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A blueprint for collaborative, pan-regional cetacean surveys in the Indian Ocean - a necessary baseline for assessing threats

IWC Secretariat



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ABSTRACT

The Indian Ocean is home to a high diversity of cetacean species. It is also a region where human activities and subsequent impacts on cetaceans and other marine megafauna species are increasing. Bycatch of cetaceans in gillnet fishing gear has been particularly recognised as a significant threat across the region. The lack of baseline knowledge on cetacean species and populations (population units, abundance, and distribution), is limiting conservation efforts to assess and address bycatch and other threats. Despite past international initiatives which have attempted to fill these knowledge gaps, the Indian Ocean has not been systematically surveyed across its entire region, and visual survey coverage remains very low in some regions. This paper aims to prompt discussions on the need for coordinated pan-regional survey initiative for cetaceans - to acquire baseline information on species and populations and to adequately monitor and address the impact of threats. We propose that such an initiative could be formed of four distinct elements: 1) the compilation, review and analysis of historical survey data and other relevant datasets; 2) national surveys, acoustic and visual, in EEZs led by individual governments; 3) international collaborative surveys in the ABNJ coordinated by lead countries; 4) the coordinated use of platforms of opportunity to maximise survey coverage. The paper suggests some next steps for the IWC Scientific Committee, contracting governments and the IWC Secretariat in exploring this proposed initiative further. The paper includes a non-exhaustive list of previous visual surveys, available in published and unpublished sources, and survey initiatives which are underway or planned in the near future. Major spatial gaps are identified. This paper was developed by the IWC Secretariat in close collaboration with individual Scientific Committee members, and their contribution will be formally acknowledged in future iterations of this paper.

Introduction

The Indian Ocean basin is home to a high diversity of cetacean species, with over 50 species recorded, although many are confined to the cold, southern waters (de Boer et al. 2003; Anderson, 2014). At least 27 species occur in the coastal inshore, shelf and pelagic tropical Indian Ocean and of which at least 18 odontocetes and five baleen whales are considered highly pelagic (Sattar et al. 2009; de Boer et al. 2003).

The IWC Indian Ocean Sanctuary, which extends across the entire Indian Ocean from 20° E to 130°E, south to 55° S (see Figure 1), including the Red and Arabian Seas and Gulf of Oman was established in 1979 and protects all large whales from commercial whaling activities. Whilst the Southern Ocean Sanctuary has a detailed management plan, which includes consideration of human activities beyond whaling, the Indian Ocean Sanctuary has never had a management plan. In addition to excluding commercial whaling, it has been hoped that the existence of this sanctuary would aid; the development of management strategies and plans for the conservation of cetacean populations, further research, and improved coordination of regional-level initiatives. A scientific research plan was designed but not fully implemented (Busby, 1981; de Boer et al. 2003; Holt, 2009). In 1982 the Scientific Committee (IWC, 1982; Leatherwood and Donovan, 1991) stated that: [the Indian Ocean Sanctuary] ‘should provide sufficient information to assess stocks of large whales and small cetaceans: it should permit direct comparison of the status of species and/or populations protected by the Sanctuary provision and exploited or unexploited stocks of the same species in other areas’.

Cetaceans in the Indian Ocean region have been the focus of some recent global and regional initiatives, including the IUCN’s [Important Marine Mammal Areas \(IMMAs\)](#). The IMMA identification process involved compiling existing information and expert opinion to identify important areas across a number of sub-regions of the Indian Ocean and this process has identified sites in the north-east Indian Ocean and across the western Indian Ocean and Arabian Seas. The Convention on Biological Diversity’s [Ecologically and Biologically Significant Areas \(EBSAs\)](#) has also identified areas which are important to cetaceans and other marine taxa. The IWC and the Convention on Migratory Species are currently working towards the possible development of a Conservation Management Plan for the Arabian Sea humpback whale population and there is an IWC small-cetacean Task Team formed which includes the Indian Ocean humpback dolphin. Regional initiatives, including the Arabian Sea Whale Network (an informal collaboration of researchers and conservation bodies in the Northern Indian Ocean, (see SC/68C/CMP/05) are also raising awareness and collaboration in the scientific community on cetacean research and conservation.

Despite widespread recognition over many decades of the need for dedicated cetacean research across the ocean basin, large parts of the Indian Ocean have never been systematically studied for cetacean distribution and abundance (Leatherwood and Donovan, 1991; de Boer et al. 2003). Regular, repeated surveys over many decades have taken place in the colder, southern waters as part of national Antarctic research programme transit legs (e.g., Thiebot and Weimerskirch 2013; national Antarctic programmes associated with IWC Southern Ocean Collaboration and Southern Ocean Research Partnership) and the IWC SOWER cruises. Furthermore, some sub-regions of the Indian Ocean have been and continue to be systematically surveyed (e.g., islands of south-west

Indian Ocean, Australia). The tropical and eastern regions of the Indian Ocean are particularly under-sampled for cetaceans, and where surveys have been conducted, they are often patchy in space or time, and one-off events which are not repeated (Ruwa and Rice, 2017; de Boer et al. 2003; Mondreti et al. 2020). The lack of systematic, ocean-basin wide surveying is not limited to cetaceans, as sampling of marine biodiversity in general has been assessed as incomplete and poorly coordinated (Ruwa and Rice, 2017). Recent multi-disciplinary, coordinated efforts include the Second International Indian Ocean Expedition (2015-2025), however, sampling of marine megafauna is not explicitly included.

The Indian Ocean marine environment region is recognised to be significantly impacted by human activities, with a high level of cumulative impacts from multiple stressors (Elwin et al. 2011; Ruwa and Rice, 2017; UNESCO IOC and UNEP, 2016). Within the region, human activities including fishing, transport, resource extraction, and tourism are impacting cetacean populations via threats such as bycatch, ship strikes, pollution, noise, and climate change (de Boer et al. 2003; IWC 2017; IWC, 2019; WCS, 2017; Nunny and Simmonds, 2019; Anderson et al. 2020).

In the case of bycatch, the Indian Ocean has long been recognised as a region with high levels of cetacean bycatch in gillnets (Leatherwood and Donovan, 1991; Anderson et al. 2014; Anderson et al. 2020; IWC, 2019). Recent rough estimates suggest that over four million cetaceans were killed in tuna gillnet fisheries across the region, up to 2018 (Anderson et al. 2020). The IWC Scientific and Conservation Committees have recognised the significant conservation implications of bycatch in the Indian Ocean and the lack of information on both cetaceans and bycatch across the ocean basin (IWC, 2019; IWC 2020a; IWC 2020b). The IWC has prioritised engagement with the Indian Ocean Tuna Commission to collaboratively address cetacean bycatch (*Recommendations: SC17325, SC1878, SC2095*). The current workplan of the IOTC's Working Party on Ecosystems and Bycatch (IOTC, 2020a) includes activities for an Ecological Risk Assessment for cetaceans, and the compilation and assessment of marine mammal abundance data (2021-2023). The joint IOTC-IWC meeting in 2020 (IOTC, 2020b) also identified the need for a gap analysis on cetacean (abundance/distribution) and bycatch data. These activities are included in a draft proposal for Phase 2 of the Common Oceans ABNJ Tuna project which would assess cetacean bycatch in Indian Ocean tuna fisheries, and develop capacity regionally to address it with mitigation and management approaches. There is therefore increasing global and regional interest in synthesising existing information on cetaceans in the Indian Ocean, the identification of data gaps, and using this information to understand and address threats.

The IWC's Bycatch Mitigation Initiative's 2019 Workshop on Bycatch Mitigation Opportunities in the Western Indian Ocean and Arabian Sea recommended (*Recommendation: BMI 1902 – Conservation Committee*) that governments and other relevant stakeholders in the Indian Ocean region carry out cetacean sampling surveys to collect information on species abundance and distribution at national and regional scales – as a priority action to understand and address bycatch in the region. Recent research efforts in Pakistan have examined the effectiveness of sub-surface setting of tuna gillnets as a cetacean bycatch mitigation measure (e.g., project led by WWF-Pakistan). However, monitoring the success of any future, region-wide implementation of such a measure (e.g., provisions in the [IOTC Resolution 19/01](#) on sub-surface setting of gillnets) – or indeed any other mitigation measure - will be challenged by the lack of information on local and regional cetacean abundance estimates.

