

SC/68B/RP/02

SH - Passive Acoustic Monitoring for blue whales and other baleen whales off Oman

IWC



INTERNATIONAL
WHALING COMMISSION



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PROJECT PROPOSAL REQUEST

1. PROPOSAL TITLE

Please provide the title of the project or the name of the workshop/meeting.

Passive Acoustic Monitoring for Blue whales and other baleen whales off Oman

2. BRIEF OVERVIEW OF THE PROPOSAL AND ITS EXPECTED OUTCOME

Give a very brief overview (max 150 words) on your proposal and its expected outcomes. Use bullet point to list outcomes. Be succinct and clear as this may be used to summarise your project for the report.

The status and population identity of blue whales in the Arabian Sea are poorly understood, and recent acoustic evidence indicates that the whales off Oman belong to an acoustic population that has not been previously described. This implies the existence of a stock in the North Indian Ocean that is distinct from the Sri Lanka / Central Indian Ocean stock, with which it has been historically conflated. Consequently, illegal Soviet whaling in the 1960's depleted this stock, potentially severely. We will use a year of passive acoustic monitoring in deep water off the coast of Oman towards the following goals:

- Commence dedicated research program for NIO blue whales in the waters of Oman, in accordance with previous IWC recommendations
- Describe seasonal variation in presence of blue whales and how this relates to what is known about other IO populations
- Collect acoustic data on Arabian Sea humpback and Bryde's whales and other cetaceans

3. RELEVANT IWC SCIENTIFIC COMMITTEE GROUPS OR SUB-GROUPS

List all the IWC Scientific Committee groups or sub-groups that the outcomes of this work would be relevant to and provide a brief (1-2 lines) explanation of how it would contribute more widely to their ongoing programmes of work. Where possible, do not simply list only the sub-committee within which or for which the project proposal was generated.

SH – In context of the population assessments of non-Antarctic blue whales, this work will fill data gaps and thereby inform catch allocations for the North Indian Ocean Populations, describing occurrence of an Oman acoustic population and assessing whether other acoustic populations may be present in the western Arabian Sea.

CMP – This work will provide data for the status assessment of NIO blue whales as a stock that can be considered for a CMP, and specifically address the question of which stock(s) were reduced by illegal Soviet whaling and may be threatened and in need of conservation action.

4. TYPE OF PROJECT (PLEASE TICK)

Research project	X
Modelling	
Workshop/meeting	
Database creation/maintenance	
Compilation work/editing (e.g. on whalewatching regulations, SOCER, etc.)	
Other (please specify below)	

5. BRIEF DESCRIPTION OF THE PROPOSAL AND ITS CONNECTION WITH SCIENTIFIC COMMITTEE RECOMMENDATIONS (DO NOT EXCEED 1500 WORDS)

(A) BACKGROUND, RATIONALE, AND RELEVANCE TO THE PRIORITIES IDENTIFIED BY THE IWC SCIENTIFIC COMMITTEE:

Provide a clear explanation of the background and rationale for the proposal and its relevance to Scientific Committee identified priorities. Clearly identify the most relevant and recent Scientific Committee recommendations.

Blue whales in the Indian Ocean (IO) are currently thought to represent two or three subspecies (Antarctic, *Balaenoptera musculus intermedia*; pygmy, *B. m. breviceuda*; and North Indian Ocean, NIO, *B. m. indica*) (Rice 1998). The classification of a NIO population as a separate subspecies, *B. m. indica*, as opposed to a population of pygmy blue whale, is debated and without scientific consensus (Rice 1998, Branch and Mikhalev 2008). Irrespective of taxonomic classification, a population reportedly resides year round in the northern Indian Ocean, ranging from the Arabian Peninsula in the west, to at least Sri Lanka in the east, and south at least to the Maldives (Baldwin 2003, Branch et al. 2007b, Branch and Mikhalev 2008, Anderson et al. 2012, Ilangakoon and Sathasivam 2012, de Vos et al. 2014, Willson et al. 2019).

