Ex situ options for cetacean conservation

Report of the 2018 workshop, Nuremberg, Germany

Edited by B.L. Taylor, G. Abel, P. Miller, F. Gomez, L. von Fersen, D. DeMaster, R.R. Reeves, L. Rojas-Bracho, D. Wang, Y. Hao and F. Cipriano

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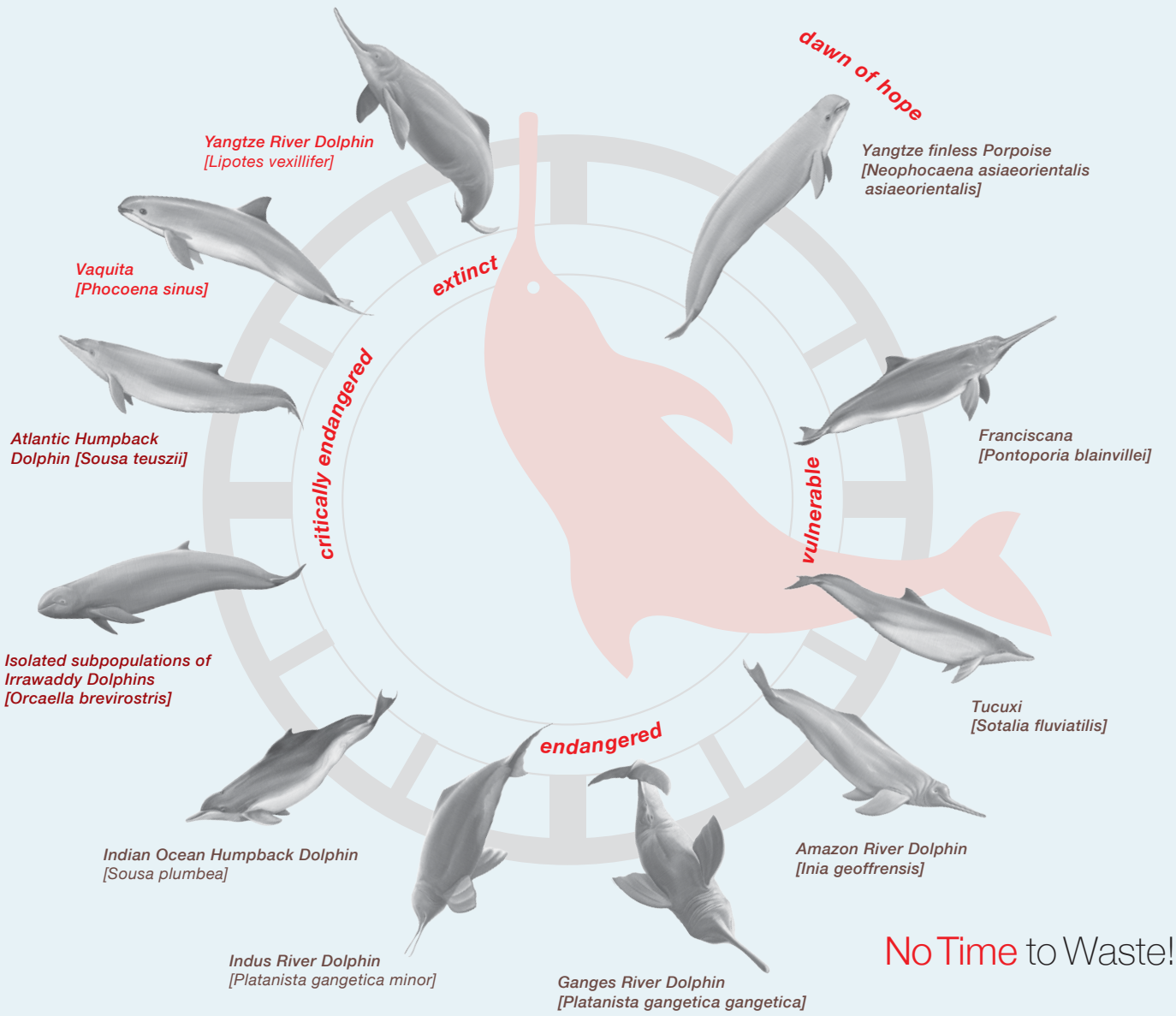

OCCASONAL PAPER OF THE IUCN SPECIES SURVIVAL COMMISSION Nº 66

SSC Species Survival Commission

IUCN SSC Cetacean Specialist Group

Conservation Planning Specialist Group — Changing the Future for Wildlife

Ex Situ Options for Cetacean Conservation

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OCCASIONAL PAPER OF THE IUCN SPECIES SURVIVAL COMMISSION Nº 66

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https://tiergarten.nuernberg.de/startseite.html

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Back cover photo: October 18, 2017. Scientists hold the first vaquita ever captured in a last minute attempt to take as many of the remaining individuals into human care as possible because the *in situ* approaches had failed. Illegal fishing had increased quickly resulting in about half of the remaining vaquitas being killed each year. This Workshop was triggered by the failure of this emergency attempt to catch and save vaquitas. Operations were halted when capture stress necessitated release of the pictured vaquita and resulted in the death of the second captured vaquita. This bitter lesson stiffened our resolve to be better prepared to use *ex situ* options for other small cetaceans that may face similar emergencies. ©VaquitaCPR

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Foreword

The extinction of China's Yangtze river dolphin in the early 2000s may have been prevented, and we might have been in a better position to deal with the more recent precipitous decline of Mexico's vaquita porpoise, if in both cases conservation outside the animals' natural habitat (*ex situ* management) had been attempted much earlier than it was. Recent decades have, however, seen a shift in public opinion in some countries, where keeping small cetaceans (dolphins, porpoises and killer whales) in captivity is increasingly opposed. Oceanariums are shutting down not only cetacean displays, but also cetacean rehabilitation facilities, in response to public outcry and in some cases, national legislation. Yet we cannot point to a single example where the greatest global problem facing small cetaceans – incidental mortality in gillnets – has been solved.

At the 2018 Workshop on *Ex Situ* Options for Cetacean Conservation, biologists, veterinarians and species experts examined trade-offs and discussed lessons learned from recent attempts to save critically endangered small cetaceans using *ex situ* management. Discussions at the workshop that led to the conclusions and recommendations in this report covered a range of issues, including the need to better inform *in situ* research, wildlife management, and advocacy communities about the full range of *ex situ* options available, as many people relegate all such efforts to 'captive breeding'. News that the workshop was being planned sparked protests and press releases from anti-captivity activists, underscoring the importance of clear communication and of working to defuse tensions among different stakeholder groups at every stage of the process.

The workshop recommended production of action plans using the One Plan approach that (i) explicitly consider both *in situ* and *ex situ* measures for species conservation, (ii) prioritize efforts to fill information gaps, and (iii) ensure that the most effective actions are identified. Although workshop participants did not see an immediate need to begin implementing *ex situ* options for all the species discussed, they agreed that it was important to be prepared, and identified four projects for priority development. The Yangtze finless porpoise provides an example of an integrated conservation programme for a small cetacean, although no formal One Plan approach was used to develop the management programme currently in place. Insurance populations are continuing to be established in 'semi-natural' oxbow lakes along the Yangtze River, while aggressive measures are still being taken to improve protection for the remaining porpoises in the river and adjoining lake systems. This example illustrates how both *in situ* and *ex situ* conservation efforts can be pursued at the same time. The workshop recommended that the current Yangtze finless porpoise management programme be reviewed and that additional mechanisms and metrics that might be needed to develop, implement, and monitor the effectiveness of a fully integrated management plan be considered. For another Critically Endangered cetacean, the Atlantic humpback dolphin, research is needed to fill gaps in basic understanding of its distribution and status, and of the threats it faces, before a conservation action plan is developed.

This report is meant to open discussions on a delicate but long overdue subject: how to integrate *ex situ* options into conservation planning for dolphins and porpoises and head off more extinctions in coming decades. The question of when *ex situ* conservation should be initiated extends far beyond cetaceans. Dozens of species have been brought back from the brink of extinction through interventions that included the capture of remaining wild individuals for breeding and future reintroduction, or the supplementation of wild populations with captive-bred individuals. But when should such efforts begin? Only after steep declines have been detected but there is still a

chance for natural recovery (i.e. as insurance)? Or earlier, well before the last-ditch moment arrives? Should conservationists exhaust all other options before attempting *ex situ* interventions (i.e. last hope)? Is there a role for preventive *ex situ* conservation or should it always be reactive? Do existing institutions have the capacity and commitment to embark on new *ex situ* conservation projects? Seventy-five species are classified on the *IUCN Red List of Threatened Species* as Extinct in the Wild, meaning that the only option for returning them to Nature is to keep viable numbers in human care until suitable reintroduction sites are available.

During the next quadrennium, the SSC plans to work with our network, our partners and the *ex situ* community to develop guidelines for integrating *ex situ* interventions into the broader conservation toolkit, and to identify triggers for deciding when to implement a programme to translocate individuals outside their natural range. The deliberations of the 2018 workshop represent a major intellectual contribution to this SSC initiative, and the workshop report comes at an opportune time for informing next steps and helping us reach wise conclusions.

Jon Paul Rodríguez
Chair, IUCN Species Survival Commission

Executive summary

China's Yangtze river dolphin (*Lipotes vexillifer*), also known as the baiji, was declared likely to be extinct in 2006[1], due to threats in the wild such as habitat loss, entanglement in fishing gear and ship strikes, which were not effectively dealt with using the management tools available prior to that time. Mexico's vaquita (*Phocoena sinus*), a porpoise found only in the Upper Gulf of California, will become extinct in the near future if the illegal fishery to obtain fish swim bladders for illicit international markets is not eliminated very soon. Biologists have found that they can't even 'buy time' for the vaquita by taking individuals into a protected captive (*ex situ*) environment because there is simply not enough information on how to handle and care for the species. In both of these cases, it took only a short time for the population to decrease from hundreds to tens of animals. This highlights the urgency of gaining information and taking action to anticipate and prevent such rapid declines in other threatened species and populations of small cetaceans. To prevent more extinctions, we must learn from these losses and work harder (and faster) – we need to ensure not only that the causes of decline are clearly understood and actions are in place to mitigate them, but also that the conservation toolbox is ready and that the ground has been prepared – politically, culturally, scientifically, and logistically – for actions that may be needed in the future. A workshop, "*Ex situ* Options for Cetacean Conservation" (ESOCC) was held in Nuremberg, Germany, 14-18 December 2018, to start those preparations.

Endangered cetacean species representing the range of conservation issues

The ESOCC workshop discussions centered on seven species of small cetaceans that are designated in the IUCN Red List of Threatened Species[2] as Critically Endangered, Endangered, or Vulnerable. These species (listed below alphabetically, not by Red List status) all have shallow-water distributions that entirely overlap areas used intensively by people.

Atlantic humpback dolphin (*Sousa teuszii)*
Franciscana (*Pontoporia blainvillei*)
Indian Ocean humpback dolphin (*Sousa plumbea*)
Inia (*Inia geoffrensis*)
Irrawaddy dolphin (*Orcaella brevirostris)*
South Asian river dolphin (*Platanista gangetica)*
Tucuxi (*Sotalia fluviatilis*)

The seven species were nominated for consideration by the workshop steering committee as representative of the imperiled conservation status and threats affecting many small cetaceans, recognizing that these are not the only species vulnerable to extinction. Such species may warrant consideration for *in situ* and *ex situ* actions combined into an integrated conservation plan in the near future, using criteria described in the IUCN "*Guidelines on the Use of* Ex Situ *Management for Species Conservation*" (hereafter "*Ex Situ* Guidelines"[3]).

The continuum of "*ex situ*" options

In practice, *ex situ* approaches comprise a continuum of actions including safeguarding of the animals in protected environments such as semi-natural reserves and netted enclosures, as well as the capture, rehabilitation, and release of

1 Turvey, S.T., Pitman, R.L., Taylor, B.L., Barlow, J., Akamatsu, T., Barrett, L.A., Zhao, X., Reeves, R.R., Stewart, B.S., Wang, K., et al. (2007). 'First human-caused extinction of a cetacean species?'. *Biology Letters* 3: 537–540. https://doi.org/10.1098/rsbl.2007.0292

2 IUCN (2018). *The IUCN Red List of Threatened Species. Version 2018-2.* http://www.iucnredlist.org.

3 IUCN SSC (2014). *Guidelines on the Use of* Ex Situ *Management for Species Conservation.* Version 2.0. Gland, Switzerland: IUCN Species Survival Commission. https://portals.iucn.org/library/node/44952

stranded or otherwise incapacitated individuals. The term *ex situ* also applies to some other kinds of action, such as rescuing animals from imminent threats like a disease outbreak or a climate catastrophe. The Conservation Planning Specialist Group (CPSG), a part of the International Union for Conservation of Nature (IUCN), has developed and is promoting a process called the One Plan approach[4] to species conservation planning. The One Plan approach means that conservationists representing both the "*in situ*" (in nature) and "*ex situ*" (outside of the natural environment) communities should combine their expertise to formulate a species conservation plan that includes all strategies necessary and appropriate to save the species – even if the plan they decide will be most effective does not explicitly recommend any *ex situ* management actions. The IUCN's Species Survival Commission published the "*Ex Situ* Guidelines", which provides guidance on if and when to employ *ex situ* management in a species conservation plan, the precise role(s) that the *ex situ* programme could play, and how to integrate those activities into the overall conservation plan for the species. This integration can optimize environmental stewardship to decrease the risk of extinction. *Ex situ* management, when deemed necessary, can support efforts to preserve and restore habitat and maintain or restore healthy *in situ* populations.

Although numerical abundance estimates are not available for most of the representative species we discussed, all of them except the Indus river dolphin are described in IUCN Red List assessments as declining. Because we recognised the considerable amount of time needed to employ *ex situ* options for cetaceans, our chosen case studies ranged from those with more time for planning (franciscanas, listed as VU) to those in immediate need of more conservation options (Atlantic humpback dolphins, listed as CR). The workshop reviewed and summarized ecological and biological information as well as threats, and followed the first two of the five steps in the process described in the *Ex Situ* Guidelines while highlighting where information was needed to make decisions about the potential utility of *ex situ* options. Significant information gaps were identified for all species.

Efforts to save the Yangtze River subspecies of narrow-ridged finless porpoises (*Neophocaena asiaeorientalis asiaeorientalis*) were also considered as the only situation where *ex situ* options have been employed for a cetacean. The subspecies has experienced a steep decline in recent years, but its prognosis looks reasonably promising at the moment due to both reported improvements in the wild (the result of *in situ* conservation efforts) and initial success in developing *ex situ* conservation options. This finless porpoise example demonstrates that approaches to prevent the extinction of small cetaceans can be complex and may require decades of research to execute.

For some species of dolphins and porpoises, we already know the clock is ticking until the next extinction event. Sustained population declines linked primarily to incidental mortality in gillnet fisheries have brought such species to the point where extinction is now an urgent concern. The use of gillnets puts food on the table and money in the pocket for many coastal and riverine communities around the world. However, it also causes serious harm to ecosystems upon which people depend by unselectively killing not only dolphins and porpoises but also sea turtles, seals and sea lions, seabirds, sharks, and many other non-targeted organisms. In developing countries, gillnet use is increasing with no viable alternatives in sight. Further catastrophic declines of additional species and sub-species are to be expected as known threats persist, and often increase, and unforeseen threats appear. An example of such an unforeseen threat is the emergence of the lucrative black-market trade that suddenly caused vaquitas to decline at 50% per year compared to the previous 8% per year. The urgency to prepare

4 Byers, O., Lees, C., Wilcken, J. and, Schwitzer, C. (2013). 'The One Plan approach: the philosophy and implementation of CBSG's approach to integrated species conservation planning'. *WAZA Magazine* 14: 2-5.

a more ample and effective set of conservation tools for cetaceans is undeniable.

Outcome of workshop discussions

Participants emphasized the urgent need to strengthen *in situ* conservation efforts for small cetaceans, especially measures to reduce gillnet entanglement and ensure sufficient habitat, particularly for the freshwater species. They also recognised the value of using the One Plan approach, identified the need for more information on the species that were reviewed, and agreed that for cases in which one or more *ex situ* options might be considered necessary, an appropriate intervention plan should be prepared. Current trends in some of the populations considered at the workshop mean that extirpation could occur within a short period of time – much sooner than the time that would be needed to implement an effective *ex situ* action plan, especially in cases with significant information gaps. Therefore, those gaps need to be addressed well before serious consideration is given to implementing *ex situ* options. Early preparation of an action plan would give greater confidence of success and help ensure that the expertise is ready if or when the need arises. Early preparation could guide choices of the optimal locations, sizes and configurations of semi-natural reserves like the oxbow lakes used for Yangtze finless porpoises. Early preparation must include: (i) learning how a given species is likely to respond to capture, transport, confinement and pharmaceutical treatment; (ii) knowing well in advance whether *ex situ* options are likely to be unsuitable for the species; and (iii) understanding the preconditions for establishing a viable *ex situ* population, e.g. habitat requirements, population size, reproductive biology and social structure.

Conclusions and recommendations

The workshop **concluded** that: 1) extensive information gaps exist regarding the distribution and abundance of the seven species discussed and the nature and magnitude of the anthropogenic threats they face; 2) most of the species still have relatively high aggregate numbers of individuals (in the thousands), but anthropogenic factors are causing population fragmentation and declines; and 3) significant funding and social and political change (in some cases throughout multiple countries) are needed to address the threats. Participants also **noted** the value of data collection through interview-based surveys of the ecological knowledge of local people (fishermen and other stakeholders)[5], as well as various 'citizen science' approaches. Such efforts potentially fill data gaps across relatively large geographical areas, in a timely and cost-effective manner. They can also help to increase awareness of the conservation issues within local communities and among stakeholders.

The workshop **recommended** that actions to conserve the most threatened small cetaceans in the wild be identified, funded and implemented with a sense of urgency. Information gaps concerning the distribution of the animals and the threats they face, and the magnitude of those threats, should be filled by 2028 at the latest. Priority should be given to Atlantic humpback dolphins because they now exist only in low numbers and highly fragmented populations, threatened by increasing entanglement in gillnets and the consumption and trade of their meat. Given the need to fill information gaps swiftly and effectively across large areas, interview survey methods, preferably ground-truthed by observational field surveys in smaller areas, should be implemented as a matter of urgency.

The workshop also **recommended** that for each of the species reviewed, veterinary field protocols (possibly including, where feasible, response to

5 Turvey et al. (2015). *Journal of Applied Ecology* https://doi.org/10.1111/1365-2664.12382

therapeutics) be applied during research activities such as health assessment, biopsy collection, and necropsy. Because practical experience with handling many of the species is lacking and their response to handling is critical to determining whether *ex situ* options could be effective, it was also **recommended** that whenever opportunities to handle animals arise (e.g. during rescues of stranded Ganges and Indus river dolphins or tagging studies), relevant information and data should be collected (e.g. on health parameters and blood values). Also, unpublished data from both field studies and captive animals should be located, compiled and analyzed.

Participants **recommended** the creation and implementation of a strategic communications plan, which should include a unifying statement that explains actions taken to conserve small cetaceans using the One Plan approach.

Participants **recommended** implementing the One Plan approach for several species as soon as possible. These initial plans can demonstrate the potential to decrease the risk of extinction by helping managers to ensure that the best balance between *in situ* and *ex situ* management is used to minimize the risk of extinction and to support efforts to preserve and restore habitat and maintain or restore healthy *in situ* populations. It was recognised that significant and sustainable funding will be required to implement such conservation programmes and to implement all these activities.

Priority projects identified at the workshop

Four projects were **recommended** as highest priority:

1. Expand the capture/tag/release programme for **franciscanas** in Brazil and Argentina to include biological data gathering in support of rehabilitation/release of live by-caught and stranded franciscanas and to inform the possible future development of an action plan using the One Plan approach. Develop goals, protocols and field trials to learn more about the response of franciscanas to capture, handling for extended periods at sea, and transport.
2. Assemble an expert panel to review the **Yangtze finless porpoise** integrated conservation project within the framework of the IUCN One Plan approach. The Society for Marine Mammalogy Conservation Fund already has an application for a similar panel review, and that application could be leveraged to help advance this recommendation. Support should also be sought from funding bodies in China.
3. Build capacity in veterinary and husbandry care for **Indus dolphins** that are rescued from irrigation canals by establishing collaborations with WWF and other groups and individuals in Pakistan.
4. Design and conduct an interview survey to fill knowledge gaps on distribution, abundance and threats to **Atlantic humpback dolphins**. Also investigate potential sites for tagging and/or photo-identification research.

Further details and additional recommendations are given in the Conclusions and Recommendations section of this Report (section 5 below).

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ESOCC workshop participants. Back row: Dag Encke, Diane Sweeney, Jay Sweeney, Merel Zimmerman, Fernando Trujillo, James Danoff-Burg, Forrest Gomez, Brian Smith, Gill Braulik, Rob Hicks, Frank Cipriano, Tim Huttner. Front row: Esmerelda Mujica de Jorquera, Ding Wang, Sandra Dollhaupl, Vera da Silva, Barbara Taylor, Julia Ribeiro Guimaraes Dombroski, Shannon Atkinson, Doug DeMaster, Sofia Trujillo, Claudia Gili, Sam Turvey, Phil Miller, Martin Zordan, Randy Wells, Cynthia Smith, Dave Bader, Tim Collins, Niels van Elk, Christina Simmons, Lorenzo Rojas-Bracho, Eduardo Secchi, Grant Abel, Robert Brownell, Jr., Lorenzo von Fersen. Not in photo: Ricardo Bastida, Ernesto Boede, Louisa Dolar, Nachiket Kelkar, Uzma Khan, Shambhu Paudel, Randall Reeves, Alex Zerbini.
Photo credit: **© Mathias Hofer**

1. INTRODUCTORY ITEMS

The ESOCC workshop was held at the Cistercian Monastery, Heilsbronn outside Nuremberg, Germany during 14-18 December 2018. The meeting was hosted by Zoo Nuremberg, the National Marine Mammal Foundation (San Diego, California) and YAQU PACHA e.V. – Organization for the Conservation of South American Aquatic Mammals. Ocean Park Corporation (Hong Kong), Zoo Nuremberg and YAQU PACHA e.V. provided funding for the workshop, and members of the IUCN SSC Cetacean Specialist Group contributed scientific and technical support. The list of participants is given in Appendix 1.

1.1 Convenor's opening remarks

Von Fersen welcomed the group and the participants introduced themselves. The participants expressed their gratitude to Zoo Nuremberg, YAQU PACHA e.V. and National Marine Mammal Foundation staff for organization and logistics support and to the Ocean Park Corporation, Hong Kong for assistance with funding.

1.2 Election of chair

DeMaster was appointed as chair and von Fersen was appointed as co-chair of the meeting.

1.3 Appointment of rapporteurs

Taylor, Abel, Gomez, von Fersen, DeMaster, Reeves, Miller and Cipriano compiled and edited this report.

1.4 Adoption of the agenda

The agenda was reviewed, updated, and adopted by the workshop participants.

2. WORKSHOP MOTIVATION, CONTEXT, AND GOALS
Lessons learned from previous attempts to use *ex situ* management for small cetaceans

2.1 Motivation for the workshop

The motivation for having this workshop came primarily from four factors: (i) the realization that a recent effort to save the vaquita through an attempt at *ex situ* management was unsuccessful due to mistaken judgment about how this species was likely to respond to capture and confinement; (ii) the fact that few practicable approaches to reducing or eliminating bycatch can be implemented without having negative impacts on local fisheries, (iii) the fact that bycatch and other threats are likely to increase in the foreseeable future, and (iv) the limited but encouraging success in China with coordinated *in situ*/*ex situ* actions for conserving Yangtze finless porpoises. The workshop was designed to improve understanding of options for ensuring that necessary conservation tools are in-hand and ready for deployment before the next small cetacean extinction crisis occurs. *In situ* conservation approaches for small cetaceans have been, at best, only partially effective to date. This is partly because the threats come from human activities that contribute directly to livelihoods and partly because conservation actions known to be effective have not been implemented. The primary threat to small cetaceans is bycatch in gillnets, and the reason it has been difficult to overcome this threat is that there are no alternatives that are practical, affordable, and socially acceptable in fishing communities.

Among other things, the workshop attempted to identify and elucidate lessons learned from efforts to save the baiji, vaquita, and Yangtze finless porpoise; reviewed the conservation status of the other representative threatened small cetacean species or populations; and discussed available *ex situ* options that might help prevent extinction.

2.2 Context of the workshop and important definitions

The *Ex Situ* Options for Cetacean Conservation workshop brought together marine mammal biologists, veterinarians, representatives of IUCN, specialists and population managers from the zoo and aquarium community, and communications experts from around the world, to discuss whether and how *ex situ* options might contribute to the overall goal of conserving species of dolphins and porpoises (small cetaceans) at risk of extinction. We used definitions provided in the IUCN *Ex Situ* Guidelines (IUCN, 2014): "*Ex situ* is a term used to describe the management of wildlife species where their living space (or that of their offspring) is restricted in some way and/or where the animals are removed from the natural ecological processes that shape and govern native habitat." *Ex situ* management of live cetaceans is one of several options available and means that

individuals are cared for under conditions where they are subjected to different stressors and selection pressures than are present under natural conditions in natural habitats. In practice, *ex situ* management includes a continuum of actions up to and including maintenance of the animals in environments outside their natural range, such as in semi-natural reserves, netted enclosures, and wildlife parks, zoos and aquariums, as well as the capture, rehabilitation, and release of stranded or otherwise incapacitated individuals.

The term *ex situ* also applies to some other kinds of action, such as rescuing animals from imminent threats like a disease outbreak or a climate catastrophe, or manipulating aspects of a population's demography by "head-starting" a particular juvenile life stage before returning the animals to the wild. Some of these kinds of actions have already been used for marine mammal populations. Notably, self-sustaining *ex situ* populations of Yangtze finless porpoises (detailed below) have been established and they provide research and training opportunities that are believed to benefit conservation directly as well as contribute to education and awareness. The rescue, rehabilitation, and release of Hawaiian monk seal pups that otherwise would have died is another example of successful *ex situ* conservation action. It must be stressed, however, that effective *ex situ* conservation requires extensive information and intensive preparation, and—crucially—it becomes less and less likely to succeed once the wild population has been reduced to tiny numbers. As such, although *ex situ* conservation is typically identified as an option in the later stages of a species' decline toward extinction, preparatory research, outreach, and planning should begin much earlier.

The One Plan approach (Byers et al., 2013) is designed to improve decision-making and thereby reduce the risk of extinction, by integrating *in situ* and *ex situ* options in planning when appropriate, while at the same time supporting efforts to preserve and restore habitat and to maintain or restore healthy *in situ* populations. The approach explicitly considers all populations of a species, whether inside or outside of their natural range, and under all conditions of management, as potential contributors to successful conservation of that species in the wild. This is made possible by involving experts from both the *in situ* and *ex situ* population management communities in the planning process, and considering options involving both communities when deciding on the best package of conservation strategies to maintain or restore healthy populations in preserved or restored habitats. In addition, the approach promotes the active engagement of all parties relevant to conservation actions and the application of all available resources from the very start of the conservation planning process. In this way, the One Plan approach seeks to encourage the formation of new partnerships, increase levels of trust and understanding among conservation practitioners across multiple management contexts, and expand and enhance the quality of the tools available for science-based conservation action.

There are numerous examples of how using a combination of *in situ* and *ex situ* efforts has helped prevent extinction and led to the re-establishment of wild, self-generating populations of many threatened species (mammals, birds, reptiles, amphibians). *Ex situ* conservation has been applied effectively only once for a threatened cetacean, the Yangtze finless porpoise (*Neophocaena asiaeorientalis asiaeorientalis*) in China. In 2017 the Ministry of Agriculture of China (which is in charge of aquatic animal conservation) released an action plan drafted by the Institute of Hydrobiology that includes both *in situ* and *ex situ* measures for protecting Yangtze finless porpoises, but an official action plan explicitly applying the One Plan approach has yet to be produced for this subspecies. With the Yangtze river dolphin or baiji (*Lipotes vexillifer*) now likely extinct and the vaquita (*Phocoena sinus*) nearing extinction, the need for broader thinking about conservation strategies for small cetaceans has become urgent.

Within the species-specific discussions (sections 3 and 4 below), we use the term 'subpopulation' to refer to cases that have been evaluated under

the IUCN definition of that term: geographically or otherwise distinct groups between which there is little demographic or genetic exchange (typically one successful migrant individual or gamete per year or less). We use the term 'population' to refer to groups of individuals that have not necessarily been assessed using the IUCN definition but are generally either geographically or ecologically isolated or are likely to be demographically independent (where internal recruitment is far more important to maintaining the group than external recruitment). We use Units-To-Conserve (UTC) to refer to the collective grouping of species, subspecies and populations. For cetaceans, the use of UTC is particularly relevant because correcting taxonomy may take longer than the time available to avoid extinction of unrecognised taxonomic diversity.

2.3 Workshop vision and goals

The workshop goals as initially set out by the steering committee were to: a) evaluate whether *ex situ* options might contribute to the overall conservation objectives for small cetaceans (as indicated by the seven representative species), b) identify information gaps that would need to be addressed before developing integrated species conservation plans that include consideration of *ex situ* options (i.e., the One Plan approach), and c) determine whether there is sufficient information to prioritize species or populations for consideration as candidates for research and planning toward an integrated species conservation plan.

During an early session of the workshop, participants discussed a set of specific tasks for meeting those goals, and agreed to the following overarching goal and vision statements:

Overarching workshop goal:
Initiate discussions concerning if, when, and how *ex situ* options might contribute to conservation strategies for a representative set of small cetaceans.

Vision statements:
Conservation plans including appropriate *in situ* and *ex situ* options (i.e. following the One Plan approach) are developed for all threatened small cetacean species as well as populations that represent genetic, cultural, and ecological diversity vital to maintaining those species across their geographical range.

Fill information gaps about the species' biology and habitat that hinder consideration of *ex situ* options in action plans.

If *ex situ* action is taken to help conserve a species or population of small cetaceans, that action is fully integrated with, and complementary to, efforts to preserve or restore its natural habitat and to maintain or restore a healthy population or populations *in situ*.

Operationalized statements:
Within the next 10 years, research on candidate species should provide data and information on:

- their *in situ* habitat, life history parameters, population and social structure, and nutritional requirements,
- feasibility of safe capture and transport, including filling knowledge gaps for veterinary care and animal husbandry,

- suitability for holding in *ex situ* facilities,
- feasibility of captive breeding (including, if deemed necessary, the use of assisted reproduction technologies),
- steps, criteria for progression, and benchmarks of success for release of individuals from *ex situ* populations into protected areas

Within 10 years, species-specific integrated conservation action plans should be developed with scientific and broad stakeholder input for at least five species or populations of small cetaceans and such plans should include consideration of both *in situ* and *ex situ* options.

2.4 Priority tasks at the workshop

Four tasks were initially chosen as top priorities to be addressed at this workshop, and a fifth task was agreed by all participants during the workshop once the need for clear communications about the benefits of action plans that routinely use the One Plan approach was recognised. It was agreed that the resulting report (i.e. this report) should reflect progress made (if any) on each point below (whether in the main body or as annexes/appendices).

1. As a way to facilitate guidelines for other species, summarize factors that contributed to the lack of success in using *ex situ* options to prevent the extinctions of the baiji and the vaquita and reflect on when *ex situ* options should have been identified and applied in those cases. Similarly, summarize factors that contributed to the apparent success, to date, of using *ex situ* options to help prevent extinction of the Yangtze finless porpoise.
2. Produce prioritized, annotated lists of species, subspecies, and geographical populations for which *ex situ* options should be further investigated immediately, in the medium term (within the next decade), and in the long term (within the next 25 years).
3. Produce a prioritized list of the species-specific research tasks that are needed to fill information gaps concerning the use of *ex situ* options to enhance the conservation of small cetaceans. For each species, subspecies, or population considered, describe the most critical (i.e., 3-5) research questions (concerning e.g. physiology, life history, behaviour, habitat characteristics, primary threats and their mitigation) that need to be addressed initially and before proceeding to a more detailed planning stage for *ex situ* options (assuming that such an approach is considered warranted).
4. For one selected species or population, create a stepwise decision matrix for implementing an *ex situ* management option.
5. Because some influential individuals and organizations are completely opposed to and dismissive of *ex situ* management as a tool for cetacean conservation, communicating its value as part of a broader One Plan approach to small cetacean conservation to all stakeholders should be included as an essential tool in any plan, and careful thought (including transparency about inherent risks) given to when and how this should be done.

Additional tasks (not listed by priority) were also identified, and it was agreed that the workshop should strive to achieve as many of the following tasks as possible, given the time available:

- Review and summarize information on the seven representative species (Table 1) and decide whether experience with any of those species is sufficient to form the basis of an integrated species conservation plan.

- Identify for each of the seven species up to five pros and five cons that respectively support or impede further consideration and inclusion of *ex situ* options in species-specific action plans.
- Identify for each of the seven representative species up to ten individuals, institutions, or organizations to be engaged in ongoing evaluation and implementation of *ex situ* options that would be included (or considered for inclusion) in action plans.

2.5 Representative small cetacean species

Seven species that were judged by the steering committee to be representative of the problematic conservation status and threats affecting many other small cetaceans were considered at the workshop. It was expected that this would bring into focus the information gaps to be addressed when developing *ex situ* components of integrated action plans. The species used here as examples for developing *ex situ* action plans are listed below in Table 1. All of these species live in habitat that is close to growing human populations and is heavily affected by human activity. The primary threat to all of them is entanglement in gillnets, but habitat destruction or modification (e.g., mainly dams that constitute barriers to movement and which have major effects on water flow as well as sediment and nutrient distribution, and also port development and habitat destruction through urbanization) are also significant threats for river dolphins and some coastal species.

Participants **agreed** that although taxonomic arguments for separate river dolphin species in different portions of the Amazon/Tocantins/Araguaia and Madeira/Mamore-Guapore river systems, and also in the Ganges/Brahmaputra/Indus river systems, had either not yet been published or had been published but were not yet accepted by the Committee on Taxonomy of the Society for Marine Mammalogy, it was best to be precautionary and treat the various allopatric populations as Units-To-Conserve (UTCs i.e., as if they were separate species) rather than risk losing one or more cetacean taxa before they were formally recognised.

2.6 Previous attempts to apply *ex situ* management to small cetaceans

2.6.1. Baiji

The baiji evolved more than 35 million years ago and was found only in the Yangtze River basin and the neighboring Qiantang River in eastern China. Before the 1990s, there was very little interest in or political will for advancing environmental conservation of the river basin, as the country's focus was on economic development (Shapiro 2001). Intensive use of the Yangtze River was a critical factor in driving the country's rapid economic growth, and although *in situ* reserves were established for the baiji in areas considered important for the species, they provided little in the way of real protection. Massive support from both government and civil society would have been needed to prevent extinction of the baiji in the wild. However, national and regional government policies and priorities at the time were at odds with baiji species conservation and conservation of its habitat, and there was little public awareness of, or interest in, its plight.

In the late 1970s and early 1980s the entire baiji population was thought to be only 300-400 individuals. In the mid 1980s, it was estimated that at most only a few hundred baijis remained. Chinese scientists had already noted that *ex situ* conservation efforts were urgently needed in view of the failure to control upstream activities such as pollutant discharge, dam construction for hydro-power and water diversion or impoundment, overfishing of dolphin prey species, fishing

Table 1. IUCN Red List Assessment status and ancillary Information as of May 2019 postings for the seven representative species (gray shading) plus subunits (UTC's) considered important, and the Yangtze finless porpoise. Abbreviations are: VU--vulnerable, EN--endangered, CR--critically endangered, Y--yes, N--no, U--unknown. Abundance estimates are for the total population. The column for 'Current total abundance' contains estimates from 2015 onwards for cases where the IUCN assessment is now outdated.

		Red List Category	Assessment Year	Population Trend Decreasing	Gillnets a Major Threat	IUCN Total Abundance	Current Total Abundance
Inia	*Inia geoffrensis*	EN	2018	Y	Y	U	U
Yangtze finless porpoise	*Neophocaena asiaeorientalis asiaeorientalis*	CR	2012	Y	U	~1,800	~1,000 (2017)
Irrawaddy dolphin	*Orcaella brevirostris*	EN	2017	Y	Y	<8,000	
	Ayeyarwady River subpopulation, Myanmar	CR	2004	Y	Y	~60	
	Mahakam River subpopulation, Indonesia	CR	2008	U	Y	~70	35 (2012)
	Malampaya Sound subpopulation, Philippines	CR	2004	Y	Y	~75	~80
	Mekong River subpopulation, Cambodia/Laos	CR	2004	Y	Y	~70	
	Songkhla Lake subpopulation, Thailand	CR	2004	Y	Y	<50	
	Iloilo-Guimaras subpopulation	CR	2019	Y	Y	<25	<25
South Asian river dolphin	*Platanista gangetica*	EN	2017	U	Y	~5,000	
Indus River dolphin	*Platanista gangetica minor*	EN	2004	N	N	~1,500	
Ganges River dolphin	*Platanista gangetica gangetica*	EN	2004	Y	Y	~3,500	
Franciscana	*Pontoporia blainvillei*	VU	2017	Y	Y	~35,000	~35,000
	Rio Grande do Sul/Uruguay subpopulation	VU	2003	Y	Y	42,000	
Tucuxi	*Sotalia fluviatilis*	DD	2010	U	Y	U	
Atlantic humpback dolphin	*Sousa teuszii*	CR	2017	Y	Y	<3,000	
Indian Ocean humpback dolphin	*Sousa plumbea*	EN	2017	Y	Y	U	

practices that killed dolphins (e.g., rolling hooks, nets) and ship traffic.

The need for captive breeding was recognised internationally in 1986 at the Workshop on Biology and Conservation of the Platanistoid Dolphins in Wuhan. By 1990 the estimated number of baijis was down to 200 (Chen et al., 1993). A female baiji was eventually captured and translocated to the Tian-e-Zhou (Swan) Oxbow Lake *ex situ* reserve in 1995. This reserve is a 21 km-long former section of the Yangtze River that is now connected to the mainstem through a small gate. However, due to the poor infrastructure and challenges managing the reserve during the initial years of its development, this individual survived for less than one year. Surveys during 1997–1999 provided a minimum estimate of only 13 animals (Zhang et al., 2003). No animals were seen or detected visually or acoustically in a range-wide survey in 2006 (Turvey et al., 2007).

2.6.2. Yangtze finless porpoise

Ex situ management actions to conserve Yangtze finless porpoises provided the first positive

Figure 1. Institute of Hydrobiology staff with QiQi, the first Yangtze River dolphin (*Lipotes vexillifer*) to be kept in an *ex situ* facility. QiQi died in 2002, after surviving in the Institute's Baiji Dolphinarium at Wuhan, China, for over 22 years.
© Xiaoqiang Wang Wuhan Baiji Conservation Foundation

example of *ex situ* management for small cetaceans. In 1992, five porpoises were captured and released into the Tian-e-Zhou Oxbow reserve. The translocation of those animals was initiated as a test case prior to translocation of baijis at a later date. Several additional translocations of porpoises from the main river to Tien-e-Zhou have been made during subsequent years, and additional reserves created. The *Hubei Changjiang Tian-E-Zhou Baiji National Nature Reserve* and *Tongling*

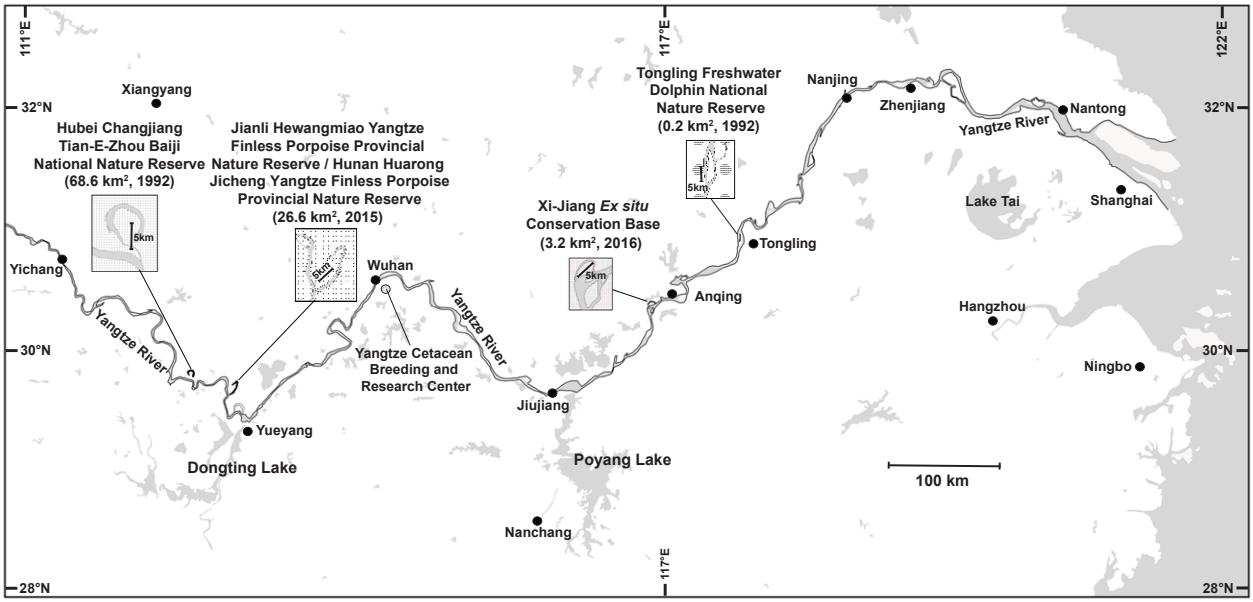

Figure 2. The four Yangtze finless porpoise semi-natural *ex situ* reserves in the central Yangtze river basin, People's Republic of China (note that the inserts are not all at exactly the same scale and have separate scale bars).
© F. Cipriano

Figure 3. Yangtze finless porpoise (*Neophocaena asiaeorientalis asiaeorientalis*) feeding on a school of fish in Poyang lake, China. **© Huigong Yu**

Freshwater Dolphin National Nature Reserve are now designated as National Nature Reserves for the Yangtze finless porpoise. Sections of the Yangtze main stem, and of Poyang and Dongting lakes, have been designated as "aspirational" reserves by national, city and provincial authorities.

