Report of the Trinational workshop on the Irrawaddy Dolphin

1st to 4th December 2020

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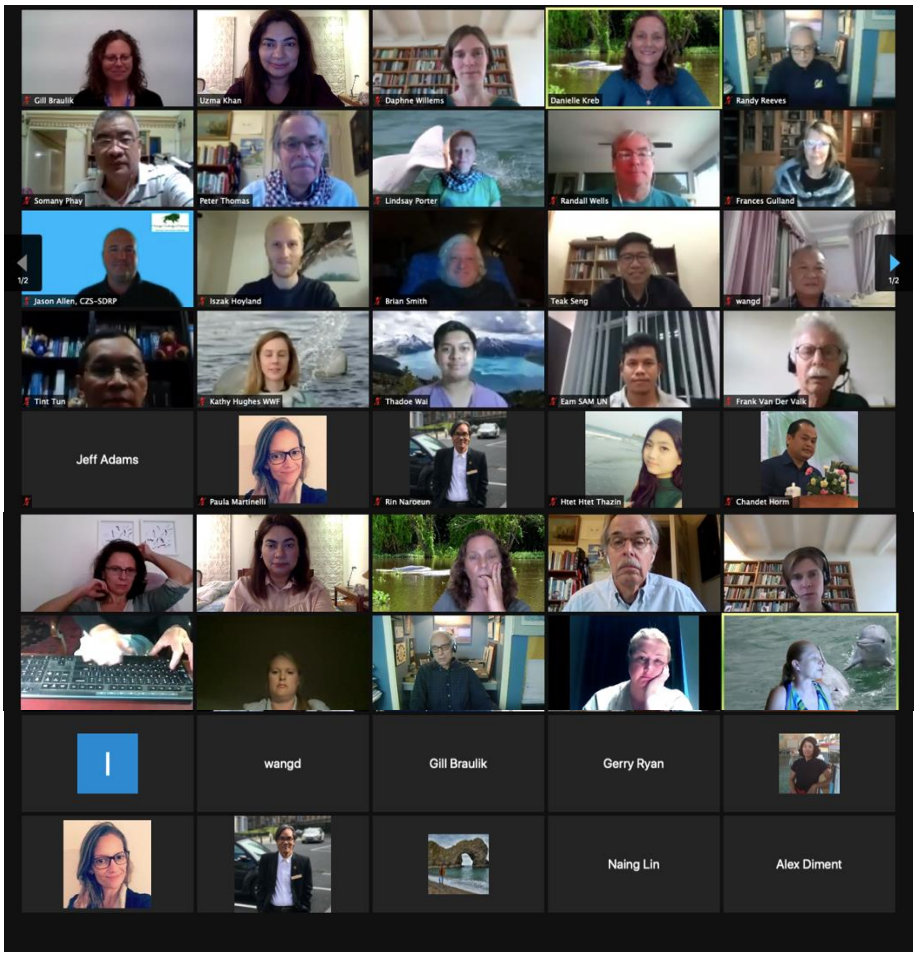

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Table of Contents

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1. Introduction

There are three freshwater populations of Irrawaddy dolphins (*Orcaella brevirostris*) in Southeast Asia, occupying the Mekong River in Cambodia and southern Lao People's Democratic Republic (PDR), the Mahakam River in Indonesia and the Ayeyarwady River in Myanmar. These subpopulations are listed in the IUCN Red List as 'Critically Endangered' subpopulations and each currently consists of fewer than 100 individuals. They are therefore high priorities for conservation action. The population in Laos is already functionally extinct with only three individuals remaining in waters spanning the Cambodia-Laos. The Irrawaddy dolphin is legally protected in all these countries.

In Cambodia the Irrawaddy dolphin is one of the 58 Endangered Fisheries Species listed in the Royal Government's sub-decree on 'the Types of Fisheries and Endangered Fisheries Product'. In the first two decades of the 21st century, regular, systematic survey have been conducted in the Mekong which has generated a series of abundance estimates, all below 150 individuals. These point estimates show a decline from 127 in 2005 to 93 in 2007, 85 in 2010 and 80 in 2015. Documented adult mortality was caused primarily by entanglement in gillnets, but it was generally agreed that the cause(s) of the recorded high calf mortality needed further required additional, pathological investigation. The Government of Cambodia created the "Commission for Conservation and Development of Mekong River Dolphin Eco-Tourism Zone(DC)[1]" in 2006 to help the Fisheries Administration (FiA) stop the ongoing decline of Mekong dolphins. Under the landmark 2012 "*Kratie Declaration on the Conservation of the Mekong River Irrawaddy Dolphin*" the DC, FiA, and WWF-Cambodia agreed to implement a joint strategy for Mekong dolphin management and conservation. The Declaration specifies management and research recommendations that have been updated and used as the basis for conservation efforts. There was an apparent increase in the Mekong dolphin population from 80 individuals in 2015 to 92 in 2017, which would represent the first such increase in the past 24 years. A survey in 2020 indicated that there were still around 90 individuals in the population.

In 2009 the Management Plan for the Ayeyarwady Dolphin Protected Area was prepared by the Myanmar Department of Fisheries in collaboration with the Wildlife Conservation Society (WCS). The dolphin population in the Ayeyarwady River consists of about 75-80 individuals, inhabiting a stretch of about 400 river kilometres. Two areas are legally protected for Irrawaddy dolphins in the Ayeyarwady, one spanning 74 river kilometres at

[1] The Commission for Conservation and Development of Mekong River Dolphin Eco-Tourism Zone that was under the management authority of the Council of the Ministers, was dissolved and transferred to the Ministry (MAFF). MAFF created a Commission under its Proclamation in 2019.

the far downstream portion of the population's range and the other spanning 119 river kilometers in the middle portion of its range.

Scientific research and conservation work in Indonesia are led by Yayasan Konservasi Rasi, a national NGO which has been working in the area for almost two decades on population assessment, threat reduction, and community engagement. A Indonesia a management plan focused on threat reduction and community engagement developed by Yayasan Konservasi RASI (a national NGO that has been working in the area for almost two decades; RASI) is currently going undergoing through an approval process. A Mahakam Protection Area, covering an area of 43,117 ha, was established in 2020. In 2019 the Mahakam dolphin population was estimated to consist of 79-81 individuals (based on respectively mark-recapture analyses and total identified individuals based on 4 surveys with 3-months interval), with an average birth rate of 5-6 newborns per year (2018-2019)and a documented average mortality rate (1995 – 2020) of average 4 dolphins/year (source: RASI).

The population is restricted to a river stretch of 420 km. Scientific research and conservation work involving awareness raising in local communities and schools is led by RASI. Yayasan Rasi also launched a sustainable aquaculture projects to help fishermen who agree to stop illegal fishing activities including electrofishing, as well as there being a monitoring programme to control illegal fishing activities. RASI is monitoring the population, piloting pingers, established, a photo-identification database and is supporting the government in management plan development.

Gillnet mortality continues to be regarded as the most acute threat to all three freshwater Irrawaddy dolphin populations. Besides addressing this threat, there is a critical need to conserve the dolphins' habitat and maintain the free-flowing character of these river sections if the survival of the three populations is to be assured. The primary **goal of this workshop,** which follows up on the trinational focus of the 2017 workshop in Kratie, Cambodia, was to enhance and maintain collaborations between the three range countries, to share knowledge, know-how and experience, and to thereby support and strengthen existing conservation work and guide future efforts.

Objectives:

Country-specific:

- Cambodia: Assess implementation of recommendations of the 2017 workshop, update recommendations and the national species action plan, and prioritize actions for the future.
- Myanmar: Define conservation priorities.
- Indonesia: Re-evaluate identified threats (from the palm oil, rubber and coal industries as well as fishing) and consider ways to eliminate or reduce those threats.

Trinational (all three Irrawaddy river dolphin countries):

- Build collaborations, learn from one another's strengths and scale-up conservation and fundraising efforts. Build upon existing knowledge and experience (e.g. research methods, analytical approaches, Finbase, alternative livelihoods, river guards, pingers).

Regional/Global:

- Identify strategies for gaining and increasing governmental support, e.g. via International Whaling Commission Scientific and Conservation Committees and the Conservation Management Plan programme, WWF freshwater cetacean strategy, a regional or global intergovernmental declaration.

2. Summary of Country Presentations

2.1 Mekong dolphin population, Cambodia (Somany Phay)

Irrawaddy dolphins were historically distributed throughout a large section of the Mekong River system, stretching from the south where the Mekong meets the South China Sea in Vietnam to Tonlé Sap (Great Lake) in the northwest and upstream to just past the Laos-Cambodia border at Khone Falls. At present the dolphins inhabit only a 180-kilometer section of the river in the northeast of Cambodia including a very small section in Laos below Khone Falls. Within the current distribution there are nine deep pools which constitute the dolphins' primary habitat.

The Irrawaddy dolphin in Cambodia is a protected species and its conservation in the Mekong is guided by the Cambodian Mekong Dolphin Conservation Strategy, produced by the Cambodian Ministry of Agriculture Forestry and Fisheries. This conservation strategy was created after scientific studies of dolphin abundance monitoring, habitat protection and law enforcement initiatives and it is updated regularly – most recently in 2017.

Law enforcement is critical to the conservation strategy and primarily carried out by the River Guard program. There are currently 72 river guards comprising fisheries officers, police officers, and local community members. The river guards operate out of 16 posts along the Mekong. The highest priority of the River Guard program is to confiscate illegal gillnets. The river guards removed an average of more than 102,000 meters of gillnet annually from 2015 to 2019. They had removed close to 69,000 meters to date in 2020 (January to October) at the time of the workshop, which was already an increase over the 2019 total of 67,000 meters. The increase in confiscations from 2019 to 2020 was likely related to the economic hardship from the current coronavirus pandemic, which led to increased illegal fishing as an alternative income source. In addition to gillnets, the river guards confiscate long-lines with multiple hooks, and the number of long-lines removed has significantly increased since 2016 (4,485 in 2016, 14,775 in 2017, 38,650 in 2018,

48,682 in 2019, also see slide no 9 of the Mekong presentation available in Annex 4). The river guards also arrest people caught electrofishing. A total of 44 people have been arrested for electrofishing since 2015, of which 39 were sent to court. Essential equipment for the river guards such as boats, boat engines, and walkie-talkies have been provided with support from multiple donors including the Cambodian government, WWF and Tiergarten Nürnberg/Yaqu Pacha.

