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Progress report from the Arabian Sea Whale Network

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Progress report from the Arabian Sea Whale Network

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Abstract:

The Arabian Sea Whale Network (ASWN) is an informal collaboration of researchers and conservation bodies interested in the conservation of whale populations throughout the Northern Indian Ocean. Formed in 2015, the Arabian Sea humpback whale acts as a flagship species, but members collaborate on all aspects of cetacean research and conservation. This progress report includes updates on regional-level collaborative activities undertaken between May 2021 and April 2022, as well as updates on project- by project or national level activities undertaken by partners in the region. Regional level activities have been limited due to the lack of funding for coordination, as well as world events that demand more immediate attention. In particular, there has been little progress on the formal establishment of a joint CMS-IWC Conservation Management Plan. However, ASWN members are in regular communication and provide continued technical support to each other. The project updates from partners demonstrate a clear trend toward increased capacity for systematic cetacean research in most ASWN member countries, with a number of peer-reviewed publications emerging from the region over the past year. The updates also demonstrate how many ASWN partners are applying knowledge gained from cetacean research to outreach, awareness raising, threat-mitigation and engagement with the relevant stakeholders responsible for conservation policy and management. These efforts will help to progress conservation-management throughout the region until such time as an effective regional conservation management plan can finally be implemented.

1. Introduction and Background

The Arabian Sea Whale Network (ASWN) is an informal collaboration of researchers and conservation bodies interested in the conservation of whale populations throughout the Northern Indian Ocean. The Arabian Sea humpback whale (ASHW) is the flagship species, but all large whale species are of interest. Formed at the conclusion of a January 2015 workshop in Dubai, the ASWN does not have formal legal status or governmental recognition. A [website](#) and a logo create a sense of unified purpose and facilitate communication, fund-raising, collaborative research and data management and analysis. [Members](#) include independent researchers and consultants, researchers linked with academic institutions, and representatives of local, national and international NGOs, IGOs and government bodies. More information and background on the network are available through the website, [2015 inaugural workshop report](#), and other documents submitted to this and [past meetings](#) (see below). While on-the-ground research and conservation work in the Arabian Sea region is conducted by members at a project or national level, the network helps to promote the exchange of information and place local experience into a regional framework. It also helps to ‘champion’ the work conducted by individual members.

2. Contributions to the IWC SC from Arabian Sea Range States

In 2021 the ASWN submitted a brief progress report to the IWC Scientific Committee meeting (SC/68C/CMP05_Rev1), and ASWN members submitted additional papers to the CMP and other subcommittees. This report represents an update on activities conducted since May 2021. Due to COVID-related restrictions on fieldwork, fewer papers are being submitted to this year’s meeting by ASWN members than in past years. Papers that are relevant to whale conservation in the Arabian Sea are:

- SC/68D/CMP/11: Oman Cetacean Research And Conservation Activities Status Update 2022
- SC/68D/CMP/03: Sightings of whales in the Northern Arabian Sea along the coast of Pakistan in 2021
- SC/68D/SM/01: Kuwait Marine Mammal Strandings for 2014
- SC/68D/ForInfo/77: Protecting Blue Corridors - Challenges and solutions for migratory whales navigating national and international seas
- SC/68D/ForInfo/70: Marine Mammal Atlas of Oman

3. Regional-level activities and developments

The ASWN coordinator role has not been funded since April 2019. As such, less time has been dedicated to some of the core functions of the network. However, a dedicated group has worked to maintain momentum on a number of initiatives described below.

3.1 Network communication and collaboration

The [ASWN website](#) is updated regularly (roughly once every few months) with [news items](#), ranging from new publications, to results of workshops, and newsworthy developments in ASHW range states. ASWN members remain in regular contact through a group email list (Google Group), which has been used throughout 2021 to share news between members about whale sightings and strandings in the region, as well as announcements of important meetings, funding opportunities, new publications and resources, etc.

The network held a virtual meeting in [June 2021](#) focusing on the ASWN Flukebook platform and ways that ASWN members can make more use of it for humpback whale and humpback dolphin photo-identification.