The lack, regionally, of information on cetacean distribution, abundance, population units and population trends limit national and international conservation efforts and prevents a full understanding of cetacean population status. Detailed information on cetacean species distribution and abundance is necessary to understand, monitor and address threats through conservation and management actions. At the ocean-basin scale, coverage of cetacean visual survey has been very low when compared to the Atlantic, North Pacific, and Southern Ocean (Kaschner et al. 2012). These gaps pertain to both coastal and national waters (Exclusive Economic Zones - EEZs), where many of the most threatened cetacean species occur (e.g., Indian Ocean and Indo-Pacific humpback dolphins, Indo-Pacific finless porpoise, Irrawaddy dolphin, Arabian Sea humpback whale) and human activity is highest. Furthermore, the Areas Beyond National Jurisdiction (ABNJ) are particularly lacking in survey coverage and many highly pelagic species, such as the blue whale and poorly studied beaked whale species occur (4 out of the 11 beaked whale species, known to occur in the region, are listed as 'data deficient' on the [IUCN Red List](#)).

In this paper we highlight the available information and some of the major gaps in both the EEZs and ABNJ across the Indian Ocean and propose an initiative for a pan-regional coordinated survey. The aim of this paper is to prompt discussions on the need for coordinated pan-regional surveys for cetaceans - to acquire baseline information on species and populations and to adequately monitor and address the impact of threats. We also

suggest some next steps for the IWC Scientific Committee, contracting governments and the IWC Secretariat in exploring this proposed initiative further.

CETACEAN SURVEYS AND DATA SOURCES

Annex 1 is a non-exhaustive list of published and unpublished sources of information on previous relevant visual surveys in the Indian Ocean. Any known concurrent or future planned surveys of relevance are also included. The IWC Secretariat, with input from external experts, carried out a literature review of existing sources of information. Further consultation is needed and input to improve this list is requested and welcomed. Some important sources of information including earlier references, Antarctic sightings data not held by the IWC, acoustic data-sets, photo-ID catalogues etc are not included in Annex 1. Data held by the IWC on direct catches in the Indian Ocean region were extracted but not included in the regional tables with visual survey data.

For the purposes of this paper, we divide the Indian Ocean into the Western and Eastern regions (Figure 1), based on the FAO Major Fishing Areas¹ ([Area 51](#) and [Area 57](#)) and identify where some previous visual surveys have occurred, or relevant datasets collected. We summarise the information available and any information on upcoming surveys for the:

- Arabian Sea (FAO Areas 51.3; 51.4 – above the equator)
- South-West Indian Ocean (FAO Areas 51.4 below equator; 51.5; 51.6; 51.7; 51.8)
- Bay of Bengal (FAO Area 57.1)
- North-East and Central Indian Ocean (FAO Area 57.2; 57.3; 57.5)
- Oceanic Indian Ocean (FAO Area 57.4)

¹ The authors note that the recently published bioregionalization of the Indian Ocean would be highly relevant to use for future sub-division and assessment of survey coverage in the ocean basin (Dunstan et al. 2020).

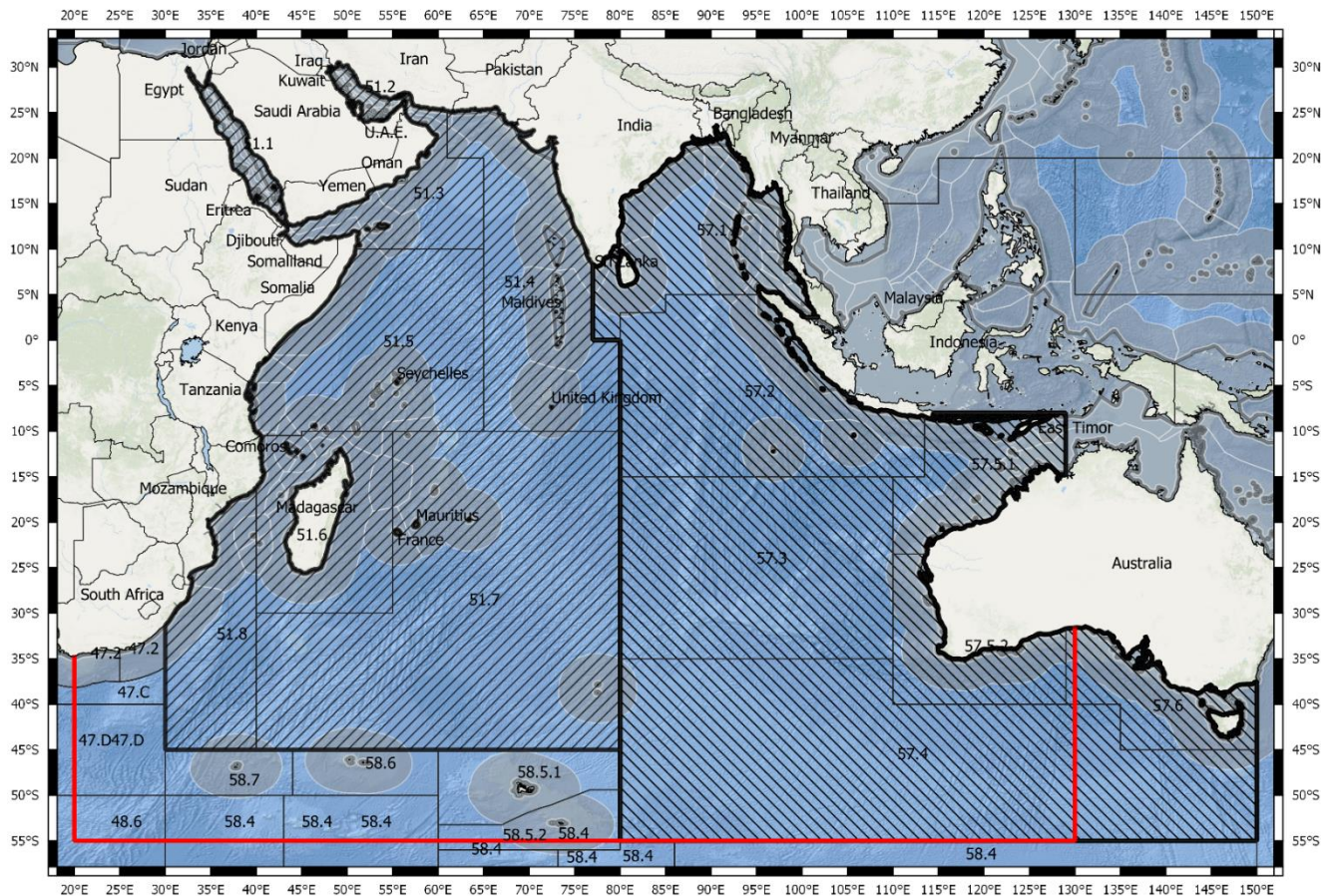


Figure 1 Map of Indian Ocean, with Indian Ocean Sanctuary, and FAO Major Fishing Areas and sub-divisions.

FAO Major Fishing Areas 51 (Western Indian Ocean) and Area 57 (Eastern Indian Ocean) and sub-divisions shown with hatched symbology. Additional FAO Major Fishing Area sub-divisions (47, 48, 58) shown where relevant. Indian Ocean Sanctuary southern hemisphere boundary shown in red outline. Exclusive Economic Zones of countries indicated in grey, Areas Beyond National Jurisdiction shown as blue ocean bathymetry. Data sources: FAO and Flanders Marine Institute (2020)

The need for a coordinated Indian Ocean research programme

The Indian Ocean has historically been identified as being particularly poorly surveyed for cetaceans (Leatherwood and Donovan, 1991; Kaschner et al. 2012; de Boer et al. 2003; Ruwa and Rice, 2017). At the regional scale, visual survey efforts have mostly been ad hoc. Surveys have, in general, been focused in specific sectors of the Indian Ocean, (e.g., within some EEZs), often with patchy spatial and temporal coverage, although there are some exceptions. Given the size of the area, and the fact that surveys have been taking place over many decades, it is understandable that previous surveys were not carried out in a systematic manner and use a wide variety of often incompatible methodologies. Indeed, many surveys are not suitable for abundance estimation or analysis of population trends. Compounding these issues is the fact that only a small proportion of previous surveys have occurred in the past decade (2010-2020) and (known) planned surveys are sparse, covering only very few areas. Given the limited activity in the Indian Ocean it is understandable that very few areas have been surveyed over multiple years.