Dolphin abundance is estimated by visual surveys. Individual dolphins can be identified and tracked based on the unique characteristics of their dorsal fin. The population declined from 200 dolphins estimated in 1997 to 93 dolphins estimated in 2007. Since 2007, the population appears to have stabilized, and the most recent estimate in 2020 was 89 individuals (95% confidence interval = 78-102 individuals). While modeling of abundance from 2020 surveys provided a point estimate within 3 dolphins of the 2017 abundance estimate, given the large confidence interval and the fact that 25 identifiable dolphins have disappeared since the 2017 survey, it is difficult to define a trend at this time.

One concern is the age structure of the population with 73% of the dolphins thought to be more than 20 years old. The estimated lifespan of Irrawaddy dolphins is estimated to be 27 to 30 years (Stacey & Leatherwood, 1997) therefore with the high mortality of calves and juveniles the population seems to be aging which remains a challenge. The numbers of dead dolphins as well as the probable causes of death are recorded to gain insights into current threats. A regular necropsy program to analyze the cause of death has been in place several decades and this program has confirmed the risk to adults and juveniles of fishing gear entanglement. However, the high unexplained mortality of calves is an ongoing cause of serious concern, although it is lower compared to 2007 and before, but majority of the dead dolphins still include calves (see Mekong presentation slide 18 in Annex 4).

The WWF program and its partners have also focused on community outreach to raise awareness about dolphins and educate the community on issues related to dolphin conservation. Village meetings, school visits, and cooperation with monks has helped spread valuable information about dolphins. The WWF program operates on the assumption that by supporting people with alternative food sources, such as aquaculture, vegetable gardens, and chicken rearing, the stress on dolphins and the river ecosystem from unsustainable fishing can be reduced.

Conservation of the Mekong ecosystem, including the dolphin population, is a transboundary problem and therefore collaboration with Laos would be desirable, particularly when it comes to protecting the few dolphins residing in the Laos/Cambodia transboundary pool had once numbered 22 (Ryan, 2012) and declined to 7 or 8 (Ryan et al 2011) but now number only three. Such collaboration with Laos is important not only for the dolphin population but also for the overall health of the river system. The construction of dams in Laos, such as the Don Sahong Dam located about 1.5 kilometers from the border , has had significant impacts on the river downstream in Cambodia.

2.2 Ayeyarwady population, Myanmar

Two groups work on multiple aspects of dolphin conservation and education on Myanmar.

2.2.1 Ayeyarwady population, Myanmar (Naing Lin, WCS Myanmar)

The Ayeyarwady River is an iconic free-flowing river in Myanmar. The river has high biodiversity and is vital to local communities. There are an estimated 79 Irrawaddy dolphins divided among three braided river sections separated by narrow defiles. As estimated in 2020, the Bhamo (upstream) river section (36 km) supports an estimated 14 individuals that do not occur within a protected area. The Mhale/Shwe Ku (central) section (119 km long), which was declared as a protected area in 2018, supports an estimated 37 individuals. The Mingun/Kyauk Myaung (downstream) section (72 km long), which was declared as a protected area in 2005, supports an estimated 28 individuals. Direct count abundance surveys, which have been conducted annually since 2011, indicate a relatively stable aggregate population over this period. Dolphin mortality has been monitored since 2009. Eight deaths were recorded in 2020, which is the highest single-year number on record. It is thought that the apparent increase in mortality in 2020 is a result of increased fishing due to the economic challenges related to the Covid-19 pandemic.

Unique to the Irrawaddy dolphins of Myanmar is a human-dolphin cooperative fishery. Cooperative fishing is a mutualistic relationship between Irrawaddy dolphins and cast-net fishermen. The dolphins herd fish into the fishing nets, increasing the fishermen's catch, while the dolphins benefit by catching fish escaping the net.

The main threats to Irrawaddy dolphins are bycatch in gillnets, pollution from gold mining, and electrofishing. According to annual surveys, gold mining no longer occurs inside of protected areas. However, it still occurs outside of protected areas. Gillnets over 100 m long are prohibited. Electrofishing, which occurs more frequently here than in the Mekong and Mahakam, is illegal because it may kill dolphins and reduce the abundance of their prey (Thomas et al. 2019).

Since 2005 the Myanmar Department of Fisheries and the Wildlife Conservation Society have worked in partnership to conserve dolphins. Their conservation activities include supporting enforcement and monitoring patrols, community engagement/awareness and population surveys. An update to the 2009 Management Plan for the Ayeyarwady Dolphin Protected Area is in progress but delayed due to the Covid-19 pandemic. Community-based nature-oriented tourism has grown steadily since 2014. However, the pandemic has set back international tourism and the short-term focus has been on local domestic tourism.

2.2.2 Ayeyarwady population, Myanmar (Htet Htet, WWF Myanmar)

The mortality rate of Irrawaddy dolphins increased significantly in 2020. The Ayeyarwady River is heavily used for its ecosystem services. Illegal and unsustainable fishing, a lack of fisheries management, and limited capacity to enforce regulations are major issues. Other issues include risk of injury and mortality due to boat traffic, and habitat degradation and loss due to dredging, resource extraction, and pollution.

There is considerable support in Myanmar on social media, primarily Facebook, for the conservation of Irrawaddy dolphins. The 'Save Irrawaddy Dolphins' online campaign by the Nature Advocacy Group has over 17,000 followers. The goal of this campaign is to urge the Myanmar government to apply to UNESCO to declare the dolphin habitat a World Natural Heritage Site. Save Irrawaddy Dolphin week (November 22-28) was organized by the Nature Advocacy Group and other NGOs to raise awareness and provide education about Irrawaddy dolphin conservation.

The presentation also referred to the recent publication by WWF Myanmar about free-flowing rivers and their importance for biodiversity and economies (Mapping Myanmar's Free flowing rivers – Assessment of current and future impacts of dam-infrastructure development on river connectivity. All three large rivers in Myanmar – the Irrawaddy, its tributary, the Chindwin, and the Salween – are categorised as free-flowing rivers and total about 4,500 km in length.

2.3 Mahakam population, Indonesia (Danielle Kreb, RASI, Indonesia)

Similar to the other two riverine populations, Irrawaddy dolphins in the Mahakam River, Kalimantan, Indonesia is Critically Endangered (IUCN Red List). The population is protected by Indonesian law. The Mahakam River is 980 kilometers long and has five tributaries and three large lakes. The Irrawaddy dolphin population inhabiting the Mahakam is estimated to have become isolated from other populations for ~ 500,000 years and the population has two unique genetic haplotypes compared to samples from other freshwater populations or in Indonesia from coastal populations (Budi, 2018). The population's range has decreased significantly from its historical distribution. Until 2010 two 'core' areas were used by the dolphins. Since then, the western core area became degraded due to nearby palm oil agriculture and its impacts on fish spawning habitat and consequently depleted the fish stocks themselves. The levels of heavy metal pollution in the river are considered very high. Other major threats are from gillnet fishing and electrofishing. Coal mines operate close to the river, causing pollution from runoff, and necessitate large ships to travel through this one critical habitat, resulting in channelization, noise and strike risk.

Population abundance was monitored during 1997-2002 using transect methods; since 2005 photo-identification methods have been used. The most recent population estimate is 81 individuals (2019 survey), a slight decrease from 88 individuals in 2005. Birth rate has been monitored since 2017 and an average of five or six new calves have been documented annually. The documented mortality rate averages four individuals annually, 75% of which are classified as adults. Gillnet entanglement is the greatest cause of dolphin mortality, comprising 66% of deaths with a known cause. Vessel strikes are the next greatest cause at 9%. A recent decrease in mortality is largely attributed to awareness efforts with fishermen and community members, experience at disentangling dolphins from nets, and rescuing stranded dolphins from swamps. Since 2002, 7 individuals have been rescued from swamps while 10 dolphins have been safely released by fishermen from gillnets.

There are currently ten river guards forming five local patrol teams that work to prevent illegal fishing and promote dolphin conservation. The river guards focus on illegal activities (poisoning and electrofishing) as well as monitoring dolphins. As gillnets are not illegal in the Mahakam River, this gear cannot be confiscated, however, the guards have reported nets that were placed in a dangerous way (not parallel to shore but across the river) and based on these reports RASI has approached the village chiefs and requested that these nets be removed at three locations. The River Guards programme is expected to become more effective in reducing gillnet mortality in the future when they can enforce new regulations for a PA that will be proposed during a district representatives meeting in 2021.

One of the national action plan measures related to gillnets besides the enactment and enforcement under Protected Area plan include: Making an inventory of all gillnet fishermen inside the PA and reducing gillnet related entanglements. This inventory is expected to be useful in efforts to provide these impoverished fishermen with alternative, non-entangling gear or assisting them in engaging in sustainable aquaculture. RASI has done a study where it seems that gillnet fishermen target certain fish species using large-mesh size nets, other gear (bubu and rawai) seems to be more profitable (higher yields). However, the small fish is often targeted by small-mesh size nets are commercially not so attractive but these fish are then bought very cheap and often for these fishermen it is only used to supplement their income as they also grow crops. The gillnets were also often distributed by the fisheries agency as part of national fisheries gear aid but we have already lobbied to stop this particular gear aid.

Clearly, however, the first step will be to identify viable alternatives and ensure their availability and reduce gillnet-related entanglements. This will include reducing the number of gillnets. Gradually, a RASI will lobby for stricter laws to district representatives, including a ban on gillnets in the PA. Meanwhile, regulations for the next years will be proposed including a strict enforcement of the current legal 2-4cm mesh size gillnets with breakable nylon threads (not from stronger materials), and max length of 20 m and set no deeper than 2m. Also, with these regulations may come along a program in which the large mesh size gillnets may be returned for alternative gear (fish trap, long line) that do not by-catch dolphins but are equally or even more profitable. The small gillnets from fishermen who indicated that dolphins often destroy their nests and/ or 'steal' fish from their nets maybe equipped with pingers provided the trials are successful.

RASI is now working at the village level to obtain community agreements and map conservation zones within buffer habitat of the existing PA that combined form essential habitat for Pesut Mahakam. At the government level, an indicative map of Pesut Mahakam Essential Ecosystem Habitat including at total area 221,299 ha in size has just been signed by the governor. The indicative map of pesut habitat that also includes peat swamp habitat is one of 14 maps of proposed essential ecosystems identified within East Kalimantan including habitats for the following: orangutan, proboscis monkey, freshwater crocodile, limestone, peat swamp, mangrove lowland forest. The decree of this indicative map will make it more difficult for the authorities to issue permits for new or expansion of

concession areas. To make (part) of the indicative map functional a multiple stakeholder forum may be built and community conservation zones assigned.

