

Darwin Plus Main: Annual Report

To be completed with reference to the “Project Reporting Information Note”
(<https://darwinplus.org.uk/resources/information-notes>)

It is expected that this report will be a **maximum of 20 pages** in length, excluding annexes)

Submission Deadline: 30th April 2024

Submit to: BCF-Reports@niras.com including your project ref in the subject line

Darwin Plus Project Information

Project reference	DPLUS188
Project title	Hungry humpbacks: measuring seasonal foraging intensity at South Georgia
Territory(ies)	South Georgia
Lead Partner	British Antarctic Survey
Project partner(s)	Government of South Georgia and the South Sandwich Islands (GSGSSI), Aarhus University, University of California Santa Cruz (UCSC), Federal University of Rio de Janeiro (UFRJ), and South Georgia Heritage Trust / Friends of South Georgia Island
Darwin Plus grant value	£346,812.00
Start/end dates of project	01 April 2023-30 September 2025
Reporting period (e.g. Apr 2023-Mar 2024) and number (e.g. Annual Report 1, 2)	April 2023-April 2024 Annual Report 1
Project Leader name	Dr. Jennifer [REDACTED]
Project website/blog/social media	https://www.bas.ac.uk/project/hungry-humpbacks/ , Instagram:@hungryhumpbacks TikTok @hungryhumpbacks X(Twitter):@wildwaterwhales
Report author(s) and date	Jennifer [REDACTED]

1. Project summary

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.

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.

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 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), diving rates (using satellite tags) and epigenetically-measured age.



Fig 1. Example aerial images of (A) a humpback whale and (B) a southern right whale, showing the measurement locations.

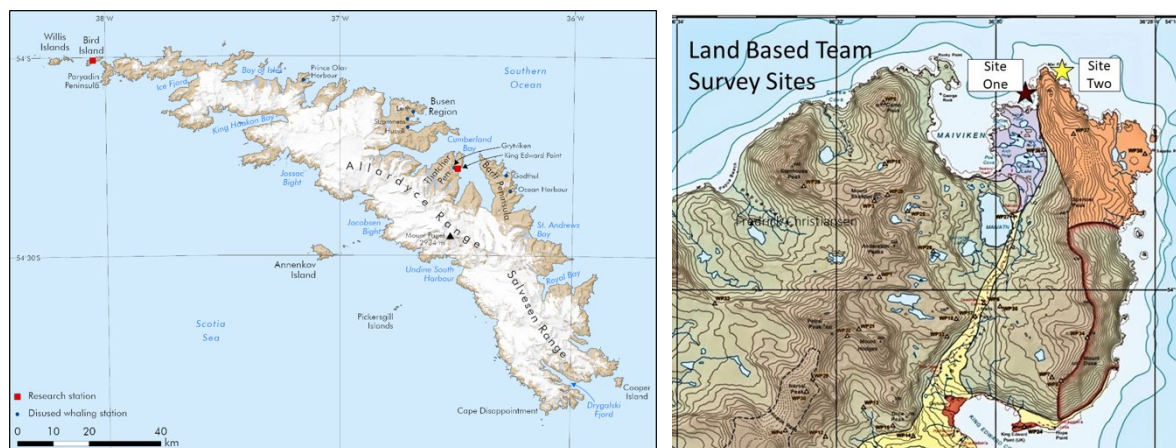


Fig 2. (left) South Georgia showing King Edward Point Research Station; (right) land-based UAV survey sites in west Cumberland Bay

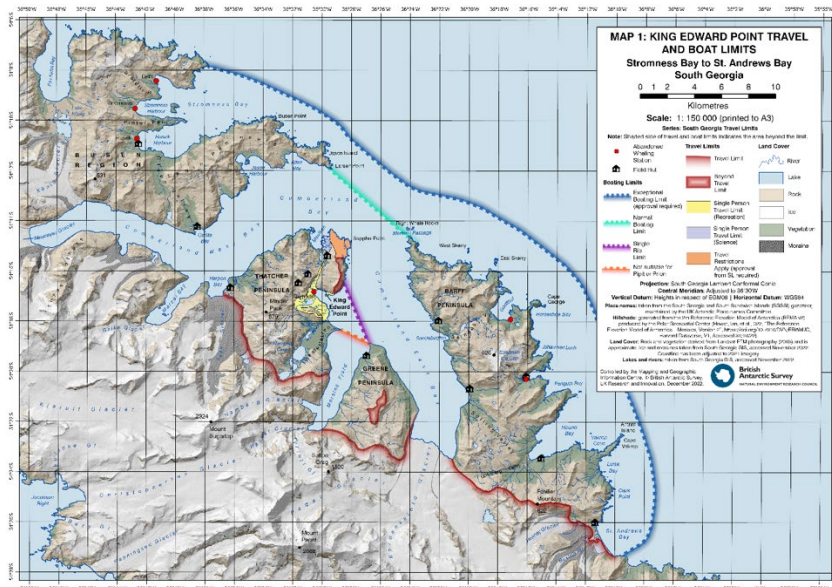


Fig 3. Boat Survey Area from Stromness to St. Andrews out to 5 nautical miles.

2. Project stakeholders/partners

Project partners have been regularly consulted through online meetings and circulated project update reports while the teams have been in the field (see evidence). Project meetings and workshops have taken place as planned. Project stakeholders GSGSSI, South Georgia Heritage Trust, and CCAMLR and IWC scientists have also been regularly updated through Stakeholder meetings and the project update reports and provided feedback on progress. We are happy with how the partnerships have worked this year.

Key stakeholder GSGSSI:

- The project delivered UAV pilot training for two South Georgia mariners for the GSGSSI as planned, and one mariner received additional in-field UAV training from the project UAV pilot.
- During the season, the project also assisted GSGSSI with their bird flu response with the project UAV pilot doing overflights of bird colonies to check for avian flu mortality in birds and seals (<https://gov.gs/hpai-confirmed-in-penguin-populations-on-south-georgia/>).
- The team were key contributors to the GSGSSI's 5 year MPA review scientific discussions and management planning, advising on whale distribution in relation to planned fishery closure areas (<https://gov.gs/mp-enhancements-feb24/>).
- The team worked well with this stakeholder and built a good working relationship which was mutually supportive over the year.