Populations of IO blue whales are thought to be defined by diagnostic song-types (McDonald et al. 2006). Antarctic blue whales are characterized by their own song-type, whereas pygmy/ NIO blue whales are thought to be structured into three populations each with a diagnostic song-type: Southwest IO pygmy (Madagascar), Southeast IO pygmy (West Australia) and NIO/Central IO (Sri Lanka). There are no published accounts of blue whale song in the Arabian Sea, and within the NIO the only acoustic data are limited to boat-based recordings in the 1980's off eastern Sri Lanka, which first documented the Sri Lanka song-type (Alling and Payne 1987).

Through the use of long-term passive acoustic monitoring (PAM), the Sri Lanka song-type has been more extensively documented throughout the Central Indian Ocean from equatorial Chagos Archipelago, as far south as the Amsterdam Island (43°S) and Crozet Island (46°S) basins (Samaran et al. 2010, 2013, Stafford et al. 2011, Leroy et al. 2018). Despite the limited evidence in the NIO, the Sri Lanka acoustic population has been assumed to be synonymous with the northern Indian Ocean population, or subspecies (Branch et al. 2017b, Anderson et al. 2012). However, there is an apparent incongruence between the concept of a resident NIO population/subspecies and the documentation of its putative song-type well into the temperate latitudes of the Southern Hemisphere.

Recently, a previously unreported song-type was described, recorded off Oman in the northern IO/Arabian Sea, off the western Chagos Archipelago in the equatorial central IO, and off Madagascar in the southwestern IO (Cerchio et al. in review, SC/68B/INFO/28). As this was the only blue whale song detected off Oman, and therefore the only song-type identified in the Arabian Sea, it was labelled the "Oman" song-type. Spatiotemporal variation at the three sites suggested a distribution west of 70°E, with affinity for the northern IO/Arabian Sea, and only minor presence in the southwestern IO. Recordings from Oman were made from a shallow water recorder perched on the edge of the shelf-break, and consequently were limited in detection range and provided song occurrences that were degraded due to propagation loss from deep water sources onto the shallow shelf. Additional PAM effort in the deeper water of the shelf slope off Oman is required to provide higher quality data, greater detection range, better description of temporal distribution, and an assessment of the presence/absence of other song types.

Of particular relevance to this discovery, a period of illegal whaling by the Soviet Union during 1963-1967 captured 1,294 blue whales in the northwestern IO (Mikhalev 1996, 2000). The largest numbers of catches in the Arabian Sea was off northern Somalia (Gulf of Aden) and the Arabian Peninsula (ca. 10°-17°N, 45°-55°E), with additional smaller clusters in the central-eastern Arabian Sea off Lacshadweep/Maldives/western Sri Lanka (ca. 5°-10°N, 65°-80°E) and off the Indus Canyon in the northeastern Arabian Sea (ca. 22°-24°N, 66°-68°E). These catches are generally allocated to the Sri Lanka acoustic population (Branch et al. 2007a, 2019, Anderson et al. 2012). However, timing of presence of the Oman song-type off Oman suggests that the Soviet whaling targeted this population, as opposed to the more widely spread Sri Lanka acoustic population. Moreover, based upon geographic distribution and potential aseasonal reproduction found in the Soviet catch data, Cerchio et al. (in review) suggest that if there is a northern Indian Ocean subspecies, it is likely this acoustic population. Furthermore, the potentially restricted range, intensive historic whaling, and the fact that the song-type has been previously undetected, suggests a small population that is in critical need of status assessment and conservation action.

This work has particular relevance to the priorities of the SH subcommittee, in context of the population assessments of non-Antarctic blue whales. Identification of a new population, and definition of a new IO song-type, provide critical new information for current efforts to assign catch allocations to IO populations (Branch et al. 2019, SC/68B/SH/09); the new data from the NIO will have profound effects on

these models and the resultant conclusions regarding status of IO populations. In addition, the work is of relevance to the CMP subcommittee, specifically addressing the question of which stock(s) were reduced by illegal Soviet whaling and may be threatened and in need of conservation action. Given the large number of blue whales taken in the Arabian Sea, it is likely that this population may be as threatened as the Arabian Sea humpback whale (which was taken by the Soviet whalers in far fewer numbers; Mikhalev 1997, Minton et al. 2011), and thus should be considered for a CMP.