A brief examination of the literature from previous surveys (in Annex 1) has allowed the identification of the following major gaps in spatial survey coverage:

- all the ABNJ area of the Indian Ocean, but particularly those in the Central and Eastern Indian Oceans (FAO Area 51.7, 57.31 57.4.)
- North-East and Central Indian Ocean, including both the EEZs and ABNJ (FAO Area 57.2; 57.3; 57.5)
- Bay of Bengal (FAO Area 57.1), particularly in the ABNJ, and in the EEZs of Myanmar, Thailand, Indonesia and Malaysia

- The EEZs, including the coastal and offshore areas of many different countries, including India, Kenya, Somalia, Pakistan, Thailand, Indonesia, Myanmar (although details of surveys in some countries may not have been found in the literature search)

Despite the potentially relevant studies identified in Annex 1, there is a clear need for a pan-regional initiative that includes a coordinated synthesis and collation of existing data, collection of new data, and analyses to establish baseline information for many cetacean species (population units, relative abundance, population trends, distribution). The IWC's POWER and SOWER programmes would be ideal models for the Indian Ocean. Such a regional initiative, coordinated by the IWC would likely inspire a wide range of collaborations, between countries, research groups, and others across the region. We suggest that such an initiative could be divided into four elements, 1) collaborative analysis of historical datasets, 2) the coordinated collection of cetacean data in EEZs (led by national governments), 3) international collaborative surveys in the ABNJ, and 4) the coordinated use of platforms of opportunity to collect cetacean data. Given the extremely large area, a prioritisation of different geographical areas is likely to be needed and an emphasis will be needed on coordinating with existing initiatives and platforms of opportunity and utilising lower cost monitoring technologies and approaches (e.g., Braulik et al. 2016 for visual surveys, acoustic monitoring etc).

In relation to the existing data sets identified in Annex 1, we suggest that it would be extremely useful to update and refine the list of data sources by sub-region, including acoustic monitoring data, photo-ID catalogues etc. As a preliminary activity it would be important to closely evaluate whether existing data would be available and appropriate for abundance estimation and other analysis. A spatial analysis of the data from previous surveys, historical catch data and acoustic monitoring would allow more accurate identification of the spatial and temporal gaps across the ocean basin. A detailed review of the existing survey coverage is likely to highlight many other gaps in spatial and temporal coverage across the region, and we suggest that this be further evaluated as a follow on to this paper. This would be particularly important in identifying which sub-regions should be prioritised for future surveys (either opportunistically or through a dedicated survey programme).

The development of a central repository for Indian Ocean cetacean data is likely to be an important aspect of any future programme, and it is something that the IWC may be able to facilitate, if it does not exist already (e.g., an updated version of Kaschner et al. 2012 spatial database). Some sighting data are shared by some researchers, organisations and countries through portals such as the Ocean Biodiversity Monitoring System (OBIS), however OBIS does not appear to not be universally used by the cetacean research community. The IWC could potentially consider a closer collaboration with such platforms, or with others who hold existing databases, to facilitate any future work. The Arabian Sea Whale Network has recently developed an [Arabian Sea regional whale and dolphin database](#) in collaboration with *Flukebook*, and this could accommodate sighting data – making it another potential repository. A regional database would facilitate the extraction and analysis of data from across the Indian Ocean, and in the future, new survey initiatives taking place in the Indian Ocean which have collected cetacean information would ideally then share these with this regional initiative (for conservation purposes, and under certain agreed conditions). The IWC and its collaborating partners could then incorporate this information in region-wide cetacean assessments if appropriate.

In this paper we propose that an important aspect of a pan-regional cetacean research initiative would be the collaboration with existing survey initiatives, and other 'platforms of opportunity'. Importantly, we note the apparent lack of any existing global or regional mechanism for identifying upcoming surveys (multi-disciplinary ecological or other research including geophysical etc) which could serve as platforms of opportunity for cetacean data collection. This gap means that opportunities can only be identified on an ad hoc basis and many surveys are likely to have been missed. Indeed, the second International Indian Ocean Expedition, which is a multi-country and multi-disciplinary oceanographic research programme, is potentially an important opportunity for coordination and collaboration – should a pan-Indian Ocean survey for cetaceans be implemented. This initiative began in 2015 and has been extended from 2020 to 2025. There is an opportunity for the IWC to play an important role in bringing together national efforts, and international efforts of research institutes, IGOs and NGOs in the IWC community, to help coordinate access to platforms of opportunity.

Proposed pan-Indian Ocean survey initiative **SCALE**

The proposed initiative would, over its lifetime, aim to collect distribution and abundance data across the full spatial extent of the Indian Ocean. We propose that the initiative be composed of four distinct elements:

- 1) Compilation, review and analysis of historical survey data and other relevant datasets
- 2) National surveys in EEZs led by individual governments or organisations, in coordination with the IWC, including lower cost, rapid visual surveys (e.g., Braulik et al. 2016 approach), acoustic monitoring, tagging studies etc.
- 3) International collaborative surveys in the ABNJ coordinated by lead countries (or organisations) within the framework of the IWC (visual, acoustic, tagging studies etc.)
- 4) Coordinated use of platforms of opportunity by the IWC Secretariat and lead countries and participating organisations, including: commercial/tourism and whale-watching vessels, research cruises focused on other marine taxa or geophysical exploration.

DURATION

We propose an initial 10-year programme to provide adequate spatial and temporal coverage and for repeated surveys across the region.

PROPOSED OBJECTIVES

- Systematically survey the Indian Ocean region for cetaceans
- Collect baseline information on cetaceans in coastal, pelagic and ABNJ areas including distribution, abundance and movements.
- Repeat visual surveys in key regions which have been surveyed previously
- Coordinate with other initiatives, organisations, national programmes etc to take advantage of platforms of opportunity, and sharing of data collected on cetaceans across region
- Collate existing datasets (visual, acoustic, catch) and evaluate their appropriateness for regional analysis of abundance, population trends and distribution etc.
- Assist in developing capacity across the region for cetacean surveys and analysis of abundance and distribution data
- Produce outputs for baseline cetacean assessments at regional scale - including abundance estimates, population units, population trends, distribution and movements in the Indian Ocean which will be useful for IWC Scientific Committee and IWC Conservation Committee and external organisations (e.g., RFMOs such as the IOTC) in relation to assessment of threats and monitoring of conservation efforts
- Assist in directing future research and conservation efforts to areas of concern (with vulnerable populations, or areas with high overlap between cetaceans and human activities)

PROPOSED ROLE OF IWC, LEAD COUNTRIES AND PARTICIPATING COUNTRIES, AND ORGANISATIONS

The IWC is well placed to develop and facilitate a coordinated, multi-country research programme in the Indian Ocean. Ideally this would be based on the model of POWER or SOWER (with one or more countries willing to lead on the international surveys in ABNJ), but it should also develop collaborations nationally, regionally and globally and take advantage of platforms of opportunity.

We propose that this initiative be open for both contracting and non-contracting governments of the IWC, observer organisations, and other partners. There may also be opportunities to coordinate with existing initiatives, such as the [second International Indian Ocean Expedition \(2015-2025\)](#), which is a mechanism for multi-disciplinary, multi-country oceanographic and marine research across the Indian Ocean Basin. The proposed IWC initiative could potentially aim to be incorporated into or collaborate with this programme in the future.

Regarding the proposed IWC initiative, an outline of potential roles for the different parts of the IWC, lead and participating countries, and organisations is provided below.

THE IWC SECRETARIAT WOULD PROVIDE:

- Administrative support to participating and new countries and organisations involved in the initiative
- Support and outreach on external fundraising
- A database/repository for all survey data
- Respond to requests for data extraction, analysis, and use of information.