The porpoise population in the Tian-E-Zhou Oxbow reserve has increased rapidly, especially since 2010. A 2015 survey estimated the population in that reserve at around 60 animals; in 2018 it was estimated at 80 individuals. In 2015 a second *ex situ* population of porpoises was established in Jianli Hewangmiao Oxbow in Hubei Province (the same area is called Huarong Jicheng Oxbow in Hunan Province – the oxbow forms the border between the two provinces and is administered jointly by both). Since then, three translocation efforts have resulted in twelve animals being introduced into this second reserve, and four calves have since been born there. The carrying capacity of this reserve is estimated to be over 120 porpoises. A third *ex situ* population was established in 2016 with 18 porpoises translocated into the smaller Xijiang Oxbow reserve in Anhui Province. Although its estimated carrying capacity is only about 30 individuals, this third reserve is nonetheless considered important for maintaining genetic diversity among the *ex situ* populations. Approximately 160 Yangtze finless porpoises are now living in the four semi-natural *ex situ* reserves in China, and work is continuing to improve the *ex situ* metapopulation by increasing the population size and managing genetic diversity by exchanging individuals between reserves and if necessary introducing more wild individuals.

Figure 4. Yangtze finless porpoise (*Neophocaena asiaeorientalis asiaeorientalis*) in pens awaiting health assessment and translocation from Poyang Lake, China, 2011. **© Grant Abel**

The wild population of porpoises in the Yangtze River continued to be affected negatively by anthropogenic pressures, at least between 1991 and 2012. Successive surveys indicated declines from around 2,700 animals in 1991, to 1,800 in 2006, and 1,045 in 2012. However, results of a 2017 survey suggest that the decline has slowed and possibly even stopped [Report of Yangtze Finless Porpoise Survey in 2017 (in Chinese, drafted by IHB and released by MOA at a press conference on 24 July, 2018). More surveys will be needed to verify what appears to be an encouraging change in the population's trajectory. The fact that authorities in China are continuing efforts to conserve the wild population while maintaining insurance populations in the *ex situ* reserves shows that this strategy can, under the right circumstances, be successful.

2.6.3. Vaquita

The vaquita is a small porpoise endemic to the Upper Gulf of California, Mexico. The species was first described in 1958 and has likely always been naturally rare (low abundance) (Taylor & Rojas-Bracho 1999) with a single population and small distribution (Brownell 1986). Its range is entirely in waters that are heavily used for fishing with trawls and gillnets. Concerns that incidental mortality (bycatch) in gillnets is unsustainable are long-standing. The first estimates of abundance and bycatch confirmed that the vaquita population was unable to withstand the existing level of bycatch. An international recovery team (Comité Internacional para la Recuperación de la Vaquita, or CIRVA) was established in 1997 and has repeatedly stressed that if vaquitas are to survive, the bycatch threat must be addressed through implementation of a permanent ban of all gillnets throughout its range.

A legally protected area known as the Vaquita Refuge was established in December 2005, which banned the use of gillnets in about half of the vaquita's range. However, enforcement was at best inconsistent, and the Refuge remained essentially unmanaged. The species' total population declined by around 57% between 1997 and 2008.

To prevent the next cetacean species after the baiji from disappearing, an acoustic monitoring system was developed so that trends in vaquita

Figure 5. Yangtze finless porpoise (*Neophocaena asiaeorientalis asiaeorientalis*) encircled during a translocation program, Poyang lake, China. The gradual reduction in area following initial capture has eliminated mortality in translocation and health assessment processes. **© Baoyan Gao**

Figure 6. Wild vaquita (*Phocoena sinus*) displaying the characteristic dark eye-patch and shown in the glassy calm conditions needed to detect this cryptic species of porpoise. October 2008. **© Thomas A. Jefferson / Viva Vaquita**

abundance could be monitored on an annual basis; this was expected to enable the detection of a catastrophic decline. The acoustic data revealed a collapse of the population, at a decline rate of more than 40% per year from about 2011, coinciding with an increase in illegal fishing for totoaba (*Totoaba macdonaldi*), a large fish also assessed on the IUCN Red List as Critically Endangered. Although vaquitas die in all types of gillnets, those set for totoaba are the most lethal because of similarities in the sizes of vaquitas and totoaba. A lucrative black market for totoaba swim bladders in mainland China and Hong Kong (EIA, 2016; EAL, 2018) meant that a single fish was worth thousands of U.S. dollars, creating an irresistible lure for artisanal fishermen in the region. Increased legal protections, which expanded the protected area for vaquitas, and a valiant effort to remove both active and lost nets by the Sea Shepherd Conservation Society and the Museo de la Ballena y Ciencias del Mar, with help from the government of Mexico, failed to halt the population decline.

CIRVA started in 2016 to develop a step-by-step plan for learning to capture and care for vaquitas in captivity. By that time it was estimated that only 30 animals remained, and the Vaquita Conservation, Protection and Recovery (VaquitaCPR) consortium was formed (Rojas-Bracho et al., 2018). In 2017, given the continued drastic decline, CIRVA concluded that the only hope for survival of the species in the short term was to abandon the step-by-step approach, and advocated the immediate capture of as many vaquitas as possible so that they could be brought into a safe haven, away from the gillnets and under human care until such time as their natural environment became threat-free.

It was recognised that "the risks of capture and captive management are high, but these are greatly outweighed by the risk of entanglement in illegal gillnets in the wild" (CIRVA, 2017). In early 2017, planning for the VaquitaCPR field programme began with the clear understanding of the risks due to gaps in knowledge about the species, including the possibility that vaquitas could die during capture and handling/movement. The timeline of the field programme was accelerated to start in autumn 2017, before the 2018 totoaba spawning migration to the Upper Gulf, when another half of the vaquitas that remained was likely to die in illegal gillnets targeting totoaba.

Figure 7. October 18, 2017, the first vaquita (*Phocoena sinus)* caught (V01F) during the Vaquita Conservation, Protection & Recovery project. The female porpoise was released later that day when it became clear the young animal was stressed and not settling. **© VaquitaCPR**

No one had ever attempted to catch vaquitas and hence no body of experience with handling or housing this species existed before 2017. Vaquitas are known to be shy animals and they tend to keep well away from motorized vessels. In this respect their behaviour is similar to other species such as the harbor porpoise (*Phocoena phocoena*), which has nevertheless been successfully captured for tagging and also brought into captive facilities, rehabilitated, and released by stranding programmes in Europe. In contrast, Dall's porpoises (*Phocoenoides dalli*), which frequently approach and ride the bow waves of boats, had shown signs of stress when captured and were known to be susceptible to capture myopathy or exertional rhabdomyolysis, a potentially fatal condition associated with vigorous muscle activity following stressful events such as pursuit, capture, and transport (Chalmers & Barret, 1982). Published and unpublished accounts of these two other porpoise species (*Phocoena phocoena* and *Phocoenoides dalli*) and interviews with experts in the capture and handling of harbor porpoises and finless porpoises were used to guide efforts to develop an emergency action plan for vaquita.

The VaquitaCPR field effort ran from 13 October to 4 November 2017 (Rojas-Bracho et al., 2019). The team, which consisted of 90 researchers, technicians, animal handlers, and veterinarians from nine countries, faced many challenges, including finding vaquitas in view of how few remained; safely capturing and transporting them; and establishing appropriate sea- and land-based housing facilities. It was, of course, impossible to know if the effort would be successful, or how long the porpoises would need to remain in captivity before they could be released back into gillnet-free natural habitat.

Two vaquitas were captured. The first, an approximately 6-month-old female, was released four hours post-capture, due to an assessment by the field team that the animal was not responding well to the stress associated with being captured. The second, a 15 year-old non-lactating female, died of capture myopathy after initially appearing to adjust to the confined environment. The VaquitaCPR team decided to immediately suspend further capture attempts after the female died. The risk of additional deaths with so few vaquitas remaining, coupled with the need to understand why this death occurred and how to prevent another

death, was deemed too high to proceed. The tragic failure to save this species despite years of *in situ* research, direct interventions, negotiations with government agencies on management measures, and the VaquitaCPR emergency *ex situ* effort, provides important lessons for other rapidly declining species reduced to small population sizes and facing similar anthropogenic threats that could lead to extinction. The establishment of an *ex situ* population is difficult, and the learning curve is steep. Animals are likely to be lost while essential knowledge is gained on how to keep them alive and healthy *ex situ*. The behavioural and physiological responses of a species to interventions necessary to establish an *ex situ* population need to be understood well before a population reaches critically low numbers.

2.7 Lessons learned

Setbacks such as the death of the baiji captured in 1995 and the death of a vaquita in 2017 are likely to be inevitable during the early stages of an *ex situ* programme, whether the animals are maintained in a semi-natural or other form of captive environment. Allowance for this kind of learning-curve cost should be factored into contingency planning, so that a single death does not derail the larger initiative to save a species. An example of a serious delay was the halt to research for the California condor triggered by the death of a single chick during handling in 1980 (Snyder & Snyder, 2000). At the time of the death, permits had been granted for the first radio-tagging of condors to determine what was causing the species' decline. The single death resulted in a great deal of conflict among researchers, managers, and conservation organizations and a research delay of two years while condors declined to only about 20 individuals in the wild. Ultimately, the tag results revealed that the primary cause was lead poisoning of adults and not reproductive failure due to disturbance on the breeding ground as was previously believed. In contrast, early deaths of captive giant pandas did not hinder *ex situ* conservation efforts. Sūlín, a cub taken to the United States in 1936, was the first giant panda in captivity outside of China. She died two years later (and many other captive pandas also died during the initial years), but this did not prevent a long series of giant pandas sent abroad as part of the *ex situ* efforts. Today, more than 1,800 giant pandas are believed to persist in the wild (SFA China, 2015; Wildt et al., 2012) and in 2016, the *ex situ* population comprised 470 animals in 85 institutions around the world. (Traylor-Holzer & Ballou, 2016).

Today, the government of China is beginning to focus on preserving freshwater ecosystems with greater consideration for biodiversity, including the declared intention to ban all fishing in the Yangtze River by 2020. If an *ex situ* population of baijis had been established, either in captivity or in semi-natural reserves, then options for future actions would have been kept open, and eventual reintroduction into the species' natural habitat could have been a real possibility. The rapid extinction of the baiji shows that it is necessary to react much more quickly and aggressively, including with the timely development of *ex situ* components of integrated conservation action plans and needed expertise in capture, handling, transport procedures, health assessment, and husbandry practices.

The integrated approach of *in situ* and *ex situ* action to save Yangtze finless porpoises is an encouraging example of a One Plan approach for a population of small cetaceans and, as such, it shows what might be achieved with other highly threatened species and populations in the future.

In addition to China's efforts to establish *ex situ* populations in semi-natural reserves, small numbers of finless porpoises are being maintained in land-based captive facilities, allowing study of their biology, behaviour, and physiology. These animals have successfully reproduced and have been the subject of numerous scientific articles.

The captive porpoises have also been used to help educate many thousands of schoolchildren by giving them the opportunity to see this endearing species up-close and underwater in viewing tanks. Engaging young students in this way appears to have helped to create more public support for *in situ* conservation of porpoises. This is particularly important for animals that are hard to see in the wild because they are small, dark, live in muddy waters, and have no dorsal fin.

The VaquitaCPR effort was hampered by significant gaps in information that could have been filled many years earlier, when there were still hundreds of vaquitas. *Ex situ* options were initially rejected by CIRVA because members had concluded that, prior to the resumption of the illegal totoaba fishery and the resulting catastrophic decline of vaquitas, the animals had a better chance of surviving in the wild than in captivity. CIRVA did not consider that, at least before the catastrophic decline began, both *in situ* and *ex situ* actions could have been taken in tandem to maximize the chances of conservation success. There were also funding limitations. In fact, even when vaquitas were on the brink of extinction, the funds were insufficient to carry out the full programme as recommended by the VaquitaCPR consortium. The operation proceeded as it did only because the situation was so dire.

The vaquita's story therefore serves as a cautionary tale: if *ex situ* options are to serve as viable conservation tools, the information critical to success must be acquired when populations are still relatively large, and managers must accept that avoiding extinction requires developing action plans that consider both *in situ* and *ex situ* options when populations of small cetaceans still number in the many hundreds. For vaquitas, research on their reaction to being captured likely should have begun as soon as gillnet mortality was recognised to be unsustainable, around 1997.

Finally, many members of CIRVA felt that taking vaquitas into captivity would remove or significantly lessen the political will that was needed to deal with the considerable negative social reaction to the 'extreme' measure of banning gillnets in the Vaquita Refuge. In hindsight, the complexities of working with all stakeholders within government and fisheries were vastly underestimated. Parts of the Mexican government appeared to be working against each other, or at least inefficiently. In the final analysis, conservation energy and resources devoted to attempting, against impossible odds, to achieve wholesale social, political, and administrative reform in the Upper Gulf may have been better invested in developing the knowledge and skills for *ex situ* management of vaquitas. In other words, the concerns that moving ahead with *ex situ* planning would derail efforts to make the vaquita's natural habitat safe for its continued survival and recovery may have been misplaced.

In summary, *ex situ* options are potentially valuable, but complex, tools for supporting the survival and recovery of populations of small cetaceans. However, becoming ready to implement *ex situ* actions can take several years and should be initiated well before such tools are urgently needed. Populations of threatened species can decline to critical levels in a very short period of time due to unexpected or unforeseen events.

3. SUMMARIES OF PRESENTATIONS INCLUDING REPRESENTATIVE SPECIES REVIEWS

Workshop participants with expertise concerning the seven representative species and other participants familiar with conservation and logistical issues related to *ex situ* management were requested in advance to prepare papers. Summaries of these papers were presented, each followed by a brief discussion. The full papers prepared for the workshop and abstracts of the presentations that were not accompanied by a paper are given in Appendix 3. The background presentations and discussions on each of the representative species are summarized below, followed by a synopsis of the important considerations and conclusions that were identified during the discussions.

3.1 General background information on *ex situ* practices and methods used to fill information gaps

Information on how *ex situ* efforts have improved and been integrated into the conservation of many species was provided by experts from the IUCN Species Survival Commission's Conservation Planning Specialist Group (CPSG) and several associations of zoos and aquariums.

3.1.1. Integrated species conservation planning (Phil Miller)

Phil Miller summarized the various tools and processes used by the IUCN SSC CPSG to guide their implementation of the One Plan approach: integrated species conservation planning across the *in situ* – *ex situ* spectrum. The analytical and deliberative tools developed by the CPSG have been designed to work within the framework of the IUCN SSC's diverse guidelines for endangered species conservation, and promote transparent decisions using available species biological and human sociological data. These tools were explained using a variety of planning examples, including a risk assessment for the Mexican wolf (*Canis lupus baileyi*) that informed the species' long-term recovery plan. The relevance of this approach to cetaceans was explored in discussion - successful implementations of the One Plan approach can be used as templates upon which to pattern future programmes for small cetaceans.

3.1.2. International zoo and aquarium associations (Martín Zordan, Merel Zimmerman)

Modern zoos and aquariums participate in regional and international associations that promote cooperation among members, not only to share and advance the quality of care provided to animals in their collections, but also to support effective education and research activities and to carry out conservation projects.

Most of these facilities collaborate with wildlife field experts and join scientific and academic institutions. Martín Zordan, representing the World Association of Zoos and Aquariums (WAZA), noted the potential value of WAZA as a conservation network for threatened species of small cetaceans. WAZA is a consortium of zoos and aquariums, plus regional and national associations, including 350 institutions from more than 50 countries. This consortium may be able to assist with the development of *ex situ* components of conservation

action plans by providing access to institutions with relevant expertise.

Merel Zimmermann, representing the European Association of Zoos and Aquariums (EAZA), which is a member of WAZA and has a WAZA board representative, emphasized the importance of inclusive programmes that involve independent researchers and the IUCN specialist groups. Modern zoos and aquariums that manage their collections effectively can contribute to conservation by providing *ex situ* solutions and, at times, fulfilling some of the needs of *in situ* conservation programmes. Member zoos and aquariums generally act individually but many of the *ex situ* contributions to species conservation are managed on a cooperative regional level by species coordinators.

In 2021 the EAZA Taxon Advisory Group for marine mammals will go through a 5-step decision process for planning the extension and maintenance of captive populations of endangered species, region by region. This will be based on the Integrated Collection Assessment and Planning approach (Traylor-Holzer et al., 2019), which was developed with consideration of both the *Ex Situ* Guidelines and the One Plan approach. Under this approach for considering establishment of captive populations, institutions consider a range of factors including: whether the species is endangered or threatened, the potential for education and research, the potential to gain experience with captive confinement, the potential for coordinating *in situ* and *ex situ* activities, and indications from IUCN that such captive care programmes are needed. This process allows for systematically determining if and which *ex situ* activities might be appropriate for inclusion in overall conservation strategies for cetaceans. The decision-making process allows for input from relevant external stakeholders, such as the IUCN SSC Cetacean Specialist Group, in addition to EAZA members. Coordination provided by individual institutions and associations facilitates networking, capacity-building, and fundraising.

The process by which zoos and aquariums become involved in and support *ex situ* programmes was the main topic of discussion. In response to questions, it was clarified that WAZA assists with such coordination and tries to align interested members with global priorities; the association does not maintain a comprehensive database of facilities but does send out occasional surveys to track available space, which could be used to compile a list of most of the zoos and aquariums in particular regions.

3.1.3. Development of a new sea-pen facility for cetaceans (Rob Hicks)

This presentation by Rob Hicks of Merlin Entertainment was provided as a case-study of the time and effort needed to establish a new facility for the captive care of small cetaceans. The company has created a facility in Iceland initially for two belugas (*Delphinapterus leucas*) that are now 'retired' from a commercial aquarium in China, where they had been maintained for approximately fifteen years. The story of developing a sea-pen facility with on-shore treatment pools and resources for long-term care of captive belugas provides insight into the challenges of re-locating captive belugas from a land-based concrete tank to a sea-pen enclosure in a protected bay. The amount of time, planning, and funding to create this facility demonstrates that a similar effort as part of an *ex situ* action plan for small cetaceans would be a significant logistical and financial undertaking.

3.1.4. Community stakeholder surveys (Samuel Turvey)

There are known gaps in conservation-relevant information (e.g. population status, distribution, and trends; primary drivers of population declines; dynamics of human-cetacean interactions) for all of the representative species considered at this workshop. Samuel Turvey of the Institute of Zoology, Zoological Society of London described methods used to fill such gaps rapidly for both the baiji and Yangtze finless porpoises. Interview-based surveys of the ecological knowledge of local people (fishermen and other stakeholders) can provide valuable information on species

occurrence at a given locality, as well as an index of relative population abundance, population trends over time, and patterns of population survival and extinction between landscapes to inform spatial conservation prioritization. Such surveys can also help to characterize human interactions with target species and identify key threats. Interview surveys conducted across the former range of the baiji following its extinction were able to characterize its distribution, relative abundance, and spatio-temporal decline dynamics in different areas as the species became depleted and then extinct. Analysis of the information content of existing boat-based survey data for Yangtze finless porpoises (2006, 2012), together with results of interview surveys in fishing communities (2008, 2011–2012), helped to inform conservation decision-making, in this case by comparing different datasets to assess the relative impact of different known or potential threats on declines of porpoises (Turvey et al., 2013). In discussion, the workshop agreed that interview-based surveys are a very promising method for filling information gaps in a timely and inexpensive way and for obtaining information on populations of small cetaceans over large areas, especially when ground-truthed by direct observation, such as line-transect surveys in smaller areas.

3.2 Advances in small cetacean *ex situ* care and health assessments

3.2.1. Advances in cetacean care (Jay Sweeney)

Jay Sweeney, representing Dolphin Quest, reviewed advances in small cetacean care since 1970 by facilities accredited with organizations such as the Alliance for Marine Mammal Parks and Aquariums (AMMPA). Individual animal longevity for common bottlenose dolphins (*Tursiops truncatus*) within these facilities has improved greatly due to an increase in technical and species knowledge, experienced staff, and collaborations among institutions leading to advancements in the management of cetaceans in captivity. There have been improvements in health and welfare, individual longevity, and the genetic diversity and sustainability of *ex situ* populations of these animals. This has been achieved through the development of different housing modalities, technological skill sets, and protocols and procedures for basic and specialized husbandry. Advancement in the *ex situ* management of bottlenose dolphins serves as a basic model with the potential for application to a variety of other small cetacean species.

3.2.2. Veterinary considerations for *ex situ* conservation of cetaceans (Cynthia Smith, Forrest Gomez)

Forrest Gomez, representing the National Marine Mammal Foundation (NMMF), summarized the state of veterinary knowledge and techniques applicable to small cetaceans in the wild. She also proposed methods to acquire new information that will be needed to assess and potentially incorporate *ex situ* options into conservation action plans. As outlined by the *Ex Situ* Guidelines, for an *ex situ* option to be implemented successfully, it is vital that strategic planning and data collection be undertaken early and not at the last minute. Although there have been many advances in the management of several species of small cetaceans under human care, there are inherent risks to handling and caring for a species for which experience-derived knowledge of capture, handling, and health care is limited. From a veterinary perspective, the following are among the critical needs: baseline ecological and biological data; knowledge of response to capture, handling and transport; knowledge of baseline health and reproduction parameters; knowledge of how and when to apply pharmaceuticals; emergency response options; appropriate housing; capacity for genetic analysis and cryopreservation. Gomez highlighted the

importance of existing but unpublished data as well as the value of learning as much as possible from animals previously or currently under human care, either in facilities or during rescue operations, health assessment captures, or tagging attempts. In discussion, the workshop **agreed** that a stepwise approach using the health assessment model as standardized by R.S. Wells and colleagues with bottlenose dolphins in Sarasota Bay, Florida (Wells et al., 2004) and implemented in other areas where cetaceans are at risk (Schwacke et al., 2014; Smith et al., 2017) was the most appropriate approach for gathering much of this information, to support *ex situ* efforts as components of conservation action plan.

3.3 Background and discussion on representative species

Information on status, threats, and information available to support potential development of *ex situ* components of conservation action plans for the seven representative species compiled prior to the workshop by invited experts was presented, and followed by a brief discussion (see abstracts and full papers in Appendix 3 below)

3.3.1. *Inia geoffrensis* and *Sotalia fluviatilis* (Vera da Silva, Fernando Trujillo, Ernesto O. Boede, Esmeralda Mujica-Jorquera)

The presenters noted that here, to emphasize the taxonomic uncertainty concerning how many species or subspecies should be recognised in the genus *Inia*, and the fact that these dolphins inhabit several river basins in addition to the Amazon, they do not use the common name "Amazon river dolphin" but instead use the genus name *Inia* for all three described but not broadly recognised species or subspecies.

Da Silva described how *Inia* and tucuxi (*Sotalia fluviatilis*) are threatened by multiple factors throughout their distribution, and pointed out that it is important to resolve the taxonomy of *Inia* and define population structure to improve threat

Figure 8. Capture of an Amazon River dolphin (*Inia geoffrensis*) in the Orinoco River, Colombia, during a satellite tracking program of the South American river dolphin initiative (SARDI). **© Fernando Trujillo**

Figure 9. Amazon River dolphins (*Inia geoffrensis*) in the Orinoco displaying aerial activity in a breeding area.
© Fernando Trujillo

evaluation. *Inia* occur in the Amazon and Orinoco river basins, in an area of approximately 8.380 million km^2 across six countries (Brazil, Bolivia, Colombia, Ecuador, Peru and Venezuela). Tucuxi do not occur above the dams of the Madeira River in Brazil and Bolivia, or in the Orinoco River basin in Colombia and Venezuela. In some areas there is strong evidence of a continuous decline in the populations of both species (da Silva et al., 2018). Primary threats are bycatch of both species in gillnets, and the intentional killing of *Inia* for use as bait. The magnitude and spatial extent of these threats and the rate at which population sizes are changing in different parts of the range is a fundamental information gap for both species. Some populations of *Inia* are isolated in reservoirs, such as in the Tocantins and Madeira rivers (Brazil). Threat assessment is particularly important for these fragmented populations.

The presenters documented that there has been considerable experience with the capture, transport, and handling of these two freshwater cetaceans for research and exhibition. Records of capture, transport, and exhibition of *Inia* date back to 1956, with animals removed mainly from the Colombian Amazon (>100) and relocated to the United States, Europe and Japan. *Inia* have been kept in captivity in the Aquarium of Valencia, Venezuela for 41 years, with a successful captive breeding programme there (Boede et al., 2018). Two individuals of *Inia* are currently maintained in captive conditions: one in Germany (44 years in captivity) and the other in Peru (13 years in captivity). The animal in Germany was an already-weaned calf (Gewalt 1978) and the animal in Peru was rescued as a calf and raised in poor conditions on artificial milk from a baby bottle. Published information on the reproductive biology of *Inia*, which is key to successful management, is available based on field studies and modelling (Martin & da Silva, 2018; Moore et al., 2018) and on observations of captive specimens (Boede et al., 2018).

Tucuxi have not been held in captivity but the sister marine species *Sotalia guianensis* (known as the Guiana dolphin) has been held in aquariums in several parts of the world. It was subsumed under the name *Sotalia fluviatilis* prior to the recognition of separate marine and freshwater species in the genus. In most South American countries, keeping cetaceans in captivity is prohibited although it is allowed under specific conditions in Brazil. The presenters suggested that translocation actions

Figure 10. Adult male tucuxi (*Sotalia fluviatilis*) caught for scientific purpose by the Projeto Boto Team and later released. **© Projeto Boto**

should be considered only in cases where habitat quality has severely deteriorated or there is no possibility of genetic exchange among small isolated groups. They did not feel that initiation of *ex situ* options was warranted at present despite the numerous threats to different populations; instead, they urged that *in situ* conservation actions be continued, and expanded, to the greatest extent possible.

Experiences with capture, handling, and transport of *Inia* were the main topics of discussion. In response to questions, da Silva suggested that the early captures of over 100 individuals (1955–1966) likely resulted in extremely low survival rates because handling methods and equipment were crude, and there was little attempt to provide adequate physical conditions (*e.g.* long periods of restraint in small containers, no temperature control, unpressurized cargo areas of aircraft, holding facilities without humidity control). The da Silva and Martin tagging studies (Project Boto, 1994–2017) involved the capture of over 1300 *Inia*, and some individuals have been recaptured up to seven times. *Inia* thus appear to be relatively robust to capture and handling.

Many stranded and trapped *Inia* have been rescued by untrained personnel, and both mortality and capture myopathy have occurred in those extreme situations. However, the Aliaga-Rosel team has rescued 46 *Inia* in Bolivia, of all sizes and sexes, and no death or injury and no stress myopathy has occurred. No sedatives or therapeutics were used. Some of the rescued animals were transported by boat to release sites 1-20 km away, which took a maximum of 20-25 minutes. The Valencia Aquarium has the most information on captive care of *Inia*, developed over 41 years – four of the animals held there lived 2 years or longer, and one has survived in captivity for 15 years.

Sotalia appear much less robust than *Inia* to capture and handling. Da Silva and Martin's studies in Brazil (1994–2017) involved the capture of 25 tucuxis by net. Compared with their experience with *Inia*, tucuxi individuals more often showed signs of stress-induced capture myopathy. Individuals showing such signs were released immediately.

3.3.2. Franciscana *Pontoporia blainvillei* (Eduardo Secchi, Alexandre Zerbini, Randall Wells, Ricardo Bastida)

The franciscana (*Pontoporia blainvillei*) is endemic to coastal waters of Argentina, Brazil, and Uruguay. Five management units are recognised, with abundance estimates ranging from a few hundred to around 15,000 individuals. Small, discrete resident populations have been identified in bays in Argentina and Brazil. Bycatch in gillnet fisheries is the main threat to the species, taking 3-6+%/year of some of the populations. Other threats include habitat degradation and pollution. Current mortality levels and projected declines resulted in the listing of the franciscana as Vulnerable in the IUCN Red List. Recent fisheries regulations implemented in areas with extensive bycatch in Brazil are expected to improve the species' conservation status.

Little is known about handling and care of franciscanas. Twenty-four individuals have been captured, handled briefly for tagging, and released. During 30 years of attempts to rehabilitate stranded franciscanas, mostly in Argentina, only two non-calves have survived for more than one year. No franciscanas have been released for evaluating the effectiveness of the rehabilitation process. It is important to emphasize that the species is relatively abundant in much of its range and there is still the potential for successful *in situ* conservation and long-term viability of franciscanas in the wild. Therefore, the franciscana is currently not a high-priority candidate for *ex situ* management. If *ex situ* management is considered in the future, improved knowledge is needed about the requirements for successful handling and maintenance of animals under human care and preparation for their subsequent release.

Bycatch, live stranding, and the potential to fill data gaps for capture, handling, and husbandry of franciscanas were the main topics of discussion. The presenters identified some attempts to document bycatch over many decades in some areas, and pointed out that relatively crude estimates of the magnitude of fishing-related mortality together with abundance estimates led to the establishment of management areas and the development of conservation action plans specific to each of

Figure 11. Preparing to release a tagged Franciscana (*Pontoporia blainvillei*) in Bahia San Blas, Argentina, March 2008. **© Chicago Zoological Society's Sarasota Dolphin Research Program**

these areas. Funding is now available from fines levied on coastal and offshore developers by the Brazilian government. Improved analytical techniques and larger data sets have resulted in better estimates of bycatch, and assessments of compliance with and effectiveness of fisheries regulation to reduce bycatch are now being conducted. In response to questions about any attempts to remove ghost nets from franciscana habitat, Secchi stated that ghost nets have not been considered a concern for franciscanas because there is relatively smooth bottom topography where gillnet fishing effort is highest and there is good communication between trawl and gillnet fishermen in order to minimize overlap. Efforts in Argentina to reduce bycatch include education and outreach, including working with artisanal fishermen to modify fishing techniques. The large number of live strandings, primarily of calves, in some areas may be due to the setting of gillnets along the seabed, which may preferentially catch adults so that their calves strand nearby.

Given that there has been some experience with capture-release for tagging and more such work is planned, the workshop recognised that there are opportunities for using *Pontoporia* as an additional model system for developing health assessment protocols for wild dolphins that are more stress-prone than *Tursiops*, in order to develop and refine blood-draw and other health assessment methods for such species. This would be quite different from the previous efforts focused on tagging with minimal handling time, as most franciscana individuals to date have not responded well to extended handling on a padded deck. Future efforts could try holding animals in a water-filled container. This might be a good next step toward developing better handling methods that could facilitate holding animals for longer periods, allowing more thorough health assessments as well as (potentially) attempts to transport franciscanas. The success of the initial tagging studies indicates that follow-up monitoring is possible.

3.3.3. South Asian river dolphin *Platanista gangetica* (Gill Braulik)

The South Asian river dolphin (*Platanista gangetica*) consists of two subspecies, the Indus river dolphin (*Platanista gangetica minor*) endemic to the Indus river system primarily in Pakistan, and the Ganges river dolphin (*Platanista gangetica gangetica*) which occurs in the Ganges, Brahmaputra

Figure 12. South Asian river dolphins (*Platanista gangetica gangetica)* foraging below the Sapta Koshi barrage, Nepal. 2017. **© Grant Abel**

and Karnaphuli-Sangu river systems of India, Bangladesh and Nepal. Taxonomic resolution is needed for these subspecies, as they may prove to be separate species, with no significant genetic connectivity between the two forms.

The Indus river dolphin has undergone an 80% reduction in range and is thought to number approximately 2,000 individuals, fragmented into five different sections of the river system. Since a ban on the hunting of dolphins in the 1970s the dolphin population is believed to have been steadily increasing in abundance. Unlike other taxa discussed in this report, bycatch is not the largest threat to this subspecies. The primary threat is continued loss of habitat due to the use of riverine water for irrigation of arid lands occupied by an increasing human population. Additionally, most individuals are constrained to a single section of the river and are thus vulnerable to a catastrophic event.

The Ganges river dolphin is more numerous than the Indus dolphin, has a wider range, and has suffered a less drastic range decline. However, increasing threats including bycatch in fishing gear, high levels of industrial pollution, shipping, poaching, habitat fragmentation by barrages, flow regulation for hydropower generation, and flow depletion from diversions for irrigation make it likely that Ganges dolphins are declining in numbers and range. The recently proposed Indian Waterways project (Kelkar et al., 2017) and other proposals to link Indian river systems may cause rapid catastrophic declines in the future if they proceed as planned.

Platanista are not currently held in captivity. In the 1970s a total of 16 *Platanista* were maintained in facilities outside the subcontinent, four at the Steinhart Aquarium in the USA (Indus dolphins), seven at the Berne Institute of Brain Anatomy in Switzerland (Indus dolphins), and five at Kamogawa Sea World in Japan (Ganges dolphins). Survivorship was low, ranging from a few weeks up to approximately 3-4 years, and no reproduction ever occurred. Experience from a variety of rescue programmes to recover and translocate *Platanista* from canals and side channels leads to the impression that this species is capable of withstanding the stresses of capture and transport; however, suspected capture myopathy has occurred in a number of older individuals. There is very little technical

Figure 13. An Indus River dolphin (*Platanista gangetica minor)* follows a ferryboat near the village of Karmowala in the Beas Conservation Reserve, Punjab, India. 2018. **© Gitanjali Kanwar**

or infrastructural capacity for holding cetaceans in South Asia at present, the quality of care and husbandry in most zoos is poor, and in India the keeping of cetaceans in captivity for entertainment has been prohibited.

Rescues of Indus dolphins that have become trapped in irrigation canals offer opportunities to handle animals, and such opportunities might be used to gather the data required to fill information gaps relevant to handling, health assessment, and husbandry. The net impact of climate change on already-stressed river environments is somewhat uncertain but likely to cause further habitat degradation, e.g., through reduction in monsoon rain and intensification of extreme events in both regions. Both Indus and Ganges dolphins appear to be resilient and may persist in severely degraded areas with high pollutant levels and much human activity as long as there is sufficient water and food for them.

The potential for *Platanista* conservation through translocations, improved habitat management and restoration, designation of protected areas, and development of capture, handling, and husbandry methods were the main topics of discussion. The workshop recognised that the challenges for conserving dolphins in rivers running through arid regions that are used intensively for irrigation, human water supplies, waste disposal, fisheries, and industry are immense and many of the associated conservation issues are beyond the scope of biologists alone to address. There may be some, but very limited opportunities to designate protected areas following the "oxbow reserve" model. Current rescues of dolphins isolated in canals by reduced water flow and diversions for irrigations are generally successful, and such occurrences offer the potential to handle animals opportunistically, which might be used to facilitate gathering data to fill gaps relevant to handling, health assessment, and husbandry considerations.

3.3.4. Irrawaddy dolphin *Orcaella brevirostris* (Brian Smith, Louella Dolar)

The Irrawaddy dolphin (*Orcaella brevirostris*) is widely distributed but poorly known. There are

Figure 14. Two Irrawaddy dolphins (*Orcaella brevirostris*) surfacing in the Guimaras Strait, central Philippines.
© Louella Dolar

Figure 15. Irrawaddy dolphin (*Orcaella brevirostris*) cooperating with cast-net fishermen in the Ayeyarwady River, Myanmar. After herding fish toward a cast-net fisherman, the dolphins forage on fish that escape but whose movements are confused by the falling net and fish that fall out of the net when it is pulled up. **© Brian Smith**

concerns for its conservation status because it is mainly comprised of small and discrete populations. With a few exceptions, Irrawaddy dolphin populations have been estimated to number less than a hundred individuals; five of these are red-listed as Critically Endangered subpopulations. The primary threat to this species throughout its range is bycatch in gillnets. There has been some apparent progress on addressing threats by establishing protected areas, improving enforcement of fishing regulations and engaging local communities in conservation efforts, for example with the population in the Mekong River (Thomas & Gulland, 2017). However, there is no credible evidence that these efforts have resulted in an increase in abundance for any of the populations.

One of the two isolated populations in the Philippines was discussed as a potentially high priority for an *ex situ* action plan: the Iloilo-Guimaras Straits population, which was only discovered in 2007. This extremely isolated population was estimated to consist of only 21 dolphins (CV = 25.5%, 95% CI = 10-31) in a 2013–2014 study and only 13 dolphins (CV = 20.9%, 95% CI = 9-19 dolphins) in a 2015–2016 study (De la Paz et al., 2017). Historical distribution reconstructed from interviews suggests a much wider distribution for this population 40–50 years ago (Dolar 2012). Fishing practices that can cause dolphin entanglement, habitat destruction, boat traffic and pollution coming from industrial activities (e.g., alcohol distilleries, coal power plant and cement factory), agricultural and domestic wastes (solid wastes from coastal communities and from passenger ships and ferries) that contributed to the decline of the population, continue to the present day. In addition, construction of the recently approved bridge connecting Negros and Guimaras islands will bring disturbances to the dolphins and their core habitat. Although a protected area totalling 130 km² has been established, this cannot guarantee the continued existence of the Irrawaddy dolphin population. Protected areas in the Philippines often have implementation difficulties, and unless very strict adherence to the provisions that came with the Protected Area Ordinance is exercised, this population can be lost in the not so distant future.

The main topics of discussion were: 1) the dire situation of the small, isolated, critically endangered (CR) populations of *Orcaella* (in Cambodia/Laos, Indonesia, Myanmar, Philippines, and Thailand) and 2) the potential value of the *Orcaella* captive in display facilities. Notwithstanding published records for the capture and transport of this species in Indonesia and to Japanese aquariums (Tas'an & Leatherwood, 1984), there is limited published information about the long-term care and breeding of Irrawaddy dolphins in captivity. Given this information gap and very low abundance, the workshop recognised that there is a distinct risk that attempts to capture and maintain individuals from this isolated subpopulation in captivity, could lead to its extirpation. The *in situ* conservation effort initiated in 2016, which has the cooperation of the local government, resulted in the establishment of a protected area in 2017. Conservation efforts

need to be aggressively pursued with the goals of monitoring for effective enforcement, continued assessment of population status, and enhanced conservation education of the local community. Another concern is the potential for undermining *in situ* conservation efforts if *ex situ* programmes offer an excuse for more development and less effort to improve natural habitat quality. The most appropriate populations for research to support future *ex situ* management programmes were discussed as those where removing some individuals does not doom the wild population.

Orcaella are kept in Thailand, Vietnam and Indonesian aquariums. It is understood that *Orcaella* from a freshwater habitat are kept in Indonesia, whereas all others maintained in aquariums are from coastal marine environments. This experience is of potential use for developing an *ex situ* conservation programme as part of a One Plan approach. Identifying all those facilities, and those who are willing and able to participate in *ex situ* conservation efforts, especially investigation of ways to encourage effective breeding, offers a dual opportunity for improvements in the care of the animals and understanding of the health and care requirements of *Orcaella*. Participants noted that if there is a positive response to initial inquiries to these facilities, a next step might be to integrate them into a more robust research programme, e.g. gathering data for developing an assisted breeding programme, which would be of importance to any *ex situ* conservation plan.

3.3.5. Indian Ocean humpback dolphin *Sousa plumbea* (Gill Braulik)

The Indian Ocean humpback dolphin (*Sousa plumbea*) has only been recognised as a distinct species since 2014. It is presumed to occur in at least 23 countries, from Sri Lanka and southern India in the north, around the rim of the western Indian Ocean, and to South Africa in the south. These dolphins inhabit coastal waters generally less than 30 m deep or within 2km of shore, which means they live in the most disturbed and degraded part of the ocean ecosystem. Indian Ocean humpback dolphins are poorly known and in approximately 50% of their suspected range, especially in Somalia, Yemen, and Mozambique, there is no information even on their presence or absence. In the majority of places where surveys have been conducted, abundance has been estimated at fewer than 200 individuals in semi-discrete nearshore

Figure 16. Three endangered Indian Ocean humpback dolphins (*Sousa plumbea*) surface in calm waters, in the protected area west of Pemba Island, Tanzania. **© Gill Braulik**

Figure 17. Juvenile Atlantic humpback dolphin (*Sousa teuszii)* caught in an artisanal gillnet in the coastal waters of Conkouati-Douli National Park in the Republic of Congo. The catch was voluntarily reported by the fisherman as part of a successful program of cooperation between park authorities and fishing communities. **© Tim Collins**

populations. The largest known populations are in the United Arab Emirates (about 700 in 2015) and Algoa Bay, South Africa (about 400 in the 1990s) (Karczmarski et al., 1999; López et al., 2017). Recent collaborative work in South Africa showed that Indian Ocean humpback dolphins frequently move several hundred kilometers along the coast, sometimes up to 500 km (Vermeulen et al., 2018). In South Africa, levels of persistent organic pollutants in this species were the highest of all cetaceans studied (Gui et al., 2016), reflecting their distribution near to coastal developments and pollutant sources. In all places where there is a time series of survey data (Madagascar, South Africa, Zanzibar), Indian Ocean humpback dolphins have shown declining encounter rates, group sizes, and abundance. The species' nearshore distribution means that it is subject to high levels of fishing pressure, is exposed to the most polluted parts of coastlines, and is subject to habitat degradation from numerous nearshore developments.