Specifically, this project addresses recommendation (2) for northern and western Indian Ocean blue whales, as follows. Moreover, it is the intention of the research team that this work more generally represent the start of a concerted effort and long-term project to address all recommendations as stated below:

Reiterating its advice that the distribution and population isolation of blue whales is poorly understood in the northern and western Indian Ocean (IWC 2019b:21), the sub-committee encourages researchers and range states to address the following research priorities:

- (1) continued photo-identification and genetic sampling of blue whales off Oman,
- (2) passive acoustic monitoring to determine seasonal presence, population abundance and trends;
- (3) comparison of blue whale photographic catalogues with other blue whale catalogues in Oman, India, Sri Lanka and any others available in the Indian Ocean (and possibly the Antarctic);
- (4) collection and analysis of tissue samples, to better understand the taxonomy and stock structure of Arabian Sea blue whales.

(B) SPECIFIC OBJECTIVES OR TOR AND DELIVERABLES/OUTCOMES:

Provide the specific objectives and the expected deliverables. In the case of workshops and meetings, include the Terms of Reference (ToR) and expected outcomes.

Objectives:

1. Collect one year of PAM data from the continental slope waters off the coast of Dofar, Oman. This effort is viewed by the P.I.s as the first part of a long-term effort to assess blue whales off Oman and the Arabian Sea.
2. Assess and describe the presence of the Oman blue whale song-type over the course of the year, on multiple temporal scales (monthly, daily, hourly).
3. Assess the presence of other blue whale song-types.
4. Collect acoustic data on Arabian Sea humpback whales, Bryde's whales and other cetaceans (e.g., Sperm whales, delphinids), to be analysed under separate funding.

Deliverables

1. Report to the IWC Scientific Committee on results of blue whale song assessment.
2. Peer-reviewed publication submission, following report.

(C) METHODOLOGICAL APPROACH/WORK PLAN/ADMINISTRATIVE DETAILS

Specify the methods to be applied (novel methods require more explanation than standard ones) and the broad workplan – the detailed timetable appears under Item 5 below.

In the case of workshops and meetings, include the broad work plan including any pre-requisites for the workshop/meeting to take place (apart from funding, e.g. completed analyses, papers etc.) and administrative details (e.g. location, dates, number of participants).

PAM data collection has already commenced off Dofar, Oman, in Hallaniyats Bay with the deployment of an archival recorder in March 2020. An Ocean Instruments SoundTrap 500-STD autonomous archival recorder (oceaninstruments.co.nz) was deployed on March 6, 2020, with the intention to conduct two deployments of 6-7 months each from March to September 2020, and September 2020 to March 2021. The instrument was anchored just off the shelf break at position 17.38°N, 55.31°E, at a bottom depth of 301m. A Vemco Ascent acoustic release was suspended above the anchor for recovery using the Vemco VR100 surface communication station. The SoundTrap recorder has a flat response from 20Hz-60kHz (+/- 3dB) with a 34dB re 1V μ Pa-1 noise floor and a full scale response of 174.1 dB re 1V μ Pa-1 including system gain.

During the first 6-month deployment, recording parameters were set for 50% duty cycle (30min every 60min) and 24kHz sample rate; at this parameter setting the expected recording endurance is 340-370 days. These settings were chosen as a precaution, in the event that funds or logistics would not allow for a field trip during September-October 2020; in such case the unit is capable of an endurance of one complete year of data collection at the 50% duty cycle. Ideally, with sufficient funds, a field trip will be mobilized in September 2020 for the recovery/redeployment of the unit; in such case, the second deployment will be conducted with continuous recording at 24kHz sample rate, with an expected endurance of 180-200 days, and recovery during March 2021.

