SC/67b/RP28

SH - Updated catch series and assessments of four pygmy blue whale populations

.

INTERNATIONAL
WHALING COMMISSION

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PROJECT PROPOSAL REQUEST

1. PROPOSAL TITLE

Updated catch series and assessments of four pygmy blue whale populations

2. BRIEF OVERVIEW OF THE PROPOSAL AND ITS EXPECTED OUTCOME

I propose to conduct the first assessments of pygmy blue whale populations in the northern Indian Ocean (NIO), south-west Indian Ocean (SWIO), south-east Indian Ocean (SEIO) and south-west Pacific Ocean (SWPO). I presented preliminary catch times to this meeting (SC/67B/SH23), and here propose to refine these catch time series, and prepare assessments of stock status for each population. The expected outcomes are:

- Improved catch separation using better statistical models that will be fitted to monthly instead of annual call data.
- Estimates of catch uncertainty through bootstrapping of call location data.
- Minimum assessments of population status using abundance estimates for SWIO, SEIO, and SWPO populations (and NIO if available) that apply to variable portions of each population.
- Alternative assessments based on extrapolation of abundance estimates using (1) ratio of the area surveyed to geographic range, and (2) ratio of catch in area surveyed to catch in geographic range of each population.

[150 words]

3. RELEVANT IWC SCIENTIFIC COMMITTEE GROUPS OR SUB-GROUPS

The SH sub-committee is conducting in-depth assessments of populations of Southern Hemisphere blue whales. Assessments have previously been conducted by myself and others for two of the six populations (Antarctic blue whales, and Chilean blue whales), but not for the four pygmy blue whale populations addressed by this proposal. The proposal would provide crucial catch separation data and associated uncertainty needed to conduct stock assessments, and provide the first stock assessments for each of the four populations. Such data are critical inputs for the assessments planned by the SC.

4. TYPE OF PROJECT (PLEASE TICK)

Research project	X
Modelling	X
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.

The Scientific Committee initiated an in-depth assessment of Southern Hemisphere (and northern Indian Ocean) blue whale populations 12 years ago. Stock assessments have been completed for Antarctic blue whales (Branch et al. 2004, Branch 2008a), and for Chilean blue whales (Williams et al. 2010, Jackson 2016), but not for the four pygmy blue whale populations (NIO, SWIO, SEIO, SWPO).

This year, I outlined the region inhabited by pygmy blue whales based on length distributions by latitude and longitude, and presented the first detailed maps separating the four pygmy blue whale populations (Fig. 1, Branch et al. 2018), based on acoustic song types that are used to define each population (e.g. Širović et al. 2018).

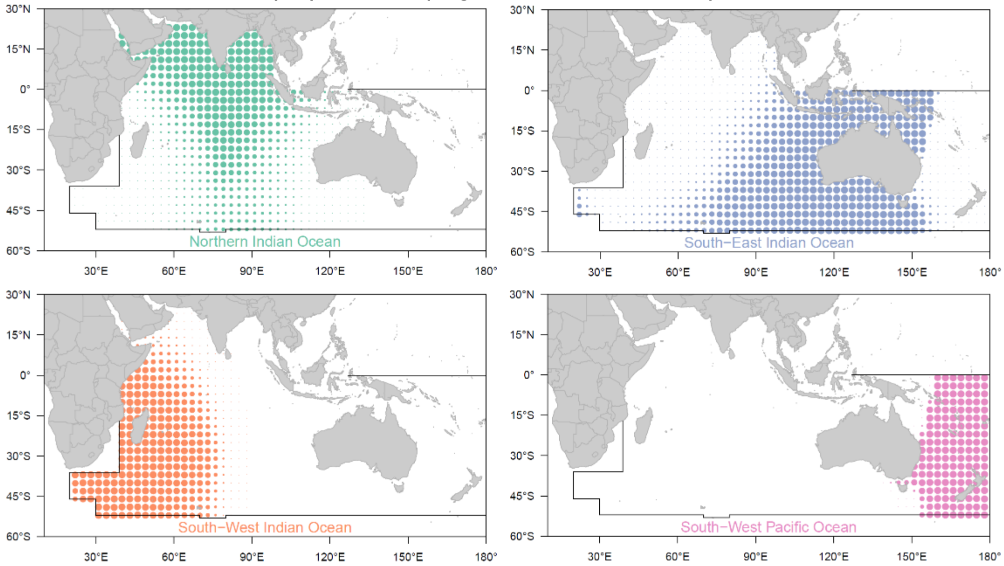

Fig. 1. Regions inhabited by the four pygmy blue whale populations (Branch et al. 2018).

Catch time series were developed for pygmy blue whales (Branch et al. 2018) by examining the catch timing, lengths, trends in catches, and lengths of mature females in all land station catches in the Southern Hemisphere, and by applying the fitted model surfaces in Fig. 1 to the pelagic catches (Fig. 2). In the southern Indian Ocean, there is some overlap between NIO, SWIO and SEIO populations. This is dealt with by estimating the probability each catch is assigned to a particular population. The resulting time series of catches is provided in Table 4 of Branch et al. (2018).