During discussion it was reported that one Indian Ocean humpback dolphin is believed to have been kept at the Dolphin Resort in Bahrain since at least 2002, and several individuals are believed to be kept as part of a private collection in the United Arab Emirates, but this requires confirmation. Discussion focussed on threats, and it was suggested that interview surveys could be an efficient means to fill data gaps for distribution and relative abundance. Care would need to be taken to determine whether fishermen can reliably identify *S. plumbea*, since Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) are also found in many of the same areas and could be mistaken for humpback dolphins, or visa-versa. There is potential to develop a better understanding of response to capture, handling, and husbandry processes for this species, which may also be applicable to Atlantic humpback dolphins. Most research has been conducted in South Africa where there is the greatest capacity for research. Several Indian Ocean humpback dolphins were captured and maintained for very short periods in South Africa in the 1960s (Best & Ross, 1984) however, aquarium facilities in South Africa have not maintained any dolphins long term.

Figure 18. A group of Atlantic humpback dolphin (*Sousa teuszii)* sighted in the near shore waters of southern Gabon. Their proximity to shore is typical for the species, and also highlights the difficulty of finding these animals using traditional boat based techniques on open coastlines which are routinely exposed to coastal swells. **© Tim Collins**

3.3.6. Atlantic humpback dolphin *Sousa teuszii* (Tim Collins)

The Atlantic humpback dolphin (*Sousa teuszii*) is endemic to the tropical and subtropical nearshore waters of western Africa. It has been recorded in 13 countries to date, ranging from Western Sahara in the north to Angola in the south. Its current distribution is uncertain given incomplete research coverage, including an absence of survey effort in Sierra Leone, Liberia, Côte d'Ivoire, Ghana, mainland Equatorial Guinea, and the Democratic Republic of Congo. However large gaps in distribution are likely to be present and the species is considered rare in most places where it is known to occur. The species has precise habitat requirements, limiting its resilience and ability to escape environmental and anthropogenic stressors. It occurs in relatively shallow (usually <30 m) depths, in warm waters (average sea surface temperatures of between 16° and 32° Celsius), and in dynamic habitat strongly influenced by tidal patterns (e.g., mudflats, sandbars, channels, surf zones and estuaries). However, most aspects of its ecology and biology remain unknown. Current estimates of abundance for discrete areas are few, but include a minimum of 47 animals in the Rio Nuñez estuary (Guinea), a minimum of 103 animals in the Saloum Delta (Senegal), approximately 50 in Conkouati Douli in the Republic of Congo, and 10 in Angola. All other published 'estimates' of population size can be described as informed guesses, with the largest population believed to occur in Guinea Bissau, where there may be several hundred, although recent declines are suspected (Collins et al., 2017).

The species is under severe threat from bycatch in gillnets and habitat loss from large-scale coastal development (ports, mining projects, and associated urban development). The pace of development is far greater than the ability of local and international scientists to conduct the research needed to inform measures to mitigate the impacts of development on this species, other marine species (such as the West African manatee), and the ecosystem as a whole. Appropriate regional capacity for concerted action is limited and rare, and where it does exist, resources for work and conservation are typically in short supply.

Discussion focused on threats to the species and the potential for setting up effective sanctuary areas in the species' range. There are small populations in areas of poor habitat, high fishing pressure, and known bycatch risk (e.g. Republic of Congo), raising questions concerning how these populations persist. Currently protected areas within national parks of Mauritania, Senegal, Guinea Bissau and Gabon provide good habitat to extant populations. The level of protection varies at each site, but includes some enforcement of fisheries and rules that limit hunting. Healthy habitat is also found in Guinea and the Republic of Congo although there is some overlap with community fishing zones. Some countries in the region (e.g. Nigeria) are politically unstable, so prospects for designating and securing protected areas over the span of decades is unlikely. Some efforts to support marine spatial planning and the designation of marine protected areas have been funded (for instance in Gabon), and there are possibilities to improve protection in relatively large areas such as the Saloum Delta, Senegal, a National Park that is also a UNESCO World Heritage Site and a Wetland of International Importance listed under the Ramsar Convention. Assistance in such planning efforts and in leveraging funding by partnering with appropriate NGOs and associated zoo/aquarium facilities would enhance such initiatives.

3.4 Overall considerations and conclusions

- The One Plan approach could be a useful model for developing action plans for threatened small cetacean species or populations;
- the world's zoo and aquarium associations are willing allies and have many skills and resources for developing, promoting, and executing integrated species conservation action plans;
- interview survey methods can be relatively rapid and inexpensive (compared to on-water field research), have been successfully used to fill information gaps along the Yangtze River, and could be applied in other regions for filling specific information gaps, especially when ground-truthed with observational surveys in a few areas;
- extensive work has been conducted to identify gaps in understanding small cetacean health, and more information can be gleaned from historical records and current holdings of small cetaceans in aquariums;
- considerable progress has been made in maintaining and breeding bottlenose dolphins in captivity; this should speed the learning process for other species, but it could take considerable time and effort to transfer capabilities and adapt practices for application to other less-known species;
- opportunities exist (e.g., the entrapment of Indus dolphins in irrigation canals, live strandings of franciscanas, and tagging work with franciscanas) to test health assessment methods, gain practice with general handling and health assessment, and perhaps carry out short trial periods of captive care with those species;
- health assessment techniques and knowledge, ranging from dart biopsy to full health assessments, are available for consideration for all species. Early information gathering using these techniques is essential to increase the likelihood of success for any future *ex situ* attempts.

4. CONSIDERING THE SEVEN REPRESENTATIVE SPECIES WITH RESPECT TO THE IUCN *EX SITU* GUIDELINES

4.1 Steps in the IUCN *ex situ* guidelines

The IUCN *Ex Situ* Guidelines document (IUCN SSC, 2014) provides a useful process divided into 5 steps (see figure 19) leading to the final decision (whether or not to include any form of *ex situ* management in the conservation strategy for a species) as follows: 1) Compile a status review of the species, including a threat analysis, 2) Define the role(s) that *ex situ* management could play in the overall conservation of the species, 3) Determine the characteristics and dimensions of the *ex situ* population needed to fulfil the identified conservation role(s), 4) Define the resources and expertise needed for the *ex situ* management programme to meet its role(s) and appraise the feasibility and risks, and 5) Make a decision that is informed (i.e. uses the information gathered above) and transparent.

Because the steps are sequential and significant information gaps needed to complete Steps 1 and 2 were apparent for all the representative species considered (such as necessary information on conservation status and animal health), the steering committee decided that proceeding to step 3 would not be possible during the workshop. Steps from 3 onwards are thus not considered further in this report, but need consideration in future integrated species conservation action plans.

4.2 Working groups

During the workshop, small working groups were formed to concentrate the specialized expertise needed to address information gaps with regard to veterinary and animal care, conservation status, and threats for the representative species considered at the workshop. These relate to one of the workshop's top-priority items: to produce a prioritized list of the species-specific research tasks that are needed to fill information gaps concerning the use of *ex situ* options to enhance the conservation of small cetaceans. For each species, subspecies, or population considered, participants attempted to identify the most critical (i.e., 3-5) research questions (concerning e.g. physiology, nutrition, life history, behaviour, habitat characteristics) that would need to be addressed before proceeding to a more detailed planning stage for *ex situ* options (assuming that such is considered warranted).

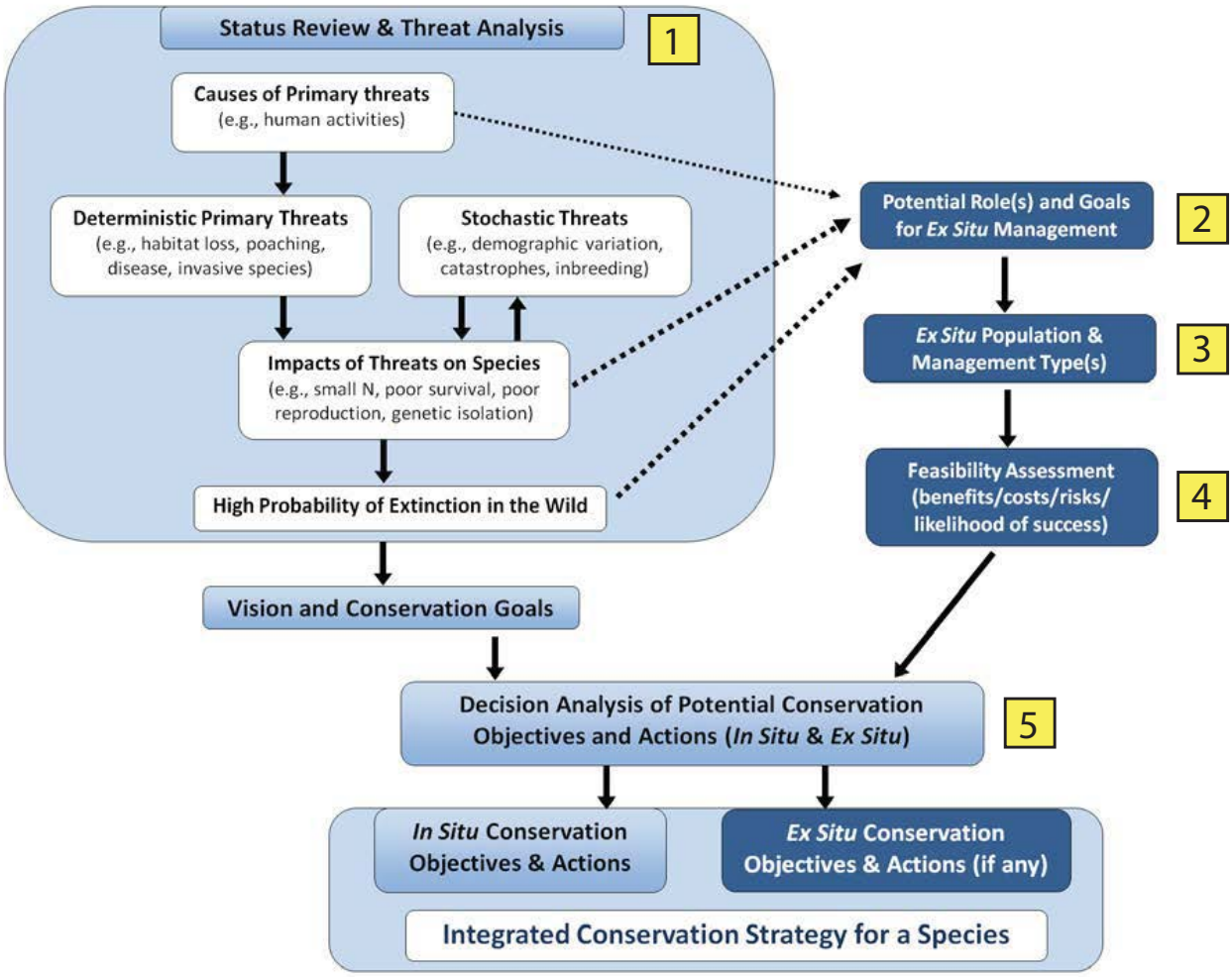

Figure 19. Incorporation of the five-step decision process (yellow numbers) into the species conservation planning process to develop an integrated conservation strategy for a species. From the *Ex Situ* Guidelines (IUCN SSC, 2014).

4.2.1. Addressing information gaps in veterinary care and animal husbandry

Specific priority tasks:

1. For each species, develop an action plan to fill the gaps in knowing whether *ex situ* and translocation options are feasible from a veterinary care and animal husbandry perspective.
2. Develop a general protocol to obtain data that would be needed to assess such feasibility for other small cetaceans not considered here.

Chair : Forrest Gomez
Rapporteurs: Julia Dombroski/Grant Abel

Members: Vera da Silva, Randy Wells, Cynthia Smith, Katrin Baumgartner, Rob Hicks, Esmeralda Mujica de Jorquera, Jay Sweeney, Niels Van Elk, Bob Brownell

To develop a framework for identifying gaps in veterinary care and animal husbandry knowledge, the information needed for successful *ex situ* management was identified and prioritized by rank order into information groups as shown below. The working group then considered all available data for five *in situ* and *ex situ* intersectional categories for three species/subspecies: Atlantic humpback dolphin, Indus river dolphin, and *Inia* (Tables 2-5). The intersectional categories for which state of knowledge was assessed

included: *in situ* knowledge, capture and handling, transport, *ex situ* care, and return to the wild. Available information on each species were identified and categorized as: (1) published, (2) unpublished or (3) absent. The extent of published and unpublished data was then assessed and colour-coded in order to describe and characterize each information gap by situational category. These colour codes are shown in Table 2. Once the information gaps were identified and agreed upon by the species experts, the working group discussed recommendations for future data acquisition.

Information Groups:

- Biology and natural history (life history, reproduction, morphometrics, physiology, species-specific behaviour, activity patterns, key environmental features, group dynamics, ontogeny, composition, mating and rearing strategies, communication)
- Vital physiological statistics (baseline heart rate, respiration, stress response, capture myopathy, blood work, and other baseline health information)
- Disease (types and prevalence)
- Application of medical therapies (pharmaceuticals, dosage rates, responses)
- Environmental conditions (natural habitat features, historical records in *ex situ* facilities)
- Nutrition (prey items, diet and thereby inferences on kcal requirements, energy budgets)
- Reproductive physiology (hormone levels, receptivity, gestation)

Selected species and subspecies evaluations and recommendations

Atlantic humpback dolphin (*Sousa teuszii*) (Table 3)

The species occurs in at least 13 western African states but these are nested within a broader distribution of 19 western African states. Some areas of the known distribution are challenging to work in, which hampers necessary research. Of the four *Sousa* species, *S. teuszii* is the least known/studied and has never been in captivity. Very limited natural history data exist, but some ecological and dietary parameters are known. There are some natural history records for Indian Ocean humpback dolphins (*S. plumbea*), and it is possible that medical and husbandry records from a facility in Bahrain are accessible and could be used for general reference.

Atlantic humpback dolphin recommendations:

Further enquiries should be made concerning access to records of *S. teuszii* in French archives. Reviews should be performed of all published and unpublished data on *S. plumbea* in the wild to assist with interpreting data collected in the future. Protocols for collecting and storing biological samples from dead dolphins should be shared with research personnel working in the range states of the species. Existing samples (skeletal material, genetic samples, stomach contents, etc.) from across the range should be catalogued and comprehensive analyses of these should be attempted. In some instances, a directed effort will be required to gain access to materials; for instance skeletal material, including 11 skulls, are stored at the headquarters of Conkouati Douli National Park in the Republic of Congo. A plan for remote sampling should be developed and operationalized. Training local personnel in capture and handling methods should take place as soon as possible, perhaps in association with ongoing field programmes on other species at other sites (such as Sarasota Dolphin Research Program Sarasota, FL, USA; National Marine Mammal Foundation Conservation Medicine Program, various locations, USA). These recommendations should proceed as a matter of urgency.

Indus river dolphin (*Platanista gangetica minor*) (Table 4)

Due to the extreme turbidity and seasonal conditions of the Indus River, there are significant information gaps regarding behaviour and social organization, ecological parameters, and life history for Indus dolphins. Environmental data on the riverine habitat have been published (Braulik et al., 2012). Historical records are available describing capture and transport methods used for both Indus and Ganges river dolphins, including publications on the species' behaviour, husbandry, and medical care while in *ex situ* situations. There are opportunities to collect behavioural and physiological data on Indus river dolphins and possibly on Ganges river dolphins as well during canal rescue and recovery operations.

Indus river dolphin recommendations:

Capacity building for first responders, including veterinarians, during canal entrapment response and rescue efforts is highly **recommended**. On-site training should commence as soon as possible, potentially during the January 2020 rescue season. It is **recommended** that a questionnaire is prepared by an ESOCC team immediately to be used by first responders when collecting additional behavioural data and vital statistics such as respiratory rates and responses to human handling and transport. A review is **recommended** of medical and animal care records from the three facilities that have maintained this species.

Inia (*Inia geoffrensis* including all three species or subspecies) (Table 5)

Extensive capture-release efforts involving more than 1,000 individuals have been carried out in the wild and a considerable amount of published information exists describing the species' natural history, ecology, nutritional needs, diseases, and reproductive parameters. However, there is still a dearth of information on vital statistics, indicators of stress, and response to pharmaceuticals. A large amount of unpublished information on all information groups (listed above) is known to exist and should be available for future review and analysis. *Inia* have been caught, transported, and maintained in captivity, and there is considerable experience of handling them and enabling reproduction in captivity (Boede et al., 2018). There are no known examples of reintroduction of *Inia* back into the wild, but releases after capture for tagging have demonstrated suitable techniques for follow-up monitoring (da Silva & Martin, 2000; Martin & da Silva, 2018).

In 1989 a group of 13 *Inia* were trapped below the dam of the Balbina UHE (Usina HidroElétrica) in the Uatuma River (Brazil) after the gates were closed to fill the reservoir. With no water in the river below the dam and the nearest river about 200 km away, these animals were captured one by one using hand-modified harpoons and small nets, marked with plastic tags, and transferred into the reservoir, above the dam. No deaths were recorded as resulting from transportation. Today, an isolated population exists inside the reservoir in an area of 4,437 km^2. The number of animals estimated by minimum counting surveys along a 490 km transect was 70 individuals and by stationary observers 30 individuals, including calves and juveniles. A project to estimate the population structure, size, and genetic diversity of this isolated population is underway.

Inia (*Inia geoffrensis* including all three species or subspecies) recommendations:

A thorough examination of the types and extent of unpublished data is **recommended**. This includes, but is not limited to, biological samples, field notes, aquarium husbandry, medical, and behavioural records. The group **recommends** that the species expert leads this undertaking with input on prioritization from *ex situ* management experts. Recognizing that this is will require extensive effort, the species expert can identify students from the range countries who could help undertake a structured systematic review of unpublished data.

Table 2: Colour codes for evaluated information gap scores, indicating status of data for each "intersectional category": the intersection between an activity or body of knowledge (columns) and a functional or operational discipline (rows).

	Adequate data exist in the literature and/or with the species experts
	Moderate amount of data exists
	Small amount of data exists
	No data exists
	Not (Directly) Applicable

Table 3: Atlantic humpback dolphin information gaps

Sousa teuszii	*In situ* Knowledge	Capture & Handling	Transport	*Ex situ* Care	Return to the Wild
Biology & Natural History					
Vital Physiological Statistics					
Disease					
Application of Medical Therapies					
Environmental Conditions					
Nutrition					
Reproductive Physiology					

Table 4: Indus river dolphin information gaps

Platanista gangetica minor	*In situ* Knowledge	Capture & Handling	Transport	*Ex situ* Care	Return to the Wild
Biology & Natural History					
Vital Physiological Statistics					
Disease					
Application of Medical Therapies					
Environmental Conditions					
Nutrition					
Reproductive Physiology					

Table 5: *Inia* information gaps

Inia geoffrensis	*In situ* Knowledge	Capture & Handling	Transport	*Ex situ* Care	Return to the Wild
Biology & Natural History					
Vital Physiological Statistics					
Disease					
Application of Medical Therapies					
Environmental Conditions					
Nutrition					
Reproductive Physiology					

Recommendations for all species and UTCs considered at the workshop:
To advance *ex situ* options for all species, it is **recommended** that new or refined training materials and protocols for filling information gaps be created with relevant translations for each range state. It is **recommended** that training opportunities be created for veterinarians and first responders and that local participation be encouraged and supported. It is **recommended** that published material for all species and UTCs should be compiled and reviewed. Support should be provided that encourages in-country students seeking their Masters or Doctoral degrees to participate in the review and publication of these data. Lastly, it is **recommended** that the feasibility of additional *in situ* data acquisition through remote sampling, capture/release attempts, and animal health assessments be considered for all species.

4.2.2. Addressing information gaps in status and threats as identified by species experts

Specific priority tasks:
1. Produce prioritized, annotated lists of species, subspecies, and geographical populations (units-to-conserve) for which *ex situ* options should be further investigated immediately, in the medium term (within the next decade), and in the long term (within the next 25 years).
2. Develop a plan to fill the critical information gaps identified in *Ex situ* Guidelines Steps 1 & 2. For each unit-to-conserve this includes developing an action plan to address the gaps in information on relative abundance and to evaluate threats throughout the range.

Chair: Barbara Taylor
Rapporteur: Frank Cipriano

Members: Samuel Turvey, Tim Collins, Edu Secchi, Brian Smith, Fernando Trujillo, Phil Miller, Gill Braulik, Doug DeMaster

As background to discussion of threats, it was agreed that for all Units-to-Conserve except Indus river dolphins, gillnetting was the primary threat, with hunting for bait or meat a problem for some species. Although in principle the primary threat could be eliminated quickly by stopping gillnet fishing (both legal and illegal) throughout the population's distribution, in practice the problem has not been solvable because gillnetting is a cheap and efficient method to catch fish and no alternative gear can compete without being heavily subsidized. No cases have been described from developing countries where gillnets were replaced by alternative gear. The gillnet threat is more likely to increase than to decrease in the foreseeable future. In addition to the threat of bycatch (and in some cases hunting), habitat destruction is a serious issue that is not reversible for some units-to-conserve, especially freshwater dolphins.

Because numerous species and UTCs were considered and time was short, the steering committee asked species specialists to address only the relevant items for cetaceans in the first two steps of the *Ex Situ* Guidelines (items in bold italics below).

Step 1 is further broken down into areas where information is needed. Here we summarize the state of knowledge for all species considered for these areas. For "data type" categories, species experts classified the state of knowledge as:

- Known,
- Uncertain—unknown but not critical, or
- Gap—unknown and critical for evaluating status or feasibility of *ex situ* options.

Availability of status reviews (IUCN Red List assessments). For the purposes of this workshop,

participants agreed to treat what is currently recognised as one species of *Inia* as 3 Units-to-Conserve (UTC) that correspond to proposed species that await further evidence to receive taxonomic recognition: *Inia geoffrensis*, *Inia boliviensis,* and *Inia araguaiaensis*. The rationale was that no rescue was possible from one river basin to the next and therefore it is precautionary to treat them as different UTCs for conservation purposes until the data are martialed to resolve the taxonomic uncertainty. IUCN Red List documentation is available for the currently recognised single species (with 2 subspecies). No separate assessments have yet been carried out on what are considered here as three separate UTCs. We **recommend** that separate assessments be conducted for these UTCs, regardless of the clarity of their taxonomic status. The workshop also treated the two recognised subspecies of South Asian river dolphins as if they were two separate species: *Platanista minor* (Indus river dolphins) and *Platanista gangetica* (Ganges river dolphins). Red List assessments for both of these putative species, as subspecies, are available. Red List assessments are available for all of the other representative species, subspecies, and populations considered by the workshop.

Availability of threat analysis. No spatial descriptions of threats was available for the Atlantic humpback dolphin or the Irrawaddy dolphin and only partial descriptions were available for the other species. We **recommend** that full spatial descriptions of the threats be undertaken and made available for all species.

Availability of modeling of extinction risk or genetics. Some analyses have been conducted for at least parts of the ranges of franciscanas, tucuxis, Inia, and Indus and Ganges river dolphins.

Data type categories

Taxonomic uncertainty. The taxonomic uncertainty in the river dolphins has been mentioned above. Many information gaps remain for taxonomic (species, subspecies) and population-level distinctions among Irrawaddy dolphins. For Irrawaddy dolphins, we **recommend** that taxonomy be resolved as a high priority because a number of subpopulations consist of fewer than 100 individuals and are listed as Critically Endangered. Should any of these subpopulations turn out to be distinct subspecies or species, the development of one or more integrated species conservation plans would become a high priority. The group **noted** that existing collections could be used and that many samples with known geographical provenance were identified in a recent study that led to the formal separation of Irrawaddy and Australian snubfin dolphins (*Orcaella heinsohni*) (Beasley et al., 2013). Some information gaps could be filled if research were undertaken to measure and sample specimens in existing museum collections. However, it is likely that gaps will remain and a more general research effort to collect samples from Asia to elucidate both taxonomy and population structure would fill many data gaps identified in this workshop. Indian Ocean humpback dolphins are classified as having uncertain taxonomy because there are animals in Bangladesh that could either be a new species or belong to either *S. plumbea* or *S. chinensis* (Amaral et al., 2017). Should the animals in that region be recognised as another new species, they would also need evaluation for whether the development of an integrated species conservation plan is needed.

Population structure. Gaps remain in understanding population structure for all species. The amount of data needed to make decisions about *ex situ* management is case-specific and was beyond the scope of this workshop.

Spatial distribution of threats. Gaps were listed for all *Inia* Units-to-Conserve (especially the threat of gillnet entanglement), the tucuxi, the Atlantic and Indian Ocean humpback dolphins, and the Irrawaddy dolphin. Threats to the franciscana and Indus river dolphin were listed as Known.

Magnitude (severity) of threats. Most species were categorized as Gap (all *Inia*, the tucuxi, the Atlantic and Indian Ocean humpback dolphins, the Irrawaddy dolphin, and the Ganges dolphin). The franciscana was listed as Known. The Indus dolphin

was categorized as Uncertain (the largest population is increasing, but the trends of others are uncertain). It is worth noting that although numerical estimates are not available, all Units-toConserve except the Indus dolphin are described in IUCN Red List assessments as declining.

We categorized urgency as follows: Identify status of species or populations as G(Green) = safe (>1000, not declining), U = unknown abundance and trends, Y(ellow) = at risk in near term (>1000 and declining or <1000), R(ed) = critical (<100 or high rate of decline). The workshop wanted to rank species at a finer scale than these categories alone and therefore used a set of questions to score species (see Appendix 3). The scores ranked the species from most to least urgent, as follows: Atlantic humpback dolphin, Indus river dolphin, Ganges river dolphin, all four Amazon species, Indian Ocean humpback dolphin, Irrawaddy dolphin, and franciscana. There was consensus that the Atlantic humpback dolphin is in most urgent need of having information gaps filled in a timely fashion so that next steps can be considered (steps 3, 4 and 5 (the *ex situ* decision)). Using interview survey methods to elicit data on both the distribution of sightings and the distribution and magnitude of threats (intensity of shallow-water gillnet fishing activity and direct hunting) was **recommended** by consensus as a top priority for research on Atlantic humpback dolphins. Such surveys were also recommended for the other species with gaps in those same categories of information, though with less urgency. The group **recommended** initial development of interview methods during a planned workshop to standardize survey methods for river dolphins to be held in India in June/July 2019.

The group also considered other data gaps that would inform *ex situ* action plans. If 'safe havens' were available *in situ* (i.e. areas within the natural habitat that could be effectively protected), then *ex situ* actions may not be needed. Ironically, the only unit-to-conserve with what are currently considered to be safe havens is the Atlantic humpback dolphin for which three areas were identified: Gabon (although there appears to be a low density of animals), the Saloum Delta, and Orango National Park in Guinea-Bissau. It is possible that safe havens for other species will be identified following the recommended interview surveys, but participants felt it less likely for dolphins in the Amazon River given animal movements.

Following the pioneering efforts to establish insurance populations through *ex situ* management of Yangtze finless porpoises in oxbow reserves, the group also considered whether there were such opportunities for other units-to-conserve. We **recommend** that an international panel review of the Yangtze finless porpoise programme be conducted to assess the first implementation of a One Plan approach for a small cetacean. For some other units-to-conserve, opportunities for nearly natural protected areas exist. For example, in the range of Ganges river dolphins there are appended lakes (called 'beels') that could possibly serve as sanctuaries. Oxbows also exist near the Amazon mainstem (ex. Juruá region) and there are some already protected areas. Reservoirs in the Tocantins basin as well as in the Madeira river could be designated and managed as sanctuaries. However, there is little opportunity for designating natural protected areas in the Araguaia basin as there is heavy agricultural use of the entire region. Similarly, there are no such opportunities for *Platanista gangetica minor* in the Indus river because the land is semi-desert and there are no significant and semi-permanent lakes adjacent to the mainstem. For franciscanas, there is no easily fenced-off area along the coast. The possible exception is Babitonga Bay which has a population of about 50 resident animals, but gillnet fishing and other anthropogenic threats would need to be eliminated for this bay to serve an *ex situ* role.

A final question of interest is whether there is a 'danger trigger', i.e. some form of data or information that would signal that a species needs urgent *ex situ* intervention (e.g. an observed change in population status beyond a predetermined threshold, or a quantitative or qualitative change in threat intensity or identity). There was insufficient time to

discuss this at a species level, but it was agreed that such triggers would be useful to establish and that they would probably have to be species-specific.

Step 2 in the *Ex Situ* Guidelines (IUCN SSC, 2014) considers the role or roles that *ex situ* action could play in species conservation. "Insurance" is defined as "maintaining a viable *ex situ* population of the species to prevent predicted local, regional or global species extinction and preserve options for future conservation strategies." 'Long-term' is defined as "Maintenance of an *ex situ* population long-term after extinction of all known wild populations and as a preparation for reintroduction or assisted colonization if and when feasible." For cetaceans, the group concluded that 'insurance' and 'long-term' strategies could not be distinguished because it was not possible to foresee when threats in the wild could be removed to allow re-introduction.

4.2.3. Developing a strategy to communicate the One Plan approach

Specific priority tasks:

1. Because some influential individuals and organizations are opposed to *ex situ* management, socialization (i.e. gaining social acceptance) of the concept, including transparency in the acknowledgment of inherent risks, is included as an essential step in any plan and careful thought must be given to when and how to achieve socialization.

Operationalized objective: Develop a communications plan and materials to make it clear that (i) any identified *ex situ* management option should always be thoroughly integrated into the broader species conservation plan, thereby complementary with all other *in situ* conservation actions; (ii) *ex situ* management is not a final solution or an end in itself; and (iii) species recovery can succeed only when effective *in situ* conservation measures are implemented.

Chair: Lorenzo Rojas-Bracho
Rapporteur: Christina Simmons

Members: Shannon Atkison, Lorenzo Von Fersen, Dave Bader, James Danoff-Burg, Dag Encke, Wang Ding, Merel Zimmermann, Martín Zordan, Diane Sweeney, Claudia Gili

The workshop proposed the following plans for future communications to support the outcomes of the workshop and implement the conservation steps identified as critical to conserving small cetaceans.

Creation of reference communications materials in multi-language formats

- It is important for content to be constantly evaluated and improved and to be freely available for public dissemination.
- Develop a unifying statement that can be used as an umbrella to explain actions taken to conserve small cetaceans under the One Plan approach
- Create a system for sharing communications materials with a 'living' key-message document
- Regularly disseminate research findings and actions being taken to create support, understanding, and community engagement
- Make species-specific fact sheets available highlighting challenges and needs for action
- Create 'lessons learned' story sheets
- Build an image library showing species, effects of human activities, and hands-on human conservation activities
- Offer templates for press releases and suggested language for social media tags

- Develop education curriculum on small cetaceans and the One Plan approach to conservation
- Seek out letters of support from key influencers
- Suggested wording to include in on-site graphics in zoos, aquariums, parks, and museums.

Outreach to develop support with key influencers

- Build a network of scientists, communicators, and others working to support ESOCC initiatives
- Reach out to local stakeholders influential in target species conservation
- Work with other conservation groups, including NGOs, zoos and aquariums, and industry associations, to build engagement and support
- Approach government officials and politicians to give them background on about the One Plan approach and *ex situ* management for conservation
- List potentially useful influencers to reach out to for future support
- Identify professional workshops and conferences where presentations can be made about the One Plan approach and *ex situ* management for conservation
- Create workshops, briefings, and regular press outreach to give background to reporters and science writers

Message training, updates and evaluation

- Prepare a list of experts that can speak about the One Plan approach
- Train experts in skills related to messaging with an emphasis on developing local expertise
- Gather testimony from experts on importance of the One Plan approach
- Create a mechanism for tracking news stories related to small cetaceans and particularly those using the One Plan approach to evaluate message reach
- Develop processes to be aware of alternate messaging so that communications can be modified to increase understanding of species needs and conservation status, and of decisions being made to conserve the animals

Media relations deployment

- Post-workshop press release
- Post-workshop reporting and sharing of summary report in science and industry publications
- When possible, prepare strategic opinion editorials for release
- Develop a base message that can be included in related news releases by all organizations working with target species or other small cetaceans
- Identify and take advantage of news stories where we can include messaging about the One Plan approach

Emergency communications to help deal with extinction crises

- Define emergency situations where ESOCC communications should be activated
- Draft an emergency communications plan that includes notification of ESOCC members and emergency contact lists of key scientists and stakeholders involved with small cetaceans
- Identify other emergency response entities (e.g. IWC Rapid Response task force) and seek ways to collaborate with them and complement or reinforce their efforts

5. CONCLUSIONS AND RECOMMENDATIONS

The workshop agreed that certain tasks could be identified immediately to advance the development of integrated species conservation plans for the Units-to-Conserve being considered.

5.1 Major recommendations from the working groups

5.1.1. Veterinary and animal husbandry information gaps

1. Create a plan for acquiring biological samples from *S. teuszii*. Gain access to any *S. teuszii* specimens and data in archives. Develop and implement a health assessment programme. Train local personnel in capture, handling, and sampling protocols.
2. Provide training and materials for first responders and veterinarians to use during canal rescues of Indus river dolphins. Collect behavioural and physiological data such as vital statistics, and information on response to handling and transport. On-site training should commence at the earliest opportunity.
3. Conduct a survey of small cetaceans currently or historically held in Asia, Africa, the Middle East, and South America, to identify any threatened species that are or have been kept, and document demographic characteristics of those specimens. Initiate efforts to work cooperatively with zoos and aquariums that house, or have housed, any of the species (or close relatives) with the goal of collecting data needed to fill information gaps. Review (for the purposes of understanding) the quality of care being provided and initiate cooperation to assist facilities in improving husbandry and medical care if needed.
4. Initiate efforts to use rehabilitation and necropsy data from stranded animals of the seven species for the purpose of collecting data to address information gaps related to *ex situ* management.
   a. Analyse all the soft and hard tissues (mainly teeth) that have been collected but not yet analyzed and that have potential value for developing health assessments.
   b. Provide appropriate protocols for specimen handling for each species.
5. Assess the need for and feasibility of *in situ* data collection for all seven species, and other species as identified most likely to require integrated *in situ*/*ex situ* conservation. Apply a step-wise approach (remote biopsy followed by capture/release, capture/tag/release +/- health assessments) in order to (eventually) assess the reaction of different species to capture, handling, transport, and the application of pharmaceuticals.

5.1.2. Status and threats information gaps

1. Develop interview methods for local residents and stakeholders in the areas occupied by the Asian river dolphins to improve our understanding of *Platanista* distribution, abundance and overlap with threats. Progress on this could be made during a planned survey methods workshop to be held in India, tentatively scheduled for June/July 2019.
2. Use interview methods or readily available data to fill information gaps for both animal and threat distributions together with threat magnitude and potential sanctuary locations. Sanctuary locations

allow the possibility of maintaining 'insurance populations' of threatened species in protected portions of their native habitat where effective mitigation of threats can be assured, as has been done for Yangtze finless porpoises in semi-natural reserves in China. Specific target dates were considered only for species discussed at this workshop, but an effort to consider the urgency for all shallow-water small cetacean species could add more taxa to these target date categories.

   a. For Atlantic humpback dolphins within 2 years
   b. For freshwater dolphin species and populations (*Inia*, *Sotalia*, *Orcaella*, and *Platanista*) within 4 years
   c. For Indian Ocean humpback and marine Irrawaddy and tucuxi dolphins within 6 years

3. Resolve taxonomy within what can be regarded as the Irrawaddy dolphin complex. This should have high priority since many isolated populations would require immediate attention should they turn out to be subspecies or full species.
4. Conduct an independent international panel review of the *in situ* and *ex situ* efforts for the conservation of Yangtze finless porpoises and use its findings to work with Chinese researchers and stakeholders as they develop a 'One Plan approach document' that can serve as a template for others.
5. Develop within one year a list of all species, subspecies, and populations of small cetaceans known or suspected to be in immediate need of a One Plan approach.

5.1.3. Communications plan/stakeholder involvement/education

1. Create communications that convey the complexity of the situation and clarify that *ex situ* management alone is not a final solution (end in itself) and that species recovery and long-term conservation can only occur when *in situ* conservation has been accomplished.

5.2 Minor recommendations from the working groups

5.2.1. Veterinary and animal husbandry information gaps

1. For all seven species, identify a team of species experts within range countries to guide students as they identify and collate comprehensive reviews of published and unpublished data to help fill animal health information gaps, including but not limited to the collection and evaluation of biological samples, field notes and aquarium husbandry, medical and behavioural records.

5.2.2. Status and threats information gaps

1. Develop separate IUCN Red List assessments of the three putative species of *Inia*.

5.3 Financial considerations

The workshop **recognised** the need for funding to implement research programmes to acquire the information to be included in a One Plan approach for any species, and that this should be a priority for the future organizational structure recommended below.

6. FOLLOW-UP COMMITTEE TO MANAGE AND PROMOTE IMPLEMENTATION OF RECOMMENDATIONS

The steering committee agreed that a follow-up committee would be needed to effectively oversee and operationalize the various recommended actions developed during the workshop. Several action items for the follow-up committee were identified and include, without being limited to: determining an organizational structure suited to accomplishing the identified immediate recommendations, designating an overall convener or chairperson, and designating several subject-area sub-committees and action-item leads.

This follow-up committee was established in February 2019 with members and their roles identified, to progress the priority recommendations arising from the workshop in the form of four projects as listed below. In the interests of moving these recommendations forward, the following steering committee members and workshop participants agreed to take part in this follow-up committee: Barbara Taylor (chair), Grant Abel, David Bader, Jay Barlow, Gill Braulik, Frank Cipriano, Tim Collins, Doug DeMaster, Lorenzo von Fersen, Forrest Gomez, Hao Yujiang, Phil Miller, Randall Reeves, Lorenzo Rojas-Bracho, Wang Ding, and Randy Wells.

6.1 Priority projects

We **recommend** four projects as top priorities for filling data or information gaps and for developing a better understanding of *ex situ* options for small cetacean conservation:

1. Expand the capture/tag/release programme for franciscanas in Brazil and Argentina to include biological data gathering for future development of an *ex situ* action plan and to support efforts to rehabilitate and release live by-caught and live-stranded franciscanas in the three range states (Brazil, Uruguay, and Argentina).

   Leads: Randy Wells for developing goals, protocols, and field tests for animal reactions to capture, handling for extended periods at sea, and transport techniques. Lorenzo von Fersen for coordinating the development of a stranding programme in Argentina.

2. Assemble an expert panel to review the Yangtze finless porpoise project within the framework of a One Plan approach. The SMM conservation fund already has an application for a similar evaluation that may be leveraged to include this recommended action. Also seek support from funding bodies in China.

   Lead: Grant Abel. Committee to include: Wang Ding, Randy Reeves, Sam Turvey, Phil Miller, Jay Barlow.

3. Provide capacity building in veterinary and husbandry care for Indus river dolphins that are rescued after becoming stranded (i.e. cut off from the main channel of the river) in irrigation canals by working with WWF and others in Pakistan.

   Lead: Gill Braulik. Forrest Gomez/NMMF to provide support for training and capacity building.

4. Design and conduct an interview survey to fill knowledge gaps on distribution, abundance, and threats for Atlantic humpback dolphins. Also investigate potential research sites to conduct tagging and/or photographic identification research.

   Chair: Douglas DeMaster. Leading members to include: Tim Collins, Sam Turvey and Barbara Taylor. Additional members TBD.

Target dates for recommended actions remain to be established and the new committee will meet regularly to assess progress. Additionally, projects to progress recommendations arising from the *Ex Situ* Options for Cetacean Conservation Workshop will need funding, and a mechanism to receive and distribute funds for the various projects will need to be incorporated into the organizational structure.

7. ADOPTION OF REPORT

The report, including conclusions and recommendations agreed by all participants, and the designation of the follow-up committee and priority projects was adopted by emailed consensus in late March 2019.

Bibliography

Amaral, A.R., Smith, B.D., Mansur, R.M., Brownell, R.L. Jr. and Rosenbaum, H.C. (2017). 'Oceanographic drivers of population differentiation in Indo-Pacific bottlenose (*Tursiops aduncus*) and humpback (*Sousa* spp.) dolphins of the northern Bay of Bengal'. *Conservation Genetics* 18:371-381 https://doi.org/10.1007/s10592-016-0913-7

Beasley, I., Robertson, K.M. and Arnold, P. (2005). 'Description of a new dolphin, the Australian snubfin dolphin *Orcaella heinsohni* sp. n. (Cetacea, Delphinidae)'. *Marine Mammal Science* 21:365-400. https://doi.org/10.1111/j.1748-7692.2005.tb01239.x

Best, P. B. and Ross, G. J. B. (1984). 'Live-capture fishery for small cetaceans in South African waters'. *Reports of the International Whaling Commission* 34: 615-618.