The resulting sound files will be down-sampled to 2kHz to reduce size and increase manageability of the data set for low-frequency analysis. Manual evaluation of spectrograms will be conducted in Raven Pro 1.5 for review of baleen whale vocalizations and logging for hourly presence as conducted for Cerchio et al. (in review, SC/68B/INFO/28). During the manual browse, presence of the Oman blue whale song-type will be logged for each hour, and the number of singing individuals estimated based upon overlapping sequences of song units. Other low frequency (in the 10-100Hz frequency range) baleen whale vocalizations, including any other blue whale song-types (e.g., Sir Lanka song-type), potential Bryde's whale vocalizations, and LF downsweeps (potentially attributed to blue whales) will also be logged. Results will be collated and reported as the number of hours per day with Oman song-type presence, and coded for estimated number of singers (as in SC/68B/INFO/28).

(D) SUGGESTIONS FOR OUTREACH

Please, note that successful proponents will be requested to produce ad hoc material that will be used by the IWC Secretariat for dissemination and outreach.

Results of the proposed work will be highlighted and publicised by the Environment Society of Oman, Five Oceans Environmental Services, and the African Aquatic Conservation Fund, each having outreach capacity that ranges from their local region to global in scope. Materials will be made available for to the IWC Secretariat to disseminate and use for outreach.

6. TIMETABLE FOR ACTIVITIES AND OUTPUTS

Specify the timetable for project activities and expected out puts separately. For projects with multiple distinct elements please indicate interim goals and timeframes. Add as many rows as you need to the tables below. If publications are an expected output please note whether you will submit the manuscript to the IWC's Journal of Cetacean Research and Management.

Activity to be undertaken	Key person(s)	Start(mm/yy)	Finish (mm/yy)
Deployment of ST500 recorder off Oman (<i>completed, co-funded</i>)	A. Willson, S. Cerchio	03/20	03/20
Recovery and redeployment of ST500 recorder after first deployment ¹	A. Willson, S. Cerchio	09/20	10/20
Analysis of first six months of data ²	S. Cerchio	10/20	03/21
Recovery of ST500 recorder after second deployment	A. Willson, S. Cerchio	03/21	03/21
Analysis of second six months of data ²	S. Cerchio	04/21	06/21
Preparation of final report	S. Cerchio, A. Willson	06/21	07/21
¹ Pending availability of funds, the recorder will be recovered and redeployed after 6-7 months during September or October 2020.			
² Pending availability of funds for a Sept/Oct 2020 recovery, the first 6-7 months of data will be analysed; in the absence of funds, the entire deployment will be analysed after the final recovery in March 2021			

Expected outputs	Completion date (mm/yy)
Progress Report to IWC Scientific Committee, SC 69A	05/21
Final Report to IWC Scientific Committee	07/21
Submission to peer-reviewed journal	11/21

7. RESEARCHERS' (OR STEERING GROUP) NAME(S) AND AFFILIATION

Please, also specify if the project team has any direct connection (e.g. same research group or institute, collaborator on common project) with people involved or likely to be involved in taking the funding decision (e.g. IWC SC heads of delegations, SC convenors, etc.). Add as many rows as you need to the table below.

Name	Affiliation	Connection with decision
Salvatore Cerchio, P.I.	African Aquatic Conservation Fund (AACF)	None
Andrew Willson, P.I.	Five Oceans Environmental Services (5OES)	None
Robert Baldwin	Five Oceans Environmental Services (5OES)	None
Danielle Cholewiak	NOAA Northeast Fisheries Science Center (NEFSC)	None

8. TOTAL BUDGET

Breakdown into: (1) salaries/wages (include name/position of each individual and breakdown of time and duties i; (2) travel/subsistence expenses (breakdown by person and justification) unless for IPs for workshops where a total estimate based on an average for the total number of IPs is acceptable; (3) services (e.g. aircraft/vessel time, consultancy fees, ARGOS fees, etc.); (4) reusable capital equipment (e.g. reusable equipment such as a hydrophone, cameras, etc. Note that this equipment will have to be registered at the IWC Secretariat and will remain property of the IWC at the end of the project), (5) expendable capital equipment (e.g. consumables, tags, stationery), (6) shipping costs, (7) insurance costs, (8) in kind co-funding (specify whether other funding is available for personnel/name, equipment, venues, etc.). Note that "Overheads" are not admissible. Add as many rows as you need to the table below.