The Mahakam dolphins are treasured by the community and there is strong motivation for their conservation. Education programmes at schools have helped raise awareness of the dolphins and the threats they face. There are efforts to promote aquaculture and other alternatives to fishing. Rescue trainings are intended to increase the safe release of entangled dolphins and to reduce chances of mortality.

RASI has conducted pinger trials on the Mahakam, and has found that they may be an effective tool for keeping dolphins away from potentially entangling fishing gear. The pinger study shows that when the pinger is on, dolphins occur more frequently in zones with an estimated radius of 10-20m from the pinger than in zones of 0-10m. Conversely, when the pinger is off, dolphins surface more in the estimated 0-10m zone than in the 10-20m zone. Observations of behavior indicate that dolphins never appear to forage in the 0-10m zone when the pinger is on even though they do forage in the 0-10m zone when the pinger is off. Foraging activity continues at distances of 20m or further more when the pinger is on. Activities in the 0-10m range when the pinger was on predominantly involved fast travel and to a much lesser extent slow travel and play.

So even though dolphins may still occur within 0-10 m of the pinger, their frequency of occurrence was significantly less and no feeding behaviour was observed or acoustically detected (further acoustic research is needed as it was only done during two days).

Distance estimation between pingers and surfacing dolphins was calculated by placing the pinger under a buoy that represented point 0 and then placing buoys at 0-10m; 10-20m; 20-40m; 40-60m; 60-80m and 80-100m on both sides of the zero buoys. We used distance ranges to provide more reliable estimates than would have been possible using the laser range finder to mark each individual dolphin's position as we would not have been able to keep track of all the surfacing dolphins at once. Using distance ranges greatly facilitated the fast estimation of a dolphin's surfacing distance from the pinger. The observers counted the number of surfacings and individual behaviours within each range. We only compared the distance ranges that were of most interest (0-10m and 10-20m) to see if there were differences.

2.4 Discussions

Numerous comments were made following the presentations and these are summarized here.

2.4.1 Mekong

In 2020, 4 of the 8 recorded newborn calves died, without a known cause of mortality. High calf morality is an ongoing concern for this population and has not been reduced, as adult mortality appears to have been, by the enforcement of a gill net ban. Thanks to the efforts

of the international necropsy team, tissue samples have been investigated for brucella (a possible cause of cetacean mortality) but those samples were negative for brucella. While these findings are important, the samples came from a few rather decomposed animals, so continued sampling and analysis is recommended to provide more conclusive evidence regarding brucella. Behaviour related to observed calf mortality still needs to be investigated more closely.

There is some concern about the small number of newly marked individuals being added to the photo-identification catalogue, indicating that this is an older population, with few new recruits from lower age classes. The dolphin identifications in the catalogue show that 73% of all individually identified dolphins are more than 20 years old. The other 27% are newly added individuals. The older dolphins will expire and if calves and juveniles do not survive to adulthood, then this will create a major challenge for the Mekong sub-population.

Additionally, it was noted in 2020 that the dolphins are not using all the nine deep pools that they once frequented. While it is not known why the dolphins appear to have abandoned six of the deep pools, the WWF field team suggested that at least some of them dolphins relocated to other already-inhabited deep pools.

2.4.2 Ayeyarwady

Dolphin distribution in the Ayeyarwady is now known to extend downstream of Mandalay with recent sightings near Ywathit village in Pokokku township at the confluence of the Ayeyarwady and Chindwin rivers. In April 2015, dolphins were also sighted farther downstream near Pyay.

No movement has been recorded between sections of the Ayeyarwady where dolphins occur, possibly because of the fast-flowing water in the narrow defiles that separate the braided channels where the dolphins are found. This inference, however, is not based on individual tracking or photo-identification. Some demographic interaction may occur between different river sections but it is likely rare.

The direct-count survey method used in Myanmar are from the direct counts method published by Smith and Reeves (2000). It was opined that as the Ayeyarwady has more of a sandy riverbed, the dolphins may not scar as much as other populations and therefore may not be suitable for photo ID studies. It was noted, on review of the material presented by Myanmar, that several of the Myanmar dolphin images shown did exhibit identifying features that are suitable for photo-identification studies, so this may be a possible research tool that can be used in the future. It was suggested that future surveys should integrate passive acoustics (Wang et al 2020) with visual counts (Richmon et al 2014)

A pattern of increased mortality similar to that recorded in Cambodia was seen in Myanmar in 2020. This has been attributed to restrictions put in place during the current

Covid-19 pandemic which resulted in fewer patrols by law enforcement and, moreover, there was an increase in fishing activities due to the loss of other livelihoods.

2.4.3 Mahakam

The range decline mentioned above for the Mahakam seems greater than could be explained by the decline in abundance (88 in 2005 to 81 in 2019). It was suggested that there could be a possibility that the remaining core area is more densely populated than before and could be reaching carrying capacity.

The Rainforest Trust supports 10 community river guards in the Mahakam who conduct patrols three times per week. Considering that these guards do not have the power to enforce any laws, the patrols can only record the use/occurrence of electrofishing and other illegal activities. There is little information on the impact of electrofishing on the dolphins, but one calf has certainly been killed by this type of fishing.

The age profile of dolphins in the Mahakam is not known. Calf mortality is not thought to be high in the Mahakam and most specimens encountered are thought to have been from some time ago. It would be beneficial to better understand the age demographics within the Makaham dolphin population.

2.4.4 Cross-cutting issues

Different causes of mortality have been investigated in the Mekong subpopulation, including various histopathological examinations, heavy metal content, e.g., mercury, Persistent Organic Pollutants (POPs) prevalence, Brucella presence, and genetic diversity mapping. Therefore, it is important to explore social structures and aggressive behaviour towards calves to better understand calf mortality better and the reasons why dolphins seem to be moving away from their historical range.

Vessel strikes are known to have killed Mahakam dolphins. This source of mortality was not mentioned in regard to the other two populations.

Kreb and her colleagues in Kalimantan have experience in rescuing and transporting Mahakam dolphins. It was suggested that the opportunity to learn from her and her team how the dolphins respond to handling and transport could prove useful for those working with dolphins in the Mekong and Ayeyarwady.

Range decline is a serious issue and a potential sign of lessening resilience of the Mahakam and Mekong dolphin populations.

There are differences among the three countries in the nature of dolphin-centered tourism – land-based short trips in the Mekong, long day and multi-day cruises in the Ayeyarwady, and comparatively limited tourism in the Mahakam. It would be worth exploring how these

activities do or do not contribute to the livelihoods and incomes of local communities but the time was insufficient for pursuing this at the workshop.

3. Summary of Progress on the 2017 International Expert Workshop Recommendations for the Mekong population

The Kratie Declaration on "The Conservation of the Mekong River Irrawaddy Dolphins" was developed in 2012 through collaboration among the Cambodian Fisheries Administration of the Ministry of Agriculture, Forestry and Fisheries, World Wide Fund for Nature (WWF), the former Commission for Conservation and Development of Mekong River Dolphin Eco-Tourism Zone, and international experts. The Kratie Declaration outlined 25 management and research recommendations. In 2017, the recommendations were reviewed, updated, and expanded. This is a summary of the progress made on the recommendations, as of October 2020.

Fisheries and Law Enforcement

1. Faster and safer vessels should be provided to the river guards and floating stations established during the dry season to decrease the response time of river guards to reports of illegal fishing activity.
Recommendation partially achieved. Eight fibreglass and seven larger boat engines with higher-speed capacity were purchased; however, floating stations could not be established.

2. Night patrols should be continued and potentially increased from the current number of seven per month per outpost.
Recommendation fully achieved. Night patrols occur seven times per month at all 16 outposts.

3. Feedback from SMART data collection should be provided to the river guards on a timely basis, ideally before the next patrol is conducted.
Recommendation fully achieved. Monthly SMART reports have been produced, analyzed, and distributed to river guards.

4. Stronger support from the courts to ensure that arrested illegal fishermen are successfully prosecuted.
Recommendation partially achieved. 14 illegal fishers were arrested and sent to provincial courts; however, there is a lack of communication and support from the courts. According to the law on fisheries, these 14 fishermen should have been detained in the jails in Kratie and Stung Treng from 3 to 5 years (Penalty No. 3); however, they were released after staying in the jails for a couple of months, due to lacking of evidence.

5. Patrolling effort in the dry season should be concentrated in core dolphin zones while in the wet season effort should be expanded according to the more wide-ranging movements of the dolphins.
Recommendation fully achieved.

6. Enforcement efforts conducted by the river guards should also concentrate on fish landing sites or depots.
Recommendation partially achieved. The river guards have authority to confiscate gillnets only in protected areas and cannot confiscate gillnets for sale in markets.

7. The river guards' salaries should be increased, and health and life insurance should be provided.
Recommendation partially achieved. Salaries have increased; however, health and life insurance have not been provided to all river guards.

8. There should be greater patrolling effort in the wet and dry seasons. Effort should be increased from 18 days per month to 20 or 25 days per month.
Recommendation partially achieved. In 2017 effort was increased to 22 days per month. Effort then decreased to ten days per month from July 2020 due to a funding shortage.

9. Signboards should be placed to demarcate the upstream and downstream ends of the dolphin core zones.
Recommendation partially achieved. A few signboards were placed at the first core zone only. There are plans to add more signboards in 2021.

10. Large patrol boats should be used in all channels during the wet season and in large channels during the dry season.
Recommendation fully achieved. Boats are used in all accessible channels in the wet and dry seasons.

11. Additional training for the river guards on fisheries laws and relevant legislation.
Recommendation fully achieved. River guards were trained on fishery laws, the code of conduct for human rights, and relevant legislation by WWF law enforcement staff.

12. Three additional river guard stations should be established (two in Kratie and one in Stung Treng).
Recommendation not achieved. There were insufficient funds to construct the three additional stations.

13. The number of river guards should be increased from 68 to 98.
Recommendation partially achieved. The number of river guards was increased from 68 to 72, not 98, due to limited funding.

14. In the wet season patrolling effort should be expanded to encompass the wider-ranging movement of dolphins.
Recommendation fully achieved. River guards closely monitor the movement of dolphins outside the core and buffer zones in the wet season.

15. River guards should be provided with necessary equipment.
Recommendation fully achieved. Necessary equipment was provided, including 12 walkies-talkies, 72 life jackets/year, 5 GPS, 72 hammocks/year, 72 raincoats/year, 16 tents/year, and one drone.

16. The current system of collecting SMART data on paper should be replaced by data collection on a hand-held device using Cyber Tracker software.
Recommendation partially achieved. The river guards continue to collect SMART data on paper due to limited internet in sections of the river; however, there are plans to use SMART-Connect in 2021.