Boede, E.O., Mujica-Jorquera, E., Boede, F., and Varela, C. (2018). 'Reproductive management of the Orinoco river dolphin *Inia geoffrensis humboltiana* in Venezuela'. *International Zoo Yearbook* 52: 1-13. [DOI:10.1111/izy.12195].

Braulik, G.T., Findlay, K., Cerchio, S., Baldwin, R. and Perrin, W. (2017). *Sousa plumbea*. The IUCN Red List of Threatened Species 2017: e.T82031633A82031644. https://doi.org/10.2305/IUCN.UK.2017-3.RLTS.T82031633A82031644.en (Accessed February 20, 2020).

Braulik, G.T., Reichert, A.P., Ehsan, T., Khan, S., Northridge, S.P., Alexander, J.S. and Garstang, R. (2012). 'Habitat use by a freshwater dolphin in the low-water season'. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 22:533-546. https://doi.org/10.1002/aqc.2246

Braulik, G.T. and Smith, B.D. (2019). *Platanista gangetica* (amended version of 2017 assessment). The IUCN Red List of Threatened Species 2019: e.T41758A151913336. http://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T41758A151913336.en (Accessed February 20, 2020).

Braulik, G.T., Smith, B.D. and Chaudhry, S. (2012). *Platanista gangetica* ssp. *minor*. The IUCN Red List of Threatened Species 2012: e.T41757A17628296. https://doi.org/10.2305/IUCN.UK.2012.RLTS.T41757A17628296.en (Accessed February 20, 2020).

Brownell, R.L.Jr. (1986). 'Distribution of the vaquita, *Phocoena sinus*, in Mexican waters'. *Marine Mammal Science* 2:299-305. https://doi.org/10.1111/j.1748-7692.1986.tb00137.x

Byers, O., Lees, C., Wilcken, J. and Schwitzer, C. (2013). 'The One Plan approach: the philosophy and implementation of CBSG's approach to integrated species conservation planning'. *WAZA Magazine* 14:2-5.

Chalmers, G. and Barrett, M. (1982). 'Capture myopathy'. In: G.L. Hoff and J.W. Davis, J.W. (eds.) *Noninfectious Diseases of Wildlife*. First ed., pp.84-94. Ames, IA, USA: Iowa State University Press.

Chen, P., Zhang, X., Wei, Z., Zhao, Q., Wang, X., Zhang, G. and Yang, J. (1993). 'Appraisal of the influence upon baiji *Lipotes vexillifer* by the Three-gorge Project and conservation strategy'. *Acta Hydrobiologica Sinica* 17:101–111.

Collins, T., Braulik, G.T. and Perrin, W. (2017). *Sousa teuszii*: The IUCN Red List of Threatened Species 2017: e.T20425A123792572'. Available at: https://doi.org/10.2305/IUCN.UK.2017-3.RLTS.T20425A50372734.en. (Accessed February 20, 2020).

Collins, T., Braulik, G.T. andPerrin, W. (2017). *Sousa teuszii* (errata version published in 2018). The IUCN Red List of Threatened Species 2017: e.T20425A123792572. https://doi.org/10.2305/IUCN.UK.2017-3.RLTS.T20425A50372734.en (Accessed February 20, 2020).

Comité Internacional para la Recuperación de la Vaquita (CIRVA) (2017). *Report of the Ninth Meeting of the Comité Internacional para la Recuperación de la Vaquita (CIRVA-9)*. Available at: http://www.iucn-csg.org/index.php/downloads/ (Accessed February 20, 2020).

De la Paz, M., Casipe, K., Lirazan, G.M., Espinosa, K.E., Yulo, E.V.R., Valderrama, M.T.K. and Jarabello, C.J. (2017). 'Irrawaddy dolphins of Bago-Pulupandan: updated population estimate, habitat use and fisheries interaction'. Technical Report submitted to the Protected Areas Management Enhancement Project of the

Department of Environment and Natural Resources of the Republic of the Philippines and the Deusche fur Gesellschaft Internationale Zusammenarbeit (GIZ) GmbH of the Republic of Germany.

Dolar, M.L.L. (2012). 'Assessment of the Irrawaddy dolphin population and its habitat in western Negros and investigation of its occurrence in other areas in the Visayas and Mindanao, Philippines'. Technical report submitted to Ocean Park Conservation Foundation, Hong Kong.

Dolar, M., de la Paz, M. and Sabater, E. (2018). *Orcaella brevirostris* (Iloilo-Guimaras Subpopulation). The IUCN Red List of Threatened Species 2018: e.T123095978A123095988. https://doi.org/10.2305/IUCN.UK.2018-2.RLTS.T123095978A123095988.en (Accessed February 20, 2020).

Dolar, M.L.L., Sabater, E.R. and de la Paz M.E. (1991). 'Distribution, population size and conservation status of the Irrawaddy dolphin, *Orcaella brevirostris* (Owen in Gray 1866) in the Visayas, Philippines'. In: J.H.W. Gipps (ed.), *Beyond captive breeding: re-introducing endangered mammals to the wild: the proceedings of a symposium held at the Zoological Society of London on 24th and 25th November 1989.* Symposia of the Zoological Society of London, no. 62.. Oxford : New York: Published for the Zoological Society of London by Clarendon Press ; Oxford University Press. xviii + 284 pp.

Elephant Action League (EAL) (2018). 'Operation Fake Gold'. [online report, 100 pp.] Available at: https://earthleagueinternational.org/wp-content/uploads/2018/07/EAL-Operation-Fake-Gold-Final.pdf (Accessed Feb. 20, 2020)

Environmental Investigation Agency (EIA) (2016). 'Collateral Damage: How illegal trade in totoaba swim bladders is driving the vaquita to extinction.' [online report, 20 pp.] Available at: https://eia-international.org/wp-content/uploads/EIA-Collateral-Damage-FINAL-mr.pdf (Accessed Feb. 20, 2020)

Gewalt, W. (1978). 'Unsere Tonina (*Inia geoffrensis*, Blainville 1817) Expedition 1975'. *Der Zoologische Garten* 48:366-367.

Gui, D., Karczmarski, L., Yu, Ri-Qing, Plön, S., Chen, Laigua, Tu, Qin, Cliff, G., and Wu, Y. (2016). 'Profiling and spatial variation analysis of persistent organic pollutants in south african delphinids'. *Environmental Science and Technology*: 50:4008-1017. https://doi.org/10.1021/acs.est.5b06009 (Accessed Feb. 23, 2020)

International Union for Conservation of Nature Species Survival Commission (IUCN SSC) (2014). *Guidelines on the Use of* Ex Situ *Management for Species Conservation*. Version 2.0. Gland, Switzerland: IUCN SSC. Available at: https://portals.iucn.org/library/node/44952 (Accessed Feb. 23, 2020).

IUCN (2018). *The IUCN Red List of Threatened Species*. Version 2018-2. Available at: http://www.iucnredlist.org. (Accessed Feb. 20, 2020).

Jefferson, T.A., Karczmarski, L., Kreb, D., Laidre, K., O'Corry-Crowe, G., Reeves, R., Rojas-Bracho, L., Secchi, E., Slooten, E., Smith, B.D., Wang, J.Y. and Zhou, K. (2008). *Orcaella brevirostris (Mahakam River subpopulation)*. The IUCN Red List of Threatened Species 2008: e.T39428A98842174. https://doi.org/10.2305/IUCN.UK.2008.RLTS.T39428A10237530.en (Accessed February 20, 2020).

Karczmarski, L., Winter, P.E.D., Cockroft, V.G. and McLachlan, A. (1999). 'Population analyses of Indo-pacific humpback dolphins *Sousa chinensis* in Algoa Bay, Eastern Cape, South Africa'. *Marine Mammal Science*, 15:1115-1123. https://doi.org/10.1111/j.1748-7692.1999.tb00880.x

Kelkar, N. (2017). 'A River Dolphin's Ear-View Of India's Waterways Development Plans'. *Sanctuary Asia*, Vol. XXXVII No. 2, February 2017. Available at: http://www.sanctuaryasia.com/magazines/conservation/10561-a-river-dolphins-ear-view-of-indias-waterways-development-plans.html (Accessed Feb. 20, 2020).

López, B.D., Grandcourt, E., Methion, S., Das, H., Bugla, I., Al Hameli, M., Al Ameri, H., Abdulla, M., Al Blooshi, A. and Al Dhaheri, S. (2017) 'The distribution, abundance and group dynamics of Indian Ocean humpback dolphins (*Sousa plumbea*) in the Emirate of Abu Dhabi (UAE)'. *Journal of the Marine Biological Association of the United Kingdom* https://doi.org/10.1017/S0025315417001205 (Accessed: 23 Feb. 2020).

Martin, A.R. and da Silva, V.M.F. (2018). 'Reproductive parameters of the Amazon river dolphin or boto, *Inia geoffrensis* (Cetacea;Iniidae); an evolutionary outlier bucks no trends'. *Biological Journal of the Linnean Society* 123:666-676. https://doi.org/10.1093/biolinnean/bly005 (Accessed: 23 Feb. 2020).

McGowan, P.J.K., Traylor-Holzer, K. and Leus, K. (2016). 'IUCN guidelines for determining when and how *ex situ* management should be used in species conservation'. *Conservation Letters* 10:361–366. https://doi.org/10.1111/conl.12285

McGowen, M.R., Tsakogeorga, G., Álvarez-Carretero, S., Dos Reis, M., Struebig, M., Deaville, R., Jepson, P.D., Jarman, S., Polanowski, A., Morin, P.A. and Rossiter, S.J. (2019). 'Phylogenomic resolution of the cetacean tree of life using target sequence capture'. *Systematic Biology*. https://doi.org/10.1093/sysbio/syz068 (Accessed: 20 Feb. 2020).

Minton, G., Smith, B.D., Braulik, G.T., Kreb, D., Sutaria, D. and Reeves, R. (2017). *Orcaella brevirostris (errata version published in 2018)*. The IUCN Red List of Threatened Species 2017: e.T15419A123790805. https://doi.org/10.2305/IUCN.UK.2017-3.RLTS.T15419A50367860.en (Accessed February 20, 2020).

Moore, J.E., Martin, A.R. and da Silva, V.F.M. (2018). 'Intrinsic growth (r_{max}) and generation time (T) estimates for *Inia geoffrensis*, in support of an IUCN Red List Re-Assessment'. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-596. Available at: https://doi.org/10.7289/V5/TM-SWFSC-596 (Accessed: 23 Feb. 2020).

Reeves, R. R. , Smith, B.D. Smith and Kasuya, T. (eds.). (2000). *Biology and Conservation of freshwater cetaceans in Asia*. SSC Occasional Paper 23. Gland, Switzerland and Cambridge, UK: . viii + 152 pp. https://portals.iucn.org/library/node/7688

Rojas-Bracho, L., Gulland, F.M.D., Smith, C.R., Taylor, B., Wells, R.S., Thomas, P.O. et al. (2019). 'A field effort to capture critically endangered vaquitas *Phocoena sinus* for protection from entanglement in illegal gillnets'. E*ndangered Species Research* 38:11-27 https://doi.org/10.3354/esr00931 (Accessed: 20 Feb. 2020).

Schwacke, L.H., Smith, C.R., Townsend, F.I., Wells, R.S., Hart, L.B., Balmer, B.C., Collier, T.K., DeGuise, S., Fry, M.M., Guillette, L.J. Jr., Lamb, S.V., Lane, S.M., McFee, W.E., Place, N.J., Tumlin, M.C., Ylitalo, G.M., Zolman, E.S., and Rowles, T.K. (2014). 'Health of common bottlenose dolphins (*Tursiops truncatus*) in Barataria Bay, Louisiana,following the Deepwater Horizon oil spill'. *Environmental Science and Technology* 48:93-103. https://doi.org/10.1021/es5009278

Secchi, E. (2012). Sotalia fluviatilis. The IUCN Red List of Threatened Species 2012: e.T190871A17583369. https://doi.org/10.2305/IUCN.UK.2012.RLTS.T190871A17583369.en (Accessed February 20, 2020).

Secchi, E. and Wang, J.Y. (2012). *Pontoporia blainvillei (Rio Grande do Sul/Uruguay subpopulation)*. The IUCN Red List of Threatened Species 2012: e.T41761A17690417. https://doi.org/10.2305/IUCN.UK.2012.RLTS.T41761A17690417.en (Accessed February 20, 2020).

Shapiro, J. (2001). *Mao's War Against Nature*. New York, USA: Cambridge University Press. 287 pp. + 24 illus. https://doi.org/10.1017/CBO9780511512063

da Silva V.M.F., Freitas, C.E.C., Dias, R.L. and Martin, A.R. (2018) 'Both cetaceans in the Brazilian Amazon show sustained, profound population declines over two decades'. *PLoS ONE* 13(5): e0191304. https://doi.org/10.1371/journal.pone.0191304 (Accessed February 20, 2020).

da Silva, V.M.F. and Martin, A.R. (2000). 'A study of the boto, or Amazon River dolphin (*Inia geoffrensis*), in the Mamirauá Reserve, Brazil: Operation and Techniques'. In: R.R. Reeves, B.D. Smith and T.Kasuya (eds.) *Biology and Conservation of Freshwater Cetaceans in Asia*, SSC Occasional Paper no. 23, pp.121-130. Gland, Switzerland and Cambridge, UK: IUCN SSC. Available at: https://portals.iucn.org/library/node/7688

Smith, B.D. (2004). *Orcaella brevirostris (Ayeyarwady River subpopulation)*. The IUCN Red List of Threatened Species 2004: e.T44556A10919593. https://doi.org/10.2305/IUCN.UK.2004.RLTS.T44556A10919593.en (Accessed February 20, 2020).

Smith, B.D. and Beasley, I. (2004a). *Orcaella brevirostris (Malampaya Sound subpopulation)*. The IUCN Red List of Threatened Species 2004: e.T44187A10858619. https://doi.org/10.2305/IUCN.UK.2004.RLTS.T44187A10858619.en (Accessed February 20, 2020).

Smith, B.D. and Beasley, I. (2004b). *Orcaella brevirostris (Mekong River subpopulation)*. The IUCN Red List of Threatened Species 2004: e.T44555A10919444. https://doi.org/10.2305/IUCN.UK.2004.RLTS.T44555A10919444.en (Accessed February 20, 2020).

Smith, B.D. and Beasley, I. (2004c). *Orcaella brevirostris (Songkhla Lake subpopulation)*. The IUCN Red List of Threatened Species 2004: e.T44557A10919695. https://doi.org/10.2305/IUCN.UK.2004.RLTS.T44557A10919695.en (Accessed February 20, 2020).

Smith, B.D., Braulik, G.T. and Sinha, R. (2012). *Platanista gangetica* ssp. *gangetica*. The IUCN Red List of Threatened Species 2012: e.T41756A17627639. https://doi.org/10.2305/IUCN.UK.2012.RLTS.T41756A17627639.en (Accessed February 20, 2020).

Smith, C.R., Rowles, T.K., Hart, L.B., Townsend, F.I., Wells, R.S., Zolman, E.S., Balmer, B.C., Quigley, B., Ivancic, M., McKercher, W., Tumlin, M.C., Mullin, K.D., Adams, J.D., Wu, Q., McFee, W., Collier, T.K. and Schwacke, L.H. (2017). 'Slow recovery of Barataria Bay dolphin health following the Deepwater Horizon oil spill (2013-2014) with evidence of persistent lung disease and impaired stress response'. *Endangered Species Research* 33:127-142. https://doi.org/10.3354/esr00778 (Accessed: 23 Feb. 2020).

Snyder, N. and Snyder, H. (2000). *The California Condor: A Saga of Natural History and Conservation*. San Diego, California, USA: Academic Press. 432 pp.

Tas'an, M. and Leatherwood, S. (1984). 'Cetaceans Live-Captured for Jaya Ancol Oceanarium, Djakarta, 1974-1982'. *Reports of the International Whaling Commission* 34:485-489.

Taylor, B.L. and Rojas-Bracho, L. (1999). 'Examining the risk of inbreeding depression in a naturally rare cetacean, the vaquita (*Phocoena sinus*)'. *Marine Mammal Science* 15:1004-1028. https://doi.org/10.1111/j.1748-7692.1999.tb00875.x

Thomas, P. and Gulland, F. (2017). *Report of the International Workshop on the Conservation of Irrawaddy Dolphins in the Mekong River. Kratie, Cambodia, January 2017*. [online report, 36 pp.] Available at: https://iucn-csg.org/wp-content/uploads/2010/03/Report-of-the-2017-International-Workshop-on-the-Conservation-of-Irrawaddy-Dolphins-in-the-Mekong-River.pdf (Accessed: 23 Feb. 2020).

Traylor-Holzer, K., Leus, K. and Bauman, K. (2019). 'Integrated collection assessment and planning (ICAP) workshop: Helping zoos move toward the One Plan Approach'. *Zoo Biology* 38:95-105. https://doi.org/10.1002/zoo.21478 (Accessed: 23 Feb. 2020).

Turvey, S.T., Pitman, R.L., Taylor, B.L., Barlow, J., Akamatsu, T., Barrett, L.A., Zhao, X., Reeves, R.R., Stewart, B.S., Wang, K. et al. (2007). 'First human-caused extinction of a cetacean species?' *Biology Letters* 3: 537–540. https://doi.org/10.1098/rsbl.2007.0292

Turvey, S.T., Risley, C.L., Moore, J.E., Barrett, L.A., Hao, Y., Zhao, X., Zhou, K. and Wang, D. (2013). 'Can local ecological knowledge be used to assess status and extinction drivers in a threatened freshwater cetacean?' *Biological Conservation* 157: 352-360. https://doi.org/10.1016/j.biocon.2012.07.016

Turvey, S.T., Trung, C.T., Quyet, V.D., Nhu, H.V., Thoai, D.V., Tuan, V.C.A., Hoa, D.T., Kacha, K., Sysomphone, T., Wallate, S., Hai, C.T.T., Thanh, N.V. and Wilkinson, N.M. (2015). 'Interview-based sighting histories can inform regional conservation prioritization for highly threatened cryptic species'. *Journal of Applied Ecology* 52:422–433 https://doi.org/10.1111/1365-2664.12382 (Accessed: 23 Feb. 2020).

Vermeulen, E., Bouveroux, T., Plön, S., Atkins, S., Chivell, W., Cockcroft, V., Conry, D., Gennari, E., Hörbst, S. and James, B.S. (2018). 'Indian Ocean humpback dolphin (*Sousa plumbea*) movement patterns along the South African coast'. *Aquatic Conservation: Marine and Freshwater Ecosystems* 28:231-240. https://doi.org/10.1002/aqc.2836 (Accessed: 23 Feb. 2020).

Wang, D., Turvey, S.T., Zhao, X. and Mei, Z. (2013). *Neophocaena asiaeorientalis* ssp. *asiaeorientalis*. The IUCN Red List of Threatened Species 2013: e.T43205774A45893487. https://doi.org/10.2305/IUCN.UK.2013-1.RLTS.T43205774A45893487.en (Accessed February 20, 2020).

Wells, R.S., Rhinehart, H.L., Hansen, L.J., Sweeney, J.C., Townsend, F.I., Stone, R., Casper, D.R., Scott, M.D., Hohn, A.A. and Rowles, T.K. (2004). 'Bottlenose dolphins as marine ecosystem sentinels: Developing a health monitoring system'. *EcoHealth* 1:246-254. https://doi.org/10.1007/s10393-004-0094-6 (Accessed: 23 Feb. 2020).

Wildt, D.E., Zhang, A., Zhang, H., Janssen, D.L. and Ellis, S. (eds.) (2012). *Giant Pandas: Biology, Veterinary Medicine And Management*. New York, USA: Cambridge University Press. 612 pp.

Zhang, X., Wang, D., Liu, R., Wei, Z., Hua, Y., Wang, Y., Chen, Z. and Wang, L. (2003). 'The Yangtze River dolphin or baiji (*Lipotes vexillifer*): population status and conservation issues in the Yangtze River, China'. *Aquatic Conservation: Marine and Freshwater Ecosystems* 13:51–64. https://doi.org/10.1002/aqc.547

Zerbini, A.N., Secchi, E., Crespo, E., Danilewicz, D. and Reeves, R. (2017). *Pontoporia blainvillei (errata version published in 2018).* The IUCN Red List of Threatened Species 2017: e.T17978A123792204. https://doi.org/10.2305/IUCN.UK.2017-3.RLTS.T17978A50371075.en (Accessed February 20, 2020).

Appendix 1

List of participants

Although attendance at the workshop was limited to participants and invited guests, the organizers planned to share the information and recommendations widely, including by making this report publicly available for download online, and disseminating by providing links in the Society for Marine Mammalogy's Conservation Committee newsletter, announcements via social media, and presentations at upcoming scientific and zoo/aquarium community conferences.

Surname, First name(s)	**Affiliation**
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Atkinson, Shannon	University of Alaska Fairbanks, College of Fisheries and Ocean Sciences
Bader, David	Aquarium of the Pacific, AZA Vaquita SAFE
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Baumgartner, Katrin	Zoo Nuremberg
Boede, E.O.**	Fundacion para el Desarrollo de las Ciencias Fisicas, Matematicas y Naturales (FUDECI)
Braulik, Gill	University of St Andrews
Brownell, Robert L., Jr.	National Oceanic and Atmospheric Administration
Cipriano, Frank	California Academy of Sciences
Collins, Tim	Wildlife Conservation Society - Ocean Giants Program
Danoff-Burg, James	The Living Desert Zoo and Gardens, AZA Vaquita SAFE
DeMaster, Douglas	National Oceanic and Atmospheric Administration
Dolar, L.*	Silliman University, Philippines
Dollhäupl, Sandra	Zoo Nuremberg
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Gili, Claudia	Acquario di Genova / EAZA Marine Mammal TAG (Chair)
Gomez, Forrest	National Marine Mammal Foundation, VaquitaCPR
Hicks, Rob	SEA LIFE - Merlin Entertainments
Hüttner, Tim	Zoo Nuremberg
Khan, Uzma*	WWF International

* remote attendance
** contributed but did not attend

Kelkar, Nachiket*	Ashoka Trust for Research in Ecology and the Environment
Mägdefrau, Helmut	Zoo Nuremberg
Miller, Phil	IUCN SSC Conservation Planning Specialist Group
Mujica de Jorquera, Esmeralda	Asociación Venezolana de Zoológicos y Acuarios, AVZA
Paudel, Shambhu**	Tribhuvan University, Pokhara, Nepal
Reeves, Randall. R.*	IUCN Cetacean Specialist Group
Ribeiro Guimaraes Dombroski, Julia	Syracuse University
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Secchi, Eduardo	Instituto de Oceanografia, Universidade Federal do Rio Grande/FURG
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Simmons, Christina	San Diego Zoo
Smith, Brian	Wildlife Conservation Society
Smith, Cynthia	National Marine Mammal Foundation, VaquitaCPR
Sweeney, Jay	Dolphin Quest
Taylor, Barbara	National Oceanic and Atmospheric Administration, VaquitaCPR
Trujillo, Fernando	Fundacion Omacha
Turvey, Samuel	Institute of Zoology, Zoological Society of London
van Elk, Niels	Marine Mammal Veterinarian (private practice)
von Fersen, Lorenzo	Yaqu Pacha e.V., Zoo Nuremberg
Wang, Ding	Institute for Hydrobiology of the Chinese Academy of sciences, Wuhan, China
Wells, Randall	Sarasota Dolphin Research Program, Chicago Zoological Society, VaquitaCPR
Zerbini, Alex**	Alaska Fisheries Science Center - NOAA
Zimmermann, Merel	European Association of Zoos and Aquaria
Zordan, Martín	World Association of Zoos and Aquariums

Appendix 2

Proposed steps for deciding whether and how to proceed with consideration of *ex situ* management actions

The IUCN 5-step process will require an in-depth meeting for each species. This initial meeting, however, is meant to identify what information is available and what critical gaps remain for the 7 species under consideration for *ex situ* management. An important goal for our meeting will be to determine which (if any) of those species are both in urgent need of developing *ex situ* management and have sufficient grounds for believing *ex situ* protocols would be both feasible and successful (step 4, which will likely have the greatest information gaps). The scoring system below (and see below for worked examples) was developed to help us do the ranking during our meeting efficiently so that we can focus discussion on those species/populations with the highest needs. It is likely that our scoring system will not operate perfectly and should not be applied rigidly, but it should get species/populations in close to a ranking from most-in-need of *ex situ* management (highest score) to least-in-need and potentially some that are not suitable. Once we have a roughly ranked list, participants can consider how to improve that list including how to treat uncertainty. The next action for the species/populations ranked most in need is to convene a species conservation planning workshop to better identify research and management needs with a broader representation of experts who know that species/population. However, because this is an *ex situ* management workshop the species/population would need to have some recognised feasibility for *ex situ* management before considering to proceed to convening a planning workshop.

The workshop also tested the utility of a set of evaluation questions for scoring which species have the greatest need for *ex situ* management, and for which are such actions most likely to be successful, compiled by Taylor, as listed below. These questions were designed to help workshop participants use a consistent set of criteria to rank species/populations by urgency and feasibility – "worked examples" for vaquita (scores real), and *Inia* (current scores in this draft are hypothetical) are given at the end.

Questions for scoring sheet to rank species/populations by feasibility and urgency

(worked examples are given at the end using vaquita (real), ***Inia*** (hypothetical))

1) Are the threats causing declines in abundance likely to be mitigated in the next 25 years?
    a. Yes…***ex situ*** not a needed tool (Score 0…and…you're done)
    b. No…***ex situ*** may be needed. Proceed to 2
2) When will the population/species likely reach <1000 mature individuals (the stage where numbers alone put it at risk of extinction (VU))?
    a. If > 35 years then not yet a high priority for ***ex situ*** (Score 0, done)
    b. If between 25 and 35 years then should be considered a low priority for ***ex situ***. Proceed to 5. Score 1
    c. If < 25 years proceed to 3

3) When will the population/species likely reach <250 mature individuals (the stage where numbers alone put it at risk of extinction (EN))?
    a. If between 10 and 25 years then a high priority for ***ex situ***. Score 3, proceed to 5.
    b. If < 10 years then proceed to 4
4) When will the population/species likely reach <50 mature individuals (the stage where numbers alone put it at risk of extinction (CR))?
    a. If < 10 years then an urgent priority for ***ex situ***. Score 5, proceed to 5
5) Is the population likely to be highly fragmented such that the overall population size underestimates the level of risk to the species?
    a. If Yes add Score of 1
    b. If no add Score of 0
6) What is the role of ***ex situ*** management?
    a. If rescue or long-term Score 3
    b. Other roles Score 1
7) Is capture myopathy likely to occur?
    a. Yes
        i. If < 250 individuals then leave score
        ii. If > 250 then subtract 3 and consider research prior to further ***ex situ*** planning
    b. No. Add score of 1
8) Are there suitable locations for captive animals that allow the animals to behave close to their wild state?
    a. Yes (improved chance of successful reintroduction). Add score 1
    b. No. No score added
9) Is it plausible that either the individuals captured will be released into a wild population or released with other captured individuals within a generation? In other words, are the threats likely to be removed within one generation?
    a. Yes (improved chance of successful reintroduction or translocation). Add score 1
    b. No. No score added and proceed to 9
10) If animals must be kept for multiple generations (no to Q8) then are resources likely to sustain the animals for the long-term?
    a. Yes. Add score 1
    b. Unknown. No score added
    c. Unlikely or No. Not suitable for ***ex situ*** consideration at this time (Score goes to 0)

Vaquita example:

1) No
2) C
3) B
4) Score 5
5) No, leave score
6) Rescue and Long-term Score 3 (total 8)
7) Yes but <250 so leave Score
8) No, leave Score
9) No, leave Score
10) Unknown, leave Score

Final Score 8

***Inia* example (Hypothetical answers, offered to illustrate the process):**

1) No
2) B Score 1
3) Na
4) Na
5) Yes (fragmented) Score 1 (total 2)
6) Insurance population Score 1 (total 3)
7) No, score 1 (total 4)
8) Yes, score 1 (total 5)
9) Yes, (translocated individuals released below dam) score 1 (total 6)
10) 9 Unknown, leave score

Final Score 6

Appendix 3

Abstracts of presentations and species summary papers compiled by workshop participants

Using risk assessment tools and processes to guide integrated conservation planning for cetaceans across the *in situ* – *ex situ* spectrum

Phil Miller
IUCN SSC Conservation Planning Specialist Group

Abstract: As wildlife populations decline in abundance and demographic/genetic stability through human pressures on the environment, *ex situ* management can be a valuable component of an endangered species conservation programme. However, its successful design, implementation and integration with continued *in situ* population management requires careful consideration of a number of important questions. When is it appropriate to initiate an *ex situ* programme, relative to the size of the remaining wild population? Can the desired number and composition of founder animals be removed periodically from the wild population without jeopardizing the short-term viability of this valuable *in situ* source? When can population managers initiate releases to the wild, and how many individuals of a given demographic composition can be released, without compromising the viability of the *ex situ* population? Does the proposed release of captive animals include unacceptable risks of negative outcomes for the wild population (e.g., disease introduction)? Scenario-based quantitative risk assessment tools rooted in population viability and disease risk analysis can be used to address these and related questions in a rigorous and transparent process. The strengths and weaknesses of these tools will be discussed, with accompanying examples of their use in selected integrated conservation planning processes facilitated by CPSG – from wolves in the southwest United States to amphibians in Panama. Lessons learned from these case studies will be applied to the prospects of integrated conservation for small cetaceans.

WAZA as a conservation network

Martín Zordan
World Association of Zoos and Aquariums

Abstract: The World Association of Zoos and Aquariums (WAZA) is the global alliance of zoos and aquariums, their national and regional associations, dedicated to the care and conservation of animals and their habitats around the world. The membership consists of more than 400 leading institutions and organisations from more than 50 countries. WAZA promotes cooperation between its members as well as with wildlife experts and academia. WAZA provides support for species-conservation management and husbandry of animals in human care, while encouraging the highest standards in member institutions. WAZA has a valuable potential as a conservation network for threatened and endangered species of small cetaceans. The *ex situ* roles that zoos, aquariums and other *ex situ* facilities can fulfil for these species should be identified using the IUCN Species Survival Commission Guidelines on the Use of *Ex situ* Management for Species Conservation. All *ex situ* conservation efforts should integrate Animal Welfare as an essential component as detailed

in the WAZA Animal Welfare Strategy. Evaluating whether the animal welfare implications of management interventions are outweighed by their conservation benefits, building understanding of the importance of integrated species conservation frameworks that include assessing animal welfare and making sure that in all conservation work take into account individual's needs are some of the recommended actions.

EAZA *ex situ* conservation programme

Merel Zimmerman
European Association of Zoos and Aquaria

Abstract: In the ideal world all (threatened) species are covered by an integrated conservation plan, developed according to the One Plan approach (OPA) and applying the *IUCN Species Survival Commission (SSC) Guidelines on the Use of* ex situ *Management for Species Conservation*. This would make it clear to professional zoos and aquariums, like the EAZA membership, which species require some form of *ex situ* management for conservation and which of those *ex situ* activities are best delivered by EAZA and its membership. Despite a steady growth in the number of taxa for which this is the case, and it being the ambition of the IUCN SSC to scale up the development of such conservation action plans, the majority of species is not yet covered by such an integrated plan. Whilst EAZA is fully on board with the ambitious targets for conservation action planning as set by the IUCN SSC, this obviously is a long-term project. In the meantime, EAZA (like other regional zoo and aquarium associations) needs to be able to continuously plan its collections and thus take a leading role in applying the OPA and the IUCN *ex situ* guidelines to develop the *ex situ* conservation priorities for EAZA to focus on as part of the EAZA Regional Collection Plan. EAZA together with the IUCN SSC Conservation Planning Specialist Group (CPSG) and other regional zoo and aquarium associations have jointly developed a process to assist zoos with collection planning in this way, called Integrated Collection Assessment and Planning (ICAP). EAZA utilises the five-step decision process to systematically determine if and which *ex situ* activities might be appropriate to be included in overall conservation strategy for a species. In this context, the EAZA Taxon Advisory Group for Marine Mammals will go through this process in 2021 for cetaceans. The decision-making process allows for input from relevant external stakeholders, like the IUCN SSC Cetaceans Specialist Group, besides EAZA members and offers a benefit, feasibility and risk assessment method to reach consensus on recommended roles a species has within the EAZA region.

International vaquita conservation actions

Lorenzo Rojas-Bracho[1], Cynthia Smith[2], Barbara Taylor[3]

[1] CONABIO-VaquitaCPR, CIRVA

[2] National Marine Mammal Foundation, VaquitaCPR

[3] NOAA, VaquitaCPR

Abstract: Vaquitas have been declining as a result of unsustainable bycatch for many decades and now number fewer than 30 individuals with no signs that the catastrophic decline has lessened. The various conservation actions are reviewed with the focus on what could have been done differently and how the history of this species can inform future conservation actions for small

cetaceans. Development of methods to monitor vaquita population have made great progress. However, there was no understanding of vaquita behaviour to guide us in the 2017 attempt to take as many vaquitas as possible into captivity (Vaquita Conservation, Protection and Recovery – Vaquita CPR). We will review in some detail the Vaquita CPR programme and will focus on several questions related to when *ex situ* conservation might have been appropriate to add as a conservation strategy: 1) Why was the Vaquita Refuge ineffective, 2) Why was the recovery Plan ineffective, 3) Why was *ex situ* conservation not considered by the recovery team earlier, 4) Would a One Plan approach have been a) politically viable, and b) fundable, 5) What lessons were learned about support for *ex situ* conservation (both financial and conceptual support) from a) the scientific community, b) NGOs and c) Zoos and Aquariums?

Lessons learned from conservation efforts for the baiji and Yangtze finless porpoise

Wang Ding, Hao Yujiang
Institute for Hydrobiology of the Chinese Academy of Sciences, Wuhan, China

Abstract: An *ex situ* conservation plan for the baiji was first proposed by Chinese scientists in the early 1980s due to intensifying anthropogenic impacts on its survival. Unfortunately, it was too late when the plan was accepted as an indispensable measure for its conservation. The baiji was finally declared functionally extinct in 2007 based on a range-wide survey conducted in 2006. *Ex situ* management, however, has been successful for the Yangtze finless porpoise since the early 1990s. Three *ex situ* populations have been established in oxbows of the Yangtze River (called "semi-natural reserves"). With a total *ex situ* population currently estimated at over 110 individuals, these efforts are considered important components for conserving this freshwater subspecies. In light of the lessons learned from the baiji and finless porpoise *ex situ* programmes, the Chinese government recently proposed the Yangtze River Protection policy, attaching greater importance to protection of the lotic ecosystem and all species that it supports. There is now greater optimism for environmental improvement of the Yangtze river in the near future. A survey conducted in 2017 confirmed that the rapid decline of the porpoise population had slowed if not stopped. By comparing the outcomes of the baiji and the Yangtze finless porpoise conservation initiatives, this paper aims to discuss several issues concerning the *ex situ* options for small cetaceans more generally, which include: 1) population status and threat evaluation; 2) parameters and standards for *ex situ* protection site selection; 3) capture, rehabilitation and transportation; and 4) management of *ex situ* metapopulations.

The importance of evidence-based conservation in decision-making for aquatic mammals

Samuel Turvey
Institute of Zoology, Zoological Society of London

Abstract: Decision-making for conservation of species must be informed by robust empirical data for key parameters relevant to conservation, including status, population trends/dynamics, and threats. Lack of data can lead to delays in identifying or implementing necessary conservation actions, sometimes resulting in species extinctions. It is therefore essential to investigate the

usefulness of data sources that are under-used in cetacean conservation research, as well as re-assessing the information content of available field data that might be able to provide further conservation insights. Relevant information about target species is often available from untrained local people utilizing the same environments, which can provide information about the status of species and ecological resources that may be unavailable from other sources. Interview based surveys may thus provide information on species occurrence at a given locality, an index of relative population abundance, population trends through time, and patterns of population survival and extinction between landscapes, to inform spatial conservation prioritization, and may also be able to characterize human interactions with target species and identify key threats. Interview surveys across the middle-lower Yangtze river system were able to characterize the spatio-temporal pattern of decline of the baiji as that species became depleted and then extinct, and can provide a rapid, cost-effective method for assessing relative abundance patterns and potential declines for the Yangtze finless porpoise across different areas of the river system. Analysis of the information content of existing conservation-relevant field data from the Yangtze system, including boat-based survey data for Yangtze finless porpoise (2006, 2012) together with interview surveys in fishing communities (2008, 2011–2012), used generalised linear model (GLM) analysis to investigate whether density of fishing activities and ship traffic could predict patterns of observed porpoise mortality, and found that the only significant predictor was ship traffic. Further analysis at different spatial scales still showed no significant relationship with fishing activities. Population modelling with observed Yangtze finless porpoise mortality data, using multiple possible population models that estimate different levels of sustainable removal, estimated sustainable removal of 3.35 indiv/year under a Potential Biological Removal (PBR) model, and 30 indiv/year under a density-dependent logistic model. Reported porpoise mortality from the 2008 interview survey estimated 30 dead porpoises in the previous 12-month period (6 from fishing gear entanglement and 7 from propeller collisions); since these estimates are likely to be greatly under-representative of actual annual porpoise mortality in the Yangtze, modelling results suggest that direct mortality rather than indirect factors (e.g. reduction in habitat carrying capacity or prey base) might be driving porpoise decline in the Yangtze.

Lessons learned from developing a sea sanctuary for long term care of captive belugas (*Delphinapterus leucas*) which offer potential options for small cetacean conservation.

Rob Hicks
SEA LIFE - Merlin Entertainments

Abstract: SEA LIFE began as a small seal sanctuary on the banks of Loch Creran in Oban, Scotland in 1979. Almost 40 years and 50 aquariums later, SEA LIFE is now part of the largest aquarium organisation in the world as part of the company Merlin Entertainments. From the beginning, SEA LIFE and now Merlin, have held to the belief that cetaceans should not be kept in captivity. As the organisation grew, a series of strategic business acquisitions brought cetaceans into the company, which gave an opportunity and need to creatively find alternative ways to increase the welfare of those cetaceans, whilst under human care.

Chang Feng Ocean World in Shanghai, China was acquired by Merlin in 2012. At that time the aquarium housed three beluga whales (*Delphinapterus leucas*), originally collected from the White Sea (n=2) and Sea of Okhotsk (n=1), of the Russian Federation. Since acquiring the business, Merlin

has focussed on increasing the welfare of the animals in the aquarium and developing the world's first open water sea sanctuary for belugas, with a vision to improve the welfare of belugas in other facilities elsewhere in the future.

The journey from vision to reality, which has led to constructing the SEA LIFE Trust Beluga Whale Sanctuary in Iceland, has, at the very least, been interesting and thought-provoking. Lessons learnt during key stages of the project are many, but for the purposes of this presentation will be focussed around location criteria, site search, facility specifications, preparation of animals, welfare assessment of the belugas, development of the facilities in Iceland, establishment of teams and permits. The opportunities from this project are far reaching and include alternative holding and long-term or temporary care options for small cetaceans, which could be used to assist the conservation of other cetacean species.

History of cetaceans under human care

Jay Sweeney
Dolphin Quest

Abstract: Over the past 50 years (since 1970), the marine mammal Public Display Community has experienced a very significant learning curve in the development of cetacean health care management and individual animal longevity. Today there are many veterinarians and some veterinary schools which have provided technical support and experience to this process. Included are specific protocols and procedures for implementing basic and specialized husbandry and technological skill-sets that directly improves both the welfare of individual animals, and their accumulative longevity, genetic diversity and population sustainability. These methodologies have been put to routine practice in some advanced facilities and are fully applicable to *ex situ* conservation projects directed to the salvation of at-risk cetacean populations around the world. This presentation includes a discussion on some of the specific areas of potential implementation as above.

Veterinary considerations for *ex situ* conservation of marine mammals

Cynthia Smith, Forrest Gomez
National Marine Mammal Foundation, VaquitaCPR

Abstract: A key tenet of medicine is that prevention is always better than treatment. Within marine mammal conservation medicine, it is imperative to apply this principle not only to each individual and population we care for, but also to conservation projects as a whole. As part of the larger interdisciplinary team, veterinarians can help ensure that animal health considerations are well thought out during each phase of any conservation project, to include planning, implementation and evaluation. Additionally, as outlined by the IUCN guidelines, if a programme is to be successful it is vital that strategic planning and data collection be done as early as possible. Although there have been many advances in the management of cetaceans under human care, there are inherent risks to handling and caring for species with little known capture and health history. This highlights the importance of prevention to include early, responsible data collection. Data considered critical from a veterinary perspective includes: response to capture and handling, basic health parameters, drug use, emergency procedures, nutritional needs, social structure and behaviour, appropriate housing,

genetics, cryopreservation and reproduction. Existing data for the species in question will be reviewed and data gaps will be highlighted for discussion as a group. The health assessment model as standardized by R.S. Wells and colleagues with bottlenose dolphins in Sarasota Bay, Florida is proposed as the most appropriate model for gathering much of this information prior to execution of an *ex situ* conservation attempt. As zoos and aquariums work towards advancing endangered species recovery and wildlife reintroductions, conservation medicine can help provide an ecological framework and holistic, preventative approach for these efforts. As a veterinary community, we aim to help the larger conservation team working so hard to try and save these critical species and their habitats.

