



Darwin Plus: Overseas Territories Environment and Climate Fund Final Report

*To be completed with reference to the “Writing a Darwin/IWT Report” Information Note: (<https://dplus.darwininitiative.org.uk/resources/reporting-forms-change-request-forms-and-terms-and-conditions/>). It is expected that this report will be a **maximum** of 20 pages in length, excluding annexes)*

Darwin Project Information

Project reference	DPLUS057
Project title	Population recovery of right whales in South Georgia waters
Territory(ies)	South Georgia
Lead organisation	British Antarctic Survey
Partner institution (s)	Sea Mammal Research Unit, School of Biology, University of St Andrews, Scotland/ University of Auckland, New Zealand International Fund for Animal Welfare, Woods Hole Oceanographic Institute, Massachusetts, USA Department of Biology, University of Utah, Instituto Aqualie, Minas Gerais, Brazil (NGO) Projeto Baleia Franca, Instituto Australis, Santa Caterina, Brazil (NGO) Happywhale.com University of Barcelona, Spain
Darwin Plus Grant value	£312,738
Start/end date of project	April 2017 – March 2021
Project leader name	Jen Jackson
Project website/Twitter/blog etc.	www.facebook.com/sgwhale and https://www.bas.ac.uk/project/south-georgia-right-whale-project/
Report author(s) and date	Jen Jackson, 13th August 2021

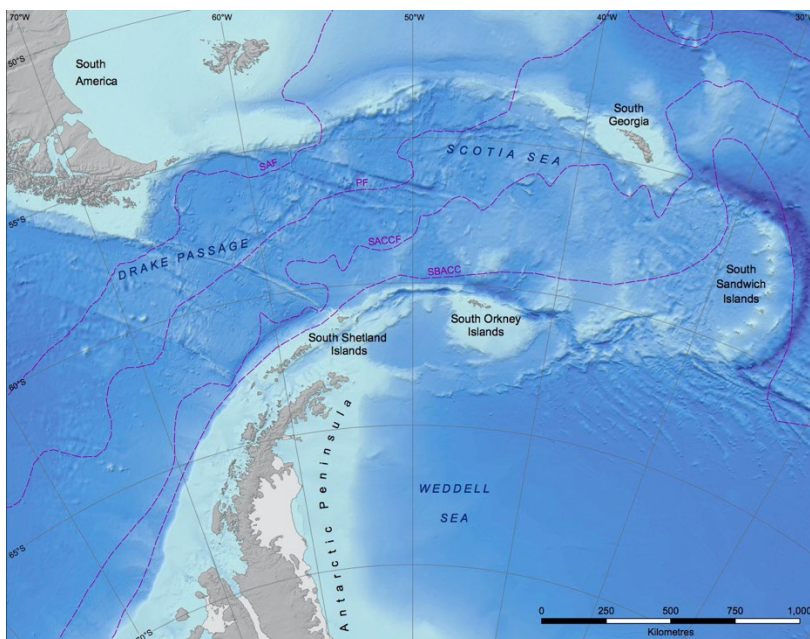
1 Project Summary

The project was located in South Georgia (Figure 1), a sub-Antarctic island which is surrounded by oceanic fronts on three sides, with high densities of krill supporting multiple krill predators, and a winter-time krill fishery managed by the Government of South Georgia and the South Sandwich Islands (GSGSSI). South Georgia (SG) was historically a very important feeding ground for multiple baleen whales, and became an epicentre of commercial whaling in the early 20th century, with over 170,000 whales killed there between 1904-1965. Since this exploitation ended,

there has been little dedicated research conducted into the recovery and habitat use of whales feeding in South Georgia waters. A survey in 1997 indicated that the area was becoming important for southern right whales, with subsequent reports by visitors suggesting this was the most frequently encountered species.

