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**Oman Cetacean Research and Conservation Activities Status Update 2022**

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INTERNATIONAL
WHALING COMMISSION

# Oman Cetacean Research and Conservation Activities Status Update 2022

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## ABSTRACT

Marine mammal research was initiated in Oman in the mid 1980s, with formal vessel-based research starting in 2000, focused on humpback whales (*Megaptera novaeangliae*) of the Arabian Sea. These efforts resulted in the description of an isolated population of humpback whales estimated to number fewer than 100 individuals based on studies conducted off the coast of Oman. The small population size together with documentation of escalating threats throughout the region have been key elements forming the research and conservation agenda. The work includes a focus on generating metrics to track the health and status of the population and identifying and evaluating threats. Research is complemented by outreach activities and the development of capacity for local institutions to engage in management efforts. This report provides updates on activities from May 2021 through March 2022, including studies on body condition and visual health assessment work, and progress with deployments and analysis of passive acoustic monitoring units. It also documents successes with the translation of research into science communication documents, including the *Marine Mammal Atlas of Oman* and *Protecting Blue Corridors* report and the advocacy of efforts to communicate ship strike risk assessments to local authorities. Recent funding secured for trainees in field research, advocacy and outreach in 2022/2023 will further help to ensure that research results obtained to date are translated into effective conservation management. The document also reflects the positive influence of IWC SC recommendations and funding support for addressing the important components required for management of cetaceans in the Sultanate of Oman.

# INTRODUCTION

Scientific investigations of Oman's marine mammals began in the mid-1980s when the Oman Natural History Museum began cataloguing stranded specimens. At the same time, a database of at-sea sightings made during coastal zone management field surveys was also established. Standardised vessel-based surveys were initiated in 2000, with a primary focus on humpback whales off the Arabian Sea coast of Oman (5OES & ESO, 2021). Since this time, photo-identification, acoustic, genetic sequencing and bio-logging techniques have been used to describe the identity, conservation status, health, and spatial ecology of the population, referred to as the Arabian Sea Humpback Whale (ASHW), currently listed as Endangered on the IUCN Red List of Threatened Species and potentially isolated in the northern Indian Ocean for approximately 70,000 years (Minton et al. 2008, Pomilla, Amaral et al. 2014, Cerchio et al. 2016, Willson et al. 2018).

Research and conservation work in Oman is primarily hosted by the Environment Society of Oman in conjunction with a broad array of collaborators and under the guidance of the Ministry of Agriculture, Fisheries Wealth and Water Resources and the Environment Authority. Much of the scientific project work in Oman has been initiated as a result of the support and recommendations made by delegates at IWC SC meetings. The small population size of the ASHW population (N=82 95% CI 60-111), together with concerns of escalating threats throughout its range has necessitated promotion of management and mitigation strategies to protect the population (Minton et al. 2008, Minton et al. 2011Convention on Migratory Species 2017, Baldwin et al. 2010). The IWC first recommended a regional Conservation Management Plan (CMP) for this population in 2011, with several successive recommendations thereafter. Relevant stakeholders are still engaged in discussions aimed at advancing a joint CMS-IWC regional CMP. This report presents recent research and conservation activities in the Sultanate of Oman which target conservation management needs and the previous recommendations of the IWC. Locations referenced within the report are found within Figure 1 below.

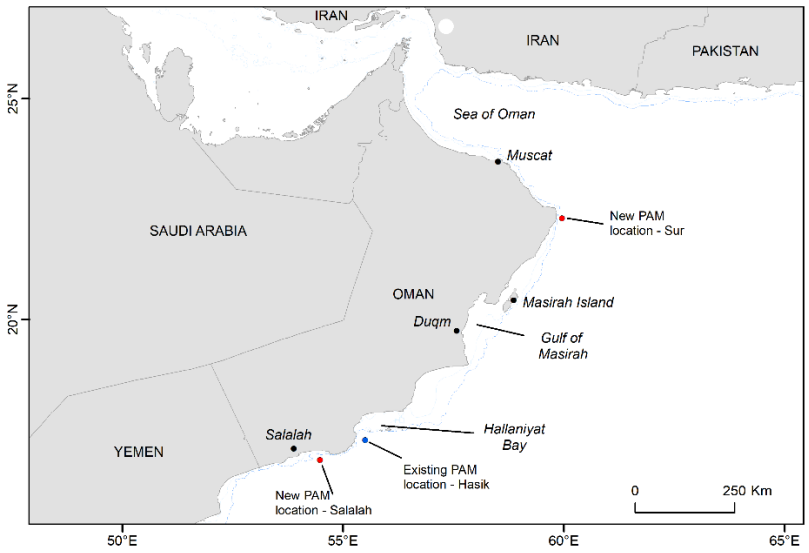


Figure 1. Locations related to Oman research and conservation activities referenced within this report.