Ex situ options for cetacean conservation: *Inia geoffrensis* and *Sotalia fluviatilis*

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Abstract

Inia geoffrensis and *S. fluviatilis* are threatened by multiple factors along their distributional area. *Inia* occur in the Amazon and Orinoco river basins, in an area of approximately 8.380 millions km^2 in six countries (Brazil, Bolivia, Colombia, Ecuador, Peru and Venezuela), while the *S. fluviatilis* doesn't occur above the dams of the Madeira River in Brazil and Bolivia territory, as well as in the Orinoco River basin in Colombia, and in Venezuela. In some geographical areas there is strong evidence of the continuous decrease of populations in both species, and also, the isolation of populations/ individuals of *Inia* in dam reservoirs, such as in the Rivers Tocantins and Madeira (Brazil). However, despite the numerous threats, these different populations along their distributional area do not require initiating *ex situ* conservation processes. It is urgent to start implementing actions that guarantee the conservation of their habitats and populations.

The first records of capture, transport and exhibition of Amazon river dolphins go back to 1956 with animals removed mainly from the Colombian Amazon (>100), and Venezuela (Orinoquia), and relocated to the United States, Europe and Japan. On the other hand, there is an important historical reference of animals kept in captivity in the Aquarium of Valencia, Venezuela for 41 years. Currently there are two individuals of *Inia* still alive in captivity conditions; one in Germany and the other in Peru. Information on the reproductive biology of this species has recently published, providing robust parameters, which are key to its management. Regarding the gaps of information about *Inia*, it is important to elucidate the taxonomy of the species and define the different existing population units and their level of threat. This is particularly important for dolphins in the Tocantins-Araguaia basin and Madeira river due to the population fragmentation created by several hydroelectric dams along their course. Translocation actions should be considered only in cases where habitat quality has severely deteriorated and / or genetic exchange is very low in isolated small groups. A long experience in the capture, transportation and handling of these two Amazonian dolphins already exists. Incidental catching and negative interaction with fisheries are today's main threats to *Inia* sp. and *S. fluviatilis*. The quantification of the magnitude of these catches

and the knowledge of population trends in key areas to evaluate the population status and corroborate the level of threat are fundamental.

1 Summary of what is known

1.1 Experience with the species in captivity, including attempts to rehabilitate and/or maintain individuals under managed care (i.e. in captive or 'semi-captive' conditions)

For over six decades, the *Inia geoffrensis*, boto or tonina, was captured and transported long distances to be displayed in aquariums in North America, Europe, Japan and in South America. Table 1 covers the places, year and numbers of these dolphins captured and maintained in captivity in aquariums around the world.

From 1956 to 2006, 147 individuals were captured and brought into captivity, however over 50% of these animals died during transportation or only a few hours or days into captivity (Caldwell et al., 1989; Collet, 1984; Tobayama & Kamiya, 1989; Boede et al., 1998; Bonar et al., 2007). Reports show that the main problems related to transportation by old post second war planes were the high altitudes, duration of flights and probably also low temperatures. The temperature of the waters in the Amazon rivers varies from 24º to 26º C (Sioli, 1984) but for transport and captivity conditions, water and air temperature must be maintained between 24º to 29º C. On the transport in the fifties and sixties, besides endoparasites, the cold air during flights, was also the cause of "pneumonia", which was recorded as the most common disease in captive botos (Caldwell et al., 1989, Bonar et al., 2007; Boede et al., 2018). The facilities in which botos were kept ranged from open-air artificial pools, natural springs, to partially and completely enclosed artificial environments, with depths varying from 1.1 to 3.3 m (Caldwell et al., 1989; Tobayama & Kamiya, 1989;

Fig. 1 – *Inia geoffrensis* from the Orinoco river, rescued and translocated to deeper waters, during low water season. **© Ernesto O. Boede**.

Bonar et al., 2007; Boede et al., 2018). In the sixties and seventies the first three *Inia geoffrensis* were born in captivity in the United States, but they survived less than 15 days.

Later on in Venezuela the Valencia Aquarium had 22 years of experience with reproduction of *Inia geoffrensis* humboldtiana. Of eight births, four survived their first year and reached a maximum lifespan of 16.3 years (Caldwell & Caldwell, 1972; Huffman, 1970; Boede et al., 2018). World wide the *ex situ* history of *Inia geoffrensis* clearly shows that they can be successfully maintained in captivity for decades (Table 1), and that conception, birth and rearing of offspring under human care is possible (Bonar et al., 2007; Boede et al., 2018). The Valencia Aquarium *Inia geoffrensis* captive breeding program, has led to an increase of knowledge on reproductive parameters and biological data for this species. But also their 41 year experiences in husbandry and management procedures could be helpful for future *ex situ* conservation planning of other critically endangered small cetacean (Boede et al., 1998). New information on these experiences, there are numerous examples of rescue animals that are trapped in water bodies that dried quickly during periods of low water, mainly in the Colombian and Venezuelan Orinoquia, and the Rio Grande in Bolivia. Between 1973 and 2018, at least 69 copies have been counted. In some cases, it has been possible to mobilize them quickly and release them in deeper parts of the river, and in others swimming pools had to be improvised to have them for several days before making a longer transport (> 3 hours), usually by truck (F. Trujillo, pers. comm.; Boede, 2016).

In Venezuela, between 1973 and 2016, a total of 15 toninas were rescued during low water season and translocated to the nearby river in deeper waters (Fig. 1).

Of these, two died: at the area of the middle Orinoco river a neonate was found entangled in a fishing net, and stranded female adult that

Fig. 2 – Adult Amazon river dolphin rescued from Formoso River, and transported by truck for 15km on a dirt road to be released at the Javaés river (Tocantins State, Brazil). **© Associação Amigos do Peixe-boi (Friends of Amazonian Manatee Association)**

was maintained some weeks in a nearby zoo for veterinary treatment, rehabilitation and release (Boede & Mujica-Jorquera, 1999; Boede, 2016).

In 2010, at the beginning of the low water season (May), a large group of 26 botos was trapped in the river Pailas, a tributary of the Rio Grande (Department of Santa Cruz, Bolivia). Calves, juveniles and adults including pregnant females, were rescued and translocated successfully to three different stretches of the same river from 1, 10 and 20 km downstream from the blockage to avoid food competition (Aliaga-Rossel & Escobar, in press).

In Brazil, the first time that botos were rescued and translocated into different rivers was in 1989, when a group of nine botos was trapped below the Balbina dam. These animals were captured and then placed inside the reservoir (V.M.F. da Silva, unpublished data). In September 2010, in the Rio Branco, Acre State, due to severe drought during the low water season, a young male was captured and transported in an open truck for

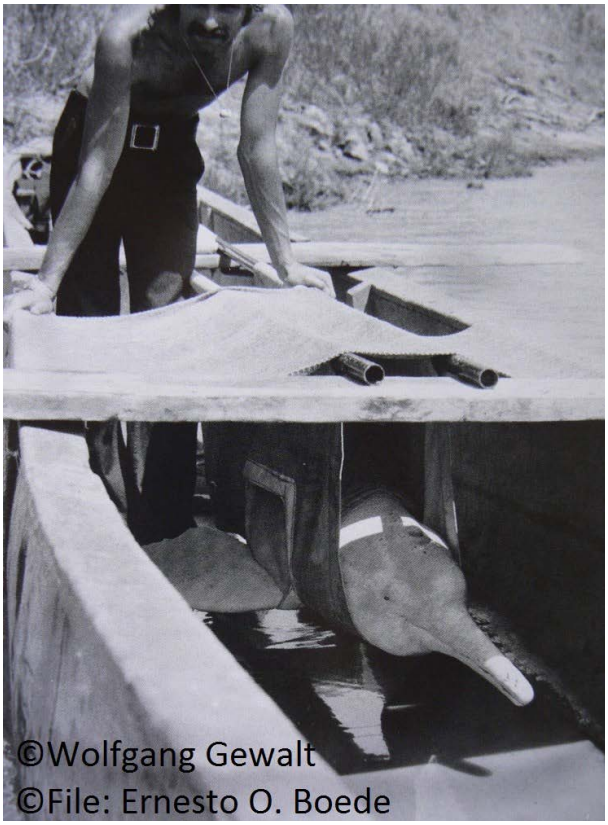

Fig. 3 – *Inia geoffrensis* from the Orinoco, captured in March 1975 from Rio Apure, Venezuela, and transported to Duisburg Zoo, Germany (Gewalt, 1998). **© Wolfgang Gewalt / File: © Ernesto O. Boede**

Table 1 – Places, year and numbers of Amazon and Orinoco river dolphin *Inia geoffrensis* captured and maintained in captivity in aquariums around the world.

Capture Locality	Year of Capture	No. of Animals	Aquarium & Place	Time in Captivity	References
Colombian Amazon (near Leticia)	1956	4	Silver Springs in Florida (USA)		Layne, 1958; Layne & Caldwell, 1964
Colombian Amazon	Between 1956 & 1966	70	Several (>13) aquariums in USA	From 1 day up to 32.6 months average	Collet, 1984; Caldwell et al., 1989
Colombian Amazon	1968	2	Sea World Kamogawa (Japan)	F: Oct 68- Jan 72 (>3yrs) M: Oct 68- Apr 86 (16 yrs)	Tobayama & Kamiya,1989
unknown	1970	1	Pittsburgh Zoo (USA)	23,5 yrs	Schreib, S., A. Burrows and T. Smith. 1994
Apure river, San Fernando de Apure, Venezuela (Orinoquia)	1975	5	Duisburg Zoo (Germany)	From 6 mo to 43,7 yrs (still alive)	Gewalt, 1978; E.O. Boede pers. comm.
Apure river, San Fernando de Apure, Venezuela (Orinoquia)	1975	3	Morón, Puerto Cabello (Venezuela)	Less than 1 year	Trebbau, 1975; Boede et al., 1998
Apure river, San Fernando de Apure, Venezuela (Orinoquia)	1975 to 1994	17	Valencia Aquarium (Venezuela)	From 8 month to 29,2 years	Boede et al. 1998, Bonar et al. 2007, Curry et al., 2013, Boede et al., 2018
Ucayali river, Pucallpa, Peru	2006	1	Quistococha Zoo in the city of Iquitos (Peru)	12 years (still alive)	F. Trujillo pers. comm., E.O. Boede pers. comm.

approximately 30 min (25 km far from the rescue site), until its release in the Rôla river. In August 2016, at the Maria river (Floresta do Araguaia – Pará state), an adult female, a calf and a young male were rescued from a very shallow isolated section of the river and carried in a stretcher for 150m along the dry river bed, then transported by truck for about 50km (1:30h) to the Araguaia river where they were released. In the same period, another rescue \operation was necessary at the Formoso river (Lagoa da Confusão – Tocantins state), a tributary of the Araguaia river, where nine botos, including females with calves, were trapped in a shallow isolated pond, due to the excessive water pumping for crop irrigation. These botos were transported by truck for 15km on a dirt road to be released at the Javaés river (Fig. 2). These animals were kept on a foam mattress and physically restrained with large towels, were constantly wet, and their vital signs monitored (da Silva, et al., 2016.). No sedatives and therapeutics were been used and no posterior monitoring was done in these areas.

No information is available about *Sotalia fluviatilis* kept in captivity. Apparently, in the sixties, some individuals could have been exported to the United States (F. Trujillo pers. comm). The most abundant information is on the marine *Sotalia*, *S. guianensis* from the Colombian Caribbean, when more than 20 individuals were sent to European aquariums in the late 70's (Bossenecker, 1978; Terry, 1993). Of these, the surviving last and oldest individual lived until 2009 in the Münster Zoo, Germany, fulfilling an approximate biological age of 47 years and an age in captivity of 32 years (E.O. Boede, pers. comm.).

According to Collet (1984) between middle of the 1800's and 1980' at least 40 European institutions in 13 countries live-captured a minimum of 393 dolphins (including 67 released and 16 born in captivity). These include 5 *Inia geoffrensis* and 87 *Sotalia fluviatilis*. These five toninas were captured in March 1975 from rio Apure, Venezuela, and transported to Duisburg Zoo, Germany (Gewalt, 1998 – Fig. 3).

One of the males caught as a month old calf, is still alive today (Table 1). The *Sotalia*'s were live-captured near San Antero in Colombia (Caribbean), of which 56 were released shortly after capture. The remaining 24 were sent to aquariums in Germany and Netherlands; 2 died in transit, 3 died within 2-3 weeks and 1 died after 2 month. From the remaining, in 1978, 7 tucuxis died and 4 were still alive in 1984 (Collet, 1984). In April 1979, 3 tucuxis (cf. *S. guianensis*) were caught in Colombia and held in captivity in the Netherlands at least until 1980 (Dral, Stades & van Foreest, 1980).

1.2 Knowledge of the focal species with respect to stress-induced capture myopathy, including the use of sedatives and therapeutics to manage cardiovascular effects of catecholamines

Stress-induced capture myopathy is reported by Curry (1999) as muscle damage in some net caught dolphins, but no case has been reported in 123 *Inia geoffrensis* Amazon and Orinoco river dolphins, captured by net, transported and brought into captivity from 1956–2006 (Bonar et al., 2007). Neither by this transfers, have sedatives and therapeutics been used for cardiovascular effects of catecholamines. Aubin and Dierauf (2001) report on hematology and blood cells count an increase of leukocyte (white blood cells) in dolphins under stress.

In stranding of six Orinoco river dolphins in a flooded lagoon that was drying out in dry season, they were captured on low depth with fishing nets and transported back to release to the nearby Arauca river, Apure state, Venezuela, with 7 km on dirty savanna track and paved road, in stretchers and foam mattress, overlaid with wet blankets and sprayed with water, in an open truck covered with canvas. Blood samples were taken after capture and significant leukocytosis were also observed. The capture and translocation proved successful, 6 hours passed from the

moment of capturing all the animals until the release in the nearby Arauca river. No sedatives and therapeutics to manage cardiovascular effects were used (Boede & Mujica Jorquera, 1999; Boede, 2016) (Fig.1).

Caldwell et al., (1989) reports with air transport of Amazon river dolphins between 1956–1966 from the Amazon region of Colombia to the United States, that problems related to flight, altitude, and duration are characteristic of the species, so there must be good oxygenation, pressurization and warm temperature during the flight and the initiation of a prophylactic antibiotic program prior to transport because these river dolphins are prone to respiratory distress leading to pneumonia and infections from possible cuts and abrasions suffered during handling. Gewalt (1978) reports no problems with five Orinoco river dolphins caught with long fishing nets and canoes with low depth in the Apure river. These dolphins were transported in wooden transport boxes units with inside stretchers and covered with wet blankets, in room temperature, by plane from San Fernando de Apure airport to Caracas national airport, and from here to Düsseldorf airport, Germany, and the last distance in a closed truck to the Zoo Duisburg. With five days of stressful manipulation, handling, land and air transportation, from the day of capture until the day of arrival at the German zoo, no dolphin got ill or died during the procedures. No sedatives and therapeutics to manage cardiovascular effects were used, but some therapeutics were used to prevent infectious processes (P. Schulz, pers. comm.). Boede et al., (1998) reports for Venezuela in a c. 12 h. land transportation in an open truck that had canvas attached to the sides to protect the animals from the sun, in cloth hammocks covered with wet blankets and occasionally sprayed with water onto the animals in order to help maintain body temperature between 35.4 and 36.6°C, also did not happen any problems during this kind of transport. No sedatives and therapeutics to manage cardiovascular effects were used, and no preventive infections therapeutics were used prior or during transportation, but afterwards, Boede (1990) also reports, once arrived the dolphins at the Valencia Aquarium that it was necessary to use therapeutics against pneumonia, skin infections and endoparasites. Bonar et al., (2007) conclude that transport for Amazon or Orinoco river dolphins must be done in appropriately slings, under sanitary conditions, and with good temperature control, water and air between 25°C and 29°C would be prudent to prevent post transport morbidity and mortality due to pneumonia.

For over 25 years the Projeto Boto has handled in the Brazilian Amazon over 1300 botos of all ages and sizes. These individuals have been captured and manipulated for the collection of biological samples (e.g. morphometric data; skin, blood, milk, and ultrasound), VHF- telemetry, and branded with liquid nitrogen for identification purposes. The average time handling the botos was 20 minutes. These animals were caught with nets specifically made for this purpose, individually removed from the water in a stretcher, placed on a foam mattress and kept wet during all period held out of the water. For more detailed information see (da Silva and Martin, 2000). The number of experienced fisherman and boats in the water during capture is vital to cover the whole working area, never leaving a stretch of net unattended. Calves are more susceptible to stress and myopathy conditions, so in order to reduce stress, they are always captured with their mothers and kept close by during the handling process. After collection of material, the calf is kept in the water, held by hand by one of the team members. The respiratory frequency is constantly controlled and every time the animal holds its breath for a period of over ~1 min, the person holding it submerges the animal simulating a quick dive and surface behaviour. Mother and calf are always released simultaneously. Young animals and adults are always closely monitored. In general, the animals are kept on thick foam mattress and are restrained with a large stripe of foam or a large towel, placed across the caudal peduncle and held by a fisherman on its extremities.

Acute stress is detected when the animal starts showing myopathy symptoms and flaccidity in its melon and blowhole area. At these signs, a strong splash of water is thrown over the head of the animal simulating a quick dive and forcing the animal to breathe. If this measure does not work, the animal is immediately returned to the water. Results have always been positive. In different opportunities, the same animals were recaptured on the same day or in consecutive days and they reacted differently than as in the first capture. The hematologic profile of 54 males and 56 females Amazon river dolphin and its variation during acute capture stress was analyzed (Mello & da Silva, in prep.).

During 2017 and 2018 at least 36 *Inia* were captured as part of the dolphin satellite tracking program in Brazil, Bolivia, Peru and Colombia led by WWF, Omacha, Mamirauá Institute, Faunagua and Prodelphinus. From these, 23 transmitters were installed. The catches were made during periods of low water, using appropriate nets and equipment, with a team composed of veterinarians, fishermen and biologists. The installation procedures of transmitters lasted between 10 and 40 minutes. Blood and tissue samples were taken to evaluate mercury and isotopes. No dolphin died during these procedures. The installation of another 27 transmitters is planned during 2019–2020.

A total of 25 tucuxis *Sotalia fluviatilis* (tucuxi), all adults were alive-captured in the Japurá river (central Amazon, Brazil). These animals were sexed, weighted, branded with liquid nitrogen and collected body total length, blood, and skin for genetic studies. Different from the botos, the tucuxis were always handled on the beach, near the netting operation, over a small wet mattress.

Due to its small size and the maximum of ~50 kg of weight, tucuxis are easier to carry and to be moved into the water when necessary. Tucuxis however, are much more nervous and stressful than the sympatric boto. In general the stress symptoms starts with the animal shaking or trembling, contracting its muscles, followed by getting into a "U" position, lifting simultaneously the head and the tail in a very stiff curved body. When out of the water the animal is constantly monitored and as soon as the animal start showing stress symptom, a strong splash of water is thrown over its head, simulating a quick dive and forcing the animal to breathe. If the reaction of relaxation is not immediate, the animal is immediately released and monitored until disappear. No sedatives were used.

1.3 Cryopreservation of gametes and other biological material

No cryopreservation of gametes exists for *Inia* or *Sotalia*. The spermatozoa from seven adult Amazon river dolphins were analyzed showing a similar morphology to other cetaceans (Amaral et al., 2017). The Aquatic Mammals Lab at Inpa, Brazil, has preserved biological material as skin samples stored in alcohol and/or DMSO, lyophilized milk, and frozen serum, plasma, and blood.

Large collection of skulls and skeletons exists in several institutions in Brazil (INPA, IDSM, MPEG), and in Colombia at the Instituto Alexander von Humbold and Instituto de Ciencias Naturales (ICN) collections (over 100 skulls); at the Central National collection in Venezuela and IVIC Genetic samples in Colombia at the University of the Andes and University Javeriana, and in several museums in North America and Europe (da Silva, 1994). In Ecuador only two skulls are available.

1.4 The economic and cultural context with respect to *ex situ* conservation

In Brazil the maintenance of cetaceans in captivity for display is permitted only in exceptional situation and for well-justified research purpose (Portaria MMA No. 98, 14-04-2000). The only time *Inia* was kept captive in Brazil was in 1985 when a mother-calf pair was caught at the Formoso River

(Goiás State) for recreational purpose. These dolphins were transported by truck to Sao Paulo city and placed in an aquarium in a shopping center, in a small pool of about 4m deep. In May 1987 the female calf died, apparently with acute pneumonia. A campaign by an NGO demanded the release of the adult female and in July of 1988, under judicial order, the animal was transported back to the same river where she was caught and released.

In Venezuela the Valencia Aquarium housed for 41 years *Inia geoffrensis humboldtiana*, in total 14 dolphins were transferred from the Apure river to the park. Initially the dolphins were captured for recreational and educational purpose only, but for the four individuals caught and transferred in 1987 and 1994, conservation and research programs were also taken into account. The aim was to collect information and data about captive management, captive breeding, and diseases. The long term conservation goal was to send some surplus captive- bred females to the Zoo Duisburg, Germany, which at the time maintained two males, providing the opportunity to form a breeding pair in the zoo world outside Venezuela, and establish a jointly managed captive breeding program. But with the current political, economic and social Venezuelan unrest, and losing the remaining dolphins in 2011 and 2016 it is recommended, that river dolphin species should not be housed at the Valencia Aquarium in the long term (Boede et al., 2018).

In Colombia, river dolphins have not been kept in captivity. Only in 1986, two *Inia* and one *Sotalia* were captured in the Amazon near Leticia for the Santa Marta Aquarium (Caribbean). However, one of the animals died during transport and the other two, died within a few weeks. In general, there are restrictions to exhibit dolphins that are in threat category (established by the Ministry of Environment), and only marine dolphins, mainly Tursiops truncatus and *Sotalia* guianensis have been exhibited in the two existing aquariums in the country, both in the Caribbean.

In Peru, since 2006 a male *Inia geoffrensis* has been kept in captivity in the facilities of the Quistococha zoo in Iquitos. Initially it was in a small cement pond with an island in the middle with a group of spider monkeys. Later in 2010 the animal was transferred to a larger pond and subjected to conditioning to make show for the public (Table 1).

Botos are very curious animals living near the edges of the rivers and near human settlements, floating houses and boat. In 1998 a young girl living in a floating house in the Negro river at the city of Novo Airao (Amazon state) started throwing small fishes to a boto that was swimming near her house. With time, other animals joined and this activity became a big attraction. This simple interaction however, showed that wild botos could be tamed and provisioned very fast. Today, six facilities are operating commercially in the Rio Negro, near Manaus, where provisioned botos and tourists interact. For several years this activity was illegal without any regulation or control. From January 2018, the Environmental Council of the Amazon State established a set of rules (Resolução/CEMAAM nº. 28, 22 January 2018) legalizing this activity in the Amazon State. About 50 animals are involved in the tourism activity, spread in an area of about 100 km of river. These botos explore and visit at least five of the six existing places. Genetic studies revealed that all animals engaged in the interactions are males of different ages, of which, some pairs show 1st degree of relationship (Gravena, 2007; Garcia et al., 2016).

1.5 The current state of community outreach and socioeconomic solutions

In most Latin American countries, there is legislation that regulates the *ex situ* management of wildlife species. Until relatively recently, the main interest was to keep collections in zoos to attract visitors. However, the international current that made these places incorporate

environmental education processes and initiatives to support the conservation of threatened species also began to develop in South American countries. Some of the most notable examples are related to international alliances to recover the Andean condor, threatened primates and birds. More recently, this has been extended to some species of aquatic vertebrates such as the giant otter (*Pteronura brasiliensis*) with successful *ex situ* reproduction programs, as in the case of the Cali Zoo in Colombia. Another species that has been subject to *ex situ* management has been the Amazonian manatees with examples of rehabilitation and liberation processes in Brazil, Peru and Colombia. In general, there is a positive perception at the social level that these wildlife centers make every effort to recover wildlife, often the result of illegal trafficking.

In the case of river dolphins, the most widespread position among governments and scientists is that all possible efforts be made to guarantee healthy habitats that allow populations to remain stable, and in other cases to recover. The challenge is large and complex, since the economic agendas and the lack of governability in these regions lead to the prioritization of over-exploitation, pollution, and even directed hunting of species such as dolphins.

1.6 The current state of global awareness of the species, its conservation status, and media coverage

Inia geoffrensis is classified by the IUCN as Endangered Species (EN) (da Silva et al., 2018). In Venezuela, as "Low Risk"; In Bolivia, Colombia and Peru *Inia* is classified as "Vulnerable"; and in Brazil and Ecuador as "Endangered".

There is great concern at the regional and international level about the increase in threats to river dolphins in South America. This has materialized through the new categorization of *Inia geoffrensis* (EN) and *Sotalia fluviatilis* (DD - still under evaluation) in 2018. Likewise, these species have been the subject of attention at a media level by campaigns worldwide against the deliberate hunting of dolphins to use them as bait in the fishery of the piracatinga (*Calophysus macropterus*), which led Brazil to establish a moratorium (2015–2020) on this fishery, and Colombia to permanently ban the commercialization of this fish. Likewise, there is a South American Action Plan (Trujillo et al., 2010) and national action plans in Bolivia, Brazil, Colombia, Ecuador and Venezuela. In several of them, the issue of *ex situ* management is mentioned.

Additionally, at the 67th meeting of the Scientific Committee of the International Whaling Commission in Slovenia (2018), it was recommended the formulation of a Conservation Management Plan for river dolphins integrating actions among all the countries where it exists.

2 Summary of information needs

2.1 Identifying data gaps and what needs to be done to fill those gaps

With regard to gaps in information about *Inia* that are key to fill, is to elucidate the taxonomy of the species and establish the different existing population units and their level of threat. Incidental catching and negative interaction with fisheries are today's main threats to *Inia* sp. and S. *fluviatilis*. The quantification of the magnitude of these catches and the knowledge of population trends in key areas to evaluate the population status and corroborate the level of threat needs to be established and monitored in the different areas or population units.

It is important to mention that although the species of freshwater dolphins in the Amazon and Orinoquia are in the threat category, they are not yet at the level of initiating *ex situ* conservation programs. It is important to focus technical, financial and political efforts on ensuring healthy

habitats and reducing or stopping the threats that are currently facing them. However, and with the aim of constructing a conceptual framework around the *ex situ* conservation of these species, information is presented in some of the items required in the workshop

3 Necessary next steps

3.1 A timeline for actions based on current abundance estimates and trajectories

Although in recent years estimates of abundance have been made in many rivers in the region, studies of population trends are required, which to date are only available in relatively small geographic areas in Brazil and Colombia.

In Brazil, a population monitoring for over 20 years revealing a drastic reduction of botos, forced the Brazilian government to establish a moratorium between 2015–2020, stopping for 5 years the fishing of the piracatinga catfish, caught with dolphins and caimans carcasses (Brum et al., 2015; da Silva et al., 2018).

3.2 Other aspects relevant to workshop focus

Given the great heterogeneity of habitats and the number of dolphins throughout their distribution area, efforts must be made in specific areas to measure population changes in the short, medium and long term. This should also be associated with quantifying several of the threats that affect these species such as directed capture, bycatch, overfishing and depletion of fish stocks, among others.

Literature cited

Aliaga-Rosel, E. and Escobar, M. (In press). 'Translocation of trapped Bolivian river dolphins *Inia boliviensis*'. *Journal of Cetacean Res. Management.*

Aubin, D.J.St. and L.A. Dierauf (2001). 'Stress in marine mammal'. In: L.A. Dierauf, and F.M.D. Gulland (eds.) *Handbook of Marine Mammal Medicine*, 2nd ed, pp.253-269. Boca Raton, Florida: CRC Press. https://doi.org/10.1201/9781420041637.ch13

Boede, E.O. (1990). 'Management of gastrointestinal problems in Orinoco river dolphins *Inia geoffrensis* kept in captivity at Aquarium J.V. Seijas, Venezuela'. *Proceedings. American Association of Zoo Veterinarians, October 21-26, South Padre Island, Texas*: 41-41.

Boede, E.O., Mujica Jorquera, E. and Boede, N. (1998). 'Management of the Amazon river dolphin *Inia geoffrensis* at Valencia Aquarium, Venezuela'. *International Zoo Yearbook* 36: 214-222. https://doi.org/10.1111/j.1748-1090.1998.tb02904.x

Boede, E.O. and Mujica Jorquera, E. (1999). 'Esfuerzos de conservación para la Tonina *I. geoffrensis*'. *Natura: Fundación La Salle de Ciencias Naturales, Tipodín C.A., Caracas* 114: 23-24.

Boede, E.O. (2016). 'Historial sobre algunos varamientos de toninas *Inia geoffrensis* en Venezuela, 1973-2016.' Informe preliminar, FUDECI, Caracas, Venezuela: 1-7.

Boede, E.O., Mujica Jorquera, E., Boede, F. and Varela, C. (2018). 'Reproductive management of the Orinoco river dolphin *Inia geoffrensis humboldtiana* in Venezuela'. *International Zoo Yearbook* 52: 1-13. https://doi.org/10.1111/izy.12195

Bonar, C.J., Boede, E.O., García Hartmann, M., Lowenstein-Whaley, J., Mujica Jorquera, E., Parish, S.V., Parish, J.V., Garner, M.M. and Stadler, C.K. (2007). 'A retrospective study of pathologic findings in the Amazon and Orinoco river dolphin (*Inia geoffrensis*) in captivity'. *Journal of Zoo and Wildlife Medicine* 38 (02): 177, 189. https://doi.org/10.1638/1042-7260(2007)038[0177:ARSOPF]2.0.CO;2

Bossenecker, P.G. (1978). 'The capture and care of *Sotalia guianensis*'. *Aquatic Mammals*, 6:13-17.

Brum S., da Silva, V.M.F., Rossoni, F. and Castello, L. (2015). 'Use of dolphins and caimans as bait for *Calophysus macropterus* (Lichtenstein, 1819) (Siluriforme, Pimelodidae) in the Amazon'. *J. of Applied Ichthyology*, 1-6.. https://doi.org/10.1111/jai.12772

Caldwell, M.C. and Caldwell, D.K. (1972). 'The littlest ugly dolphin'. *Sea Frontiers* 18 (1): 24-29.

Caldwell, M.C., Caldwell, D.K. and Brill, R.L. (1989). '*Inia geoffrensis* in captivity in the United States'.In: W.F. Perrin, R.L. Brownell Jr., Zhou Kaiya, and Liu Jiankang (eds.), *Biology and conservation of the river dolphins*, pp. 35-41. SSC Occasional Paper no. 3. Gland, Switzerland and Cambridge, UK: IUCN SSC. Available at: https://portals.iucn.org/library/node/6485

Collet, A. (1984). 'Live capture of cetaceans for European institutions'. *Rep.Int. Whal. Comm*. 34, 603-607.

Curry, B.E. (1999). *Stress in mammals: The potential influence of fishery-induced stress of dolphins in the eastern tropical Pacific Ocean*. NOAA Technical Memorandum NMFS, NOAA- TM-NMFS-SWFS-260. La Jolla, CA, USA: Southwest Fisheries Science Center.

Curry, B.E., Ralls, K. and Brownell Jr., R.L. (2013). 'Prospects for captive breeding of poorly known small cetacean species'. *Endangered Species Research* 19: 223-243. https://doi.org/10.3354/esr00461

da Silva, V.M.F. and Martin, A.R. (2000). 'A study of the boto, or Amazon River dolphin (*Inia geoffrensis*), in the Mamirauá Reserve, Brazil: Operation and Techniques'. In: R.R. Reeves, B.D. Smith and T. Kasuya (eds.) *Biology and Conservation of Freshwater Cetaceans in Asia*, pp.121-130. SSC Occasional Paper no. 23. Gland, Switzerland and Cambridge, UK: IUCN. Available at: https://portals.iucn.org/library/node/7688

da Silva, V.M.F., Amaral, R.S., Carmo, N.A. and Fugita, E.S. (2016). 'Resgate e Translocação de botos-vermelhos no Brasil'. In: *XI Congreso de la Sociedad Latinoamericana de Especialistas en Mamíferos Acuáticos, Valparaíso*, p.71 Libro de Resúmenes del XI Congreso de la Sociedad Latinoamericana de Especialistas en Mamíferos Acuáticos.

da Silva, V., Trujillo, F., Martin, A., Zerbini, A.N., Crespo, E., Aliaga-Rossel, E. and Reeves, R. (2018). *Inia geoffrensis*. The IUCN Red List of Threatened Species 2018: e.T10831A50358152. Downloaded on 28 November 2018.

Dral, A.D.G., Stades, F.C. and van Foreest, A.W. (1980). 'Some cases of synechia anterior in aquatic mammals'. *Aquatic Mammals* 8(1):11-14.

Garcia, E., de Pinho., H.S., da Silva, V.M.F., Farias, I.P., Hrbek, T. and Gravena, W. (2016). 'Relação genética e níveis de parentesco em agregações de boto-vermelho (*Inia geoffrensis*) do Baixo Rio Negro, Amazonas – AM'. *Anais do V Congresso de Iiciaçao Cientifica do INPA – CONIC*: 380-385.

Gewalt, W. (1978). 'Unsere Tonina (*Inia geoffrensis*, Blainville 1817) Expedition 1975'. *Zool. Garten N.F. Jena* 48: 366-367

Gravena, W. (2007). 'Isolamento e caracterizacao de marcadores microssatelites para analyses de parentesco no boto-vermelho (*Inia geoffrensis*).' Master Thesis, INPA, Biol. Tropical e Recursos Naturais.

Huffman, W.E. (1970). 'Notes on the first captive conception and live birth of an Amazon dolphin in North America'. *Underwater Naturalist* 6(3): 9-11

Layne J.N. (1958). 'Observation of freshwater dolphins in the upper Amazon'. *J. Mammal* 39: 1-23. https://doi.org/10.2307/1376605

Layne J.N. and Caldwell, D.K. (1964). 'Behaviour of the Amazon dolphin, *Inia geoffrensis*, in captivity'. *Zoologica* 49: 81-108.

Mello, D.M.D. and da Silva, V.M.F. (In prep.). 'Hematologic profile of Amazon River Dolphin *Inia geoffrensis* and its variation during acute capture stress'.

Ministério do Meio Ambiente (2000). *Estabelecimento de normas para a manutenção de mamíferos aquáticos em cativeiro Portaria* MMA No. 98, de 14-04-2000, Brazil.

Sioli, H. (1984).'The Amazon and its main affluents: hydrography, morphology of the river courses, and river types'. In: H. Sioli (ed.) *The Amazon: Limnology and Landscape Ecology of a Mighty River and its Basin*, pp. 127-165. Dordrecht, The Netherlands: Dr. W. Junk. https://doi.org/10.1007/978-94-009-6542-3_5

Schreib, S., Burrows, A. and Smith, T. (1994). 'The Amazon river dolphin'. *Soundings (Newsletter of the International Marine Animal Trainer's Association)* 19:5-30.

Terry, R. P. (1983). 'Observations on the captive behavior of *Sotalia fluviatilis guianensis*'. *Aquatic Mammals* 10:95-105.

Tobayama, T. and Kamiya T. (1989). 'Observations on *Inia geoffrensis* and *Platanista gangetica* in captivity at Komagawa Sea World, Japan'. In: W.F. Perrin, R.L. Brownell Jr., Zhou Kaiya, and Liu Jiankang (eds.) *Biology and conservation of the river dolphins*, pp.42-45. SSC Occasional Paper no.3. Gland, Switzerland: IUCN. Available at: https://portals.iucn.org/library/node/6485

Trebbau, P. (1975). 'Measurements and some observations of the freshwater dolphin, *Inia geoffrensis*, in the Apure, Venezuela'. *Zoologische Garten, Jena* 45:153-167.

Is the franciscana (*Pontoporia blainvillei*) a candidate for *ex situ* conservation?

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Abstract

The franciscana is endemic to the coastal waters of Argentina, Brazil and Uruguay and is regarded as the most endangered cetacean in South America. Five management units are recognized, with abundance estimates ranging from a few hundred to around 15,000 dolphins. Small, discrete resident populations have been identified in bays in Argentina and Brazil. Bycatch in gillnet fisheries is the main threat to the species, taking 3-6^{+}%/year of some of the populations. Other threats include habitat degradation and pollution. Current mortality levels and projected declines resulted in the listing of the franciscana as Vulnerable in the IUCN Red List. Recent fisheries regulations implemented in areas with extensive bycatch in Brazil were expected to improve the species' conservation status, but current data suggests mortality is still high in most of the species range. Little is known about handling and care of franciscanas. Twenty-four have been captured, handled briefly for tagging, and released with follow-up tracking. During 30 years of attempts to rehabilitate

Members of a small, resident population of franciscana (*Pontoporia blainvillei*) surface in Babitonga Bay, Brazil.
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stranded franciscanas mostly in Argentina, only two non-calves survived for more than one year. No franciscana has been released for evaluating the effectiveness of the rehabilitation process. It is important to emphasize that the species is relatively abundant in much of its range and there is potential for successful conservation and long-term viability of franciscanas in the wild. Therefore franciscanas are not high priority candidates for *ex situ* management at this time. If *ex situ* management is considered in the future, improved knowledge of what is required to successfully handle and maintain the animals under human care and prepare them for release is needed.

1 Summary of what is known

Efficacy of any *in situ* activities and recovery plans aimed at ameliorating anthropogenic threats to the species or population survival

Geopolitical, socioeconomic and cultural contexts with respect to *ex situ* conservation

Current state of local community engagement, international outreach/coordination, geopolitical and socioeconomic solutions aimed at addressing the primary threats

Current state of global awareness of the species, its conservation status, and media coverage

The franciscana is, perhaps, the most scrutinized and well-known cetacean species in South America. The species conservation status has been evaluated through most of its range. Bycatch in gillnet fisheries, which removes an estimated 3-6^{+}%/year of some of the populations, represents the main threat to this small cetacean. Other threats include habitat degradation and pollution. Current mortality levels and projected declines resulted in the listing of the franciscana as Vulnerable in the IUCN Red List (Zerbini et al., 2017). After several years of negotiation with stakeholders, scientific-based advice was used for management decisions and, in 2012, the gillnet fishery was regulated in areas with extensive bycatch in Brazil. It was expected that these regulations resulted in improvements in the species' conservation status, but current data indicate that franciscana mortality remains high because of lack of enforcement and/or insufficiency of current conservation measures. More recently, in 2018, a Rio Grande do Sul State Law expanded the exclusion zone for the trawl fishery from 3 to 12 nautical miles from shore in southern Brazil. Although trawling does not represent a major threat to fransciscanas in Brazil, this type of fishery was responsible for the collapse of fish stocks that were important to the franciscana's diet. The collapse of these stocks also led to the increase of gillnet fishing effort. It is expected that the regulation of these two fisheries will promote ecosystem restoration and the reduction of franciscana fishing-related mortality.

1.1 Experience with the species in captivity, including attempts to rehabilitate and/or maintain individuals under managed care (i.e. in captive or 'semi-captive' conditions)

In Argentina, from 1987 to 2015, 148 franciscanas have live-stranded, and undergone rehabilitation treatments. Of these, 97% were newborns or only a few days old, and 3% were subadults. During the first decades in which rehabilitation techniques were developed in Argentina, young calves survived only a few days. As artificial diets improved, survival increased to a few weeks, and recently a franciscana calf survived 80 days. Two rescued subadults were maintained under human care for about a year, although it was not possible to return them to the wild. In recent decades, of the total number of rescued cetaceans in the Province of Buenos Aires, 80% were dependent franciscana calves.

1.2 Knowledge of the focal species with respect to stress-induced capture myopathy, including the use of sedatives and therapeutics to manage cardiovascular effects of catecholamines

In total, 25 franciscanas have been captured for tagging, with subsequent release and tracking efforts, in Argentina (Fundación AquaMarina and Chicago Zoological Society, 2005–2010, n=19, Bordino et al., 2008; Mendez et al., 2010; Wells et al., 2013) and Brazil (Universidade da Região de Joinville, Fundación AquaMarina and Chicago Zoological Society, 2011–2013, n=6; Cremer et al., 2017). The same specially designed seine net and dolphin catcher, an Argentine artisanal fisherman, were used for all of the captures. Small groups of dolphins were encircled by the seine net in water <4 m deep, supported by trained personnel in the water, and brought aboard a small inflatable vessel or held in the water alongside the boat for tagging. Experienced marine mammal veterinarians were present for all tagging efforts. Small VHF tags were attached by single pins through the dorsal fin in 2005 (n=3); multi-pin sidemount satellite-linked tags were used during 2006–2008 (n=12), and single-pin finmount satellite-linked tags were attached during 2010–2013 (n=10).

These efforts represent the first for capture-release of this species, and in light of the lack of knowledge about how they would respond to handling, efforts were made to minimize the duration of the period from "net out" to release, with this period ranging from 10 to about 40 min. Initially, tagging required 8-10 min, but time on-deck including tagging was eventually reduced to as little as 2.5 min. The dolphins proved to be highly variable in their response to the capture/handling/tagging process. Nine individuals were noted as behaving well on deck and/or as being "feisty" or "aggressive" (attempting to bite people), and four others were returned to the water to complete tagging because of concerns about their respiration quality and quantity – most responded well to being returned to the water. The remainder were unremarkable during handling. Lactate was measured for five dolphins via i-STAT blood analysis during 2008–2010; analyses were performed upon return to shore, several hours post-collection. Values ranged from 14.40 to 27.84 mmol/L, exceeding the normal range of values for bottlenose dolphins, especially those with capture-release experience.