17. Efforts should be made to monitor, bring greater accountability, and incentivize river guard performance based on evidence from the SMART database.
Recommendation fully achieved. Monthly SMART report has been used to monitor river guards' performance and to improve the monthly patrol.

18. Quarterly meetings should be convened to share information and plan joint fishery enforcement patrols with Community Fishery Committees.
Recommendation fully achieved. Communication with community fishery representatives about river guard patrolling activities occurs regularly.

19. Support should be provided to Community Fishery Committees.
Recommendation fully achieved. Fuel and other supplies are provided to Community Fishery Committees.

20. Workshops should be organized to build on the law enforcement capacity of river guards.
Recommendation fully achieved. Two workshops were organized as well as follow-up field trips.

Population dynamics, behavior, and ecology
1. Calves and the reproductive history of individual females should be monitored.
Recommendation partially achieved. The birth and survival/mortality of calves was monitored; however, the reproductive histories of individual females were not monitored due to limited capacity.

2. WWF and Isabel Beasley photo-identification catalogues should be integrated. The identity of stranded individuals should be incorporated into this database.
Recommendation partially achieved. WWF and Isabel Beasley photo-identification catalogues were not integrated but stranded dolphins were incorporated into the catalogues.

3. Three photo-identification surveys should be conducted per year for population data.

Recommendation fully achieved. Three photo-identification surveys are conducted every year.

4. There should be an exchange of knowledge between dolphin research projects in the Southeast Asia region.
Recommendation partially achieved. An exchange trip was conducted by Myanmar WWF team to the Mekong.

5. People present in the deep pools should be equipped to collect opportunistic identification or behavioral data for documentation.
Recommendation fully achieved. The river guards and tour operators at Kampi and Koh Pdao dolphin viewing sites were trained on collecting opportunistic identification and behavior data, and the occurrence of calves.

6. Analysis of dolphin reproductive histories should be conducted, including fecundity, age at first birth, age at last birth, and calving interval.
Recommendation not achieved. There is no progress on the analysis of reproductive histories.

7. Enhance behavioural observations and understanding of reports of potential infanticide.
Recommendation partially achieved. Multiple steps were taken to improve observations and knowledge of infanticide, including training at the Sarasota Dolphin Research Program. There has been no progress on reviewing existing data from previous studies.

8. Analysis of stomach contents and the establishment of an otolith catalogue to use for fish identification is recommended.
Recommendation partially achieved. The stomach contents of dolphin carcasses were checked, and prey species were identified. There is no progress on establishing an otolith catalogue.

Education and outreach
1. Existing data and analysis should be published in peer-reviewed journals.
Recommendation not achieved. Two assessment reports were produced but were not submitted to academic journals.

2. Public awareness should be increased through the use of media.
Recommendation fully achieved. Awareness of dolphin conservation was spread through radio and television media.

3. Giving individual dolphins popular names to raise public awareness should be explored.
Recommendation fully achieved. The third calf born in 2020 was named ‘Sao Minea’.

Necropsy Program
1. Continuation of the necropsy program to determine cause of death.

Recommendation fully achieved. Necropsies were conducted on 12 of 22 collected dolphins. The research team has a limited capacity to determine if cause of death was from gillnet entanglement.

2. Continuation of training of the Kratie-based WWF team so that it can carry out necropsies of fresh animals.
Recommendation fully achieved. Important training was provided by experts on dolphin necropsies.

3. Maintenance of laboratory equipment and supplies. One new freezer should be obtained.
Recommendation fully achieved. Laboratory equipment is old but operational. A new freezer was supplied.

4. Various collected samples should be sent for analysis.
Recommendation partially achieved. No results on age estimation of tooth samples sent to NOAA were available at the time of the workshop. However, in January 2021 results were received by Gulland from Bob Brownell and forwarded[2]. Samples sent for brucella testing were negative but further brucella testing is recommended if new samples are available. CITES permits were received for all necessary shipments. Stomach contents of dolphins were checked and prey species were identified but no otolith catalogue has been developed.

5. The identity of dead dolphins should be matched to the photo-identification catalogue and used to determine sex and reproductive histories.
Recommendation partially achieved. Dead dolphins were identified from the photo-identification catalogue; however, reproductive histories have not been determined.

Hydropower dam development
1. Collection of information to build the case for concern over the construction of Sambor and Stung Treng dams.
Recommendation fully achieved. The Cambodia government does not intend, at least for now, to move ahead with any plans to build dams in the mainstem of the Mekong River.

2. WWF should work with coalition partners to gather public attention and use their experience with hydropower strategy.
Recommendation fully achieved. The Cambodia government announced a ten-year moratorium on the construction of Sambor and Stung Treng dams.

3. Use the FiA Technical Working Group's hydropower sub-group as a mechanism to maintain a sustainable Mekong River.
Recommendation fully achieved. The hydropower sub-group was reactivated.

[2] Uzma Khan to follow up Frances Gulland.

4. Ensure rigorous scientific evaluation and transparency for all stages of dam development.
Recommendation fully achieved. WWF has initiated a Memorandum of Understanding with the Ministry of Mines and Energy to strengthen its engagement with the ministry and support the development of non-hydro renewable energy.

Summary

Overall, 24 of the 40 recommendations were fully implemented, 13 were partially implemented, and three were not implemented. The failure to fully implement some of the recommendations was due to limitations in funding and capacity. A shortage of smartphones and limited cell phone reception in some sections of the Mekong has inhibited the collection of digital data. An effort to provide the river guards with smartphones is ongoing and it should be possible to record data without cellphone reception or SIM cards. It was suggested that many of the recommendations are now several years old and should be revaluated and possibly reorganized, based on the accountabilities and the available funding sources.

Discussion of current challenges to management and conservation of Mekong population

The dolphins previously occupied nine deep pools but as of 2020 , now only occupy only three. There are remaining questions about why the dolphins would have left the other pools, and about whether this apparent change is temporary or permanent. There has been no noticeable reduction in fish availability in markets and reports by fishermen do not indicate a reduction in prey availability. However, it was recommended to investigate whether there has been any decrease in the availability of the particular fish species that the dolphins are known to eat. Lower water levels, caused by drought and upriver dams, are possible factors, as is electrofishing activity. The significance of electrofishing, both as a direct threat to dolphins and to their prey, is not yet fully understood and it is difficult to determine by necropsy if a given death was caused by electrocution (see Thomas et al. 2019).

Twenty-five identified individual dolphins have not been photo-identified since the 2017 population survey. While modeling of abundance from 2020 surveys provided a point estimate within 3 dolphins of the 2017 abundance estimate, given the large confidence interval and the fact that 25 identifiable dolphins have disappeared since the 2017 survey, it is difficult to define a trend at this time. The large increase in counts at the three currently inhabited deep pools in 2020, the 'missing' 25 dolphins may have moved to side channels but have not yet been located; exploration of the side channels is recommended. It is important to determine if these dolphins are now inhabiting waters that are not surveyed, or have been lost from the population and probably died. The loss of 25 dolphins from such a small population would be of great concern.

The cause of high calf mortality remains unclear, and further work on necropsy examination of animals combined with observations of dolphin behaviour and electric fishing practices in dolphin habitat are needed to investigate this mortality further.

Recent observation of decreasing water levels in the Mekong raised questions of whether sufficient habitat conditions will remain in some areas of current dolphin occupancy and if ex situ conservation options should be considered. The dams in Laos are a major contributor to the decreasing water levels and the dams in China have also contributed to flow changes, despite success in opposing dams in Cambodia, two more are planned for construction in Laos and this may further compromise water flows.

There was a firm consensus among the international experts in attendance that ex-situ approaches for conserving this population are impractical and would pose serious risk both to the dolphins and to the capture teams (see Item 4 under 4.1, below). In-situ conservation should remain the focus, as the Mekong is still a relatively natural river and represents the only habitat for Mekong River Irrawaddy dolphins. The idea of somehow 'fencing' the dolphins in to prevent them from undertaking high-risk movements outside their current range was mentioned as, according to the WWF team in Cambodia, 11 of 13 individuals known to have moved outside of the current range between 2002 and 2019 have died ("Stranded Mekong Dolphin Database", unpublished WWF Cambodia). This database is an excel file and we haven't had any publication on the Mekong stranded dolphins. The time period of these stranded dolphin collection was from 2002 to 2019). However, this fencing approach was not deemed safe or practical .

Given the uncertainty over the current occupancy of several deep pools it is important to re-survey these pools and deploy acoustic monitoring devices (such as F-PODs) to track dolphin presence and possible movement between pools. Also, better use could be made of the river guards to document dolphin occupancy (and absence) in the nine pools where dolphins historically occurred.

4. Recommendations

Most of the recommendations in this list, particularly those for the Mekong and Ayeyarwady populations and trinational matters, were initially drafted by a subgroup of the international experts in attendance (Reeves, Smith, Wells, Gulland and Thomas). They were then edited and annotated, sometimes extensively, by other participants during report review. The Mahakam recommendations came partly from the international group and partly from Danielle Kreb.

Note that for some recommendations (mainly Mekong ones), the individuals or organizations responsible for implementation as well as potential sources of funding are identified in square brackets.

4.1 Mekong population

1. *River guard program.*

Investment to date is well justified but WWF needs to find ways to ensure the program is financially viable for the long term. The program should focus on prevention of electrofishing as well as gillnetting in dolphin habitat. It should be recognized and emphasized that the SMART patrols have a dolphin monitoring component, which means the river guards could be a great asset in searching for dolphins outside the three currently occupied pools.

In addition to continuing, and if possible strengthening, the river guard program, efforts should be made to (i) educate police, prosecutors, and judges about the destructive impacts of electrofishing, fishery laws and rules that prohibit such fishing and (ii) collect and interpret evidence for successful prosecution.
[WWF-Cambodia; WWF, Tourism revenue, external donors]
WWF Annotation:
Sustainable funding of the River Guards Programme needs to be ensured, and the WWF River Dolphin Rivers Initiative is best positioned to take the lead, especially with regard to identifying, advocating and lobbying donors.

2. Photo-ID program. Much more collaborative work with international experts (e.g. Wells, Porter) is needed to produce reliable and relevant analyses using available photo-id information and data. It is understood that one of the primary obstacles to updating and completing the database is a shortage of WWF staff time to prepare data for entry into FinBase, and to proceed with analyses of reproductive histories. The Chicago Zoological Society's Sarasota Dolphin Research Program (Wells and his team) remains committed to helping with FinBase efforts and would be interested in assisting with analyses for developing reproductive histories. Remote assistance with FinBase can continue to be provided by SDRP at no cost to the Mekong river dolphin program, but in-person work by SDRP in Cambodia will require external funding for travel expenses, and an end to pandemic-related travel restrictions.