3.2 Regional database

The Arabian Sea Whale Network continues to test and refine its **regional online database** developed using the [Flukebook](#) platform and funded in part by the IWC SC. This is accessible through a [dedicated page](#) on the ASWN website, which includes instructions for obtaining an account, as well as links to videos demonstrating how to conduct data searches and matching on the platform. The volunteer coordinator has worked with the Indian Ocean Network for Cetacean Research ([Indocet](#)), and the Flukebook developers to continue to refine the work flow and tools within Flukebook intended to support long term photo-identification data management and collaboration between research groups. These tools are described in a recent peer-reviewed publication titled “Flukebook: an open-source AI platform for cetacean photo identification” (Blount et al., 2022).

3.3 Regional tools for stranding response

During a virtual ASWN meeting in February 2021 a Stranding Working Group was formed, with the aim of compiling and/or creating improved resources for stranding response in the region. This working group is convened by Yusuf Bohadi and Ada Natoli. As a starting point, the working group reviewed information and resources available through the [Global Stranding Network](#) and the [IWC Strandings Initiative](#) and these were shared with all ASWN members.

In order to better support ASWN members in countries that do not have an official or functional stranding network, the working group is striving to provide tools that can guide data and sample collection at three different levels depending on responders’ experience and the equipment available:

- Tier 1: guiding the responder in reporting basic data (date/ location), taking useful pictures and basic measurements
- Tier 2: guiding the responder in gathering more detailed measurements and collecting basic samples through simple procedures.
- Tier 3: guiding the responder in implementing a more comprehensive necropsy having available the required skills and facilities

Ada and Yusuf have almost completed these draft protocols, but are currently reviewing additional protocols used in the region. Once a draft of the protocols is complete, it will be shared with ASWN members and external experts for feedback before it is translated into Arabic and other range country languages and shared throughout the network. Yusuf is also testing an online reporting system, which will be easy for a wide range of stakeholders to use and share.

The working group has noted that one common obstacle to effective and timely stranding response is the question of who has the legal authority to respond and collect data and samples. Different governments have different legislation in this regard and it is important that responders are aware of this. It is also important that the authorities are aware and are involved in the process, as they can provide the necessary authorizations if required.

3.4 Genetic analysis of ASHW samples and the *Megaptera indica* type specimen

Funding was approved by the IWC SC in 2016 to conduct genetic analysis of ASWH samples and the type specimen for *Megaptera indica*. The type specimen was sampled at the Paris Museum of Natural History in November 2019. However, issues related to COVID-19 have prevented its shipment from France to New

York, and thus prevented analysis. This is also a factor in the delay of analysis of additional samples from Oman to better understand taxonomy of ASHW. In recent weeks all the relevant permissions (e.g., CITES, ESA, MMPA) were finally secured by WCS, AMNH, and Paris Museum to complete the shipment; unfortunately delays with the carrier understanding/adhering to permit requirements continued, possibly due waves of COVID and staffing. A colleague now based in Paris is now coordinating with the carrier to complete shipment.

3.5 Progress toward a joint IWC-CMS Conservation Management Plan (CMP)

In October 2017, the Convention on Migratory Species approved a [Concerted Action for Arabian Sea humpback whales](#) (CMS, 2017). Since that time, discussions have been underway between relevant stakeholders in order to promote the implementation of a joint IWC-CMS regional Conservation Management Plan. An IWC CMP would require endorsement by the only two ASHW range countries that are IWC members, India and Oman. Due to COVID and changes in key government and IGO positions, efforts to draft and implement such a regional CMP have not progressed in the past year. However, the Environment Society of Oman has secured funding to embark on a national CMP process involving relevant government stakeholders. More details are provided in the section focusing on Oman below, and Annex 1, which outlines progress made against each of the categories of actions proposed in the CMS Concerted Action for Arabian Sea humpback whales (CMS, 2017).

