Report of the South Asian River Dolphin Task Team Workshop

Kuala Lumpur, Malaysia, 19-21 July 2019

Report of the South Asian River Dolphin Task Team Workshop[1]

CHAIR'S SUMMARY

The threats to South Asian river dolphins (genus *Platanista*: the Ganges river dolphin (*Platanista gangetica gangetica*) and the Indus river dolphin (*P.g. minor*) are myriad. Habitat alteration, degradation and loss affects the entire range of the species across all four range states. Discussion and deliberations within the Scientific Committee (SC) led to the formation of a Task Team, in 2017, to assess emerging issues from across the species' range. The IWC creates task teams to provide timely advice on situations where populations of cetaceans are known or suspected to be in danger of significant decline that could lead to extirpation or extinction, with the ultimate aim of ensuring that this does not occur. The Asian River Dolphin Task Team (AR-TT), convened by Sutaria and Kelkar, invited a group of river dolphin researchers to meet in an intersessional workshop to discuss progress towards achieving the AR-TT aims. A key objective of this workshop was to develop a trans-national plan that coordinated research efforts among range states and regions.

In particular, the workshop aimed to:

(a) identify information gaps and research priorities for South Asian river dolphin populations;
(b) identify research projects that require coordinated effort and sharing of expertise;
(c) identify key threats across the entire range of the species and any region, or country-specific threats; and
(d) communicate the results of the workshop to government agencies and other bodies concerned with river wildlife conservation.

The workshop was held between 19-21 July 2019 at the University of Nottingham, Kuala Lumpur, Malaysia, and was attended by members of the IWC SC and river dolphin experts from each range state – Bangladesh, India, Nepal and India. A review of the species' taxonomy indicate that two independent lines of evidence, morphological and mitochondrial, strongly suggest that the two subspecies currently recognised should be elevated to species status. The workshop supported the proposed taxonomic revision based on the evidence presented. Updates of population status were presented from each of the range states and it became apparent from the country updates that a substantial part of the dolphins' habitat (>80%) had been altered by river flow regulation measures or construction. Overall, mortality as a result of bycatch was recognised as the second greatest threat to river dolphins, following habitat fragmentation.

Five themes were discussed in detail: dams, hydro-climatic change and water availability; population surveys and ecological modelling approaches; dolphin bycatch; other types of interactions with fisheries; and human use of the animals (aquatic wildmeat) – all with the goal of identifying practical conservation solutions and emerging issues.

Following the deliberations of this workshop, the South Asian River Dolphin Task Team recommended that:

- By 2022, all range states identify key sections of national habitat that should be surveyed every five years, so that population trends can be monitored. Methodology should be replicated in each identified habitat but need not be standardised throughout the range, as different habitats require different methodological adaptations. This recommendation is targeted at the following:
  - Pakistan: WWF Pakistan, Punjab Wildlife Department, Sindh Wildlife Department and KPK Wildlife Department – co-ordinated through WWF Pakistan.
  - Nepal: Department of National Parks and Wildlife Conservation, Department of Forest and Soil Conservation, WWF Nepal, Institute of Forestry Pokhara and Hetauda Campus, University of Tribhuvan (co-ordinated by Shambhu Paudel and Usha Thakuri).
  - Bangladesh: Forestry Department and WCS.
  - India: India's Conservation Action Plan for Ganges dolphins, State Forest Departments.
- All existing survey methods in use for population estimation be reviewed, and a decision system prepared to guide monitoring agencies and conservationists to identify and implement statistically robust and optimal survey methods based on river conditions and available survey resources.
- Starting from 2020, surveys to establish population size be initiated as early as possible in the Padma, Jamuna and Meghna mainstems and tributary networks (excluding the Bangladesh Sundarbans), Bangladesh and the Budhi Gandak, Baghmati, Rapti and Mahananda, India.
- The review of Platanista taxonomy be completed and published.

[1]Presented to the IWC Scientific Committee as SC/68B/REP/04.

- As a priority, studies be conducted to better understand movements of dolphins across barrages in all countries and quantify the extent of population connectivity and impacts on dolphin populations in fragmented riverine habitats.
- Pingers be assessed as an effective tool, both to minimise bycatch and to reduce the risk of dolphins becoming strand in canals.
- A feasibility study be conducted to assess areas and methods to translocate Indus River dolphins (WWF-Pakistan) and to adapt existing marine mammal translocation initiatives specifically for river dolphins (co-ordinated by the Society for Marine Mammalogy and IUCN).
- As a priority and with data currently available, assess the level of dolphin bycatch throughout the species' range and evaluate its impact on local populations. From the outcomes of this assessment, provide recommendations for future monitoring and actions to mitigate impacts, ranging from technical changes to the revision of fisheries policies.
- Assessment be undertaken of the extent of targeted take and the use of dolphins for oil and as wildmeat, particularly in India and Bangladesh, by involving social and ecological scientists – as part of co-ordinated survey actions listed above.

In conclusion, the AR-TT members agreed to start working towards fulfilling these recommendations through compiling data sets, taking forward ideas for joint and collaborative work, and planning additional workshops to fill the identified information gaps and research needs for each country. The AR-TT agreed to report progress on its actions to the Task Team Steering Committee intersessionally.

1. INTRODUCTION

In 2016, the Scientific Committee (SC) of the International Whaling Commission (IWC) agreed that South Asian river dolphins (genus *Platanista*), currently recognised as two subspecies, the Ganges river dolphin (*Platanista gangetica gangetica*) and the Indus river dolphin (*P.g. minor*), required prompt and coordinated action to better protect the species from escalating anthropogenic threats throughout its range. At the 2017 SC meeting, a presentation on the Indian inland waterways development and river interlinking projects highlighted the likely have large-scale impacts on the habitat and distribution of Ganges river dolphin populations (Kelkar, 2017). Due to the complexities of water sharing between the four South Asian countries where river dolphins occur, it was also clear that the issue would not remain limited to India, but would have basin-level impacts across the Indus-Ganga-Brahmaputra (IGB) and associated basins. The IWC had considered these emerging issues as significant threats to be addressed through wider transnational collaborations between the four countries and thus had advised the formation of a Task Team to assess these impacts and changes. The IWC creates 'task teams' to provide timely advice on situations where populations of cetaceans are known or suspected to be in danger of significant decline that could lead to extirpation or extinction, with the ultimate aim of ensuring that this does not occur. Thus, the Asian River Dolphin Task Team (AR-TT) was formed in 2017 and Sutaria and Kelkar were nominated as co-Convenors. As a first action, an intersessional workshop was proposed, the key objective of which was to develop a trans-national plan that coordinated research efforts between range countries and regions.

In particular, the workshop aimed to:

(a) identify information gaps and research priorities for South Asian river dolphin populations;
(b) identify research projects that require coordinated effort and sharing of expertise;
(c) identify key threats across the entire range of the species and any region/country-specific threats; and
(d) communicate the results of these studies to government agencies and other bodies concerned with river wildlife conservation.

The workshop was convened at the University of Nottingham, Chulan Campus, Kuala Lumpur, Malaysia, from 19-21 July 2019. There were eight participants representing all four range states. The participants list is provided in Annex A. The workshop report was presented and endorsed at the 2020 IWC Scientific Committee Meeting (SC68B) Virtual Meetings.

1.1 Opening remarks

Fernando Trujillo welcomed the participants to the workshop and thanked the AR-TT for their on-going contribution to the work of the small cetacean (SM) sub-committee of the Scientific Committee of the IWC.

1.2 Election of Chair and appointment of Rapporteurs

Trujillo was elected as Chair. Porter and Sutaria were appointed as rapporteurs.

1.3 Adoption of Agenda

An addition was made to the agenda to include an update on *Platanista* taxonomy to be presented by Braulik. Duly revised, the adopted agenda is given as Annex B.

2. THE CURRENT STATUS OF RIVER DOLPHINS IN SOUTH ASIA: WORKSHOP VISION AND SCOPE

Detailed initial discussions on the purpose and outcomes of the meeting and workshop were critical, as multiple conservation plans and initiatives were being considered (e.g. CMS Concerted Actions (CA) for South Asian River Dolphins, WWF Global

River Dolphin Initiative, and IUCN revisions of Red List Assessments for both *Platanista*). Many national action plans are either in place, or being discussed, in each of the range countries. Some of the task team members are also involved in providing CA recommendations for CMS assessments at COP-13, India, in 2020. Thus, it was important for the AR-TT report to identify specific targets and recommend conservation actions that could complement and advance the outcomes of these parallel, multiple initiatives.

Sutaria provided the opening presentation in which she discussed the inception of the AR-TT and the urgent need for such a trans-national mechanism. Sutaria stated that the AR-TT would have to be sensitive to various aspects of power dynamics: between individuals, between NGOs, between scientists and conservationists, and between countries and their governments. These power dynamics, being strongly historical and culturally embedded, might become a significant hindrance to the conduct and application of effective cross-border science and conservation for Asian River dolphins.