Scientific stakeholders CCAMLR and IWC have been consulted over scientific design of the field project (see Project reports), but have not been involved in outputs at this first stage of the project.

Local stakeholder South Georgia Heritage Trust (and US counterpart Friends of South Georgia Island) provided financial support to the project (<https://x.com/SouthGeorgiaHT/status/1795349390598476277>), included our project story in their outreach on expedition cruise ships, and did weekly updates on our project on their Facebook feed (<https://www.facebook.com/share/U9crbV74RhNeBCwUJ/?mibextid=WC7FNe>). Our project stories are helping them to fundraise for their protection of South Georgia's heritage (<https://sght.org/whale-story-project/>).

3. Project progress

3.1 Progress in carrying out project Activities.

The main activities for 2023/2024 were the planning and execution of two field seasons: the Abrolhos Bank, Brazil fieldwork in October 2023 and the South Georgia fieldwork in the austral summer of 2023-2024.

Output 1: Trends in humpback whale body condition and mass across the feeding season for adults, mothers, calves, and juveniles

Good progress has been made on activities under Output 1. All pre-season activities up to **1.2.6** were completed on time to prepare for the South Georgia field season.

For **Activity 1.1**, Abrolhos Bank, fieldwork was conducted between 20th September and 18th October 2023, with six research cruises surveyed for 819.51 km (442.50 nautical miles) for 100 hours of sampling with 68.35 hours of whale sightings. 126 flights sampled 458 individual whales. A total of 271 individual humpback whales and 81 calves were observed. Drone flight results were for 200 whale measurements, and 34 whale biopsy samples were collected. Analysis of the images for body condition measurements is ongoing.

All photo IDs have been submitted to Project Partner HappyWhale, totaling 99 individuals. The result was that 20 of these whales were sighted in previous seasons, and 70 whales were first sighted in 2023.

For Activity 1.2, the timeline for fieldwork in South Georgia began earlier than originally scheduled as the end of the season's best return transport option was the RRS Sir David Attenborough (SDA) ship's last call in the last week of March. Therefore, the South Georgia fieldwork started earlier to give the best data collection opportunity for land and boat-based work. Land-based work was conducted from mid November 2023 to mid January 2024. Boat-based work was from mid January until late March 2024.

For Activity 1.2.6, 1.2.7 and 1.2.8, the South Georgia land-based two-person UAV team was in the field from 18 November 2023 until 14 January 2024 for 205.5 hours of fieldwork and 110.25 hours of observation. The original field site proved of limited suitability for whale observations, so the team relocated to a more challenging-to-reach location with better access to the bay for UAV deployments. Humpback whales were sighted on four outings, but due to unexpected equipment failure, only one whale was measured for body condition analysis from land. The team added an additional opportunistic five days of survey time on the SGSSI government patrol vessel but, due to rough weather conditions, only attempted to use UAV for body condition measurements once. The UAV flipped during the landing, causing damage. Despite many attempts to repair it, this UAV was unusable for the rest of the season.

For Activity 1.2.10, 1.2.11, 1.3.1 and 1.3.2 the South Georgia boat-based team was in the field from 15 January until 25 March. A total of 2,282.8 km (1232.613 nautical miles) of visual transect data was conducted during 102.5 hours on 17 days. A total of 39 UAV flights were conducted on 10 survey days for 29 humpback whales, three southern right whales (with one calf), four blue whales (with one calf), and ~ 20 killer whales (with several calves).

A total of 16 skin and blubber biopsy samples were collected. For humpback whales, 11 biopsies from 10 individual whales, and 9 of these whales also had drone images for body condition analysis. One blue whale biopsy and two southern right whales were also biopsied with drone images for body condition analysis.

From the boats, 1,597 cetacean images were collected to identify 13 humpback whales, three southern right whales, three Antarctic blue whales, and at least 8 killer whales. The blue whale and killer whale photographs have been shared with regional Antarctic photo-ID catalogues for inter-matching with the existing photo-identified whales. Right whale images will be compared within the existing SGRW catalog and with the catalogs from right whale calving grounds in Argentina, Brazil, and South Africa. Humpback whale fluke images will be submitted to HappyWhale.com for comparison with their global catalog.

Social media posts (Instagram: @hungryhumpbacks; TikTok @hungryhumpbacks;

X (Twitter):@wildwaterwhales) documented field activities. The Instagram account saw increased stakeholder engagement during both field seasons as the audiences for these media grew (see Section 11).

Field reports for the Abrolhos Bank and the South Georgia seasons are included in Annex 4.

Output 2: Trend in humpback whale diving rates across the feeding season

Activities 2.1.1-2.1.6 were all completed on time. For **Activity 2.1.4**, no humpback whales were satellite-tagged. Humpback whales were sighted on seven of the seventeen survey days. When humpbacks were observed, ocean swell was too high to attempt satellite tagging safely. A large, tabular ice field moved into the survey area on 17 February, reducing the field of view for cetacean surveys by 10-25%. No humpback whales were sighted after 22 February. Consequently we will not be able to measure Output 2 (trend in humpback whale diving rates across the feeding season). We are raising funds for a second field season in January-March 2025 in order to collect these data.

One southern right whale was satellite tagged on 9 March and continues to transmit location and dive data (<https://www.bas.ac.uk/project/south-georgia-right-whale-project/south-georgia-right-whale-project-whale-tracking/>). Since this is also a krill feeding species, the pattern of its dive rates can be used to look at rate of krill consumption by right whales at South Georgia, a result of relevance to the CCAMLR krill risk assessment.