4. Project-based and national level progress

As COVID 19 restrictions were gradually or intermittently lifted over the past year, ASWN members have continued to conduct important research and conservation activities throughout the ASHW range, making contributions to progress on the CMS Concerted Action and the hoped-for progression to a joint IWC-CMS CMP. The updates below demonstrate a trend toward increased capacity for systematic cetacean research in most ASWN member countries, with a number of peer-reviewed publications emerging from the region over the past year. The updates also demonstrate how many ASWN partners are applying knowledge gained from cetacean research to outreach, awareness raising, threat-mitigation and engagement with the relevant stakeholders responsible for conservation policy and management.

4.1 Oman:

Capacity building and Outreach

The Environment Society of Oman (ESO) has been engaged in a social media campaign to raise awareness of Endangered ASHW, and to encourage members of the public to share sightings and photos with [this video](#). Funds have also been secured to support a dedicated capacity building programme for ASHW conservation. Two interns have been funded to work with ESO over a period of two years. Their training and experience has included participation in whale surveys, as well as educational and social media outreach activities focused on ASHW. Following some classroom and boat-based training in Muscat, they participated in three days of the November 2021 field survey (detailed below), and gained more experience in survey methodology, including data collection, photography for individual identification, and data download and archiving.

In March 2022, additional funding was secured to conduct classroom- and field-based training for up to five Omani graduates, who, by the end of the training, should be able to contribute to multiple aspects of ASHW research and conservation. More details on this initiative are available [here](#), as well as in SC/68D/CMP/11.

A collaborative effort between the ESO, the Environment Authority, and Five Oceans LLC resulted in the publication of the [Marine Mammal Atlas of Oman](#), which will serve as a resource for a wide range of stakeholders who can now more effectively take cetaceans into account in any activities that they are planning.

Field Research

In November 2021, an international team conducted a three-week long survey in the Gulf of Masirah to document distribution, conduct photo-identification, and use UAV photogrammetry to assess the body condition of Arabian Sea humpback whales. In contrast to the March 2021 fieldwork during which no humpback whales were encountered, over 20 individual ASHW were encountered and photographed over 17 days of fieldwork, which was split between a film and research crew based near the Port of Duqm and a purely research-based team based further north at Sarab. This fieldwork, partially funded by a research grant awarded by through the CMP Subcommittee during IWC SC 68C, also included a training component for Omani graduates, one of whom was present for over 10 days of fieldwork, by the end of which she had mastered fully mastered data collection, download and entry protocols.

Fieldwork also included mapping of fisheries effort, which will contribute to a wider project focused on mapping and assessing co-occurrence of whales and fisheries. Finally, in addition to the field work in Gulf of Masirah, a short trip was conducted to Hasik in November 2021, for the retrieval and redeployment of a SoundTrap recorder that was originally deployed in May 2021, and recorded from May to October. A more detailed summary of the results of this 2021 fieldwork are presented in SC/68D/CMP/11.

Conservation management measures

A Willson contributed a section focusing on the Indian Ocean to a WWF Report titled “Protecting Blue Corridors - Challenges and solutions for migratory whales navigating national and international seas” (submitted to this meeting as SC/68D/ForInfo/77). This chapter highlights risks to ASHW and blue whales in the Northern Indian Ocean/Arabian Sea posed by co-occurrence with shipping routes. Willson and the ESO are currently engaged in discussions with relevant government authorities in Oman, as well as shipping industry representatives to evaluate different risk mitigation strategies. See SC/68D/CMP/11 for more details.

An entangled humpback whale was [successfully released in Duqm Port, Oman in January 2021](#) through a wide collaborative effort between the Environment Authority, Five Oceans Environmental Services LLC and Future Seas Global SPC, supported by the Environment Society of Oman (ESO) and the Port of Duqm. Assistance was also sought from Oman’s Coast Guard, Royal Air Force of Oman, as well as members of the IWC entanglement expert panel. Later reports and photographs revealed that the same individual whale (OM11-016) was observed near the port in October 2020, and then inside the port for several days in December 2021. Given the risk this prolonged presence inside the port presented to both the whale and port operations, the same stakeholders that collaborated to release the whale in January 2021 worked together to design and implement a monitoring and mitigation plan until the whale exited the port in January 2022.

Stakeholders are now collaborating to form an effective long-term management plan for this potentially habituated whale.

