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.

Assessing endangered baleen whales in the eastern North Atlantic through Passive Acoustic Monitoring off Senegal, West Africa

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.

Passive acoustic monitoring is an important tool for improving our understanding of stock structure and distribution for endangered baleen whales. Critical data gaps exist for multiple species of large whales in the North Atlantic Ocean. In the eastern North Atlantic, the coasts of Mauritania and Senegal are believed to be important winter habitat for stocks of humpback, sei and Bryde's whales. This new project will contribute passive acoustic monitoring data for assessing protected species distribution and stock structure, as well as potential impacts of anthropogenic noise. In particular, these data will be used to:

i) Assess baleen whale presence and timing of occurrence off the coast of Senegal
ii) Assess stock identity for humpback whales off Senegal, comparing with the Endangered Cape Verde/Northwest Africa distinct population segment;
iii) Assess occurrence and potential stock identity of sei whales off Senegal, by comparing vocalizations with those recorded in the Gulf of Maine (the latter to be pursued under separate funding);
iv) Assess the potential presence and vocal characteristics of Bryde's whales;
v) Assess prevalence and potential impacts of local seismic survey exploration (to be pursued under separate funding),
vi) Build the capacity of Senegalese scientists to conduct PAM surveys.

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.

NH – This project will provide new information on baleen whale diversity and occurrence in the tropical eastern North Atlantic, and specifically will assess whether this region comprises an extension of the North Atlantic humpback breeding population that is known to utilize the Cape Verde Islands.

SH - As both Cape Verde Islands and Senegal have been suggested to host Southern Hemisphere humpback whales at the most northern extent of their range, this project will establish whether West Africa is an area of cross-equatorial use by southern hemisphere humpbacks breeding in the austral winter.

Conservation Committee/E – This project will provide information on the occurrence and prevalence of airgun noise from seismic surveys, with consideration to the impacts of anthropogenic noise on potential baleen whale breeding habitats. Separate funding will be pursued for the analysis of this component of the project.

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.

Critical data gaps exist for multiple species of large whales in the North Atlantic Ocean, including humpback (*Megaptera novaeangliae*), sei (*Balaenoptera borealis*) and Bryde's (*B. edeni brydei*) whales. For humpback whales, two main breeding groups are recognized, the primary one being the population that breeds in the Greater Antilles. The Cape Verde Islands and northern West Africa represent a second breeding area for what is likely a remnant population; genetic data suggest that these animals may be part of the same genetic cluster as a small population breeding in the Lesser Antilles (IWC/68C). The range of the Cape Verde breeding population is poorly known, but is likely to include the coast of West Africa (particularly Mauritania and Senegal), and lack of data on this population has led to considerable uncertainty with regards to the risk of extinction of this "distinct population segment" (Bettridge et al. 2015). In addition, evidence exists that this region serves as breeding habitat for both northern and southern hemisphere populations of humpback whales in opposing hemispherical winters, with the region from Dakar, Senegal, south to Guinea hosting females with young calves during the austral late winter/spring (Van Waerebeek et al. 2013). For sei whales, stock structure and connectivity between the west and east North Atlantic is poorly understood; the IWC has adopted a framework of 3 management units for sei whales in the North Atlantic but note that stock identity remains a major research gap (Donovan 1991). A breeding area along the coast of West Africa has been hypothesized, but not explored. For Bryde's whales, considerable uncertainty exists regarding the distinction between coastal and offshore populations and their relationship to species/subspecies status, as well as differences between western and eastern populations.

While fairly extensive visual and acoustic survey effort is conducted in the western North Atlantic along the coast of North America, the coasts of Africa represent poorly researched regions where marine ecosystems rich in biodiversity are poorly understood. Historic whaling data, shipboard surveys and stranding data have established the presence of multiple species of interest off the coasts of Mauritania and Senegal, but little is known about their stock identity. Baines & Reichelt (2014) reporting data from geophysical surveys, indicate that the continental slope waters off Mauritania at ca. 20^{o}N are important winter habitat for blue and sei whales, with observations of up to 18 skim feeding sei whales in an aggregation. Camphuysen et al (2013) reported blue, fin, Byrde's,

sei and humpback whales off the coast of Mauritania between 17.5°-20°N. The Senegal Stranding Network of the African Aquatic Conservation Fund (AACF) has recorded 30 baleen whale strandings of *Balaenoptera* sp.; these include up to potentially 6 sei whales, as well as 11 humpback whales (including 5 juveniles), between Dakar and St. Louis, Senegal from 2014-2019 (AACF/ W. Mullié, pers comm). Several sightings of humpback whales near Dakar, including mothers with calves, have also been reported as further evidence of breeding habitat.

