Applicant: **Jackson, Jennifer**
Organisation: **British Antarctic Survey**
Funding Sought: **£346,812.00**

DPR11S2\1018

Hungry humpbacks: measuring seasonal foraging intensity at South Georgia

Whales are the largest krill-predators at South Georgia (SG), yet their impacts on krill stocks are poorly understood. Recently, whale surveys revealed high summer abundance and extended use of SG waters into winter, coincident with a krill fishery. This project measures how whale foraging intensity varies across the feeding season in SG, using UAV-based measurements of body condition and satellite-tracking of diving rates to measure season-specific krill consumption, and inform krill quota-setting for the Subarea 48.3 CCAMLR krill risk assessment.

PRIMARY APPLICANT DETAILS

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Section 1 - Contact Details

PRIMARY APPLICANT DETAILS

Title	Dr
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GMS ORGANISATION

Type	**Organisation**
Name	British Antarctic Survey
Phone (Work)	[redacted]
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Section 2 - Title & Summary

Q3. Project Title:

Hungry humpbacks: measuring seasonal foraging intensity at South Georgia

What was your Stage 1 reference number? e.g. DPR11S1\1123

DPR11S1\1048

Q4. Summary of project

Please provide a brief summary of your project: the problem it is trying to address, its aims, and the key activities you plan to undertake.

Successful Darwin Plus Main projects in Round 11 must demonstrate substantial measurable outcomes in at least one of the themes of Darwin Plus either by the end of the project's implementation or via evidenced mechanisms for post-project delivery.

Preference will be given to discrete projects implementing existing identified environmental solutions on the ground.

The broad themes of Darwin Plus Main are:

- **Biodiversity:** improving and conserving biodiversity, and slowing or reversing biodiversity loss and degradation;

- **Climate change:** responding to, mitigating and adapting to climate change and its effects on the natural environment and local communities;
- **Environmental quality:** improving the condition and protection of the natural environment;
- **Capability and capacity building:** enhancing the capacity within OTs to support the environment in the short- and long-term.

Please write this summary for a non-technical audience.

Whales are the largest krill-predators at South Georgia (SG), yet their impacts on krill stocks are poorly understood. Recently, whale surveys revealed high summer abundance and extended use of SG waters into winter, coincident with a krill fishery. This project measures how whale foraging intensity varies across the feeding season in SG, using UAV-based measurements of body condition and satellite-tracking of diving rates to measure season-specific krill consumption, and inform krill quota-setting for the Subarea 48.3 CCAMLR krill risk assessment.

Section 3 - UKOT(s), Dates & Budget Summary

Q5. UKOT(s)

Which UK Overseas Territory(ies) will your project be working in?

☑ South Georgia and The South Sandwich Islands (SGSSI)

*** if you have indicated a territory group with an asterisk, please give detail on which territories you are working on here:**

No Response

In addition to the UKOTs you have indicated, will your project directly benefit any other Territories or country(ies)?

⦿ No

Q6. Project dates

Start date:	End date:	Duration (e.g. 2 years, 3 months):
01 April 2023	30 September 2025	2 years, 6 months

Q7. Budget summary

Year:	2023/24	2024/25	2025/26	Total request
Amount:	£298,311.00	£16,996.00	£31,505.00	**£** 346,812.00

Q8. Proportion of Darwin Plus budget expected to be expended in UKOTs (%) [redacted]

Q9a. Do you have matched funding arrangements?

⦿ Yes

What matched funding arrangements are proposed?

[redacted] of matched funds have been committed by Friends of South Georgia Island/South Georgia Heritage Trust, delivered as [redacted] each in 2023/24 and 2024/25. Substantial in-kind salary support is also provided by BAS and project

partners ([redacted]).

Q9b. Total confirmed & unconfirmed matched funding (£) [redacted]

Q9c. If you have a significant amount of unconfirmed matched funding, please clarify how you fund the project if you don't manage to secure this?

No Response

Section 4 - Problem statement

Q10. Problem the project is trying to address

Please describe the problem your project is trying to address in the UKOTs, relating to at least one of the themes of Darwin Plus.

For example, what are the specific threats to the environment that the project will attempt to address? Why are they relevant, for whom? How did you identify these problems? How will your proposed project help? Please cite the evidence you are using to support your assessment of the problem (references can be listed in your additional attached PDF document).

Recently, >30,000 whales (predominantly humpback whales) were estimated to visit SG in summer [1], making this UKOT the highest-density UK hotspot for recovering whales. This recovery has management implications for the Government of South Georgia and the South Sandwich Islands (GSGSSI) krill fishery, as whales are major krill consumers. For example in summer 2018/19 whales were estimated to consume 3.38-5.08 million tonnes of krill at SG [1]. The krill fishery is in winter, when there are fewer whales because many migrate to lower latitudes. However, some whales are resident in SG waters from summer to winter [2], particularly humpback whales*.

To maintain sustainable Antarctic fisheries, the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) is conducting regional krill risk assessments (KRA), integrating spatial data relating to krill stocks, predator foraging and krill fisheries into summer and winter data-layers. A KRA is anticipated for South Georgia (CCAMLR Area 48.3) from 2025/26. The krill fishery in the South Atlantic has an annual quota limit of 0.093 million tonnes summed across four sub-Areas. At SG, annual catch varies greatly, between 18,500-115,000 tonnes of krill in the last decade**.

Each KRA requires summer and winter data on whale abundance, distribution and krill consumption rates. Krill consumption estimates vary widely [see 1,3,4] and are mostly derived from summer feeding or whaling data. In the western Antarctic Peninsula (WAP), ~73% of krill consumed by higher-predators in summer (~17% of krill consumed by krill-predators) was estimated to go to whales, showing their impact and importance in the KRA [3,5]. However, WAP humpback whale tagging studies found that foraging rates declined 51% across the feeding season from summer to winter [6]. Similar patterns are seen in historical whaling data with mass of landed animals changing most rapidly early in the feeding season [4]. Therefore, applying summer consumption rates to whales present in other seasons (autumn and winter) may substantially overestimate total krill consumed, if whale behaviour is not considered. Another important consideration is age-class, sex and reproductive status and body condition (health status) of feeding individuals, because feeding rates correlate with body size (e.g. consumption rates by juveniles will be less than adults), and may also be related to health or pregnancy status.

This project will provide seasonal krill consumption estimates for humpbacks to the KRA (aggregated across demographic classes), and generate satellite tracking-based winter habitat use models [e.g. 2] to describe whale distribution. Both datasets will be integrated into the Area 48.3 KRA and will provide the first baseline measurements of krill consumption in SG waters by whales, across seasons.

The project will be implemented by measuring humpback demography and foraging rates at SG from summer to winter using established proxies: body condition and size (using unmanned aerial vehicle, UAV, measurements [6]), diving rates (using satellite tags [5]) and epigenetically-measured age [7].

The overall aim is to improve GSGSSI's capability to sustainably manage its krill fishery by specifying the level of impact of its largest krill predator.

*https://www.bas.ac.uk/project/winter-krill-at-south-georgia/#data
**Accessed via https://www.gov.gs/environment/marine-protected-areas-data-portal/

Section 5 - Environmental Conventions, Treaties and Agreements

Q11. Environmental Conventions, Treaties and Agreements

Please detail how your project will contribute to the aims of the national and/or international agreement(s) your project is targeting. What key OT Government priorities and themes will it address and how? You should also consider local, territory specific agreements and action plans here. Letters of support from UKOT Government partners/stakeholders should also make clear reference to the agreements/action plans your project is contributing towards.

Note: No additional significance will be ascribed for projects that report contributions to more than one agreement.

The project will directly address the CCAMLR priority to develop and implement a new management approach for the krill fishery [9,10]. Whale prey consumption patterns will be used by CCAMLR to provide data-layers on spatial habitat use and estimates of seasonal krill consumption for the CCAMLR sub-Area 48.3 krill risk assessment.

This project supports multiple aspects within two key Research Themes in the GSGSSI MPA Research and Monitoring Plan:

Theme 3 (Higher predator ecology and demography) with identified high-priority research needs to: (1) collect tracking data for humpback and southern right whales; (2) obtain krill consumption rates for cetacean species.
Theme 8 (Impact of fisheries – interaction with higher predators) with high-priority research needs to: (1) develop the CCAMLR Risk Assessment framework for krill fishery management; (2) track krill-dependent predators during winter; (3) understand how the recovery of previously exploited marine mammals has affected food webs; competition of major krill consumers with other krill-eating predators and with the krill fishery.

SG was recently designated as an Important Marine Mammal Area by the IUCN*, formally recognizing this as an important area for marine mammals which may merit place-based protection and/or monitoring.

Multi-season whale habitat use and foraging rates are also important for the Ecosystem Modelling Working Group of the International Whaling Commission, which seeks to develop realistic models of whale bioenergetics and consumption rates in the Southern Ocean.

*https://www.marinemammalhabitat.org/portfolio-item/scotia-arc/

Section 6 - Method, Project Stakeholders, Gender, Change Expected, Pathway to Change & Exit Strategy

Q12. Methodology

Describe the methods and approach you will use to achieve your intended Outcome and contribute towards your Impact. Provide information on:

- **How have you reflected on and incorporated evidence and lessons learnt from past and present activities and projects in the design of this project?**
- **The need for this work and a justification of your proposed approach.**
- **How you will undertake the work (materials and methods).**

- **How you will manage the work (roles and responsibilities, project management tools, etc.).**

-DPLUS149 surveys confirmed the presence of whales at SG in autumn and winter*, indicating the need for whale abundance and consumption rates to be accounted in the KRA. Previous krill-consumption models assume a 120-day summer presence, with fixed consumption rates across seasons [3,5].

Design considerations
-Humpback whale foraging rates decline across the feeding season in the WAP [6,7]; whaling data from the Antarctic Balleny Islands shows a similar pattern [4]. However sub-Antarctic SG has much more productivity variability and flux than Southern Ocean sites, so patterns may differ at SG [12].
-UAV photogrammetry can be used to non-invasively measure body-size (length, mass) and condition (energy reserves) of humpback whales [8,13-14], and was recently applied to right whales at SG [15]. This innovative method will be used to measure the increase-rate in whale body-condition (mass) over the feeding season [13], from which krill-consumption rates will be estimated.
-DPLUS057 demonstrated that small-boat whale studies can be conducted from SG, collecting biopsy samples from humpback whales. Humpbacks were sighted on 60% of 15 surveys between St Andrews Bay/Stromness (2.9 whales/survey) and 50% of 6 surveys within Cumberland Bay.
-Cumberland Bay can be spanned with a UAV flight with the pilot working from land (~80 land-based flights at two/day, assuming 1/3 good weather days), yielding ~40-50 imaged whales. Deployments from boats should double the size of this dataset.
-To increase tagging and biopsy success compared to DPLUS057, we budget for a dedicated boatman (to maximise good-weather windows) and increase boating time by 10%.

Methodology
WP1:Body condition trends and demography
-Four UAV pilots will collect calibrated UAV aerial images from ~100 humpback whales near Cumberland Bay, identifying adults and juveniles, and estimating body-condition trends (% fat reserves) between December 2023-March 2024. UAVs will be deployed from land, and opportunistically from local vessels (project partner (PP) Christiansen). When deployed during small-boat surveys, images will be paired with biopsy-samples of the same individual, to identify sex, reproductive-status and age-specific body-mass changes related to foraging.