- Liaise with governments and organisations on potential platforms of opportunity and coordinate with lead and participating countries/contact points to get survey teams on board
- Liaise with governments and organisations on plans for dedicated cetacean surveys
- Facilitate the analysis of data with the Scientific Committee
- Facilitate capacity building initiatives across the region in relation to cetacean surveys and analysis
- Disseminate outputs from the project

THE IWC SCIENTIFIC COMMITTEE WOULD PROVIDE:

- Steering Committee to oversee initiative and provide scientific advice
- Survey design
- Analysis of data for cetacean abundance and distribution
- Expert time for training and capacity building

PROPOSED ROLE OF COORDINATING COUNTRY(IES)

- Provision of ship/plane time and crew on dedicated surveys in ABNJ
- Lead on coordination of participating countries in ABNJ surveys
- Coordinate with the IWC Secretariat
- Coordinate with national survey efforts
- Lead role in development of external fundraising proposals
- Raise awareness of initiative, including with those offering platforms of opportunity

PROPOSED ROLE OF COLLABORATING COUNTRIES AND ORGANISATIONS

- Provide scientists to participate on survey teams on joint international surveys and platforms of opportunity
- Lead in implementing surveys in own EEZ.
- Participation in capacity building (peer to peer and other initiatives)
- Coordination with IWC Secretariat and lead countries in relation to platforms of opportunity

FUNDING & PARTNERSHIPS

The proposed initiative is ambitious in scale and scope. The funding implications have not been considered in detail; however, it is clear that it cannot be funded with the existing IWC budget (SC, Secretariat etc). Any identified lead countries may be able to provide ship time, however it will be necessary to raise extensive funds to implement this programme. We suggest that it will be necessary to develop collaborative partnerships with national governments, international organisations, research institutions and other organisations. External fundraising and partnership efforts could be focused on:

- UN Decade of Ocean Science
- Partnerships with UNEP, including Nairobi Convention etc
- Partnership/collaboration with the Second International Indian Ocean Expedition (including utilisation of platforms of opportunity)
- Partnerships with the Indian Ocean Commission
- Partnerships through GEF/FAO Common Oceans ABNJ Tuna and Deep-Sea Projects
- Partnerships with GOBI project, IUCN IMMAs etc.
- Partnerships with WIOMSA and Indian Ocean Marine Research Centre (UWA)
- Partnerships with the Coral Triangle Initiative, and other relevant initiatives in the Coral Triangle Region
- Marine science research initiatives (e.g. Indocet, ASWN, REV Ocean)
- Partnerships with the Indian Ocean Rim Association (IORA) including its whale watching group
- Research Institutions with interest in region (e.g., WHOI, CSIRO, Duke, Florida International University, University of Seychelles, other local institutions etc)
- NGOs and organisations with research programmes in the region (Greenpeace, WCS, ZSL, WWF, WDC and local organisations)
- Private donors

- Commercial and tourism operators
- National Government contributions (including in-kind) or national government research funds.

PROPOSED NEXT STEPS

We propose the following steps in order to make progress on establishing this initiative.

- 1) Recommendations from the ASI sub-committee at SC 68C in support of the development of this initiative
- 2) Recommendations from the ASI sub-committee and other relevant sub-committees in relation to the role proposed for the Scientific Committee.
- 3) Schedule a virtual workshop to scope out the key elements/structure of the initiative
- 4) Establish a working group to compile additional sources of information and further assess existing data for applicability to abundance estimation and ecological research
- 5) Establish smaller working groups to address specific topics, including: identifying lead countries and collaborating countries and defining coordination mechanism; fundraising; further gap analysis; survey design and prioritisation of areas; identification of upcoming platforms of opportunity
- 6) The IWC Secretariat to explore potential collaborative opportunities with existing initiatives and organisations, including the Second International Indian Ocean Expedition and partnering countries