Growing evidence suggests that SG environmental conditions influence whale population dynamics, suggesting foraging success is a primary factor influencing reproductive-rates. Given the past importance of this area for whales and current management both in terms of Marine Protected Area designation and krill fishing, we proposed to conduct surveys of the feeding ground with a primary focus on the most abundant whale species (southern right whales), to investigate prey sources and habitat-use between seasons and in relation to krill fishing within the Marine Protected Area (MPA), population abundance and connectivity with calving areas, health and population recovery status. In summary, the project conducted surveys of South Georgia feeding ground recovery, post whaling, characterising the distribution, diversity, habitat use, health and calving ground connections, abundance and recovery status of southern right whales, as well as gathering opportunistic data on other whale species, following whaling.

The results of this project are particularly relevant to the OT government who manage the South Georgia marine ecosystem, and oversee biodiversity monitoring, MPA planning and sustainable management of the krill fishery. Whales have not previously been factored into these management decisions, but as they are recovering from whaling and are the most significant krill consumers in the ecosystem, it is now timely and important for them to be explicitly considered in fishery and management decisions in the OT. The project provides information to the OT government on whale distribution, habitat use and density patterns in relation to shipping traffic, so that they can incorporate this information into future fishery management decisions, MPA boundary reviews, and assessment of mitigation measures in relation to potential ship strike risks.



2 Project Stakeholders/Partners

2.1 Government of South Georgia and the South Sandwich Islands (GSGSSI)

The principal stakeholder in this project is the Government of South Georgia and the South Sandwich Islands (GSGSSI). We have engaged with this stakeholder regularly over the course of the project, working closely with them during field planning, providing follow-up feedback on research outcomes and sharing draft reports for feedback. As an example of this close working relationship, we received significant in-kind support from the GSGSSI for our 2019 expedition, funding 100hrs of dedicated boat time for whale surveys (Section 10.2).

Government representatives attended the 2019 workshop on “South Georgia right whales: past, present, future” in the Falklands in 2019 (Annex 6.6.1) as well as the final project webinar and workshop in March 2021 (Activity 5.1). Following the 2020 expedition, government officials met

with the expedition team to discuss initial findings, and attended a public presentation of the voyage (held in the Falklands in 10th Feb 2020, Annex 6.9.1).

The Project Leader has attended annual GSGSSI Stakeholders meetings in September 2019 (e.g. <http://www.gov.gs/sept-19/#News-4>) and 2020 (virtual meeting), contributing to discussions of next steps for management of wildlife recovery at South Georgia.

In 2020, the Project Leader was invited to participate in a new artistic collaboration between GSGSSI and SGHT, to commission new artwork to re-develop the whaling station “flensing plan” at South Georgia (<http://www.sght.org/the-story-of-the-whale-at-south-georgia/>) and help raise the profile of South Georgia’s whaling heritage and the positive subsequent story of whale recovery; this work is now being developed by artist Michael Visocchi <http://www.sght.org/news/artistic-commission-winner-announced/>.

As a consequence of the good relationship we have developed with this stakeholder:

(1) In consultation with GSGSSI, we analysed the ship strike risk to whales in South Georgia and presented these results to the IWC Scientific Committee (Annex 6.3.3). This report helps the GSGSSI develop mitigation measures for reducing ship strike risks to whales, addressing Objective 2 of the UKOT’s strategic objectives. This summary is also provided in the end of project report to the GSGSSI (Annex 6.5.2) and has been identified by GSGSSI as a “shared challenge” to work on with IAATO in their new 2021 Stewardship Framework for the SGSSI (p15, <https://www.gov.gs/docsarchive/Environment/Protect%20Sustain%20Inspire.pdf>).

(2) We have obtained approval to collaborate with the GSGSSI and organise future whale research surveys on board their Fisheries Patrol Vessel Pharos, as Patrol Vessel time and logistics permit. The Project Leader and two project partners are now partners on DPLUS149 to conduct winter-time cetacean surveys at South Georgia from the Pharos in 2022 and 2023 (<https://dplus.darwininitiative.org.uk/project/DPLUS149/>, see section 10.2).

(3) The GSGSSI is featuring the results of our whale research project in a newly commissioned postage stamp series, to be released in the next few months, demonstrating the value they put on our results as stewards of the South Georgia marine environment. They also highlight our work demonstrating whale recovery within their new “Protect Sustain Inspire” Stewardship framework for SGSSI (see link above, p7 and 16).