Output 3: Season-specific krill consumption rates used in CCAMLR Sub-Area 48.3 Krill Risk Assessment

All the activities for this output are due in the next reporting period.

Output 4: Spatial habitat use at SG by humpback whales in winter used in CCAMLR Sub-Area 48.3 Krill Risk Assessment

All the activities for this output are due in the next reporting period.

Output 5: Project Management and Monitoring

Good progress has been made on **Activities 5.1.1-5.1.3**, with the website created and updated (<https://www.bas.ac.uk/project/hungry-humpbacks/>). The whale tracking page was created and is being shared on social media channels (<https://www.bas.ac.uk/project/south-georgia-right-whale-project/south-georgia-right-whale-project-whale-tracking/>). For **Activity 5.2.1**, Project Partners meetings were not held each month due to time differences, conflicting schedules, and the Project Manager being in the field from January to April 2024. During the first project partner meeting, the group agreed to have the meetings when necessary, resulting in meetings in May and October 2023. Email updates were sent out in July 2023 and April 2024, and the Project Manager was available to answer questions anytime (See all minutes in Annex 4.1). For Activity 5.3.1, the first Stakeholder meeting was held on 5 September 2023 due to conflicts in the schedule for project partners. Video of Stakeholders meeting available at <https://www.youtube.com/watch?v=5Zk2BV78sUk>.

3.2 Progress towards the project Outcome

Output 1: Trends in humpback whale body condition and mass across the feeding season for adults, mothers, calves and juveniles

Progress has been made toward this output, with two of the three field seasons completed.

- Indicator 1.1: 200 UAV images were collected during the Brazil field season, a higher number than originally planned. Biopsy samples were collected from 34 whales that will be compared to UAV images from body condition sampling.
- Indicator 1.2: UAV Images were collected for 30 humpback whales, less than was in the Indicator. An equipment failure of a range extender did not allow the UAV to fly beyond 4 km during land-based surveys. We are seeking funding for a second field season in order to collect additional UAV data in 2025.
- Indicator 1.3: A total number of 11 humpback whale biopsies were collected from 10 individual whales. This was less than planned; the last humpback whale was sighted on 22 February,

and no sightings of humpback whales in March. In addition, biopsy samples were collected from an Antarctic blue whale (*Balaenoptera musculus*) and two southern right whales (*Eubalaena australis*).

Output 2: Trend in humpback whale diving rates across the feeding season

- Indicator 2.1 During the South Georgia field season, the sea state conditions (swells above 1 meter) were unsuitable to safely satellite tag any humpback whales when they were sighted in the boating area. There were two attempts to satellite tag southern right whales, and one SPLASH tag was successfully deployed on 9 March 2024. Locational and dive depth data is still being collected.

Output 3: Season-specific krill consumption rates used in CCAMLR Sub-Area 48.3 Krill Risk Assessment

- These indicators are not part of this reporting period

Output 4: Spatial habitat use at SG by humpback whales in winter used in CCAMLR Sub-Area 48.3 Krill Risk Assessment

- These indicators are not part of this reporting period

Output 5: Project Management and Monitoring

Project documents can be found on the project website here (<https://www.bas.ac.uk/project/hungry-humpbacks/>)

Overall, the failure of Output 2 and lack of sampling in Output 1 during March 2024 means that the overall project outcome cannot be delivered without using supplementary data from other sources, or from a second field season. We are seeking funding for a second field season at South Georgia in Feb-March 2025, to collect humpback whale UAV measurements particularly in late summer (March) and to tag humpback whales to measure diving rates.

3.3 Monitoring of assumptions

Our project depends on a number of critical Output-level assumptions (Annex 2). The analytical stages of the project (Outputs 1-5) depend on successful delivery of the three project field seasons, two of which have now been completed.

Output 1. Trends in humpback whale body condition and mass across the feeding season for adults, mothers, calves and juveniles

Assumption 1 (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.*

This risk remains true, particularly as the South Georgia dataset was limited by poor weather conditions (see Section 3.1).

Assumption 2 (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.*

This risk proved correct. There were particularly poor weather conditions at SG (the largest amount of ice in 20 years in the survey area) which reduced the team's searchable field by >25% and made it difficult to locate whales, particularly for the land-based team and the boat-based team in March.

Assumption 3 (1.1-1.3) *Equipment loss or failure will be mitigated by bringing two UAVs into the field in order to provide redundancy.*

This risk proved correct as one UAV was damaged early in the field season during landing from a boat deployment (see Annex 4.3), and the UAV range extender (additional equipment which extended the UAV flight range) was non functional, requiring return to the company for repair. We did not have redundancy with the range extender and therefore the land-based team were limited to 4 km working from land. A third UAV was brought down by the second UAV pilot and this was also damaged during fieldwork.

Assumption 4 (1.2, 1.4) *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 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*

This risk proved correct. While krill catches and breeding success of krill predators looked relatively normal ahead of time, during the SG season the levels of ice were extremely high. These were not predicted ahead of time, so the project was not rescheduled. However it had the consequence of limiting the UAV data that could be collected (see Assumption 2) and no humpback whales could be tagged during the project period (Assumption 1, Output 2, Annex 4.4).

Assumption 5 (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.*

This risk held true and was mitigated by the experienced field team. Not all UAV-identified whales could be confidently linked to biopsy samples. Of a total of 11 humpback whale biopsy samples (from ten individual humpbacks) nine individuals were also confidently associated to UAV images, Annex 4.4.

Assumption 6 (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.*

A combination of high levels of ice (Assumption 2) and a broken UAV range extender (Assumption 3) limited the capacity of the land team to overfly whales early in the season (Annex 4.3).

Assumption 7 (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.*

This risk holds true. The ten individuals that were biopsy sampled will be combined with a previous dataset of 30 animals to measure population demography and pregnancy rates.

Output 2. Trend in humpback whale diving rates across the feeding season

Assumption 1 (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).