References

- Alling, A. 1986. Records of Odontocetes in the Northern Indian Ocean (1981-1982) and off the Coast of Sri Lanka (1982-1984). *Journal of the Bombay Natural History Society*. 83(2): 376-394.
- Allport, G.A., Curtis, C., Simões, T.P. and Rodrigues, M.J. 2017. The first authenticated record of Pygmy Killer Whale (*Feresa attenuata* Gray 1874) in Mozambique; has it been previously overlooked? *Mar. Biodivers. Rec.* 10:17. [Available at: <https://doi.org/10.1186/s41200-017-0119-9>].
- Anderson, R.C. 2005. Observations of cetaceans in the Maldives, 1990–2002. *J. Cetacean Res. Manage.* 7(2):119–36.
- Anderson R.C. 2014. *Cetaceans and Tuna Fisheries in the Western and Central Indian Ocean*. International Pole and Line Foundation, London
- Anderson R.C. and Alagiyawadu A. (2019) Observations of cetaceans off southern Sri Lanka in April, 2007-2013. *Journal of Cetacean Research and Management*, 20: 13-25.
- Anderson, R Charles, Herrera, Miguel, Ilangakoon, Anoukchika D., Koya, K.M., Moazzam, M., Mustika, Putu L., and Sutaria, Dipani N. .2020. Cetacean bycatch in Indian Ocean tuna gillnet fisheries. *Endangered Species Research*, 41. pp. 39-53.
- Ballance, L.T., Anderson, R.C., Pitman, R.L., Stafford, K., Shaan, A., Waheed, Z. and Brownell, R.L., Jr. 2001. Cetacean sightings around the Republic of the Maldives, April 1998. *J. Cetacean Res. Manage.* 3(2):213–18.
- Ballance, L., Pitman R. 1998. Cetaceans of the western tropical Indian Ocean: distribution, relative abundance, and comparisons with cetacean communities of two other tropical ecosystems. *Marine Mammal Science*, 14, 3. <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1748-7692.1998.tb00736.x>
- Barber, R., Sikora, I. and Nimak-Wood, M. 2016. Blue whales *Balaenoptera musculus* in offshore waters of Kenya. *African Journal of Marine Science*, 38(2), pp.279- 284.
- Best, P.B., Findlay, K.P., Sekiguchi, K., Peddemors, V.M., Rakotonirina, B., Rossouw, A and Gove, D. 1998. Winter distribution and possible migration routes of humpback whales *Megaptera novaeangliae* in the southwest Indian Ocean. *Marine Ecology Progress Series Vol.* 162: 281-299.
- Berggren, P., Amir, O. A., Stensland, E. and Jiddawi, N. S. 2001. *Marine Mammals in Zanzibar: A Resource in Need of Conservation and Management*. Paper Presented at the Wiomsa Second Scientific Symposium, 22nd - 25th October 2001, Karimjee Hall, Dar es Salaam, Tanzania.
- Bouchet PJ, Thiele D, Marley SA, Waples K, Weisenberger F, Balangarra Rangers, Bardi Jawi Rangers, Dambimangari Rangers, Nyamba Buru Yawuru Rangers, Nyul Nyul Rangers, Unguu Rangers and Raudino H (2021) Regional Assessment of the Conservation Status of Snubfin Dolphins (*Orcaella heinsohni*) in the Kimberley Region, Western Australia. *Front. Mar. Sci.* 7:614852. doi: 10.3389/fmars.2020.614852
- Branch, T.A., Stafford, K.M., Palacios, D.M., Allison, C., Bannister, J.L., Burton, C.L.K., Cabrera, E., Carlson, C.A., Galletti Vernazzani, B., Gill, P.C., Huckle-Gaete, R., Jenner, K.C.S., Jenner, M.-N.M., Matsuoka, K., Mikhalev, Y.A., Miyashita, T., Morrice, M.G., Nishiwaki, S., Sturrock, V.J., Tormosov, D., Anderson, R.C., Baker, A.N., Best, P.B., Borsa, P., Brownell Jr, R.L., Childerhouse, S., Findlay, K.P., Gerrodette, T., Ilangakoon, A.D., Joergensen, M., Kahn, B., Ljungblad, D.K., Maughan, B., Mccauley, R.D., Mckay, S., Norris, T.F., Rankin, S., Samaran, F., Thiele, D., Van Waerebeek, K. And Warneke, R.M. 2007. Past and present distribution, densities and movements of blue whales *Balaenoptera musculus* in the Southern Hemisphere and northern Indian Ocean. *Mammal Review*, 37: 116-175. <https://doi.org/10.1111/j.1365-2907.2007.00106.x>
- Braulik, G.T., Kasuga, M., Wittich, A., Said, S.S., Macaulay, J., Gordon, J., Gillespie, D., 2016. A Nationwide Survey of Cetaceans in Tanzania, p. 32. *Wildlife Conservation Society Tanzania Program, Zanzibar*.
- Busby, L. 1981. Report of the workshop to plan a programme of scientific research on cetaceans in the Indian Ocean Sanctuary. Publication of the Ministry of Cultural Affairs, Recreation and Social Welfare, Netherlands. 105pp.
- Corbett, H.D. 1994. The occurrence of cetaceans off Mauritius and in adjacent waters. *Rep. Int. Whal. Commn.* 44:393–98.
- Clark, R.A., Johnson, C.M., Johnson, G., Payne, R., Kerr, I., Anderson, R.C., Sattar, S.A., Godard, C.A.J. and Madsen, P.T. 2012. Cetacean sightings and acoustic detections in the offshore waters of the Maldives during the northeast monsoon seasons of 2003 and 2004. *J. Cetacean Res. Manage.* 12(2): 227–234.
- Cockcroft V and D Young, 1998. An Investigation of coastal marine resources along the west coast of Madagascar.
- De Boer, Marijke. 2000. A note on cetacean observations in the Indian Ocean Sanctuary and the South China Sea, Mauritius to the Philippines, April 1999. *Journal of Cetacean Research and Management*. 2. 197-200.
- de Boer, M.N., Baldwin, R., Burton, C.L.K., Eyre, E.L., Jenner, K.C.S., Jenner, M.-N.M., Keith, S.G. McCabe, K.A. Parsons, E.C.M. Peddemors, V.M., Rosenbaum, H.C., Rudolph, P. and Simmonds, M. P. 2003. *Cetaceans in The Indian Ocean Sanctuary: A Review*. A WDSC Science Report.
- De Vos, A., Clark, R., Johnson, C., Johnson, G., Kerr, I., Payne, R. and Madsen, P.T. 2012. Cetacean sighting and acoustic detections in the offshore waters of Sri Lanka: March–June 2003. *J. Cetacean Res. Manage.* 12(2):185–93.
- Dulau-Drouot, V., Boucaud, V. and Rota, B. 2008. Cetacean diversity off La Reunion island (France). *J. Mar. Biol. Assoc. UK* 88(6):1263–72.
- Dulau-Drouot, V., Fayan, J., Mouysset, L. and Boucaud, V. 2012. ‘Occurrence and residency pattern of humpback whale in Reunion Island (France) during 2004-2008’. *Journal of Cetacean Research and Management* 12(2): 255–263.
- Dunstan, P.K., Hayes, D., Woolley, S.N.C Bernawis, L., Foster, S.D., Chassot, E., Khani, E., Walton, R., Blamey, L., Bristol, U., Porter, S., Kanapatipillai, A.A., Karenyi, N., Ingole, B., Pranowo, W., Sreepada, R., Shimal, M., Bodin, N., Mohamed, S., White, W., Last, P., Bax, N., Vanderklift, M., Kloser, R., Dutra, L., Molony, B. 2020. *Bioregions of the Indian Oceans*. CSIRO Australia. [Available online: https://gobi.org/wp-content/uploads/2020/07/Final-workshop-report-Indian_v4_1-1.pdf]
- Elwen, S.H., Findlay, K.P., Kiszka, J. and Weir, C.R. 2011. Cetacean research in the southern African subregion: a review of previous studies and current knowledge. *Afr. J. Mar. Sci* 33(3):469–93.
- Estrade, V. and Dulau, V. 2020. ‘Abundance and site fidelity of bottlenose dolphins off a remote oceanic island (La Reunion Island, SW Indian Ocean)’. *Marine Mammal Science* 1–26. <https://doi.org/10.1111/mms.12693>
- Eyre, E.J. 1995. Observations of cetaceans in the Indian Ocean Whale Sanctuary, May–July 1993. *Rep. int. Whal. Commn* 45: 419–26.
- Eyre, E.J. 2000. Observations of cetaceans in the Indian Ocean Sanctuary, Mauritius to Singapore, April 2000. Paper SC/52/O16 presented to the IWC Scientific Committee, June 2000, in Adelaide, Australia
- Eyre, E.J. and Frizell, J. 2012. A note on observations of cetaceans in the Indian Ocean Sanctuary, Australia to Israel, April 1995. *J. Cetacean Res. Manage.* 12(2):277–85.
- Flanders Marine Institute. 2020. *Maritime Boundaries Geodatabase: High Seas, version 1*. Available online at <https://www.marineregions.org/>. <https://doi.org/10.14284/418>
- Gore, M.A., Kiani, M.S., Ahmad, E., Hussain, B., Ormond, R.F., Siddiqui, J., Waqas, U. And Culloch, R. 2012. Occurrence of whales and dolphins in Pakistan with reference to fishers’ knowledge and impact. *J Cetacean Res Manag.* 12(2): 235–247.

