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.

Analysis of satellite tag data for incorporation into the stock assessment process: an application with North Pacific humpback whales

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 Comprehensive Assessment of North Pacific Humpback Whales is currently evaluating various sources of input data for the model, including tagging. This project will use an independent dataset consisting of 256 satellite tags deployed across several breeding and feeding grounds in the North Pacific spanning the period 1995–2019. Proposed analyses of this data will involve:

- *investigation of connectivity between breeding and feeding areas to confirm the current stock structure hypothesis;*
- *derivation of movement patterns among the pre-defined subareas, including:*
  - *a presence/absence matrix for input into the model; and*
  - *additional metrics including timing of occurrence, travel speed, and residence time*

Beyond the goals of this assessment, and considering the widespread adoption of whale satellite tagging by the global research community, the methods developed for this project will have broad applications for the incorporation of satellite telemetry data for other stocks into the IWC assessment process.

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.

Sub-committee: IA (Agenda Item 8.1.1: Comprehensive Assessment of North Pacific Humpback Whales).

The approaches and outcomes of this project will advance how other sub-committees (NH, SH, SM CMP) conduct their review of available data for stock assessments for the growing number of species for which satellite tagging data exist (e.g., sei, blue, fin, humpback, and right whales).

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, rationale, and relevance:

A good understanding of population structure and connectivity is necessary to evaluate the status of whale populations. As part of its assessment process, the IWC Scientific Committee typically considers all available genetic, acoustic, photo-ID, satellite tagging, sightings, catch and Discovery Mark data. Work towards a Comprehensive Assessment of North Pacific humpback whales began in 2016, with much of the effort so far being devoted to addressing remaining questions about the connectivity among the proposed breeding and feeding areas through photo-ID, refining population abundance estimates through modelling, determining historical catch allocation using genetic data, and updating historical catch series (IWC, 2020; IWC/68/Rep01rev1; SC/68C/IA/WP/01). However, so far satellite tagging has not been included as an input dataset for this assessment by the Committee.

The primary techniques for assessing population connectivity in whales include historical Discovery marks, photo-ID mark-recapture, and satellite tagging. Of these three, Discovery marks and photo-ID provide only endpoints for the movements of the marked animals, often times separated by one or more years, potentially obscuring seasonal patterns. Additionally, historical Discovery marking involved the lethal removal of the individual from the population upon recapture, thereby reducing the usefulness of this method in population analyses. In contrast, satellite telemetry provides regular (daily) relocations for a tagged animal for up to several months, revealing valuable information on habitat use, migration routes, movement rates, and other aspects of movement behaviour until the tag is shed by the animal and falls to the bottom of the ocean.

*This year, paper SC/68C/IA02 provided an overview of existing humpback whale satellite tagging data collected by Oregon State University (OSU), consisting of 256 tags deployed across several breeding and feeding areas in the North Pacific spanning the period 1995–2019 (**Figure 1**). This project proposes to conduct analyses of the OSU data to generate presence/absence matrices for the pre-defined subareas, to be used as an independent input into the assessment models currently being planned. The migratory movements of satellite tagged whales will also be assessed to confirm the current stock structure hypothesis based on connectivity between breeding and feeding areas. Additional metrics obtainable from the tagging data (e.g., timing of occurrence, travel speed, and residence time in the subareas) will also be derived to provide further information that may be helpful in the assessment. Finally, a subset of 117 of the tagged whales has associated photo-ID, sex, and DNA profiles, which can be integrated with the tracking data to extend the interpretation of the results.*