Meanwhile, we suggest that funding be secured to support a position in WWF-Cambodia for a local researcher to work fulltime on the scientific aspects of dolphin research including collaboration with the Sarasota Program and others on strengthening the conservation value of the photo-id catalog. [Wells and team, Porter, WWF; WWF, possibly other international donor(s)]

In general, there should be a stronger emphasis on evaluating movements of individuals, especially between pools, and on age structure. Integrating Isabel Beasley's catalog, though perhaps no longer feasible, would be particularly useful for analyzing the population age structure and how the proportion of unmarked dolphins has changed through time. Moreover, it is recommended that WWF provide an opportunity to Wells (and a few other experts of his choosing) to look at the photos of animals considered to be unmarked, as more experienced eyes may be able to find distinctive features that would allow these new 'clean' animals to be incorporated into the catalog. Also, with such a small population, there

may be potential to obtain useful abundance data from a true census as an alternative to capture-mark-recapture approaches. [WWF, Wells and team, Porter, other selected international experts; no new funding should be needed for this]

This item should be a top priority but in addition to the proposed collaboration with Wells's Sarasota Program as described above, it should include as soon as possible a repeat attempt (as was made in 2012) at bringing a carefully selected team of international experts to Cambodia (in person) to work through a specific set of issues with the WWF team. [WWF-Cambodia team, MMC and selected international experts; WWF, MMC, other international donors]

We understand that WWF-Cambodia is unlikely to have funds to support this. External funding will need to be identified and secured to support such an expert consultation. We suggest starting with WWF reviewing sources of funding/travel support for previous workshops and identifying potential current sources.

2. ***Investigation of reported 'loss' of dolphins from some pools between 2017 and 2020 but only a very slight decline in the abundance estimate.***

This apparent paradox requires a careful independent analysis (also see other recommendations regarding the desirability of incorporating acoustic monitoring). As part of this investigation, the WWF-Cambodia team should look carefully for opportunities to take greater advantage of the dolphin monitoring aspects of SMART patrols by the river guards, who spend much more time covering the entire range of the Mekong dolphins than do the Kratie-based team that carries out dedicated surveys. Although the information and data from the river guards may not be sufficiently robust for contributing to abundance estimation, it can be used to determine presence and absence of dolphins, especially in the six deep pool areas where dolphins have been reported to have been 'lost' between 2017 and 2020, and to help guide fieldwork. Also, the design of annual photo-id surveys should be expanded to cover all channels of the Mekong mainstem.

[WWF-Cambodia; only minor additional funding should be needed to support expanding the route of annual photo-id surveys]

3. ***Transboundary pool dolphins.***

This issue appears to be unsolvable in light of the record of no progress for the last 15 years and the rapid attrition observed (steep decline in numbers, major disturbance and disruption to the habitat, inaccessibility of the animals, etc.). See Ryan (2013) as well as the table of pros and cons prepared by Wells, Gulland, Thomas & Reeves in 2019 (attached to original message). Krebs's experience of 'rescuing' and relocating dolphins over small distances in the Mahakam is not considered informative for application in the transboundary pool. Any plan to capture and move animals from the pool would be not only controversial and expensive, but also entail a very high risk to the animals as well as

the people involved in the capture operation. One river guard outpost with five river guards is located at the transboundary pool. This effort should be sustained not only to protect the few remaining dolphins in the transboundary pool but also to protect fish abundance and diversity which is important for dolphins in the other eight pools as well as sustaining fisheries for local people in both Laos and Cambodia.
[No need for additional responsible parties or funding except to fund transboundary collaboration with the Lao PDR]

4. ***Ex situ approaches.***

The international experts are unanimous in their opinion that removal of dolphins from the Mekong and placing them 'in human care' should not be further considered. Nor is there support for the idea of creating an in situ barrier or barriers to restrict their movements within the natural riverine habitat. Although the vaquita recovery team gave this concept serious consideration as a way of protecting the few remaining vaquitas in their last 'core area', in the end it was judged logistically too difficult and risky to individual animals despite the proximity to massive resources in the USA (only 4 hours drive away). There is no evidence that the 'semi-natural reserve' concept that has been successfully applied with finless porpoises in China could be implemented in the Mekong. [This item should not require further funding or technical support in the future.]

Maintaining and strengthening protection of the river and its flows and biodiversity is the highest priority. Maintaining and strengthening the river guard and other fisheries and biodiversity management programs, maintaining and strengthening survey and photo-id efforts, and integrating monitoring of dolphins with monitoring the biodiversity and ecological conditions of the river are the most effective ways to support dolphin conservation.

Deciding whether or not to apply ex-situ approaches is always difficult, as reflected in the IUCN Species Survival Commission's Guidelines on the Use of Ex situ Management for Species Conservation.

6. Passive acoustics to monitor dolphin habitat use. Strategic placement of recording devices, for example in the deep pools where most of the dolphins spend (or at least have spent in recent years) most of their time, would be an efficient, cost-effective way to monitor their presence and absence from core areas throughout the year, and possibly also to discover other areas occupied less regularly. Ideally, the listening stations should be accessible remotely so that monitoring could be done in 'real time', at least in areas where cell phone coverage exists (rather than having listening stations that must be physically accessed to download data, as established in Sarasota Bay, Florida). Estimates were provided by David Mann (Loggerhead Instruments) for costs of the PALS (Passive Acoustic Listening Stations) currently in use in Florida (data are able to be accessed remotely). Each solar-powered unit would cost ~$3,000, and would require internet access or cell-phone-to-internet access for data transmission (with attendant monthly wifi/cell phone costs).

Priority should be given to the 'abandoned' pools where sightings are rare and dolphins are more likely to be detected acoustically if they are present. Dolphin-watching tourism and SMART patrols along with photo-id surveys may be adequate in the three presently occupied pools. [WWF and partners for equipment; technical support may be available from Wang Ding and his associates and through SDRP at little or no cost.)]

7. Acoustic survey. A survey similar to the one conducted in the Ayeyarwardy by Zhi-Tao Wang et al. (2020) in 2019 should be conducted in the Mekong. This would provide a snapshot of dolphin occurrence throughout the system for use in validating and/or refining sightings-based estimates of abundance and distribution. [Technical support may be available from Wang Ding and his associates at little or no cost.]

8. Calf mortality. Completion and publication of the behavioural work conducted by Julia Goss in 2014 is long overdue, and is critical to a better understanding of the high calf mortality. Gerry Ryan reported that he was collaborating with Goss and that their intention is to integrate anecdotal reports of 'aggressive' behavior obtained from WWF researchers, visiting scientists, River Guards, boat drivers, tourists, and others along with Goss's systematic study of such behavior[3]. [Responsibility of international team to take the lead and consult widely for 'data', i.e. direct observations. Gulland remains a resource to consult on necropsies and arrangement of shipments].

9. Age estimation of dead dolphins. After the workshop, Wells and Gulland followed up with Bob Brownell to obtain data from teeth transferred to NOAA in the USA,. The teeth from 9 animals have been cut and 'read' (i.e., growth layer groups counted) by NOAA. Ages from 4 adults (5-12 years old) and 5 calves were reported by Brownell.

10. Continued vigilance to ensure no mainstem dam is constructed in Cambodia. International groups including the IUCN Specialist Groups and the IWC should use every means available to convince the Laos government to postpone further approval and construction of any more dams on the Mekong mainstem for at least the next 10 years. This 10-year timeframe would give experts in different fields the time needed to evaluate impacts and alternatives, as well as proposed mitigation before project designs have been finalized. We also suggest that the government of Laos be engaged in such a way that it will begin to incorporate the needs of Irrawaddy dolphins (and the rich biodiversity in the Mekong that they represent) into operation of the existing Xayaburi and Don Sahong dams, and to document the effectiveness of mitigation proposed by the dam developers to protect fish breeding and migration. Such information would be valuable to inform future decisions on dam design and management, or even better, on decisions not to proceed with construction due to unacceptable ecological impacts.

[3] Reeves, Gulland and Thomas had follow-up email exchanges with Ryan in early December 2020 and they were assured that he would 'take this discussion' to Goss and 'coordinate with the relevant people' to move the publication forward. However, no further communication from Ryan had been received as of mid February 2021.

Another top priority that needs international attention is the construction of additional dams farther upstream in the Mekong and its tributaries in China. We encourage efforts to convince the government of China to meet its commitments in terms of transparency and maintaining the ecological integrity of the Mekong, which should include a healthy dolphin population in Cambodia.

Broader studies of hydrology and biodiversity studies should be initiated and sustained to fully document the impacts of existing (and potentially future) dams in the Mekong. [WWF, with moral and technical support as and when needed from international experts.]

4.2 Ayeyarwady population

1. ***Updating management plan***. The management plan for the original Ayeyarwady Protected Area endorsed by the government in 2009 is being updated with expected input from international and national experts as well as local communities, including fishermen engaged in the cooperative fishery with dolphins. We encourage this updating process to proceed and support the idea of extending the scope and mandate of the plan to include the newly declared protected area as well as the third currently unprotected section of river that supports dolphins at the farthest upstream extent of their range.

2. ***Strengthening SMART patrols***. Patrols within the two protected areas for dolphins in the Ayeyarwady River should be strengthened in terms of temporal and area coverage and engagement with local communities and police. Emphasis should be given to enforcing laws that prohibit electrofishing and the use of gillnets longer than 300 feet. Whenever possible, night patrols should be undertaken since a great deal of illegal fishing activity takes place at night. However, due to previous incidents involving violence on the part of illegal fishermen, this will require close collaboration with the local police to ensure the safety of the patrolling team.

3. **Strengthening dolphin research and monitoring.** We consider the annual population surveys conducted since 2002, which appear to indicate a relatively stable number of dolphins, to be extremely valuable and we also support the ongoing protected area management and community engagement activities. However, we suggest that dolphin protection efforts could be strengthened through additional/complementary research and monitoring as summarized in items 4-7 below. Implementing these suggestions and recommendations would give managers more detailed information, helping them prioritize conservation management efforts and determine whether existing dolphin protection measures are having the intended effect. For example, electrofishing has been considered one of the most critical direct threats to the Ayeyarwady dolphins. However, while acknowledging the destructive impacts of electrofishing on riverine fisheries, the recent publication by Thomas et al. (2019) on the impacts of this type of fishing analyzed the assumption that electric fishing actually leads to electrocution (and is a significant cause of death) of dolphins (Thomas et al 2019). Items 4 and 5 below are intended to provide guidance on ways to clarify the cause of death of dolphins, whether from gillnet entanglement, electrofishing, or other factors. Another concern is that, because they are based on direct counts, the yearly abundance surveys conducted by WCS do not provide estimates of precision, and this severely limits their value for detecting patterns and trends and thus assessing the effectiveness of dolphin protection measures. Item 6 addresses this issue directly. Finally, improving research and monitoring efforts could be an effective way of attracting international support and strengthening accountability to donors for their support.