A behaviour change case study titled '*Addressing marine wildlife entanglement in derelict fishing nets using Community-Based Social Marketing: case study and lessons learned*' was published in November 2021 in the Social Marketing Quarterly journal (Sarrouf Willson et al., 2021). Results showed that fisheries operating in the Gulf of Masirah, a core habitat for ASHW, had very low rates of compliance with the offered methods of responsible disposal of fishing nets.

ESO organised a Responsible Whale and Dolphin Watching Campaign with boat operators between May and October 2021. The team compiled a [booklet](#) featuring previously produced guidelines for responsible whale and dolphin watching in Oman, in addition to material from the recently published [IWC Whale Watching Handbook](#). More details on all three of these initiatives can be found in SC/68D/CMP/11.

4.2 Pakistan

Monitoring of cetaceans through WWF-Pakistan's crew-based observer programme was initiated in 2012 (see, for example, Moazzam and Nawaz, 2017). The skippers of tuna gillnet vessels were trained to collect data on target catch, bycatch and sightings of cetaceans during their fishing operations. Although the programme has not been funded since September 2019, a core group of volunteer vessel captains continues to provide reports of whale sightings on a volunteer basis. Sightings made during 2021 are summarized in SC/68D/CMP/03, and include four sightings of Arabian Sea humpback whales, one sighting of a blue whale, one stranding of a Bryde's whale and 28 sightings of unidentified whales.

The crew-based observer programme also resulted in a pre-print publication focusing on bycatch of beaked whales (Kiani et al., 2021). Another publication by the Centre of Excellence in Marine Biology, University of Karachi will be published in the Journal of Chemical Society of Pakistan in October 2022. The paper reports the detection of 35 pollutants along with 45 metabolites from the blubber of a stranded blue whale (*Balenoptera musculus*) along the coast of Pakistan (Naz et al., In Press).

There is a strong need for the continuation of alternative monitoring programs such as crew-based observers for the improved coverage of the whales of sighting of whales from Pakistan. There is also need of the enhanced research to enhance science-based evidence to assess and better understand the population structure of the stranded whale species from northern Arabian sea.

4.3. India

2021-2022 saw an increase in passive acoustic monitoring efforts focusing on Humpback whales on the west coast of India, as well as an increase in the number of informants in the participatory network along both the east and west coasts.

Humpback whale acoustics

Karnataka: In 2021, the team started to analyse the vocalisations of a humpback whale recorded on a 300STD SoundTrap deployed off Netrani island from 2019 to Feb 2020 (D'Souza et al., In prep.). This SoundTrap stopped working in March 2020 and has been sent for repair. A new SoundTrap 500STD funded by the Karnataka State Forest Department, was deployed at the same location on 30th January 2021 and

stopped functioning in early March 2021. The Karnataka State Forest Department deployed another 500STD, which was functional between November 24th, 2021 and March 28th, 2022. The files from this latest deployment are yet to be downloaded and analysed.

Kerala: A SoundTrap 300STD with a battery pack was deployed at 37m depth in Poovar, Kerala (at the border between Kerala and Kanyakumari) on March 10th 2021. From March-June 2021 this unit recorded blue whale songs from at least two individuals, including both socialising and foraging call types. The same device was re-deployed twice, but stopped functioning in February 2022. This SoundTrap has to be sent for repair in order to hopefully retrieve the data recorded during the last deployment from December 2021 to February 2022.

Live Sightings

In 2021-2022 two records of live sightings of humpback whales were reported in India (<http://www.marinemammals.in/database/sightings-and-strandings/>).

- The first live sighting was on November 19th 2021, off the coast of Karnataka, south of Malpe. This sighting was captured in video recorded by fishers and shared with local participatory network coordinator, Professor S. Haragi.
- The second sighting, recorded by researcher Sohom Seal, on February 4th 2022 took place in the northern Gulf of Mannar. Video captured by S. Seal includes evidence that the whale was foraging

4.4. Sri Lanka

A research team involving R. Nanayakkara has have analysed sperm whale codas in Sri Lanka with a resulting publication in press. This same team is using local volunteers to monitor fishing landing sites and fishing practices in northwest, southern and eastern waters of Sri Lanka. They are also consolidating records of humpback whales in Sri Lankan waters, with a focus on the eastern half of the Gulf of Mannar, and plan to submit this to a peer-reviewed journal in the near future. Finally, the team has completed a study of Cuvier's beaked whales in the eastern half of the Gulf of Mannar, which should also result in a peer-reviewed publication.