# RESEARCH ACTIVITIES

## Health Assessments

Ongoing health assessment work on ASHW is being conducted as a result of two processes. The first being the assessment of Key Ecological Attributes (WWF, 2012) and the second being the draft Concerted Action Plan for ASHWs (Convention on Migratory Species, 2017). Current work includes:

- Visual health assessments using photographs from vessel and UAV platforms assessing the prevalence of tattoo-like skin disease and scarring related to anthropogenic and natural threats.
- Body condition analysis based on measurements derived from UAV photogrammetry techniques.

During IWC SC 68B and 68C proposals were accepted to support funding of Oman-based ASHW body condition surveys. Surveys in March 2021 failed to detect ASHWs off a study site in Hasik, southern Oman (See Willson et al 2021 – SC/68C/CMP04). In November 2021 the team conducted a 3-week survey in the Gulf of Masirah, comprising 17 days of vessel time and encounters with over 20 individual ASHWs. The surveys used the same methods as utilized in November 2019 (Christiansen et al. 2020 – SC/68B/CMP23). Boat based photo-ID data were obtained for all encounters and biopsies were obtained for 15 whales, and will contribute to future studies. Encountered whales included individuals that were first photo-identified in the same area in 2001, as well as individuals that were first identified in more recent years, and at least five individuals not previously identified in the Oman humpback whale Photo-ID catalogue (ESO 2022). Although photographs obtained during the survey have been reviewed for individual identification, analysis of health and scarring and body condition is still underway and will continue through the second half of 2022.

UAV and vessel-based photo data from 2017 and 2019 ASHW field surveys, including encounters with 18 whales, have been used to conduct a comparison between, and evaluate the utility of, each method for conducting health assessment studies. Originally proposed to the IWC SC67B as a research objective (Willson et al. 2018) the recently drafted manuscript focuses on evaluating tattoo-like skin disease in ASHWs and is currently *in prep* under the title: *Remote and non-invasive quantification of Tattoo-like Skin Disease in Endangered Arabian Sea humpback whales using drone photography (Leslie et al. in prep).*

Results of epidemiological studies using vessel-sourced photos of ASHWs previously reported in IWC SC68B (Minton et al. 2020 - SC/68B/CMP16_rev1_) and review of tattoo-like skin disease, fisheries and vessel interactions, predation and scaring from tagging research activities are currently *in press* with the Journal of Cetacean Research and Management and due for publication in 2022 under the title: *Visual health assessment and evaluation of anthropogenic threats to Arabian Sea humpback whales in Oman (Minton et al. 2022).*

Co-funding through local sponsors at the Environment Society of Oman and support through Aarhus University Department of Biology will allow for an additional ASHW body condition survey in November 2022.

The above progress addresses specific recommendations from IWC SC meetings (IWC, 2021, p 61):

*'(1)* **recommends** *that ASWN members and relevant ASHW range states undertake and support the work proposed in the CMS Concerted Action, especially those actions needed to address knowledge gaps and assess the Key Ecological Attributes (KEAs), and to apply them to practical management measures;*

*'(4)* **encourages** *….2) that research include the use of UAVs to assess body condition, and that body condition indices be used together with other metrics to assess seasonal and annual variation and to evaluate health, scarring, and foraging success (e.g. Ramp et al. 2021)…'*