PAM has been used extensively around the world as a cost effective and efficient means to assess baleen whale diversity and stock structure, particularly in remote and difficult to access regions with little existing data. The coast of Senegal, 500km east of the Cape Verde islands, was selected as an ideal location to initiate such monitoring, as all species of interest have been documented in that region, and Dakar (Cap Vert), with a narrow shelf and well developed infrastructure, represents a logistically convenient place to access deep waters of the continental slope. In this project, we are partnering with colleagues working in Senegal, to establish a long-term PAM effort to assess baleen whale diversity, stock identity and seasonality off Dakar, Senegal, and transfer PAM skills to local scientists to build long-term capacity. This project represents the first effort to conduct a PAM study off West Africa.

This work addresses specific objectives of both national and international marine science organizations (eg, NOAA Fisheries' International Science Strategy; UNEP/CMS/Resolution 10.15). The proposed work has specific relevance to the priorities of the NH subcommittee, with respect to the ongoing assessment of humpback population structure in the North Atlantic. The proposed work contributes to Recommendation SC/21/148, which encourages new data from understudied areas in the eastern North Atlantic:

*"SC21148 The Committee notes the importance of continued progress toward an in-depth assessment for North Atlantic humpback whales. To this end, the Committee: 3**) Reiterates the importance of new information from the understudied areas** in the southeastern Caribbean and **eastern North Atlantic** (IWC 2020, p.131)"*

In addition, the coast of West Africa is subject to extensive oil and gas exploration, with international interest off the coast of Senegal. The MSGBC basin, located offshore a region spanning Mauritania to Guinea, has been a region of extensive survey attention, particularly in recent years with the licensing of 12 blocks offshore Senegal in 2020 (TGS press release, January 2020). Seismic survey airgun noise from this region was previously documented as far as the mid-Atlantic ridge (Nieukirk et al. 2012), and a recent study comparing ocean noise levels across habitats documented airgun noise at every hour over a 16-month period in the equatorial Atlantic (Haver et al. 2017). The IWC SC has continually recognized anthropogenic noise as an issue (eg., Resolution 2018-04, SC/19/26, SC/20/132), and a secondary goal of this project is to assess the occurrence of airgun noise and potential acoustic impacts on the baleen whales documented at this site. This work has relevance for the future work of the Conservation Committee and noise group within the subcommittee E.

(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.

Recognizing the scientific value of passive acoustic data from this region to inform our understanding of baleen whale occurrence and stock structure in the eastern North Atlantic, one year of pilot passive acoustic data collection from June 2021-June 2022 was funded by the US NOAA Fisheries' International Science Program. That funding allowed for the initial site scouting effort, logistics coordination, and preliminary data collection. Therefore, we have high confidence in the success of the proposed project. Funds are now being sought to continue the PAM effort for a second year, as well as to support data analyses. Collection of a multi-year dataset will allow for more reliable analysis of target species occurrence and seasonal/interannual variation.

Main Objectives for this Proposal:

1. Collect one year of PAM data through June 2023, from two sites at the head of the Dakar Canyon, Senegal (*funding would faciliate recovery/redeployments in Jan 2023 and June 2023*)
2. Analyze data for daily, seasonal and annual occurrence of all baleen whale species, taking note of known and unknown song types
3. Assess stock identity for humpback whales, in particular with respect to the Cape Verde Islands breeding population and/or southern hemisphere breeding populations.
4. Assess prevalance of seismic survey noise, to be analysed under separate funding.

Deliverables:

1. Progress Report to the IWC Scientific Committee on the data collection and analysis progress
2. Final Report to the IWC Scientific Committee on project results
3. Peer-reviewed publication on baleen whale occurrence with specific focus on humpback whale song and stock identity.