Sutaria highlighted that the current pressures of infrastructure and economic development in the South Asian region is inevitably applying tremendous pressure on *Platanista* habitats. In this context, she wondered how the team, as a group of scientists and conservationists, would work in spaces impacted by geopolitics and intensive development aspirations. She suggested that to do so, team members would not only need to let go of agendas, identities, and work collaboratively, but also be realistic of the processes and scales they effectively can and cannot influence. She summarised the core scientific objectives of the meeting with the hope that population monitoring, hydrological studies, data analysis, and studies to assess impacts of threats, such as bycatch, barrages (and other hydro-infrastructure projects), pollution, etc., could be developed so that robust and comparable methods could be used regularly across the species' range. Sutaria also discussed how the teams might benefit from the exchange of each individuals experiences and could help mitigate proximate threats, both locally and regionally. She appealed to the workshop members to focus on 'small and beautiful ideas', with practical and timely outputs by next year.

In discussion, Arshad noted that science should lead to management outcomes and stressed that priority should be given to obtaining scientific information that is required by managers who have to deal with real-world challenges and conservation priorities. Alom opined that using the Task Team platform as a coordinating body was important especially in the context of transboundary conservation problems. The audience of this reports recommendations were clarified, and it was noted that any recommendations made could be directed at various parties, including the SC, the IWC Conservation Committee and various range states. Therefore, it was clarified that different recommendations could be directed to individual groups or entities. The impact of any recommendations was also discussed. Sutaria stated that there was value in formal letters from different organisations and international consortia that the four national governments were signatories to. This official medium of communication could have an impact at the highest levels of governments, as official responses from country officers can be solicited. The communication between different international bodies (e.g. IUCN, CMS, WWF) was also considered, as was the various groups' communication with governments. It was concluded that coordination between these various groups was desirable, and that SM of IWC would endeavour to highlight the workshop discussions within SC and the Conservation Committee, as well as with other international bodies.

There was concern that 'mixed messages' might result from multiple and parallel groups discussing similar issues, with the recognised need to avoid this outcome. It was noted that having one strong organisation, open to collaboration and data sharing, can significantly reduce the decentralisation of key issues and avoid confusion. The long-term and regular presence of such organisations can also assist in more effective communication, as has been demonstrated by the work of WWF in Pakistan and WCS in Bangladesh. It was highlighted that having multi-institutional systems with overlapping mandates and boundaries increases the complexity of conservation project and may create conflicts over collaboration and information sharing mechanisms (e.g. the numerous groups working on river dolphins in India). It was hoped that the AR-TT and the assistance of IWC could provide an over-arching platform to maintain coordination and cohesion with regards to Asian river dolphin priority research and conservation goals.

2.1 Update on proposed taxonomic revision

Braulik outlined the current taxonomic status of Asian river dolphin. Indus and Ganges river dolphins are currently classified as subspecies, *Platanista gangetica minor* and *Platanista gangetica gangetica*, within a mono-typic family (Braulik and Smith, 2017). Braulik *et al.* (2014b) studied mitochondrial genetics and compared sequences from the Indus and the Ganges rivers and ascertained that there were no shared haplotypes, that there were five fixed differences between rivers, and a Bayesian analysis of divergence suggested that the two populations had been isolated for around 550,000 years. This supports what is known of the riverine geology and historical river drainage patterns. A comparison of skeletal morphology demonstrated that the shape of the frontals, behind the nasals, can be used to consistently differentiate skulls of the two sub-species. Indus dolphins have, on average, five more teeth than the Ganges dolphin. And while the Ganges dolphin show sexual dimorphism (females being significantly larger than males), this is not the case for the Indus dolphin, although data from the Indus range is limited. A proposal that the two subspecies be elevated to species status is being prepared (Braulik *et al.*, In prep-a). Braulik highlighted that the taxonomic split is important for conservation, beyond the scientific importance. The workshop supported the proposed taxonomic revision based on the evidence presented.

2.2 Perspectives from South America

Trujillo presented an overview of his 32-year research and conservation efforts for the river dolphin species in South America (across Brazil, Colombia, Bolivia, Ecuador and Peru). Trujillo highlighted similarities and parallels between South America and Asia, in terms of habitat pressures, human population pressures, and impacts of hunting and bycatch on river dolphins in both regions.

Trujillo updated the workshop on the current status of *Inia* and *Sotalia* taxonomy. Current evidence indicates that the genus *Inia* taxon likely includes four species; *I. geoffrensis* (main Amazon), *I. araguianensis* (Araguian-Tocantins), *I. boliviensis* (Bolivia), and *I. humboldtiana* (Orinoco), however at present only *I. g. geoffrensis* and *I. g. boliviensis* are recognised by the Society of Marine Mammalogy (SMM), whose taxonomy committee is recognised as the authority of all marine mammal species. The genus *Sotalia* currently comprises one coastal and one riverine species, *S. guianensis* and *S. fluviatilis*, respectively.

Trujillo described the extent of human pressure in the Amazon basin. Importantly, he debunked the popular perception that the Amazon basin was a pristine and largely unaltered riverscape. The Amazon region hosts 34 million people, of which just over 10% are indigenous tribes. Hydropower dams along the Andes headwaters drastically interrupt natural flow regimes and sediment supply to the plains, affecting between 15% to 55% of river dolphin habitat in the region (Araujo and Wang, 2014; Pavanato *et al.*, 2016). Trujillo also highlighted severe threats from agrochemical pollution, oil spills, and artisanal gold mining. Gold mining, both legal and illegal, has resulted in high levels of mercury pollution and toxicity, in both fishes and river dolphins. Mercury levels in fishes and dolphins varied from 0.1 to 3.9mg/kg, noting 0.5mg/kg is the recognised 'tolerable limit'. This is also a serious risk to human health.

Accidental bycatch and hunting of river dolphins in South America for aquatic wild meat varies across the region (IWC, 2020). In the 1970s, high bycatch in gillnets was recorded, but lately, threats from bycatch are coupled with targeted, illegal hunting of dolphins. Alarming estimates of dolphin mortality (*c.* 1,000 animals per year) were recently made for a small region of the Amazon River. In response, some countries have introduced a moratorium on fisheries that cause high bycatch and mortality, e.g. Brazil has declared a moratorium on Piracatinga fishing until 2020.

Trujillo detailed the ongoing range-wide effort to monitor populations of both *Inia* and *Sotalia*, using robust methodological approaches, utilising a combination of visual, acoustic and Unmanned Aerial Vehicle (UAV) surveys, to estimate population sizes and to map key habitats (Costa *et al.*, 2018; Oliveira *et al.*, 2017). Trujillo and others have coordinated surveys over 33,000km of river and across all five range states. Trujillo also highlighted the importance of obtaining population trends (Williams *et al.*, 2016), which are thought to indicate degrading freshwater habitats (Turvey *et al.*, 2012), while also monitoring dolphin health, seasonal and other movement patterns via satellite tagging studies, and social/foraging behaviors of river dolphins. The collective mission of these efforts has been to prioritise conservation actions in areas with the greatest known pressures.

In terms of conservation success, Trujillo has observed that South American river dolphin populations are better protected in and around Ramsar sites. He also highlighted the positive impacts of local fishing agreements and eco-tourism initiatives had had, in terms of reducing negative fishing impacts on South American river dolphin. He highlighted the utmost importance of coordinating trans-national efforts in the case of the Amazon, and the outcomes of coordination were summarised in a series of country-specific and regional action plans, including an IWC-CMP(s) or Conservation Management Plan(s), coordinated through the South American River Dolphin Initiative or SARDI (Trujillo *et al.*, 2010; Trujillo *et al.*, 2018).

The discussion that followed the talk mainly involved if, and how, similar coordination could be attempted within and across South Asian range countries of *Platanista* dolphins. Similarities and differences between the South American and South Asian situations were discussed. Participants reiterated the need to start by building technical capacity as well as communication platforms for similar coordinated surveys, situation-specific and priority-based studies, and sharing learning from different experiences.