-Calibrated UAV aerial images will be collected (PP Christiansen) during the seasonal migration of the same humpback whale population to/from their wintering grounds off Brazil, providing body-condition data during their southbound migration off Abrolhos Bank towards SG (October 2023, end of fasting, PP Camargo), and on their northerly migration past Cabo Frio (June 2024, beginning fasting, PP Tardin).

-Humpback demography will be assessed: (1) using ~50 biopsy samples to identify sex, age (using epigenetics, PPs Jackson and Carroll [11]) and pregnancy status (PP Kershaw, [16]), and (2) measuring numbers of adults, mother-calf pairs and juveniles by UAV (PP Christiansen).

-UAV-based body-condition data will be used to measure demographic class-specific humpback whale weight gain and loss patterns over the migratory cycle between Brazil and the Scotia Arc, and across the SG feeding season, stratified by adults, mother-calf pairs and juveniles (PPs Christiansen, Tardin and Camargo) [e.g., 17].

WP2:Trends in diving rates across feeding season
-In February-March 2024, 120 hours of small-boat surveys will be conducted near Cumberland Bay, collecting whale sightings, photo-identifications, satellite-tagging and biopsy-sampling (coordination, PP Martin) to identify sex, age and reproductive status, combined with UAV images (above).
-Eight humpback whales will be instrumented with depth-recording satellite tags, to identify spatial habitat-use and how foraging depth and intensity varies across the feeding season (expert consultant Kennedy).
-Whale diving rates (a foraging effort proxy) will be measured across the feeding season (PP Zerbini).
-Body-condition and feeding-rate patterns will be compared between SG and the WAP, to establish if trends are shared between regions (PPs Zerbini, Friedlaender).

WP3:Season-specific SG krill consumption rates
-Synthesize multi-season data on foraging rates from body-condition measurements and satellite tracks to summarize how foraging rates vary across the feeding season at SG.
-Combine foraging rates with demographic data to model krill consumption rates by demographic class at SG across the feeding season (summer, autumn, winter).

-Incorporate consumption rates into CCAMLR Krill Risk Assessment (PP Warwick-Evans).

WP4:Spatial habitat use
-Satellite tracks will be used to create a spatial model of winter habitat use (expert consultant Kennedy), combined with data summarized in [2]. Satellite-tracking complements current winter sighting surveys (DPLUS149), providing information on habitat use through time (persistent sites of importance for whales), outside the shelf and slope areas where sighting surveys were conducted.
-Incorporate habitat use models into the Area 48.3 CCAMLR Krill Risk Assessment (PP Warwick-Evans).

Project outcomes are the responsibility of named project partners above. The project will be managed by a dedicated project coordinator (PP Martin) and kept on track with monthly meetings to meet project timelines.

*https://www.bas.ac.uk/project/winter-krill-at-south-georgia/#data

Q13. Project Stakeholders

Who are the stakeholders for this project and how have they been consulted (include local or host government support/engagement where relevant)? Briefly describe what support they will provide and how the project will engage with them.

-GSGSSI have been consulted during the project development and are Project Partners on the proposal. They have agreed to support the planned fieldwork at King Edward Point. In turn the project will help train two GSGSSI mariners to become professional drone pilots in order to enhance local support for monitoring SG wildlife in future. GSGSSI will be invited to attend monthly project progress meetings as well as the annual project workshops.

-CCAMLR are planning to conduct a krill risk assessment in the area including SG (Area 48.3) during 2025-26. The project will generate whale consumption rate values and density data which can be used to inform the Area 48.3 krill risk assessment, and is well placed to do so via the BAS CCAMLR lead scientist (PP Collins) and lead on the data layers for the krill risk assessment (PP Warwick-Evans).

-The IWC are investigating the role of cetaceans in ecosystem functioning. In particular, they are currently developing individual-based energetics models for baleen whales in order to infer functional responses of baleen whales feeding on krill [Item 15, 18]. This work will help feed into that investigation. The project team includes the IWC Scientific Committee chair (PP Zerbini) and Southern Hemisphere sub-committee chair (PP Jackson) so is well placed to deliver project outcomes as reports to the Scientific Committee as well as to respond to any further IWC recommendations.

Q14. Gender equality

All applicants must consider whether and how their project will contribute to reducing inequality between persons of different gender. Explain how your understanding of gender equality within the context your project, and how is it reflected in your plans. Please summarise how your project will contribute to reducing gender inequality. Applicants should, at a minimum, ensure proposals will not increase inequality and are encouraged to design interventions that proactively contribute to increased gender equality.

BAS is committed to creating a workplace that is fair and inclusive and welcomes diversity, with a strong commitment to Equality, Diversity and Inclusion (https://www.bas.ac.uk/jobs/working-for-bas/our-cultural-values-equality-and-diversity/). Since 2014, BAS has been a member of the Athena Swan Charter and is proud to hold an Athena Swan Bronze Award.

The project team is very balanced in terms of gender diversity, and includes a number of female scientists (Carroll, Gregory, Kershaw, Warwick-Evans), including the PI and project coordinator (Jackson, Martin). Scientific analysis and integration of data into the krill risk assessment will be done by Warwick-Evans. Consequently the project should help foster a strong and productive research network of male and female scientists working in the UKOTs.

Q15. Change expected

Detail the expected changes this work will deliver. You should identify what will change and who will benefit a) in the

short-term (i.e. during the life of the project) and b) in the long-term (after the project has ended) and the potential to scale the approach. Please describe the changes for the environment and, where relevant, for people in the OTs, and how they are linked.

When talking about how people will benefit, please remember to give details of who will benefit, differences in benefits by gender or other layers of diversity within stakeholders, and the number of beneficiaries expected. The number of communities is insufficient detail – number of households should be the largest unit used.

In the short term, this project will provide the following data for the CCAMLR Krill Risk Assessment of Area 48.3 in 2025/26:
(1) Demographic composition of humpback whales visiting SG (age, sex ratio, juveniles, adults, pregnant females, mothers and calves).
(2) Trend in whale consumption rates by demographic class at SG across the whale feeding season (summer, autumn, winter).
(3) An estimate of overall humpback whale krill consumption (in Area 48.3) by season.
(4) Humpback whale Winter habitat use patterns based on satellite tracking data.
This will benefit GSGSSI and CCAMLR, informing krill quota agreement and spatial management of the fishery.

In the long-term, the project provides baseline measurements of the demography and foraging rates of humpbacks feeding at SG for the GSGSSI MPA, so it can be used in future ecosystem management scenarios. This is currently the most numerous species (~85% of all whales sighted) but if whale populations recover to pre-exploitation levels, the number of whales using SG will double, potentially changing species-specific foraging rates and patterns.

A second long-term benefit will be the GSGSSI having two skilled mariners who can deploy UAV for wildlife monitoring in SG waters during fishery vessel surveys. UAV are playing an increasingly important role in monitoring wildlife in the OTs (e.g. 15, 19, DPLUS109) so this upskilling of two local mariners is timely and anticipated to support both at-sea and on-land wildlife monitoring at SG in future.

Q16. Pathway to change

Please outline your project's expected pathway to change. This should be an overview of the overall project logic and outline why and how you expect your Outputs to contribute towards your overall Outcome and, longer term, your expected Impact.

This project addresses a key question about the seasonal level of krill consumption by whales, and provides additional information to resolve winter habitat use and baseline population demography data on the most abundant whale species (humpback whales) that use SG as a feeding ground. In combination, these data provide useful context for the upcoming CCAMLR krill risk assessment and to measure the impact of the fishery on recovering whales, as well as contributing key data to the GSGSSI's MPA Research and Monitoring Program. The proposal combines a multi-disciplinary team of scientists with expertise in the subject areas and strong links to the Territory Government, CCAMLR and IWC, to ensure that results feed directly into management.

Q17. Exit Strategy

How will the project reach a sustainable point and continue to deliver benefits post-funding? Will the activities require funding and support from other sources, or will they be mainstreamed in to "business as usual"? How will the required knowledge and skills remain available to sustain the benefits? If relevant, how will your approach be scaled?

This project intends to deliver a timebound piece of work which is designed to support the upcoming (2025/26) CCAMLR review of the krill fishery in Area 48.3 at South Georgia (the CCAMLR krill risk assessment).

Post-funding, this piece of work also provides an important baseline for future measurements of whale habitat use at SG; in particular the key areas of importance for feeding whales and the cross-season consumption rates. With the Western Antarctic Peninsula comparison, it also provides information on how baleen whale demographics, energetics and consumption rates vary across the Southern Ocean, which will be informative for future multi-area krill risk assessments.

Following this project, we aim to deploy a UAV pilot to SG regularly, to monitor whale population parameters and body mass change in good and poor krill years. UAV pilots can support a range of SG wildlife monitoring projects, so have cross-

disciplinary use within GSGSSI. Support for the pilot could therefore be covered by a combination of funding sources, combining BAS support with small Antarctic grants.

By upskilling GSGSSI mariners to participate in UAV-based monitoring of SG wildlife, the project will also deliver a benefit that will last a number of years and further help to support GSGSSI's MPA management.

If necessary, please provide supporting documentation e.g. maps, diagrams, references etc., as a PDF using the File Upload below:

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Section 7 - Risk Management

Q18. Risk Management

Please outline the 6 key risks to achievement of your Project Outcome and how these risks will be managed and mitigated, referring to the Risk Guidance. This should include at least one Fiduciary, one Safeguarding, and one Delivery Chain Risk.

Projects should also draft their initial risk register using the Risk Register Template provided, and be prepared to submit this when requested if they are recommended for funding. Do not attach this to your application.

Risk Description	Impact	Prob.	Inherent Risk	Mitigation	Residual Risk
Fiduciary (Financial) Misuse of funds for tasks or expenditures not related to Darwin Plus, or for personal gain by project funding beneficiaries. Corrupt procurement of goods or services from favoured parties not offering best value for money.	Moderate	Rare	Minor	BAS Finance Department will maintain oversight of expenditure and time-sheets, which will be subject to independent audit at the project close. BAS adheres to UKRI rules on open, competitive procurement. BAS partners will provide evidence of expenditure on their designated activities which will be submitted for audit at project close.	Minor
Safeguarding Discrimination, bullying and harassment by staff who are part of the project, or by colleagues from outside the project.	Moderate	Rare	Minor	The PI will be vigilant for safeguarding issues within BAS and across partner organisations through regular project meetings at 1:1 discussions. Any issues will be referred to BAS HR for further advice and action. See also project partner mitigations under Q28.	Minor

Delivery Chain Field equipment (e.g. UAV, batteries, satellite tags) not secured or available in time before deployment.	Severe	Rare	Major	Purchase of field equipment will be first priority on securing grant. UAV equipment options have been checked and most are readily available online for rapid delivery. Satellite tag order will be done four months ahead of delivery, minimising risk of failure.	Minor
Risk 4 No whales present during field season (for example it may be a poor year for krill at South Georgia). Poor krill years occur every 4-5 years but are getting more frequent. The last one was in 2020/21. Consequently very few whales could be surveyed or satellite tagged by the project.	Severe	Possible	Major	Poor krill years are usually preceded by a poor winter season for krill. The PI will keep a close eye on winter observations at SG in 2023. If signs suggest a poor summer to follow, will request a one-year extension from Darwin and move the field season backwards one year.	Moderate
Risk 5 Access to King Edward Point field site on proposed dates not possible due to late changes to GSGSSI vessel schedule and berth availability.	Moderate	Possible	Major	If necessary we will endeavour to input team members ahead of planned times, in order to span planned field dates. We will discuss transit options with expedition vessels if necessary. Logistics planning will begin April 2023, giving some months notice of any transit problems, with time to find transit solutions.	Minor
Risk 6 Very few whales (2 or less) can be instrumented with SPLASH satellite tags due to weather conditions, equipment failure or evasive whale behaviour.	Major	Possible	Major	In 2018/19, only two whales were tagged near King Edward Point. Here, we extend boating time by 10% and employ a dedicated boatman, to use all good-weather windows (only sometimes possible in 2018/19). Additional dive-rate data will be available from whales tagged in Brazil and travelling to SG (Zerbini LoS).	Moderate

Section 8 - Implementation Timetable

Q19. Provide a project implementation timetable that shows the key milestones in project activities

Provide a project implementation timetable that shows the key milestones in project activities. Complete the Word template as appropriate to describe the intended workplan for your project.