## Acoustic Studies

Passive acoustic monitoring units were initially deployed off Oman for two years during 2011 to 2013, to assess soundscapes in areas associated with important ASHW habitat. Studies characterized temporal presence of song and associated ambient noise profiles, with ASHW song detected from November through to May (Cerchio et al. 2016). Data were used to complete regional song comparisons with the songs from the Southwest Indian Ocean (SWIO) and a small sample from the west coast of India. The absence of shared phrases with the SWIO further supported the isolation of ASHW; however, the finding of SWIO whale song off Oman in the Austral winter of 2012? provided positive confirmation of the presence of some SWIO whales in Omani waters during this period (Cerchio et al. 2018). Initial comparisons with a few phrases from India indicated cursory similarities in structure of songs with Oman, which together with photo-ID and satellite telemetry studies supports the hypothesis of whales moving between study sites in India and Oman (Cerchio et al. 2018, Willson et al. 2018). A more in-depth analysis of 10 years of ASHW song recordings between 2010 and 2020, including both archival recordings from 2011-2013 and opportunistic boat-based recordings from other years, is currently underway. Initial results indicate consistency in song phrase lineages off Oman across the decade; this finding implies the lack of introduction of new song material, strengthening the conclusion of isolation of ASHW from the Southern Hemisphere populations.

In-depth manual review of records from Oman, Madagascar and Chagos also enabled detection of a new type of blue whale song, termed Northwest Indian Ocean (NWIO) song, which is suggestive of a 'new' population of blue whales in the Indian Ocean (Cerchio et al. 2020). In 2020 a new passive acoustic monitoring unit (Sound Trap ST500-STD) was deployed off Hasik, in the Dhofar region of Southern Oman, at a depth of approximately 300m with the specific goal to detect blue whale song. IWC SC subsequently provided funds in 2020 to cover deployment and data processing costs for this unit (for a period of 1 year). In 2021, an additional ST500 was acquired by the team, and IWC SC provided funds to cover the purchase of a third unit (an ST600) as well as deployment of the three units to cover a 1-year cycle commencing in 2022. All gear required for the next phase of work has been received in Oman as of 11th April 2022, in preparation for the next deployments.

The first unit (a single recorder) has been deployed/recovered off Hasik according to the following timeline:

- March 2020 (initial deployment)
- March 2021 (recovery, yielding useable data from March 2020 to October 2020, ending after failure of the units hydrophone)
- May 2021 (deployment after repair)
- November 2021 (recovery, yielding useable data from May 2021 to October 2021, ending after depletion of units batteries; redeployment for planned recovery in April 2022).

The next phase is planned for May 2022, and will involve the deployment of the three units, including two units off the coast of Salalah and Hasik in the southern region of Dhofar and one unit further north in the Sharqiyah region of Oman. Acoustic data retrieved from the first two deployments off Hasik, Dhofar, spanning March to October 2020, and May to October 2021, are currently under analysis with the objective to detect and characterize the song of blue whales. Initial results indicate the extensive presence of NWIO song, as well as intermittent presence of CIO song (Sri Lanka) and a previously undescribed baleen whale song type. Analysis of these data have only recently commenced and if possible will be reported to the sub-committee.

The Oman acoustic dataset, including recent recordings from Hasik, are also being interrogated to evaluate the temporal variation and characterize vocalization type of sperm whales (*Physeter macrocephalus*). The study is employing use of convolutional neural network models for automated click detection and classification. This study is being undertaken as part of a Masters by Research project at the University of St Andrews, and includes analysis of acoustic datasets from Madagascar (Ashok et al. 2022). The intention is that, if successful, the approach can serve as a model for a cost-efficient analysis of acoustic datasets archived from other recordings from other regions.

The 2022/23 work plan includes completing planned deployments of passive acoustic monitoring equipment and continuation of ongoing data processing. Updates on progress will be presented in IWC SC 2023 and 2024 meetings. Teams deploying passive acoustic monitoring equipment in Oman and India frequently communicate, and hope that records from both locations can be compared in the near future.

The above progress addresses encouragements from previous IWC SC meetings (IWC, 2021, p 61):

*'(4)* **encourages***: 1) that research include continuous and simultaneous passive acoustic monitoring in identified ASHW habitat in both the western Arabian Sea (different parts of Oman's waters) and eastern Arabian Sea (Pakistan, India and Sri Lanka) to better understand the population's spatiotemporal distribution and potential connectivity across a larger area of suspected range, as well as to understand if range or distribution shifts begin to emerge as a result of climate change and other threats (noting that this technique also yields valuable data on other whale species, e.g. blue whales)…..'*

## Spatial Ecology and Risk Assessments

Manuscripts taken from the first author's PhD thesis (completed June 2022) are currently being drafted for peer-reviewed publication. Chapters to be published include:

