

SC/67b/RP31

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SH - Analysis of fin whale song variability  
across Southern Hemisphere



INTERNATIONAL  
WHALING COMMISSION



## PROJECT PROPOSAL REQUEST

### 1. PROPOSAL TITLE

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

Analysis of fin whale song variability across Southern Hemisphere

### 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.

Fin whale songs consist of short pulses repeated at regular interpulse intervals (IPIs). These songs have been suggested as a tool to distinguish populations. Features that have been used for fin whale song separation include: spectral structure of individual pulses, their patterning, the IPIs, and presence of a higher frequency component of the pulses. Based on this higher frequency component, there appear to be two fin whale song types in the Southern Ocean. We propose to use a combination of song feature measurements to identify whether fin whale songs in the Southern Hemisphere could be indicative of population structure. Data to be used include recorders deployed in the Western Antarctic Peninsula, Weddell Sea, and Eastern Antarctica (Kerguelen and Casey) from 2014-2016. Additional SH lower-latitude recordings are available in southeastern Pacific and South Indian Ocean. Overall, the analysis will enable a comprehensive review of fin whale song variability across the SH.

### 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, SD/DNA, IA, E – This analysis will enable development of hypothesis on possible structure in SH fin whale populations that is directly relevant to SH and SD groups. It could also be possible to use these delineations in future assessments of various SH fin whale populations in IA. Understanding the variability in fin whale songs across the region can also be used for future investigations on the impacts of noise on whale vocal behaviour (E).

### 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.*

Fin whale songs consist of short 20 Hz pulses that are repeated at regular interpulse intervals (IPIs). These songs have been suggested as a tool to distinguish populations. In the North Pacific Ocean, features that can be used for fin whale song separation include spectral structure of individual pulses, their patterning, and the IPIs (Archer et al. 2017; Širović et al. 2017). In the Southern Ocean (SO) and the Mediterranean Sea, an additional distinguishing feature is a higher frequency component of the pulses (Gedamke et al. 2007; Širović et al. 2009; Castellote et al. 2012). In 2004, the calls in eastern Antarctica had a higher frequency component at 99 Hz and the calls in the vicinity of the Western Antarctic Peninsula had that component at 89 Hz, indicating possibly two distinct populations in the SO (Širović et al. 2009). High frequency components of the fin whale song have also been reported at mid-latitude monitoring stations in the Southern Hemisphere (Gedamke et al. 2007), indicating possible presence of fin whales from Antarctic at these lower latitudes. Currently there is scant information on fin whale population structure in SH and songs could be used for forming initial hypotheses to test for possible structure. Here we are proposing to undertake such analysis across SH.

Baleen whale songs are known to undergo both gradual and abrupt shifts. Gradual shifts consist of decrease in frequency that has been documented for blue whales (McDonald et al. 2009), but also occurs in fin whale song (unpublished data). In the North Pacific Ocean, an abrupt change in fin whale song type has been documented in multiple areas (Širović et al. 2017=SC/67b/ForInfo 47). To circumvent the complications that could arise in data interpretation as a result of these song changes, it would be preferable to start the analysis of fin whale songs by focusing on the same year of data from multiple locations.

#### REFERENCES:

- Archer, F., Castellote, M., Delarue, J., Stafford, K., Koot, B., Richlen, M. & Rankin, S. (2017). Two note samba: Clustering and classification of North Pacific fin whale (*Balaenoptera physalus*) notes and songs. The 22nd Biennial Conference on the Biology of Marine Mammals, pp. 119.
- Castellote, M., Clark, C.W. & Lammers, M.O. (2012). Fin whale (*Balaenoptera physalus*) population identity in the western Mediterranean Sea. *Marine Mammal Science* 28: 325–344.
- Gedamke, J., Gales, N., Hildebrand, J. & Wiggins, S. (2007). Seasonal occurrence of

low frequency whale vocalisations across eastern Antarctic and southern Australian waters, February 2004 to February 2007. Paper presented at IWC SC/59/SH5.  
 McDonald, M.A., Hildebrand, J.A. & Mesnick, S. (2009). Worldwide decline in tonal frequencies of blue whale songs. *Endangered Species Research* 9: 13-21.  
 Širović, A., Hildebrand, J.A., Wiggins, S.M., Thiele, D. (2009). Blue and fin whale acoustic presence around Antarctica during 2003 and 2004. *Marine Mammal Science* 25: 125-136.  
 Širović, A., Oleson, E.M., Buccowich, J., Rice, A., Bayless, A.R. (2017). Fin whale song variability in southern California and Gulf of California. *Scientific Reports* 7: 10126.

**(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:
- analyse fin whale song from multiple locations across SO and lower latitudes in the SH
  - develop hypotheses on possible fin whale population structure in SH
- Expected deliverables:
- Report to the SC on the analysis results in 2019 & 2020
  - Peer-reviewed publication(s) on fin whale song structure in SH

**(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).*

**DATA AVAILABILITY**

Based on data compiled as part of the IWC-SORP Acoustic Trends Working Group, several sites have been identified in the SO with concurrent acoustic data collection during 2014-2016. Areas with recording effort during this period include: Western Antarctic Peninsula, Weddell Sea, and Eastern Antarctica (Kerguelen and Casey). These SO sites will form the starting point for the analysis of fin whale song patterns in the SH. In addition to these high latitude sites, additional data have been identified in mid and lower latitudes including data from the Comprehensive Nuclear Test Ban Treaty (CTBTO) site in the Southeastern Pacific Ocean at Juan Fernandez (S. Buchan), and data from South Indian Ocean collected by ENSTE-Bregane (F. Samaran). Additional possible sources of SH data are two other CTBTO sites: Ascension (South Atlantic Ocean) and Freemantle (Southeastern Indian Ocean), and five locations of Australia's Integrated Marine Observing System (off Queensland, New South Wales, Southern Australia, Western Australia, and South East Australia).

**DATA ANALYSIS**

We propose to use a combination of song feature measurements to try to identify whether fin whale songs in the Southern Hemisphere may indicate some population structure. For each identified recording location, a subset of days in each month with fin whale song presence will be selected during which it is possible to identify

individual song segments and collect feature measurement. These features will be: frequency characteristics of each fin whale song pulse, classify any patterning of the pulses, measure IPIs, and identify the presence and measure the frequency of the high frequency component of the pulse. Fin whale song in many regions of the world often forms choruses, during which times it can be difficult to identify individual song segments from the “noise” of the chorus. While it will not be possible to measure fine-scale features of pulses during such times, establishing the presence and frequency of the high frequency component will not be limited by chorusing. Similarities of different song features will be compared within and across recording sites.

We expect the work to analyse fin whale songs in the SH to take two years. In the first year, the work will be focused on the already identified SO and lower latitude recordings, available from the different members of the Acoustic Trends Working Group. During the first year Širović will also reach out to colleagues with access to additional mid and low latitude data streams and secure access or collaboration for analysis of as many of those data sets as possible. In the second year of the analysis the focus will be on those additional lower latitude locations, following the same data analysis protocols as used for the other data sets.

**(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.*

**6. TIMETABLE FOR ACTIVITIES AND OUTPUTS**

*Specify the timetable for project activities and expected outputs 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.*

<b>Activity to be undertaken</b>	<b>Key person(s)</b>	<b>Start(mm/yy)</b>	<b>Finish (mm/yy)</b>
Analysis of Southern Ocean data	Širović	09/18	05/19
Analysis of Southeastern Pacific data	Buchan	09/18	05/19
Analysis of South Indian Ocean data	Samaran	09/18	05/19
Identification of possible additional lower-latitude data	Širović	08/18	12/18
Analysis of additional lower-latitude data	Širović	06/19	05/19

<b>Expected outputs</b>	<b>Completion date (mm/yy)</b>
Progress report on analysis of fin whale song variability in SH	05/19
Final report on analysis of fin whale song variability in SH	05/20
Submission of paper for peer-review	05/20

## 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
Ana Širović	Scripps Institution of Oceanography/Texas A&M University Galveston	None
Susannah Buchan	Universidad de Concepción	None
Flore Samaran	ENSTA Bretagne	None
Kathleen Stafford	University of Washington	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 (by person)	TBN analyst at Universidad de Concepción (analysis of Juan Fernandez data from multiple years)	5,000
	TBN analyst at ENSTE-Bretagne (analysis of Indian Ocean data)	7,000
	TBN student at TAMUG (analysis of Southern Ocean data)	In-kind support
(2) Travel/subsistence (by person or est. total for IPs)		
(3) Services (by item)		
(4) Reusable equipment		
(5) Consumables		
(6) Shipping (by Item)		
(7) Insurance (by item)		
(8) Co-funding		
(9) Other		
<b>Total</b>		<b>12,000</b>

## 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](mailto:secretariat@iwc.int)).

The acoustic data that will be used for this analysis have already been collected and are available under the agreements with appropriate institutions. Secondary, analysed data will be made available at the time of publication of the results of this research via data depository such as Dryad.

## 10. PERMITS (PLEASE TICK)

Do you have the necessary permits to carry out the field work and have animal welfare considerations been appropriately considered?	N/A
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:

## 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	Supporting Remarks	
<i>Relevance to Scientific Committee priorities</i>				
1	How well aligned are the scientific outcomes of the project/activity with the current SC priority areas?	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?	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		
<b>Note:</b> 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.				
<i>Approach and methodology</i>				
3	What degree of scientific merit/value is there in carrying out the work?	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?	1 - Feasibility unrealistic & poor methodology or not properly addressed 2 - Feasibility & methodology acceptable but would benefit from some substantial amendments		

		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?	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?	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?	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)?	1 - No or unlikely 2 - Partially 3 - Probably 4 - Yes		
5d	Is the sample size adequate to achieve the stated objectives?	1 - Not demonstrated/not properly addressed 2 - No or unlikely (too low/too high) 3 - Probably (additional analysis needed) 4 - Yes		
6	Is the project likely to affect adversely the population(s) involved?	1 - Not properly addressed/ unknown 2 - Yes severely 3 - Possibly at a low level 4 - No		
6a	<b>IF YES</b> , are analyses provided on simulations of the effects using different time-frames for the project if applicable?	1 - No 2 - Partially 3 - Yes		
<b>Note:</b> 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.				
<b>Project team and Project management</b>				



7	To what extent does the team have the relevant expertise, experience, and balance?	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?	1 – Poor or not demonstrated 2 – Sufficient but could be improved 3 - Fully or requiring only minor suggestions or not applicable		
<b>Value for Money</b>				
10	Does the project represent good value for money?	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.	1 – No 2 – Some but significant amendments needed 3 – Yes but with some minor additions 4 – Yes or not applicable		