglement in fishing nets and the use of poison for fishing remain a threat to the Indus River dolphin. Efforts to rescue dolphins have reduced mortality and community outreach programs have raised awareness of the value the Indus River dolphin contributes to biodiversity in the region (see Section 2.3.2).

In summary, the Indus River dolphin exists in a fragment of its historical range and some populations are extremely small and vulnerable to extirpation. Water use, pollution, and

fisheries practices are major threats to the Indus River dolphin's continued existence. For these reasons, we conclude the Indus River dolphin is currently in danger of extinction throughout all or a significant portion of its range.

3.0 RESULTS

3.1 Recommended Classification:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist (*Indicate reasons for delisting per 50 CFR 424.11):*
____ *Extinction*
____ *Recovery*
____ *Original data for classification in error*
_X__ No change is needed

3.2 New Recovery Priority Number: N/A

3.3 Listing and Reclassification Priority Number, N/A

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

NMFS, in coordination with the State Department, should continue to encourage Pakistan to conserve the Indus River dolphin.

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NATIONAL MARINE FISHERIES SERVICE 5-YEAR REVIEW
for the Indus River Dolphin *(Platanista gangetica minor)*

Current Classification: Endangered

Recommendation resulting from the 5-Year Review

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__**X**_ No change is needed

Review Conducted By: Therese Conant

HEADQUARTERS APPROVAL:

Assistant Administrator, NOAA Fisheries

___✓___Concur _____ Do Not Concur

Signature_____ Date 9/12/16