Ten of 12 dolphins for which behavior upon release was noted swam off strongly. One other left slowly initially, but picked up speed and made dives of increasing length. One other individual, in 2010, did not respond well on deck, with poor respiration quality and quantity. It was returned to the water, where it vomited. The veterinarian administered *doxapram* hydrochloride (Dopram). The animal was released, and it swam away weakly. No signals were received from this individual. Its carcass was recovered the next day, and necropsy results were suggestive of capture myopathy.

Post-release tracking was performed successfully for 24 of the 25 dolphins, and tracking durations ranged from 7 to 258 days. The five dolphins for which lactate was measured were tracked for 36-176 days. The animal tracked for 176 days had a lactate concentration of 18.70 mmol/L, and was the individual described above as swimming slowly away upon initial release.

Tracking efforts for the VHF tags lasted 38-44 days. Transmission durations for the multi-pin satellite-linked tags averaged 110 days (sd = 76.6, range = 7-258 days), and for the single-pin tags, 53 days (sd = 55.1, range = 12-191 days). The dolphin with the single-pin tag tracked for 191 days has been observed repeatedly over the five years since its tagging in 2013, after shedding the tag. The single-pin tags were selected for the later work because they could be attached much more quickly and thereby reduce dolphin handling time, and because of the reduced risk from injury from tag shedding.

1.3 Cryopreservation of gametes and other biological material

In Argentina, there is already expertise in obtaining sperm with non-invasive techniques and insemination of females based on their hormonal cycles for other species (e.g., bottlenose dolphins and killer whales).

2 Summary of information needs

2.1 Identifying data gaps and what needs to be done to fill those gaps

What little is known about capture, handling, and maintenance of franciscanas comes from rehabilitation efforts, and capture-release efforts for tagging. Public display of the species has been limited primarily to rehabilitation cases, so little is known of maintenance, husbandry or veterinary requirements.

3 Necessary next steps

3.1 Actions needed to develop and implement *ex situ* management plans

Little is known about handling and caring of franciscanas. During 30 years of attempts to rehabilitate stranded franciscanas only two subadults survived for just over a year. None of these individuals has been released for evaluating the effectiveness of the rehabilitation process. To date, the chances of acquiring subadult and adult specimens to rehabilitate are minimal as most animals wash ashore dead due to incidental catch in fisheries. Typically, individuals found stranded alive are newborns, possibly offsprings of mothers incidentally killed in fisheries. Although there have been many attempts to rehabilitate these young franciscanas in Brazil and Argentina, very little progress has been made in the rehabilitation techniques for these animals. In the best-case scenarios, the young franciscanas survived for only a few weeks. Undoubtedly, the rehabilitation of subadults and adults is more feasible, but, as stated above, the chances for sufficient numbers of specimens to become available through strandings to provide opportunities for research on their care and possible reintroduction are low. Therefore, data on the many medical, biological and physiological aspects, including reproduction potential, cryopreservation of gametes of captive franciscanas that can be relevant for *ex situ* management remain scarce or lacking.

3.2 Assessing suitability and risks for capture, transport and captive management of the focal species

Although the expertise for capturing wild franciscanas has increased due to the need to restrain animals for radio and satellite-link tag deployments, consideration of *ex situ* management in the future will require improved knowledge of what is needed to successfully handle, transport and maintain the animals under human care. In addition, strategies for releasing captive individuals and for post-release monitoring to assess whether animals survive and are reintegrated to their habitat needs to be developed. Capture-release for tagging has shown that the animals respond variably to handling, with strong concerns about handling the animals for extended periods of time.

3.3 How captive or semi-captive management programs could be integrated with species recovery plans

At this time, the conservation focus for franciscanas is entirely on increasing protective measures for the thousands of animals remaining in existing populations in their natural range. The species has not been successfully maintained under human care for extended periods of time, and there has been little impetus to attempt to do this, given the

numbers of animals remaining in the wild. Results from capture-release efforts suggest that capture and transport and acclimation to captive conditions might be high risk operations.

3.4 A timeline for actions based on current abundance estimates and trajectories.

Currently, five franciscana management areas (FMAs – *sensu* Secchi et al., 2003) are recognized, three in Brazil (FMA Ia, Ib, II), one shared between Brazil and Uruguay (FMA III) and one in Argentina (FMA IV) (Cunha et al., 2014). The smallest populations are in FMAs Ia and Ib. Surveys conducted in 2011/12 detected only three off-effort franciscana sightings in FMA Ia and no abundance was computed. However, lack of sightings despite the relatively high survey effort in reasonably good visibility conditions may be indicative of a small population in this region. In FMA Ib abundance was estimated at 1800 individuals (CV=0.47) in 2011/2012, suggesting this is the smallest franciscana population for which estimates are available. Six additional aerial surveys have now been completed, and an updated analysis and population estimate for FMA I is ongoing (Danilewicz et al., in prep.) In FMA II, the most recent estimate indicated there were 6,140 individuals (CV=0.35) in 2008 (Sucunza et al., 2018). There are no estimates of population size for FMA III as a whole. Surveys have been conducted in the Brazilian portion of this region and the most recent estimate is of about 10,000 dolphins (CV=0.20) in 2014 (Danilewicz et al., unpublished). However, no estimates are available for Uruguay. In Argentina (FMA IV), estimates of abundance from 2003/4 indicate a population of nearly 15,000 individuals (Crespo et al., 2010).

There are currently no estimates of trends in abundance for franciscanas in any of the management areas. Multiple surveys have been conducted in the Brazilian portion of FMA III (Secchi et al., 2001; Danilewicz et al., 2010; unpublished data), but because the survey area varied over time and because surveys were not conducted with comparable methods, it is not possible to compute trends from these data.

Coordinated research and conservation projects, including community engagement and communication with different stakeholders, are under development or in place through most of the species range in Brazil and Argentina. These projects aim at evaluating the effectiveness of the regulations and, if proven necessary, to propose new measures of participatory planning for the fisheries, including marine protected areas or spatial and temporal reduction of effort fishing.

Despite current fisheries regulations in Brazil and Argentina, it is likely that bycatch rates will remain high at least for some franciscana populations. A database with more than 40 years of marine mammal strandings in the extreme south of Brazil and a 20-year monitoring of accidental catch of franciscanas in coastal gillnetting indicates that franciscana mortality is consistently high, on the order of hundreds of individuals per year (Prado et al., 2013, 2016). Current stranding rates are similar to those observed prior to the regulations (EcoMega unpublished data), raising questions about their effectiveness in reducing bycatch or the level of compliance. A first study to identify the areas of greatest risk of bycatch observed that the fishing exclusion zones established by the regulations cover only a small proportion of the fishing grounds (23% and 14% in the Brazilian hake and white croaker fisheries, respectively - Prado et al., in review).

3.5 For future *ex situ* efforts, anticipated issues with fund-raising, public support, security, facility construction, and on-water operations

Developing *ex situ* projects in Argentina, Brazil and Uruguay requires obtaining appropriate federal permits because the capture of marine mammals is prohibited. Although it might be feasible from a legal perspective, because the species is relatively

abundant in much of its range, it is very likely that *ex situ* management will not be perceived as reasonable at this time. Furthermore, carrying out projects of this nature require robust and long-term funding for adequate infrastructure and human resources with expertise in animal husbandry and reproduction in captivity. It is very unlikely that the governments of the three countries will consider it as a priority, especially in the current political and economic scenario, hence funding should probably come from elsewhere.

3.6 Other aspects considered relevant to workshop focus.

Considering that enforcement may fail, from a precautionary perspective, there is value to discussing *ex situ* projects aiming at improving techniques to handle, maintain and reproduce franciscanas under human care for release when needed as well as at assessing the potential for translocation of individuals from healthier to the most endangered populations. These projects should be integrated with other species recovery strategies such as the current fisheries regulations for bycatch reduction and ecosystem restoration.

Literature cited

Bordino, P., Wells, R.S. and Stamper, M.A. (2008). 'Satellite tracking of franciscana Dolphins *Pontoporia blainvillei* in Argentina: Preliminary information on ranging, diving and social patterns'. International Whaling Commission Scientific Committee Meeting, Santiago, Chile, June 2008 SC60/SM14.

Crespo, E.A., Pedraza, S.N., Grandi, M.F., Dans, S.L. and Graffo, G.V. (2010). 'Abundance and distribution of endangered Franciscana dolphins (*Pontoporia blainvillei*) in Argentine waters and conservation implications'. *Marine Mammal Science* 26: 17-35. https://doi.org/10.1111/j.1748-7692.2009.00313.x

Cremer, M.J., Holz, A.C., Bordino, P., Wells, R.S. and Simões-Lopes, P.C. (2017). 'Social sounds produced by franciscana dolphins, *Pontoporia blainvillei* (Cetartiodactyla, Pontoporiidae)'. *J. of the Acoustical Society of America*. 141(3): 2047-2054. https://doi.org/10.1121/1.4978437

Cunha, H.A., Medeiros, B.V., Barbosa, L., Cremer, M., Marigo, J., Lailson Brito Jr, J., Azevedo, A. and Sole-Cava, A.M. (2014). 'Population Structure of the Endangered Franciscana Dolphin (*Pontoporia blainvellei*): Reassessing Management Units'. *PLoS ONE* 9(1): e85633. https://doi.org/10.1371/journal.pone.0085633

Danilewicz, D., Moreno, I.B., Ott, P.H., Tavares, M., Azevedo, A.F., Secchi, E.R. and Andriolo, A. (2010). 'Abundance estimate for a threatened population of franciscana dolphins in southern coastal Brazil: uncertainties and management implications'. *Journal of the Marine Biological Association of the United Kingdom* 90: 1649-1657. https://doi.org/10.1017/S0025315409991482

Danilewicz, D., Zerbini, A.N., Sucunza, F., Andriolo, A., Ferreira, E., Denuncio, P., Secchi, E.R. and Flores, P.A.C. (In review). 'Abundance and distribution of franciscana dolphins in southeastern Brazil: red alert for the extinction of isolated populations'. Submitted to *Biological Conservation*.

Mendez, M., Rosenbaum, H.C., Wells, R.S., Stamper, M.A. and Bordino, P. (2010). 'Genetic evidence highlights serious demographic impacts of by-catch in cetaceans'. *PLoS ONE*. 5(12): e15550. https://doi.org/10.1371/journal.pone.0015550.

Prado, J.H.F., Mattos, P.H., Silva, K.G. and Secchi, E.R. (2016). 'Long-term seasonal and interannual patterns of marine mammal strandings in subtropical western South Atlantic'. *PLoS ONE* 11: 1–23. https://doi.org/10.1371/journal.pone.0146339

Prado, J.H.F., Secchi, E.R. and Kinas, P.G. (2013). 'Mark-recapture of the endangered franciscana dolphin (*Pontoporia blainvillei*) killed in gillnet fisheries to estimate past bycatch from time series of stranded carcasses in southern Brazil'. *Ecol. Indic.*32: 35–41. https://doi.org/10.1016/j.ecolind.2013.03.005

Prado, J.H.F., Kinas, P.G., Pennino, M.G., Seyboth, E., Silveira, F.R.G., Ferreira, E.C. and Secchi, E.R. (In review). 'Risk of bycatch of the vulnerable franciscana dolphin in southern Brazil: a basis for conservation strategies'. Submitted to *Animal Conservation.*

Secchi, E.R. (2010). 'Review on the threats and conservation Status of Franciscana, *Pontoporia blainvillei* (Cetacea, Pontoporiidae)'. In: J.M. Shostell and M. Ruiz-Garcia (eds.) *Biology, Evolution and Conservation of River Dolphins within South America and Asia*, pp.323-339. Hauppange: Nova Science Publishers Inc..

Secchi, E.R., Danilewicz, D. and Ott, P.H. (2003a). 'Applying the phylogeographic concept to identify franciscana dolphin stocks: implications to meet management objectives'. *J. Cetacean Res. Manag.* 5: 61–68.

Secchi, E.R., Ott, P.H., Crespo, E.A., Kinas, P.G., Pedraza, S.N. and Bordino, P. (2001). 'A first estimate of franciscana (*Pontoporia blainvillei*) abundance off southern Brazil'. *Journal of Cetacean Research and Management* 3(1): 95-100.

Sucunza, F., Danilewicz, D., Cremer, M., Andriolo, A. and Zerbini, A.N. (2018). 'Refining estimates of availability bias to improve assessments of the conservation status of an endangered dolphin'. *PLOS ONE* 13(3): e0194213. https://doi.org/10.1371/journal.pone.0194213

Wells, R. S., Bordino, P. and Douglas, D.C. (2013). 'Patterns of social association in the franciscana, *Pontoporia blainvillei*'. *Marine Mammal Science*. 29:E520-E528. https://doi.org/10.1111/mms.12010.

Zerbini, A.N., Secchi, E., Crespo, E., Danilewicz, D. and Reeves, R. (2017). *Pontoporia blainvillei (errata version published in 2018)*. The IUCN Red List of Threatened Species 2017: e.T17978A123792204. https://doi.org/10.2305/IUCN.UK.2017-3.RLTS.T17978A50371075.en. Downloaded on 05 December 2018

Indus and Ganges river dolphins (*Platanista gangetica*): *ex situ* options for conservation

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Abstract

The South Asian River dolphin (*Platanista gangetica*) consists of two subspecies, the Indus (*Platanista gangetica minor*) River dolphin endemic to the Indus River system primarily in Pakistan and the Ganges (*Platanista gangetica gangetica*) River dolphins which occurs only in the Ganges, Brahmaputra and Karnaphuli-Sangu River systems of India, Bangladesh and Nepal. The species, and both subspecies are classified as Endangered on the IUCN Red List. The Indus River dolphin is thought to number approximately 2000 individuals, fragmented into 5 different sections of river, and the species has undergone an 80% reduction in range. Since a ban on the hunting of dolphins in the 1970s the dolphin population has been increasing in abundance. The Ganges dolphin is more numerous than the Indus dolphin, has a wider range and has suffered a less drastic range decline, however the threats from fishing, high levels of industrial pollution, shipping, poaching, habitat fragmentation by barrages, flow regulation due to hydropower generation and flow depletion from diversions for irrigation suggest that its population is declining. The Indian Waterways project and proposals to link Indian river systems may cause rapid catastrophic declines in the subspecies in the future if they proceed. Platanista are not currently held in captive facilities anywhere in the world. In the 1970s a total of 16 *Platanista* were maintained in international captive facilities, 4 at the Steinhart Aquarium in the USA (Indus dolphins), 7 at the Berne Institute of Brain Anatomy in Switzerland (Indus dolphins) and 5 at Kamogawa Sea World in Japan (Ganges dolphins). Survivorship was poor, ranging from a few weeks up to approximately 3 years and no breeding ever occurred. A variety of rescue programmes to capture and translocate *Platanista* from canals and channels suggest that this species is relatively robust to capture and transport, however suspected capture myopathy has occurred in a number of individuals. There is very little technical or infrastructure capacity for holding captive cetaceans in South Asia at present, the quality of care and husbandry in most zoos is extremely poor, and in India the keeping cetaceans in captivity for entertainment has been prohibited.

General introduction

Platanista gangetica, the South Asian River dolphin, is the sole species in the Platanistidae cetacean family. Two subspecies are recognised by the Society for Marine Mammalogy Committee on Taxonomy (2018): the Indus River dolphin (*Platanista gangetica minor*), and the Ganges River dolphin (*Platanista gangetica gangetica*). There is evidence that species level differences may be present between the two subspecies, but this requires further study (Braulik et al., 2014a). The Indus River dolphin occurs only in the Indus River system, the vast majority of individuals occur in Pakistan and a small remnant population estimated as less than 10 animals is present in the Beas River, India (Aisha et al., 2017; WWF-India 2018). The Ganges River dolphin has a much larger range than the Indus subspecies, occurring in many rivers in India and Bangladesh and also in small numbers in some of the rivers in southern Nepal (Paudel et al., 2017). Braulik

and Smith (2017) made an educated guess that the entire *Platanista gangetica* species numbers less than 5,000 individuals. Throughout the range of the species the major threats are from fishing, pollution, navigation and dredging, habitat fragmentation by water infrastructure, and removal, degradation and depletion of habitat from water impoundment and diversion associated with dams and barrages. *Platanista* are competing for water in an immensely densely populated, hot and arid part of the world where their habitat is under extreme pressure from numerous competing demands. The species, and both subspecies are listed as Endangered on the IUCN Red List (Braulik & Smith, 2017).

1 Summary of what is known

1.1 Efficacy of any *in situ* activities and recovery plans aimed at ameliorating anthropogenic threats to the species or population survival

1.1.1 Indus River Dolphins

There is evidence that hunting of Indus dolphins was widespread over the past few centuries and it continued until the early 1970s (Anderson, 1879; Pilleri, 1972a). Due to the advocacy of Georgio Pilleri dolphin hunting was prohibited in Pakistan in the early 1970s and after that point its occurrence quickly declined and ceased. However, there are occasional cases of a dolphin being killed deliberately because of mistaken identity as a crocodile. Comprehensive surveys of the entire 1,500km range of the Indus dolphin in Pakistan have occurred at 5-year intervals since 2001 (4 surveys have been completed to date). Direct counts, and tandem platform mark-recapture surveys have been conducted and the most recent estimate is of approximately 2000 individuals in the subspecies (Aisha et al., 2017; WWF-Pakistan, unpublished). Direct counts and abundance estimates conducted by a variety of different organisations all show that abundance has been steadily increasing since the 1970s. Between Guddu and Sukkur barrages dolphin density (11 animals/km) is probably the highest seen for any river dolphin (Braulik, 2001; Braulik et al., 2006; Noureen, 2013; Aisha, unpublished). Despite this, the range of the dolphin is only 20% of that documented historically, with the decline due to habitat fragmentation by numerous irrigation barrages and depleted dry season flows (Braulik et al., 2014b). Early in 2018 there was confirmation that another dolphin subpopulation located between Jinnah and Chashma irrigation barrages has been extirpated demonstrating that the range decline is a continuing process (WWF-Pakistan, unpublished).

In situ conservation programmes are usually collaborative initiatives of the Pakistani government (provincial wildlife departments) with non-governmental organisations (primarily WWF-Pakistan), and have been ongoing for around 20 years. A long running programme to locate and rescue dolphins that have become trapped in irrigation canals and return them to the river has been very successful moving close to 150 animals to date (Aisha et al., 2017). The Indus river dolphin is a protected species in all provincial wildlife laws. The highest density and abundance of dolphins occurs between Guddu and Sukkur barrages on the Indus and this river section is protected as the Indus dolphin reserve (formed in the early 1970s), however fishing is permitted inside the reserve. The Indus River runs through relatively remote areas and it is not used for transportation of goods and is also not as intensively fished as many other Asian rivers. However, especially within the dolphin reserve law enforcement remains a challenge, fishing practices likely to expose dolphins too bycatch risk and mortality are common, particularly in remoter areas and enforcement is poor because of the lack of capacity and resources of the relevant government departments. Recently, there have been incidences of electro-fishing on the Indus. Cases of the use of pesticides to kill fish are relatively common and have resulted in the death of six dolphins and many freshwater turtles.

1.1.2 Ganges River dolphin

The Ganges dolphin has a large range through numerous rivers and tributary channels principally in India and Bangladesh with small populations also present in Nepal. Especially in Bangladesh, and also in India, many large and small rivers where dolphins occur have not been properly surveyed and it is possible that there are significant unrecorded populations. The dolphin is known to have been extirpated from many rivers in its former range in India, particularly in upper reaches of rivers, generally due to low or non-existent dry season flow due to water diversions (e.g. Upper Ganga), often combined with pollution (Ganga at Kanpur), localized fishing impacts (e.g. Barak river), which are aggravated by habitat fragmentation by barrages (Sinha et al., 2010). The population above the Kaptai dam in the Karnaphuli River in Bangladesh disappeared after the construction of a dam (Smith et al., 2001). Dolphins disappeared from the main stem of the Ganges, above the Middle Ganga Barrage at Bijnor (about 100kms downstream Haridwar) 12 years after its construction because there is very low discharge, and dolphins no longer occur in the upper Yamuna River around Delhi (Sinha et al., 2010). Similarly, the range has declined in the tributaries of the Brahmaputra River in north-east India (Wakid et al., 2009). Dolphins in Nepal occur in very small numbers in three rivers (Karnali, Narayani, Koshi), a declining trend has been observed and there is complete extirpation from some upper river segments. Barrages on the India-Nepal border might prevent their dispersal into India (Smith et al., 1994; Paudel & Koprowski 2017).

Targeted hunting of dolphins using harpoons still occurs in some areas in India (Assam, Bengal), and animals accidentally entangled in gillnets may not be released because the meat and oil has value to fishers (Sinha et al., 2010). Dolphins and fishers usually target the same productive deep pool habitat which increases the chances of dolphin entanglement in gillnets (Kelkar et al., 2010). In addition, many river stretches in India and Bangladesh are extremely polluted by untreated industrial waste, and high levels of contaminants (heavy metals, pesticides, and toxic organic compounds) have been recorded in the few dolphin carcasses that have been analysed (Kannan et al., 1993; 1994; 1997). India has ambitious plans for implementing large-scale development of its river systems. The National Waterways Act was passed in 2016 and identified 111 river stretches along a length of 18,240km of river to convert to inland waterways for shipping of goods, tourism and transport (covering about 90% of the Ganges dolphin's current range in India; Kelkar, 2017). This is portrayed as an eco-friendly project that will reduce India's carbon footprint. However, it will involve large-scale dredging of channels and increases in motorised ship traffic, with adverse impacts on river dolphins already becoming evident (Dey, 2018). Waterways are planned in conjunction with India's ambitious plans for river inter-linking projects (for inter-basin water transfers), which would mean more barrages and more diversions, with clearly devastating impacts on dolphins in the Ganges and Brahmaputra basins (Kelkar, 2017).

There are numerous dolphin counts from various rivers across the range of the subspecies and based on this a total of about 1,200–1,800 animals provides a reasonable lower range for the total metapopulation abundance (Smith et al., 2012). According to Sinha et al., (2010) 2,500-3,000 animals are assumed to survive across their entire range, and Sinha and Kannan (2014) estimated the number at around 3500. Upcoming data from recent surveys indicates that the population might be higher than these estimates, notwithstanding significant local declines in many stretches. From most areas there is no measure of trends in abundance, but the decline in range and extirpation from many rivers combined with intense utilisation of rivers for fishing, transportation, and for discharging waste means that it is highly likely that overall abundance of the subspecies is declining (Smith et al 2012). Along a 175 km stretch of the Ganga River in Bihar, in which the 67km Vikramshila Gangetic Dolphin Sanctuary is situated, a clear trend of recent population decline has been detected after a fairly stable trend

from 2008–2015 (Kelkar et al., unpublished). This decline corresponded with the simultaneous occurrence of poor dry-season flow and increase in dredging activity, during a severe ENSO drought in April-May 2016 (Kelkar et al., unpublished). A high rate of calf mortality was recorded in this period.

The Vikramshila Gangetic Dolphin Sanctuary was designated in 1991 for the conservation of Ganges river dolphins in the Bhagalpur district of Bihar, India. The Sanctuary is known to largely be a paper sanctuary, with little effectiveness for dolphin protection. Kelkar et al., (2015) reported similar population densities of *Platanista*, and similar local threats, in the 'protected' and adjacent non-protected river reaches. However, despite its apparent ineffectiveness, these authors highlighted the legal and cultural significance of the sanctuary as a potential safeguard against the impacts of imminent waterways development and other large-scale linking projects.

Dolphin populations also exist (and incidentally receive some protection) in a few other riverine and terrestrial protected areas across northern and eastern India – notable examples include the National Chambal Sanctuary, Katerniaghat Wildlife Sanctuary (WLS), Hastinapur WLS, and Kaziranga National Park. Plans for a community reserve (co-managed by local fishing communities and the West Bengal state forest department) are underway along the Hooghly River in the state of West Bengal. Rivers where dolphins occur in Nepal also pass through national parks established primarily to protect other species (e.g. tigers, elephants, rhinos) but could also offer some protection to dolphins especially because human access is restricted (Paudel et al., 2015; Khanal et al., 2016). Dolphins are protected in the Sundarbans Biosphere Reserve in Bangladesh and specifically within three small dolphin sanctuaries located in dolphin distributional hotspot areas (Smith et al., 2010). Despite this, the vast majority of the range of the subspecies is not protected in any way.

Since 2016, the Wildlife Institute of India, has been running a 5-year project on "Ganges river dolphin recovery" funded under the Compensatory Afforestation Fund Management and Planning Authority Act (CAMPA), 2016. So far, the project has conducted preliminary river dolphin surveys in some yet unsurveyed regions (e.g. along the Hooghly River in Bengal, Kosi river in Bihar), has been monitoring the impacts of dredging for the waterways on dolphins, and on seasonal changes in river dolphin distribution in selected river stretches. Many outreach and awareness programmes have been conducted along the Ganga and Brahmaputra rivers under this project. However, the efficacy of the project for amelioration of anthropogenic threats has yet been limited. Civil society efforts led by university scientists, activists, and biodiversity conservationists across northern and eastern India have led to significant increases in local awareness and might have reduced the intensity of targeted hunting and poaching of river dolphins. In 2010 a high profile Conservation Action Plan for Ganges River dolphins in India was released and it included a number of conservation actions to be conducted by 2020 (Sinha et al., 2010). Captivity was not addressed in the action plan other than one activity: 'Evaluation of the genetic diversity of the species and development of in vitro systems for possible future captive breeding efforts'. Unfortunately, the action plan recommendations have not been implemented.

1.2 Experience with the species in captivity, including attempts to rehabilitate and/or maintain individuals under managed care (i.e. in captive or 'semi-captive' conditions)

Captive records

South Asian river dolphins are not currently represented in captivity and have not been for about four decades. The earliest captive record of a Ganges River dolphin was an animal that was captured near Dacca in the 1870s and transported to Calcutta where it was kept in a bath tub for ten

days and fed on fish provided (Anderson, 1879). Pelletier and Pelletier (1980) report on a young dolphin that was kept for 5 weeks in Bangladesh and then released back to the river. Between January 1970 and May 1973, thirteen Ganges River dolphins were taken from various sectors of the Brahmaputra, Jamuna and Meghna rivers in Bangladesh and were maintained in small portable swimming pools and a civil-works pond (Haque et al., 1977). This number includes the five Ganges River dolphins that were transported to Kamogawa Sea World in Japan, described below. The fate of the remaining eight dolphins is unclear. One anecdotal report indicates that a Ganges dolphin calf obtained live from a fisherman's net in the Hooghly River was openly displayed in an aquarium shop for sale in the city of Kolkata, West Bengal (India), in 2016. However, this could not be verified, and the calf probably died shortly after its display in the shop. There are suggestions that rich landlords that reside along the river in Pakistan sometimes keep dolphins in pools in their property.

In the 1970s a total of 16 *Platanista* were maintained in international captive facilities, 4 at the Steinhart Aquarium in the USA (Indus dolphins), 7 at the Berne Institute of Brain Anatomy in Switzerland (Indus dolphins) and 5 at Kamogawa Sea World in Japan (Ganges dolphins) (see Table 1). Three dolphins were captured from Sindh Pakistan in November 1968 and were transported to the Steinhart Aquarium in California, and survived only 24, 38 and 44 days respectively. A subsequent female, also from the Indus river, survived 14 months from May 1970–July 1971 (Herald et

Table 1 - Records of *Platanista gangetica* kept in captivity

#	Subspecies	Capture date	Facility	Field No.	Sex	Length (cm)	Weight (kg)	Survival	Reference
1	Indus	Nov-1968	Steinhart Aquarium, USA	CAS1	F	121	26.7	38 days	Herald 1969; Herald et al. 1969
2	Indus	Nov-1968	Steinhart Aquarium, USA	CAS2	F	115	22.2	24 days	Herald 1969; Herald et al. 1969
3	Indus	Nov-1968	Steinhart Aquarium, USA	CAS3	F	107	19.5	44 days	Herald 1969; Herald et al. 1969
4	Indus	May-1970	Steinhart Aquarium, USA	CAS	F	Immature	-	14 months	Bob Brownell pers. comm
5	Ganges	5-Feb-1970	Kamogawa Sea World, Japan	UT22	M	122	24	186 days	Tobayama & Kamiya 1989
6	Ganges	5-Feb-1970	Kamogawa Sea World, Japan	UT15	F	114	16.4	74 days	Tobayama & Kamiya 1989
7	Ganges	5-Feb-1970	Kamogawa Sea World, Japan	UT16	F	120	17	78 days	Tobayama & Kamiya 1989
8	Ganges	5-Feb-1970	Kamogawa Sea World, Japan	UT17	F	120	23	158 days	Tobayama & Kamiya 1989
9	Ganges	7-Oct-1970	Kamogawa Sea World, Japan	UT23	F	119	14.4	299 days	Tobayama & Kamiya 1989
10	Indus	Dec-1969	Bern Institute, Switzerland	BA457	M	108	10.5	-	Pilleri 1970
11	Indus	Dec-1969	Bern Institute, Switzerland	BA453	F	126	18	-	Pilleri 1970
12	Indus	27-Feb-1972	Bern Institute, Switzerland		M	145	-	a few weeks	Pilleri 1972
13	Indus	9-Jan-1973	Bern Institute, Switzerland		F	Adult	-	>1 year, possib. >3-4 yrs.	Pilleri et al. 1976
14	Indus	16-Dec-1972	Bern Institute, Switzerland		F	Calf	-	11 months	Pilleri et al. 1976
15	Indus	5-Dec-1972	Bern Institute, Switzerland		F	Subadult	-	>1 year, possib. >3-4 yrs.	Pilleri et al. 1976
16	Indus	9-Dec-1972	Bern Institute, Switzerland		M	Subadult	-	>1 year, possib. >3-4 yrs.	Pilleri et al. 1976

al., 1969; Herald, 1969; Brownell, R. pers. comm.) Four Ganges River dolphins (1M/3F) were taken from the Jamuna river, Bangladesh in January 1970 and were transported to Kamogawa Sea World, Chiba, Japan, arriving on February 5th, 1970. The three females survived for 74, 78 and 158 days respectively and the male survived for 186 days. A fifth Ganges River dolphin female, also from Bangladesh, was transported to Kamogawa Sea World, arriving on October 7th 1970 and survived for 299 days (Tobayama and Kamiya 1989). At least seven Indus dolphins were caught and taken to the Brain Anatomy Institute in Switzerland, two were collected in December 1969, one in March 1972 and four in December 1972 (Pilleri, 1970; 1972b; Pilleri et al., 1976). Survivorship of these dolphins ranged from a few weeks to approximately four years or possibly more (exact days not available).

There are many publications that give a large amount of details about the live captures, transport and management of these captive animals (Herald, 1969; Pilleri, 1970; Pilleri et al., 1970; Pilleri et al., 1971; Pilleri, 1972b; Tobayama & Kamiya, 1989). *Platanista* have never successfully bred in captivity, and most animals survived for well under a year.

Capture methods

The expedition that was conducted from Steinhart Aquarium and the three capture expeditions conducted by the Berne Institute in Switzerland both reported that dolphins from the Indus were caught by local fishers using traditional methods. A platform was constructed in the shallows and a fishermen stood on the platform, sometimes at night, and waited for a dolphin to approach at which point a large basket net was thrown over the animal and the fisher jumped on the dolphin to prevent it from moving (Herald, 1969). A tethered fish, a tame otter, or another tethered dolphin were all noted to attract the dolphin towards the platform. No mortality during capture was noted by any of these expeditions. In Pakistan fishers tethered dolphins by the lower jaw using a rope. The three dolphins that were captured by the Steinhart aquarium by fishers were tethered by the lower jaw and one (animal 3) had a serious injury down to the bone (Herald, 1969). During the second of Pilleri's capture expeditions, which was conducted in December 1972, an adult female was tethered by the rostrum causing severe injury almost to the bone that took almost 6 months to heal (Pilleri et al., 1976). It is interesting to note that this method of capturing dolphins was that used by the dolphin hunters that were still resident along the river at that time. Now hunting of dolphins has long ceased and it seems that this knowledge and the skills for catching dolphins may also have been lost, as these days fishers use nets when animals need to be rescued from canals.

In the Gela Bil (floodplain palaeo-channel or side-channel) in India near the Brahmaputra Pilleri attempted to capture Ganges River dolphins in 1969. The river was narrow and two bamboo barriers were placed across the river 50m apart and the dolphins trapped in between. Fishers then captured the dolphins 'in a net thrown from a canoe'. It took several hours for the animal to be captured in the net. All females captured were pregnant and died within a very short time in the net before it could be removed from the water. Only two males were still alive when removed from the water (Pilleri et al., 1970).

Transport

Anderson (1879) reported that a dolphin was caught in the Hooghly River and had laid in the hot sun for at least half an hour, was then transported by bullock cart for 3 miles without shade. The animal was out of water in the sun for four hours and died soon after (Anderson, 1879).

After capture, the three Steinhart aquarium dolphins were transported by train from Sukkur to Karachi a journey of 12 hours. In Karachi they were held in a swimming pool, and after flying from Karachi to Japan they were held in a 5,000-gallon holding tank for 24 hours en route to San Francisco. Total transport time from departing the capture site, to arrival

at the facility in the USA, was 4½ days (Herald, 1969). The animals were shipped in containers made from tea boxes with a small amount of water maintained in the bottom. For some portions of the journey the boxes were filled with water so the animals floated (Herald, 1969). Pilleri claimed that his first capture expedition was more successful than his second (in which a single animal died quickly) for the following reasons: 1. The first two animals were smaller than the second animal captured that died. They could turn around in their transport containers. 2. The first two animals were captured and transported in December which is much cooler than February when the second capture took place, and 3. The first animals 'recuperated' in a holding pen adjacent to the river for 10 days after capture which allowed them to stabilize and begin feeding, whereas in the second capture the animal was only held for two days (Pilleri, 1972). During his third capture expedition Pilleri transported four dolphins from their capture location by boat and then train and kept them in a pool in Karachi for some hours before departure by plane on a direct flight from Karachi to Switzerland. Drinking water from the Indus River was given to animals during transport by a stomach tube. For the four animals Pilleri successfully transported to Berne in January 1973, no antibiotics or tranquilisers were used during the journey. The dolphins were transported for 119 hours of which 54 hours they were in holding crates and 65 hours they were in pools recuperating along the journey (Pilleri et al., 1976). This was Pilleri's third capture and transportation expedition and he had by this time refined his methods. He considered it important for success to allow considerable time in a pool after capture, so that feeding by humans was established prior to transport, and then repeated rest periods in pools along the journey (Pilleri et al., 1976).

Feeding in captivity

In the wild this species is considered a generalist feeder with species consumed including catfish, carp, freshwater shrimps etc. During the Steinhart expedition animals were held temporarily in a muddy pool next to the Indus and the pool was stocked with fish seined from the river. Although the muddy water prevented direct observation of the fish being consumed, the behaviour of the animals (rapid surfacing) suggested they were eating the released fish. After this, from arrival in Karachi and during their captivity at the Steinhart Aquarium the dolphins did not eat despite being offered a large variety of live and dead fish including White catfish (*Ictalurus catus*), Carp (*Cyprinus carpio*), Goldfish (*Carassius auratus*), Hitch (*Lavinia exilicauda*), Bluegills (*Lepomis macrochirus*) and Largemouth bass (*Micripterus salmoides*). Because the animals would not feed they were force fed with a stomach tube (Herald, 1969).

The first two animals kept in Berne were reported to eat well and to have grown in captivity (Pilleri et al., 1970). Initially they were fed on live fish, then on dead fish and finally on defrosted previously frozen fish. Fish taken were 10-12cm in length. Species most frequently consumed were Dace (*Leuciscus leuciscus*). Other species were *Idus idus* and *Carassius carassius*. Quantity consumed per day ranged from 1.5 to 3kg (Pilleri, 1971). A single animal captured in early 1972 did not eat on arrival in Berne. After 12 days the animal was force-fed and a second time died of cardiac arrest (Pilleri, 1972).

The four animals that were captured by Pilleri in his third capture expedition are the ones that have survived the best in captivity, suggesting that there was a steep learning curve in their captive care. They arrived in Switzerland in 1973 and for the first two weeks were fed live fish, mainly dace (*Leuciscus leuciscus*). Dead fish were introduced after this and one animal took them immediately, the other two took several weeks before they would eat dead fish. Carp (*Cyprinus carpio*) and trout (*Salmo trutta*) were offered but eaten very rarely. Swim bladders, scales and bones were regurgitated. During the first weeks of captivity fish about 5g in size were given, by three months of captivity the two sub adults were taking dace of 100-160g. On average each animal ate 800g/day during the summer and 570g/day in winter rising to a peak of 1800g/each

dolphin, at one point. Animals were hand fed after five weeks in captivity. After an attempt to capture one dolphin by placing humans in the water both individuals stopped feeding by hand after that and never resumed (Pilleri et al., 1976).

Cause of death

Cause of death of the three Steinhart animals was bacterial septicemia, pneumonia, and loss of immunological response due to dexamethasone. Full necropsy reports are in Herald (1969). Exact details about the length of survival and the cause of death were not found in the numerous papers published by Pilleri in Investigations on Cetacea except for the single animal captured in early 1972 that died of cardiac arrest during force-feeding (Pilleri, 1972). Cause of death was not listed for the Kamogawa Sea World animals (Tobayama & Kamiya, 1989).

Medicines

Details of medicines administered by the Steinhart Aquarium were provided by Herald (1969). These included. By mouth: 1) Oxytetracycline tablets x 250mg and 2) Chloromycetin x 250mg and by injection: 1) Azium (dexamethasone) x 2mg/cc, 2) Liquimycin x 50mg/cc, 3) Terramycin liquid x 50mg/cc, 4) Vitamin B complex 50mg/cc, 5) Erysipelas Bacterin, 5) Thiamine hydrochloride. After the death of the first animal it was revealed that Platanista have extremely thick blubber, and the hypodermic syringe had not penetrated through the blubber and many of the administered drugs had not entered the tissue. Blood samples were collected from one animal near death at the Steinhart aquarium and blood chemistry is reported in Herald (1969). Pilleri applied topical antibiotic Sterosan to skin wounds on fins and flippers during transport (Pilleri et al., 1976).

1.3 Knowledge of the focal species with respect to stress-induced capture myopathy, including the use of sedatives and therapeutics to manage cardiovascular effects of catecholamines

In the Indus canal network (Pakistan) and the canal network in the upper Ganga and Ghaghara basins (India), regular rescue-rehabilitation-release operations are being conducted by WWF, the Turtle Survival Alliance, and local forest or wildlife departments. Dolphins stranded in canals are captured and released back to river stretches with adequate river flows. These rescue operations provide excellent opportunities for both captive or semi-captive caregiving and management, and also for tagging/other invasive research for DNA/pollutant/health-condition sampling and surveying.

Sedatives have not been used during translocations. Rescue of entrapped Platanista from canals to the main river stream is common in Pakistan and since 1992 there is a data of 137 successful rescues. However, an additional 33 animals died during the rescue operation itself, which is about 19% of animals. Uzma Khan has directly witnessed 4-5 cases of suspected capture myopathy during Indus canal rescues. Gill Braulik witnessed one mortality during a canal rescue operation in which an individual died within seconds of hitting the fishing net presumably due to shock. After capture, Indus dolphins have been transported sometimes for up to nine hours over rough unpaved roads, using a variety of transport, including in the back of an open pick up truck (now replaced by a sound-proof ambulance) and there are no records of animals dying during transport. It appears that, provided animals survive capture, they are relatively robust during transport. Another record of an animal dying very quickly during rescue perhaps due to shock was sourced from the Ganges. In the Ghaghara and Sharada canal networks, efforts in rescue and release operations by Turtle Survival Alliance and the Uttar Pradesh Forest Department (India) have seen considerable

success, although failed attempts could be under-represented in media reports. In these canal branches, the reported stranding rates range from 2-8 dolphins per year (Prajapati 2018).

Giorgio Pilleri noted that Indus and Ganges dolphins behaved differently, when captured. Ganges dolphins were much more flighty and distressed while attempts were being made to catch them, and they showed immediate stress-induced mortality in more cases than Indus dolphins (Pilleri, 1980).

1.4 Cryopreservation of gametes and other biological material

No cryopreservation of gametes that we are aware of has yet been attempted.

1.5 Geopolitical, socioeconomic, and cultural contexts with respect to *ex situ* conservation

The geopolitics of South Asia is complex, and trans-boundary water sharing forms a serious bone of contention between all of the range countries of *Platanista.* Only India has borders with all the three other geographically disconnected nations. Water sharing conflicts between India and its neighbours are thus relevant to the continued sustenance of *Platanista* habitat and *in situ* conservation efforts.

In terms of regional geopolitics and its likely impact on an *ex situ Platanista* conservation initiatives, it is important to realise collaboration between Pakistan and India is likely to be highly challenging, if not impossible. Relations between all other countries are complex, but less hostile. In addition to this, conservative conservation acts and laws that mean high-level permissions are required to handle dolphins may also impact on planning and implementation of transboundary conservation initiatives.