The Oceanswell research team has also undertaken a range of research initiatives including:

- Contribution of sperm whale coda analysis from Sri Lanka to a global coda analysis (Gero et al. In prep – working title ‘Global ethnogeography of sperm whale clans’)
- A paper on sperm whale diet currently in prep.;
- Contribution to a review of humpback whale records from the Central Indian Ocean (Anderson et al. In press – see more below under Maldives);
- An analysis of lesions on blue whales in Sri Lankan waters;
- An ongoing analysis of entanglements of Sri Lankan blue whales;
- An update to the Oceanswell photo ID database including blue, Bryde's, Omura's, humpback and pilot whales from Sri Lanka up through 2020 and ongoing progress on updates through 2022; and
- Three papers related to whale watching and whales in Southern Sri Lanka currently in prep.

4.5 Maldives

A review of humpback whale records from the Maldives and elsewhere in the central Indian Ocean (southern India, Sri Lanka and Chagos) is in press with the IWC's Journal of Cetacean Research and Management (Anderson et al., In press). The data show a bimodal pattern of seasonal occurrence. Those humpback whales occurring during the northern winter (December to March) are known from other studies to belong to the Arabian Sea population. There have been no humpback whales recorded in Maldives during the northern winter since 2002, suggesting a possible range contraction for the Arabian Sea humpback whale population. Humpback whales occurring during the southern winter (June to October) are assumed to belong to the southwest Indian Ocean population (IWC breeding stock C). In this case, numbers of opportunistic sightings are increasing and the population appears to be spreading northwards as it recovers from commercial whaling, with several recent southern winter records from as far north as 5°N in northern Maldives and southern Sri Lanka. For this southern hemisphere population, calves are first seen in August, with numbers of calves increasing in September and October. For both populations, interactions with regional fisheries, particularly pelagic gillnetting, may be a major cause of mortality.

A line-transect survey is underway in Maldivian waters April 2022, with the aim of estimating cetacean relative abundance around the northern Maldivian atolls. This survey repeats previous surveys from April 1998 and April 2013, potentially providing a time series for the estimation of population trends. The Maldives Marine Research Institute (MMRI- the government agency responsible for marine biological research and the provision of management advice on marine resources) has, appointed a staff member with official responsibility for cetaceans. This MMRI staff member is currently participating in the April 2022 cetacean surveys.

4.6 Iran

Plan for the Land Society

Plan for the Land members published a peer-reviewed journal article titled " Abundance estimation, group dynamics, and residence patterns of Indian Ocean humpback dolphin (*Sousa plumbea*) in the Dayer-Nakhiloo Marine National Park, Northern Persian Gulf, Iran " (Mohsenian et al., 2022). This publication is the result of 4 years of photo-identification effort focusing on the Indian Ocean humpback dolphin in the Dayer Nakhiloo Marine National Park. The results of this study have been used to draft a national action plan for Indian Ocean humpback dolphins in the north Persian Gulf.

In the past two years, two dead baleen whales were stranded on Kish Island, and the Plan for the Land team was involved in data and sample collection as well as the necropsy. Plan for the Land also responded to a stranding of a live finless porpoise calf. Efforts to rehabilitate the animal were sadly unsuccessful, despite remote support from stranding experts and veterinary pathologists.

COVID and sanctions prevented boat surveys over the past year, so the team has used the time to focus on preparing training materials for the release of small mammals in the fishing nets, including a book and animation, and face-to-face training with fishing communities.