2.3 Pakistan (Arshad)

Arshad thanked the long-term efforts of Braulik that have laid the foundation for the Indus dolphin research and conservation programme at WWF-Pakistan, and for the provincial governments of Punjab, Khyber-Pakhtunkhwa (KPK), and Sindh in Pakistan. Arshad also described the new WWF Global River Dolphin Initiative of WWF, and its Global River Dolphin Strategy or GRDS (2018-30, World Wildlife Fund [WWF], 2018) as being a major new effort towards river dolphin conservation in South America and Asia. In Pakistan, Arshad is in charge of implementing the recommendations of the GRDS for the Indus basin. He emphasised that the programme will be implemented under the 'Freshwater Practice' of WWF-Pakistan, to provide a holistic canvas for understanding the threats and implementing specific, targeted measures for river dolphins in relation to basin-scale water allocations for irrigation, power generation, and domestic use. The situation in Pakistan is very interesting from a management point of view: whereas the range of the Indus dolphin has shrunk by 80% from Anderson's 1879 baseline (Braulik *et al.*, 2014a), the population densities in two sections of the Indus river, between the Taunsa and Guddu, and the Guddu and Sukkur barrages, have been showing an increasing trend (Hamera *et al.*, 2017). In the upper and

lower sections of the Indus, and in its tributaries, Indus dolphins either persist in tiny populations or have been extirpated completely (the 5-11 strong population of Indus dolphins in the Beas River, India, is an exceptional case of an isolated remnant population of dolphins; (Braulik *et al.*, In prep-b; WWF-India, 2018).

Another significant issue is the high frequency of canal stranding of Indus dolphins in the Indus plains of Pakistan. Since 2000, nearly 150 dolphins have been 'rescued' from canals and released back to other sites on the river (Braulik *et al.*, 2015). Arshad showed data that indicated a nearly 90% success rate of rescue-release, i.e. 90% of the 150 individuals survived until release time. A 'dolphin ambulance' is run by WWF-Pakistan with the help of the Sindh Wildlife Department to respond to stranding cases and conduct rescue operations (Hamera *et al.*, 2017). Trujillo asked if any data on genetics, health, or other factors was being collected during these operations, because it was a great opportunity to do so. Trujillo suggested, based on his long-term data collection on Amazon river dolphins, that procedures for tissue sampling by skin-scraping and tail-bit collection will be helpful.

Satellite telemetry was also an obvious outcome of the discussion on stranded individuals captured by the dolphin ambulance. Toosy *et al.* (2009) had actually tagged a male Indus dolphin, which was tracked for 15-20 days. This dolphin moved upstream and downstream of the Sukkur barrage through the gates, when the gates were opened and the water levelled out. Telemetry studies were recommended by Arshad and other participants to understand movements of dolphins across barrages, as well as between the river and canals. Braulik said that Indus and Ganges dolphins needed customised tags and telemetry devices, due to their tiny surfacing times and the lack of a clear dorsal fin for anchoring tags. Porter suggested that customised tags can be developed on the lines of how technologies are being specifically developed for Irrawaddy dolphins in different habitats.

Arshad and Braulik also said that to deal with the peculiar issue of increase in dolphin densities and abundances in a shrinking range, assessing efforts for 'Conservation Translocations' is a priority. For this, WWF-Pakistan was interested in conducting a feasibility assessment of river stretches in the Upper Indus, to evaluate the habitat quality, prey availability, water availability, social indicators and the levels of all threats would be reviewed to assess whether translocated dolphins would be likely to survive well enough for small populations to be re-established (Braulik *et al.*, 2015; 2018; Khan, 2013). The idea is that, as a pilot effort, stranded dolphins rescued from canals, or from areas with extremely high densities (>10 dolphins per km) could be released in the sections with lower density. Arshad and Braulik also highlighted that consensus needs to be built between provincial governments prior to translocating animals from one province to the other. Translocations may be an important intervention in Pakistan in the near future. Discussions are in the early stages at present and unequivocal support is still wanting from all concerned authorities who will design and implement translocation programmes. Braulik identified the IUCN Guidelines on 'Reintroduction and Conservation Translocations' as a good starting point to prepare procedures for the rescue, captive maintenance, and relocation of Indus dolphins in Pakistan's context (Braulik *et al.*, 2018). At present, a draft concept note has been completed on the matter and is likely to be discussed with provincial departments in charge of permissions and clearances in Pakistan.

Arshad presented a graphic map from Braulik *et al.* (2014a) that highlighted the 'time since last sighting' of Indus dolphins in each of the river sections. The rapporteurs asked if a similar graphic could be prepared for all populations of the Ganges dolphins as well. To this, Kelkar replied that this was being undertaken for the IUCN Red List Assessment for Ganges dolphins, which is currently on-going.

Other important points highlighted by Arshad included the creation and maintenance of protected area networks for Indus dolphins (including the Indus Dolphin Reserve in Sindh, multiple Ramsar sites in the Indus river-floodplains, and potential new areas), legislative changes in fisheries policy, and the creation of a program for comprehensive ecologically informed water management that could ensure 'Conservation Assured River Dolphin Standards (CARDS)'. Arshad also identified themes of work in the Indus basin, from which funds had been secured also for monitoring and conservation efforts for Indus dolphins in Pakistan (which have included programmes on food security, livelihoods, water resources and climate change, and human development). He also flagged the issue of microplastic pollution in Indus dolphins based on a study recently conducted by a student at the Punjab University. An examined dolphin had 2,653 microplastic pieces, highlighting the grave extent of this problem.

Trujillo wanted to know if the WWF GRDS goal of doubling river dolphin populations in Pakistan would be realistic. Arshad replied that the more important aspect of this goal would be to increase the range of the Indus dolphin at least to some areas where it historically occurred (Anderson, 1879). He said that currently, all eggs were only in one or two baskets (the Taunsa-Guddu and Guddu-Sukkur populations on the Indus mentioned earlier). To ensure the rise of dolphin populations in more viable habitats, the number of baskets had to be increased by translocating adult dolphins to allow more areas to support populations, as explained before.

Kelkar asked for more detailed information on the 'revision of fisheries policy' that was emphasised by Arshad in his presentation. Arshad said that different fishing regimes exist on different stretches of the Indus. In Punjab province, fishing is commercial and intensive, and conducted under a system of leasing out river stretches to private contractors for fishing over one to a few years. In Sindh, however, the fishing is effectively an 'open-access' regime – whereby fishers can purchase

fishing licenses very cheaply (PKR 100 for one license for a year). This led to a significant rise in the number of fishers, activity of fishing gears, and intensity of fishing. Such subsidised licensing systems needed a critical review in order to make them more sustainable and socially just. Contractual fishing systems (as in the Punjab province) were likely to be exploitative of fishermen, while effectively open-access systems (as in Sindh) might lead to overfishing as well as conflicts. In response to Trujillo's query about the influence fish traders hold on the fishery (as in South America), Arshad replied that traders indeed hold sway on how specific areas of rivers under contracts are fished. Both regimes have had impacts on Indus dolphins in terms of accidental bycatch, but hunting had reduced substantially as a result of extensive awareness campaigns and monitoring by provincial wildlife departments and WWF-Pakistan. As the Indus dolphin populations had been increasing both under the contract regime and the open-access system, at present it is not easy to establish a causal relationship between the institutional regimes and negative interactions of dolphins with fisheries.

Finally, Arshad identified that alternative livelihood systems to support fishing communities without increasing their impact and dependence on river fishing was important. This was attempted by WWF-Pakistan for about 3,000 families under a UKAID Global Poverty Action Fund (GPAF) programme.

2.4 Nepal (Thakuri/Paudel)

Thakuri gave an overview of the major threats and the current status of research and conservation efforts for Ganges river dolphins in Nepal. The species is protected in Nepal under the National Park and Wildlife Conservation Act (1973). River dolphins used to occur in four rivers of Nepal (Mahakali, Karnali-Mohana, Narayani, Koshi) but are now found only in three rivers (they are extinct from the Mahakali). The total population size in the three rivers may not be more than 28 animals (Paudel *et al.*, 2015). Dolphins have been extirpated from some upper segments of the Karnali, Narayani and Sapta Koshi recently, indicating a range contraction (Khanala *et al.*, 2016). Barrages on the India-Nepal border and irrigation intakes (e.g. Upper Karnali Hydropower dam, Rani Jamuna Kulariya Irrigation Intake) remain important threats and continue to affect river dolphin habitats in these rivers (Smith *et al.*, 1994). Four cases of mortality due to entanglement/targeted killing were recorded from the Karnali and Sapta Koshi. One animal was found trapped in the gates of the Koshi barrage. This level of mortality can be highly significant for the small persisting populations. In the Sapta Koshi, dolphins with broken snouts and injury marks have also been recently observed, which could indicate potential conflicts between artisanal fisheries and river dolphins. Thakuri highlighted that there is stronger need for government engagement with the issue of river dolphin conservation. This applies not only to the Nepal Government, but also to trans-boundary management of barrages for ecological river flows between India and Nepal. India and Nepal have had bilateral water sharing treaties from the 1960s and the operation of the barrages is controlled by the clauses of the treaties. Although Nepal is geographically the upstream nation, India had built the border barrages in the 1960s. Based on water demand, India gets the larger share of water between the two nations.

Insufficient research and conservation funding for river biodiversity in Nepal were also cited as constraints, and the preparation of a conservation action plan for Nepal, including plans for sustainable fisheries management was recommended (Paudel *et al.*, 2016).