This risk held true. However even with this extra support the team were unable to satellite tag any humpback whales due to heavy ice and poor weather conditions (assumption 2, output 1). We therefore cannot deliver on this Output with new data, and will use previously collected tagging data (one whale) from the Brazilian wintering grounds to examine dive rates, and are seeking further funding to support a second field season at South Georgia to collect these data.

Output 3. Season-specific krill consumption rates used in CCAMLR Sub-Area 48.3 Krill Risk Assessment

This analysis has not yet been done, so no change to current assumptions.

Output 4. Spatial habitat use at SG by humpback whales in winter used in CCAMLR Sub-Area 48.3 Krill Risk Assessment

***Assumption 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).*

This assumption holds, and as no humpback whales were tagged this season. Unless a second field season can be organised, the spatial analysis will rely on previously collected tag data from Brazil and South Georgia.

Output 5: Project Management and Monitoring

There is no change to current assumptions. The project has progressed as predicted by these assumptions.

4. Project support to environmental and/or climate outcomes in the UKOTs

This year our project supported the GSGSSI in delivering on one of the research themes of its MPA Research and Monitoring plan, theme 3¹ (higher predator ecology and demography), by delivering one of its identified “high priority” research needs, tracking a southern right whale in South Georgia waters (<https://www.bas.ac.uk/project/south-georgia-right-whale-project/south-georgia-right-whale-project-whale-tracking/>). The tracking data will be used to measure right whale habitat use at South Georgia.

The project is measuring the role of humpback whales in the food web at South Georgia by assessing their feeding rates. The additional opportunistically collected data obtained from other species during fieldwork (southern right whale, blue whale, killer whale) will provide additional information on whale recovery in the South Georgia foodweb, identifying individual whales by matching with existing Antarctic photo-ID catalogues, and measuring diet through assessing stable isotopes of biopsy samples, and genetic ID of faeces (for one southern right whale). These results can help the government deliver on their high priority Theme 3 research need: “Foraging distances and habitat use of species within and outside the MPA and factors influencing key foraging areas”.

In order to continue to opportunistically collect UAV images for body condition analysis, two mariners from the SGSSI fisheries patrol vessel successfully attained their UAV certification during the reporting period. These images will aid in the longer-term monitoring of all whale species observed at South Georgia (high priority Theme 3 research need: “distribution of cetacean species within the MPA”).

Other contributions to research Themes 3 and 8 relating to krill consumption are in progress and not delivered at this point. Since this year was focussed on project fieldwork, we have not yet delivered the outputs that will feed into other Government biodiversity and monitoring plans, and to IWC and CCAMLR risk assessments.

¹ <https://gov.gs/stewardship-framework-for-sgssi/>

5. Gender Equality and Social Inclusion (GESI)

Please quantify the proportion of women on the Project Board ² .	58% (7 of 12 members of the project board)
Please quantify the proportion of project partners that are led by women, or which have a senior leadership team consisting of at least 50% women ³ .	Ten of 18 Project Partners (56%) are women. The main Project Partner (BAS) is led by a female director. The Project Leader (Jackson) and the Project Manager (Martin) at BAS are women. The main project partner (GSGSSI) also has a female Chief Executive. For the Brazil field season, two researchers and four interns are women. For the South Georgia Field season, the Field Team Leader/Satellite Tagger (Kennedy), Boat Driver (Martin), Biopsy Sampler (Kershaw), and Drone Assistant (Clarke) are women.

GESI Scale	Description	Put X where you think your project is on the scale
Not sensitive yet	The GESI context may have been considered but the project isn't quite meeting the requirements of a 'sensitive' approach	
Sensitive	The GESI context has been considered and project activities take this into account in their design and implementation. The project addresses basic needs and vulnerabilities of women and marginalised groups and the project will not contribute to or create further inequalities.	
Empowering	The project has all the characteristics of a 'sensitive' approach whilst also increasing equal access to assets, resources and capabilities for women and marginalised groups	X
Transformative	The project has all the characteristics of an 'empowering' approach whilst also addressing unequal power relationships and seeking institutional and societal change	

The leadership of this project (PI Jackson, Project Manager Martin and field team leader Kennedy) are all female. Throughout this project, we have maintained an equal gender balance in the field teams embarking on expeditions.

6. Monitoring and evaluation

As this project is in its first year, we do not have many Outputs to report, but project challenges to date have been handled as anticipated through regular consultation with project partners and stakeholders. The achievements of our activities to date have been recorded through detailed field reporting (see Section 3.1 and Annex 4). Feeding these forward to generate Project Outcomes will come in Years 2 and 3.

Project progress has been monitored with regular online meetings to which all project partners have been invited (30 in total) and regular email updates during times when online meeting was

² A Project Board has overall authority for the project, is accountable for its success or failure, and supports the senior project manager to successfully deliver the project.

³ Partners that have formal governance role in the project, and a formal relationship with the project that may involve staff costs and/or budget management responsibilities.

not feasible. During the fieldwork planning and implementation period (one year from May 2023 to April 2024), monthly meetings were also 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) was held in July 2023 to receive feedback.

So far this M&E approach has been helpful in engaging with the broader team, and has helped particularly when setbacks have been encountered, as the team have been able to troubleshoot solutions. We have adapted the M&E plan based on project partner availability and with less frequent online meetings than originally planned, but regular email updates providing opportunities for feedback. The M&E work is located within BAS between the Project Coordinator and Project Leader. Information is shared with partners via regular calls and emails, and with stakeholders via meetings every six months to present and discuss project results.

7. Lessons learnt

This year, communications with project partners worked well, and the first season of UAV-based fieldwork in Brazil was successful. However, due to poor weather conditions and UAV equipment failure, the dataset collected from South Georgia was smaller than anticipated to deliver Output 1 (trend in body mass of humpback whales), and no data were collected to deliver Output 2 (trend in humpback whale dive rates) as no humpback whales were tagged. High levels of ice encountered later in the South Georgia field season meant it was very difficult to spot cetaceans at sea. This could not have been anticipated, so we are still considering how best to tackle this if it occurs in future years.