4.7 United Arab Emirates

Fujairah Whale and Dolphin Project

As part of on-going research on whales and dolphins of the Emirate of Fujairah, U.A.E., conducted under the auspices of the newly established Fujairah Research Centre, the first cetacean survey of 2022 was conducted in March including an aerial survey and vessel-based survey in offshore waters of Fujairah. The main objective of the survey, which occurred between 21-25th March inclusive, was to allow for determination of the relative distribution and presence or absence of species in offshore Fujairah waters and to compare results with previous surveys, including surveys conducted in 2017, 2018 and 2021. Cetaceans were encountered on 37 occasions in March 2022, including six different species: common bottlenose dolphin (*Tursiops truncatus*), Indo-Pacific common dolphin (*Delphinus delphis tropicalis*), spinner dolphin (*Stenella longirostris*), Risso's dolphin (*Grampus griseus*), striped dolphin (*Stenella coeruleoalba*), and rough-toothed dolphin (*Steno bredanensis*). Analysis of data has begun to estimate absolute abundance of species for which sufficient data are available, and plans are underway to begin photo-identification studies based on a growing photo-database. The project also seeks collaborators for analysis of *T. truncatus* biopsy samples (n=32).

(see www.fujairahwhales.com and follow the social media links).

UAE Dolphin Project & Zayed University

From February 2021 onward, dolphin surveys in Dubai waters have been supported by Atlantis the Palm, Zayed University and F3 Marine. These surveys are conducted under a permit from the Dubai Municipality. In total 60 surveys comprising a total of 344 hours of navigation have achieved systematic spatial coverage of 1000 Km² of Dubai coastline extending 20 km offshore. A total of 18 cetacean sightings were recorded: 12 of Indo Pacific Bottlenose Dolphin (*Tursiops aduncus*) and six of finless porpoise (*Neophocaena phocaenoides*). No sightings of Indian Ocean humpback dolphins (*Sousa plumbea*) were recorded, despite the similar effort compared to 2014 surveys, when humpback dolphins were the most abundant species recorded in the area. Photo-identification and abundance estimate analysis of the recent survey data is ongoing. Acoustic monitoring has also started with one F-Pod placed in a coastal area known to be frequented by humpback dolphins during the 2014 survey. Funding has been secured for a second year of surveys.

Project members published a peer-reviewed paper titled "Citizen science data of cetaceans in the Arabian/Persian Gulf: Occurrence and habitat preferences of the three most reported species" (Natoli et al., 2021). The paper provides an analysis of the different habitat preferences of the coastal species most commonly reported through citizen science efforts between 2012-2019. Citizen science data collection still continues with active participation from a broad base of stakeholders.

In collaboration with the local authorities (Dubai Municipality, Environment Agency Abu Dhabi and EPAA Sharjah) a number of stranding events were investigated to conduct necropsies and collect data and samples. These strandings include a male Bryde's whale stranded in June 2021 in Dubai. The UAE Dolphin Project is collaborating with the local authorities of Dubai and Abu Dhabi to support the formation of an effective stranding network.

4.8 Kuwait

A volunteer group has established a foundation focusing on whale and dolphin conservation in Kuwait: the Whales and Dolphins Protection Team (@wdpt_q8). Formally recognised and approved by the Kuwait Ministry of Affairs, the team is collaborating with relevant government agencies (see below) in order to maximise effectiveness in Kuwait's management of cetacean-related issues. The group previously known as cetaceansQ8, is also coordinating citizen science reporting of sightings and strandings through a [mobile App](#). The WDPT will be offering a workshop on photo-identification survey methodology the end of the current year.

The Environmental public authority of Kuwait (EPA) has been collaborating with the IUCN Biodiversity & Protected Areas, World Heritage Programme, regional Office for West Asia to prepare for and conduct surveys to monitor cetaceans. These surveys have yielded sightings of Indo-Pacific bottlenose dolphins (*T. Aduncus*), which were documented for the first time in Khiran and Qaruh island. The Kuwait Institute for Scientific Research (KISR) is also currently involved monitoring cetaceans.

The pathology lab at the Public Authority for Agriculture and Fisheries has also been documenting and investigating marine mammal strandings. ASWN member, Mr. Husain Al-Sayigh, is working with colleagues to prepare and disseminate a report on earlier records of finless porpoise and Bryde's whale stranding events (see SC/68D/SM/01).