It emerged during the discussions that although transboundary biodiversity conservation and wildlife management plans exist between India and Nepal (Government of Nepal, 2018) for charismatic terrestrial megafauna (rhinos and tigers), a similar effort was wanting for Ganges river dolphins. Current research in Nepal is in the early stages but acoustic research and attempts at photo-identification based population size estimation are underway. Kelkar requested Thakuri to update the audience on the status of the large hydropower projects on the Karnali and other rivers. Thakuri responded that the second phase of construction of the Rani Jamara Kulariya Irrigation Intake and Upper Karnali hydropower project was on-going. It is deemed that once completed, these projects on the Karnali River might have significant impacts on river flows downstream. Kelkar also hinted at prospects for a biodiversity component that could be under discussion in the context of water sharing treaties and MoUs between Nepal and India.

Trujillo asked about the methods used to assess population size and whether the known numbers were believable, with a measure of uncertainty known. This would be important because Nepal's populations, in terms of numbers, might be at the highest risk. Braulik's comment was that if we compared the current population sizes with those recorded by Smith *et al.* (1994), it would appear that there has been no major change in population size. Probably there were never large populations of dolphins in Nepal, as the river stretches are not big enough to support an abundance of dolphins. The Karnali, for example, has numerous whitewater rapids, deep pools, and fast-flowing riffles, and the remaining river habitats might at best be marginal habitats for river dolphins (Khanala *et al.*, 2016). These rivers probably represent the most upstream extents of suitable habitat for *Platanista*. Kelkar agreed and also pointed out that the three rivers had interesting similarities and differences in hydrology and the nature of flow regulation by barrages. The extent of suitable river dolphin habitat upstream of these barrages and within Nepal varies, and the remnant population sizes could be related to the differential extent of floodplain. He said that this situation merited a study to understand what barrage operations might affect habitat availability for the small populations in Nepal. A map was also shown with the locations of the barrages on the three rivers.

Trujillo suggested that measurements of suitable habitat area in Nepal that might remain untransformed by dams and other human interventions would be a useful effort to undertake. Braulik added that studies to confirm whether river dolphins move through the barrages on the India-Nepal border will be critical, for their implications of regular movement are for local population connectivity and dynamics. In Nepal, the restricted lengths of their floodplain river stretches, above which mountainous areas and gorges begin, might naturally limit river dolphin habitat. The river flows in Nepal's plains are currently 'near-natural', altered only at minor levels by a few hydropower projects on mountain tributaries.

With regards to the issue of estimating dietary overlap between fishing catches and river dolphins, Alom opined that unless stomach content analyses were carried out, the estimate of dietary overlap would not be robust.

2.5 Bangladesh (Alom)

Alom summarised the extensive science, conservation, and outreach work being done by the Wildlife Conservation Society-Bangladesh (Alom *et al.*, 2014; Mansur *et al.*, 2014a; WCS and BCDP, 2014a; 2014b; 2014c), in the Bangladesh Sundarbans with the Forest Department, Ministry of Environment and Forests, Bangladesh (Forest Department *et al.*, 2015). Alom focussed on conservation interventions for *Platanista* in particular, with: (1) three river dolphin sanctuaries along deep pools in identified key habitats of the Sundarbans; (2) community engagement and outreach to reduce fishery impacts on river dolphins, especially accidental entanglement in fishing gears, and also occasional targeted killing; and (3) insights from fisheries monitoring and bycatch mortality reporting in the Bangladesh Sundarbans (Mansur *et al.*, 2014b). He stressed that fishing impacts were the primary conservation concern for Bangladesh's river dolphins by direct and indirect impacts.

In Bangladesh, between February 2007 and August 2019, 118 deaths of Ganges river dolphins were recorded by a cetacean mortality monitoring network maintained by the Wildlife Conservation Society (WCS). Most of these deaths (66.9%) occurred in waterways of the Sundarbans mangrove forest where a large portion of WCS activities are concentrated. This means that reporting rates are probably higher in this area compared to the river stretches upstream. The cause of death was known for more than half of the deaths (60 animals) of which 81.7% were due to entanglement in fishing gears. Dolphins were beaten to death (probably in retaliation for depredation) for 8.3%, hunted by harpoon for 5.0%, and fatally injured in boat collisions for 5.0% of the remaining mortalities, with known cause of death. Of the total number of fishing related mortalities when the gear type was known (41), 80.5% were in gillnets, 12.2% in set bag nets, and 7.3% were in long lines (WCS, unpublished data). The large percentage of dolphins killed in gillnets with large mesh-sizes in Bangladesh is consistent with what is known about the vulnerability of Ganges dolphins to this fishing gear in other areas of their distribution. This points to gillnets as a major threat that could drive the species to extinction in the absence of urgent interventions.

The use of SMART technology in patrolling and monitoring river stretches has been a key feature of increased effectiveness in fisheries monitoring and prevention of illegal fishing. Coupled with vast outreach efforts by WCS in fishing villages (Alom, 2015; Mansur *et al.*, 2014a), SMART patrols have led to both enforcement of fishing bans and no-go areas (e.g. over 4,300 gillnets and 1,140 small boats have been seized), as well as awareness among fishing communities. Outreach efforts have involved boat-based and land-based 'dolphin fairs', development of playing stations and interactive materials, and field-kits for fishers with manuals in the Bengali language for fishers and wildlife managers (equipped with fisheries seasonal calendars and information brochures on legal and illegal practices, mesh-size, species, and seasonal restrictions on fishing in particular areas). Alom expressed that securing sustainable financing mechanisms for developing community engagements has been a challenge, but so far there has been a fair measure of success in this regard (Iyer *et al.*, 2019).

Sutaria and Arshad asked Alom if the outreach materials they had prepared (and demonstrated by Alom in his talk) could also be made available to teams in other countries, to adapt, replicate, and use for educational activities. Alom replied that the materials were developed by the WCS Program with the purpose of wider dissemination and conservation outreach, and they were happy to share the materials.

Kelkar asked Alom to identify some measures of success, i.e. the effectiveness of the river dolphin sanctuaries in reducing gillnet entanglements, which was their objective. Alom responded that due to outreach efforts, reporting rates of bycatch or mortality cases had increased significantly, which he regarded as a measure of success. Fishers are not only keen to report on mortality cases, they also now realise that it is likely to provide them with economic and cultural benefits (e.g. by becoming conservation stakeholders rather than being viewed as antagonistic to dolphins). Increasingly, fishers have been learning that society values river dolphins for their intrinsic 'beauty' and their conservation is hence a must.

Braulik remarked that the Bangladesh work had been going on for a long time and involved the inspiring efforts of many people. She wanted to know how the small hotspot areas protected as dolphin sanctuaries worked as community-led reserves. Alom said that the entire Sundarbans region includes a Ramsar site, and is a World Heritage Site and thus are protected, while the local sanctuaries had the specific objective of reducing dolphin entanglements (Smith *et al.*, 2010a). Braulik also submitted that the major existing data gap on Ganges river dolphin population size was now from the rivers of northern Bangladesh (Padma, Jamuna, Meghna, and their tributary-distributary networks), and asked if WCS-Bangladesh was planning to survey this region, to arrive at a country-level population estimate for Bangladesh. Alom said that no proper or systematic surveys had been conducted in the rivers of northern Bangladesh so far, except for anecdotal information

and occurrence records (Baki *et al.*, 2017; Rashid *et al.*, 2015) that confirmed only the presence of dolphins. To put in place a survey of the entire river network in Bangladesh would be challenging, but needs to be attempted soon. Alom said that WCS could partner with other local NGOs and the government's environment departments to complete extensive surveys.

Arshad suggested that different activities conducted with fishing communities could involve options such as signing conservation agreements with industries that are promising labour and other employment opportunities to local rural fishing communities. It might be possible to argue that, because new jobs are becoming available in part due to conservation engagements, industries could be requested to support dolphin conservation programs in the long term.

2.6 India (Kelkar)

Kelkar provided a country update on India's Ganges river dolphin populations, describing existing and emerging threats. There are numerous teams from different institutions (including state-level forest/environment departments, university groups, government and non-governmental research institutes, NGOs and non-profits, etc.) involved in dedicated, long-term surveys of Ganges dolphin populations and threats in India. According to Kelkar, individual state-level environment and forest departments in India were best placed to bring all the different teams together and allow coordination. Apart from them, the Wildlife Institute of India's River Dolphin Recovery project (2016-21, Bihar, West Bengal, Assam) and WWF-India (for the states of Punjab and Uttar Pradesh) were thought to be important nodal organisations that could facilitate coordinated surveys in the future (see point 1 in the Recommendations of this report).