4. ***Strengthening necropsy facilities and improving access to local, national and regional expertise***. This could be done in coordination with and support from Gulland. She

can identify the basic equipment and training needed for the necropsies, conduct training sessions for staff and assist in establishing connections with international laboratories for sample analysis as needed, including for measuring tissue mercury levels.

There may be a need to build the capacity of local WCS and WWF staff to carry this forward. Gulland can discuss matters with the teams and facilitate access to virtual trainings that cover necropsy procedures, sample collection and sample storage. Such a workshop could be organized in coordination with the Mekong team.

5. ***Enhanced network for reporting dead dolphins***. Investment in this aspect is important because carcasses decompose quickly and the earlier the carcass is detected, reported, and necropsied, the greater the chances of determining cause of death. This is especially important for reliably diagnosing electrocution as the cause of death.

6. ***Incorporation of acoustics into surveys for abundance estimation***. We recommend that teams conducting annual abundance surveys in the Ayeyarwady incorporate an acoustic detection component into their methodology, following the successful piloting of this approach by Zhi-Tao Wang et al. (2020). Doing so would not compromise or prevent continuation of the existing time series of estimates based on the older visual direct-count methodology.

7. ***Exploration of photo-identification***. The dorsal fins of dolphins in the Ayeyarwady are relatively 'clean' in comparison to those of Irrawaddy dolphins in other areas. This may be related to differences in river morphology, but regardless of the underlying reason(s) for the lack of scarring, it has long been felt that photo-identification was not a practical tool for studying the Ayeyarwady animals. Discussion within the FinBase group during the workshop led some participants to conclude that it would be worth investigating the matter further in collaboration with FinBase experts. However, our view is that although a few Ayeyarwady dolphins can probably be identified from ephemeral marks using improved camera equipment, for photo-identification to be useful a fairly large proportion of the study population would need to be unambiguously identified using marks that last at least as long as the period between surveys. We therefore conclude that this idea should be a low priority and should not be allowed to detract the conservation teams from pursuing other higher-priority work.

8. ***Investigation of pingers to reduce mortality in gillnets***. Pingers could be piloted to see if they help reduce mortality in gillnets. However, a rigorous study design will be needed for evaluating effectiveness. Also, it is very important that the deployment of pingers does not interfere with the traditional cooperative fishery between the dolphins and cast-net fishermen, which relies on acoustic 'calling' of the animals to approach the net and 'assist' the fishermen, leading to increased fish catches. There may be an inbuilt conflict between pinger use and cooperative fishing as gillnet fishermen seek to *exclude* the dolphins from an area while the cast-net fishermen are calling them *into* an area, so the selection of area and type of pinger for any trial would need to be done with extreme caution (also see item 3 in the Mahakam section and item 8 in the Trinational section).

4.4 Mahakam population

1. ***Reducing mortality***. A stated goal of RASI is to reduce dolphin mortality (referring to all documented mortality regardless of cause) by 50%, from a recent average of 4 per year to 2 per year in the next two years. This would be accomplished by holding workshops for local officials, promoting the use of pingers on gillnets, and continuing the community-based river guards program with the expectation that illegal fishing inside the Protected Area, where there are reportedly more than 150 incidents of illegal fishing per month, will be reduced. It was not made clear at the workshop how significant a factor vessel strikes are in causing dolphin mortality, but according to Kreb, such strikes do occur in the Mahakam, and therefore mortality reduction efforts should also include stricter control of vessel routing, speed, etc.

Although it would be helpful to know more about how this goal of a 50% reduction in mortality was arrived at (e.g., by applying something similar to the Potential Biological Removal (PBR) concept used in the United States), we recognize that any reduction in mortality would be a good thing, and perhaps for such a small population that is monitored as closely as this one is, a 'rule-of-thumb' or common-sense approach to setting a target for mortality reduction is adequate. Specific comments on the three types of measures to achieve the reduction are treated individually below.

If using PBR, then the average annual mortality is much greater than the PBR level, which for a population of 81 dolphins would be 0.324 for recovery factor (F_r) of 0.01 (as recommended for endangered species), or 1.62 for F_r of 0.5. According to Kreb, an average (over 26 years) of 4.4 dolphins are known to have died per year, of which 80% were from identified causes (= 3.3 dolphins per year with known cause of death), with 66% attributed to gillnet entanglement (=2.2. dolphins per year). This last figure has been lower during the last 10 years, with 1.5 dophins dying from gillnet entanglement per year. The aim of RASI is to reduce the mortality caused by gillnets in particular.

2. ***Mortality reduction workshops***. Workshops will be conducted in the Regional House of Representatives (DPRDR) to prepare local regulations regarding the types of fishing gear allowed and prohibited in the PA. This will be an important step forward as currently gillnets are allowed in the protected area.

3. Pingers. Pinger trials with Irrawaddy dolphins indicate that pingers may be effective in displacing dolphins from the immediate area around nets with active pingers. We were impressed with Kreb's efforts to date but believe a more rigorous study is needed before pingers are considered to be an effective, reliable mitigation tool in lowering the entanglement risk to Irrawaddy dolphins. The estimation of distance between pingers and dolphins could be more accurately estimated (e.g. by using a digital theodolite. Also, in Kreb's study, the distance from the pinger at which the dolphins were surfacing was estimated by eye by a research assistant (trained with a laser range-finder) and the observers were aware of when the pinger was turned on or off, which could have biased the distance estimation results. We **recommend** that Kreb consider, on the basis of the specific recommendations, practical means of testing of pinger effectiveness in the

conditions of the Mahakam. This can include a double-blind approach where neither the fisherman nor the observer knows whether the pinger is turned on or off while the dolphin movements are being tracked. This could be done in parallel with a phase-in approach to deploying pingers provided to the fishermen with a rigorous monitoring protocol to examine differences in fish catch, dolphin bycatch and net-approach distances over time.

4. ***River guards***. While we welcome the news that a community-based river guard program is in place to combat illegal fishing inside the Protected Area, we do not know enough about the program to comment constructively on how it might be improved. It would be useful to see the evidence (assuming there is some) to support the belief that the program can and will contribute to a reduction in dolphin mortality.

5. ***Population monitoring and awareness***. These elements are central, or should be, to all three rivers. The work led by RASI in the Mahakam is exemplary and should continue. The workshop did not propose specific measures to improve the efforts of RASI but called for strong general support from government agencies at all levels, from local and international funding agencies and organizations, and from the marine mammal research community to ensure the uninterrupted continuation and strengthening of these studies into the future.

6. ***Upgrade Protected Area to national status***. The district status of the Mahakam dolphin protected area should be upgraded to national status.

7. *New regulations to be proposed for protected area management:* The following proposed regulations should be forwarded to the district government: 1) Within the PA core zone: no fishing allowed including gillnets. 2) Within the sustainable fisheries zone inside the PA: a) gillnets can be deployed along the river bank but not across or in the middle of the river, b) gillnets are not allowed to be deployed within a 1km radius of river mouths or confluences, c) gillnets cannot be deployed at night (as an alternative if this motion fails to get support from the district representatives, nets equipped with pingers may be allowed), d) all gillnets are equipped with acoustic 'pinger' devices approved by the government and distributed by RASI (but only after final trial studies have shown that the dolphins effectively avoid nets with pingers (e.g. no signs of depredation on caught fish, no net damage by dolphins, no dolphin habituation demonstrated by repeated trial study, analysis of fishermen's observations of dolphin behavior and separation distances between dolphins and nets, and half-yearly evaluation of continued effectiveness) and e) fishermen are obliged and trained to release dolphins if they are found alive in gillnets following procedures that will be or have already been socialized.

8. Collaboration with Roundtable on Sustainable Palm Oil (RSPO). The goal of such collaboration would be to (i) better understand the impacts of proliferating palm oil production in the Mahakam watershed on dolphins (and their environment), (ii) create greater awareness in the region concerning the risks to dolphins, and (iii) try to influence how this industry and its supply chain are regulated in order to reduce the impacts on dolphins and the river, e.g. through a certification program.

The local district government is willing to facilitate a meeting in 2021, to request attendance by company stakeholders in areas bordering the PA to explain their responsibilities for mitigating any adverse impacts on the PA, to request them to explain what mitigation actions they will undertake, and require such stakeholders to make a commitment to follow through on implementing the agreed mitigation actions.

9. ***Secure buffer zone for Protected Area.*** We support the concept of a dolphin Protected Area and agree that a buffer zone such as the identified 175,000 ha area (including 125,000 ha of peat swamps in Kutai Kartanegara and Kutai Barat districts) is needed to prevent or at least mitigate land-based pollution. Without knowing a great deal more about the entire topic, we (the international experts) are unable to provide constructive advice.

10. ***Morphometric and genetic studies:*** Perform morphometric measurements of skulls that may be supported by genetic research that have been done already or are underway to understand differentiation between populations of Irrawaddy dolphins. Ideally this would include data already collected by Isabel Beasley from the Mekong.

4.5 Trinational matters (i.e. those applying to all three river systems)

1. ***Continuing and strengthening SMART patrols***. Although there are distinct differences in the patrolling approach taken in each of the three rivers, whether it is government-led or community-led, SMART enforcement and monitoring patrols have proven to be effective tools for reducing threats, particularly illegal fishing, in the Mekong river. A high priority should be to ensure sustainable financing so that these patrols can be maintained and, ideally, strengthened. We also believe that better use could be made of these patrols as 'eyes on the water' to help monitor for shifts in the dolphins' range, which have been reported recently in all three rivers. Finally, we encourage exchanges among senior and field-level staff in the three rivers so that they have opportunities to learn from one another and thereby improve patrolling techniques.

2. ***Night patrols***. Night patrolling continues to be a challenge due to safety considerations even though a great deal of illegal and destructive fishing activity occurs during the night. To encourage more effective overall programs and facilitate additional night patrols, we **recommend** (i) strengthened partnerships with local police to join SMART patrols, (ii) laws and rules to facilitate prosecution of fishermen who threaten or take hostile action against patrolling teams, (iii) continuing to provide, enhance and maintain field equipment available to patrol teams, to increase safety and effectiveness of the patrols, and (iv) that health and life insurance be provided to patrolling team members.