ASWN members Manickam Nithyanandan and Yusuf Bohadi also published a recent paper titled "Incidental mortality events of the Indo-Pacific Finless Porpoise, *Neophocaena phocaenoides* in Kuwait, Northwestern Arabian Gulf" (Nithyanandan and Bohadi, 2021).

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Annex 1 Progress on the activities identified in the CMS Concerted Action for Arabian Sea humpback whales as of April 2021

Arabian Sea Humpback Whale Concerted Action: Priority Activities and Outcomes		
Activity	Expected Outcome	Progress as of April 2021
<i>Addressing knowledge gaps</i>		
The development of a marine mammal reporting smartphone App and citizen science tools, to allow the crews of fishing, coast guard and whale-watch vessels and ferries to record and report whale and dolphin observations.	Improved data and models of current humpback whale distribution throughout the Arabian Sea	ASWN members have briefly tested Apps that can be used by tourism companies and members of the public, as well as for research (e.g. Spotter Pro , Whale Alert , Seafari). However, due to COVID and lack of funding to date, none are yet in regular use, or translated into the languages used by range states.
Collaborative boat-based research to continue photo-identification studies, collect genetic samples, and identify critical habitat. The involvement of local scientists in this research will build capacity for future conservation in the region.	Improved data on whale distribution, habitat use, population identity and connectivity between regions, and increased number of qualified cetacean researchers in the region.	Boat-based research has continued in Oman. A survey was planned in Pakistan in January 2020, but cancelled due to permitting and security issues, and not rescheduled due to COVID. Funding was also secured to conduct boat surveys in the Karnataka province of India. Equipment was procured, and surveys were due to commence in March-April 2020, but were postponed due to COVID-19. Funding has not yet been obtained for large-scale collaborative research efforts. However, a systematic cetacean survey is taking place in the Maldives in April 2022. Furthermore, researchers working in India, Sri Lanka, the Maldives and Chagos have published a review of all available information on humpback whales in the Central Indian Ocean to assess seasonal trends and possible population affiliations. A publication is expected later this year.
Use of passive acoustic recorders to detect the presence of whales and monitor human introduced noise in areas that are logistically difficult or dangerous to survey.	Improved understanding of whale distribution in Eastern Arabian Sea (e.g. Gujarat and Rann of Kutch)	Recordings made in Oman in 2012-13 have been analyzed and the valuable results have presented at the IWC (Cerchio et al., 2016; Cerchio et al., 2018). A manuscript on blue whale song recorded offshore from Oman was published with great media attention, and a new PAM effort to record in deep water off Oman commenced in March 2020. Opportunistic recordings have also been analyzed from India (Mahanty et al., 2015; Madhusudhana et al., 2018). SoundTraps procured with funding from the IWC and the Karnataka State Forest Department have been collecting data which is currently being analyzed, with one paper already submitted for peer-review. Funding and logistics. Funding and logistics have not yet been in place to conduct larger scale passive acoustic surveys off of Pakistan.
Genetic analysis of samples collected from strandings and during dedicated whale surveys to determine whether Arabian Sea humpback whales comprise a new sub-species.	Likely designation of ASHW as new species or sub-species, understanding of kinship and relatedness of sampled whales	The type specimen for <i>Megaptera indica</i> was sampled at the Paris Museum of Natural History in November 2019. However, issues related to COVID-19 have prevented its shipment from France to New York, and thus prevented analysis. This is also a factor in the delay of analysis of additional samples from Oman to better understand taxonomy of ASHW. In recent weeks all the relevant permissions (e.g., CITES, ESA, MMPA) were finally secured by WCS, AMNH, and Paris Museum to complete the shipment; unfortunately delays with the carrier understanding/adhering to permit requirements continued, possibly due waves of COVID and staffing. A colleague now based in Paris is now coordinating with the carrier to complete shipment.
		Although not listed as one of the targeted activities in the Concerted Action, the rationale refers to the need to monitor humpback whale health and threats through . An IWC grant facilitated a visual health assessment of all humpback whale images collected off the coast of Oman from 2000 onward. This assessment is in press with the Journal of Cetacean Research and Management. IWC support also facilitated modelling of abundance and trends for the ASHW population based on photo-identification and genetics data from Oman.
		Regional ASHW ecological niche modeling work previously presented to the IWC (Willson et al. 2017) has been updated with results of more recent satellite telemetry work and a refined method. A ship strike risk assessment based on co-occurrence between identified whale habitat and AIS derived shipping traffic density mapping contributed to a WWF