- Huijser LAE, Estrade V, Webster I, Mouysset L, Cadinouche A, Dulau-Drouot V. 2020. Vocal repertoires and insights into social structure of sperm whales (*Physeter macrocephalus*) in Mauritius, southwestern Indian Ocean. MMS <https://doi.org/10.1111/mms.12673>
- Hermans, A., Pistorius, P. 2008. Marine mammal diversity in the remote waters of Aldabra atoll, southern Seychelles. *Atoll Research Bulletin* No 564.
- Holt, S. 2009. Negotiating the Indian Ocean Sanctuary. *Journal of Cetacean Research and Management*. 12 (2) 140-150
- Ilangakoon AD. 2012. Cetacean diversity and mixed-species associations off southern Sri Lanka. In *Proceedings of the 7th International Symposium on SEASTAR2000 and Asian Bio-logging Science (The 11th SEASTAR2000 workshop)*, 23-28. Graduate school of Informatics, Kyoto University.
- Ilangakoon, A.D., Alling. 2016. Cetacean sightings, mixed-species assemblages and the easternmost record of *Indopacetus pacificus* from the northern Indian ocean. *Marine Biodiversity Records* volume 9, Article number: 88.
- IOTC. 2020b. Report of the 16th Session of the IOTC Working Party on Ecosystems and Bycatch. IOTC-2020-WPEB16-R[E]. 7 -10 September 2020. [Available online: https://www.iotc.org/sites/default/files/documents/2020/11/IOTC-2020-WPEB16-R_FINAL.pdf]
- IOTC. 2020a. Report: Meeting on collaborative activities for cetacean bycatch, IOTC-IWC. WPEB, Information document. 6.
- IWC. 1982. Report of the Scientific Committee. Rep. mt. Whal. Commn 32:43-149.
- IWC. 2017. Strategic Plan to Mitigate the Impacts of Ship Strikes on Cetacean Populations: 2017-2020
- IWC. 2019. Report of the IWC Workshop on Bycatch Mitigation Opportunities in the Western Indian Ocean and Arabian Sea. BMI workshop report 05-19
- IWC. 2020a. Report of the Scientific Committee. Annex J. Report of the Sub-Committee on Non-Deliberate Human-Induced Mortality of Cetaceans. (unpublished). [Available online at: <https://archive.iwc.int/?r=17766>]
- IWC 2020b – Report of the Conservation Committee [available online at: <https://archive.iwc.int/pages/view.php?ref=18698&k=c4fadd5dec>]
- Jayasankar, P., Krishan, A.M Rajagopalan, M., Krishnakumar, P.K. 2007. A note on observations on cetaceans in the western Indian sector of the Southern Ocean (20-56°S and 45-57°30'E), January to March 2004. *Journal of Cetacean Research and Management*. 9(3):263–267, 2007.
- Kaschner K, Quick NJ, Jewell R, Williams R, Harris CM. 2012. Global Coverage of Cetacean Line-Transect Surveys: Status Quo, Data Gaps and Future Challenges. *PLoS ONE* 7(9): e44075. <https://doi.org/10.1371/journal.pone.0044075>
- Keller, Leatherwood and Holt 1982 Indian Ocean cetacean survey Seychelles Islands April through June 1980. Rep to the Int Whaling Commission 32: 502-513
- Kiszka, J., Vely, M. and Breyse, O. 2010b. Preliminary account of cetacean diversity and humpbackwhale (*Megaptera novaeangliae*) group characteristics around the Union of the Comoros (Mozambique Channel). *Mammalia* 74:51–56.
- Kiszka, J., Ersts, P.J. and Ridoux, V. 2007. Cetacean diversity around the Mozambique Channel island of Mayotte (Comoros Archipelago). *J. Cetacean Res. Manage.* 9(2):105–10.
- Kiszka, J., Ersts, P.J. and Ridoux, V. 2010a. Structure of a toothed cetacean community around a tropical island (Mayotte, Mozambique Channel). *Afr. J. Mar. Sci* 32(3):543–51.
- Laran, S., Authier, M., Van Canneyt, O., Dorémus, G., Watremez, P. and Ridoux, V. 2017. A comprehensive survey of pelagic megafauna: their distribution, densities, and taxonomic richness in the tropical southwest Indian Ocean. *Front. Mar. Sci.* 4:139. [Available at: <https://dx.doi.org/10.3389/fmars.2017.00139>].
- Laran, S., Doremus, G., Mannoçi, L., Van Canneyt, O., Watremez, P., Cadinouche, A., Dulau-Drouot, V., Mayer, F.X., Monthy, D., Andrianarivelo, N., Razafindrakoto, Y., Toilibou, A. and Ridoux, V. 2012. Progress of the REMMOA aerial surveys conducted in the French EEZ and adjacent waters: contrasted cetacean habitats in the southwest Indian Ocean. Paper SC/64/E14 presented to the IWC Scientific Committee, June 2012, Panama City (unpublished). 14pp. [Paper available from the Office of this Journal].
- Leatherwood, S., C. B. Peters, R. Santerre, M. Santerre and J. T. Clarke. 1984. Observations of cetaceans in the northern Indian Ocean Sanctuary, November 1980-May 1983. Reports of the International Whaling Commission 34:509-520.
- Leatherwood S. and G.P. Donovan. 1991. Cetaceans and cetacean research in the Indian Ocean Sanctuary. *UNEP Marine Mammal Technical Report*, 3:1-287.
- Mansur, R.M., Strindberg, S. and Smith, B.D., 2012. Mark-resight abundance and survival estimation of Indo-Pacific bottlenose dolphins, *Tursiops aduncus*, in the Swatch-of-No-Ground, Bangladesh. *Marine Mammal Science*, 28(3):561-578
- Minton G., Collins T., Findlay K. and Baldwin R. 2010. Cetacean distribution in the coastal waters of the Sultanate of Oman. *Journal of Cetacean Research and Management*, 11(3): 301-313
- Mondreti, R., Davidar, P., Ryan, P.G., Thiebot, J.B. & Gremillet, D. 2020. Seabird and cetacean occurrence in the Bay of Bengal associated with marine productivity and commercial fishing effort. *Marine Ornithology* 48: 91–101.
- Meyler SV, Felix H, Crouthers R. 2012. Abundance and Distribution of Indo Pacific Humpback Dolphins (*Sousa chinensis*) in the Shimoni Archipelago, Kenya. *Western Indian Ocean Journal of Marine Science* 10 (2): 201-209
- Nunny, L & Simmonds, M. 2019. Climate Change and Cetaceans - an update. SC/68A/E/07. Paper to IWC 2019, Scientific Committee meeting. [Available online here: SC/68A/E/07]
- Panicker, D., Sutaria, D., Kumar, A., Stafford, K.M. 2019. Cetacean Distribution and Diversity in Lakshadweep Waters, India, Using a Platform of Opportunity: October 2015 to April 2016. *Aquatic Marine Mammal*. 46, 1.
- Parnum, B. 2018 Occurrence of Marine Fauna in Offshore Northwest Myanmar. ERM Worldwide Group Ltd. Western Australia.
- Peddemors, V.M., Best, P.B., Findley, K.P., Gove, D., Rakotonirina, B., Rossauw, A., Sekiguchi, K. 1997. Small cetaceans of the Southwest Indian Ocean. Paper SC49/SM33 presented to the IWC Scientific Committee.
- Pérez-Jorge, S. 2016. Ecology of the Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) around Kisite-Mpunguti Marine Protected Area (KMMPA), Kenya. PhD Thesis. Biology Department, University of Cadiz, Spain. Pp. 141.
- Perez S, Gomez I, Crouthers R, Lemarkat R. Corti, G., 2010. IndoPacific bottlenose dolphin (*Tursiops aduncus*) population study of Kisite-Mpunguti Marine Protected Area, east Africa. Poster presented at the 24th Conference of the European Cetacean Society, Stralsund, Germany
- Ponnampalam L.S. 2009 Ecological studies and conservation of small cetaceans in the Sultanate of Oman, with special reference to spinner dolphins, *Stenella longirostris* (Gray, 1828). PhD thesis, University of London. 347pp.
- Priyadarshana, T., Randage, S.M., Alling, A., Calderan, S., Gordon, J., Leaper, R. and Porter, L., 2016. Distribution patterns of blue whale (*Balaenoptera musculus*) and shipping off southern Sri Lanka. *Regional Studies in Marine Science*, 3, pp.181-188.
- Rosenbaum HC, Walsh P, Razafindrakoto Y, Vely M, Desalle R. 1997. First description of a humpback whale wintering ground in Baie d'Antongil, Madagascar. *Conservation Biology* 11: 308–314.
- Russell, G., Bridge, M. and Nimak-Wood, M., 2020. Blue whales off the southern coast of Sri Lanka during the southwest monsoon season. *J. Cetacean Res. Manage.*, 21(1), pp.1-7.
- Ruwa, R. and Rice, J. 2017. Chapter 36. Indian Ocean in Inness, Lorna & Simcock, Alan. 2017. The first global integrated marine assessment: World ocean assessment i. 10.1017/9781108186148.

- Rosenbaum HC, Walsh P, Razafindrakoto Y, Vely M, Desalle R. 1997. First description of a humpback whale wintering ground in Baie d'Antongil, Madagascar. *Conservation Biology* 11: 308–314.
- Sattar S.A., Anderson R.C. and Adam M.S. (compilers). 2009. Report of the Indian Ocean Cetacean Symposium 2009, held at Paradise Island Resort and Spa, Maldives, 18-20 July 2009. Marine Research Centre, Maldives. 46pp. Revised edition 2012. www.mrc.gov.mv
- Sharpe, M, Berggren, P. 2019. Indian Ocean humpback dolphin in the Menai Bay off the south coast of Zanzibar, East Africa is Critically Endangered. *Aquatic Conserv: Mar Freshw Ecosyst.* 29: 2133–2146. <https://doi.org/10.1002/aqc.3221>
- Smith, B. D., Ahmed, B., Mansur, R. and Strindberg, S. 2008. Species occurrence and distributional ecology of nearshore cetaceans in the Bay of Bengal, Bangladesh, with abundance estimates for Irrawaddy dolphins *Orcaella brevirostris* and finless porpoises *Neophocaena phocaenoides*. *Journal of Cetacean Research and Management*, 10:45–58.
- Smith BD, Tun MT. 2008. A note on the species occurrence, distributional ecology and fisheries interactions of cetaceans in the Mergui (Myeik) Archipelago, Myanmar. *J Cetacean Res Manag.* 0:37–44.
- Stensland, E., Carlén, I., Särnblad, A., Bignert, A. and Berggren, P. 2006. Population size, distribution and behaviour of Indo-Pacific bottlenose (*Tursiops aduncus*) and humpback (*Sousa chinensis*) dolphins off the south coast of Zanzibar. *Mar. Mam. Sci.* 22(3):667–82.
- Thiebot J.-B and Weimerskirch H. 2013. Contrasted associations between seabirds and marine mammals across four biomes of the southern Indian Ocean. *Journal of Ornithology* 154:441–453
- Thilakarathne, E.P.D.N., Kumara, P.P. and Thilakarathna, R.M.G.N., 2015. Diversity and distribution of cetaceans off Mirissa in the southern coast of Sri Lanka II. Relationship with sea surface temperature, salinity and water density. *Sri Lanka Journal of Aquatic Sciences*, 20(1).
- UNESCO IOC and UNEP. 2016. The Open Ocean: Status and Trends. United Nations Environment Programme (UNEP), Nairobi.
- Wamukoya, G.M., Mirangi, J.M., Ottichillo, W.K. 1996. Report on the marine aerial survey of the marine mammals, sea turtles, sharks and rays. KWS Technical Series Report No. 1. 22 pp
- Wildlife Conservation Society. 2017. Threats posed to Marine Life in the Western Indian Ocean from Anthropogenic Ocean Noise and Shipping, including Ship strikes. Submission to United Nations Environment Programme on SDG14 and SDG16.
- Webster I, Cadinouche A. 2013. Agalega expedition report: Summary of results with recommendations for management, research and monitoring. Report to the Outer Island Development Corporation. 27pp
- Webster, I. Cockcroft, V. Cadinouche, A. Huggins, A. 2020. Cetacean Diversity of Mauritius J. *CETACEAN RES. MANAGE.* 21: 45–58.
- Webster, I, Rowat, R. 2016. Conserving marine mammals around Seychelles while maintaining sustainable use of marine resources against a background of urban development, petroleum exploration and climate change. *Marine Conservation Society Seychelles.*