As a result of multiple teams working mostly independent of each other, different survey methods have been used in different areas. So far there has been no agreement on standardising methodology across the range, and most groups used single-observer, downstream survey methods that provide the bare minimum of 'direct counts', based on Smith *et al.* (2000). Kelkar took stock of the different methods in use across the species' range. He also described their own independent-observer double-observer survey methodology (used in the Ganga in Bihar, India), from small, basic country-boats with wooden platforms and shades built from bamboo poles and thatching materials. Improvisation of survey platforms from available materials was discussed further. Double-observer survey methods involving both visual observers, visual + acoustic observers, independent-, tracking-, and tandem observers were all discussed (Akamatsu *et al.*, 2013; Braulik *et al.*, 2012a; Kelkar *et al.*, 2010; Richman *et al.*, 2014; Smith *et al.*, 2006).

Braulik responded to Trujillo's question about whether there was a need for standardising methodology, saying that it was not easy, or perhaps even desirable, given the diversity of hydrological contexts across the numerous rivers of the region. Braulik emphasised that although the best methods need to be chosen given the river conditions (navigability, depth, geomorphology etc.) and resources available (skilled observers, boats, funds), it is not always possible. She said that ideally, if direct counts could be augmented by additional information (dive times, sightability models, etc.), then correction factors and estimators of bias (detection and availability) could be derived. These estimators could be used to upgrade the inferences that could be drawn from direct counts, with the necessary caveats. Direct counts might also be useful for basic comparisons of present studies with historical data.

Trujillo, Braulik, and Sutaria suggested that it would be good to review all methods for their effectiveness in population size and trend estimation. At present, apart from single-observer downstream counts, different types of double-observer surveys and upstream single-observer surveys are also in use. In some cases, bank-based surveys or interview surveys have also been used to detect occurrence of dolphins (Richman, 2014; Sinha *et al.*, 2010b; Turvey *et al.*, 2013). Based on the available design-based and model-based methods in use, if a decision system could be developed for teams to decide what survey would be most ideal for them to use, given their study area and available resources that could be a valuable document for reference. Porter and Trujillo suggested that the team try to compile a working paper on this issue, for the upcoming IWC/SC meeting in 2020.

Kelkar gave an overview of the population sizes and trends known from different rivers across the Ganga and Brahmaputra basins in India. Kelkar, Braulik, and other co-authors are working on the IUCN Red List Assessment for Ganges dolphins this year, and have synthesised this information already. In the Assessment, they are following a method similar to Braulik *et al.* (2014b) used for Indus dolphins to estimate range reduction of Ganges dolphins. From this estimate, an approximate range reduction of 20% in the Ganga River and 35% in the Yamuna River. The northern tributaries of the Ganga (Ghaghara, Gandak, Kosi) have also witnessed minor range reductions (<10%) in this time. Dolphins might have been extirpated from the Ramganga, a major northern tributary of the Ganga (Sinha *et al.*, 2010b). Canal strandings of Ganges dolphins are also being reported from the Ghaghara-Sharda canal networks over the last few years (Prajapati, 2018). The Brahmaputra was the river with the least range reduction (probably <5%). Ganges dolphins appear to have been extirpated from all southern tributaries of the Ganga and Yamuna, except for the Chambal River (Singh *et al.*, 2014; Sinha and Kannan, 2014). Most of these rivers have multiple dams, and dry-season flows have been reduced to almost zero. These rivers originate in the Indian peninsula and are not snowmelt-fed (see summary of discussion theme 1 for more details). However, in three major northern tributaries of the Ganga (Ghaghara, Gandak, Kosi), dolphin populations appear to be significant (>150 animals at least). The Mahananda, another major tributary remains unsurveyed (except for a small stretch), along with the Rapti, Budhi Gandak, and Bagmati rivers. Choudhury *et al.* (2019) reported the local extinction of a 10-15 strong dolphin population from 2000 onwards in the Barak River, Assam, India.

Kelkar also highlighted the collective learning from long-term research and conservation work at Bihar, India, in which he is involved. Kelkar represented the basic and applied research efforts of their informal and collaborative effort by researchers from various institutions. He spoke about three arenas of their research: (1) on the effectiveness of protected areas for Ganges dolphins (Kelkar, 2015); (2) on the interactions between water availability and fisheries bycatch risk to dolphins; and (3) acoustic studies to assess impacts of underwater noise from vessel traffic on river dolphins. In his presentation, Kelkar highlighted three broad findings of interest. It was found that large-scale hydrological changes had stronger impacts on river dolphin densities and persistence as compared to local fishing impacts. Kelkar also said that this result was likely because their study area was located in the middle Ganga River, where annual discharge was much higher compared to upstream reaches. Dolphin densities were also found to be very similar within the river stretch of the Vikramshila Gangetic Dolphin Sanctuary and stretches upstream and downstream (see (Choudhary *et al.*, 2006; Kelkar, 2015) for details).

India has plans to commercially develop inland waterways on about 100 of its rivers, which include most rivers of the Ganga and Brahmaputra plains. It is predicted that rapidly increasing vessel traffic and dredging for waterways development and maintenance might negatively impact Ganges river dolphins. Kelkar also shared the main findings of a recent study by their team. The study (Dey, 2018) showed that underwater noise resulting from increased vessel traffic was found to severely impact Ganges river dolphins in terms of elevated metabolic costs from altered acoustic activity and frequency levels.

Kelkar said that there was a need to ask large-scale and crosscutting research questions in order to understand and respond to various conservation threats to river dolphins in an adaptive manner. He provided some examples where comparative research across different basins with certain similar variables (e.g. barrage effects, dolphin populations in link canals, etc.) could provide vital specific as well as general insights. He also said that closely observing hydro-climatic change in the Indus-Ganga-Brahmaputra and associated basins will be critical to make predictions about emerging threats.

2.7 Country review discussions

From the country updates, it became apparent that a substantial part (in the region of approximately 80-90%) of the habitat of Ganges and Indus dolphins was altered by some level of river flow regulation by dams and barrages (Reeves and Smith, 1999; Smith *et al.*, 2000). The rivers of Nepal and the Brahmaputra probably had the least level of flow regulation, but it was not entirely absent if one included hydropower projects on headwater tributaries of each of the rivers. Braulik and Kelkar reminded the team that the estimate of affected habitat could vary based on what criteria are used for the extent of flow regulation. For instance, a recent multi-author study in the journal *Nature*, on 'mapping the world's free-flowing rivers' (Grill *et al.*, 2019) included only high storage dams (but not barrages) in their definition of flow regulation. This meant that many rivers in the Gangetic plains (especially northern tributaries like the Ghaghara, Gandak, Kosi, etc.) were considered 'free-flowing' in spite of having barrages. Bycatch mortality was the second major threat common across countries.

3. DISCUSSIONS

3.1 Theme 1. Dams, hydro-climatic change and water availability for South Asian river dolphins

Across the range of *Platanista* dolphins, adequate water availability is critical for maintenance of habitat (deep pools) and longitudinal connectivity along the river during the dry season. How much water dolphins need to persist in regulated rivers is a very important aspect of river dolphin conservation. In this discussion, the team shared scenarios known to them about 'minimum flows' and 'ecological flows'. Most of the range of the Indus and Ganges dolphin is strongly influenced by barrage and dam operations, which decide how much downstream as well as upstream habitat is available for dolphins. The Indus and Ganga basins are the most flow-regulated, while the Brahmaputra is the least. Among the countries, Pakistan and India have the highest levels of flow regulation, and Nepal has the lowest. In most of the region, studies on ecological flow measurements and assessments are important. It was agreed that e-flow assessments have to be specific to the context and history of each of the dams and barrages.

For comparative studies, it is important to have common metrics for evaluating river dolphin responses (in terms of population densities and spatial distribution) to river discharge. Kelkar introduced some remotely sensed hydrological datasets available online for free use under the creative commons, which could be used across major rivers for discharge measurements. This would make estimates of flow comparable across rivers, as biases or measurement errors are already known for these datasets. It is easy to ground-truth the satellite-based data from direct field measurements or from published data sources for river discharge.

A future exercise could be to assess river dolphin densities and distribution in response to discharge values across the range. This can help identify temporal and spatial trends emerged over the last 20 years, from which most systematic monitoring data are available for different rivers.

Pakistan provides freely accessible daily data on barrage discharge online. In India, Bangladesh and Nepal, river discharge data appear to be available upon request. India is perhaps the only country that assigns 'classified information' status to river flow data across the Indus, Ganga, and Brahmaputra river basins, perhaps due to the implications for trans-boundary water sharing with its neighbours. As a result, data is available only to Indian researchers upon special request.

Arshad spoke about imminent discussions on environmental water management (by IWMI, IUCN, and WWF) in Pakistan to commit and ensure flows through the Indus Delta of between 5 million acre-feet per year (4,055m^3/s) or 25 million acre-feet (20,275m3/s) in 5 years to the sea. He believed that Pakistan could use these estimates to test their importance for ecology and help improve baselines and estimate flows for Indus dolphins in particular. The Prime Minister of Pakistan heads the National Water Council and it would be a good idea to discuss e-flows as a key part of agenda items. Managing water utility in irrigation is a very high priority for Pakistan.