2.2 South Georgia Heritage Trust and Friends of South Georgia Island

A second key stakeholder who has provided significant additional funding for our work is the South Georgia Heritage Trust and its US partner the Friends of South Georgia Island (three grants awarded since 2018). They contributed significant funds towards the 2019 survey and 2020 expedition (Section 10.2) and regularly promote our work across their social media networks (e.g. <http://www.sght.org/the-story-of-the-whale-at-south-georgia/>, <http://www.fosgi.org/news-2/latest-news/>, <http://www.fosgi.org/what-we-do-2/what-we-do/>, <https://www.sght.org/news/blue-whale-sightings-off-south-georgia-raise-hopes-of-recovery/>, <https://www.sght.org/news/humpback-whales-return-to-south-georgia/>). We have also given multiple talks for the South Georgia Heritage Trust, most recently at their Southern Ocean Stories event on 3rd March 2021 (<https://www.sght.org/news/the-whales-tale-southern-ocean-stories/>, Annex 6.9.1), and they kindly hosted our final project webinars on 23-24th March 2021 and made them available via Youtube (<https://www.sght.org/news/the-wild-water-whales-of-south-georgia-science-webinars/>). More recently, we facilitated a partnership between SGHT and Wild Socks (<https://www.wildsocks.co.uk/>), who were inspired by our discovery of Antarctic blue whales returning to South Georgia (Calderan et al. 2020, <https://www.int-res.com/abstracts/esr/v43/p359-373/> see Annex 6.6.4) to launch a sock range featuring Antarctic blue whales (Christmas 2021): they will be donating a portion of profits from this range to SGHT to support whale conservation.

The trust are largely funded by tourist donations and are anticipated to provide a sustainable avenue for support of future whale monitoring in SG waters; it is a positive and mutually beneficial relationship, as they use our project results to enhance the Antarctic visitor experience, through the outreach material (slides and images) we provide to the South Georgia museum, which keeps them updated with project news, and through sharing of our research news on their websites.

2.3 International Whaling Commission

The International Whaling Commission (IWC) receive annual updates on project progress through their Scientific Committee meetings in May (via the Southern Hemisphere sub-committee). In May 2019, the Scientific Committee were informed about progress on genetic analysis of southern right whale samples at South Georgia (SC/68a/SH06, subsequently published as Carroll et al. 2020 <https://doi.org/10.1093/jhered/esaa010>). The lack of observations of southern right whales during the 2019 expedition was highlighted (Item 6.1.2, IWC 2020)¹. In May 2020, report SC/68b/CMP22 was presented (Annex 3.2), which documented the field expedition conducted during January/February 2018 and provided an opportunity for Scientific Committee feedback. The presentation was positively received (Items 8.2.2 and 8.2.3.4, IWC In press)¹. Blue whale photo-IDs opportunistically collected by the 2020 expedition were also matched with the existing Antarctic blue whale catalogue (no matches found, indicating that these are all “new” whales). These images contributed to the upcoming IWC Antarctic blue whale assessment, which used photo-ID images to provide a new estimate of circumpolar blue whale abundance (SC/68c/ASI15, found at <https://archive.iwc.int/?r=19268&k=838502ed25>). In 2021, IWC Scientific Committee report SC/68c/CMP08 presented analyses of right whale population connectivity, foraging ecology and health at South Georgia (this report is welcomed and discussed under Item 9.2.1 of the 2021 Scientific Committee Report <https://archive.iwc.int/?r=19277&k=f3bf41b6ed>). Report SC/68c/HIM09 provided an analysis of humpback whale ship strike risk at South Georgia (discussed in Item 13.2 together with a Committee recommendation for these waters to be added to a list of high risk areas considered under the IWC’s Strategic Plan to mitigate the impacts of ship strikes on cetacean populations, <https://archive.iwc.int/?r=19277&k=f3bf41b6ed>).