Implementation Timetable Template

Please add/remove columns to reflect the length of your project. For each activity (add/remove rows as appropriate) indicate the number of months it will last, and fill/shade only the quarters in which an activity will be carried out.

BCF-Implementation-Timetable-Template-2022-23-Forecol_v3
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Section 9 - Monitoring and Evaluation (M&E)

Q20. Monitoring and evaluation (M&E) plan

Describe how the progress of the project will be monitored and evaluated, making reference to who is responsible for the project's M&E.

Darwin Plus projects will need to be adaptive and you should detail how the monitoring and evaluation will feed into the delivery of the project including its management. M&E is expected to be built into the project and not an 'add' on. It is as important to measure for negative impacts as it is for positive impact. Additionally, please indicate an approximate budget and level of effort (person days) to be spent on M&E. For more information, see Finance Guidance**.**

Project progress will be monitored with monthly online meetings to which all project partners are invited (30 in total). During the fieldwork planning and implementation period (one year from May 2023 to April 2024), monthly meetings will also be held with BAS Operations to progress logistical support across the field season and identify any issues arising (12 in total).

One virtual three-hour workshop (involving project partners and relevant stakeholders) will be held each year in June to receive feedback, with the third workshop intended to finalise outputs (see Q19 and Logframe).

One virtual seminar (for the general public, stakeholders and partners) and workshop (stakeholders and partners) will be held in September 2025 to review findings, wrap up krill assessment deliverables and identify recommendations for future work. Seminar will be over one day and the workshop will span two days. The seminar will be recorded and published online.

Project coordinator Martin will minute project meetings, feed back relevant discussions to stakeholders, and organise the annual virtual workshop (10% of time in year 1). Project Leader Jackson is responsible for M&E throughout the project and organisation of later workshops (5% of time in years 2 and 3). See Output 5 (Log Frame) for the planned monitoring framework.

Total project budget for M&E in GBP (this may include Staff, Travel and Subsistence costs)	[redacted]
Percentage of total project budget set aside for M&E (%)	[redacted]
Number of days planned for M&E	51

Section 10 - Logical Framework

Q21. Logical Framework (logframe)

Darwin Plus projects will be required to monitor and report against their progress towards their Outputs and Outcome. This section sets out the expected

Outputs and Outcome of your project, how you expect to measure progress against these and how we can verify this.

Stage 2 Logframe Template

The **logframe template** (N.B. there is a different template for Stage 1 and Stage 2) needs to be downloaded from Flexi-Grant, completed and uploaded as a PDF within your Flexi-Grant application – **please do not edit the logframe template structure (other than adding additional Outputs if needed) as this may make your application ineligible.** On the application form, you will be asked to copy the Impact, Outcome and Output statements and activities - these should be the same as in your uploaded logframe.

Please upload your logframe as a PDF document.

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Impact:

Impact of the South Georgia krill fishery on krill-predators is understood and mitigated through direct measurement of season-specific krill consumption rates and habitat-use by the biggest krill predator (humpback whales)

Outcome:

To ensure that the South Georgia krill fishery is managed sustainably, by providing key information on humpback whale demography, foraging rates and krill consumption for the CCAMLR krill risk assessment.

Project Outputs

Output 1:

Trends in humpback whale body condition and mass across the feeding season for adults, mothers, calves and juveniles

Output 2:

Trend in humpback whale diving rates across the feeding season

Output 3:

Season-specific krill consumption rates used in CCAMLR Sub-Area 48.3 Krill Risk Assessment

Output 4:

Spatial habitat use at SG by humpback whales in winter used in CCAMLR Sub-Area 48.3 Krill Risk Assessment

Output 5:

Project Management and Monitoring

Do you require more Output fields?

It is advised to have fewer than 6 Outputs since this level of detail can be provided at the Activity level.

◉ No

Activities

Each activity is numbered according to the Output that it will contribute towards, for example, 1.1, 1.2, 1.3 are contributing to Output 1.

1.1.1 UAV equipment purchased [April-June 2023]
1.1.2 Boat hire secured for Abrolhos Bank (Brazil) fieldwork [June 2023]
1.1.3 Travel and accommodation organised for fieldwork participants in Abrolhos Bank [August 2023]

1.1.4 UAV surveys in Abrolhos Bank take place October 2023 and collect a minimum of 50 overhead images of humpback whales [October 2023]
1.1.5 Field report made and sent to BAS for upload on project website [November 2023]
1.2.1 King Edward Point field equipment purchased for Outputs 1 and 2 [April-June 2023]
1.2.2 Animal ethics forms, risk assessments, South Georgia science permits and UAV flight permits applied for and secured [September 2023]
1.2.3 Medicals, sea survival training, any other training requirements conducted by field team [September-October 2023]
1.2.4 Shipment of field equipment to King Edward Point, South Georgia [October 2023]
1.2.5 Flight and vessel itineraries finalised for field team [October 2023]
1.2.6 Two UAV pilots travel to South Georgia [end November 2023]
1.2.7 Two months of land based surveys of humpback whales conducted from King Edward Point station. Opportunistic surveys from local vessels also carried out where practical [December 2023-January 2024]
1.2.8 At least 100 calibrated overhead images of humpback whales collected (minimum estimates 50 from land, 50 from sea)
1.2.9 Images will be processed (to measure volume and mass) while in the field where possible [December 2023-March 2024]
1.2.10 One UAV pilot leaves and new UAV pilot arrives to continue season [end January 2024]
1.2.11 Second part of field season includes other whale work from KEP powerboats (see Output 2.1). UAVs will be deployed from King Edward Point and from powerboats during whale surveys [February-March 2024]
1.3.1 Team biopsy sample up to 50 humpback whales, opportunistically biopsy sample any other cetaceans encountered (up to 50 samples), and collect photo-ID from all encounters [February-March 2024]
1.3.2 Field team leave South Georgia [end March/start April 2024]
1.3.3 Field report finalised and uploaded on BAS project website [May 2024]
1.3.4 Biological samples (biopsy samples) shipped from South Georgia to UK via BAS shipping [June 2024]
1.4.1 Boat hire secured for Cabo Frio (Brazil) fieldwork [April 2024]
1.4.2 Travel and accommodation organised for fieldwork participants in Cabo Frio [April 2024]
1.4.3 UAV surveys in Cabo Frio take place and collect a minimum of 50 overhead images of humpback whales [~June 2024]
1.4.4 Field report finalised and sent to BAS for upload on project website [September 2024]
1.5.1 Genetic identification of whale sex at BAS Cambridge [August 2024]
1.5.2 Whales identified to be female sent to University of Aberdeen for hormone assay to measure pregnancy [September 2024]
1.5.3 Measure whale age using epigenetic methods, for all biopsy-sampled whales at BAS Cambridge [September-October 2024]
1.5.4 Whale image dataset subdivided using information from biopsy samples, generating eight datasets of juveniles and adults (unknown sex), male and female juveniles, male adults, pregnant and non-pregnant female adults, and mother-calf pairs [July-December 2024].
1.5.5 Dataset is summarised in an open-access report (Report A) presented to the IWC Scientific Committee [May 2025], also available via the BAS project website.
1.6.1 All biopsy data (~30 samples previously collected, combined with ~50 collected during this project, see Activity 2.1.5) are used to estimate the demographic composition of humpback whales feeding at South Georgia (i.e. the proportion of adults, juveniles, males and females, and pregnancy rate of females), using information on sex, age and pregnancy generated during Activities 1.4.1, 1.4.2 and 1.4.3 [October – December 2024].
1.6.2 Demographic composition of humpback whales feeding at South Georgia described in an open-access report to the IWC Scientific Committee [May 2025], also available via the BAS project website.
1.7.1 Demographically stratified whale image dataset (from Activity 1.4.4) used to measure demographic class-specific trends in body condition across the feeding season for South Georgia humpback whales.
1.7.2 Regression of body condition trends will be used to identify whether foraging rates are constant across the feeding season (null hypothesis) or if they vary/fluctuate significantly, and in what direction.
1.7.3 Body condition trends will be summarised in an open-access report presented to the IWC Scientific Committee [May 2025], also available via the BAS project website.
1.8.1 Body condition trend data will be compared between two sites (South Georgia and Western Antarctic Peninsula) to establish if patterns are concordant (whales feed most intensively in the early period of the feeding season).
1.8.2 The comparison between Antarctic humpback feeding sites will be summarised in an open-access report presented to the IWC Scientific Committee [May 2025], also available via the BAS project website.
2.1.1 Boatman travels to King Edward Point for three month contract. First month is used to familiarise boatman with jet boat driving [January 2024]
2.1.2 BAS tracking webpage is prepared for new whale tracking data (https://www.bas.ac.uk/project/south-georgia-right-whale-project/south-georgia-right-whale-project-whale-tracking/)
2.1.3 Field team of biopsy sampler, satellite tagger and photo-ID specialist travel to King Edward Point (KEP) [end January