In India, e-flow studies are on-going in some rivers for assessing how barrage operations might translate into adequate discharge to maintain dolphin habitat and sustain populations downstream (in terms of river depth, longitudinal connectivity, flow velocity, and channel geomorphology). Kelkar shared that such studies were underway in the Upper Ganga, Gandak, and Kosi rivers at present. Depth requirements have already been studied in some detail for the alluvial rivers in India, as well as in Nepal and Bangladesh (Bashir *et al.*, 2012; Choudhury *et al.*, 2012; Kelkar *et al.*, 2010). However, detailed e-flow studies are still needed. For Bangladesh, the downstream impacts of barrages on the India-Bangladesh border (e.g. Farakka: Gain and Giupponi (2014) and for Nepal, the upstream effects of barrages on the India-Nepal border need to be studied (Smith *et al.*, 1998; Smith *et al.*, 1994).

Braulik said that in general, water availability and connectivity improve from west to east if one travels from the Indus to the Brahmaputra and the Ganga-Brahmaputra delta and the Sundarbans. In the Indus, upper Ganga, and Ghaghara basins, dolphins were found stranded in canals quite regularly. Kelkar said that the southern tributaries of the Ganga have always been more water-stressed than the northern tributaries, as the former do not receive glacial melt and dry-season base flows are strongly influenced by groundwater extraction. The northern alluvial tributaries had much shallower groundwater aquifers and led to greater recharge of river base-flows in the dry season.

The discussion between the participants on new, upcoming dams and hydropower projects underscored the importance of producing a map showing all rivers with dolphin populations, and all dams and barrages that affected historical and current dolphin distribution and densities, to update information in Sinha *et al.* (2000), Smith *et al.* (2000), Braulik and Smith (2017). Trujillo said that recommendations on the need to study ecological flows needed to be very specific. Alom and Kelkar said that while at present, the Brahmaputra basin had the relatively least flow regulation, upcoming controversial dam projects on the India-Bangladesh border needed a close watch.

Due to the current development of inland waterways in India, and its recent extension through India-Nepal and India-Bangladesh bilateral MoUs (Anon., 2018), there might be trade-offs and implications for water sharing between these countries. Waterways could potentially even lead to greater seasonal water availability in some river stretches. However, the other impacts of waterways (from dredging, increase in river pollution, port construction, river channel modifications, etc.) could increase and likely undo or even suppress any possible positive effects of flow availability.

Braulik suggested the importance of research to assess river dolphin movements across barrages within and between countries. She said it will be important to conduct studies across different barrages to see what operations might allow for dolphin movements through barrages both in the flood and dry-season (Braulik *et al.*, 2012b). In Pakistan, Braulik and Arshad will try to bring together engineers, biologists, and statisticians in a workshop to discuss the concept and come up with some technical options to monitor movement through canals, and also potential mitigation measures to avoid issues like canal strandings, such as bubble curtains on canal gates, for example. In this context, Braulik also said that it would worth testing if pingers could deter dolphins from entering canals. Alom and Kelkar responded that pinger trials conducted in Bangladesh (Smith, 2013) and India did not yield very encouraging results, but more research and field trials were still needed.

Participants discussed whether it would be feasible to rejuvenate rivers where dolphins had become locally extinct, with the aim of reintroducing dolphins to these areas. Ecological flow management was not important not only for quantity of river flows, but also their quality. Water chemistry monitoring and measurements have been done in many rivers, but the data needed to be compiled together in the context of ecological flows. This was similar to the status of floodplain and flood management plans that existed in all countries, but specific links with river dolphin habitat maintenance needed more studies. Kelkar had mentioned in his presentation that they found a positive response of river dolphin densities to flood strength and extent in Bihar, India, showing that dolphins will respond in terms of spatial distribution to riverine productivity, which could be maintained by near-natural regimes of flooding.

Actions

(1) A map of all dams and barrages in the historical and current range of dolphins.
(2) Comparative studies on ecological flows across regulated rivers with common hydrological datasets.

3.2 Theme 2. Population surveys and ecological modelling approaches

The outcomes of the discussion on survey methodology during Kelkar's presentation can be summarised as: (1) at present, multiple different methods are in use across different rivers, some of which might not be able to present very clear and statistically meaningful trends; (2) there is a need to develop a working paper that provides a comparative summary and

decision framework on the best methods to use, according to river conditions and survey resources available; (3) the priority is to fill existing gaps in population size and distribution across the range; and (4) continue monitoring of trends where possible, and try to estimate correct trends where disparate survey methods exist but long-term survey data are available. These activities will help in the ultimate aim of getting range-wide estimates that can be monitored over the coming years with coordinated surveys within each of the four countries.

The Wildlife Institute of India coordinated large-scale, multi-team surveys in the states of Bihar, West Bengal, and Assam, 2017-18 (Wildlife Institute of India, 2018; Wildlife Institute of India (WII-GACMC), 2017). The Bihar Forest Department coordinated surveys across Bihar in 2018 and WWF-India, along with the Uttar Pradesh Forest Department surveyed the rivers of Uttar Pradesh in 2013-14 (Behera *et al.*, 2014). These two efforts led to a major upgrading of country-wide population estimates for India. After these efforts, the only rivers with potential dolphin populations left to be surveyed are the Mahananda, Budhi Gandak, and Bagmati in Bihar, and the Rapti in Uttar Pradesh. These rivers could be surveyed by early 2020. Surveys carried out by the Wildlife Institute of India and others in the Indian Sundarbans in 2014-16 found almost no river dolphins (communication by Sutaria and Kelkar with Dr. Q. Qureshi in 2019; (Manjrekar and Prabhu, 2016). Other reports have found only 1-2 dolphins in 200 to 300km of survey effort in the Indian Sundarbans. These low numbers could be due to the low freshwater flows into the Indian Sundarbans as compared to the Bangladesh Sundarbans. Information from which trends could be estimated, is available from a few stretches such as: (1) the Ganga from Munger to Farakka; (2) the Gandak River; (3) the Kosi River; (4) the Ganga from Bijnor to Narora; (5) the Beas River in Punjab (the only Indus dolphin population in India); (6) the Chambal River; (7) the Brahmaputra River in India (Wakid, 2009); and (8) the Farakka Feeder Canal.

A list of the main teams working in different rivers of India is as follows:

(1) WWF-India (Beas River, Upper Ganga, Yamuna, etc.);
(2) Turtle Survival Alliance (Ghaghara River);
(3) Uttar Pradesh Forest Department (Ghaghara, Ganga, and other rivers of the state);
(4) Rajasthan, Uttar Pradesh, and Madhya Pradesh Forest Departments (Chambal River);
(5) Wildlife Trust of India (Gandak and Ghaghra rivers in Bihar);
(6) Patna University and Zoological Survey of India (Ganga in Bihar up to Munger);
(7) T.M. Bhagalpur University, Ashoka Trust for Research in Ecology and the Environment (ATREE), and Wildlife Institute of India (Ganga from Munger to Farakka, Gandak, Kosi, and Mahananda Rivers);
(8) Wildlife Institute of India (rivers of West Bengal and Assam, especially the Brahmaputra, Hooghly, Subansiri, Kulsi, Farakka Feeder Canal, etc.); and
(9) Silchar University (Barak River).

In Bangladesh, trends between 2002 and 2012 for the Bangladesh Sundarbans need to be assessed. Alom said that at present, the data from these large-scale surveys, collected by the captains of tourism vessels (Alom *et al.*, 2014; Smith *et al.*, 2010b). From the surveys in Southeastern Bangladesh made in 1999-2000 and 2013-14, dolphin populations might be stable in the Karnaphuli-Sangu basins (Richman, 2014; Smith *et al.*, 2001). Rivers in north Bangladesh have not been surveyed yet, and this region remains the biggest gap for population surveys. It was suggested that interview surveys could be used as a first step to identify key areas to distribute survey effort and plan large-scale surveys. Alom said he could start work on a concept note for planning and execution of surveys in the rivers of northern Bangladesh.

In Pakistan, four full surveys of the Indus have been carried out over twenty years: 2001, 2006, 2011/12, 2017/18. These surveys have indicated an unambiguous trend of an increase in the population of Indus dolphins from 1,200 to almost 2,000 dolphins in the Indus. Excluding the 5-11 animals found in the Beas River in India, the dolphins in Pakistan are restricted to four sub-populations between five barrages on the Indus River, of which one sub-population is very small and persists in marginal habitat.

In Nepal, population sizes have been estimated and also monitored for the three river sections where Ganges dolphins persist. From a review of available information it is apparent that river dolphins have persisted at small populations in these rivers over the last 30 years. There have been some declines in the range and local population sizes from some of these rivers. The on-going IUCN Red List Assessments for Ganges and Indus dolphins will summarise available information on population size and trends as of 2019.