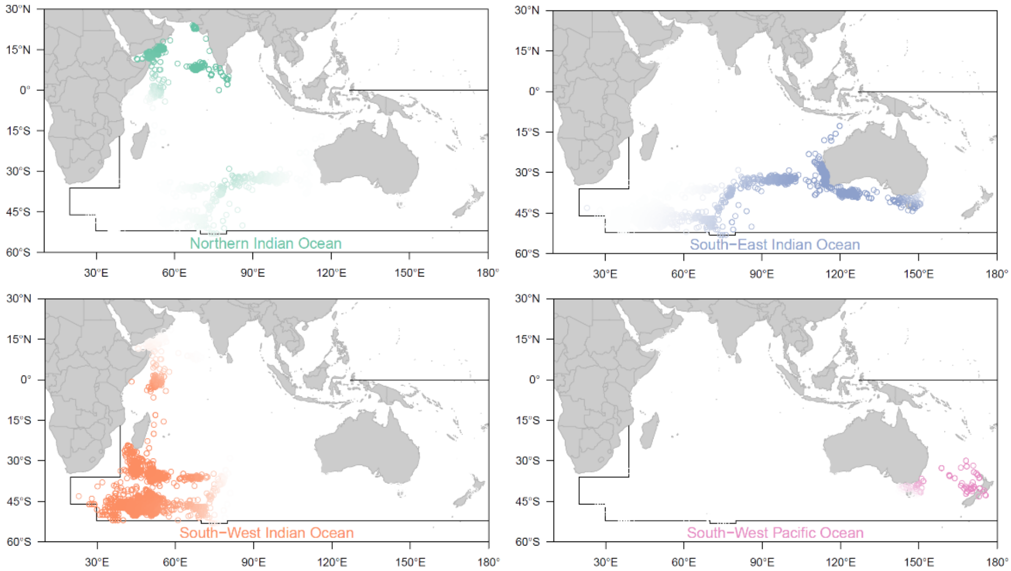

Fig. 2. Catches assigned to each population using a probabilistic algorithm depicted here by color intensity: bright colors in each panel represent probability near 100% that a catch belongs to a population, which fades from bright to white as the probability drops to 0%.

Available biological data: previous work by the PI involved using lengths of mature females to separate Antarctic, pygmy, and Chilean blue whales (Branch et al. 2007a), leading to the designation of Chilean blue whales as a putative subspecies; demonstrating that pygmy blue whales comprise no more than 0.1% of blue whales south of 52°S using ovarian corpora vs. length data (Branch et al. 2009); finding that NIO pygmy blue whales have slightly shorter length at maturity (by 0.5-0.6 m) than other pygmy blue whale populations (Branch & Mikhalev 20008); compiling all available catch, stranding, sighting, and acoustic data for blue whales in the region (Branch et al. 2007b); and estimating age-length relations, adult survival (0.93-0.95), age at maturity (9.9 yr), and inter-ovulation intervals (2.6 yr) from Japanese and Soviet earplug (Branch 2008b).

Abundance estimates: abundance estimates are available for Antarctic blue whales (Branch & Butterworth 2001, Branch 2007), and for Chilean blue whales (Galletti Vernazzani et al. 2017), which have been used in past assessments. For the NIO, no abundance estimates are available, although photo-id data could be used to obtain mark-recapture estimates. For the SWIO, only a small region south of Madagascar has been surveyed, with an estimate of 424 (CV = 0.42) (Best et al. 2003). For the SEIO, a survey in a small area south of Australia obtained an estimate of 671 (Kato et al. 2007); a photo-id mark-recapture estimate, which is the best available but needs updating, is 791 (95% CI 569-1147) (Jenner et al. 2008); and an estimate from passive acoustic recordings is 1100 (95% CI 662-1559) (McCauley & Jenner 2010), although it is challenging to convert calling rates to abundance. For the SWPO, a conservative abundance estimate from photo-id mark-recapture is 718 (95% CI 279-1926) (Barlow et al. 2018).

Prior distributions: estimates of the intrinsic rate of increase for blue whales have been obtained from meta-analysis of other whale populations (Branch et al. 2004, Punt & Allison 2010), and have been used in assessments of north-east Pacific blue whales (Monnahan et al. 2015, Monnahan & Branch 2015).

Assessment outline: in brief, the minimum abundance estimates for each population, and the catch time series, can be used to provide a conservative assessment of current numbers relative to pre-whaling levels. For example, when applied to Chilean blue whales this showed that they were above 5-34% of pre-whaling levels (Williams et al. 2011, Anon 2017), and thus on a different path than Antarctic blue whales. A method involving extrapolation, that seeks to provide a more realistic but more uncertain assessment of status, is also outlined below.

(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. Improved separation of catches for each pygmy blue whale population, including assessment of uncertainty.
2. Minimum assessments of status for the SEIO, SWIO, and SWPO pygmy blue whale populations, and for NIO if an abundance estimate is available.
3. Assessment of status based on abundance extrapolated from the area surveyed to the full region inhabited by the population.