- *Horizontal and vertical habitat utilization by Arabian Sea humpback whales*. This analysis includes presentation of home range, modelled movements (from space state modelling) and dive profiles associated with 14 animals instrumented with bio-logging equipment between 2014 and 2017.
- *Developing regional ensemble ecological niche models for Arabian Sea humpback whales in a data poor seascape*. Components of this study utilize bio-logging data to project surfaces of habitat presence across the known range of ASHWs with refence to existing sightings data.
- *Where two worlds collide. Risks to Arabian Sea humpback whales from commercial shipping in the north Indian Ocean.* The risk assessment draws on the niche modelling work together with AIS data to identify high risk areas for ASHWs within its known range.

The outputs of this work have encouraged authorities to review XXXX ship strike risk assessments presented in more detail in the section below. The authors are currently engaged in discussions with additional collaborators to address temporal and sex-ratio associated gaps in previous bio-logging studies in order to improve existing models and associated risk assessments. Consultation on conducting future tagging work of ASHWs will be presented to the IWC SC 2022 meeting as a working paper.

Use of satellite-based remote sensing imagery (Sentinel 2) together with ground truthing of fishing vessel location was proposed to the IWC SC in 2020 as a methodology to develop fisheries-based risk assessment maps for ASHWs. This project was funded together with ASHW health assessment studies. Vessel-based surveys tested and collected fishing vessel location data during surveys in March and November 2021 and serve as ground truthing for the remotely sensed data. The final analysis is on hold given the limited availability of the collaborator tasked with conducting the remote sensing analysis.

In November 2021 ASHWs were observed engaging in breeding behaviours including displays of song, competition between multiple individuals and pairing of males and females. Field observations from this survey (made during the fisheries data collection exercise) confirmed these activities occur in an area with a high density of artisanal fisheries. Active fishing effort observed included smaller vessels using purse seines to capture sardines, a documented ASHW prey source (Mikhalev, 1997), and larger 15-25m- long ‘artisanal’ vessels (‘dhows’) using gillnets to target pelagic and demersal fish species. Observers witnessed gillnets being set between groups of whales engaged in competitive behaviour in turbid waters (visibility <2m) and low light levels at sunset, forcing whales to navigate around and underneath nets to continue their social interactions. These observations, together with previous studies that demonstrated a minimum of 67% of ASHWs showed evidence of fisheries entanglement (Minton et al. in press), underlines the importance and urgency of risk assessment studies and adoption of mitigation measures in core home range areas of ASHWs habitat (Willson 2021).

Authors engaged in ASHW biologging-driven risk assessments and marine turtle biologging and bycatch studies in Oman have also been developing proposals for multi-taxa fisheries-based risk assessments. These plans have been authorised by the Oman Ministry of

Agriculture, Fisheries Wealth and Water Resources, and Environment Authority and include funding and collaboration with the US Fish and Wildlife Service, NOAA Southwest Fisheries Science Center, US Department of State, Environment Society of Oman, San Francisco State University, Florida State University, Duke University, Ocean Ecology Network and Future Seas Global SPC. The collaborations present a positive step towards addressing threats with the initial phase of the work expected to commence in 2022 with the employment of the Bycatch Risk Assessment Toolbox (Hines et al. 2020, Vertues et al., 2020). Pending funding, subsequent phases of the project will conduct fisheries experiments to trial bycatch reduction mitigation methods (Kiszka et al., 2021). Preparations for this work have benefited from events organized by, and in consultation with, the IWC Bycatch Mitigation Initiative and the Indian Ocean Tuna Commission working party on ecosystem bycatch.

The above progress addresses recommendations and encouragements from prior IWC SC meetings (IWC, 2019c, p 61):

'(4) **encourages**…. *that future research includes methods to assess (modelled) whale distribution in relation to oceanographic variables and data on fisheries and likely prey species, to better understand the drivers of distribution for ASHW, as well as the potential threat of fisheries interactions.'*

'(2) **recommends** *that the work of the crew-based observer programme in Pakistan (SC/68C/CMP/03) continue, and where possible, be replicated throughout the region, especially in areas where systematic cetacean surveys are not feasible….'*