2024]
2.1.4 Team work from a Jet boat and a powerboat in extended boating area around KEP, tagging eight humpback whales with SPLASH tags [February-March 2024]
2.1.5 Locations from tracked whales are automatically uploaded to BAS website (Activity 2.1.2)
2.1.6 Field team and KEP boatman leave KEP [April 2024]
2.2.1 Satellite track data combined with data available from previous Brazilian deployments (see Output 2.2) to measure how whale dive rates vary across the humpback whale feeding season [July – Sept 2024]
2.2.2 Analysis reported in a scientific report to the IWC Scientific Committee (Ecosystem modelling working group) [May 2025]
2.3.1 Dive rates analysis compared between South Georgia and western Antarctic Peninsula to identify any differences in foraging behaviour.
2.2.3 Analysis reported in a scientific report to the IWC Scientific Committee (Ecosystem modelling working group) [May 2025] (Output 0.1)
3.1.1 Whale feeding rates will be measured by season (summer, autumn, winter) using the model fits from the regression trends for UAV-based body condition estimates (Activity 1.6) and dive-rate measurements (Activity 2.2) to provide an overall measure of foraging rate variation [Oct-Dec 2024].
3.1.2 Temporal variation in feeding rates will be summarised in a scientific report to the IWC Scientific Committee (Ecosystem modelling working group) and CCAMLR WG-EMM in 2026.
3.2.1 Humpback whale body condition will be converted to body volume and mass estimates (Christiansen et al., 2019; Christiansen et al., 2022a) using published estimates of humpback whale body density (Lockyer 1976; Aoki et al., 2021) [Jan – March 2025]
3.2.2 Changes in body mass will be converted to tissue energy content, using previously published estimates of lipid and protein concentrations (Lockyer 1981; Christiansen et al., 2022a), to calculate the energy (fat) deposition of humpback whales in SG. [Jan – March 2025]
3.2.3 To estimate the total energy requirement of humpback whales, the daily cost of body maintenance will be calculated from the body mass data (using metabolic scaling, Kleiber 1975), the cost of somatic growth will be calculated from published length-at-age relationships from whaling data, and added to the energy deposition costs. [Jan – March 2025]
3.2.4 The total energy requirement of humpback whales will be converted to prey consumption rates by incorporating the digestive efficiency and assimilation efficiency of the whales and their prey (Lockyer 1981), and also factoring in the energetic content of Antarctic krill, to obtain an estimate of the biomass of krill consumed per day by a whale of a given size [Jan – March 2025]
3.2.5 Cost of reproduction (gestation) will be factored for a proportion of pregnant females (identified through biopsy sampling, Activity 1.5.1) using foetus length data from humpback whales from the southern hemisphere (n=635), and calculated foetus maintenance costs (heat of gestation), following the approach of Christiansen et al., (2022b). [Jan – March 2025]
3.2.6 Total krill consumption will be measured across all demographic groups using resampling methods to account for uncertainty in the parameter estimates (Activities 1.8.1-1.8.4) [April-May 2025]
3.2.7 A model of krill consumption will be constructed, incorporating variation in the length of the feeding season in SG (identified via satellite tags in Activity 2.1.4) and the demographic composition (Activity 1.5.2) and size distribution of whales (based on UAV measurements, Activity 1.6.1), to calculate realistic estimates of overall prey consumption by humpback whales in SG. [April-May 2025]
3.2.8 Total krill consumption will be summarised in an open-access report presented to the IWC Scientific Committee [May 2025], also available via the BAS project website and on the GSGSSI Data Portal.
3.2.9 Estimates of krill consumption by season (summer, autumn, winter) will be provided to CCAMLR WG-EMM for the Krill Risk Assessment [May 2025] (Output 0.2).
4.1.1 Humpback whale geolocations provided from satellite tag deployments (Activity 2.1.4) and previous satellite tag deployments (Bamford et al., 2022) will be used to identify key areas of whale habitat use in South Georgia waters across the feeding season (summer, autumn, winter) [July-September 2024]
4.1.2 Report on spatial habitat use provided to the CCAMLR WG-EMM for the Krill Risk Assessment [May 2025] (Output 0.3).
5.1.1 Dedicated project webpage set up on BAS website with project description [April 2023]
5.1.2 Whale tracking map embedded into project webpage [May 2023]
5.1.3 Project webpage updated over project period with field reports, images from the field, project reports and minutes of stakeholder meetings.
5.2.1 Monthly meetings scheduled (via an initial Doodle Poll) to keep partners on track with project updates and implementation.
5.2.2 Meeting minutes compiled in shared project folder for Project Partner and Darwin Plus review.
5.3.1 Partner and stakeholder virtual meeting organised in June of each year.
5.3.2 Meeting minutes are uploaded to the BAS project webpage. Any actions arising are chased forward via activity 5.2.1.
5.4.1 Public seminar promoted on social media ahead of final workshop [August 2025]

5.4.2 Hold a 3 day virtual workshop in September 2025. Day 1 will be a publicly accessible seminar with a series of talks by project partners, and the second two days the stakeholders and project partners will review findings for the krill risk assessment, and identify recommendations for future work [September 2025]
5.4.3 Final project report compiled from workshop, summarising findings and including future actions and recommendations. Accessible on BAS project webpage and submitted to the GSGSSI Data portal.

Section 11 - Budget and Funding

Q22. Budget

Please complete the template below which provides the Budget for this application. Some of the questions earlier and below refer to the information in this spreadsheet.

Budget form for projects over £100k

Please ensure you include any co-financing figures in the Budget spreadsheet to clarify the full budget required to deliver this project.

NB: Please state all costs by financial year (1 April to 31 March) and in GBP. Darwin Plus cannot agree any increase in grants once awarded.

Please upload the Lead Partner's financial accounts at the certification page at the end of the application form.

Please upload your completed Darwin Plus Budget Form Excel spreadsheet using the field below.

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xlsx 91.15 KB

Q23. Funding

Q23a. Is this a new initiative or a development of existing work?

⦿ New Initiative

Please provide details:

This is a new initiative for South Georgia/the UK Overseas Territories. Scientifically, it builds on previous work led by Christiansen on southern right whales using UAV to estimate similar population parameters (changes in body condition to measure changes in volume and mass across the migratory cycle), demonstrating the application of the approach [e.g. 8, 13].

Q23b. Are you aware of any other individuals/organisations/projects carrying out or applying for funding for similar work?

⦿ No

Q24. Balance of budget spend

Defra are keen to see as much Darwin Plus funding as possible directly benefiting OT communities and economies. While it is appreciated that this is not always possible every effort should be made for funds to remain in-Territory.

Explain the thinking behind your budget in terms of where Darwin Plus funds will be spent. What benefits will the Territory/ies see from your budget? What level of the award do you expect will be spent locally? Please explain the decisions behind any Darwin Plus funding that will not be spent locally and how those costs are important for the project.

The GSGSSI will receive [redacted] ([redacted] of total budget) in costs from BAS for supporting the field season at King Edward Point. In addition, there are dedicated funds ([redacted]) included to support drone pilot certification for two GSGSSI mariners.

All of the DPLUS award will be spent locally, with the exception of field consumables and capital items (Q25), personnel time for project coordination, leadership and data analysis in order to progress project goals. Capital items (two Inspire 2 UAV) will also be available for use in the Territory after the project close.

Q25. Capital items

If you plan to purchase capital items with Darwin Plus funding, please indicate what you anticipate will happen to the items following project end. If you are requesting more than 10% capital costs, please provide your justification here.

We plan to purchase two Inspire 2 UAV. Following the project end, both UAV will remain at BAS Cambridge and will be available for further work in South Georgia on whales and other wildlife. If practical, one Inspire 2 will be kept on the GSGSSI's Fisheries Patrol Vessel, to be used by trained UAV pilots to support wildlife monitoring at SG in future.

Q26. Value for Money

Please describe why you consider your application to be good value for money including justification of why the measures you will adopt will secure value for money.

The work will generate important baseline information in a remote area, and the land-based setup of the field season is substantially less expensive than doing the work at sea ([redacted]/day for running costs from King Edward Point, compared to standard per-day charter costs of [redacted] or higher).
A lot of in-kind time is contributed to this project by Project Partners ([redacted], see budget). We have also secured [redacted] of in-kind funding from Friends of South Georgia Island/South Georgia Heritage Trust towards this work in order to help offset fieldwork and personnel costs (see attached Letter of Support).

Fieldwork costs are kept low by using a substantial quantity of previously-acquired equipment (including a bowsprit mounted to the powerboat for supporting the satellite tagger, specialist PPE for working in Antarctic and marine conditions, high quality cameras for photo-ID and crossbows for biopsy sampling); these items contribute a minimum value of [redacted] to the project. Where new field equipment must be purchased (UAV and satellite tags), our prices reflect the market value of these items following a recent review of available supplies. For all items over [redacted] in value, three quotes for these items will be reviewed prior to purchase in order to secure the best value for money.

Section 12 - Safeguarding and Ethics

Q27. Outputs of the project and Open Access

All outputs from Darwin Plus projects should be made available on-line and free to users whenever possible. Please outline how you will achieve this and detail any specific costs you are seeking from Darwin Plus to fund this.

All satellite tracking data generated by this project (dive data, tracking patterns) will be made open access via the BAS Polar Data Centre by the end of the project, and will also be published in real time on a BAS project webpage during the project.

Primary data on whale body mass and body mass trend will be made available as open-access supplementary material to a

peer-reviewed publication of this work for example through Data Dryad.

Data compiled for the krill risk assessment (density layers and per-season consumption rates) will be made available via the GSGSSI Data Portal.

Project reports to the IWC Scientific Committee summarising datasets and analytical results will be available open access at www.iwc.int. Where they are published in peer-reviewed journals, we will ensure that the publications are open-access.

There are no specific costs requested for open access (e.g. journal or publication fees), but the costs for personnel time in this budget include time for the accessible archiving of data generated and analysed in this project.

Q28. Safeguarding

Projects funded through Darwin Plus must fully protect vulnerable people all of the time, wherever they work. In order to provide assurance of this, projects are required to have appropriate safeguarding policies in place.

Please confirm the Lead Partner has the following policies in place and that these can be available on request:

Please upload the lead partner's Safeguarding Policy as a PDF on the certification page.

We have a safeguarding policy, which includes a statement of our commitment to safeguarding and a zero tolerance statement on bullying, harassment and sexual exploitation and abuse	Checked
We have attached a copy of our safeguarding policy to this application (file upload on certification page)	Checked
We keep a detailed register of safeguarding issues raised and how they were dealt with	Checked
We have clear investigation and disciplinary procedures to use when allegations and complaints are made, and have clear processes in place for when a disclosure is made	Checked
We share our safeguarding policy with all partners	Checked
We have a whistle-blowing policy which protects whistle blowers from reprisals and includes clear processes for dealing with concerns raised	Checked
We have a Code of Conduct for staff and volunteers that sets out clear expectations of behaviours - inside and outside the work place - and make clear what will happen in the event of non-compliance or breach of these standards	Checked

Please outline how you will implement your safeguarding policies in practice and ensure that all partners apply the same standards as the Lead Partner.

UKRI (of which BAS is a component) has detailed policy and guidance on Safeguarding in International Development Research. This guidance will be shared with all partners at the outset of the project and will be included as an Agenda item in monthly meetings so that any issues can be raised.

For fieldwork carried out by project partners in Brazil, we have secured copies of their Code of Conduct policies. Project partners Tardin and Camargo have also agreed to implement the project safeguarding policy (see UKRI policy attached to this application) and share with all members of the field team for their signature at the start of fieldwork.

Q29. Ethics

Outline your approach to meeting the key ethical principles, as outlined in the guidance. Additionally, are there any human rights and/or international humanitarian law risks in relation to your project? If there are, have you carried out an assessment of the impact of those risks, and of measures that may be taken in order to mitigate them? Any risk assessment and mitigation of human rights and/or international humanitarian law risks should be included in the Question 18 on Risk Management.

Our project aims to measure krill-consumption using an innovative, non-invasive approach, minimising disturbance to whales. Previously such data could only be obtained by analysing stomach contents. New technologies now make it possible to measure consumption rates in a way that does not compromise animal welfare.

During project delivery we will adhere to the BAS Research Ethics policy and its associated principles (https://www.bas.ac.uk/about/about-bas/our-organisation/our-policies/ethics-policy/). The Territory Government will be consulted throughout the project implementation and are included as a Project Partner to ensure project benefits are shared with the Territory.