(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 Collection:

PAM data collection was initiated in June 2021 off Dakar, Senegal. Site scouting was conducted with the assistance of local biologists and fishers, after which two passive acoustic recorders were deployed off the Dakar Peninsula (Figure 1). Acoustic recorders are Ocean Instruments SoundTrap ST600-STDs, with a flat response from 20Hz-60kHz (+/- 3dB), a 34dB re 1V µPa-1 noise floor and a full scale response of 174.1 dB re 1V µPa-1 including system gain. The SoundTrap recorders are tethered above INNOVASEA/Vemco VR2AR acoustic release units and suspended above the anchor using an 11" deep water trawl float. The recorders were positioned 13.9 km apart at bottom depths of 319 m and 313 m, on the continental slope past the steep drop off from the shelf. The location offers an unobstructed acoustic "view" of offshore deep water habitat, at the head of the Dakar submarine canyon. Recording parameters were set to continuously record at a sample rate of 48 kHz, providing an estimated endurance of approximately 200 days. A first deployment was successfully conducted from June 6, 2021 – November 16, 2021. Recorders were recovered and redeployed on November 17, 2021 for a second 6-month period (Table 1), and will be recovered in July 2022 (Table 1).

Table 1: Summary metadata for current PAM deployments

Deploy #	Sample Rate (kHz)	Depth (m)	Latitude	Longitude	Deploy day/time	Recovery day/time	Duration (complete days)
DK-21-S1-D1	48	319	14.61568°	-17.63057°	6/6/2021 11:33	11/16/2021 8:37	162
DK-21-S2-D1	48	313	14.74127°	-17.63648°	6/6/2021 10:38	11/16/2021 9:48	162
DK-21-S1-D2	48	306	14.61505°	-17.63019°	11/17/2021 10:35	(expected by: 7/4/2022)	(expected: 229)
DK-21-S2-D2	48	316	14.74083°	-17.63476°	11/17/2021 9:32	(expected by: 7/4/2022)	(expected: 229)

The proposed project will allow for continued data collection for a second year at these sites, by funding the field expeditions needed in January and June 2023. After retrieval and data download in July 2022, recorders will be redeployed at the same sites for up to 200 days. An interim recovery/redeployment will be conducted in January 2023, with the final recovery (in the absence of any future additional funding) to be conducted in June 2023.

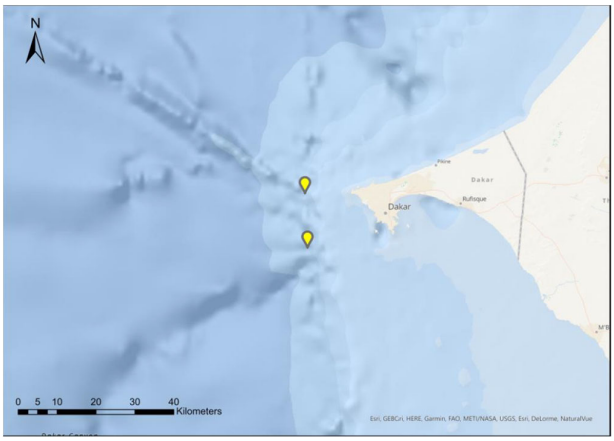

Figure 1. Chart showing final deployment positions of two recorders deployed off the Dakar Peninsula, Senegal, on June 6, 2021.

Data Analysis:

For baleen whale and seismic survey analyses, the resulting sound files will be down-sampled to 2kHz to improve resolution for low-frequency analysis. An initial data QA/QC will be performed by Cholewiak and Cerchio to verify recorder functionality and data quality, using the software packages Raven Pro and Triton.

Daily Analyses of Baleen whale presence:

An automated detector (LFDCS, Baumgartner and Mussoline 2011) will be run over the entire dataset to document putative detections of target baleen whale signals from the North Atlantic (specifically, humpback and sei whales, though other species will be documented as well). The call library for this detector, trained with vocalizations from the North Atlantic, includes blue, fin, humpback, sei and North Atlantic right whales. This detector has been used extensively by NOAA Fisheries and colleagues for monitoring baleen whale occurrence in the North Atlantic (eg., Davis et al. 2017, 2020). Detections of target species will be validated on a daily basis following Davis et al. (2020).

In addition, long-term spectrograms will be manually browed using the software packages Triton and/or Raven Pro to identify putative Bryde's whale signals, which are poorly described for this region. Other low frequency (in the 10-100Hz frequency range) baleen whale vocalizations, including downsweeps (potentially attributed to blue whales) will also be logged.

Assessment of humpback whale stock identity:

Seasonality of humpback song detections will be evaluated with respect to both northern and southern hemisphere breeding cycles. Periods with detected humpback whale song will be manually reviewed to characterize song structure and pattern (eg., Cholewiak et al. 2018). Song patterns will be compared at a thematic level to those being simultaneously collected in the western North Atlantic (by NOAA Fisheries and colleagues), Caribbean, and/or Cape Verdes (pending suitable data availability by collaborators) to confirm whether the recorded song patterns are consistent with others recorded in the North Atlantic (following Cholewiak et al. 2018). Any songs detected in time periods corresponding to the southern hemisphere humpback whale breeding season (austral winter) will be compared at a thematic level to recordings collected concurrently in the southern hemisphere (by Cerchio and colleagues). Results will be summarized in terms of daily and seasonal occurrence of humpback song and putative stock identity.