# MANAGEMENT AND ADVOCACY ACTIVITIES

## Stranding and Entanglement Response

*Monitoring and response to ASHW threats*

In January 2021 an ASHW was reported within the Port of Duqm port basin entangled in rope and gillnet material. Port operations responses referenced the Port of Duqm Whale Management and Mitigation Plan implemented in 2017, with details previously presented to IWC SC66A (Baldwin et al. 2015). The whale was successfully disentangled with support of the Environment Authority and associated collaborators including the IWC entanglement Expert Panel. Review of port photo archives revealed the whale (OM11-016) was also observed near the Port entrance in October 2020 prior to the entanglement incident. The same whale was reported again inside the port between November 2021 and January 2022. Its reappearance triggered the mobilisation of a whale monitoring/response team from the same collaborating entities to ensure that Port authorities could be made aware of the location of the whale during all daylight hours, and to take appropriate measures to avoid harm to the whale or undue risk to crews or equipment. Videos document the whale displaying surface feeding behaviour inside the port basin. The whale appears to use the port basin on at least an occasional basis, presenting a new management quandary. Authorities are in communication regarding the possible habituation of the humpback whale to the port area and are continuing to implement the Port of Duqm Whale Management and Mitigation Plan and alert all vessels approaching the Gulf of Masirah on the sensitivities of the area to ASHWs.

These events highlight the value in training of local authorities and personnel in cetacean monitoring, and operational response techniques, including the stranding and disentanglement training provided to Omani authorities by the IWC in 2018. This training requires revision, and the team welcomes suggestions for reinforcing and updating appropriate training to deal with entangled whales and monitoring/response in relation to port operations.

## Outreach and Awareness

*Marine Mammal Atlas of Oman*

In August 2021 the Environment Society of Oman Launched a publication entitled 'Marine Mammal Atlas of Oman' (5OES & ESO, 2021). The document is available on-line (http://www.eso.org.om/index/images/file/2021-08/MarineMammal_2_.pdf) and is presented to this meeting as SC/68D/FORINFO/XX. The atlas draws on evidence collated from 20 years of dedicated research on marine mammals in Oman and was funded by Renaissance Services SAOG and produced by Five Oceans Environmental Services in association with the Environment Authority and the Ministry of Agriculture, Fisheries Wealth and Water Resources.

The atlas presents a milestone in collating and disseminating scientific information related to Oman's marine mammals, with the intention that it can be used by industry, public authorities and the general public to guide marine resource management through increasing awareness and knowledge of which species and areas are most sensitive to anthropogenic threats. The intention is that the atlas is periodically updated to include stranding data and new scientific information as it becomes available.

*Global Outreach; Protecting Blue Corridors Report*

Results of the Oman satellite telemetry and risk assessment studies analysed by the first author were included into a chapter of the WWF 'Protecting Blue Corridors Report' launched in December 2021 (Johnson et al. 2022) . The chapter, which addresses migratory corridors in the Indian Ocean, highlights the distribution of ASHW and pygmy blue whales and the known co-occurrence of these species with high density shipping traffic, fishing and whale watching activities. The document notes the challenges of managing populations within data poor seascapes and calls on Regional Management Fisheries Organizations to support risk assessment and mitigation measures for all cetaceans in the region. Specifically, for ASHWs it calls on authorities and industry to support investigation of ship strike mitigation measures off the Arabian Sea coast of Oman.

*Whale and Dolphin Guidebook*

The Environment Authority of Oman has completed a guidebook entitled 'Whales and Dolphins in Oman's Marine Environment'. The book has been designed as a guide for the general public, particularly for the education of local coastal communities and for tourists.

Available in English and Arabic the book is due for release in May 2022. The production team are grateful to the support of the IWC Secretariat in provision of materials.

*Advocacy of Responsible Whale and Dolphin Watching*

Between May and October 2021, ESO organized a Whale and Dolphin Responsible Watching Campaign with boat operators. 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, and responsible whale shark watching quick facts and guidelines. A total of 38 booklets were distributed to 18 different marine operators at two marinas in Muscat, Oman: Marina Bandar Rawdha and Al Mouj. The campaign was shared on ESO's social media platforms. ESO recommends additional outreach targeting boat operators throughout Oman, as most of them appear to not fully understand the importance of responsible whale and dolphin watching, how to share the guidelines with customers, or how to apply them in practice. The work follows from previous training and outreach initiatives initiated in 2013, which were supported by the IWC SC.