A recommendation from the discussion was that coordinated surveys are conducted at least at five-year intervals in each country, and population trends estimated for all rivers, where they are lacking. This will need to be coupled with the development of guidelines for choosing optimal survey methods for different rivers. Braulik said that population and threat monitoring surveys will lead to more knowledge on the ecological resilience of *Platanista* dolphins and their ability to adapt to changing conditions. Studies in this direction will be of help in assessing the vulnerability of South Asian river dolphins to emerging threats in changing social and ecological contexts (Smith and Reeves, 2012).

3.3 Theme 3. River dolphin bycatch, interactions with fisheries, and human utilisation

Estimates of river dolphin bycatch remain wanting across the range of *Platanista*, but the occurrence of bycatch events is not uncommon, especially across India and Bangladesh. Bangladesh has the most rigorous monitoring programme for bycatch mortality of Ganges river dolphins (Mansur *et al.*, 2014b), with data collected with high reporting rates (about 80% of actual events reported) across the Sundarbans region. Nepal also has some recent reports of bycatch. In Pakistan, data on fishing intensity in different stretches of the Indus are available, but no systematic assessments of bycatch mortality from entanglement in gillnets exist. In India it is known that bycatch is frequent in areas with high intensity, especially in the dry-season. It is likely that bycatch cases almost never, or rarely, get reported during the monsoon floods, because accessing many river-floodplain areas can become very difficult. Systematic reporting of bycatch has been done in a few areas, but rates might be significantly under-reported. Gillnets with larger mesh-sizes are observed to be the main gears causing entanglements.

In Bangladesh, 118 Ganges river dolphin deaths were recorded by a cetacean mortality monitoring network maintained by the Wildlife Conservation Society (WCS) between February 2007 and August 2019. Of these, over 80% were due to fishing mortality, of which most deaths were in gillnets (see Item 2.6 [Bangladesh country update] for details). WCS-Bangladesh has also collected systematic data from carcasses, including skin samples, stomach contents, etc. A database of fish otoliths from dolphin stomachs is also being compiled to assess dolphin diet and its overlap with fishery targets. The intensive efforts of WCS for mitigation of bycatch and hunting reduction have been through a combination of rapid response to bycatch or mortality events, and education outreach programs. The use of SMART patrolling by range officers of forest departments has proved successful in improving bycatch monitoring and sightings of dolphins as well. Outreach programs that have actively involved fishers have also likely led to reductions in targeted killing. Some notable examples of outreach program involve distribution of field kits and manuals to fishers to avoid illegal gear usage, bycatch-prone gears, and fishing in closed areas. Educational outreach programs such as the boat-and land-based dolphin fairs, or the Shushuk Mela, have seen great success in this regard.

To test their potential for bycatch mitigation, field trials of pingers were also conducted in Bangladesh to estimate dolphin displacement based on theodolite tracking (Smith, 2013). The results were not published but it was suggested that the pingers were not effective.

In India, based on a fairly consistent bycatch reporting network between 2001 and 2013, Kelkar and others estimated mortality of 6-12 animals per year for a population of 170-190 dolphins in 65km of the Vikramshila Gangetic Dolphin Sanctuary in Bihar, India (Kelkar, 2015). These results are not published yet, and are likely to be underestimates. At present, there is no systematic bycatch monitoring programs in almost any river stretch, and records are available on an opportunistic basis only. Kelkar suggested that there were social implications to the monitoring of bycatch, especially in terms of the delicate relationship between conservationists and impoverished fishing communities (Choudhary *et al.*, 2015; Kelkar, 2018), who needed to be involved in conservation even as their fishing activities caused bycatch mortality. Mortality is expected to be fairly high in India's rivers.

In terms of aquatic wild meat (products used) from Ganges river dolphin, most of the bycaught animals are likely to be used for oil (non-targeted salvage and non-targeted deliberate usage). Dolphin oil is used as bait for catching the Ailiid catfish *Clupisoma garua*) in India and Bangladesh, countries to which the use of dolphin oil appears specific (Mohan *et al.*, 1999; Mohan and Kunhi, 1996). Alternatives from fish oils have been proposed instead of dolphin oil (Sinha, 2002) but their use and application has been very limited.

Targeted killing of dolphins is known only from India and Bangladesh, in the present day. There has been a near-total stop to dolphin hunting in Pakistan, although hunting was regular until the 1970s and may have persisted in to the 1990s in some areas. No targeted killing was known from Nepal at any time.

In India, targeted killing appears to be significant in the states of West Bengal, Assam, and Bihar, as per decreasing order of threat. Researchers of the Wildlife Institute of India (Wildlife Institute of India, 2018) estimated that dolphin hunting and oil extraction was rampant and regular along the Ganga River on the India-Bangladesh border (Murshidabad district, downstream of the Farakka barrage). Their interview surveys found that even school children had detailed knowledge of processing dolphin carcasses to obtain oil. In India and Bangladesh, dolphin meat was not usually eaten, except by the poorest and socially marginalised minority fishing people. In Bangladesh, Hindu fishers and some indigenous tribes were known to eat dolphin meat if fresh and opportunistically landed. In India, so-called low-caste Hindu and Muslim fishers were known to use the meat. In contrast, Muslims in Bangladesh and Pakistan regarded the dolphin meat as *haraam* (kosher) and did not consume it. There could be diverse religious and cultural factors influencing dolphin meat consumption by fishers across the region. Other uses were also reported: (1) to relieve rheumatic pain or as an aphrodisiac (Bangladesh and India); (2) to mix oil with fish food for livestock (Khulna, Bangladesh); (3) to deter wild herbivores from raiding crops (Gandak River, India); and (4) for lighting earthen lamps (a practice now very rare in India).

In Nepal, an active network of local informants is present who report bycatch cases to research teams. There are fines of USD 40 to 70 enforced by Nepal's wildlife department, if anyone is caught with a dolphin carcass. Between 2010 and now, 4-5 bycatch mortalities have been reported, which is nearly 20% of the total population of Nepal's dolphins.

WWF-Pakistan maintains a database of mortality records using a standard protocol, although reporting is *adhoc* and the level of detail is low. Annual mortality is 3-5 dolphins per year. They are also compiling a database of fishing gear with all relevant details.

The participants felt that it would be a worthwhile exercise to characterise fishing nets and gears with common definitions to be used across the range of *Platanista*. Given the remarkable diversity of nomenclature, technical details, and specialisation of fishing gears used across the four countries, this would be a challenging but exciting task. Once such a gear dataset was available (as developed in Bangladesh and some sites in India), it was recommended that fishing gear use information be mapped to estimate spatial risk of bycatch for dolphins. Sutaria suggested that disentanglement and release response protocols needed to be spread among fishers and ecologists working in the field, so that mortality could be reduced in case of entanglement. Also, there is a need to streamline sample collection, data storage, and necropsy procedures from carcasses recovered. At present, very little data is being collected from India, in the event of finding carcasses.

3.4 Theme 4: Identifying practical conservation solutions

Arshad provided insights from WWF-Pakistan's long-term efforts on Indus dolphin conservation in Pakistan, and also shared some ideas about the dimensions in which the task team's effort could have most impact. Arshad spoke from the viewpoint of how managers could successfully engage both with scientists and policy makers to effect change at the ground level. He summarised the existing gaps in applied research for conservation, and also synthesised learning from examples of involving communities, lobbying, management of habitats and populations, and outreach in conservation programmes. Arshad suggested that the efforts of Bangladesh in conservation outreach, bycatch response, and threat mitigation needed wider replication and adaptation in the other countries. He expressed interest in potential collaborations between Pakistan and Bangladesh on extending outreach programs. Such collaborations could continue and strengthen capacity building of technical teams across the region.

Translocation and rescue of canal-stranded dolphins were clearly important priorities for Pakistan. There was a need to strengthen data collection on dolphin health, sample collection for genetic and eco-toxicological studies, tagging and telemetry studies, etc. Studies on fish prey abundance, water chemistry, eco-toxicology, use of emerging technologies for dolphin surveys (e.g. drones), and economic valuation studies of conservation options (including ecotourism) would be most important in fulfilling these objectives. Engaging with fisheries policy and fishing communities in the designation of conservation areas and fisheries development was also key across the range. Arshad and Kelkar also mentioned that socio-cultural and anthropological research on fisher communities in the four countries might be valuable to understand the cultural and historical factors that continue to remain relevant in spurring conservation action. They shared the example of the Kehal community in Pakistan and possibly related fisher groups in Bihar, who still exert a significant impact on riverine wildlife through targeted hunting.