Lessons learned:

- We purchased two UAV for project use, reducing the risk that equipment failure would impact the project. However we only purchased one UAV range extender (required to overfly all areas of Cumberland Bay when working from land) and this is the item that failed. Future missions will always include two range extenders if work from land is anticipated.
- The original planned vantage site for land-based UAV deployment (to overfly whales in Cumberland Bay) was not optimal, and better deployment sites were located, but were more challenging for researchers to reach on foot, with risks of exposure and injury (Annex 4.3). Following this experience we recommend that all future cetacean UAV surveys be planned from boat-based platforms given the risks of working on land, coupled with the small numbers of datapoints gathered. All further work will be planned on boats with no land-based component.

One additional administrative lesson was that when collaborating with Federal universities in Brazil, funds cannot be sent to these institutes directly, and payment through a third party foundation is required (the lead partner was also asked to sign a contract with the university that conflicted with the conditions of the Darwin grant). It proved challenging to get agreements in place for this payment, which put the third stage of fieldwork (UAV monitoring of the northbound migration at Cabo Frio) at risk (Output 1.4), as the approvals are not in place to get the fieldwork funds to the Brazilian project partner (Federal University of Rio de Janeiro) at the time of writing. If doing this again, we would ensure that the route for payment is formally agreed among all parties at the point the grant begins. We have submitted a change request to Darwin to provide the funding to our other project partner in Brazil (Instituto Baleia Jubarte), who has agreed to collaborate with the partner at the Federal university in delivering the field season.

8. Actions taken in response to previous reviews (if applicable)

Here we respond to the feedback provided in the project offer letter (December 2022).

- *How will the cost of maintaining and running the capital items (drones) be funded post-project and how long is a drone expected to last?*

One UAV will be given to the South Georgia government as part of the project's legacy to be used in future projects including monitoring the fisheries. The other UAV will be added to BAS's UAV fleet to be made available to future research projects, including monitoring wildlife at Bird Island, KEP or other BAS research stations. These organisations will bear the cost of any

maintenance (new batteries or parts). UAV are covered by a one year/200 hour warranty. However with regular preventative maintenance they should run for ~1000 hours of use or more (i.e. ~5 years).

- *Is there any risk that unmanned aerial vehicle (UAV) techniques will not be effective in assessing whale dynamics and krill consumption, or that weather conditions at South Georgia disrupt the project? If the answer is yes to either of these, outline how these risks will be mitigated;*

Project partner Christiansen has direct prior experience of using UAV measurements to assess whale dynamics in other locations for humpbacks and other species. These measurements have also been used to assess krill consumption rates for humpbacks in the Antarctic Peninsula (paper in review), so there is a precedent for this work. However it does rely on sufficient data being collected to populate a krill consumption model. We mitigated this risk by setting up a very long (four month) field season for the UAV work, and including equipment redundancies to buffer against failure.

Weather conditions are the main risk factor in delivering a project like this, as South Georgia is so remote and subject to regular periods of poor weather and high wind, as well as periodic years where very few krill arrive, with negative impacts on all the local krill predators. We proposed to mitigate risk of doing work in a poor krill year by moving the field season back by one year if early indications from krill surveys in September/October suggested it would be a poor year. However early indications suggested no cause to cancel the fieldwork. Otherwise, it is very difficult to minimise weather disruption. We buffered as best we could by factoring >100 hours of boat time including a dedicated, experienced boatman for the project, using a field team with considerable expertise of remote fieldwork, having back-up equipment, and only operating our equipment in suitable weather conditions.

- *It would be useful to train a broader number in drone operations to avoid a focus on too few individuals.*

We have trained the two mariners working on the GSGSSI Fisheries Patrol Vessel who are most experienced with cetacean surveying during the course of their work, and so are best placed to continue monitoring after project close. We have made this recommendation for training additional personnel to the GSGSSI.

9. Risk Management

An unforeseen risk that arose during the South Georgia field season was the breakup of iceberg D-30A to the north of the survey area. As the iceberg moved along the northern shelf edge of SG, large tabular icebergs moved into the boat team survey area on 17 February. This reduced the boat survey field of view to 10-25% of the horizon and impacted boating surveys until the end of the field season in March.

An image from NASA WorldView from 20th February documents the iceberg breakup and icefield impacting the survey efforts. (<https://worldview.earthdata.nasa.gov/?v=-39.323612547464265,-55.258856090906804,-34.17809956201582,-52.20748324884376&t=2024-02-20-T07%3A40%3A36Z>). The boat team continued to survey through this ice field as safely as possible but did not have any humpback whale sightings after 22 February 2024.

The only adaptation we have made to the project design in view of the poor weather at South Georgia (previously identified as a risk) is to plan a second field season at South Georgia in 2025, to increase the chances of achieving Outputs 1 and 2 and fully delivering our project Outcome.

10. Sustainability and legacy

The Project Manager has held regular meetings with the South Georgia government project partner representative, sharing regular updates. When working in the field, the project manager attended weekly meetings with South Georgia government officers and scientists when possible and emailed weekly updates to the South Georgia government officers.

DPIUS188 work has been highlighted in South Georgia through regular research updates to the Territory's museum staff, which they have included in their presentations on tourist vessels throughout the South Georgia summer season. During customs inspections, South Georgia

government officers also mentioned DPLUS188 when speaking with cruise ship Expedition Leaders.

DPLUS188 was promoted in the Facebook group “Expedition Boat People” at the start of the summer to raise the project’s profile in the expedition cruise ship community. In the first half of the season, the Drone Pilot and Drone Assistant gave presentations about the project on the expedition cruise ship that provided their transport to and from KEP. The Project Manager gave several presentations about the project and interacted with expedition staff members from various expedition cruise ships throughout the second half of the South Georgia season.