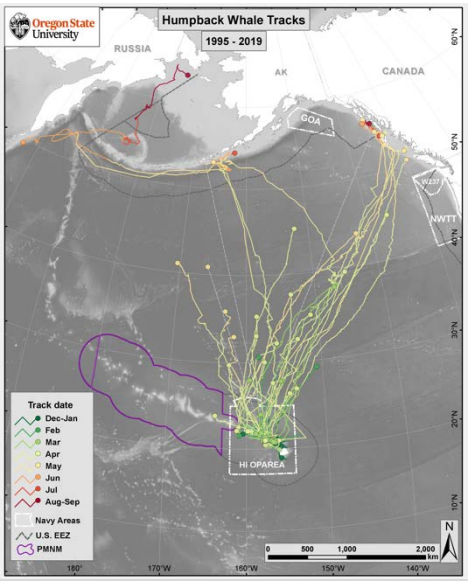

***Figure 1**. Map of the North Pacific showing the tracks of 105 whales satellite tagged by OSU in Hawaii between 1995 and 2019 (see SC/68C/IA/02).*

The Committee clearly regards satellite tagging as a valuable source of input data for the assessment process. For other species undergoing a Comprehensive Assessment, the Committee has welcomed recent satellite tagging data and has encouraged further tagging expeditions for North Pacific sei whales in order to contribute information on their movement patterns (Recommendation Number SC1908). Additionally, other sub-committees working towards in-depth assessments have recently welcomed, encouraged, endorsed, or recommended initiatives to conduct satellite tagging on Antarctic blue whales (SH), southern right whales (SH), North Atlantic right whales (NH), and Arabian Sea humpback whales (CMP), among others (IWC, 2020; IWC/68/Rep01rev1). In this context, and given the widespread adoption of satellite tagging by the research community, the methods developed for this project will have broad applications for the incorporation of satellite telemetry data (and associated data) into the IWC assessment process.

In the case of North Pacific humpbacks, the tagging data collected by OSU in the last couple of decades at great expense is already in hand and will be made available for this project at no additional cost, representing an outstanding value for the money. Additionally, for a subset of 117 tagged whales OSU has associated photo-ID, sex, and DNA data that has already been analysed with funding from the U.S. Navy, and that would be integrated into the results of this project.

In terms of links to the wider research community, since skin biopsy samples and fluke photo-IDs were collected during tagging, the PI (Palacios) and his team (Hayslip) are collaborating with researchers conducting genetic (Baker) and photo-ID analyses (Cheeseman/Happywhale) as part of the North Pacific Collaboration (see SC/68C/IA/WP/01). Also, the PI is actively collaborating with other researchers (Horton, Zerbini, Stafford) to advance our knowledge of whale migration globally, and is currently engaged in several global initiatives such as MiCO, MegaMove, and WWF's "Protecting Blue Corridors," which is aimed at policy makers engaged in protection of whale migration in the upcoming UN Biodiversity Beyond National Jurisdiction Treaty negotiations.

Finally, in terms of capacity building, the PI (Palacios) is engaged with NGOs in Panama studying Central American humpback whales and collaborates with Mexican colleagues (Urbán-Ramirez), including providing training opportunities for students (Jiménez-López et al. 2019).

References:

International Whaling Commission. 2020. Report of the Scientific Committee 2019. J. Cetacean Res. Manage (Suppl.) 21:1-65.

International Whaling Commission. 2020. Report of the Scientific Committee 2020, SC/68B. Document IWC/68/Rep01rev1.

International Whaling Commission. 2021. Report of the Intersessional Working Group on the Comprehensive Assessment of North Pacific Humpback Whales. Paper SC/68C/IA/WP/01.

Jiménez-López, M.E., D.M. Palacios, A. Jaramillo, J. Urbán R., and B.R. Mate. 2019. Fin whale movements in the Gulf of California, Mexico, from satellite telemetry. PLoS ONE 14(1):e0209324. doi:10.1371/journal.pone.0209324.

Palacios, D.M., and B.R. Mate. 2021. Summary of humpback whale satellite tagging efforts in the North Pacific Ocean, 1995–2019. Paper SC/68C/IA/02 presented to Annual Meeting of the International

Whaling Commission (IWC) Scientific Committee (SC/68C), April 27–May 14, virtual. 7pp.