Recognising the long-term local marine knowledge held by those who patrol the Territory (the Fisheries Patrol Vessel) we propose to upskill two mariners to train as professional UAV pilots, enabling them to participate in science projects and combined their local knowledge with this expertise. All contributors to project outcomes, scientists or support staff, will be co-authors on reports and outputs they have contributed to.

The Health and Safety (H&S) of project staff is of paramount importance. BAS plays a leading role conducting research in the Antarctic and maintains a good track record of supporting all personnel conducting field research with BAS, as well as the supporting staff on our Antarctic bases (in this case King Edward Point base). All work conducted in the Territory also undergoes lengthy review both within BAS and by the GSGSSI to ensure that any H&S concerns are considered and mitigated. Safety procedures are also implemented and closely monitored during planned fieldwork in Brazil, using skilled boat pilots.

Section 13 - Project Staff

Q30. Project staff

Please identify the core staff (identified in the budget), their role and what % of their time they will be working on the project.

Please provide 1-page CVs or job description, further information on who is considered core staff can be found in the Finance Guidance.

Name (First name, Surname)	Role	% time on project	1 page CV or job description attached?
Jennifer Jackson	**Project Leader**	10	Checked
Stephanie Martin	Project Coordinator	20	Checked
Vicky Warwick-Evans	Integrating data layers into CCAMLR krill risk assessment	17	Checked
Martin Collins	CCAMLR guidance and fieldwork implementation	3	Checked

Do you require more fields?

⦿ Yes

Name (First name, Surname)	Role	% time on project	1 page CV or job description attached?
Amy Kennedy	Satellite tagging and habitat use analysis	14	Checked
Fredrik Christiansen	UAV fieldwork and SG body mass analysis	16	Checked
Rodrigo Tardin	UAV fieldwork in Brazil	5	Checked
Eduardo Camargo	UAV fieldwork in Brazil	5	Checked
Ari Friedlaender	Advising on dive rates and consumption rate analysis	4	Checked
Alex Zerbini	Satellite tracking and habitat use advice	4	Checked
Emma Carroll	Advising on epigenetic analysis	3	Checked
Joanna Kershaw	Hormone analysis to identify pregnant whales	3	Checked

Please provide 1 page CVs (or job description if yet to be recruited) for the project staff listed above as a combined PDF.

Ensure the file is named clearly, consistent with the named individual and role above.

Forecol_allCVs
16/10/2022
15:40:46
pdf 1.73 MB

Have you attached all project staff CVs?

Yes

Section 14 - Project Partners

Q31. Project partners

Please list all the Project Partners (including the Lead Partner – i.e. the partner who will administer the grant and coordinate the delivery of the project), clearly setting out their roles and responsibilities in the project including the extent of their engagement so far and planned.

This section should demonstrate the capability and capacity of the Project Partners to successfully deliver the project. Please provide Letters of Support for all project partners or explain why this has not been included.

The partners listed here should correspond to the Delivery Chain Risk Map (within the Risk Register template) which you will be asked to submit if your project is recommended for funding.

Lead partner name:	British Antarctic Survey

Is the Lead Partner based in a UKOT where the project is working?	⦿ No
Please explain why this project is led from outside the UKOT	The territory is not permanently inhabited.
Website address:	www.bas.ac.uk
Details (including roles and responsibilities and capacity to engage with the project):	British Antarctic Survey (BAS) is a component of the Natural Environment Research Council (NERC). NERC is part of UK Research and Innovation www.ukri.org. BAS delivers and enables world-leading interdisciplinary research in the Polar Regions. Its skilled science and support staff based in Cambridge, South Georgia, Antarctica and the Arctic, work together to deliver research that uses the Polar Regions to advance our understanding of Earth as a sustainable planet. Through its extensive logistic capability and experience BAS facilitates access for the British and international science community to the UK polar research operation. BAS will be responsible for overall project management and lead on scientific aspects of the project. BAS will field an experienced team including Project Lead Jen Jackson (Antarctic biologist, previous lead on two South Georgia cetacean projects) and Project Partners Vicky Warwick Evans (spatial ecologist, lead on delivering the Area 48.3 Krill Risk Assessment) and Martin Collins (marine ecologist and ex-GSGSSI CEO). BAS will appoint a Project Coordinator Stephanie Martin (former Antarctic Expedition Leader and whale biologist) to oversee project and fieldwork delivery.
Allocated budget (proportion or value):	[redacted]
Representation on the Project Board (or other management structure)	⦿ Yes
Have you included a Letter of Support from this organisation?	⦿ Yes
Have you provided a cover letter to address your Stage 1 feedback?	⦿ Yes

Do you have partners involved in the Project?

⦿ Yes

1. Partner Name:	Government of South Georgia & the South Sandwich Islands
Website address:	www.gov.gs

Details (including roles and responsibilities and capacity to engage with the project):	The Government of South Georgia & South Sandwich Islands (GSGSSI) are based in Stanley, Falkland Islands, where they report to the Commissioner (who is also the Governor of the Falklands). GSGSSI has a small team mostly based in Stanley, but with some staff working remotely from the UK. GSGSSI are responsible for the management of the Territory. Through project partner Sue Gregory (GSGSSI Marine Environment & Fisheries Manager) we will feed back to GSGSSI at each stage of the project and receive advice on how best to deliver results into the krill risk assessment and GSGSSI MPA management.
Allocated budget (proportion or value):	[redacted]
Representation on the Project Board (or other management structure)	⦿ Yes
Have you included a Letter of Support from this organisation?	⦿ Yes

2. Partner Name:	Aarhus University
Website address:	https://international.au.dk/
Details (including roles and responsibilities and capacity to engage with the project):	Fredrik Christiansen at Aarhus University is a leader in the emerging field of using UAV photogrammetry to quantify marine mammal body volume and condition. He has multiple previous publications on this topic demonstrating the use of this approach in other areas of the world and been leading fieldwork in this domain for over 8 years. Christiansen will be the lead UAV pilot conducting humpback whale fieldwork in Brazil (Abrolhos Bank and Cabo Frio) and SG to measure body condition trends across the feeding season and during migration. He will use these data to measure trends in body mass in SG whales across the feeding season.
Allocated budget (proportion or value):	[redacted]
Representation on the Project Board (or other management structure)	⦿ Yes
Have you included a Letter of Support from this organisation?	⦿ Yes

3. Partner Name:	University of California Santa Cruz (UCSC)
Website address:	https://btbel.pbsci.ucsc.edu

Details (including roles and responsibilities and capacity to engage with the project):	Ari Friedlaender at the UCSC is an expert on cetacean biologging and behavioural ecology with 20 years of experience studying the foraging behaviour and habitat use of Antarctic cetaceans. His lab have used trends in UAV-based body measurements and dive rates of cetaceans as a proxy for krill consumption rates in the Western Antarctic Peninsula (WAP). Friedlaender will collaborate on a comparison between SG and WAP feeding ground trends in krill consumption rates and advise on interpretation of results.
Allocated budget (proportion or value):	[redacted]
Representation on the Project Board (or other management structure)	⦿ Yes
Have you included a Letter of Support from this organisation?	⦿ Yes

4. Partner Name:	Federal University of Rio de Janeiro (UFRJ)
Website address:	https://ufrj.br/en/
Details (including roles and responsibilities and capacity to engage with the project):	Rodrigo Tardin of UFRJ is an expert in cetacean ecology with over 15 years of experience conducting fieldwork on cetaceans in Brazil. Tardin will organise UAV fieldwork on the humpback whale northbound migration, Cabo Frio, Brazil and participate in the analysis of migratory changes in humpback whale body condition.
Allocated budget (proportion or value):	[redacted]
Representation on the Project Board (or other management structure)	⦿ Yes
Have you included a Letter of Support from this organisation?	⦿ Yes

5. Partner Name:	Instituto Baleia Jubarte
Website address:	https://www.baleiajubarte.org.br/

Details (including roles and responsibilities and capacity to engage with the project):	Eduardo Camargo is the Executive Director of Instituto Baleia Jubarte, a NGO based in Brazil founded in 1996 which aims to protect the recovering population of humpback whales in Brazil. The Institute works in research, education and conservation policies. Camargo will organise UAV fieldwork on the humpback whale southbound migration at Abrolhos Bank, Brazil and participate in the analysis of migratory changes in humpback whale body condition.
Allocated budget (proportion or value):	[redacted]
Representation on the Project Board (or other management structure)	⦿ Yes
Have you included a Letter of Support from this organisation?	⦿ Yes

6. Partner Name:	South Georgia Heritage Trust / Friends of South Georgia Island
Website address:	http://www.sght.org and http://www.fosgi.org/
Details (including roles and responsibilities and capacity to engage with the project):	The South Georgia Heritage Trust (SGHT) was established in 2005, and Friends of South Georgia Island (FOSGI) was created in 2011 to raise funds to collaborate on projects with South Georgia Heritage Trust and conserve the biodiversity of the sub-Antarctic Island of South Georgia. One of the main goals of the charities is to help efforts to conserve and protect those species of indigenous fauna and flora that breed and grow on South Georgia or in the surrounding seas and to raise awareness of South Georgia's threatened species. As part of this project, FOSGI/SGHT are providing £[redacted] of matched funding spread over the first two years of the project (2023/24 and 2024/25). FOSGI Board Member and Woods Hole Oceanographic Institution scientist Michael Moore will attend virtual project meetings on behalf of FOSGI, provide advice on project implementation and communicate project news back to FOSGI and SGHT.
Allocated budget (proportion or value):	[redacted]
Representation on the Project Board (or other management structure)	⦿ Yes
Have you included a Letter of Support from this organisation?	⦿ Yes

If you require more space to enter details regarding Partners involved in the project, please use the text field below.

All Partners represented on project board, Letters of Support attached.

University of Aberdeen (https://www.abdn.ac.uk/people/joanna.kershaw)

Joanna Kershaw (University of Aberdeen) is an expert in cetacean health and physiology including measuring physiological stress markers and pregnancy status in free-ranging whales. Kershaw will assess pregnancy status of all whales genetically identified as female.
Budget: [redacted]

Instituto Aqualie (https://cicoes.uw.edu/research/principal-investigators/alex-zerbini/)
Alex Zerbini is Science Director at Instituto Aqualie and senior research scientist at the University of Washington. He has >20 years of experience deploying satellite tags on humpback whales and measuring habitat use and behaviour with tracking data. He is also current Chair of the IWC Scientific Committee so well placed to communicate project results within the IWC. Zerbini will advise on deployment of satellite tags, analysis of whale dive-rates and habitat use.
Budget: [redacted]

University of Auckland Waipapa Taumata Rau (https://profiles.auckland.ac.nz/e-carroll)
Emma Carroll (University of Auckland) is a leader in cetacean genetics, combining genetic approaches with non-genetic tools including stable isotopes, population demography and epigenetics (measuring animal age). She is leading a project calibrating epigenetic ageing measurements for southern right whales. Carroll will advise on the genetic and ageing work conducted on the humpback whales as well as subsequent demographic analysis.
Budget: [redacted]

Please provide a cover letter responding to feedback received at Stage 1 if applicable and a combined PDF of all letters of support.

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Section 15 - Lead Partner Capability and Capacity

Q32. Lead Partner Capability and Capacity

Has your organisation been awarded Darwin Plus, Darwin Initiative or Illegal Wildlife Trade Challenge Fund funding before (for the purposes of this question, being a partner does not count)?