Type	Detailed description	Cost in GB pounds
(1) Salaries	S. Cerchio, AACF P.I., Project supervision, Analysis, Write up of results, 24 days	£8,000.00
	A. Willson, 5OES P.I., Field Manager, 5 days	£2,000.00
	5OES field support staff, 4 days	£1,300.00
(2) Travel/subsistence	Field team expenses	£100.00
	Boat Fuel	£40.00
(3) Services	Boat Hire	£310.00
	Car Rental	£250.00
(4) Reusable equipment	n/a	
(5) Consumables	n/a	
(6) Shipping	n/a	
(7) Insurance	n/a	
(8) Co-funding	NEFSC: Loan of recording gear, including 2 ST500 recorders, 1 Vemco Ascent AR, 1 Vemco VR100 surface station and hydrophone, and shipping from US to Oman (in kind)	£17,950.00
	5OES: Costs for March 2020 field trip for deployment (cash outlay)	£6,000.00
	AACF: Balance of salary costs for project preparation, data analysis and write up, including blue whales and assessment of other species (in kind)	£11,500.00
(9) Other	n/a	
Total	Project Total	£47,450.00
	Total requested from IWC	£12,000.00
<p>Note: Upon the initiation of this project in early 2020, funding was pending or secured by 5OES for two planned field trips in Oct/Nov 2020 (for recovery and redeployment) and March 2021 (for final recovery). Due to the COVID-19 global pandemic, this funding has been lost due to withdrawal of client funders, or at best become uncertain. Therefore contribution of IWC SC towards one field trip is requested, in order to secure at least the final recovery of the recorder, or ideally provide for a Sept/Oct 2020 recovery/redeployment in the event that other funds are secured for the Mar 2021 recovery.</p>		

9. DATA ARCHIVING/SHARING

Please state your plans for data archiving and sharing. Note that data collected primarily under IWC grants are considered publicly available after an agreed period of time for publication of papers, usually about two years. The work of the IWC depends on the voluntary contribution of data to the various databases and catalogues IWC supports. Please consult the Secretariat (secretariat@iwc.int).

Data will be archived by the African Aquatic Conservation Fund and Five Oceans Environmental Service, with a backup copy maintained by NOAA Northeast Fisheries Science Center, and requests for further sharing agreements can be made to the project PI's.

10. PERMITS (PLEASE TICK)

Do you have the necessary permits to carry out the field work and have animal welfare considerations been appropriately considered?	Yes
Do you have the appropriate permits (e.g. CITES) for the import/export of any samples?	n/a

If 'Yes' please provide further details and enclose copies where appropriate:

Five Oceans Environmental Services has obtained the appropriate permits for the field research off Oman, and can provide copies upon request.

References

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- Anderson C, Branch TA, Alagiyawadu A, Baldwin R, Marsac F (2012) Seasonal distribution, movements and taxonomic status of blue whales (*Balaenoptera musculus*) in the northern Indian Ocean. *J Cetacean Res Manag* 12: 203-218
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- Branch TA, Abubaker EMN, Mkango S, and Butterworth DS (2007a) Separating southern blue whale subspecies based on length frequencies of sexually mature females. *Mar Mamm Sci* 23: 803–833
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Appendix 2 – DRAFT SCORING SHEET

If a project presents multiple primary objectives which are achieved using sub-projects, a sheet should be used to evaluate each single sub-project. Note that not all criteria are equally applicable depending on the nature of the project (e.g. field work versus workshops).