According to the Multidimensional Poverty Index (2018), in South Asia the proportion of people living in poverty is lowest in Pakistan, followed closely by Bangladesh, Nepal, and then India. Between 2005/06 and 2015/16, India nearly halved its poverty rate, from 55 percent to 28 percent however this figure (and the absolute number) is still large (MPI 2018). All four countries are developing rapidly, improving infrastructure, education, health care and access to electricity. However, there is still inconsistent power supply in many parts of the region, including in major cities.

The capacity for *ex situ* conservation of *Platanista* is very limited throughout the region, due to technical and institutional constraints and also because the need has not been felt to build this capacity. In general, the management of zoos and other captive facilities in India, Pakistan, and Bangladesh, leaves a lot to be desired (Walker, 2004). None of the countries has a precedent of successful management of dolphinariums or of successfully keeping any fully aquatic mammal species (freshwater or marine dolphins) in captivity. Earlier attempts to create a dolphinarium (Dolphin City) in Chennai in the late 1990s failed, when four marine dolphins were imported from Bulgaria only to die out of poor veterinary care in a few months. Since then, the Animal Welfare Board of India, as well its Central Zoo Authority, have been against the creation of dolphin parks in the country, for numerous reasons primarily related to poor facilities and technical limitations, and for preventing cruelty http://www.dolphinproject.com/blog/no-dolphinariums-in-india/. In 2011, there was a proposal by Maharastra Sea World in India to keep captive dolphins in their facility. A letter was sent by the Chair of the IUCN Cetacean Specialist Group expressing concern about the facility and the source of the dolphins (http://www.iucn-csg.org/wp-content/uploads/2013/03/Maharashtra-Sea-World-Letter.pdf). Approximately 8 years ago, after the release of the Conservation Action Plan there was a proposal by the Delhi zoo to keep *Platanista* in captivity. There was considerable opposition to this proposal from specialists inside and outside India and the proposal was scrapped.

Recently Indian banned the keeping of dolphins in captivity for entertainment, classifying them as 'non-human persons'. In Nepal, only one central zoo exists in the capital city, predominantly managing terrestrial animals. One captive breeding centre has been running effectively for Gharial and some bird species in the Chitwan National Park, close to Narayani river and in India also critically endangered gharial are bred by the Department of Forests and are being re-introduced to different river stretches.

In Pakistan there have been several proposals to keep river dolphins in captivity, but WWF-Pakistan, the primary wildlife NGO in the country, has been strongly opposed. WWF-Pakistan has been arguing that Platanista are not suited for captivity and survives poorly, and that the population is doing well in the wild and therefore there is not a strong conservation rationale. No captive plans have come close to fruition in Pakistan to date and there has not been any recent proposal to keep river dolphins in captivity, in fact Lahore Zoo has been collaborating with the Sindh Wildlife Department to provide veterinary help for river dolphins rescues, and a river dolphin model was placed in Lahore Zoo with a sign, explaining why Indus dolphins cannot be kept in captivity. There is a facility in Karachi that since 2014 has hosted captive beluga and bottlenose dolphins https://tribune.com.pk/story/659580/standing-up-for-the-belugas/.

Approximately 60 Platanista skulls and other skeletal material are held at international institutions with the largest collections housed in Stuttgart, Tokyo, Edinburgh, and London (full list of specimens available from G. Braulik). The specimens in Stuttgart are those that were collected by Giorgio Pilleri and this is the only collection with good quality large specimens of both Indus and Ganges dolphins. In addition to skulls many specimens include salted preserved pectoral flippers with skin and tissue intact. Teeth are available in the majority of skulls in the collections.

1.6 Current state of local community engagement, international outreach/coordination, and socioeconomic solutions aimed at addressing the primary threats

Local community engagement

The involvement of local communities in river dolphin conservation is highly variable across the region. In some places there are small-scale successful examples of community engagement, however, the human populations in South Asia are vast and involvement of sufficient numbers of communities to positively impact river dolphins at a population level is a large task to accomplish. In addition, many projects to work with communities are reliant on short-term funding and these projects often do not last for long periods. However, in many places, *Platanista* tend to occur in specific favoured habitats (deep pools, confluences etc) that persist over years and there is great potential for working with communities that are adjacent to these preferred habitats. This has occurred in many areas including on the Brahmaputra, Ganges, in the Sundarbans of Bangladesh, and on the Beas River. In India, various conservation and civil society groups and NGOs regularly work with local riverine fishing communities towards river dolphin conservation. In some areas, conservationists have attempted to interface between state government departments charged with biodiversity conservation and fisheries, and local community stakeholders, for working towards river dolphin conservation. The primary outcome of these efforts has been a reduction in the intensity of targeted killing of dolphins for oil (used as bait) or meat. However, accidental bycatch might remain a serious threat. In Nepal, a small group of dolphins migrate to a tributary (Mohana) of the Karnali river giving a chance for local eco-tourism activities and education outreach activities. A Dolphin Conservation Centre and its active members are locally improving awareness and also generating livings through some eco-tourism activities.

In Pakistan local community engagement is restricted to project sites (Taunsa and the Indus Dolphin Reserve between Guddu and Sukkur barrages) and involves awareness outreach programmes in schools and communities, involvement in reporting of entrapped dolphins, livelihood support, vocational trainings, sustainable fisheries schools, community involvement in ecotourism initiative etc. However, such programmes are dependent on funding resources. These programmes have decreased the killing of dolphins in canals, improved reporting of canal entrapped animals and increased awareness of this species.

International outreach/coordination

WWF is launching a Global River Dolphin Initiative, which is the first global effort to coordinate river dolphin conservation and research activities in both the Asian and South American regions region and already developed a Global River Dolphin Strategy. It is hoped to gain political momentum through a global-level summit of the range state governments and partners. WWF is very active in both Pakistan and India in river dolphin conservation, and to a lesser extent in Nepal. Given their important role, their collaboration would be essential if a *Platanista ex situ* effort was ever needed.

The International Whaling Commission's Small Cetaceans' sub-committee (SM) agreed to set up a task team for *Platanista* including experts from the four range countries and external advisors. The task team is currently being formed and funding is being solicited.

There is a new initiative under the Convention on Migratory Species (CMS) to draft a Concerted Action Plan for river dolphins in both Asia and South America. It is hoped that it will be presented at CMS COP13 which will be held in Delhi, India in 2020 with the draft planned to be submitted to the Scientific Committee in June 2019.

Socio-economic solutions

Local fishers will be an important stakeholder group in case captive management facilities are realized. More often than acknowledged, local fishers are involved in rescue- and release work either when animals are trapped in pools or canals, or when they are entangled in gillnets. In Pakistan it is local fisher groups that have been trained to conduct safe capture and transport of dolphins from canals. Similarly, during all the past international expeditions to capture *Platanista* for transport to international aquariums it was the expertise of local fishers that was utilised for the capture. The experience of local fishers can be a useful source of practical knowledge in captive management.

1.7 Current state of global awareness of the species, its conservation status, and media coverage

Globally river dolphins are not high-profile species. Most people in most parts of the world do not know that dolphins live in rivers and have never heard of river dolphins.

However, in South Asia there has been a huge increase in awareness of the presence and importance of these animals in the rivers. The Gangetic dolphin was recognized as India's National Aquatic Animal in 2010, and this has resulted in a significant increase in media coverage especially in India and Nepal. Similarly, in Pakistan, there has been sustained media coverage over many years regarding the Indus dolphin, and especially because this is one of Pakistan's few endemic mammals, it is a very profile animal nationally. Awareness is lower in Nepal and the likelihood of local extirpation of dolphins higher. Despite the regional awareness about *Platanista* this does not translate into affirmative conservation action or specific policy interventions to mitigate multi-scale threats. So far, national, regional, or international funding for the conservation of these species has also been extremely small. This may also be due

to the complexity of the conservation issues that they face, making measurable outcomes for conservation proposals difficult to articulate. Without drastic changes in critical policy direction such as for irrigation water management, infrastructure, or pollution control, even localized outcomes remain difficult to realize.

2 Summary of information needs

2.1 Identifying data gaps and what needs to be done to fill those gaps

Data gaps and actions to fill these gaps

1. Gap: A robust range-wide population estimate for the Ganges dolphin does not exist, with a significant lack of information from Bangladesh.

   Action: Conduct coordinated, range-wide surveys across India, Bangladesh and Nepal using a standardised methodology to identify hotspots of occurrence and also refugia from threats.

2. Gap – Lack of information regarding the location of Ganges dolphin populations that are isolated (either due to dams, barrages, or some other reason), information which will be important for setting priorities for reintroduction or captive/semi-captive management.

   Action- Activity above, as well as specific investigations of smaller tributaries isolated from main rivers where data is lacking.

3. Gap – River dolphin responses to alterations in water availability in regulated river systems is lacking, as well as a methodology for determining how much water is required to maintain a population of dolphins. This is one of the most important areas for future research that can positively impact management *in situ* or even in a semi-captive situation. This is critical not just now but because demands on river water are increasing dramatically in response to climate change and increasing populations, but also as more hydropower dams are planned on the upper reaches of rivers to meet energy and water requirements, and in the face of the Indian waterways and river linking projects. Strong and clear guidelines on maintaining dry-season minimum water levels and seasonal variability for dolphins to safely persist would be extremely helpful for advocacy to river water managers.

   Action – Detailed studies of dolphin habitat use (depth and velocity) at different flow levels in different types of river in consultation with aquatic habitat modellers and river engineers.

4. Gap – It is not known how frequently and in what circumstances river dolphins move through irrigation barrages and what are the implications to long-term sustainability of isolated subpopulations.

   Action – Observers can search for dolphins downstream of barrages after the gates have been opened, observers may be placed on the barrages to visually track dolphins during times that the gates are open (flood/canal maintenance), acoustic tracking from static passive acoustic recorders adjacent to barrages may allow animals to be tracked moving across barrages, possibly radio/satellite tracking animals and environmental DNA studies may also reveal movements and potential 'stranding' cases. Any other ideas from the workshop are gratefully received.

5. Gap – Although the threats to the species are generally well known, knowledge of interactions and synergistic impacts of different threats is still limited. Especially in densely populated parts of India and Bangladesh animals are exposed to intense fishing activity, ship noise, and high pollution levels that may compromise health and induce severe stress.

Action – More applied and academic studies involving a combination of data-driven, observation-based field research, along with modelling and simulation studies.

6. Gap – Especially relevant for *ex situ* conservation, the information available on life history and reproduction of these animals is limited to a few studies conducted in the 1970's (Kasuya, 1972; Brownell, 1984). There is evidence that there might be differences in growth patterns between the two subspecies (Braulik et al., in review).

   Action – Train personnel to conduct detailed necropsies, encourage reporting of dead animals, enable research permissions through government agencies (e.g. India's state forest departments) for river dolphin researchers to collect data from cases of mortality.

3 Necessary next steps

3.1 Identify actions needed to develop and implement *ex situ* management plans

1. Determine whether to conduct *ex situ* conservation for Indus dolphins, Ganges dolphins, or both subspecies.
2. Decide whether to hold the animals in a range state or to take them to an international facility
3. Solicit and obtain endorsement for the project from local governments, NGOs and conservationists (could be time consuming and difficult).
4. Identify the location for the facility, an organisation to host it, and if it is to be in South Asia raise funds to build it as no local facilities exist.
5. Identify local personnel who could be trained at international facilities for a period of time before returning to work in a South Asian captive facility.
6. Identify where animals will be obtained to stock the facility.
7. Make a transportation plan to move animals from the capture location to the facility.

3.2 Assessing suitability and risks for capture, transport and captive management of the focal species

Evidence suggests that in general this species is relatively robust to capture and transportation.

A moderate percentage of individuals appear to die during capture but not the majority. A capture plan would need to account for the fact that some individuals might die during capture, and the limited evidence suggests that younger animals might be more robust than older individuals. A considerable risk is that the evidence suggests that these animals are difficult to keep in captivity. Current survivorship has been poor, and there has been no prospect at all of creating a self-sustaining captive population. If *ex situ* conservation were pursued it would be vital to examine whether advances in knowledge and technical expertise with captive cetaceans has advanced sufficiently that the chances of animals staying alive is now significantly greater than it was in the 1970s. A plan for calm and safe capture without trauma or injury, and the early introduction of feeding from humans in pools near to the river, as described by Pilleri, seems to have played a role in his success relative to other facilities.

3.3 How captive or semi-captive management programs could be integrated with species recovery plans

Semi-captive management programs might assist in reintroduction of animals to river stretches where dolphins were recently extirpated or to augment recovery of small and isolated local populations.

3.4 A timeline for actions based on current abundance estimates and trajectories

Both the Indus and Ganges dolphins will almost certainly persist for the next decade.

The population trajectory for the three largest subpopulations of the Indus dolphin is positive, despite increasing pollution and fishing pressure on the habitat, this subspecies is, miraculously, not in immediate danger of extinction. Abundance is estimated to have increased from approximately 1,100 individuals in 2001 (Braulik 2006) to almost 2000 individuals in 2017 (WWF-Pakistan, unpublished).

Although the Ganges dolphin is almost certainly more numerous and widely distributed than the Indus dolphin at present, its persistence into the future is perhaps less certain. It is possible that there could be a rapid and precipitous decline in the near future. If the general belief that considerable numbers of dolphins may exist in Bangladesh in rivers that have not yet been surveyed turns out to be false the subspecies would be considerably less numerous that currently suspected. In the next decade, however, major interventions (esp. waterways, hydropower, and river linking projects) that are sure to hurt the integrity of river flows in South Asia could cause serious declines in the quality and availability of habitat. The most worrying developments are those related to opening up commercial waterways for shipping on the Ganga and Brahmaputra rivers and their tributaries by the Government of India (also plans to extend these to Nepal and Bangladesh through bilateral treaties are being finalized). If realized to its projected capacity (of vessel traffic and channelization/port building), this project would cover large tracts of the Ganges dolphin's current habitat, threatening it with intensive maintenance dredging, underwater noise, and related impacts. There is a need to closely watch these threats unfold in order to plan in advance for *ex situ* conservation efforts in a timely manner. India also has ambitious river basin interlinking projects in the pipeline, but their implementation might take longer than the next ten years. The river linking projects represent the biggest future threat to Ganges dolphins beyond more proximate threats from waterways.

3.5 For future *ex situ* efforts, anticipated issues with fund-raising, public support, security, facility construction, and on-water operations

In India in 2011–2012, following the declaration of the Ganges dolphin as India's National Aquatic Animal, there was serious interest in maintaining Ganges river dolphins in captivity to increase public awareness. According to reports, the Government of India had even considered creation of a display of Ganges river dolphins in the Delhi Zoo (https://www.businessghana.com/site/news/general/118630/Delhi-Zoo-exploring-feasibility-of-building-dolphinarium). At the same time, other proposals to create dolphinariums in the country were also developed. These proposals elicited negative responses from conservation and animal rights groups in India, leading the Ministry of Environment and Forests (Govt. of India) to declare dolphins as "non-human persons". Thus public support is likely to be opposed even though business interests in creating dolphinariums may exist. It is possible that a captive facility in a more remote part of the country, such as Assam, might attract less negative public attention than one in the capital city. Similarly, in Pakistan there has been considerable opposition to maintaining dolphins in captivity partly because of the poor conditions in local zoos, lack of capacity for maintaining cetaceans in captivity, and also because with the Indus dolphin increasing in abundance – the conservation rationale might become weakened. At the same time, this positive development might also present opportunity to begin pilot projects to streamline efforts in captive research. In Pakistan, security is also poor and on-water operations might be challenging.

Throughout South Asia, despite repeated proposals to keep *Platanista* in captivity, conservationists working on the species have been opposed because of the low technical capacity that exists, because of the poor track record from elsewhere of keeping these animals alive in captivity and because of a lack of an immediate and persuasive conservation rationale.

3.6 Other aspects considered relevant to workshop focus

Translocation is likely to be a highly useful strategy for both Indus and Ganges dolphins. Throughout their range dolphins are isolated into rivers and sections of rivers by dams and barrages and many isolated populations are so small that their long-term persistence is questionable. A second factor supporting the use of translocation is that both Indus and Ganges dolphins often become stranded in various pools or canals, where they can be fairly easily captured and rescued and placed back into their river habitat. These rescued dolphins are good candidates for translocation to new areas. Translocations could be conducted either to repopulate areas where dolphins have been extirpated or to supplement the numbers of dolphins in areas where abundance is low.

For the Indus River, a concept note was recently prepared for WWF-Pakistan describing the requirements of a feasibility study to be conducted to fully explore the factors that would need to be considered in an Indus dolphin translocation programme (Annex 1). Translocation of Indus dolphins would likely either be towards the following aims.

1. Re-establishment of a dolphin population between Jinnah and Chashma barrages where animals were recently extirpated despite the presence of apparently good habitat with few obvious threats.
2. Supplementing the number of dolphins in the Beas River in India where there are less than 10 animals remaining again, despite apparently good habitat with few direct obvious threats. (Beas is one of 100+ rivers listed for development under India's Waterways Act but is not high-priority at present).

3. For Ganges River dolphins, priority areas might be linked to supplementing the number of individuals in selected river stretches in Nepal (e.g. upper segments of Sapta Koshi and Narayani), and isolated or nearly extinct populations in minor rivers of the Ganga-Brahmaputra and associated basins (e.g. the Budhabalanga, Barak, Mahananda, Budhi Gandak, Rapti, Jalangi, Teesta, etc.) in India. These stretches hold such small populations that translocation or reintroduction efforts might be important in these systems in the near future.

Literature cited

Aisha, H., Braulik, G., Khan, U., Leslie, A. and Nawaz, R. (2017). 'Indus River dolphin (*Platanista gangetica minor*) - an update on the current assessment and conservation challenge'. Working Paper presented at the International Whaling Commission, Bled, Slovenia, 2017. SC/67A/SM/22.

Anderson, J. (1879). *Anatomical and zoological researches: comprising an account of the zoological results of the two expeditions to western Yunnan in 1868 and 1875 and a monograph of the two cetacean genera* Platanista *and* Orcella*.* Bernard Quaritch, Piccadilly, London.

Braulik, G.T. (2006) 'Status assessment of the Indus River dolphin, *Platanista gangetica minor*, March-April 2001'. *Biological Conservation* 129:579-590. https://doi.org/10.1016/j.biocon.2005.11.026

Braulik, G.T., Bhatti, Z.I., Ehsan, T., Hussain, B., Khan, A.R., Khan, A., Khan, U., Kundi, K., Rajput, R., Reichert, A.P., Northridge, S.P., Bhaagat, H.B. and Garstang, R. (2012). 'Robust abundance estimate for endangered river

dolphin subspecies in South Asia'. *Endangered Species Research,* 17:201-215. https://doi.org/10.3354/esr00425

Braulik, G.T., Barnett, R., Odon, V., Islas-Villanueva, V., Hoelzel, A.R. and Graves, J.A. (2014a). 'One species or two? Vicariance, lineage divergence and low mtDNA diversity in geographically isolated populations of south Asian river dolphin'. *Journal of Mammalian Evolution,* 21. https://doi.org/10.1007/s10914-014-9265-6

Braulik, G.T., Arshad, M., Noureen, U. and Northridge, S. (2014b). 'Habitat fragmentation and species extirpation in freshwater ecosystems: causes of range decline of the Indus River dolphin (*Platanista gangetica minor*)'. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0101657

Braulik, G.T. and Smith, B.D. (2017). *Platanista gangetica*: The IUCN Red List of Threatened Species 2017: e.T41758A50383612*. Downloaded on 08 December 2017*.

Brownell, R.L. (1984). 'Review of reproduction in Platanistid dolphins'. *Report of the International Whaling Commission***,** 149-158.

Committee on Taxonomy (2018). 'List of marine mammal species and subspecies.' Society for Marine Mammalogy, www.marinemammalscience.org. Consulted on 4th December 2018.

Dey, M. (2018). 'Conserving river dolphins in a changing soundscape: acoustic and behavioral responses of Ganges river dolphins to anthropogenic noise in the Ganga River, India'. MSc Thesis (Wildlife Biology and Conservation), PG Program in Wildlife Biology and Conservation, National Centre for Biological Sciences-TIFR and Wildlife Conservation Society-India Program, Bangalore, India.

Haque, A.K.M., Aminul, Nishiwaki, M., Kasuya, T., and Tobaya, T. I(1977). 'Observations on the behaviour and other biological aspects of the Ganges Susu *Platanista gangetica*'. *Scientific Reports of the Whales Research Institute* (Tokyo). 29:87-94.

Herald, E.S. (1969). 'Field and aquarium study of the blind river dolphin *Platanista gangetica*'. Unpublished Report. Steinhart Aquarium, California Academy of Sciences, San Francisco, CA.

Herald, E.S., Brownell, J.R.L., Frye, F.L., Morris, E.J., Evans, W., E. and Scott, A.B. (1969). 'Blind river dolphin: first side-swimming cetacean'. *Science,* 166:1408-1410. https://doi.org/10.1126/science.166.3911.1408

Kannan, K., Sinha, R.K., Tanabe, S., Ichihashi, H. and Tatsukawa, R. (1993). 'Heavy metals and organochlorines residues from Ganges River dolphins from India'. *Marine Pollution Bulletin,* 24:159-162. https://doi.org/10.1016/0025-326X(93)90128-7

Kannan, K., Tanabe, S., Tatsukawa, R. and Sinha, R.K. (1994). 'Biodegradation capacity and residue pattern of organochlorines in Ganges River dolphins from India'. *Toxicological and Environmental Chemistry,* 42:249-261. https://doi.org/10.1080/02772249409358010

Kannan, K., Senthilkumar, K. and Sinha, R.K. (1997). 'Sources and Accumulation of Butyltin compounds in Ganges River Dolphin, *Platanista gangetica*'. *Applied Organometallic Chemistry,* 11:223-230. https://doi.org/10.1002/(SICI)1099-0739(199703)11:3%3C223::AID-AOC543%3E3.0.CO;2-U

Kasuya, T. (1972). 'Some informations on the growth of the Ganges dolphin with a comment on the Indus dolphin'. *Scientific Reports of the Whales Research Institute,* 24:87-108.

Kelkar, N., Krishnaswamy, J., Choudhary, S. and Sutaria, D. (2010). 'Coexistence of fisheries with river dolphin conservation'. *Conservation Biology* 24:1130-1140. https://doi.org/10.1111/j.1523-1739.2010.01467.x

Kelkar, N., Dey, S., Choudhary, S.K. (2015). 'Strengthening the meaning of a freshwater protected area for the Ganges River Dolphin: looking within and beyond the Vikramshila Gangetic Dolphin Sanctuary, Bihar, India'. Final report submitted to the Small Cetacean Fund, International Whaling Commission (IWC), United Kingdom.

Kelkar, N. (2017). 'A River Dolphin's Ear-View Of India's Waterways Development Plans'. *Sanctuary Asia,* XXXVII, http://www.sanctuaryasia.com/magazines/conservation/10561-a-river-dolphins-ear-view-of-indias-waterways-development-plans.html.

Khanal, G., Suryawanshi, K.R., Awasthi, K.D., Dhakal, M., Subedi, N., Nath, D., Kandel, R.C., and Kelkar, N (2016). 'Irrigation demands aggravate fishing threats to river dolphins in Nepal'. *Biological Conservation* 204:386–393. https://doi.org/10.1016/j.biocon.2016.10.026

Noureen, U. (2013). 'Indus River dolphin *(Platanista gangetica minor)* abundance estimations between Chashma and Sukkur barrages, in the Indus River, Pakistan'. MPhil Thesis. Quaid-e-Azam University.

Paudel, S., Pal, P.C., M.V., Jnawali, S.R., Abel, G., Koprowski, J.L. and Ranabhat, R. (2015). 'The Endangered Ganges River dolphin *Platanista gangetica gangetica* in Nepal: abundance, habitat and conservation threats'. *Endangered Species Research* 29:59-68. https://doi.org/10.3354/esr00702

Paudel, S. and Koprowski, J.L. (2017). 'The endangered Ganges river dolphins in Nepal: a small and declining population'. Working paper presented to the International Whaling Commission. SC/67A/SM/19

Pelletier, C. and Pelletier, F.X. (1980). 'Report sur l'expedition Delphinasia (Sept 1977- Sept 1978)'. *Annales de la Societe des Sciences Naturelles de la Charaente Maritime* 6:647-679.

Pilleri, G. (1970). 'The capture and transport to Switzerland of two live *Platanista gangetica* from the Indus River'. *Investigations on Cetacea* 2:61-68.

Pilleri, G., Gihr, M. and Kraus, C. (1970). 'Feeding behaviour of the Gangetic dolphin, *Platanista gangetica*, in captivity'. *Investigations on Cetacea* 2:69-73.

Pilleri, G., Gihr, M. and Kraus, C. (1971). 'Further observations on the behaviour of *Platanista indi* in captivity'. *Investigations on Cetacea* 3:34-42.

Pilleri, G. (1972a). 'Field observations carried out on the Indus dolphin *Platanista indi* in the Winter of 1972'. *Investigations on Cetacea* 4:23-29.

Pilleri, G. (1972b). 'Transport of a live *Platanista indi* from the Indus to Berne'. *Investigations on Cetacea* 4: 30-33.

Pilleri, G., Gihr, M., Purves, P.E., Zbinden, K. and Kraus, C. (1976). 'Ethology, bioacoustics and behaviour of *Platanista indi* in captivity'. *Investigations on Cetacea* 6:13-70.

Prajapati, S. (2018). **'**A study on straying incidences of Gangetic dolphins (*Platanista gangetica gangetica*) into irrigation canals along Ghaghara-Sarju river system'. MSc thesis, Forest Research Institute, Dehradun, India.

Reeves, R.R. and Smith, B.D. (1999). 'Interrupted migrations and dispersal of river dolphins: some ecological effects of riverine development'. In: UNEP/CMS (eds.) *Proceedings of the CMS Symposium on animal migration (Gland, Switzerland, 13 April 1997)*. CMS Technical Series Publication No. 2. Bonn/The Hague, p 9–18. http://www.harishkapadia.com/siachen-peace-park/

Sinha, R.K. and Kannan, K. (2014). 'Ganges River dolphin: an overview of biology, ecology, and conservation status in India'. *Ambio* 43:1029-46. https://doi.org/10.1007/s13280-014-0534-7

Sinha, R.K. (2000). 'Status of Ganges river dolphin, *Platanista gangetica*, in the vicinity of Farakka Barrage'. In: R.R. Reeves, B.D. Smith, and T. Kasuya (eds.), *Biology and Conservation of Freshwater Cetaceans in Asia*. IUCN Species Survival Commission Occasional Paper No. 23. Gland, Switzerland and Cambridge, UK: IUCN SSC. Available at: https://portals.iucn.org/library/node/7688

Sinha, R.K., Behera, S. and Choudhary, B.C. (2010). *Conservation Action Plan for the Gangetic River dolphin 2012-2020*. National Ganga River Basin Authority, Ministry of Environment and Forests, India.

Smith, B.D., Haque, A.K.M.A., Hossain, M.S. and Khan, A. (1998). 'River Dolphins in Bangladesh: Conservation and the Effects of Water Development'. *Environmental Management* 22:323-355. https://doi.org/10.1007/s002679900108

Smith, B.D., Ahmed, B., Ali, M.E. and Braulik, G.T. (2001). 'Status of the Ganges river dolphin or shushuk *Platanista gangetica* in Kaptai Lake and the southern rivers of Bangladesh'. *Oryx* 35:61-72. https://doi.org/10.1046/j.1365-3008.2001.00153.x

Smith, B.D., Diyan, M.A.A., Mansur, R.M., Fahrni-Mansur, E. and Ahmed, B. (2010). 'Identification and channel characteristics of cetacean hotspots in waterways of the eastern Sundarbans mangrove forest, Bangladesh'. Fauna and Flora International: *Oryx* 44:241-247. https://doi.org/10.1017/S0030605309990159

Tobayama, T. and Kamiya, T. (1989). 'Observations on *Inia geoffrensis* and *Platanista gangetica* in captivity at Kamogawa Sea World, Japan'. In *Biology and Conservation of the River Dolphins. Proceedings of the Workshop on Biology and Conservation of the Platanistoid Dolphins, held at Wuhan, People's Republic of China. October 28-30, 1986* (eds W.F. Perrin, J.R.L. Brownell, Z. Kaiya and L. Jiankang), pp. 42-45. Gland, Switzerland: IUCN. https://portals.iucn.org/library/node/6485

Wakid, A. (2009). 'Status and distribution of the endangered Gangetic dolphin (*Platanista gangetica gangetica*) in the Brahmaputra River within India in 2005'. *Current Science* 97:1143-1151.

Walker, S. (2004). 'Central Zoo Authority and Indian Zoos: A Current Overview'. *Zoos' Print* 19:5-11.

WWF-India (2018). 'Status of the Indus River dolphin in India'. WWF-India, Lodhi Estate, Delhi.

Annex 1 – Project concept

Feasibility study for translocation of Indus River dolphins from high density to low density areas

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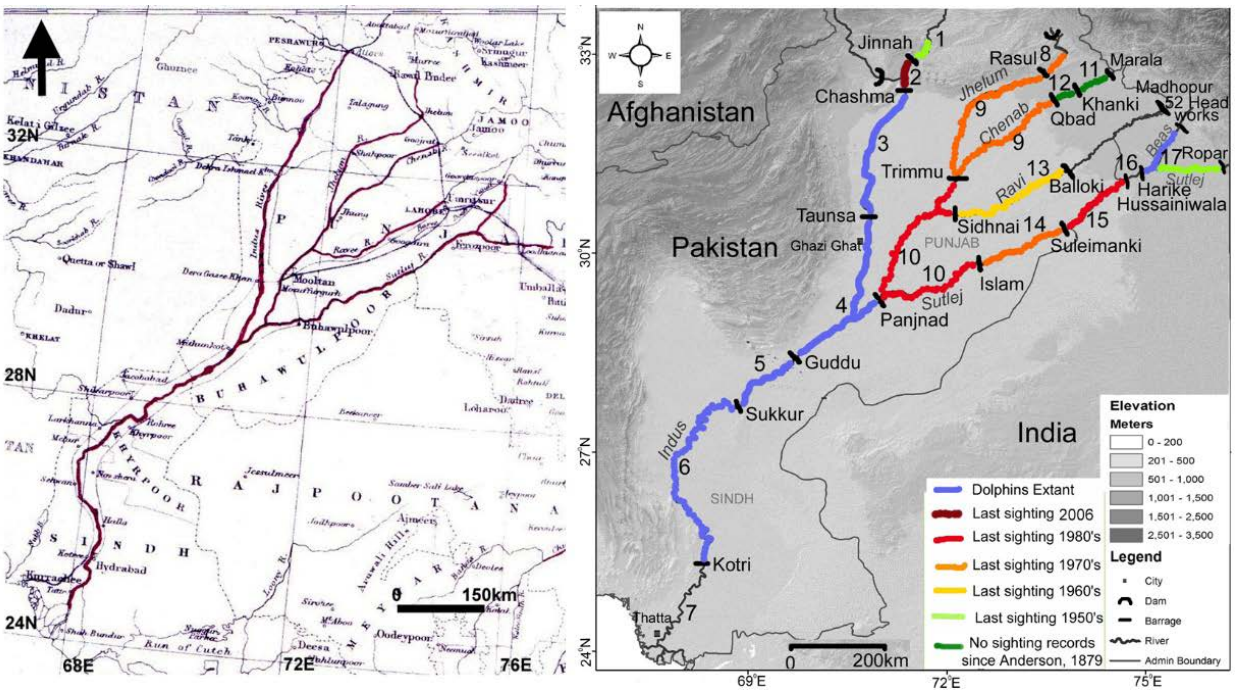
Background

The Indus River dolphin (*Platanista gangetica minor*) is a subspecies of freshwater dolphin that is essentially endemic to the Indus River system of Pakistan, with a tiny remnant population of less than 10 animals persisting in neighbouring India. The Indus dolphin is listed on the IUCN Red List as Endangered, because it has suffered an 80% decline in range since the construction of irrigation barrages throughout its habitat beginning around the 1880s (Braulik et al., 2012). Barrages divert water for irrigation reducing the quality of habitat downstream, and they contain a series of gates



Left: Range of the Indus dolphin in the 1870's (Anderson 1879).
Right: Habitat fragments and dolphin extirpation date (updated from Braulik et al., 2014).

that when closed are a complete barrier to dolphin movement thereby isolating animals into subpopulations between barrages for most of the year.

The previous range of the dolphin has been fragmented by barrages into 17 different sections by barrages, and clearly viable dolphin populations persist in only 3 sections (Guddu-Sukkur, Taunsa-Guddu and Chashma-Taunsa), while dolphins have been extirpated from 12 river sections (Braulik et al., 2014). Remnant populations of less than 20 animals persist in the Sukkur-Kotri section of the Indus River in Pakistan, and in the Beas River in India. Range decline is a dynamic process, and the range of the dolphin continues to shrink; exemplified by the confirmation in 2018 that dolphins no longer occur between Jinnah-Chashma barrages meaning that another subpopulation has disappeared (WWF-Pakistan, unpublished).

Abundance monitoring of the three largest dolphin subpopulations has been conducted since the 1970s and repeated dolphin counts, as well as recent abundance estimates using mark recapture from tandem counts, all conclude that abundance of all three subpopulations is steadily increasing (Braulik et al., 2012; Aisha et al., 2017). Current abundance estimates for the subspecies are approximately 2000 individuals (WWF-Pakistan, 2013). The area with the highest density and estimated abundance is Guddu-Sukkur with 1139 (CV = 8%) dolphins estimated in 2017. A total of 660 (CV = 6%) were estimated between Taunsa and Guddu, and 188 (CV = 8%) between Chashma and Taunsa in the same year (WWF-Pakistan unpublished). The reason for the increase in abundance in these three areas is not clearly understood but is likely to be partly due to the cessation of dolphin hunting in the mid-1970s.

Over several decades there have been reports of dolphins entering and becoming trapped in irrigation canals. It is unclear whether dolphins enter the canal gates intentionally, or accidentally, but once they are inside a canal it is seldom possible for them to re-enter the river. Annually canals are drained for de-silting maintenance, and dolphin rescue programmes have been initiated at several barrages to systematically search for dolphins in canals and rescue and return them to the main river each year. Twelve dolphins were rescued from the Sukkur area in 2016 (Aisha et al., 2017). Dolphin rescues are not considered here as translocations, but as localised rescues, because animals are typically moved short distances and returned to the same river section from which they originated, and because the rescues are unlikely to have sub-species level impacts or result in changes in population dynamics.

Dolphin translocation

It has been discussed in Pakistan for many years that it may be possible to take rescued dolphins and return them to a different stretch of river. Depending upon the stretch of river selected, this would either have the effect of supplementing the numbers of dolphins in low density areas, or repopulating an area where dolphins were recently extirpated. Conservation translocation is generally intended to yield a measurable conservation benefit at the levels of a population, species or ecosystem, and not only provide benefits to translocated individuals (IUCN SSC, 2013). There is potential merit to an Indus dolphin conservation translocation programme, but it would need to be carefully conceived, with a clearly stated goal and objectives, a risk assessment, evaluation of alternative conservation options, and a long-term monitoring programme (Braulik et al. 2015).

This project concept note outlines the components of a comprehensive feasibility study of Indus dolphin conservation translocations. The feasibility study will follow the framework laid by the IUCN Species Survival Commission (2013) for conservation translocations and reintroductions. It is proposed to convene a small panel of national and international experts to lead the translocation feasibility assessment.

Dolphin translocation feasibility study approach

There are several options regarding how this work might be approached. Principally:

1. A workshop can be convened in Pakistan where experts are invited to discuss the feasibility and also to visit the river and proposed translocation sites. A final report would be the output of a workshop.
2. An expert panel can be convened and commissioned to work on a desktop feasibility study report. Communication would be via conference calls and email.

A workshop would allow a detailed and comprehensive discussion of the issue, with field visits, and a more detailed report with clearer guidance and recommendations.

A desktop study would produce a shorter and more general report than one produced following a workshop. However, it would be cheaper and quicker to produce and could be an initial step that could be followed at a later date by a more detailed workshop.

Expertise required on an expert panel

Platanista specialist, IUCN Cetacean Specialist Group members, Pakistani Senior Conservation Scientists, Chinese expert on Yangtze finless porpoise translocations, expert on Hawaiian Monk Seal translocation programme, marine mammal veterinarian, geneticist or demographer.

Dolphin translocation feasibility study report

The feasibility study report would include the following components:

- **Evaluation of whether translocation is an acceptable option for this subspecies:**
  Summary of subspecies current status and level of endangerment
  Dynamics of range decline
  Current abundance and trajectory of each subpopulation
  Threats: Past, ongoing and emerging threats that caused the range decline
  Summary of IUCN Translocation Guidelines
  Potential source of translocated individuals and the impact of removing animals from a subpopulation
  Evaluation of the destinations for translocated individuals
  Evidence of capture, transport and release resilience or sensitivity
  Discussion of possible goals: including supplementing numbers of existing subpopulations versus re-establishing extirpated populations.
  Discussion of possible objectives to meet the final goal, with final objectives selected.
  Cost / Benefit of conducting translocations
  Consider alternative conservation options if translocation not attempted
  General recommendations and conclusions on whether translocation is feasible and in what circumstances

- **Case studies of translocations conducted for marine mammals and lessons learned**
  Yangtze finless porpoise
  Hawaiian monk seal

- **Site level translocation considerations**
  Biological suitability of the species and the receiving environment
  Habitat suitability of the receiving environment
  Climatic suitability
  Disease and invasive species transfer
  Animal Welfare considerations
  Local threats
  Local community involvement and perceptions

Local government involvement and management

- **Risk assessment**
  Assess the severity of impact and likelihood of occurrence of all identifiable risks

- **Planning a translocation**
  Capture
  Transport
  Release

- **Translocation Monitoring Programme**
  Define measures of success and failure
  Describe how progress will be measured
  Outline data collection protocols

- **Time frame for feasibility study:**
  3 months for a desk-based study, approximately 9 months for a workshop.

Literature cited

Aisha, H., Braulik, G., Khan, U., Leslie, A. and Nawaz, R. (2017). 'Indus River dolphin (*Platanista gangetica minor*) - an update on the current assessment and conservation challenge'. Working Paper presented at the International Whaling Commission, Bled, Slovenia, 2017. SC/67A/SM/22.

Braulik, G.T., Smith, B.D. and Chaudhry, A.A. (2012). *Platanista gangetica* ssp. *minor*. The IUCN Red List of Threatened Species. Version 2014.3: http://www.iucnredlist.org. Downloaded on 23 April 2018.

Braulik, G.T., Arshad, M., Noureen, U. and Northridge, S. (2014). Habitat fragmentation and species extirpation in freshwater ecosystems: causes of range decline of the Indus River dolphin (*Platanista gangetica minor*). *PLoS ONE*. https://doi.org/10.1371/journal.pone.0101657

Braulik, G.T., Noureen, U., Arshad, M. and Reeves, R.R. (2015). Review of status, threats, and conservation management options for the endangered Indus River blind dolphin. *Biological Conservation*, 192: 30-41. https://doi.org/10.1016/j.biocon.2015.09.008

International Union for Conservation of Nature Species Survival Commission (IUCN SSC) (2013). *Guidelines for reintroductions and other conservation translocations.* Gland, Switzerland and Cambridge, UK: IUCN-SSC Re-Introduction Specialist Group. Available at: https://portals.iucn.org/library/node/10386

Potential for captive breeding and reintroduction of Irrawaddy dolphins into their native habitat

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Abstract

Captive breeding and reintroduction of Irrawaddy dolphins back into their native habitat are currently not considered to be viable options for conserving the species due to problems with capture, transport, poor survivorship in captivity (although data are sparse), and a lack of information about husbandry and ecological/behavioral adaptations. Also, there is also little justification for initiating a captive breeding program for Irrawaddy dolphins if threats, which include fishery entanglement and habitat loss, in their native habitat are not assertively addressed.

Little information is available on Irrawaddy dolphins in captive or in semi-captive conditions including attempts to rehabilitate and/or maintain individuals under managed care. There is also little knowledge on stress-induced capture myopathy, including the use of sedatives and therapeutics to manage cardio-vascular effects.

In Asia, there is a general lack of understanding on the role of *ex situ* conservation. A danger is that managers, politicians and civil society will consider captive breeding as a conservation end and that the incentive for protecting wild habitat will be reduced. Although a great deal of work remains to be done there has been some progress on addressing primary threats especially in the five populations considered critically endangered in the IUCN Red List. This includes establishing protected areas, better enforcement of fishing regulations and engaging local communities in conservation efforts.

Irrawaddy dolphin (*Orcaella brevirostris*) from the northern Bay of Bengal, Bangladesh, that was entangled and died in a gillnet, photographed by a fisherman participating in a citizen science network collecting information on marine wildlife bycatch. **© Wildlife Conservation Society Bangladesh.**

With a few notable exceptions (e.g., in coastal Bangladesh and a transborder population in Cambodia and Thailand), most Irrawaddy dolphin populations have been estimated to number less than a hundred individuals. This means that that the removal of even a few dolphins for captive breeding could be the final "nail in the coffin" for isolated populations. It is recommended that, if captive breeding and reintroductions are to be considered viable options for conserving Irrawaddy dolphins, foundation building activities including behavioral and genetic studies and health assessments are needed. In addition to technical issues related to capture, transport, survivorship, husbandry, behavioral adaptations and reintroductions, the substantial challenges posed by the geopolitical, socioeconomic and cultural context would also need to be addressed.