Deliverables
1. Peer-reviewed paper and SC document for the 2019 SC meeting outlining improved catch separation.
2. SC document with minimum status and extrapolated status for each pygmy blue whale population for which abundance estimates are available (at a minimum SWIO, SEIO, SWPO).

(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.

Improved catch separation algorithm: several technical improvements are proposed to the method used in Branch et al. (2018). First, the acoustic data are currently based on annual averages of the call types at each location, but a more precise separation may be possible using monthly averages, as used in Monnahan et al. (2014) for the North Pacific. This would come at the expense of acoustic data currently collected at a point in time rather than from year-round recorders. Second, the current data fit by the model are multinomial proportions of the call types attributed to each population, at each recorder (e.g. if two populations are recorded 80% of the time and the others 0%, the multinomial proportions would be 0.5, 0.5, 0.0, 0.0). An improvement proposed here is to base the modelled surface for each population on the (binomial) proportion of hours (or days) on which a particular population was recorded at a location (i.e. 0.8 for populations 1 and 2 and 0.0 for populations 3 and 4). This would provide a statistically consistent surface for each population. Third, uncertainty in the fitted model surfaces is not accounted for in the current time series. A bootstrapping method developed by Monnahan et al. (2014) will be applied that repeatedly resamples recorder locations, fits surfaces, and calculates time series, to obtain means and 95% intervals for catches for each population.

Bayesian assessment models: Bayesian assessment models will be fitted to the catch data and abundance estimates using the standard IWC baleen whale model (e.g. Monnahan et al. 2015, Williams et al. 2011):

$$N_{1904} = K$$

$$N_{t+1} = N_t + rN_t\left(1-\left[\frac{N}{K}\right]^z\right) - C_t$$

where N_t is the abundance in year *t, r* is the intrinsic growth rate, *K* is carrying capacity, C_t is catch in year *t*, and z = 2.39 ensures that maximum productivity occurs at N_{MSY} = 0.6*K*. The assessment will be conducted in a Bayesian framework, allowing the incorporation of data from other sources as priors. A uniform prior will be placed on ln(*K*), and different priors will be tested for *r* including a uniform prior with an upper bound corresponding to the maximum possible for baleen whales (Zerbini et al. 2010), and informative priors based on meta-analyses of population growth in whales (Branch et al. 2004, Punt & Allison 2010). Catch uncertainty will be included by drawing 1000 sets of catch time series from the bootstrapping analyses, and running the Bayesian model for each, and then sampling a random draw from the posterior to provide 1000 posterior draws (Monnahan et al. 2015). Separate models will be run for minimum abundance and for abundance extrapolated to the full range of each population.

Extrapolated abundance estimates: available abundance estimates do not cover the full range of each population. Two methods will be used for extrapolation. The first will multiply the estimate by the ratio of total catches of that population divided by catches taken within the region of the estimate; the second method will multiply the estimate by the ratio of the area inhabited by that population divided by the area of the region providing the estimate. These estimates may be biased high or low and are likely to be quite uncertain.

(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.

I teach a course on beautiful graphics and will produce graphics that can be used by the Secretariat for dissemination and outreach.

Social media: I run a Twitter account called @BlueWhaleNews with 3,800 followers, that tweets about every blue whale paper when published. I have posted 2171 tweets; in 2017 tweets from this account were viewed 556,000 times. I also tweet from @TrevorABranch with 8,900 followers, which I use to amplify outreach; tweets from this account were viewed 7,648,000 times in 2017.

Links to broader research community: extensive collaboration will be needed with other scientists in (1) obtaining acoustic records in the right format (Samaran, Leroy, Stafford, Širović), (2) obtaining abundance estimates (Barlow, de Vos, Jenner), (3) checking catch data (Allison, Ivashchenko), and other inputs. Connections made over the past 15 years, including with the many coauthors of Branch et al. (2007b) will be used extensively, as in the many past blue whale papers.

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)

Improved catch separation	Branch	04/18	04/19
Stock assessments	Branch	05/19	04/20

Expected outputs	Completion date (mm/yy)
SC document on catch separation	04/19
SC document on stock assessments	04/20

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
Trevor Branch	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)	PI Branch, salary plus benefits for 0.5 mo in 2018 and 1.0 mo in 2019	£6,185 (Year 1) £12,865 (Year 2)
(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		
Total		£19,050

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).

Input data is held by the Secretariat. Resulting R code and outputs will be submitted to the Secretariat or available on request from the author, as required. Peer-reviewed papers will be published from the two projects.

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:

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Ljungblad, B. Maughan, R. D. McCauley, S. McKay, T. F. Norris, Oman Whale and Dolphin Research Group, S. Rankin, F. Samaran, D. Thiele, K. Van Waerebeek, and R. M. Warneke. 2007b. 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.

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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**	**Supporting Remarks**
Relevance to Scientific Committee priorities				
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		
<u>Note</u>: 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.				
Approach and methodology				
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		

5		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	**IF YES**, are analyses provided on simulations of the effects using different time-frames for the project if applicable?	1 – No 2 – Partially 3 - Yes		
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.				
Project team and Project management				

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		
Value for Money				
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		