11. Darwin Plus identity

The project included the Darwin Plus logo in all presentations relating to the project, and included mention of Darwin Plus in all written outputs and outreach. The project has worked closely with SGSSI government partners to promote and publicize the DarwinPlus funding scheme, which we have continued to build on from the previous project (DPLUS 057). While this project forms part of the South Georgia Wild Water Whales project, we have established the Hungry Humpbacks project as a distinct project with a logo and specific communication channels dedicated to project news.

Public Presentations:

Project Leader and Project Manager attended the South Georgia & South Sandwich Islands Marine Protected Area 5-Year Review Science Symposium (13-14 June 2023). The Project Manager on behalf of the Project Leader, presented “Baleen whale recovery and habitat use in South Georgia Waters” and also presented “Hungry Humpbacks: Measuring Seasonal Foraging Intensity at South Georgia”. Both presentations mentioned DPLUS188 and showed the DarwinPlus logo. The presentations are included in the government website: <https://www.gov.gs/sgssi-marine-protected-area-5-year-review-science-symposium/>

Project Leader and Project Manager attended the South Georgia & South Sandwich Islands Marine Protected Area 2nd 5-Year Review Workshop (12-13 December 2023). The project manager presented an update for the DPLUS188 project that included the DarwinPlus logo.

During the first half of the South Georgia field season, the drone pilot and assistant gave two presentations on expedition cruise ships. The project manager gave three presentations on expedition cruise ships during the second half of the South Georgia field season. The Biodiversity Challenge Funding program was discussed, and the DarwinPlus logo was displayed on slides.

Social Media:

For outreach through social media, DPLUS188 has mainly focused on creating an Instagram page called @hungryhumpback. We have created 58 posts with seven video reels, which have 500-3,000 plays, and over 1,400 accounts have been reached. We tag the @biodiversitychallengefunds and #darwin in all of our posts.

The project’s PhD student also created a TikTok account @hungryhumpbacks to engage with younger stakeholders. Posts have had 4,671 views, 16 followers and 395 likes.

On X (formerly Twitter), we created the Wild Water Whales-Hungry Humpbacks @wildwaterwhales account but got very little engagement from this platform. We repost Instagram reels, but the main social media outreach focus will continue on Instagram and TikTok.

12. Safeguarding

Has your Safeguarding Policy been updated in the past 12 months?	Yes
Have any concerns been reported in the past 12 months	No
Does your project have a Safeguarding focal point?	Yes, we have a safeguarding lead across BAS plus a Health and Wellbeing Manager who will work with the safeguarding lead.

<p>Has the focal point attended any formal training in the last 12 months?</p>	<p>Yes, the lead has attended a formal training session on her role and responsibilities as safeguarding lead.</p>
<p>What proportion (and number) of project staff have received formal training on Safeguarding?</p>	<p>Past: % [and number] Planned: % [and number] 30% of our total staff have been trained. They are primarily staff living and working on a research vessel and their managers. More training is planned this year.</p>
<p>Has there been any lessons learnt or challenges on Safeguarding in the past 12 months? Please ensure no sensitive data is included within responses.</p>	
<p>The most challenging part continues to be developing a clear understanding of safeguarding and who it affected. We do not employ staff working with children. However, many of our staff live and work in isolated environments and under challenging conditions. These make them more vulnerable than others.</p>	
<p>Does the project have any developments or activities planned around Safeguarding in the coming 12 months? If so please specify.</p>	
<p>More training across all BAS personnel is planned this year.</p>	
<p>Please describe any community sensitisation that has taken place over the past 12 months; include topics covered and number of participants.</p>	
<p>No community sensitisations have taken place.</p>	
<p>Have there been any concerns around Health, Safety and Security of your project over the past year? If yes, please outline how this was resolved.</p>	
<p>No Health, Safety, and Security concerns in the last year.</p>	

13. Project expenditure

Table 1: Project expenditure during the reporting period (1 April 2023 – 31 March 2024)

Project spend (indicative in this financial year)	2023/24 D+ Grant (£)	2024/25 Total actual D+ Costs (£)	Variance %	Comments (please explain significant variances)
Staff costs				
Consultancy costs				
Overhead Costs				
Travel and subsistence				Fieldwork T&S has come in substantially lower than expected.
Operating Costs				Boat fuel has come in under budget, as have the satellite tags.
Capital items				UAV costs are higher than budgeted
Others (Please specify)				
TOTAL	£298,311.24	£257,340.06	-14%	These figures are still subject to change owing to outstanding financial reporting.

Table 2: Project mobilised or matched funding during the reporting period (1 April 2023 – 31 March 2024)

	Secured to date	Expected by end of project	Sources
Matched funding leveraged by the partners to deliver the project (£)			Friends of South Georgia Island
Total additional finance mobilised for new activities occurring outside of the project, building on evidence, best practices and the project (£)			

14. Other comments on progress not covered elsewhere

Change Requests:

We made four change requests: The first was to revise the first-year budget so that most of the staff time allocated for Project Leader Jen Jackson to be paid instead to the Project Coordinator Stephanie Martin as Jen Jackson was on maternity leave from June.

The second change request was to change the budgeting for a professional consultant to a student to support the land-based UAV in South Georgia. The budget change was approved to support the student's rent and utility costs while working at KEP from mid-November to mid-January.

The third was a request to move UAV expenses from Other Costs to Capital Equipment. The request was granted because it was to simply reclassify existing spending from one category to another.

The fourth change request was to transfer the underspend from Q2 Jan-March 2024 to Q2 Jan-March 2025. It was only after resolving all the expenses at the end of our planned fieldwork in March 2024 that we realized some costs, including boat fuel and international fieldwork T&S, were substantially less than originally budgeted. The request is to transfer the underspend to this current financial year. This amount would allow the project to send a two-person team to collect UAV data from whales in February and March 2025. This would help fill in the data gaps from the last field season, enable us to deliver Output 1, and substantially increase our capacity to deliver a successful project Outcome for DPLUS188. This request has been approved.