Annex 1. Summary of published and unpublished literature of relevant surveys, sighting and catch data across the Indian Ocean sub-regions, and identification of current survey plans.

Western Indian Ocean (FAO Major Fishing Area 51)

ARABIAN SEA (FAO AREAS 51.3; 51.4)

HISTORIC SURVEY – GEOGRAPHIC COVERAGE	TIME PERIOD	SOURCE	CURRENT SURVEY PLANS – GEOGRAPHIC COVERAGE	TIME PERIOD
Oman	2001-2003 2004-2006	Minton et al. 2010 Ponnampalam 2009		
Maldives Northern Maldives Maldives EEZ (atoll slope) Maldives	April 1998 Repeated in 2013 2003 and 2004 72 days at sea August 1990 to June 2002. 68 trips, 535 days at sea	Ballance et al 2001 Unpublished – Anderson Unpublished – Anderson Clark et al. 2012 Anderson 2005	Northern Maldives: a vessel has been chartered to repeat the 1998 and 2013 surveys in April 2022 – although still needs some funding. Additional unpublished data collected from whale-watch cruises, 2002-2020. Needs analysis	2022
Central Arabian Sea pelagic western tropical Indian Ocean covering 9,784 linear km	March to July 1995,	Ballance and Pitman (1998),		
Pakistan shelf and shelf break	2005-2009 65 days at sea	Gore et al. 2012		
Suez Canal-Red Sea- Arabian Sea to Sri Lanka (stopped in Djibouti, Oman, India)	29 Nov 1981- 14 Feb 1982	Alling 1986		
India Lakshadweep waters using platforms of opportunity Sindhudurg waters, under the Sindhudurg Cetacean Population Assessment project.	October 2015- April 2016 -2016	Panicker et al. 2019		

SOUTH-WEST INDIAN OCEAN (FAO AREAS 51.4 BELOW EQUATOR; 51.5; 51.6; 51.7; 51.8, 58.4)

HISTORIC SURVEY – GEOGRAPHIC COVERAGE	TIME PERIOD	SOURCE	CURRENT SURVEY PLANS – GEOGRAPHIC COVERAGE	TIME PERIOD
Somalia - offshore	1995 March/April/ May March – July 1995	Eyre and Frizell 2012 Ballance and Pitman 1998		

<p>Tanzania & Zanzibar</p> <p>line transects out to 50km offshore</p> <p>South coast Zanzibar</p> <p>Zanzibar</p> <p>Aerial survey Zanzibar channel and coastal waters of Unguja Island, within 10 nautical miles of the coast</p>	<p>March- April 2015</p> <p>January and March 1999–2002, 2015</p> <p>March 2000</p>	<p>Braulik et al 2016</p> <p>Stensland et al 2006</p> <p>Berggren et al 2001</p> <p>Sharpe and Berggren 2019</p>		
<p>Kenya</p> <p>Aerial surveys whole 500km coast.</p> <p>Kisite-Mpunguti MPA Kenya</p> <p>Shimoni Archipelago, Kenya.</p> <p>Seismic surveys in the offshore waters of Lamu in northern Kenya</p>	<p>18-25 Nov 1994</p> <p>2006 near-daily surveys, during four, ten week periods</p> <p>2006-2013</p> <p>September and October 2014</p>	<p>Wamukoya et al 1996</p> <p>Perez et al 2010</p> <p>Meyler et al 2012</p> <p>Perez PhD 2016</p> <p>Barber et al 2016</p>		
<p>Mozambique</p> <p>(Mozambique and southern Madagascar)</p> <p>From Maputo Bay</p>	<p>-?</p> <p>14 surveys between 2011-2017</p>	<p>Peddemors et al. 1997</p> <p>Allport 2017</p>		
<p>Madagascar</p> <p>Port Elizabeth (South Africa) to Bazaruto (Mozambique)</p> <p>Cetacean Diversity in Malagasy Waters</p>	<p>-?</p> <p>21 March 1998 - 20 May 1998</p>	<p>Rosenbaum et al. 1997</p> <p>Unpublished-Cockcroft and Young, 1998</p> <p>Cerchio et al in press (book)</p>	<p>West and north coast Madagascar (Moz channel)</p>	<p>Greenpeace survey- (March 2021)</p>
<p>Comoros and NW coast of Madagascar</p> <p>3 areas of Madagascar</p> <p>Seychelles EEZ</p> <p>La Reunion EEZ</p> <p>Mauritius EEZ</p>	<p>December 2009 to April 2010.</p>	<p>Laran et al 2017</p>		
<p>Comoros</p>	<p>2010 August and September 2002, and opportunistic sightings collected from 2000 to 2003</p>	<p>Kiszka et al 2010</p>		<p>Greenpeace survey- (March 2021)</p>
<p>Mayotte- the lagoon and surrounding waters, i.e., external barrier reef slope, insular slope (200-1,000m) and oceanic (>1,000m) waters</p>	<p>July 2004 to August 2005;</p> <p>July 2004 and June 2006</p>	<p>Kiszka et al 2007, 2010</p>		<p>Greenpeace survey- (March 2021)</p>
<p>Mauritius</p> <p>West coast of Mauritius, opportunistic sightings on cargo/cruise ship: Mauritius to La Reunion to Durban close by southern coast of Madagascar and return (Oct-Nov 1991), Mauritius to Rodrigues and return (June 1992)</p> <p>Mauritius to Agalega</p>	<p>July 1991-July 1992</p> <p>July 2013</p>	<p>Corbett 1994;</p> <p>unpublished -Webster and Cadinouche 2013</p>	<p>Mauritius- Saya de Malha Bank</p>	<p>Greenpeace survey- (March 2021)</p> <p>MMCO-local</p>

Coastal Mauritius	2008-2014	Webster et al 2020	Whales of Mauritius-Surveys around main islands of Mauritius	NGO – COVID-19 disruption to plans.
La Reunion – (including surveys between La Reunion, Mauritius, Antarctic Territories) La Reunion to Mauritius and return	Six surveys 2008-2013	Huijser et al 2020		
Mauritius to Reunion and south (Mauritius; 20°09'S, 57°30'E) The cruise proceeded to 31°S, 45°E and further along the meridian 45°E to 56°S latitude. The return leg was along 57°E	23 Jan -4 March 2004	Jayasankar et al 2007		
La Reunion and ABNJ to French Antarctic islands - FAO Areas 51.7, 58.4	1978-2005 5x per year	Thiebot and Weimerskirch 2013		
La Reunion up to 11km offshore south and west coasts	2004-2007	Dulau-Drouot et al 2008 Dulau-Drouot et al 2012 Estrade and Dulau, 2020		
Seychelles Seychelles Islands	April- June 1980 March-July 1995	Keller et al 1982 Ballance and Pitman	Greenpeace survey- (March 2021) University of Seychelles (Kiszka)	(March 2021) Nov. 2020, surveys planned in 2021, 2022, 2023
Sightings from Aldabra island based staff	1973-2007	A Hermans & P Pistorius 2008		
Surveys between Mahe and several inner islands, aerial surveys and consolidated sightings from outer islands, seismic vessel survey	2001-2015	Webster and Rowat 2016 Unpublished report		
NW of Seychelles	1995 1993	Eyre and Frizell 2012 Eyre, 1995		
South Africa Annual aerial surveys to study Southern Right Whales	1979- current			
IWC SOWER cruises (FAO AREA 51.8, 51.7) 316 cetacean sightings between 20°E-81°E and 22° S - 45°S	1979-2000	IWC SOWER		
SWIO (FAO areas 51.6, 51.7, 51.8) 3 Transects out of Durban (1) 20" and 33"S, 30" and 57"E, (2) between 35" and 42"S, 30" and 49E, and (3) between 31" and 34"S, 30" and 67"E	24 Nov 1973- Feb 1974	Best et al 1998		