1 Summary of what is known

1.1 Experience with the species in captivity, including attempts to rehabilitate and/or maintain individuals under managed care (i.e. in captive or 'semi-captive' conditions)

Irrawaddy dolphins have been kept in captivity since the mid-1970s. Between 1974 and 1984, 26 individuals were caught from the Mahakam River, Kalimantan, Indonesia, using a drive method (Tas'an et al., 1980; Tas'an & Leatherwood, 1984; Wirawan, 1989). Of the six dolphins with information on the date of capture and death, except for a single individual that lived for 3.7 years, the average survival time was only 31 days (range = 1-115) with three of these deaths occurring when the dolphins were kept in a sea pen while transitioning from feeding on live to dead fish before being transported to the Jaya Ancol Aquarium in Jakarta. Survival times of the remaining 20 Irrawaddy dolphins are unknown. However, six of 16 individuals with unknown survival times were alive in 1985, two remained alive in 1995 (Tas'an et al., 1980; Tas'an & Leatherwood, 1984, Stacey & Leatherwood, 1997) and none by 2007 (Beasley, 2007).

Other than the Mahakam River there have been no known captures of Irrawaddy dolphins from freshwater populations. However, while the total numbers are unknown and details sparse, Irrawaddy dolphins have been captured in coastal waters of Thailand, Cambodia and Vietnam for captive display (Stacey & Leatherwood, 1997; Beasley, 2007).

Nine Irrawaddy dolphins, including four males and five females, were captured from the Gulf of Thailand in 1983 and one male was captured in 1988. All were reportedly taken to Oasis Sea World in Laem Sing, Thailand (Beasley, 2002).

In 1994, eight Irrawaddy dolphins were caught using nets in the coastal waters of Cambodia and taken to Safari World in Bangkok, Thailand (Stacey & Leatherwood, 1997). In 1995, two Irrawaddy dolphins believed to have been from the 1994 Cambodia collection, were exported from Safari World to Marine World Uminonakamichi, Fukuoka City, Japan. By 1998, only one of the dolphins at Marine World Uminonakamichi was still alive, but reportedly it has since died.[1]

At least eight Irrawaddy dolphins were captured in Cambodia in January 2002 for captive display at the Koh Kong International Resort Hotel on the Thailand/Cambodia border (Beasley & Davidson, 2007). All were reported dead by 2004.[1]

Seven Irrawaddy dolphins were captured in 2008 and 20 were captured in 2011 by the Vietnam–Russia Tropical Center for 'scientific research and

1 A History of Captive Rarities and Oddities (Part 2) | Dolphin Project https://www.dolphinproject.com/blog/a-history-of-captive-rarities-and-oddities-part-2/

circus performances' for facilities in Vietnam. No information is available on the survival of these animals except for two adults and one immature dolphin that were reported on display at Dai Nam Van Hien Wonderland in Vietnam in 2012 (Nguyen et al., 2010; 2012a,b as cited in Curry et al., 2013).

As mentioned above, records of survivorship of Irrawaddy dolphins in captivity are sparse but overall appear poor. As summarized in Curry et al., (2013), in the Mahakam two dolphins from the 1974 capture died 10-20 days after being captured due to gastrointestinal ulcers; two from the 1978 capture died after 30 and 115 days due to pneumonia and liver cirrhosis, and 'constitutional heart weakness,' respectively; and one calf died that was born on the same day its mother was captured.

There are a few records of Irrawaddy dolphins born in captivity. In 1979, one female was born in captivity at the Jaya Ancol Aquarium after a reported gestation period of 14 months, based on the date of the last observed mating and parturition. The calf nursed within 12 hours, consumed dead fish at six months and was weaned after two years (Beasley 2007). Another calf was born the same year but died shortly afterwards. In 1981 a third dolphin was born. Both calves born in 1979 and 1981 were reported alive in 1984. There are no reports if either of these captive-born Irrawaddy dolphins produced offspring. One Irrawaddy dolphin calf was also reported born in captivity at Oasis Sea World in March 2012.[1]

1.2 Knowledge of the focal species with respect to stress-induced capture myopathy, including the use of sedatives and therapeutics to manage cardiovascular effects of catecholamines

No specific information is available on stress-induced capture myopathy, including the use of sedatives and therapeutics to manage cardiovascular effects of catecholamines.

1.3 Cryopreservation of gametes and other biological material

The author is unaware of any cryopreservation of gametes or any other biological material of Irrawaddy dolphins. However, active *in situ* research/conservation initiatives in several key areas of the species' range (e.g., Ayeyarwady River in Myanmar, Chilika Lagoon in India, Mahakam River in Indonesia, Mekong River in Cambodia, Sarawak coast in Malaysia, and the Trat coast in Thailand) include mortality monitoring networks. This means that with adequate funding, a platform is available for collecting and cryopreserving samples. However, a key challenge for rescuing and preserving gametes and other biological material will be to collect and freeze the samples quickly enough after death to avoid cell degeneration. Another challenge is to ensure long-term cryo-storage in the context of frequent electricity blackouts in most Irrawaddy range states which could result in thawing and subsequent cell damage.

1.4 Geopolitical, socioeconomic and cultural contexts with respect to *ex situ* conservation

The geopolitical, socioeconomic and cultural context of *ex situ* conservation with respect to Irrawaddy dolphins is particularly complex. This is due in part to the great diversity of political systems, socio-economic status, and cultures that characterize the human condition within the coastal and riverine distribution of the species in Asia. This diversity is probably greater than the human context of other threatened small cetaceans, except for finless porpoise and Indo-Pacific humpback dolphins, which are generally sympatric with Irrawaddy dolphins across most of their range. One example of cultural diversity is that there are more than 300 native languages (which may be a rough indicator of cultural diversity) spoken in Indonesia alone, which comprises an important part of the range of Irrawaddy dolphins, while 96% of its 264 million people live within 100 km of the coast.

Beyond considerations of cultural/language diversity, the sheer number of people that interact directly or indirectly with coastal ecosystems in Asia adds a further layer of complexity to implementing *ex situ* conservation solutions for Irrawaddy dolphins. According to Schwatz (2006) 55% of 165 million people live within 100 km of the coast in Bangladesh while the same situation applies to 24% of 16 million people in Cambodia, 98% of 32 million people in Malaysia, 100% of 105 million people in the Philippines, 83% of 96 million people in Vietnam, 49% of 53 million people in Myanmar and 38% of 69 million people in Thailand - with population sizes increasing since these estimates were made.

The complexity and magnitude of human interaction with coastal and river environments make *ex situ* as well as *in situ* conservation of Irrawaddy dolphins particularly challenging. It also ensures that human considerations are critical for evaluating the feasibility of effective conservation approaches regardless of whether they are *ex situ* or *in situ*. However, with respect to *ex situ* approaches, there are some common threads, albeit with notable exceptions, that should be considered. One is that dolphins are generally held in high regard by local people with stories and fables that give them with a certain degree of cultural protection. For instance, in Vietnam coastal fishers worship dolphins and whales for their purported role in rescuing them if they are lost at sea. Many Irrawaddy dolphin skulls are kept at "whale temples" collected from stranded and accidentally entangled animals where they are worshiped to honour the dead. Another example is in the Ayeyarwady River where there is a cooperative fishery between Irrawaddy dolphins and fishers. There is a myth in local villages along the banks of the river that if anyone harms an Irrawaddy dolphin the entire village will fall into the water. It is also significant that, with a few exceptions, direct exploitation is not a factor threatening the species. The affinity of many people in Asia for dolphins means that there is overall support for their conservation. However, because this support is generally based on a sentimental attachment versus the ecological role of Irrawaddy dolphins in riverine and coastal habitat, *ex situ* conservation approaches can easily be considered a conservation end versus a stopgap measure needed to boost the population before reintroducing animals back into their native habitat.

This perception that captive breeding is synonymous with species conservation is exemplified by the following paragraph taken from the Oasis Sea World's website on its swim with dolphin program:

"Both the pink dolphins [humpback, *Sousa chinensis*] as well as the Irrawaddy dolphins are indigenous to Thailand, but their numbers are rapidly declining due to excessive droughts and fishing net related accidents. Especially the Irrawaddy dolphin's numbers are declining fast, as this species can live and feed in rivers as well as in the sea and is thus susceptible to double the dangers. It is, therefore, important that Oasis Sea World continues its good work of breeding of these near extinct species. You can support this caring and breeding station by visiting their theme park to experience the dolphin swim and by spreading the word to others. Remember: a dolphins swim is not only a once in a lifetime experience for you, but you will be helping all the needy animals and keep them from becoming extinct."[2]

Meanwhile, the sentimental view of Irrawaddy dolphins in many Asian cultures also means that potential mortalities caused by capture, acclimating the dolphins to a captive or semi-captive environment, and transport, as well as the generally low survivorship of the species in captivity, could easily result in a withdrawal of public support for *ex situ* conservation.

2 http://swimwithdolphins.information.in.th/

1.5 Current state of local community engagement, international outreach/coordination, geopolitical and socioeconomic solutions aimed at addressing the primary threats

Local community engagement and international outreach/coordination are relatively rare in most of the species' distribution. However, where communities have been engaged and international outreach/coordination and geopolitical and socioeconomic solutions have been prioritized in long-term conservation initiatives, positive progress has been made at addressing primary threats with population-level benefits for the species.

Perhaps the most encouraging example of local community engagement and international outreach/coordination, geopolitical and socioeconomic solutions applied to Irrawaddy dolphin conservation is in the Mekong River where the Cambodia Fisheries Administration (FiA) and the World Wildlife Fund (WWF) Cambodia have made a long-term commitment to Irrawaddy dolphin conservation by engaging local communities, promoting policies changes, conducting educational outreach, enforcing fishery laws and rules through SMART[3] patrols conducted by local River Guards, and engaging international experts coordinated through the IUCN Species Survival Commission Cetacean Specialist Group. The involvement of international experts began with a workshop convened by WWF in 2009 after studies in the Mekong indicated alarming population declines and unsustainable mortalities of Irrawaddy dolphins especially calves. These reports led to discussions within WWF that an aggressive *ex situ* conservation approach would be needed to prevent this Critically Endangered dolphin population from disappearing from the Mekong River. After rigorous analysis of available information, the expert panel rejected the *ex situ* conservation proposal but instead proposed recommendations for *in situ* research and conservation measures prioritized according to immediate and long-term needs.[4] WWF and the FiA responded positively and the international expert panel remained engaged in monitoring progress, providing technical support, and making follow-up recommendations during field visits and additional workshops in 2012, 2014 and 2017. At the 2017 workshop, the expert panel concluded that progress had been outstanding with apparent increases in dolphin abundance and reductions in mortality.[5]

1.6 The current state of global awareness of the species, its conservation status, and media coverage

Global as well as regional awareness of Irrawaddy dolphins has increased in the last decade. Articles on dolphin research and mortalities are frequently highlighted in local print and social media leading to increased regional awareness of the species and their vulnerability to extinction. The species has enjoyed less international exposure. However, a few stories on new discoveries of relatively large Irrawaddy dolphin populations in Bangladesh and Thailand and on the impacts of dams, particularly in the Mekong, have received some international attention.

2 Summary of information needs

2.1 Identifying data gaps and what needs to be done to fill those gaps

As discussed in further detail below, at the present time there are few compelling arguments for initiating an aggressive *ex situ* conservation program

3 https://smartconservationtools.org/

4 http://www.iucn-csg.org/wp content/uploads/2010/03/Mekong_Dolphin_Mortality_report_ from_international_experts.pdf

5 http://www.iucn-csg.org/wp-content/uploads/2010/03/Report-of-the-2017-International-Workshop-on-the-Conservation-of-Irrawaddy-Dolphins-in-the-Mekong-River.pdf

for Irrawaddy dolphins. However, a great deal of foundation building work could be done that would enable the more rapid development of an effective *ex situ* approach for Irrawaddy conservation should the status of the species deteriorate. Filling these information gaps can also better inform *in situ* conservation approaches.

A partial list of data gaps and what needs to be done to fill those gaps could include:

i. Long-term behavioural studies to better understand the social ecology of different populations. These are also needed to guide the conditions of captive and semi-captive habitats and the sex-age composition of *ex situ* populations, and to understand the impacts of removing individuals that may play important leadership roles in complex dolphin societies. Social grouping can be critical to reproductive success while inappropriate social grouping can harm the overall health and longevity of small cetaceans in captivity (Curry et al., 2013).
ii. Studies to learn more about genetic diversity and population identity for evaluating issues including the number of animals needed for establishing founder populations and which wild populations are best suited for capturing dolphins to establish a reproductively healthy *ex situ* group. Captive populations require careful demographic and genetic management to avoid excessive loss of genetic diversity and a high risk of extinction (Ralls & Meadows, 2001; Ballou et al., 2010).
iii. Studies on habitat preferences of Irrawaddy dolphins during different life history stages and times of the year so areas critical for their survival in the wild can be protected. If animals are removed from wild populations before these studies are done, this vital information may be lost and undermine the potential success of future reintroductions.
iv. After careful consideration of feasibility, risk and conservation value, health assessments that include live captures could be considered to, among other research priorities, evaluate the suitability of Irrawaddy dolphins for live capture, handling and transport.
v. Partnering with existing facilities that keep Irrawaddy dolphins in captivity (e.g., Oasis Sea Word, Safari World and Pattaya Dolphin World) to obtain better information on past experiences with capture, transport, husbandry, and survivorship
vi. Dedicated research at these same captive facilities, including (1) taking blood samples on a regular basis to evaluate physical condition, (2) collecting fecal, saliva, and blowhole secretion samples to monitor and research reproductive hormone patterns, and (3) observing behavior to monitor mating.
vii. Experiments at these same captive facilities using assisted reproductive technologies such as artificial insemination and synchronization of estrus for improved genetic management and allowing more efficient breeding among captive facilities without animal transport and possibly achieving a shorter interval between generations. According to Curry et al., (2013), assisted reproductive technologies are species specific and many endangered species will not benefit due to an insufficient understanding of structural anatomy, estrous cycles, seasonality, gamete physiology, and appropriate sites for semen deposition.

3 Necessary next steps

3.1 Identifying actions needed to develop and implement *ex situ* management plans

Despite Irrawaddy dolphins recently being uplisted from Vulnerable to Endangered and five Critically Endangered populations in the IUCN Red List, in the opinion of the author there is currently little justification for implementing *ex situ* management plans for Irrawaddy dolphins. A few reasons include that (1) The species is still widely distributed in nearshore coastal waters and in three large rivers; (2) No populations of Irrawaddy dolphins

have gone extinct despite the enormity of threats and their fragmented distribution which makes isolated populations particularly vulnerable to extirpation; (3) Protecting Irrawaddy dolphin habitat is a challenging task that can be anchored by the dolphins' role as a flagship species; and (4) Long-term *in situ* conservation programs for Irrawaddy dolphins have shown encouraging signs of success (e.g., in the Mekong) at arresting population declines and raising the profile of the species to address development issues affecting their habitat. However, key steps could be taken to establish a stronger foundation and get a head start on developing an *ex situ* conservation approach if the situation of the species deteriorates. From a research perspective, these steps are summarized in Section 2.1 *Summary of Information Needs*. Two additional steps that could be taken include:

i. Strengthening efforts to protect Irrawaddy dolphin habitat in the three large rivers where the species occur (Ayeyarwady in Myanmar, Mahakam in Indonesia, Mekong in Cambodia and Lao PDR) and in coastal ecosystems near river mounts. This is essential not only for supporting *in situ* conservation efforts but also for an *ex situ* strategy that includes plans for future reintroductions.
ii. Raising the profile of Irrawaddy dolphins as flagships for healthy rivers and coastal seas, both internationally and in their range states, and educating civil society on the importance of biodiversity conservation with an emergency option for saving species on the brink of extinction that includes captive breeding and reintroduction back into a healthy native habitat.

3.2 Assessing suitability and risks for capture, transport and captive management of the focal species

As summarized in Curry et al., (2013) and Section 1.1 *Experience with the species in captivity*, problems have arisen during the capture, transport and captive management of Irrawaddy dolphins especially from their riverine habitat. Another example is that in 1999. while attempting to transport Irrawaddy dolphins from Oasis Sea World, Thailand, to Underwater World, Singapore, Beasley (2002) reported that one of four Irrawaddy dolphins died while the condition of the other three animals were not considered stable enough for transport leading to the cancellation of the planned inter-aquarium transfer.

3.3 How captive or semi-captive management programs could be integrated with species recovery plans

Attempting to integrate a captive of semi-captive management program with species recovery plans presents a dilemma because the capture of live individuals for establishing a founder population in a captive or semi-captive facility means that individuals are lost from the wild source population. Furthermore, establishing a captive or semi-captive management program could undermine *in situ* conservation efforts for Irrawaddy dolphins through the diversion of scarce conservation funds and expertise needed for these efforts. Perhaps more importantly it could reduce the impetus for protecting their native habitat since captive or semi-captive management can be viewed, particularly in Asia, as a conservation end versus a stop-gap measure need for reintroduction back into their native habitat.

Under captive or semi-captive management, politicians and the public may see Irrawaddy dolphins swimming in a netted off bay or tank and get the impression that the population/species is being saved. Better understanding that dolphin conservation is interlinked with protecting healthy freshwater and coastal marine habitat is essential. However, changing knowledge and behaviour takes a great deal of time and habitat loss and fishery exploitation can happen quickly and be irreversible. In the experience of the author, much of the incentive for dolphin conservation in Asia comes from a sentimental attachment, which can

lead to a greater acceptance that dolphins in a tank to watch, pet and swim with are synonymous with species conservation.

Careful consideration is needed on whether captive or semi-captive management programs are compatible with robust *in situ* conservation which depends a great deal on human perception of the conservation value of Irrawaddy dolphins remaining in their native habitat. Although several Irrawaddy dolphin populations are considered Critically Endangered, dedicated, long-term programs have shown encouraging signs of arresting declines and promoting recovery.

Despite some positive signs, the long-term conservation prospects of Irrawaddy dolphins in their native habitat remain uncertain. Prospects for their long-term survival could deteriorate quickly, especially given their patchy distribution in coastal waters near freshwater inputs and in deep pools of three large rivers. This makes populations and semi-isolated groups vulnerable to "blinking out" with increasing geographic gaps in their range and reduced demographic connectivity. It also implies that foundation building steps (see above) should be taken so that if the status of the species significantly deteriorates a robust *ex situ* recovery strategy could be more effectively and quickly implemented.

3.4 A timeline for actions based on current abundance estimates and trajectories

Current abundance estimates for Irrawaddy dolphin populations generally number less than the low hundreds, with some as low as the middle tens, but with larger populations of about 400 along the Trat coast of Thailand and 5,800 in coastal Bangladesh including waterways of the Sundarbans mangrove forest. For each of the five subpopulations classified as Critically Endangered (see below), and a sixth subpopulation in Chilika Lake, India, the number of reproductively mature individuals is estimated to be less than 50. Available evidence suggests that mortality rates of Irrawaddy Dolphins are consistently at, or above, the rate that would result in a 50% or greater decline in three generations.[6]

A specific timeline of actions is difficult to recommend given uncertainties about the nature of actions to be taken. However, the actions recommended to advance both *ex situ* and *in situ* conservation goals in *Section 2.1 Identifying data gaps* and *Section 3.1 Identify actions needed to develop and implement ex situ management plans* could begin immediately.

3.5 For future *ex situ* efforts, anticipated issues with fund-raising, public support, security, facility construction, and on-water operations

All the above issues are anticipated for implementing a future *ex situ* effort. This implies that a long lead time will be needed for all these issues to be adequately addressed. A major consideration is sustainability. Ideally any *ex situ* effort should be funded through a conservation trust to ensure long-term support.

In the opinion of the author, captive breeding programs should not be linked with or funded by commercial live displays (or dolphin circuses or swim-with-dolphin programs) which will reduce the impetus for reintroduction and habitat protection, not to mention teach behaviours that will reduce their survival/reproductive fitness when released back into their native habitat.

6 https://www.iucnredlist.org/species/15419/123790805

3.6 Other aspects considered relevant to workshop focus

Irrawaddy dolphins were recently revaluated in the IUCN Red List which resulted in the species being uplisted from Vulnerable to Endangered based on criteria A2cd+3cd+4cd. According to the assessment "Criteria A2, A3, and A4 refer to a population size reduction of ≥50% over the past 60 years, future 60 years, and a time period encompassing 60 years in both the past and future, respectively; c refers to declines in the area of occupancy and quality of habitat, and d refers to levels of exploitation which in this case is fisheries bycatch. The Endangered classification of the species is reinforced by the fact that five subpopulations have been assessed as Critically Endangered, as well as the ongoing intensity of bycatch and habitat degradation throughout the species' range without substantial mitigation."[7]

A vital consideration for considering an *ex situ* conservation approach for Irrawaddy dolphins or any other small cetacean should be to incorporate explicit plans for reintroduction and protecting native habitat. *In situ* species conservation can anchor habitat protection. If Irrawaddy dolphins are removed from their native environment to establish an *ex situ* breeding population, it could reduce pressure for reducing/eliminating entangling gears that are the most immediate threat to the species and stopping the construction of dams in their running water habitat – a major consideration in both the Mekong and Ayeyarwady rivers.

Literature cited

Ballou, J.D., Lees, C., Faust, L.J., Long S., Lynch, C., Bingaman, L., and Foose, T.J. (2010). 'Demographic and genetic management of captive populations'. In: D.G. Kleiman, K. Thompson and C. Kirk-Baer (eds.) *Wild mammals in captivity*, 2nd ed, pp.263-283. University of Chicago Press, Chicago, IL.

Beasley, I.L. (2002). 'Monitoring of Thai captive cetacean facilities'. Report to Whale and Dolphin Conservation Society (WDCS), WDCS, Adelaide.

Beasley, I.L. (2007). 'Conservation of the Irrawaddy dolphin, *Orcaella brevirostris* (Owen in Gray, 1866) in the Mekong River: biological and social considerations influencing management'. PhD thesis, James Cook University, Townsville.

Beasley, I.L. and Davidson, P.J.A. (2007). 'Conservation status of marine mammals in Cambodian waters, including seven new cetacean records of occurrence'. *Aquatic Mammals*, 33: 368−379. https://doi.org/10.1578/AM.33.3.2007.368

Curry, B.E., Ralls, K. and Brownell, Jr., R.L. (2013). 'Prospects for captive breeding of poorly known small cetacean species'. *Endangered Species Research*, 19:223-43. https://doi.org/10.3354/esr00461

Nguyen, N.T., Cu, D.N., Trinh, C.L.T., Phan, T.X. et al. (2010). 'Ket qua danh bat, thuan duo'ng, huan luyen ca heo ong su (*Orcaella brevirostris*) Vung Bien Kien Gian [Results on catching, domestication, and training of Irrawaddy dolphin (*Orcaella brevirostris*) in the Sea of Kien Giang Province]'. In: *Ve Sinh Thai Nhiet Doi, Giai Doan 2008−2010* [Scientific report on tropical ecology 2008−2010], pp.38-45. Vietnam−Russia Tropical Center, Ha Noi−Ho Chi (in Vietnamese with English summary).

Nguyen, N.T., Mukhametov, L.M., Cu, D.N., Phan, T.X., Nguyen, A.T., Tran, H.T.T. and Tru'ong, H.B. (2012a). 'Ket qua nghien cuu hoan thien cong nghe danh bat thuan du'ong thich nghi va van chuyen ca heo ong su Vung Bien Kien Giang, Viet Nam [Perfect survey result on technologies of fishing, taming, adapting and transporting of the Irrawaddy dolphins at the Kien Giang coastal areas, Vietnam]'. In: *On the 20th anniversary of the formation of the southern branch, Vietnam−Russia Tropical Center, 20.2.1992− 20.2.2012*, pp.114-121. Vietnam−Russia Tropical Center, Ha Noi−Ho Chi (in Vietnamese with English summary).

Nguyen, N.T., Trjnh, C.L.T., Le, T.H.T., Alexander, S. et al. (2012b). 'Ket qua thuan du'ong, huan luyen ca heo ong su (*Orcaella brevirostris*) bieu dien xiec tai trung tam thuan du'ong huan luyen ca heo dai nam−binh du'ong

7 https://www.iucnredlist.org/species/15419/123790805

[The result of taming and training of Irrawaddy dolphin on the circus performance at Dai Nam Taming and Training Center, Binh Doung province]'. In: *On the 20th anniversary of the formation of the southern branch, Vietnam−Russia Tropical Center, 20.2.1992−20.2.2012*, pp.122-131. Vietnam−Russia Tropical Center, Ha Noi−Ho Chi (in Vietnamese with English summary).

Ralls, K. and Meadows, R. (2001). 'Captive breeding and reintroduction'. In: Levin SA (ed.) *Encyclopedia of biodiversity*, Vol 1, pp.599-607. Academic Press, San Diego, CA. https://doi.org/10.1016/B0-12-226865-2/00041-9

Reeves, R. and Leatherwood, S. (1987). *The Sea World Book of Dolphins*, 1st edition. Harcourt Children's Books.

Schwart, M. (2006). *Encyclopedia of Coastal Science*. Springer Science and Business Media.

Stacey, P.J. and Leatherwood, S. (1997). 'The Irrawaddy dolphin *Orcaella brevirostris*:a summary of current knowledge and recommendations for conservation action'. *Asian Marine Biology*, 14:195−214.

Tas'an, A. and Leatherwood, S. (1984). 'Cetaceans live-captured for Jaya Ancol Oceanarium, Djakarta, 1974−1982'. *Report of the International Whaling Commission* 34:485−489.

Tas'an, A., Irwandry, A., Sumitro, D. and Hendrokusumo, S. (1980). '*Orcaella brevirostris* (Gray, 1866) from Mahakam River'. Report to Jaya Ancol Oceanarium, Jakarta.

Wirawan, N. (1989). 'Protecting the Pesut (freshwater dolphin) in the Mahakam River of Kalimantan, Borneo'. WWF Report WWF/IUCN Natural Resources Project 1687.

The Irrawaddy dolphin, *Orcaella brevirostris* (Owen in Gray 1866) subpopulation in Iloilo-Guimaras Straits, Philippines

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The Irrawaddy dolphin, *Orcaella brevirostris* (Owen in Gray 1866), is one of the least known and most vulnerable cetaceans. With the exception of the population in the coastal waters of Bangladesh which is estimated to consist of over 5,000 animals (Smith et al., 2008), Irrawaddy dolphin populations are small, distributed in small patches in rivers, coastal waters, estuaries, protected bays and lagoons throughout the Indo-Pacific region (Fig. 1) (Minton et al., 2017, Smith 2018). In 2017 the International Union for the Conservation of Nature (IUCN) raised the conservation status of the Irrawaddy dolphin, *Orcaella brevirostris* from "Threatened" to "Endangered". Five populations have been declared "Critically Endangered": the Malampaya Sound population in Palawan (Smith & Beasley, 2004a), Mekong River population (Beasley et al., 2007), Mahakam River population in Indonesia (Kreb et al., 2007), Ayeyarwaddy River in Myanmar (Smith et al., 2007) and the Songkhla Lake in Thailand (Smith & Beasley, 2004b; Minton et al., 2017).

The Philippines has two known subpopulations, the Malampaya Sound subpopulation, declared Critically Endangered in 2004, and the Iloilo-Guimaras Straits subpopulation (also referred to as the Visayan subpopulation because it is found the region of Visayas) only discovered in 2007(Fig 2). A possible third subpopulation was discovered in Quezon, Palawan, 230 km south of the Malampaya Sound in 2012.

The population assessment conducted for the Iloilo-Guimaras subpopulation using the mark-recapture method and the program MARK yielded population size estimates of 23 dolphins (CV = 23.6, 95% CI = 15-36) during the 2010–2012 study, 21 dolphins (CV = 25.5%, 95% CI = 10-31) in the 2013–2014 study and only 13 dolphins (CV = 20.9%, 95% CI = 9-19 dolphins), in the 2015–2016 study. This population is smaller than the Malampaya Sound's where the 2004 estimate was 77 dolphins, (CV = 27.4%) (Smith et al., 2004) and the 2015 estimate was 35 dolphins (CV = 22.9%) (Whitty, 2016).

Historical distribution reconstructed from interviews suggests a much wider distribution than at present. Destructive fishing practices, habitat destruction, boat traffic and pollution that contributed to the decline of the population continue to the present day. Conservation measures are being undertaken to help mitigate these threats. Conservation education and outreach as well as training on rescuing stranded dolphins have been carried out. Cooperation of local government units has been sought and to date, a protected area has been established totalling to 130 km^2. Although this does not cover the entire core habitat, it is considered as a step by the local government toward recognizing the importance of protecting this population of Irrawaddy dolphin. Recently, the proposal to make this locality an Important Marine Mammal Area (IMMA) under the IUCN Marine Mammal Protected Areas has been accepted by the IUCN MMPA Task Force. An IUCN Red List Assessment was conducted for this subpopulation in 2015 putting it under Critically Endangered status. An updated draft including more recent studies was submitted in July 2018 and is under review.

Feasibility of an *ex situ* conservation approach

Currently, there is not enough information about the best way to capture, transport, care and breed Irrawaddy dolphins in captivity, thus it may not be the time to prioritize *ex situ* approach for

the Iloilo-Guimaras subpopulation (Smith, this worksop). Because of that gap in knowledge and because of the very small population size, there is a risk that attempts to capture individuals could wipe out the entire population. Efforts on the local level to mitigate some of the pressures that contribute to the decline of this population should be supported.

However, knowing that many of the Irrawady dolphin subpopulations are small and many of them are found in countries where conservation is often not the first priority or not a priority at all, there is a need to prepare for the time when *Ex situ* approach is the only option left to save the species or a subpopulation. In our experience with the Malampaya Sound and the Iloilo-Guimaras Straits subpopulations, population size can decline quickly. (For example the subpopulation in Malampaya Sound declined by half, from 77 to 35 in less than 15 years, and the Ilo-ilo Guimaras subpopulation from 21 to 13 in less than five years).

If we are to start including *ex situ* approaches as one of our conservation options, basic foundations to support that need should start as soon as possible. First step that will have the least impact on any of the sub-populations will be to obtain information from the experiences of oceanaria that have or had Irrawaddy dolphins in captivity (e.g. Oasis Seaworld in Thailand, Safari World, Pattaya Dolphin World, Jaya Ancol). Working closely with these groups will be important, and these facilities can serve as a training ground for interested interns in Irrawaddy dolphin husbandry and care. Also important is identifying facilities / individuals to train in proper capture of dolphins, *e.g* encourage internships of interested and competent individuals from the region, in programs like what they have in Sarasota Bay. Skills obtained from this experience will not only prepare for future capture plans but can also be used in *in situ* conservation, e.g. helping rescue dolphins when they strand or get tangled in fishing nets.

Strengthening *in situ* conservation efforts

While *ex situ* procedures are being developed, local conservation efforts should be enhanced, and studies on the behaviour and ecology of Irrawaddy dolphins should be encouraged. Exchanges, visits or internships between institutions that have Irrawaddy dolphin conservation programs will be a good learning experience and at the same time will highlight the need to conserve habitats. Exchange can include not only scientists and students but also important/key local political figures that can have meaningful conservation impacts.

Literature cited

Beasley, I., Phay S, Gilbert, M., Phothitay, C., Yim, S., Lor, K.S. and Kim, S. (2007). 'Review of the status and conservation of Irrawaddy dolphins *Orcaella brevirostris* in the Mekong River of Cambodia, Lao PDR and Vietnam'. In: Smith, .D, Shore, R.G. and Lopez, A. (eds.) *Status and conservation of freshwater populations of Irrawaddy dolphins*, pp.67-82. Wildlife Conservation Society, Bronx, NY.

Kreb, D., Budiono, Syachraini (2007). 'Status and Conservation of Irrawaddy dolphins, *Orcaella brevirostris* in the Mahakam River of Indonesia'. In: Smith, B.D., Shore, R.G. and Lopez, A. (eds.) *Status and conservation of freshwater populations of Irrawaddy dolphins*, pp.53-66. Wildlife Conservation Society, Bronx, NY.

Minton, G., Smith, B.D., Braulik, G.T., Kreb, D., Sutaria, D. and Reeves, R.R. (2017). *Orcaella brevirostris*. The IUCN Red List of Threatened Species 2017. http://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T15419A50367860.en

Smith, B.D. (2018). 'Irrawaddy dolphin, *Orcaella brevirostris*'. In: Würsig, B., Thewissen, J.G.M. and Kovacs, K.M. (eds.) *Encyclopedia of Marine Mammals*, Third Edition, pp.525-529. Academic Press, Elsevier, San Diego. https://doi.org/10.1016/B978-0-12-804327-1.00161-8

Smith, B.D., Mya, T.T. and Tint, T. (2007). 'Review of the status and conservation of Irrawaddy dolphins *Orcaella brevirostris* in the Ayeyarwady River of Myanmar'. In: Smith, B.D, Shore, R.G. and Lopez, A. (eds.) *Status and conservation of freshwater populations of Irrawaddy dolphins*, pp.21-39. Wildlife Conservation Society, Bronx, NY.

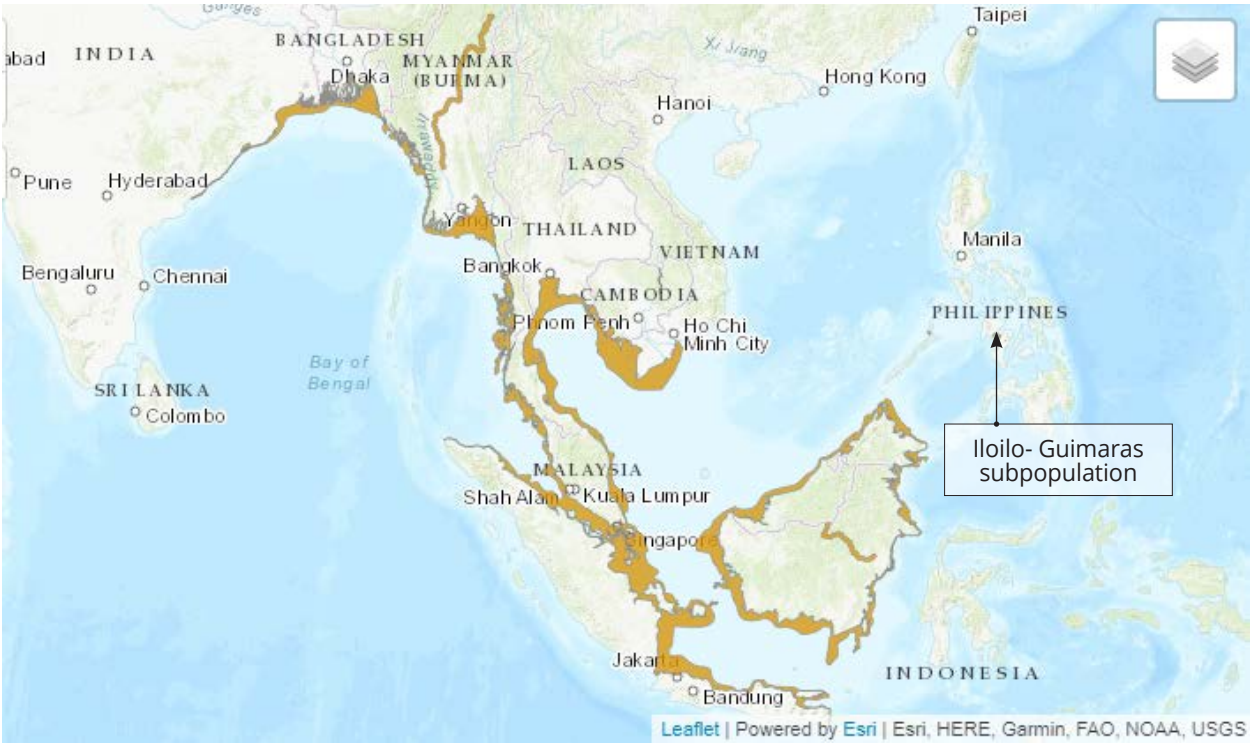
Smith, B.D., Ahmed, B., Mowgli, R.M. and Strindberg, S. (2008). 'Species occurrence and distributional ecology of nearshore cetaceans in the Bay of Bengal, Bangladesh with abundance estimates for Irrawaddy dolphins, *Orcaella brevirostris* and finless porpoises, *Neophocaena phocaenoides*'. *Journal of Cetacean Research and Management*, 10:45-58.

Smith, B.D. and Beasley, I. (2004). *Orcaella brevirostris (Malampaya Sound subpopulation)*. The IUCN Red List of Threatened Species 2004. http://dx.doi.org/10.2305/IUCN.UK.2004.RLTS.T44187A10858619.en

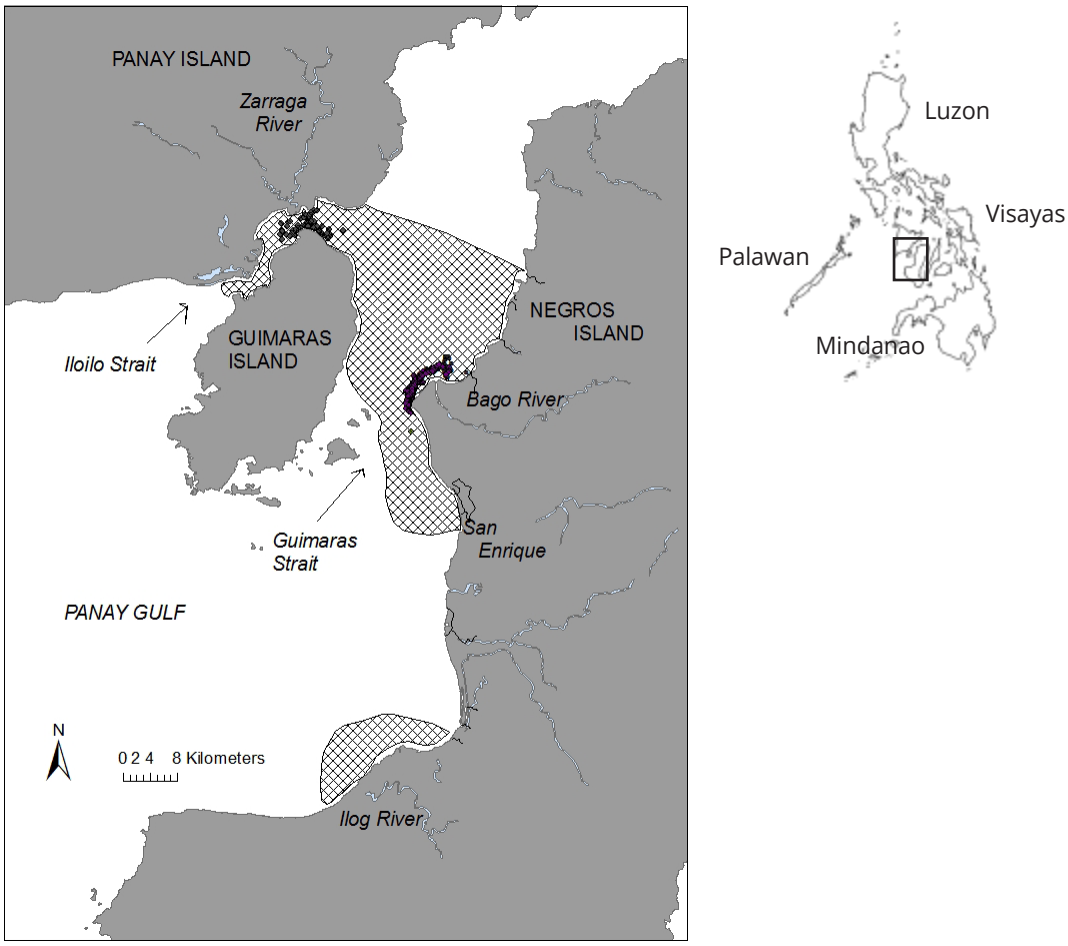
Smith, B.D. and Beasley, I. (2004b). '*Orcaella brevirostris* (Songkhla Lake subpopulation)'. IUCN 2012. *IUCN Red List of Threatened Species*. Version 2012.1. <www.iucnredlist.org> (accessed 20 Jan 2018).

Smith, B.D., Beasley, I., Buccat, M., Calderon, V., Evina, R., de Valle, L.J., Cadigal, A., Tura, E. and Visitacion, Z. (2004). 'Status, ecology and conservation of Irrawaddy dolphins (*Orcaella brevirostris*) in Malampaya Sound, Palawan, Philippines'. *Journal of Cetacean Research and Management* 6:41-52.

Whitty, T.S. (2016). 'Multi-methods approach to characterizing the magnitude, impact, and spatial risk of Irrawaddy dolphin *(Orcaella brevirostris*) bycatch in small-scale fisheries in Malampaya Sound, Philippines'. *Marine Mammal Science* 32:1022—1043. https://doi.org/10.1111/mms.12322



Distributional range of *Orcaella brevirostris* (from IUCN website (https://www.iucnredlist.org/species/15419/123790805).



Irrawaddy dolphin sightings are represented by black dots. Historical distribution (hatched areas) of Irrawaddy dolphin in Iloilo and Guimaras Straits as reconstructed from interviews.

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