◉ Yes

If yes, please provide details of the most recent awards (up to 6 examples).

Reference No	Project Leader	Title
DPLUS179	Liszka	Characterising pelagic biodiversity at South Georgia through novel sampling methods
DPLUS166	Hollyman	Improving identification of fish bycatch in the Antarctic krill fishery
DPLUS149	Collins	Resolving ecosystem effects of the South Georgia winter krill fishery
DPLUS132	Fretwell	Monitoring albatrosses using very high resolution satellites and citizen science
DPLUS120	Warwick-Evans	Spatial segregation and bycatch risk of seabirds at South Georgia
DPLUS109	Hollyman	Initiating monitoring support for the SGSSI-MPA Research and Monitoring Plan

Have you provided the requested signed audited/independently examined accounts?

If yes, please upload these on the certification page. Note that this is not required from Government Agencies.

⦿ Yes

Section 16 - Certification

Certification

On behalf of the

Company

of

British Antarctic Survey, a constituent part of the Natural Environment Research Council and UKRI

I apply for a grant of

[redacted]

I certify that, to the best of our knowledge and belief, the statements made by us in this application are true and the information provided is correct. I am aware that this application form will form the basis of the project schedule should this application be successful.

(This form should be signed by an individual authorised by the applicant institution to submit applications and sign contracts on their behalf.)

- **I have enclosed CVs for project key project personnel, a cover letter, letters of support, a budget, logframe, Safeguarding Policy and project implementation timetable.**
- **Our last two sets of signed audited/independently verified accounts and annual report are also enclosed.**

Checked

Name	Margaret Clark
Position in the organisation	Head of Finance
Signature (please upload e-signature)	Clark_sig 17/10/2022 17:11:29 jpg 9.37 KB
Date	17 October 2022

Please attach the requested signed audited/independently examined accounts.

UKRI-190822-AnnualReportAccounts2021To2022
16/10/2022
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pdf 958.13 KB

UKRI-200721-AnnualReport2020-2021
16/10/2022
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Section 17 - Submission Checklist

Checklist for submission

	Check
I have read the Guidance, including the "Darwin Plus Guidance**", "**Monitoring Evaluation and Learning Guidance**", "**Risk Guidance**" and "**Financial Guidance**".**	Checked
I have read, and can meet, the current Terms and Conditions **for this fund.**	Checked
I have provided actual start and end dates for the project.	Checked
I have provided my budget based on UK government financial years i.e. 1 April – 31 March and in GBP.	Checked
I have checked that our budget is complete, correctly adds up and I have included the correct final total at the start of the application.	Checked
The application been signed by a suitably authorised individual (clear electronic or scanned signatures are acceptable).	Checked
I have attached my completed logframe and timeline as a PDF using the templates provided.	Checked
I have included a 1 page CV or job description for all the Project Staff identified at Question 30, including the Project Leader, or provided an explanation of why not.	Checked
I have included a letter of support from the lead partner and main partner organisation(s), including relevant OT Governments, identified at Question 31, or an explanation of why not.	Checked
I have included a cover letter from the Lead Partner, outlining how any feedback received at Stage 1 has been addressed where relevant.	Checked
I have included a copy of the Lead Partner's safeguarding policy, which covers the criteria listed in Question 28.	Checked
I have included a signed copy of the last 2 annual report and accounts for the Lead Partner, or provided an explanation if not.	Checked
I have checked the Darwin Plus website **immediately prior to submission to ensure there are no late updates.**	Checked
I have read and understood the Privacy Notice on the Darwin Plus website.	Checked

We would like to keep in touch!

Please check this box if you would be happy for the lead applicant (Flexi-Grant Account Holder) and project leader (if different) to be added to our mailing list. Through our mailing list we share updates on upcoming and current application rounds under the Darwin Initiative and our sister grant scheme, the IWT Challenge Fund. We also provide occasional updates on other UK Government activities related to biodiversity conservation and share our quarterly project newsletter. You are free to unsubscribe at any time.

Checked

Data protection and use of personal data

Information supplied in the application form, including personal data, will be used by Defra as set out in the **Privacy Notice**, available from the Forms and Guidance Portal.

This **Privacy Notice must be provided to all individuals** whose personal data is supplied in the application form. Some information may be used when publicising the Darwin Initiative including project details (usually title, lead partner, project leader, location, and total grant value).

Project Title: **Hungry humpbacks: measuring seasonal foraging intensity at South Georgia**

	Activity	No. of months	Year 1 (23/24)				Year 2 (24/25)				Year 3 (25/26)			
			Q1	Q2	Q3	Q1	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Output 1	Trends in humpback whale body condition across the feeding season for adults, mothers, calves and juveniles	27												
1.1	UAV-based survey of body condition of humpback whales on southbound migration at Abrolhos Bank, Brazil (October 2023)	1												
1.2	UAV-based survey of humpback whale body condition carried out at King Edward Point, SG (December - March 2024)	4												
1.3	Biopsy samples collected during boat-based surveys (to measure whale age, sex and pregnancy status); shipped to UK	5												
1.4	UAV based survey of humpback whale body condition carried out at Cabo Frio, Brazil (June 2024)	1												
1.5	Humpback whale UAV body condition dataset stratified by sex, age (BAS Cambridge) and pregnancy status (University of Aberdeen)	6												
1.6	Humpback whale demography at South Georgia described by combining UAV and demography data	1												
1.7	Trend in body condition summarised for each demographic group (mother-calf pairs, juveniles, adults, sex where available)	1												
1.8	South Georgia feeding ground body condition trend compared with trend in the Antarctic Peninsula	1												
Output 2	Trend in humpback whale diving rates across the feeding season for humpback whales	5												
2.1	Eight humpback whales instrumented with SPLASH satellite tags at King Edward Point, South Georgia	2												
2.2	Diving rates per individual combined to identify any trend in foraging rates	2												
2.3	South Georgia feeding ground dive rates compared with trend in the Antarctic Peninsula	1												
Output 3	Season-specific krill consumption rate used in Subarea 48.3 Krill Risk Assessment	5												

Project Title: **Hungry humpbacks: measuring seasonal foraging intensity at South Georgia**

	Activity	No. of months	Year 1 (23/24)				Year 2 (24/25)				Year 3 (25/26)			
			Q1	Q2	Q3	Q1	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
3.1	Bioenergetic model of multi-season whale feeding at South Georgia developed using temporal information on dive rates and demographically specific body condition changes	3												
3.2	Total krill consumption estimated by combining winter krill consumption rate with inter-seasonal whale abundance data from DPLUS104	2												
Output 4	Spatial habitat use at SG by humpback whales in winter used in Subarea 48.3 Krill Risk Assessment	7												
4.1	Spatial model of winter habitat use developed using current and previous humpback whale satellite tracks in South Georgia waters in winter	3												
4.2	Spatial data integrated into SG krill risk assessment	4												
Output 5	Project Management and Monitoring													
5.1	Dedicated project webpage set up on BAS website, including document section, whale tracking maps and project summary.	0.5												
5.2	Monthly project meetings to track progress	0.25												
5.3	Annual partner and stakeholder meeting	0.1												
5.4	End of project public seminar	0.1												

Project Title: **Hungry humpbacks: measuring seasonal foraging intensity at South Georgia**

Project Summary	SMART Indicators	Means of Verification	Important Assumptions
Impact: Impact of the South Georgia krill fishery on krill-predators is understood and mitigated through direct measurement of season-specific krill consumption rates and habitat-use by the biggest krill predator (humpback whales).			
Outcome: To ensure that the South Georgia krill fishery is managed sustainably, by providing key information on humpback whale demography, foraging rates and krill consumption for the CCAMLR krill risk assessment.	0.1 Humpback whale feeding rates at South Georgia, measured using variation in body condition and mass, and dive rates over the feeding season [July-September 2024]	0.1 Scientific report to the IWC Scientific Committee (Ecosystem modelling working group) and CCAMLR WG-EMM.	
	0.2 Seasonal krill consumption rates used in the CCAMLR krill risk assessment for Subarea 48.3 [April-July 2025]	0.2 Estimates provided to the CCAMLR WG-EMM for the Krill Risk Assessment.	
	0.3 Model of winter habitat use used in CCAMLR krill risk assessment for Subarea 48.3 [July-September 2024]	0.3 Data layer provided to the CCAMLR WG-EMM for the Krill Risk Assessment.	
Outputs: **1**. Trends in humpback whale body condition and mass across the feeding season for adults, mothers, calves and juveniles	1.1 High quality images of approximately 50 humpbacks obtained from UAV-based survey of southbound migration of humpback whales carried out on their breeding ground at Abrolhos Bank, Brazil, [October 2023].	1.1 Field report documenting science activities with field photographs available on BAS project website. Photographs of animals collected on survey will be made available open-access through Data Dryad associated with publication.	1.1-1.3 Interpretation of changes in body condition and mass over time can be difficult where there are no prior data and if SG is a place of temporary habitat use for whales rather than being their summer residence. To aid interpretation of these data, they will be placed in the context of body mass measurements of whales photographed on their Brazilian wintering ground prior to

			(October 2023) and after (June-July 2024) the SG field season, to identify whether SG whales fit the pattern of body mass seen on the wintering ground, or whether they are in poorer condition for example. 1.1-1.3 Weather conditions enable UAV deployment over whales. The UAV being used (DJI Inspire 2) is able to fly in a range of weather conditions. In Brazil, costs and sample estimates assume that up to 50% of field days are too poor to collect data. In SG, costs factor that 66% of days are too poor to collect data, which is conservative. Operating from land gives the UAV pilot capacity to overfly Cumberland Bay without requiring station support. Sending multiple UAV pilots into the field also means more flying capacity, for example if one pilot is working from the boats and the other is on land. 1.1-1.3 Equipment loss or failure will be mitigated by bringing two UAVs into the field in order to provide redundancy.
	1.2 Images of around 100 humpback whales obtained and catalogued from UAV-based survey of humpback whales carried out near Cumberland Bay, South Georgia	1.2 Field report documenting science activities with field photographs available on BAS project website and GSGSSI Data Portal. Photographs of animals	1.2 South Georgia shows interannual variability in terms of the numbers of whales that visit, and the breeding success of krill predators. Bad years with low sighting numbers occur

	from December to March 2024 (estimate ~100 high quality images) with two UAV pilots.	collected on survey will be made available open-access through Data Dryad associated with output publication and archived in the open-access BAS Polar Data Centre.	roughly every 4/5 years (the last in 2020/21). If the season 2023/24 shows early indications to be a bad year (based on 2023 winter krill catches, breeding success of land-based krill predators), we will endeavour to reschedule field plans to the following year 2024/25.
	1.3 50 humpback whale biopsy samples collected at King Edward Point and analysed for demographic information on humpback population (sex, age and pregnancy status)	1.3 Results of genetic analysis provided in report to the IWC Scientific Committee, May 2025. Report is open-access at www.iwc.int and will also be linked through BAS project website.	
	1.4 High quality images of approximately 50 humpbacks obtained from UAV- survey of northbound migration of humpback whales carried out at Cabo Frio, Brazil [June/July 2024]. .	1.4 Field report documenting science activities with field photographs available on BAS project website. Photographs of animals collected on survey will be made available open-access through Data Dryad associated with publication.	See 1.1 above.
	1.5 Humpback whale body condition and mass dataset stratified by sex, age and pregnancy status, using UAV images associated with biopsy samples [July-Dec 2024].	1.5 Report to the IWC Scientific Committee, May 2025. Report is open-access at www.iwc.int and will also be linked through BAS project website.	1.5 Whale feeding rates can be linked to demography via concurrent collection of sex/age information via biopsy. When multiple whales are present, it can be challenging to link a biopsy to a UAV-identified whale in the field, requiring close observation and conference between pilot and sampler. This risk will be mitigated as far as possible by using experienced UAV pilots and biopsy samplers (who are familiar with discriminating individual whales),