## Management and Mitigation

*Addressing Ship Strikes*

Dialogue initiated between the project advisors and collaborators in Oman during the development of the Protecting Blue Corridors report (Johnson et al. 2022),) led to a discussion of ship strike risks to ASHW during meetings between the Environment Society of Oman and the Chairman of the Environment Authority and Minister of Transport, Communications and Information. Discussions drew on materials developed for the first author's PhD thesis. Subsequent meetings have resulted in an agreement to conduct a collaborative exercise to evaluate the practical and economic implications of implementing various mitigation strategies from a conservation and industry perspective. This exercise is planned to take place in 2023 once the relevant research has been assessed and published through the peer review process (see list of papers in prep above).

*Publication of behaviour change study*

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). The study was conducted on Masirah Island which hosts fishing communities that frequently set their gears in core habitat for ASHW (Willson et al. 2021). Results revealed a low rate of behaviour-adoption by skiff and launch vessel fisheries for the responsible disposal of fishing nets, (5.36 % and 2.58 %, respectively). Positive results were observed for a short time but did not reach the estimated target value throughout the study period. The study showed that focusing on specific behaviours with appropriate measurement to solve pressing conservation problems is both resource and time demanding, particularly ones generated by complex industries such as fishing. Various lessons, useful for other social marketers, have been drawn from the evaluation of the overall study. Continuation of this

work is on-going and focused on consultation with fishermen with the Masirah Island community to better understand barriers and incentives that would limit the amount of abandoned lost and discarded fishing gear.

## Capacity Building

*Report a sighting campaign*

The Environment Society of Oman (ESO) has been engaged in a social media campaign to raise awareness of Endangered ASHWs, and to encourage members of the public to share sightings and photos with this video (https://www.facebook.com/EnvironmentSocietyOfOman/videos/2810693035894769/).

*Field research training*

Partners have also been collaborating on field survey training for Omani graduates. ESO funds were secured to support a dedicated capacity building programme for ASHW conservation. Two Omani interns have been funded to work within the organisation over a period of two years. Their training and experience have included participation in whale surveys, as well as educational and social media outreach activities focused on ASHW. Trainee staff from ESO, the Environment Authority and Futures Seas also participated in a 1-day field excursion in Muscat and attended two classroom sessions focusing on theory and data entry as a training exercise prior to joining a full ASHW health assessment study in the Gulf of Masirah in November 2021 (detailed elsewhere in this report). During the health assessment study attendees gained experience on a verity of survey tasks including logistics, survey methodology, recording sightings, photographing, identifying individuals and data processing. The training was conducted in association with staff from the Environment Authority and supported by Future Seas and Megaptera Marine Conservation. Elements of this training activity were tied to the outputs of the collaborative ASHW research with Future Seas, Megaptera Marine Conservation and Aarhus University Department of Biology through the IWC SC proposal accepted in 2021 and entitled: *'Tools to support ASHW conservation in Oman; population status and health assessments, knowledge transfer and science communication of large whale conservation activities'.*

In March 2022, additional funding was secured by ESO to conduct classroom and field-based training for up to five young Omani scientists. The intention is to foster a new generation of scientists motivated and equipped to contribute to multiple aspects of ASHW research and conservation.

*Advocacy for Conservation Management Planning*

In March 2022 ESO secured funding to engage relevant government stakeholders in a collaborative process to demonstrate the steps to draft a national Conservation Management Plan for ASHWs in Oman. The proposal was funded under the title: *'Arabian Sea Humpback Whale Capacity Building, Science Communication and Advocacy'.*

The funds will allow ESO to host a workshop drawing together specialists who can help brief stakeholders in Oman on the elements within a CMP, the benefits of such a plan (including those for industry) and the practicalities of introducing such a plan as a multilateral exercise. More details on this initiative are available here (https://arabianseawhalenetwork.org/2022/04/05/environment-society-of-oman-partners-with-hsbc-oman-for-whale-conservation-and-capacity-building-programmes/).

The above progress addresses prior concerns from IWC SC meetings (IWC, 2019c p 31):

*The Committee reiterates that Arabian Sea humpback whales are a priority candidate for a CMP (IWC, 2019c, p.31) and welcomes efforts to encourage range states to develop one.*

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