BAY OF BENGAL (FAO AREA 57.1)

HISTORIC SURVEY – GEOGRAPHIC COVERAGE	TIME PERIOD	SOURCE	CURRENT SURVEY PLANS – GEOGRAPHIC COVERAGE	TIME PERIOD
India EEZ and Sri Lanka 5-23°N and 66-95°E with a depth range of 20- 5,000m and included coastal, continental shelf and oceanic waters of the Indian EEZ and a part of the southern Sri Lankan Sea	October 2003 to February 2007	Afsal et al 2008		
Northern Indian Ocean		Leatherwood et al., 1984		
Sri Lanka (offshore)		Alling 1986		

<p>North East coast Tincomalee harbour 100nm radius surveys (2 seasons)</p> <p>West coast >500m depth, Visual and acoustic</p> <p>Sri Lanka (Mirissa, south coast)</p> <p>-</p> <p>-</p> <p>-</p> <p>-</p> <p>-2014-2015 focused on blue whales</p> <p>-2017 focused on blue whales</p>	<p>4 Feb -17 Mar 1982</p> <p>20 Jan-24 Apr 1983, 22 Feb-25 Apr 1984</p> <p>March-June 2003 (part of Ocean Alliance Indian Ocean surveys)</p> <p>April 2007-2013</p> <p>2008-2009</p> <p>2012</p> <p>2014-2015</p> <p>2017</p>	<p>De Vos et al. 2012</p> <p>Anderson and Alagiyawadu 2019</p> <p>Ilangakoon 2012</p> <p>Thilakarathne et al. 2015</p> <p>Priyadarshana et al. 2016</p> <p>Russell et al. 2020</p>		
<p>Singapore to Sri Lanka through the Straits of Malacca, Andaman Sea and across the Bay of Bengal</p>	<p>November-December 2012</p>	<p>Ilangakoon and Alling 2016</p>		
<p>Bangladesh Vessel-based, line-transect survey in the nearshore waters of Bangladesh Swatch-of-No-Ground, Bangladesh</p> <p>1,018km of systematic trackline nearshore cetacean survey in the Bay of Bengal, Bangladesh</p>	<p>16-27 February 2004</p> <p>4 winter seasons (Dec-Feb) of 2005–2009</p> <p>February 2004</p>	<p>Smith et al 2008</p> <p>Mansur et al 2012</p> <p>Smith et al 2008</p>		
<p>Myanmar vessel-based line-transect survey of the nearshore waters (to a depth of 40-60m) of the Mergui (Myeik) Archipelago of southern Myanmar Seismic surveys were conducted in the offshore waters of northwest Myanmar by oil and gas operators. Marine megafauna sightings and fishing activity data were collected.</p>	<p>23 February-6 March 2005</p> <p>between 2015 and 2017</p>	<p>Smith and Tun 2008</p> <p>Parnum 2018</p>		
<p>Bay of Bengal pelagic Nine cruises in April–May 2012, February–March 2013, and January 2014, along two major shipping routes: Chennai to Port Blair (CPB) and Kolkata to Port Blair 23-d research cruise of R/V Marion Dufresne (120 m) Passenger vessels 4722.3 km covered Singapore to Sri Lanka, through the Straits of Malacca, Andaman Sea and across the Bay of Bengal</p>	<p>39 days at sea 2012-2014</p> <p>Nov-Dec 2012</p>	<p>Mondreti et al. 2020</p> <p>Ilangakoon and Alling 2016</p>		

NORTH-EAST AND CENTRAL INDIAN OCEAN (FAO AREA 57.2 ; 57.3; 57.5.)

HISTORIC SURVEY – GEOGRAPHIC COVERAGE	TIME PERIOD	SOURCE	CURRENT SURVEY PLANS – GEOGRAPHIC COVERAGE	TIME PERIOD
Offshore and ABNJ area between Mauritius and South China Sea (1,105nm covered in the IO Sanctuary, FAO Area 51.7 across to 57.2)	March/April 1999 20 days at sea	De Boer (2000)		
Offshore and ABNJ area between South Western Australia to Red Sea FAO Area 57.5.2, 57.3, 51.7, 51.5, 51.3	March/April/ May 1995. 41 days in the IO Sanctuary	Eyre and Frizell (2012)		
Western Australia South-western Australia North-western Australia Kimberley coast – inshore dolphins Kimberley coast – humpback whales Offshore and Kimberley coast (Browse basin)	1963- current abundance surveys for humpback whales 1976 – southern right whale surveys 1999- current Blue whale surveys 2004-2020	 Bouchet et al. 2021 Jenner et al. 2001 & unpublished Jenner and Jenner (unpublished)		
Australian Indian Ocean territories			Biodiversity assessment of Australia's Indian Ocean Territories – benthic surveys O'Hara (Museums Victoria) https://iioe-2.incois.gov.in/IIOE-2/EP40.jsp	June-July 2021
Indonesia Savu Sea Solor and Alor Sea and Komodo Island Lamalera waters, Nusa Tenggara Timur	1999 - ? 2004	Some summary information presented in Wiadnyana et al. 2004 TNC & Apex Environmental; Kahn et al. 2003	Indonesia – world bank project surveys led by Putu Liza Kusuma Mustika	
Malaysia Matang, Perak	2013-2016	Kuit et al. 2019		
Thailand		No information retrieved		

Timor-Leste	Dates to be confirmed – research since 2007- ongoing	Baleia no Golfo/Blue Ventures; Karen Edyvane		
IWC SOWER Cruises FAO Area 57.3; 57.4, 57.5, 57.6 431 cetacean sightings between 80°E – 151°E and 29°S-56°S 461 cetacean sightings between 80°E – 130°E and 08°S - 30°S	1978 - 2010	IWC SOWER		
La Reunion to French Antarctic islands –80°E-110°E Amsterdam St Paul to Australia (constant track lines)	1978-2005 5x per year	Thiebot and Weimerskirch 2013		

OCEANIC INDIAN OCEAN (FAO AREA 57.4)

HISTORIC SURVEY – GEOGRAPHIC COVERAGE	TIME PERIOD	SOURCE	CURRENT SURVEY PLANS – GEOGRAPHIC COVERAGE	TIME PERIOD
IWC SOWER Cruises FAO Area 51.4, 431 cetacean sightings between 80°E – 151°E and 29°S-56°S	1978-2010	IWC SOWER		
La Reunion to French Antarctic islands	1978-2005 5x per year	Thiebot and Weimerskirch 2013		
National Antarctic programmes (e.g., Australian Antarctic Programmes) – information not compiled here.				

DIRECT CATCH DATA IN THE INDIAN OCEAN

The IWC holds records from 1908- 2019 of direct catches of large whales in the Indian Ocean region, and this data can also be useful, in addition to historical sighting and survey data for estimating past abundance of large whales (e.g., as in Branch et al. 2007).

ACOUSTIC MONITORING DATA

Not included in this paper, however many different long-term acoustic data sets are likely to exist, as well as new projects (e.g., QWIO – led by WCS, COMBAVA project, and collaborations through the ASWN).

PHOTO-ID CATALOGUES

Not included in this paper, but we note that there are many existing initiatives (e.g., ASWN Flukebook, national initiatives and those held by research institutions and independent researchers).