IWC SCIENTIFIC COMMITTEE PROPOSALS FOR FUNDING - REVIEW CRITERIA - TEST			
TITLE OF THE PROJECT/sub-projects:			
PRINCIPAL INVESTIGATOR:			
Key criteria		Explanation of scoring	Score
Relevance to Scientific Committee priorities			
1	How well aligned are the scientific outcomes of the project/activity with the current SC priority areas?	<ul style="list-style-type: none"> 1 - Not aligned/poorly aligned (e.g. too vague or generic reference to general SC priorities) 2 - Reasonably aligned (e.g. some aspects may be vague or links are not clear) 3 - Well aligned (e.g. outcomes clearly deliver in the most part on priority areas, may also address longer term or potential future issues). 4 - Closely aligned (e.g. of interest for multiple sub-groups or delivers on specific SC high priority topics/recommendations in the immediate or short term). 	
2	To what extent will the outcomes of the project/activity contribute to improvements in the conservation and management of cetaceans?	<ul style="list-style-type: none"> 1 - Not at all 2 - Poorly 3 - Reasonably or over the longer term 4 - Well or over the medium term 5 - Excellently or to almost immediate effect 	
<p>Note: if in each of the two above key criteria under this section the project does not score singularly at least 2 points, do not proceed in further evaluation. Of course, proposals within a sub-group would only be developed if in their estimation scores were of 4 or above.</p>			
Approach and methodology			
3	What degree of scientific merit/value is there in carrying out the work?	<ul style="list-style-type: none"> 1 - Not demonstrated or of low scientific value 2 - Useful/basic scientific value 3 - Very good scientific value 4 - Excellent/innovative scientific value 	
4	Is the proposed methodology scientifically sound and feasible in terms of field and analytical methods?	<ul style="list-style-type: none"> 1 - Feasibility unrealistic & poor methodology or not properly addressed 2 - Feasibility & methodology acceptable but would benefit from some substantial amendments 	

		<ul style="list-style-type: none"> 3 - Feasibility & methodology good, some small changes beneficial 4 - Feasibility & methodology excellent or a highly promising innovative approach to an important question facing the Committee 		
5	What is the likelihood of success based on the proposed overall approach and methodology?	<ul style="list-style-type: none"> 1 - No chance of success 2 - Low chance of success/better approaches available 3 - Medium chance of success/some changes to the approach necessary 4 - High chance of success/little or no changes to the approach necessary 		
5a	Are objectives of the research likely to be achieved within the proposed time-frame?	<ul style="list-style-type: none"> 1 - No or unlikely 2 - Partially or potentially ambitious 3 - Yes with some minor suggestions 4 - Yes 		
5b	Are any proposed intermediary targets timely and achievable?	<ul style="list-style-type: none"> 1 - No or unlikely 2 - Partially 3 - Probably 4 - Yes 		
5c	Is the proposed time-frame/work necessary (e.g. can the project produce results in a shorter time period)?	<ul style="list-style-type: none"> 1 - Not demonstrated/not properly addressed 2 - No or unlikely (too low/too high) 3 - Probably (additional analysis needed) 4 - Yes 		
5d	Is the sample size adequate to achieve the stated objectives?	<ul style="list-style-type: none"> 1 - Not properly addressed/ unknown 2 - Yes severely 3 - Possibly at a low level 4 - No 		
6	Is the project likely to affect adversely the population(s) involved?	<ul style="list-style-type: none"> 1 - Not properly addressed/ unknown 2 - Yes severely 3 - Possibly at a low level 4 - No 		
6a	IF YES, are analyses provided on simulations of the effects using different time-frames for the project if applicable?	<ul style="list-style-type: none"> 1 - No 2 - Partially 3 - Yes 		
<p>Note: if in each of the above key criteria under this section the project does not score singularly at least 2 points, do not proceed in further evaluation. Of course, proposals within a sub-group would only be developed if in their estimation scores were of 3 or above.</p>				
Project team and Project management				

7	To what extent does the team have the relevant expertise, experience, and balance?	<ul style="list-style-type: none"> 1 - Poor or not demonstrated 2 - Sufficient 3 - Very good 4 - Excellent 		
8	Contingency plan: To what extent have potential problems/risks been considered and appropriate mitigation proposed?	<ul style="list-style-type: none"> 1 - Poor or not demonstrated 2 - Sufficient but could be improved 3 - Fully or requiring only minor suggestions or not applicable 		
Value for Money				
10	Does the project represent good value for money?	<ul style="list-style-type: none"> 1 - No or significant amendments would be needed 2 - Yes but with some minor amendments 3 - Yes 		
11	Have sufficient links been made to the wider research community/other organisations/capacity building.	<ul style="list-style-type: none"> 1 - No 2 - Some but significant amendments needed 3 - Yes but with some minor additions 4 - Yes or not applicable 		