This session concluded with a discussion on how to secure funding for long-term, sustainable conservation and monitoring efforts. Braulik said that to do so, it is important to raise the scope of our conservation targets to larger issues of the social and environmental impacts of dams and infrastructure development, than just restricting to wildlife or dolphins. She gave the example of the recent protests against dams on the Mekong River, which approached the problem at a higher level. This way, conservationists might be able to not only secure funding and continuity, but also link conservation objectives with larger and conjoined objectives of ecological security, climate change adaptation, and human wellbeing.

Trujillo asked whether a review of the effectiveness of all protected areas and Ramsar sites along the distribution of Ganges and Indus dolphins would be possible. A map overlaying existing protected areas and Ramsar sites (or other conservation areas) could be a useful outcome of such a review.

In the four countries, there are not more than ten river PAs and Ramsar sites in the dolphins' range. The Indus Dolphin Reserve in Pakistan, and the Chambal River in India, might be examples where some degree of protection might have helped dolphins persist at increasing or at least stable population sizes (Behera *et al.*, 2014; Singh *et al.*, 2014). However, most PAs were paper parks, and the team members agreed that more were not needed unless metrics for monitoring became more encouraging for the existing areas. With or without formal protected areas, interventions to reduce fishing impacts (bycatch), sustainable fishing, pollution reduction, ensuring ecological flows etc. would have much bigger impact. Trujillo mentioned that PS funding mechanisms could be one way to finding funds for these objectives. He also asked how different organisations, research teams, and governments could be brought together in such connected programs. Arshad replied that organisations had to feed off each others' strengths within such larger programs, as one organisation would not be solely equipped to do everything from field work and research to policy change and lobbying.

Alternative incomes to floodplain dwelling people, including fishing communities, were another issue in the discussion. In Pakistan's Sindh province, the degree of dependence of people on fishing had increased after getting licenses became very easy in 2011. This might have constrained the success of community development programmes and initiatives in ensuring that the provision of benefits resulted in better management of fisheries and lower impacts on biodiversity.

3.5 Theme review, emerging issues, and conclusions

Under emerging issues, the biggest threats to river ecosystems in all countries were linked to basin-scale and intensive infrastructure development in South Asia. National waterways development projects and river interlinking plans in India were important challenges to freshwater availability for endangered dolphins in the near future. Waterways development has targeted almost all major rivers with significant dolphin populations in India. The consequences of such developments would be seen not only within India but on Nepal, Bangladesh, and Pakistan as well, because of their implications for trans-boundary water sharing across barrages. In India, studies are already showing negative impacts of increased underwater noise from vessel engines and propeller cavitation noise on Ganges river dolphins. Direct injury from propeller cuts has not been estimated. But deaths of dolphins due to propeller cuts are known from India (Hooghly River [Mallick, 2016], Ganga River near Patna) and Bangladesh (propeller hits accounted for less than 5% of recorded mortalities and was rare, but are not absent). In the wake of strong impacts of climate change on the IGB region, especially through increasing glacial melt and decreasing monsoon rainfall, severe reduction in dry-season flows are expected. There are important differences too. The annual flow of the Indus receives almost 50% of its discharge from glacial melt, which is more than twice that of the Ganga or Brahmaputra basin. Thus, the Indus might be the most affected by immediate climate change impacts, including recurring droughts. In Pakistan, the CPEC (China-Pakistan Economic Corridor) is likely to increase the number of dams on the upper Indus further, causing potentially destructive impacts on downstream dolphin populations. Nepal also deals with the issue of increasing glacial melt and a push for hydropower development, while Bangladesh might face increased upstream-downstream water inequities and the impacts of sea-level rise in the Sundarbans (Smith *et al.*, 2008; Smith *et al.*, 1998). These issues make it necessary for existing conservation actions and initiatives to expand the scope of research as well as policy engagement to study future impacts.

When asked in a rapid-fire round what different countries would prioritise given infinite funds the following answers emerged. Bangladesh would conduct country-level population abundance estimation and monitoring if they got infinite funds, and will strengthen the existing efforts in education and outreach, protected area networks, management plans, and monitoring of dolphin mortalities. Pakistan would focus on a translocation programme, while continuing to streamline population management in protected areas and revised fisheries policies. Pakistan would also strengthen its efforts on dolphin mortality monitoring, outreach and education, community livelihoods, and collect baseline data on prey and habitat availability for dolphins. They would also engage university students more actively in dolphin and fisheries research.

Nepal would focus on the formulation of a national Conservation Action Plan and fisheries management plan, while also working on awareness building, alternative livelihoods, and studies on assessing ecological flows to improve dolphin population numbers in the nation. India would develop knowledge on ecological flow studies across riverscapes in the Ganga and Brahmaputra basins, and initiate concerted bycatch monitoring, as both were high priority issues for the region. Making population monitoring frameworks more systematic and robust across different data collection teams would be another objective. Notably, the main priorities differed across all countries, as seen from the responses. But the above responses highlighted the importance of strengthening bycatch monitoring efforts and ecological flow assessments in all countries.

4. WORK PLAN

On day 3 of the meeting, the task team discussed and finalised recommendations that would form the crux of the report of the meeting. The report will be presented at SC68B in 2020. Until then, it was agreed that Task Team members would start working towards these recommendations through compiling data sets, taking forward ideas for joint and collaborative work, and also planning towards workshops based on the discussions on information gaps and research needs for different countries.

5. RECOMMENDATIONS

The IWC South Asian River Dolphin Task Team **recommends** the following.

- That by 2022, all range states identify key sections of national habitat that should be surveyed every five years, so that population trends can be monitored. Methodology should be replicated in each identified habitat but need not be standardised throughout the range, as different habitats require different methodological adaptations. This recommendation is targeted at the following:
    - Pakistan: WWF Pakistan, Punjab Wildlife Department, Sindh Wildlife Department and KPK Wildlife Department – co-ordinated through WWF Pakistan.
    - Nepal: Department of National Parks and Wildlife Conservation, Department of Forest and Soil Conservation, WWF Nepal, Institute of Forestry Pokhara and Hetauda Campus, University of Tribhuvan (co-ordinated by Shambhu Paudel and Usha Thakuri).
    - Bangladesh: Forestry Department and WCS.

  - India: already a recommendation in India's Conservation Action Plan for Ganges Dolphins (Sinha *et al.*, 2010a) and should be co-ordinated through State Forest Departments, who will identify teams best suited for river stretch-specific surveys (based on experience and available expertise).

- That all existing survey methods in use for population estimation be reviewed, and a decision system prepared to guide monitoring agencies and conservationists to identify and implement statistically robust and optimal survey methods based on river conditions and survey resources available with them.
- That, starting from 2020, surveys to establish population size be initiated at the earliest in the Padma, Jamuna, Meghna main stems and tributary networks (excluding the Bangladesh Sundarbans), Bangladesh and the Budhi Gandak, Baghmati, Rapti and Mahananda, India.
- That the current review of the taxonomy of *Platanista* is completed and published.
- That, as a priority, studies be conducted to fully understand movements of dolphins across barrages in all countries and quantify the extent of population connectivity and impacts on dolphin populations in fragmented riverine habitats.
- That pingers be assessed as an effective tool to minimise bycatch and to reduce the risk of dolphins stranding in canals
- That a feasibility study be conducted to assess areas and methods to translocate Indus River dolphins (WWF-Pakistan) and to adapt existing marine mammal translocation initiatives specifically for river dolphins (co-ordinated by SMM and IUCN).
- That as a priority and with data currently available, assess the level of dolphin bycatch throughout the species' range and evaluate its impact on local populations. From the outcomes of this assessment, provide recommendations for future monitoring and actions to mitigate negative impacts, ranging from technical changes to the revision of fisheries policies.
- To assess the extent of targeted take and the use of dolphins for oil and as wildmeat, particularly in India and Bangladesh by involving social and ecological scientists, as part of co-ordinated survey actions listed above.

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Annex A

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Annex B

Agenda

1. Introduction
   - 1.1 Opening remarks
   - 1.2 Election of Chair and appointment of Rapporteurs
   - 1.3 Adoption of Agenda
2. The current status of river dolphins in south Asia: workshop vision and scope
   - 2.1 Update on proposed taxonomic revision
   - 2.2 Perspectives from South America
   - 2.3 Maintaining the increasing population of Indus river dolphins in Pakistan: a conservation challenge
   - 2.4 Nepal: An overview of threats to river dolphins
   - 2.5 Bangladesh: Improving conservation prospects for river dolphins through effective and sustained community engagement
   - 2.6 Ganges river dolphins in India: current research needs for conservation applications
   - 2.7 Country review and conclusions
3. Discussion topics
   - 3.1 Theme 1. Dams, hydro-climatic change and water availability for south Asian river dolphins
   - 3.2 Theme 2. Population surveys and ecological modelling approaches
   - 3.3 Theme 3. River dolphin bycatch, interactions with fisheries, and human utilisation
   - 3.4 Theme 4: Identifying practical conservation solutions
   - 3.5 Theme review and conclusions
4. Emerging issues
5. Work plan