			and close communication between UAV pilot and biopsy sampler. 1.5 Use of a land-based UAV means images will be collected from a number of whales where associated biopsy information is not available. Quantitative measures of whale size will allow discrimination of adults from juveniles (using 11.2m as a size threshold based on whaling data). With images alone, adult, juvenile and mother/calf changes in body mass can be measured, as these stages are clearly identifiable without biopsy.
	1.6 Humpback whale demography at South Georgia (population composition in terms of adults, juveniles, mothers and calves) described using biopsy and UAV data combined [July-Dec 2024].	1.6 Report to the IWC Scientific Committee, May 2025. Report is open-access at www.iwc.int and will also be linked through BAS project website.	1.6 Biopsy samples in a single season may be insufficient to precisely measure the proportions of pregnant females using SG waters, or to get an accurate measure of the demographic (age-specific) composition of the population with epigenetics. However, this biopsy data will be supplemented by conducting sex, reproductive status and epigenetic age analysis on 30 previously collected biopsy samples of humpback whales from the 2018/19 and 2019/20 DPLUS057 surveys to increase sample sizes. This work will be done during Jan-June 2024 so that it is ready to be combined with project data according to the activity timeframe.

	1.7 Trend in body condition across the South Georgia feeding season summarised for each demographic group (mother-calf pairs, juveniles, adults, sex where available) [April-June 2024]	1.7 Summary of data (1.1-1.5) and trend in body condition reported in paper to the IWC Scientific Committee (Environmental sub-committee) in May 2025. Report is open-access at www.iwc.int and will also be linked through BAS project website.	1.7 This project assumes there will be sufficient UAV images to calculate temporal trends in body condition by demographic group. Some of these dependencies will be dealt with by the mitigations described above. We also note that even with less images than the numbers anticipated, the comparison with the Antarctic Peninsula (Bierlich et al. in press) and with other sites where humpback body condition changes have previously been investigated (Christiansen et al., 2016; Christiansen et al., 2020; Bierlich In press) should allow us to reject or support the null hypothesis of constant versus varying feeding rates over the feeding season. Secondly, since there is prior data on body condition changes in humpback whales from other sites (Christiansen et al., 2020) even small sample sizes collected here can be fitted within the previously composed body condition models in order to measure whether body condition is changing over time even for small sample sizes.
	1.8 South Georgia feeding ground body condition trend compared with trend in the Antarctic Peninsula [July-Dec 2024].	1.8 Comparison between South Georgia and western Antarctic Peninsula reported in paper to the IWC Scientific Committee (May 2025). Report is open-access at	

		www.iwc.int and will also be linked through BAS project website.	
2. Trend in humpback whale diving rates across the feeding season	2.1 Eight humpback whales satellite tagged with SPLASH tags at King Edward Point, South Georgia [Feb-March 2024]	2.1 Field report documenting science activities with field photographs available on BAS project website. Second BAS webpage will be updated to show movements of tracked whales in real-time (e.g. https://www.bas.ac.uk/project/south-georgia-right-whale-project/south-georgia-right-whale-project-whale-tracking/).	2.1 Poor weather conditions and often solo whale feeding activity at SG means satellite tagging can be difficult, however the extended field season will increase the chance of success and we are building on two seasons of experience tagging these whales now. To maximise the opportunity we have costed for a dedicated boatman in South Georgia so that the team is able to use all good weather windows (i.e. requiring less support from staff on base).
	2.2 Diving rates per individual combined to identify any trend in foraging rates [July – Sept 2024].	2.2 Scientific report to the IWC Scientific Committee (Ecosystem modelling working group) in May 2025. Report is open-access at www.iwc.int and will also be linked through BAS project website.	
	2.3 South Georgia feeding ground dive rates compared with trend in the Antarctic Peninsula [Oct 2024-Feb 2025].	2.3 Scientific report to the IWC Scientific Committee (Ecosystem modelling working group) in May 2025 and scientific publication. Report is open-access at www.iwc.int and will also be linked through BAS project website.	
3. Season-specific krill consumption rates used in CCAMLR Sub-Area 48.3 Krill Risk Assessment	3.1 Bioenergetic model of multi-season whale feeding at South Georgia developed using temporal information on dive rates and demographically-specific body	3.1 Scientific report to the IWC Scientific Committee (Ecosystem modelling working group) and CCAMLR WG-EMM in 2026. Report is open-access at	3.1 There is insufficient variation in whale consumption rates across the season to update previous estimates. This outcome is also useful, because it suggests that whales at SG are

	condition and mass changes, predicting summer and winter daily krill consumption by humpback whales (stratified by demographic group) [April-July 2025]	www.iwc.int and will also be linked through BAS project website.	maintaining high summer foraging rates into the winter
	3.2 Total krill consumption estimated by humpback whales across the feeding season, partitioned by season [July-August 2025]	3.2 Estimates provided to the CCAMLR Working Group on Ecosystem Monitoring and Management for the Krill Risk Assessment. The data will be summarised in a report to CCAMLR WG-EMM which will be accessible via the BAS project website (September 2025).	3.2 Assumes that body mass changes can be used to accurately measure consumption rate. Similar bioenergetic calculations have been done successfully in the past for other whale species using morphometric measurements from whaling records (e.g. Lockyer 1981). We will collect similar morphometric measurements non-invasively with UAVs. To further account for the assumptions in the methods (Activities 1.8.1-1.8.5), uncertainty in parameter estimates will be incorporated into the final prey consumption estimates using resampling methods, where each value (morphometric measurement and bioenergetic model parameters) is varied within its 95% confidence interval (Christiansen et al., 2018; Christiansen et al., 2022a), so that we obtain a range of possible prey consumption rates for humpback whales. 3.2 To account for uncertainty in the demographic composition and feeding season length in humpback whales, this model can incorporate

			variation in the length of the feeding season in SG and the size (body length and mass) distribution of whales (based on UAV measurements) into the model, to calculate realistic estimates of total prey consumption by humpback whales in SG.
4. Spatial habitat use at SG by humpback whales in winter used in CCAMLR Sub-Area 48.3 Krill Risk Assessment	4.1 Spatial model of multi-season habitat use developed using current and previous humpback whale satellite tracks in South Georgia waters [July-September 2024].	4.1 Spatial model provided as a 2025 paper to the CCAMLR WG-EMM for the Krill Risk Assessment. The data will be summarised in a report to CCAMLR WG-EMM which will be accessible via the BAS project website (September 2025).	4.1 Satellite tags do not transmit long enough to include the winter period, or whales migrate north before the winter season. To mitigate, satellite tagging is being carried out in late summer (Feb-March) to reduce the risk that transmission stops before winter. Some satellite data to inform this model is already available from previous satellite tagging projects (Bamford et al., 2022)
5. Project Management and Monitoring	5.1 Dedicated project webpage set up on BAS website, including document section, whale tracking maps and project summary.	5.1 BAS Project webpage available to view online.	
	5.2 Monthly project meetings scheduled in order to keep work on track and communicate any issues.	5.2 Minutes of project meetings appended to Darwin Plus reports.	5.2 Not all members may be able to attend due to time zone differences (e.g. UK, Denmark, west coast USA, Brazil, Falkland Isl, New Zealand). Monthly meetings will be held at a different time every 2 months to enable full participation. Minutes will also be shared with all members.
	5.3 Annual partner and stakeholder virtual meeting scheduled in June 2023, 2024 and 2025 in order to	5.3 Meeting minutes available on BAS project webpage. Parts of the	5.3 Not all members may be able to attend. A recording will be shared with those who can't attend and

	communicate findings and get feedback.	webinar will be recorded and shared on the BAS project webpage.	minutes shared with all members and stakeholders.
	5.4 Virtual end of project public seminar and workshop organised to disseminate findings to the general public, partners and stakeholders (September 2025)	5.4 Workshop will be recorded and linked via BAS project webpage. Attendance and views will be recorded. Final project report will be published on BAS project webpage and provided to GSGSSI Data portal.	

Activities (each activity is numbered according to the output that it will contribute towards, for example 1.1, 1.2 and 1.3 are contributing to Output 1. Each activity should start on a new line and be no more than approximately 25 words.)

1.1.1 UAV equipment purchased [April-June 2023]
1.1.2 Boat hire secured for Abrolhos Bank (Brazil) fieldwork [June 2023]
1.1.3 Travel and accommodation organised for fieldwork participants in Abrolhos Bank [August 2023]
1.1.4 UAV surveys in Abrolhos Bank take place October 2023 and collect a minimum of 50 overhead images of humpback whales [October 2023]
1.1.5 Field report made and sent to BAS for upload on project website [November 2023]
1.2.1 King Edward Point field equipment purchased for Outputs 1 and 2 [April-June 2023]
1.2.2 Animal ethics forms, risk assessments, South Georgia science permits and UAV flight permits applied for and secured [September 2023]
1.2.3 Medicals, sea survival training, any other training requirements conducted by field team [September-October 2023]
1.2.4 Shipment of field equipment to King Edward Point, South Georgia [October 2023]
1.2.5 Flight and vessel itineraries finalised for field team [October 2023]
1.2.6 Two UAV pilots travel to South Georgia [end November 2023]
1.2.7 Two months of land based surveys of humpback whales conducted from King Edward Point station. Opportunistic surveys from local vessels also carried out where practical [December 2023-January 2024]
1.2.8 At least 100 calibrated overhead images of humpback whales collected (minimum estimates 50 from land, 50 from sea)
1.2.9 Images will be processed (to measure volume and mass) while in the field where possible [December 2023-March 2024]
1.2.10 One UAV pilot leaves and new UAV pilot arrives to continue season [end January 2024]