(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:

Investigate how an existing, extensive satellite tagging dataset can be mined to derive information on connectivity, movement patterns, and stock structure for input into the Committee's Comprehensive and In-Depth Assessment process, such as for the current Comprehensive Assessment of North Pacific Humpback Whales.

Deliverables:

- *Public GitHub repository for project (data, R code, output)*
- *Presence/absence matrix of tagged whales in the pre-defined subareas for Privitera-Johnson and Punt for input into assessment model*
- *Paper with project results for presentation at the next meeting of the Working Group on the Comprehensive Assessment of North Pacific Humpback Whales (possible workshop or next SC meeting)*

(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 6 below.

Methods:

This project will use data already in hand from extensive satellite tagging efforts conducted by OSU across several breeding and feeding grounds in the North Pacific spanning the period 1995–2019. Argos satellite tracking data are available from 256 tags deployed as follows:

Location	Years	Tags	Biopsied & Photo-ID'd
Hawaii	1995-2019	105	39
Baja California, MX	1998	7	0
Revillagigedo Is., MX	2003	11	0
Aleutian Islands, Alaska	2008	5	4
Southeast Alaska	1997, 2014-2015	47	24
California	2004-2005, 2017	29	13
Oregon	2016-2018	10	8
Washington	2018-2019	42	29

Complete migratory movements between a breeding and a feeding area, or vice-versa, were recorded for about 10% of the tagged animals. Additionally, partial migrations long enough to indicate a likely arrival at a migratory destination were recorded for another ~20% of the tagged animals. These migratory tracks will be carefully quality-controlled and used in further analyses for the purpose of deriving input data for the assessment.

As an initial step, the migratory connections between a breeding and a feeding area (and vice-versa) will be used to confirm the current stock structure hypothesis. These connections will also be used to determine the relative apportionment of animals from an area that migrate to one or more distinct destinations in the opposite season.

For analysis of connectivity and movements between the pre-defined subareas in the North Pacific currently being used in the model, transmitted Argos locations from tags occurring in each of the subareas will be extracted and a presence/absence matrix will be generated, which is the required input for the model. If necessary, these matrices can be extracted for different subarea configurations in order to provide input data for several model scenarios.

Additional metrics will also be derived from the transmitted Argos locations, including the timing of occurrence, travel speed, and residence time in each subarea. These metrics will be similarly assembled into matrices for presentation.

For tagged animals exhibiting extended residence in feeding areas, a temporal assessment of occupation will be conducted to determine maximum residence time within subareas and identify the highest fidelity to a subarea (as opposed to simply transiting through a subarea), which could further help inform the assessment.

Where possible, the above results will be reported segregated by sex and by time period in areas where many years elapsed between tagging expeditions (e.g., Hawaii: 1995-2000 vs. 2018-2019) to capture any potential changes in movement patterns over time. Finally, data on photo-ID and DNA profile are available for a subset of tagged animals. Because the Working Group agreed that the photo-ID and genetics components of the assessment would limit input data to the same period as the SPLASH-1

effort (2004-2006) for purposes of benchmarking, the more recent photo-ID and genetic data from the tagged animals may be helpful for validating the model results.

Workplan:

This project is anticipated to take one month, including tag data preparation (QA/QC), programming in R, generation of output matrices, and drafting of a document for presentation to the Committee. Per the detailed timetable under Item 6 below, I tentatively propose to conduct this work from mid-August to mid-September 2021, but this timeline can be adjusted according to the needs of the Committee. I will coordinate with Privitera-Johnson and Punt to discuss the optimal timing for them relative to their schedule for running the models.

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).

N/A

(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.

Satellite telemetry data offer exciting opportunities for outreach and engagement, both among the broader research community as well as with the general public. Maps and animations depicting whale migrations from tagging data are of broad appeal and will be made publicly available, with the overarching goal of highlighting the applications and value of using this kind of data for informing whale management and conservation.