Assessment of sei/Bryde's whale stock identity and seismic survey acoustic impacts will be pursued under separate funding.

(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 disseminated by NOAA Fisheries and the African Aquatic Conservation Fund, each of which have both local and international outreach capacity. In addition, results will be presented at relevant conference venues. Outreach materials will be made available to the IWC Secretariat.

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)
Recovery and redeployment of 2 ST600 recorders off Dakar, Senegal	Cerchio, Senegalese assistant	1/23	06/23
Validation of new PAM dataset ; analyses of baleen whale occurrence	Cholewiak, Cerchio, Analyst	1/23	4/23
Final recovery of 2 ST600 recorders off Dakar, Senegal	Cerchio, Senegalese assistant	06/23	06/23
Validation of final PAM dataset ; analyses of baleen whale occurrence & humpback stock identity via song structure	Cholewiak, Cerchio, Analyst	07/23	11/23
Preparation of Final Report	Cholewiak, Cerchio	11/23	12/23

Expected outputs	Completion date (mm/yy)
Progress Report to IWC Scientific Committee, May 2023	05/23
Final Report to IWC Scientific Committee	05/24
Submission of data results/analyses to peer-reviewed journal	12/24

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
Danielle Cholewiak	NOAA Fisheries, Northeast Fisheries Science Center	Convenor of E
Robert Brownell	NOAA Fisheries, Southwest Fisheries Science Center	Convenor of CMP
Salvatore Cerchio	African Aquatic Conservation Fund	None
Diana Seck	African Aquatic Conservation Fund	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**			**Co-funding £GBP**
(1) Salaries (by person)	Cerchio - Project supervision, data validation	£342/day	10 days (+ 15 days co-funded)	8,550		3,420			5,130
	Senegalese Field Assistant	£190/day	6 days	1,140		1,140			0
	Junior Analyst for PAM data	£22/hr	480 hrs (+ 160 hrs co-funded)	14,080		10,560			3,520
	Cholewiak – Project supervision, analysis support	£55/hr	120 hrs (co-funded)	6,600		0			6,600
(2) Travel/subsistence (by person or est. total for IPs)	Airfare to Senegal to support field expedition	£1350/flight	2 (November 2022 + June 2023)	2,700		2,700			
	Local Transport	£400		400		400			
	Lodging	£55/room/day	12 (2 rooms; 3 days/trip, 2 trips)	660		660			
	Per diem/incidentals	£40/day	16 (2 people; 4 days/trip, 2 trips)	640		640			
	Boat hire	£400/day	4 days (2 days/trip)	1,600		1,600			
	Boat fuel	£120/day	4 days (2 days/trip)	480		480			
(3) Services (by item)	N/A								
(4) Reusable equipment	SoundTrap ST600s	£4,256	2 (co-funded)	8,512		0			8,512
	Prevco PRV (Pressure valves)	£320	2 (co-funded)	640		0			640
	Vemco VR100 surface station	£6,574	1 (co-funded)	6,574		0			6,574
	Vemco Ascent acoustic release	£3,122	2 (co-funded)	6,244		0			6,244
(5) Consumables	Custom-built anchors	£80	4 (2 per deployment)	320		320			
	Misc. supplies	£500		500		500			
(6) Shipping & Customs (by Item)	N/A								
(7) Insurance (by item)	N/A								
(8) Other	Costs associated with research permit acquisition and logistics	£955	Co-funded	955		0			955
			TOTAL	£60,595		**22,240**			38,175

Co-funding Memo:

Source	**Purpose of Funding**	**Cost £GBP**	**Secured/Tentative?**
AACF/NOAA Fisheries	Loan of equipment (Vemco VR 100, 2 Vemco Ascents, and 2 SoundTrap 600s)	£21,970	Secured
AACF	In kind coverage of permit acquisition costs, salary costs	£6,085	Secured
NOAA Fisheries	In kind coverage of salary	£10,120	Secured
	TOTAL	**38,175**	

Total value of project:	**Cost £GBP**
Funds requested from IWC	**22,420**
Co-funding	**38,175**
TOTAL	**60,595**

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 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: