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PROJECT PROPOSAL REQUEST

1 . PROPOSAL TITLE

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

Mark recapture analysis of Southern Hemisphere blue whale photo-ID datasets to estimate regional abundance

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 Southern Hemisphere blue whale catalogue (SHBWC) has generated large photo-identification datasets for blue whales in Chile (1004 identifications) and Australia (243 identifications), contributed by multiple local catalogue holders (SC/68D/SH04). Blue whale photo-identifications comprise a mixture of right-side and left-side photographs. Whales have been matched between catalogues and quality coded within the SHBWC, generating multi-year encounter histories for whales for right and left sides.

To maximise use of the information contained in the two datasets, we propose to analyse these data in a mark recapture framework that has been developed to handle multiple marks (Zhang et al. 2019) and accommodate capture heterogeneity. Given the spatiotemporal spread of these datasets, we propose to analyse these data in an open population framework.

These analyses will generate estimates of blue whale abundance for Chile (Northern and Southern Chile) and Australia, using customised models to accommodate multiple connected areas within each dataset.

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.

This work is a very high priority for the SH sub-committee in order to complete the pre-assessment of Southern Hemisphere non Antarctic blue whales. Available estimates of whale abundance from Chile and Australia have been evaluated by the ASI Standing Working Group and none have received a Category 1 (suitable for use in management).

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.

Background

The Southern Hemisphere blue whale catalogue (SHBWC) has generated large photo-identification datasets for blue whales in Chile (1004 identifications) and Australia (243 identifications), contributed by multiple local catalogue holders (SC/68D/SH04). Blue whale photo-identifications comprise a mixture of right-side and left-side photographs. Whales have been matched between catalogues and quality coded within the SHBWC, generating multi-year encounter histories for whales for right and left sides.

Rationale

To maximise use of the information contained in the two datasets, we propose to analyse these data in a mark recapture framework that has been developed to handle multiple marks (Zhang et al. 2019) and accommodate capture heterogeneity. Given the spatiotemporal spread of these datasets, we propose to analyse these data in an open population framework.

These analyses will generate estimates of blue whale abundance for Chile (Northern and Southern Chile) and Australia. For each dataset, customised models will be developed and assessed to explore how the sampling sites within the dataset are linked.

Relevance to priorities- copies of IWC recommendations below

Item 8.2.1.1 (IWC, In press)

“To finalise the southeast Pacific blue whale pre-assessment, the Committee **agrees** that the southeast Pacific photo-ID dataset should be quality coded and matched to 2018, and mark-recapture analyses conducted.”

Item 8.2.1.2 (IWC, In press)

“To finalise the Southeast Indian Ocean blue whale pre-assessment, the Committee **recommends** that the Australian photo-ID dataset be reconciled with location and time metadata urgently, and mark recapture analyses conducted”.

Item 8.1.2 (IWC, 2020)

“In order to progress regional assessments, the subcommittee also **encouraged**: (1) An intersessional assessment of the suitability of the Australian blue whale photo-identification catalogues for mark recapture analysis of regional population abundance by Galletti, Jackson and Olson.”

(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.

- Explore mark recapture models to identify best fitting models for Australia and Chile datasets
- Generate estimates of abundance (and inter-site movement rates where relevant) for Australian and Chilean blue whales
- Provide two scientific reports to the IWC for review by ASI SWG: one for Chile and one for Australia

(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).

Modelling framework

When mark-recapture data consist of multiple marks such as left- and right-side photographs, we achieve improved precision on abundance estimates if both marks are incorporated into a single analysis (Fewster & Jupp 2013). This type of analysis is challenging because many whales will appear twice in the data, respectively with left- and right-side encounter histories, and the overlap is unknown. However, we do know how to map each true combined left- and right-side history into its associated observations, which means the multimark scenario falls into a model class called linear inverse models. Zhang et al. (2019) developed a way of fitting these models by maximum likelihood using a technique called the saddlepoint approximation. This fast fitting process allows us to incorporate and readily explore a full spectrum of mark-recapture models. For these analyses we will use open population models, and develop and explore customised models for connectivity among sites within each region.

Specific work for each region is below.

Chile

- Consult with the data holders, design and conduct mark recapture analyses.
- Open population left/right models will be fitted to the northern and southern Chile datasets. We will explore models that allow the two areas to share parameters (e.g., population growth rate λ , and/or annual mortality ϕ) and assess these against models with separate parameters. We will also investigate ebb-and-flow models where influx into one area is correlated to efflux from the other in a given year. This hypothesis can be investigated in terms of recruitment and/or capture probabilities.
- Provide report to IWC estimating abundance of Chilean blue whales.

Australia

- Consult with the data holders, design and conduct mark recapture analyses.
- Open population left/right models will be fitted to Australia-wide mark-recapture data. We will explore models that allow the main survey areas to share parameters (as above) compared to separate parameter models, combined-area models to estimate overall abundance, as well as multi-site models to estimate movement rates between areas and local abundance at survey sites.
- Provide report to IWC estimating abundance of Australian blue whales.

(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.

Activity to be undertaken	Key person(s)	Start(mm/yy)	Finish (mm/yy)
Consult with data holders	Jackson/Galletti	05/22	04/23
Collate regional datasets and supply encounter histories to Fewster	Galletti	04/23	06/23
Recruit Research Assistant	Fewster	02/23	06/23
Design analysis, liaise with data holders	RA & Fewster	06/23	07/23
Estimate abundance, liaise with data holders	RA & Fewster	07/23	08/23
Prepare IWC reports	RA & Fewster	08/23	09/23

Expected outputs	Completion date (mm/yy)
IWC report – Chile abundance co-authored by Fewster, RA, catalogue holders	03/24
IWC report – Australian abundance co-authored by Fewster, RA, catalogue holders	03/24

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
Professor Rachel Fewster	University of Auckland	None
Dr Jen Jackson	British Antarctic Survey	SH convenor
Barbara Galletti	Centro de Conservación Cetacea / SHBWC coordinator	None

8 TOTAL BUDGET

PROJECT BUDGET					Please indicate when funds will be needed		Co-funding funds only
	Description	Cost per unit £GBP	Number of units	Total Cost £GBP	2023 £GBP	2024 £GBP	Co-funding £GBP
(1) Salaries (by person)	Research assistant Professor Rachel Fewster	£6,000 £150	3 months 160 hours	£18,000 £24,000		£18,000	£24,000
(2) Travel/subsistence (by person or est. total for IPs)							
(3) Services (by item)							
(4) Reusable equipment							
(5) Consumables							
(6) Shipping & Customs (by Item)							
(7) Insurance (by item)							
(8) Other	Marsden project to develop modelling framework for linear inverse model class			£180,000			£180,000
TOTAL				£222,000	0	18,000	£204,000

Co-funding Memo:

Source	Purpose of Funding	Cost £GBP	Secured/Tentative?
University of Auckland	Salary of Professor Rachel Fewster	24,000	Secured
Royal Society of New Zealand	Develop modelling framework for linear inverse model class, including left/right models (Marsden research grant with Fewster as co-PI)	180,000	Secured
TOTAL			

Total value of project:	Cost £GBP
Funds requested from IWC	18,000
Co-funding	204,000
TOTAL	222,000

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).

Mark recapture datasets generated by the SHBWC will be archived by the IWC. They are however subject to confidentiality agreements with the catalogue holders who have contributed photo-IDs to the Southern Hemisphere blue whale catalogue. Mark recapture datasets can therefore only be accessed with the explicit consent of all contributing photo-ID catalogue holders. This will be provided to a small number of catalogue representatives and the statistical analysts[s] for the duration of the project.

Abundance estimates and associated code will be made available to the IWC Scientific Committee for review.

10 . PERMITS (PLEASE TICK)

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

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

REFERENCES

Fewster, R.M., and Jupp, P.E. Information on parameters of interest decreases under transformations. *Journal of Multivariate Analysis*, 120, 34-39, 2013.

Zhang, W., Bravington, M.V., and Fewster, R.M. Fast likelihood-based inference for latent count models using the saddlepoint approximation. *Biometrics*, 75, 723-733, 2019