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)
Initial coordination with Privitera-Johnson and Punt to discuss data formats and expectations	Palacios, Privitera-Johnson, Punt	16 August 2021	20 August 2021
Data preparation (QA/QC) and creation of GitHub repository for project	Palacios	16 August 2021	20 August 2021
Write R code to extract tagged whale presence/absence in the pre-defined subareas	Palacios	20 August 2021	10 September 2021
Write R code to extract other metrics on tagged whales in the pre-defined subareas (movement rates, timing of occurrence, residence time)	Palacios	20 August 2021	10 September 2021
Final provision of output (presence/absence matrices) to Privitera-Johnson and Punt for input into assessment model, and troubleshoot as necessary	Palacios, Privitera-Johnson, Punt	13 September 2021	17 September 2021
Write draft paper with project methods and results for presentation at the next meeting of the Working Group on the Comprehensive Assessment of North Pacific Humpback Whales (workshop or next SC meeting)	Palacios	1 September 2021	17 September 2021 (or before next meeting)

Expected outputs	Completion date (mm/yy)
Public GitHub repository for project (data, code, output)	15 September 2021
Presence/absence matrix of tagged whales in the pre-defined subareas for Privitera-Johnson and Punt for input into assessment model	15 September 2021
Paper with project results for presentation at the next meeting of the Working Group on the Comprehensive Assessment of North Pacific Humpback Whales (possible workshop or next SC meeting)	15 September 2021 (or before next meeting)

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
Phil Clapham, SC Convenor of Working Group on the Comprehensive Assessment of North Pacific Humpback Whales	Seastar Scientific Inc.	Collaborator on North Pacific Humpback Whale Project (via Happywhale/Cheeseman)

8 TOTAL BUDGET

PROJECT BUDGET. Notes: Currency conversion rate used: $1 USD = £0.72 GBP. Per IWC guidance, salary and associated benefits rates are separated out. Per IWC guidance, organisational overhead costs are excluded.						**Please indicate when funds will be needed**		
	Description	**Cost per unit**	**Number of units**	**Total Cost £GBP**		**2022**	**2023 +**	**Co-funding**
(1) Salaries (by person)	Salary (Palacios) Benefits (Palacios) *Total Salary (Palacios)*	£40 per hour 40.05% on salary	176 hours	7,040 2,820 *9,860*		9,860	0	0
(2) Travel/subsistence (by person or est. total for IPs)	N/A	N/A	N/A	0		0	0	0
(3) Services (by item)	N/A	N/A	N/A	0		0	0	0
(4) Reusable equipment	N/A	N/A	N/A	0		0	0	0
(5) Consumables	N/A	N/A	N/A	0		0	0	0
(6) Shipping & Customs (by Item)	N/A	N/A	N/A	0		0	0	0
(7) Insurance (by item)	N/A	N/A	N/A	0		0	0	0
(8) Other	N/A	N/A	N/A	0		0	0	0
			TOTAL	**9,860**				

Co-funding Memo:

Source	**Purpose of Funding**	**Amount**		**Secured/Tentative?**
N/A	N/A	0		N/A
	TOTAL	**0**		

Total value of project:	**£GBP**
Funds requested from IWC	**9,860**
Co-funding	**0**
TOTAL	**9,860**

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).

The data, code, and output for the project will reside in a public GitHub (https://github.com/) repository.

At the completion of the project the raw tracking data will be quality-controlled and uploaded to Movebank (https://www.movebank.org/), the premier online repository for animal tracking data, and will be publicly available.

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:

N/A. This proposal is for analyses of existing data already in hand. However, it is worthwhile mentioning that all the tagging efforts described here (1995-2019) were conducted under research permits issued to Bruce Mate by the U.S. National Marine Fisheries Service (NMFS) and approved by the Oregon State University Institutional Animal Care and Use Committee (IACUC).

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:		Analysis of satellite tag data for incorporation into the stock assessment process: an application with North Pacific humpback whales		
PRINCIPAL INVESTIGATOR:		Daniel Palacios, Oregon State University		
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		
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.				
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		

		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		