		report on ' blue corridors ', and will be submitted for peer-reviewed publication in the coming months.
Information sharing and awareness raising		
The development of a regional shared online data platform to promote standardization, comparability and timely analyses of data collected throughout the region. This will be used to facilitate the creation of sensitivity maps and assist stakeholders in the design of local, national and regional conservation strategies, including protected areas	Improved understanding of ASHW distribution and connectivity between study areas.	Three years of collaborative development between ASWN members, Flukebook , and Indocet , have resulted in the completion of an ASWN online database that uses the Flukebook Platform. This new data platform allows uploading, archiving, and analysis of cetacean sightings data, as well as use of 'computer vision' to conduct automated matching of humpback whale tail flukes within, and between research projects in the Arabian Sea and wider Western Indian Ocean.
An improved website that provides a portal to the shared database (see above), informs the general public of whale conservation needs, and provides members with a range of outreach tools to engage governments and other stakeholders in their region and involve them in Whale conservation efforts	Increased awareness of ASHW conservation needs among stakeholders	The Arabian Sea Whale Network website has undergone some improvements, and is maintained with updates and news items , as well as a page dedicated to the new data platform . The ASWN has produced an infographic to use in reaching out to stakeholders, as well as three issues of a newsletter . The Environment Society of Oman created a very effective video on ASHW and on ghost nets . However, more could be done to create a wider variety of outreach tools, including power-point presentations, videos, or other tools in multiple languages.
Capacity building and development and implementation of mitigation strategies		
Organization of targeted regional workshops, meetings and training opportunities that will involve local and national government agencies as well as young scientists, build capacity and develop multi-stakeholder mitigation strategies and conservation measures in key range states.	More effective stranding/entanglement response leading to better survival of affected cetaceans, improved data on bycatch/entanglement rates throughout the region, increased government participation	A workshop was held in Oman, in January 2018, focusing on the final stages of development of the ASWN Flukebook data platform, as well as the issue of data collection from fisheries in the region. The full workshop report can be downloaded here . Many of the researchers working with Arabian Sea humpback whales were also involved in the IUCN Important Marine Mammal Areas workshop for the Western Indian Ocean and Arabian Seas . While organized with different aims, it also involved opportunities for regional capacity building and stakeholder engagement particularly with the Oman government representatives who were present.
Replication of ship strike mitigation strategies from Oman, and by-catch mitigation from Pakistan to other parts of the Arabian Sea.	Reduced risk of ship strike throughout region, improved chance of survival of entanglement	It is hoped that ASWN participation in the IWC hosted workshop focusing on bycatch in the Indian Ocean , and a possible IWC Pilot project in Pakistan will lead to more effective monitoring, reporting and mitigation of bycatch in the region. ASWN members are also working closely with the IOTC to report results from Pakistan. Development of a region- wide approach to ship strike mitigation is expected to be partly informed by the ship strike risk assessment currently in progress (and discussed in the section on addressing knowledge gaps above).
Development of a range-state endorsed regional ASHW Conservation and Management Plan	Regional Conservation and Management Plan to promote long-term coordinated and collaborative conservation and management across the ASHW range participation	Discussions are still underway between the CMS Appointed Councilor for Aquatic Mammals, the regional representative of CMS Office - Abu Dhabi, and the various representatives of the International Whaling Commission and its member states focused on initiating development of an IWC ASHW Conservation Management Plan that if finalized would be jointly endorsed by IWC and CMS. Government-level endorsement from both India and Oman, the only two ASHW range states that are IWC members, remains to be confirmed and discussions are still ongoing.