15. OPTIONAL: Outstanding achievements or progress of your project so far (300-400 words maximum). This section may be used for publicity purposes.

I agree for the Biodiversity Challenge Funds to edit and use the following for various promotional purposes.

Whales are the largest krill predators in South Georgia, yet their impacts on krill stocks are poorly understood. DPLUS 188 The Hungry Humpbacks project uses cutting-edge technology, including drones, satellite tagging, and biopsy sampling, to collect data to understand how and where whales feed on krill during summer in coastal waters around South Georgia to compare body conditions of humpback whales in the breeding areas in the waters off Brazil. The project collected drone images and biopsy samples of humpbacks in Brazil and in South Georgia. During the summer feeding season, the drones captured rare footage of mother-calf pairs of southern right whales and Antarctic blue whales, plus humpback, fin, and killer whales. One southern right whale was satellite tagged, and the whale's movements can be seen on this website: [//www.bas.ac.uk/project/south-georgia-right-whale-project/south-georgia-right-whale-project-whale-tracking/](http://www.bas.ac.uk/project/south-georgia-right-whale-project/south-georgia-right-whale-project-whale-tracking/).

This project will add important data to monitoring the increasing number of baleen whales in South Georgia waters, helping to understand their impact on krill stocks and contributing to conservation management.



Humpback Whale, Tail photo for identification, photo credit: Henry Slesser Images collected under scientific permit SGSSI RAP 2023-40.



Humpback Whale, Drone Image, photo credit: Fredrick Christiansen Images collected under scientific permit SGSSI RAP 2023-40

In addition, we have been communicating with Xanthe from BDF Comms and have shared additional images and videos. We shared these images with captions and subject consent.

File Type (Image / Video / Graphic)	File Name or File Location	Caption including description, country and credit	Social media accounts and websites to be tagged (leave blank if none)	Consent of subjects received (delete as necessary)

				Yes / No
				Yes / No
				Yes / No
				Yes / No
				Yes / No

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

Annex 1: Report of progress and achievements against logframe for Financial Year 2023-2024

Project summary	Progress and Achievements April 2023 - March 2024	Actions required/planned for next period
<p>Impact</p> <p>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)</p>	<p>Positive impacts on biodiversity have not yet been realised by this stage of the project.</p>	
<p>Outcome</p> <p>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.</p>		
<p>Outcome indicator 0.1</p> <p>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]</p>	<p>Not part of this reporting period</p>	
<p>Outcome indicator 0.2</p> <p>0.2 Seasonal krill consumption rates used in the CCAMLR krill risk assessment for Subarea 48.3 [April-July 2025]</p>	<p>Not part of this reporting period</p>	
<p>0.3 Model of winter habitat use used in CCAMLR krill risk assessment for Subarea 48.3 [July-September 2024]</p>	<p>Not part of this reporting period</p>	
<p>Output 1 Trends in humpback whale body condition and mass across the feeding season for adults, mothers, calves and juveniles</p>		
<p>Output indicator 1.1</p> <p>UAV-based survey of body condition of humpback whales on southbound migration at Abrolhos Bank, Brazil (October 2023)</p>	<p>Good progress has been made on activities under Output 1, All pre-season activities up to Activities 1.2.6 were completed on time to prepare for the South Georgia field season. (Section 3.1)</p> <p>For Indicator 1.1, Activity 1.1.4, Abrolhos Bank, fieldwork was conducted between 20 September and 18 October 2023. Six research cruises surveyed 819.51 km (442.50 nautical miles) for 100 hours of sampling and 68.35 hours of whale sightings. Drone flight results were for 200 whale</p>	<p>Analysis of the images for body condition measurements is ongoing. Analysis for biopsy samples are ongoing.</p>

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

	measurements, and 34 whale biopsy samples were collected. (Section 3.1)	
Output indicator 1.2 UAV-based survey of humpback whale body condition carried out at King Edward Point, SG (December - March 2024)	For Activity 1.2.6,1.2.7 and 1.2.8 , the South Georgia land-based two-person UAV team was in the field from 18 November 2023 until 14 January 2024 for 205.5 hours of fieldwork and 110.25 hours of observation. Humpback whales were sighted on four outings, but due to unexpected equipment failure, only one whale was measured for body condition analysis from land. For Activity 1.2.10,1.2.11,1.3.1 and 1.3.2 the South Georgia boat-based team was in the field from 15 January until 25 March. A total of 2,282.8 km (1232.613 nautical miles) of visual transect data was conducted during 102.5 hours on 17 days. A total of 39 UAV flights were conducted on 10 of the survey days for 29 humpback whales, three southern right whales (with one calf), four blue whales (with one calf), and ~ 20 killer whales (with several calves). (Section 3.1)	Analysis of the images for body condition measurements is ongoing.
Output indicator 1.3 Biopsy samples collected during boat-based surveys (to measure whale age, sex and pregnancy status); shipped to UK.	For Indicator 1.3 A total of 16 skin and blubber biopsy samples were collected. For humpback whales, 11 biopsies from 10 individual whales, and 9 of these whales also had drone images for body condition analysis. (Section 3.1)	Analysis for biopsy samples is ongoing.
Output 2 Trend in humpback whale diving rates across the feeding season for humpback whales		
Output indicator 2.1 Eight humpback whales instrumented with SPLASH satellite tags at King Edward Point, South Georgia	For Indicator 2.1 no humpback whales were satellite-tagged. Humpback whales were sighted on seven of the seventeen survey days. When humpbacks were observed, the swell conditions were too high to attempt satellite tagging safely, and no humpback whales were sighted after 22 February. A large, tabular ice field moved into the survey area on 17 February, which reduced the field of view by 10-25%. One southern right whale was satellite tagged on 9 th March and continues to transmit data. (Section 3.1)	
Output 5 Project Management and Monitoring		