1.2.11	Second part of field season includes other whale work from KEP powerboats (see Output 2.1). UAVs will be deployed from King Edward Point and from powerboats during whale surveys [February-March 2024]
1.3.1	Team biopsy sample up to 50 humpback whales, opportunistically biopsy sample any other cetaceans encountered (up to 50 samples), and collect photo-ID from all encounters [February-March 2024]
1.3.2	Field team leave South Georgia [end March/start April 2024]
1.3.3	Field report finalised and uploaded on BAS project website [May 2024]
1.3.4	Biological samples (biopsy samples) shipped from South Georgia to UK via BAS shipping [June 2024]
1.4.1	Boat hire secured for Cabo Frio (Brazil) fieldwork [April 2024]
1.4.2	Travel and accommodation organised for fieldwork participants in Cabo Frio [April 2024]
1.4.3	UAV surveys in Cabo Frio take place and collect a minimum of 50 overhead images of humpback whales [~June 2024]
1.4.4	Field report finalised and sent to BAS for upload on project website [September 2024]
1.5.1	Genetic identification of whale sex at BAS Cambridge [August 2024]
1.5.2	Whales identified to be female sent to University of Aberdeen for hormone assay to measure pregnancy [September 2024]
1.5.3	Measure whale age using epigenetic methods, for all biopsy-sampled whales at BAS Cambridge [September-October 2024]
1.5.4	Whale image dataset subdivided using information from biopsy samples, generating eight datasets of juveniles and adults (unknown sex), male and female juveniles, male adults, pregnant and non-pregnant female adults, and mother-calf pairs [July-December 2024].
1.5.5	Dataset is summarised in an open-access report (Report A) presented to the IWC Scientific Committee [May 2025], also available via the BAS project website.
1.6.1	All biopsy data (~30 samples previously collected, combined with ~50 collected during this project, see Activity 2.1.5) are used to estimate the demographic composition of humpback whales feeding at South Georgia (i.e. the proportion of adults, juveniles, males and females, and pregnancy rate of females), using information on sex, age and pregnancy generated during Activities 1.4.1, 1.4.2 and 1.4.3 [October – December 2024].
1.6.2	Demographic composition of humpback whales feeding at South Georgia described in an open-access report to the IWC Scientific Committee [May 2025], also available via the BAS project website.
1.7.1	Demographically stratified whale image dataset (from Activity 1.4.4) used to measure demographic class-specific trends in body condition across the feeding season for South Georgia humpback whales.
1.7.2	Regression of body condition trends will be used to identify whether foraging rates are constant across the feeding season (null hypothesis) or if they vary/fluctuate significantly, and in what direction.
1.7.3	Body condition trends will be summarised in an open-access report presented to the IWC Scientific Committee [May 2025], also available via the BAS project website.
1.8.1	Body condition trend data will be compared between two sites (South Georgia and Western Antarctic Peninsula) to establish if patterns are concordant (whales feed most intensively in the early period of the feeding season).
1.8.2	The comparison between Antarctic humpback feeding sites will be summarised in an open-access report presented to the IWC Scientific Committee [May 2025], also available via the BAS project website.

2.1.1	Boatman travels to King Edward Point for three month contract. First month is used to familiarise boatman with jet boat driving [January 2024]
2.1.2	BAS tracking webpage is prepared for new whale tracking data (https://www.bas.ac.uk/project/south-georgia-right-whale-project/south-georgia-right-whale-project-whale-tracking/)
2.1.3	Field team of biopsy sampler, satellite tagger and photo-ID specialist travel to King Edward Point (KEP) [end January 2024]
2.1.4	Team work from a Jet boat and a powerboat in extended boating area around KEP, tagging eight humpback whales with SPLASH tags [February-March 2024]
2.1.5	Locations from tracked whales are automatically uploaded to BAS website (Activity 2.1.2)
2.1.6	Field team and KEP boatman leave KEP [April 2024]
2.2.1	Satellite track data combined with data available from previous Brazilian deployments (see Output 2.2) to measure how whale dive rates vary across the humpback whale feeding season [July – Sept 2024]
2.2.2	Analysis reported in a scientific report to the IWC Scientific Committee (Ecosystem modelling working group) [May 2025]
2.3.1	Dive rates analysis compared between South Georgia and western Antarctic Peninsula to identify any differences in foraging behaviour.
2.2.3	Analysis reported in a scientific report to the IWC Scientific Committee (Ecosystem modelling working group) [May 2025] (Output 0.1)
3.1.1	Whale feeding rates will be measured by season (summer, autumn, winter) using the model fits from the regression trends for UAV-based body condition estimates (Activity 1.6) and dive-rate measurements (Activity 2.2) to provide an overall measure of foraging rate variation [Oct-Dec 2024].
3.1.2	Temporal variation in feeding rates will be summarised in a scientific report to the IWC Scientific Committee (Ecosystem modelling working group) and CCAMLR WG-EMM in 2026.
3.2.1	Humpback whale body condition will be converted to body volume and mass estimates (Christiansen et al., 2019; Christiansen et al., 2022a) using published estimates of humpback whale body density (Lockyer 1976; Aoki et al., 2021) [Jan – March 2025]
3.2.2	Changes in body mass will be converted to tissue energy content, using previously published estimates of lipid and protein concentrations (Lockyer 1981; Christiansen et al., 2022a), to calculate the energy (fat) deposition of humpback whales in SG. [Jan – March 2025]
3.2.3	To estimate the total energy requirement of humpback whales, the daily cost of body maintenance will be calculated from the body mass data (using metabolic scaling, Kleiber 1975), the cost of somatic growth will be calculated from published length-at-age relationships from whaling data, and added to the energy deposition costs. [Jan – March 2025]
3.2.4	The total energy requirement of humpback whales will be converted to prey consumption rates by incorporating the digestive efficiency and assimilation efficiency of the whales and their prey (Lockyer 1981), and also factoring in the energetic content of Antarctic krill, to obtain an estimate of the biomass of krill consumed per day by a whale of a given size [Jan – March 2025]
3.2.5	Cost of reproduction (gestation) will be factored for a proportion of pregnant females (identified through biopsy sampling, Activity 1.5.1) using foetus length data from humpback whales from the southern hemisphere (n=635), and calculated foetus maintenance costs (heat of gestation), following the approach of Christiansen *et al.,* (2022b). [Jan – March 2025]

3.2.6	Total krill consumption will be measured across all demographic groups using resampling methods to account for uncertainty in the parameter estimates (Activities 1.8.1-1.8.4) [April-May 2025]
3.2.7	A model of krill consumption will be constructed, incorporating variation in the length of the feeding season in SG (identified via satellite tags in Activity 2.1.4) and the demographic composition (Activity 1.5.2) and size distribution of whales (based on UAV measurements, Activity 1.6.1), to calculate realistic estimates of overall prey consumption by humpback whales in SG. [April-May 2025]
3.2.8	Total krill consumption will be summarised in an open-access report presented to the IWC Scientific Committee [May 2025], also available via the BAS project website and on the GSGSSI Data Portal.
3.2.9	Estimates of krill consumption by season (summer, autumn, winter) will be provided to CCAMLR WG-EMM for the Krill Risk Assessment [May 2025] (Output 0.2).
4.1.1	Humpback whale geolocations provided from satellite tag deployments (Activity 2.1.4) and previous satellite tag deployments (Bamford et al., 2022) will be used to identify key areas of whale habitat use in South Georgia waters across the feeding season (summer, autumn, winter) [July-September 2024]
4.1.2	Report on spatial habitat use provided to the CCAMLR WG-EMM for the Krill Risk Assessment [May 2025] (Output 0.3).
5.1.1	Dedicated project webpage set up on BAS website with project description [April 2023]
5.1.2	Whale tracking map embedded into project webpage [May 2023]
5.1.3	Project webpage updated over project period with field reports, images from the field, project reports and minutes of stakeholder meetings.
5.2.1	Monthly meetings scheduled (via an initial Doodle Poll) to keep partners on track with project updates and implementation.
5.2.2	Meeting minutes compiled in shared project folder for Project Partner and Darwin Plus review.
5.3.1	Partner and stakeholder virtual meeting organised in June of each year.
5.3.2	Meeting minutes are uploaded to the BAS project webpage. Any actions arising are chased forward via activity 5.2.1.
5.4.1	Public seminar promoted on social media ahead of final workshop [August 2025]
5.4.2	Hold a 3 day virtual workshop in September 2025. Day 1 will be a publicly accessible seminar with a series of talks by project partners, and the second two days the stakeholders and project partners will review findings for the krill risk assessment, and identify recommendations for future work [September 2025]
5.4.3	Final project report compiled from workshop, summarising findings and including future actions and recommendations. Accessible on BAS project webpage and submitted to the GSGSSI Data portal.

REFERENCES

Aoki K., Isojunno S., Bellot C., Iwata T., Kershaw J., Akiyama Y., Martín López L. M., Ramp C., Biuw M., Swift R., et al. (2021). Aerial photogrammetry and tag-derived tissue density reveal patterns of lipid-store body condition of humpback whales on their feeding grounds. *P Roy Soc B-Biol Sci* 288(1943): 20202307. doi: doi:10.1098/rspb.2020.2307

Bamford C. C. G., Jackson J. A., Kennedy A. K., Trathan P. N., Staniland I. J., Andriolo A., Bedriñana-Romano L., Carroll E. L., Martin S., MacDonald D., et al. (2022). Humpback whale (*Megaptera novaeangliae*) distribution and movements in the vicinity of South Georgia and the South Sandwich Islands Marine Protected Area. *Deep Sea Res. (II Top. Stud. Oceanogr.)* 198: 105074. doi: 10.1016/j.dsr2.2022.105074

Bierlich K. C. et al., (In press). Seasonal gain in body condition of foraging humpback whales along the Western Antarctic Peninsula. *Front. Mar. Sci.*

Christiansen F., Bejder L., Burnell S., Ward R., Charlton C. (2022a). Estimating the cost of growth in southern right whales from drone photogrammetry data and long-term sighting histories. *Mar. Ecol. Prog. Ser.* 687: 173-194. doi: https://doi.org/10.3354/meps14009

Christiansen F., Dujon A. M., Sprogis K. R., Arnould J. P. Y., Bejder L. (2016). Noninvasive unmanned aerial vehicle provides estimates of the energetic cost of reproduction in humpback whales. *Ecosphere* 7: e01468. doi: 10.1002/ecs2.1468

Christiansen F., Sironi M., Moore M. J., Di Martino M., Ricciardi M., Warick H. A., Irschick D. J., Gutierrez R., Uhart M. M. (2019). Estimating body mass of free-living whales using aerial photogrammetry and 3D volumetrics. *Methods in Ecology and Evolution* 10(12): 2034-2044. doi: https://doi.org/10.1111/2041-210X.13298

Christiansen F., Sprogis K. R., Gross J., Castrillon J., Warick H. A., Leunissen E., Bengtson Nash S. (2020). Variation in outer blubber lipid concentration does not reflect morphological body condition in humpback whales. *J. Exp. Biol.* 223(8). doi: 10.1242/jeb.213769

Christiansen F., Uhart M. M., Bejder L., Clapham P., Ivashchenko Y., Tormosov D., Lewin N., Sironi M. (2022b). Fetal growth, birth size and energetic cost of gestation in southern right whales. *The Journal of Physiology* 600(9): 2245-2266. doi: https://doi.org/10.1113/JP282351

Christiansen F., Vivier F., Charlton C., Ward R., Amerson A., Burnell S., Bejder L. (2018). Maternal body size and condition determine calf growth rates in southern right whales. *Mar. Ecol. Prog. Ser.* 592: 267-281. doi: 10.3354/meps12522

Kleiber M. (1975). Metabolic turnover rate: a physiological meaning of the metabolic rate per unit body weight. *J Theor Biol* 53(1): 199-204. doi: 10.1016/0022-5193(75)90110-1

Lockyer C. (1976). Body weights of some species of large whales. *ICES J. Mar. Sci.* 36(3): 259-273. doi: 10.1093/icesjms/36.3.259

Lockyer C. (1981). Growth and energy budgets of large baleen whales from the Southern Hemisphere. *FAO Fisheries Series No 5 (Mammals in the Seas)*(3): 379-487.