3. ***New water management infrastructure***. It is critical that water policies (local, national, international) are monitored closely and consistently for water management initiatives in all three river basins. The teams working in the three countries are well aware of the threats that large dam construction, in particular, represents. Vigilance must be maintained with regards to new or changing plans, and WWF should take high-level responsibility for

coordinating closely with local and national teams working in the three countries. WWF programs should monitor the activities and plans of multilateral lending institutions as well as the activities and plans of countries that are consumers of, and in the market for, hydroelectric energy and other water resources (e.g. China).

4. ***Photo-identification***. We encourage teams in all three countries to keep their photo-id catalogues and associated sighting data updated. Work needs to continue to ensure these are in formats from which individual animal records, reproductive histories, and other data can be readily extracted and compiled, and that facilitate abundance estimation through modeling or direct censuses. Also, a FinBase training session (or sessions) for river dolphin researchers should be organized in collaboration with the Sarasota Dolphin Research Program.

5. ***Acoustic monitoring***. Our specific advice on this matter is included in the comments directed towards each of the three countries. In general, we consider acoustic monitoring to be an underused but potentially powerful (and relatively low-cost) tool that should be incorporated into the conservation and research programs in all three countries, especially for detecting the presence of dolphins in areas that are not frequently surveyed. There are good opportunities for collaborative work with experienced bioacousticians (e.g.,\ Wang Ding, Nick Tregenza, Tomonari Akamatsu) who could provide technical expertise and equipment in exchange for the chance to make meaningful contributions to conservation and science. Such collaborations should always include deliberate efforts to transfer knowledge and know-how from the outside experts to researchers in the region (i.e. build capacity).
Relevant parties should follow-up on the idea mentioned at the workshop by Wang Ding that he and his team investigate the possibility of developing an audiogram for *Orcaella brevirostris*. It was suggested that this might be feasible if an arrangement could be made with facilities holding Irrawaddy dolphins in captivity in Thailand.

6. ***IWC Conservation Management Plan or Plans***. Although considerable interest has been expressed in pursuing the idea of a Conservation Monitoring Plan (CMP), or Plans, for Asian freshwater cetaceans in collaboration with the International Whaling Commission (IWC), we (most members of the international team of experts present at the workshop) are not convinced that this would be a good use of time and resources, even if it were feasible (which we doubt). None of the three countries with riverine Irrawaddy dolphin populations currently has a strong connection to the IWC, and developing such a connection would require major commitments of human and financial resources. Also, the main benefits of CMPs have been in encouraging and facilitating cooperation between or among governments that share a cetacean population. In this instance, each country has its own watershed that provides habitat for an entirely discrete dolphin population. Moreover, it is important that additional planning exercises (which an IWC CMP would be) not be allowed to draw attention away from the urgent need to implement and strengthen conservation measures that we already know are effective, and some of which groups in Cambodia, Myanmar and Indonesia are already in the process of advocating for or, in some cases, implementing.

If, for whatever reason, there is a strong wish to collaborate with the IWC, we would recommend a 'threat-based approach', interacting regularly with the IWC's Bycatch Mitigation Initiative and perhaps trying to enlist the IWC Secretariat in efforts to influence financial institutions (e.g., the World Bank) against funding water development projects that would harm endangered dolphin populations.

The WWF initiative team should search IWC documents from around the year 2000 to date, paying close attention to the annual reports of the Scientific Committee's Sub-committee on Small Cetaceans. A number of recommendations regarding dams and dolphins regarding Mekong dolphins as well as Ayeyarwady and Mahakam dolphins have been made by the sub-committee (see Journal of Cetacean Research and Management Supplements 3-21+ at https://archive.iwc.int/pages/search.php?search=!collection29&bc_from=themes). Also see Annex 4 (A table summarizing the meetings of IWC with the recommendations that are broadly relevant to *Orcaella*).

WWF may be able to assist the Cambodia IWC Commissioner in 'implementing' these recommendations on behalf of the government. The existing recommendations would in any event need to be integrated into any CMP for freshwater Irrawaddy dolphins. Mobilizing the IWC to contribute to the conservation of these dolphins in southeast Asia would require the explicit support of the relevant member government(s), so the place to start can be with the Cambodian Commissioner.

7. ***Advocacy***. Interactive advocacy can be effective in building support for dolphin conservation, including the equitable enforcement of fishery laws and rules and alternatives to the construction of water development projects, among local communities and government stakeholders. Establishing World Heritage sites in priority dolphin habitat is one mechanism that can help promote national and international support for biodiversity conservation including protecting river dolphins.

8. ***Pingers***. This issue was covered by separate comments provided for each of the three rivers. In general, however, we recommend against the wholesale distribution of pingers to fishermen and urge that WWF/RASI (or any other organisation) proceed with great caution in promoting the idea that pinger use is a safe and effective tool for reducing Irrawaddy dolphin bycatch in gillnets. We acknowledge the careful work that has begun in the Mahakam to investigate the use of pingers there, and we strongly support and encourage the plan by WWF to organize a special workshop on pinger use in freshwater systems early in 2021. It is essential that scientists with experience conducting robust experiments and field trials with pingers (e.g., in Europe, North America, Australia/New Zealand) participate in the workshop. This would be an excellent opportunity for WWF to begin forging a collaboration with the IWC Bycatch Mitigation Initiative (contact: Marguerite Tarzia, BMI Coordinator).

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Annexures

Annex 1: Workshop agenda

#	Date	Session	Focal person
1	**Day 1: 1st Dec. Background** Link: https://wwf.zoom.us/j/96787606744?pwd=ZmdmeW5JMDc1MXhxRWpKbmp2SnhFdz09 Meeting ID: 967 8760 6744 Password: 834921		
	0900-1100 Cambodia/2100-2300 previous day in Washington D.C. (Eastern Standard Time)		
	0900 - 0910	Welcome	Mr. Ouk Vibol, Director, Department of Fisheries Conservation
	0910 - 0920	Objectives of the workshop and River Dolphin River Initiative	Uzma Khan
		Technical Session 1: Subpopulation status and current conservation and research work	Chair Randall Reeves, IUCN/CSG
	0920 - 0940	Cambodia	Somany Phay, WWF
	0940 - 1000	Myanmar	Naing Lin, WCS
	1000 - 1010	Myanmar	Htet Htet, WWF
	1010 - 1030	Indonesia	Danielle Kreb, RASI
	1030 - 1045	Question and Answers	Facilitated by Uzma Khan
	1045-1100	Concluding remarks	Randall Reeves
2	**DAY 2: 2nd Dec** Link: https://wwf.zoom.us/j/97462675270?pwd=aUp6QXNhMmdzVHJXcUZDSnQ1bGF2Zz09 Meeting ID: 974 6267 5270 Password: 592216		
	0900-1100 Cambodia/2100-2300 previous day in Washington D.C. (Eastern Standard Time)		
	0900- 0930	Progress on the 2017 International Expert Workshop Recommendations	Somany Phay
	0930 - 1030	Discussion of current challenges to management and conservation of Mekong subpopulation	Chair: Peter Thomas, MMC
	1030 - 1100	Conclusion and way forward	Chair: Frances Gulland
3	**DAY 3: 3rd Dec** **Link:** https://wwf.zoom.us/j/96044642705?pwd=cUhSeEExTktzSXVLa2hxU25xdTFSZz09		

	Meeting ID: 960 4464 2705 Password: 556285		
	1900- 2100 hours Cambodia/0700-0900 in Washington D.C. (Eastern Standard Time)		
	1900 - 1910	Catch up on previous days	Uzma Khan
			Participants divide into three groups to discuss conservation priorities for each subpopulation
	1910 - 2010	Group 1 Mekong subpopulation	Lindsay Porter
		Group 2 Myanmar subpopulation	Hanna Helsingen
		Group 3: Mahakam subpopulation, especially plan to address threats from palm, rubber and coal industries	Danielle Kreb
	2010 - 1000	Plenary Group representatives brief and receive input from the workshop	Chair: Brian Smith, co-chair Lindsay Porter
4	**Day 4: 4th Dec.** Link: https://wwf.zoom.us/j/92948620533?pwd=WnIrQTNtUmxIUHFVN09pSE5EYkYvdz09 Meeting ID: 929 4862 0533 Password: 254625		
	1900- 2100 hours Cambodia/0700-0900 in Washington D.C. (Eastern Standard Time)		
	1900 - 2000	Deep dives: Research (FinBase and pingers)/Governmental engagements	The workshop participants divide into three groups for deep dives into three areas and come up with three recommendations, identifying lead partners for each area
		FinBase	Jason Allen
		Pingers (learning from the Mahakam experience – techniques and data collection)	Danielle Kreb
		Declaration and IWC CMP – future steps and engaging with governments	Daphne Willems
	2000- 2050	Key decisions/agreement	Randall Reeves
	2050-2100	Vote of thanks	Teak Seng

Annex 2: Workshop participants

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Annex 3 (A table summarizing the meetings of IWC with the recommendations)

Table 1: Priority topics of the Scientific Committee Sub-committee on Small cetaceans (1979-2012) and its main recommendations (2001-2016)

*[Please note that this table represents **only a guidance** to the main recommendations of the Sub-committee on Small cetaceans, and it was made to help proponents. **For all exact references and full details, you must refer to the published Annual Reports of the IWC Scientific Committee.** This **table is a work in progress** and it might exclude by mistake some recommendation. Please for completeness refer to the Scientific Committee Reports downloadable on the IWC website]*

Year	SC Meeting venue	Priority topic discussed
2020	**Virtual**	
	The Committee reiterates its previous grave concerns for Platanista gangetica, Orcaella brevirostris (freshwater populations) and Neophocaena asiaeorientalis asiaeorientalis. The Committee agrees that: (1) these species remain on its agenda as priority species; (2) potential mechanisms to coordinate research and management actions should be explored intersessionally and discussed in detail at SC68C; (3) range states should strive to coordinate research and management actions across the species' ranges, whenever appropriate; and (3) these species should be discussed as possible candidates for a CMP at SC68C	
2019	**Nairobi, Kenya**	**A Review of Small Cetaceans of Africa**
2018	**Bled, Slovenia**	**A Review of Small Cetaceans in Rivers and Estuaries in South America**
2017	**Bled, Slovenia**	**A Review of Small Cetaceans in Rivers, Estuaries and Restricted Coastal Habitats in Asia, Platanista Spp., Orcaella Spp. and Neophocaena Spp.**
	The sub-committee recommended: Mekong Irrawaddy Dolphin • recommends that the IWC Secretariat write to the Cambodian Council of Ministers and relevant Cambodian Ministries expressing the Committee's grave concerns regarding the impacts on Mekong dolphins of the proposed multiple dam construction • any effort to assess the conservation value and feasibility of translocating these individuals to another social group of dolphins downstream in Cambodia include consideration of the likely social and genetic consequences of such a move for the overall population (this includes determination of the age and sex of each dolphin in the transboundary pool through available information and tools, e.g. analysis of existing photo-id data, genetic analyses of skin samples collected by biopsy, and photogrammetry Coastal Irrawaddy Dolphin • continued dedicated surveys to monitor distribution, habitat use, threats and population trends in areas such as Sarawak and Chilika lagoon - survey effort should be extended to cover gap areas, such as other coastlines in the Indo-Malay Archipelago, the Sunderbans of West Bengal, and the coast of Orissa and West Bengal in India. Passive acoustics and or photo-identification should be used where feasible; and • heightened cooperation between local authorities, researchers, and the tourist industry at Chilika lagoon, India, - dolphin protection should be strengthened through better documentation of dolphin occurrence and movements, training of dolphin watch operators on dolphin watch guidelines, as well as management efforts to address the impact of fishing on the dolphins. Freshwater and Estuarine Cetaceans of Asia • recommends that targeted conservation actions be directed toward reducing the impact of fisheries bycatch and water development projects on Asian freshwater, estuarine, and coastal cetaceans to ensure their long-term survival.	
2016	Bled, Slovenia	Review of taxonomy and population structure of bottlenose dolphins (Tursiops spp.) in the wider Atlantic region
2015	*San Diego (USA)*	Review of taxonomy and population structure of bottlenose dolphins (Tursiops spp.) in the wider Indo-Pacific region
2014	*Bled (Slovenia)*	Review of status of small cetaceans in the eastern Mediterranean and Red Seas
2013	*Jeju (South Korea)*	Review current status of selected populations of small cetaceans in east Asian waters (China [including Taiwan], South Korea, Japan and Russia [white whales only])
2012 (64°)	*Panama City (Panama)*	Beaked whales of the North Pacific and Northern Indian Ocean
2011 (63°)	*Tromsø (Norway)*	Beaked whales of the North Atlantic and Mediterranean Sea
2010 (62°)	*Agadir (Morocco)*	Small cetaceans of NW Africa and E tropical Atlantic
2009 (61°)	*Madeira (Portugal)*	Review taxonomy, population structure and status of common dolphins
2008 (60°)	*Santiago (Chile)*	Small cetaceans in Southeast Pacific (conservation issues)
2007 (59°)	*Anchorage (USA)*	Killer whales

2006 (58°)	*St Kitts (St. Kitts & Nevis)*	Small cetaceans of the Caribbean and Western tropical Atlantic
2005 (57°)	*Ulsan (south Korea)*	Finless porpoise (marine populations)
2004 (56°)	*Sorrento (Italy)*	Franciscana
2003 (55°)	*Berlin (Germany)*	Small cetaceans in the Black Sea
2002 (54°)	*Shimonoseki (Japan)*	Humpback dolphins
2001 (53°)	*Hammersmith (UK)*	Dall's porpoise taken by the Japanese hand-harpoon fishery
2000 (52°)	*Adelaide (Australia)*	Freshwater small cetaceans
	The sub-committee recommended: Irrawaddy dolphin: • that further investigations be carried out using morphometric and genetic techniques to better elucidate stock structure over the geographical range of Irrawaddy dolphins and to examine potential differences between freshwater and marine habitats. • that comprehensive surveys be conducted to assess the abundance, distribution and habitat quality of Irrawaddy dolphins, with special emphasis on their fresh- and brackish-water range [given the paucity of data on distribution and abundance], • that a review be carried out of the distribution and habitat preferences of the Irrawaddy dolphin in marine systems and to define oceanographic, bathymetric and biological features associated with high density areas. • an immediate cessation of live captures until affected populations have been assessed using accepted scientific practices. • that appropriate bycatch mitigation strategies be developed for use with this species. Irrawaddy dolphin, 2004 & 2005 *Recommendation*: • that given the precarious status of Irrawaddy dolphins all live captures should cease 'until affected populations have been assessed using accepted scientific practices'. General recommendations for freshwater cetaceans: • The sub-committee recommended, therefore, that the impacts of water development on freshwater cetaceans should be investigated thoroughly and that future plans for water development projects and water usage in the range of these species take into account the habitat requirements of freshwater cetaceans and the demographic implications of population fragmentation. • It recommended, therefore, that any future protected areas or time/area fishery restrictions intended to conserve populations of freshwater cetaceans be of appropriate size and location, that potential threats be eliminated or greatly reduced in such areas and, further, that such measures are enforced adequately. • that the relative magnitude of this threat [bycatches of freshwater dolphins and porpoises in gillnets and other fishing gear] be assessed and that, where necessary, appropriate mitigation strategies be developed. • The sub-committee recommended that the effects of environmental contaminants, such as mercury, pesticides, antifoulants and oil, be evaluated for freshwater cetaceans, particularly with species that inhabit highly polluted areas. Such studies will require the development of new approaches, such as those being developed by the IWC programme POLLUTION 2000+. • The sub-committee recommended that scientists with appropriate theoretical and/or analytical skills should be directly involved in river cetacean studies, so that surveys result in statistically robust estimates of abundance. Ideally, arrangements should be made for one or more of these scientists to obtain relevant experience at a suitable range of survey sites and to make recommendations for appropriate survey and analytical methods.	
1999 (51°)	Grenada (Grenada)	- Bycatch mitigation - Monodontids
1998 (50°)	*Muscat (Oman)*	Small cetaceans in the Indian Ocean and Red Sea, with special reference to the Middle East
1997 (49°)	*Bournemouth (UK)*	- Review of the small cetaceans in the coastal waters of Africa - Further consideration of the criteria for assessing the status of harbour porpoise populations - Global review of *Stenella coeruleoalba*
1996 (48°)	*Aberdeen (UK)*	- Consideration of the criteria for assessing the status of harbour porpoise population - Consideration of the methodology to assess the magnitude of bycatches of harbour porpoise populations - Global review of the genus *Lagenorhynchus*
1995 (47°)	*Dublin (Irland)*	Review of harbour porpoises in the North Atlantic
1994 (46°)	*Puerto Vallarta (Mexico)*	Review of the status and exploitation of small cetaceans in Latin America [several species, including
1993 (45°)	*Kyoto(Japan)*	Review of abundance and exploitation of small cetaceans in the inshore waters of Southeast Asia, Indo-Malay region
1992 (44°)	*Glasgow (UK)*	- Population biology and exploitation of *Monodontidae* - Dolphin species taken in Japanese drive fisheries
1991 (43°)	*Reykjavik (Iceland)*	Review of significant directed and incidental catches of small cetaceans
1990 (42°)	Noordwijk (The Netherlands)	Population biology and exploitation of the porpoises, *Phocoenidae*
1989 (41°)	*San Diego (USA)*	Review of exploited populations of pilot whales
1988 (40°)	*San Diego (USA)*	Review of population biology and exploitation of beaked whales, *Ziphiidae*
	The sub-committee recommended: •	
1987 (39°)	*Bournemouth (UK)*	Review of life histories and status of populations of pilot whales, *Globicephala spp*
	The sub-committee recommended: • that these studies [on contamination by mercury, persistent organochlorines and heavy-metals in the Faroes] be continued and that a broad survey of organochlorines be initiated. • that every opportunity be taken to collect sightings in these latitudes [45° and 50°], with records or estimates of sighting effort.	
1986 (38°)	*Bournemouth (UK)*	Review of life histories and status of several populations of pilot whales
1985 (37°)	*Bournemouth (UK)*	- Baird's beaked whales - Incindental take of cetaceans in gillnet fisheries
1984 (36°)	*Eastbourne (UK)*	- Review of life histories, population biology and fishery involvement of the species of *Cephalorhynchus* - New data on Baird's beaked whale - New information on the Black Sea dolphins and porpoise populations and fisheries

1983 (35°)	*Cambridge (UK)*	- Exploited populations of *Phocoenids* [*Phocoena phocoena*, *Phocoena sinus*, *Phocoenoids dalli*, *Neophocaena phocaenoides*] - New data on Baird's beaked whale - New information on the Black Sea dolphins and porpoise populations and fisheries
1982 (34°)	*Cambridge (UK)*	Review of stock assessments for some exploited populations of pelagic dolphins (*Delphinus* and *Stenella* spp.) [Small-cetacean fishery in the Black Sea (*Phocoena phocoena*, *Tursiops truncatus* and *Delphinus delphis*); Stenella spp. in the eastern tropical Pacific; Stenella coeruleoalba in the western North Pacific]
1981 (33°)	Cambridge	- New information on stocks, catches and status [including *Hyperoodon ampollatus*, *Dephinapterus leaucas*, *Monodon monoceros*, *Orcinus orca*, *Globicephala melas*, *Tursiops truncatus*, *Delphinus delphis*, *Stenella coeruleoalba*, *Phocoenoids dalli, Phocoena phocoena*] - Live-capture fisheries - Problems of interactions between fisheries and small cetaceans [competition] - Effect of pollution and industrial development
1980 (32°)	Cambridge	- Management actions and research on northern bottlenose whale, striped dolphin, Dall's porpoise and harbour porpoise - Other direct catches [including narwhal and beluga] - Problems of interactions between fisheries and small cetaceans [competition] - Effect of pollution and industrial development
1979 (31°)		- Management actions and research on northern bottlenose whale, striped dolphin, Dall's porpoise and harbour porpoise - Other direct catches - Problems of interactions between fisheries and small cetaceans [competition] - Effect of pollution and industrial development - Review of definition and status of stock of the white whale, *Delphinapterus leaucas*, and the narwhal, *Monodon monoceros* - Review of small cetaceans of the south Atlantic coast of South America. - Live-capture fisheries
1978 (30°)		- Management of small cetaceans [*Hyperoodon ampollatus*: North Atlantic; *Stenella coeruleoalba*: North West Pacific; *Phocoenoids dalli*: North West Pacific, *Phocoena phocoena*: North Atlantic] - Research on direct fisheries [same species] - Regional Fisheries Accounts and Catch Statistics [Temperate North Atlantic, Black Sea, Eastern Tropical Pacific, North Pacific, Temperate South Pacific, Indian Ocean, Antarctic] -The problem of competitive interactions between fisheries and small cetaceans - Live-capture fisheries

Annex 4: Presentations PDFs