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

<p>Output indicator 5.1 Dedicated project webpage set up on BAS website, including document section, whale tracking maps and project summary</p>	<p>For Indicator 5.1, The website was created and updated: https://www.bas.ac.uk/project/hungry-humpbacks/. The whale tracking page was created (https://www.bas.ac.uk/project/south-georgia-right-whale-project/south-georgia-right-whale-project-whale-tracking/) Posts are being shared on social media channels (Instagram:@hungryhumpbacks; TikToc @hungryhumpbacks; X (Twitter):@wildwaterwhales) to document field activities and increased stakeholder engagement during both field seasons (Section 3.1).</p>	<p>Continue to update on project progress</p>
<p>Output indicator 5.2 Monthly project meetings to track progress</p>	<p>For Indicator 5.2 Project Partners meetings were not held each month due to time differences, conflicting schedules, and the Project Manager (PM) being in the field from January to April 2024. During the first project partner meeting in May 2023, the group agreed to have the meetings when necessary, resulting in meetings in May and October 2023. Email updates were sent out in July 2023, December 2023, and April 2024, and the Project Manager was available to answer questions anytime. For Activity 5.3.1, the first Stakeholder meeting was held on 5 September 2023 due to conflicts in the schedule for project partners (Section 3.1).</p>	
<p>Output indicator 5.3 Annual partner and stakeholder meeting</p>	<p>For Activity 5.3.1, the first Stakeholder meeting was held on 5 September 2023 due to conflicts in the schedule for project partners (Section 3.1).</p>	

Annex 2: Project’s full current logframe as presented in the application form (unless changes have been agreed)

Project Summary	SMART Indicators	Means of Verification	Important Assumptions
<p>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).</p>			

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

<p>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.</p>	<p>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]</p>	<p>0.1 Scientific report to the IWC Scientific Committee (Ecosystem modelling working group) and CCAMLR WG-EMM.</p>	
	<p>0.2 Seasonal krill consumption rates used in the CCAMLR krill risk assessment for Subarea 48.3 [April-July 2025]</p>	<p>0.2 Estimates provided to the CCAMLR WG-EMM for the Krill Risk Assessment.</p>	
	<p>0.3 Model of winter habitat use used in CCAMLR krill risk assessment for Subarea 48.3 [July-September 2024]</p>	<p>0.3 Data layer provided to the CCAMLR WG-EMM for the Krill Risk Assessment.</p>	
<p>Outputs: 1. Trends in humpback whale body condition and mass across the feeding season for adults, mothers, calves and juveniles</p>	<p>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].</p>	<p>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.</p>	<p>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</p>

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

			<p>(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.</p> <p>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.</p> <p>1.1-1.3 Equipment loss or failure will be mitigated by bringing two UAVs into the field in order to provide redundancy.</p>
	<p>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</p>	<p>1.2 Field report documenting science activities with field photographs available on BAS project website and GSGSSI Data Portal. Photographs of animals</p>	<p>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</p>

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

	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),

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

			<p>and close communication between UAV pilot and biopsy sampler.</p> <p>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.</p>
	<p>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].</p>	<p>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.</p>	<p>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.</p>

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

	<p>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]</p>	<p>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.</p>	<p>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.</p> <p>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.</p>
	<p>1.8 South Georgia feeding ground body condition trend compared with trend in the Antarctic Peninsula [July-Dec 2024].</p>	<p>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</p>	

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

		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 Kings 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

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

	<p>condition and mass changes, predicting summer and winter daily krill consumption by humpback whales (stratified by demographic group) [April-July 2025]</p>	<p>www.iwc.int and will also be linked through BAS project website.</p>	<p>maintaining high summer foraging rates into the winter</p>
	<p>3.2 Total krill consumption estimated by humpback whales across the feeding season, partitioned by season [July-August 2025]</p>	<p>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).</p>	<p>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.</p> <p>3.2 To account for uncertainty in the demographic composition and feeding season length in humpback whales, this model can incorporate</p>

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

			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.	

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

	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 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.	

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

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]

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

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.

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

- 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]

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

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.

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

Table 1 Project Standard Indicators

DPLUS Indicator number	Name of indicator	Units	Disaggregation	Year Total 1	Year Total 2	Year Total 3	Total date to	Total planned during the project
E.g. DPLUS-A01	E.g. Number of people in eligible countries who have completed structured and relevant training	People	Men	20			20	60
E.g. DPLUS-A01	E.g. Number of people in eligible countries who have completed structured and relevant training	People	Women	30			30	60
E.g. DPLUS-B01	E.g. Number of new or improved habitat management plans available and endorsed	Number	New	1			1	2
E.g. DPLUS-B01	E.g. Number of new or improved habitat management plans available and endorsed	Number	Improved	1			1	3

Table 2 Publications

Title	Type (e.g. journals, best practice manual, blog post, online videos, podcasts, CDs)	Detail (authors, year)	Gender of Lead Author	Nationality of Lead Author	Publishers (name, city)	Available from (e.g. weblink or publisher if not available online)

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

Checklist for submission

	Check
Different reporting templates have different questions, and it is important you use the correct one. Have you checked you have used the correct template (checking fund, type of report (i.e. Annual or Final), and year) and deleted the blue guidance text before submission?	X
Is the report less than 10MB? If so, please email to BCF-Reports@niras.com putting the project number in the Subject line.	X
Is your report more than 10MB? If so, please discuss with BCF-Reports@niras.com about the best way to deliver the report, putting the project number in the Subject line.	X
Have you included means of verification? You should not submit every project document, but the main outputs and a selection of the others would strengthen the report.	X
If you are submitting photos for publicity purposes, do these meet the outlined requirements (see section 15)?	X
Have you involved your partners in preparation of the report and named the main contributors	X
Have you completed the Project Expenditure table fully?	X
Do not include claim forms or other communications with this report.	