In 2018, the IWC co-funded the proposed development of waterproof photo-ID placards (available for download at <https://iwc.int/sorp>), describing the different species that are commonly seen in the Antarctic Peninsula and Scotia Arc regions, with examples of poor vs good photo-ID images, and a placard explaining how the photo-IDs are used in research. The placards were presented by Taylor as a poster at the UK NERC Antarctic Science conference on 11th September 2018, and also published in a Norwegian newsletter about South Georgia, Øyas Venner (<http://www.oyasvenner.org>). For further details of this initiative, see “Antarctic tour operators” below.

The Darwin project team were invited to present their results at the 2021 IWC Conservation Management Plan (CMP) workshop on southwest Atlantic right whale conservation and recovery, and gave six talks on the identification of right whales with photo-ID and acoustics, right whale tracking and habitat use at South Georgia, population dynamics and body condition. Summaries of these can be found in the Report of the Workshop, sections 4.1.1(II), 4.1.2(V), 4.1.3(III), 4.2.1 (III), 4.2.3 (III), 4.3.1 (I) (Annex 6.8.1, <https://archive.iwc.int/?r=19188&k=bb234a9351>).

2.4 CCAMLR Scientific Committee

The project aimed to engage with the CCAMLR Scientific Committee via provision of papers on whale habitat use to the CCAMLR Working Group on Ecosystem Monitoring and Management. In 2019, we presented CCAMLR with preliminary estimates of whale abundance in South Georgia and the South Sandwich Islands at the EMM meeting (Annex 6.2.1, available at <https://www.ccamlr.org/en/wg-emm-2019/27>). More in-depth habitat use models have been explored since September 2019, with two analyses using (i) sightings data from the 2019 survey and (ii) satellite tracking data from humpback whales (Annex 6.7.1 and 6.7.2). CCAMLR have been conducting virtual meetings in 2020 and 2021 and did not take our papers at EMM during this period. The above-mentioned whale datasets generated by the South Georgia project now form the whale component of a multi-species krill risk assessment that CCAMLR SC are now preparing for the South Georgia and the South Sandwich Islands (Paragraphs 3.30 - 3.3.3, CCAMLR 2019), with BAS in the lead role overseeing the modelling (DPLUS072 <http://www.darwininitiative.org.uk/project/DPLUS072/>) and funding secured (PP Trathan as project lead) for the 2019 cetacean survey data (Annex 6.7.1) to be incorporated into the risk assessment for 48.4 (Section 10.2).

2.5 Antarctic Tour Operators

¹ All IWC Scientific Committee reports are available for download at <https://iwc.int/documents>
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Our project aimed to increase the visibility of whale research within the Antarctic tourist community and to build sustainable collaborative relationships with IAATO members. Visibility of whale research has been raised through circulation of the photo-ID placards (see IWC section above), giving a number of presentations to tour vessels (in 2019), and by the South Georgia museum director and her staff providing whale project news and updates during their presentations to tourists in 2019 and 2020 summer seasons. The South Georgia museum staff give well-attended talks to nearly all tour vessels visiting South Georgia.

We worked closely with Project Partner Ted Cheeseman (who runs the photo-ID matching website www.happywhale.com) to enhance visibility of the project within this community, and to increase IAATO engagement with high latitude whale research through the placard scheme. Four hundred placards were circulated widely among International Association for Antarctica Tour Operators (IAATO) staff via an IAATO meeting, through the IAATO Facebook page, and via an email circulation by IAATO head of communications. Placards were distributed to: (1) Tourist ships (2) Private operators, (3) National Antarctic operators (4) Krill and icefish fishery and observer vessels operating in SG waters (5) Port Lockroy Post Office (western Antarctic Peninsula) (5) The Grytviken Museum (SG), who made placards freely available to tour operators and mariners visiting throughout the 2018/19 season. Total happywhale photo-ID submissions in 2017/18 from the Antarctic Peninsula and SG region (for all cetaceans) were 788, and during 2018/19, 1038 submissions were received (32% more). Within this figure, a record number of humpback whale submissions were received by www.happywhale.com during 2018/19 (927 submissions) compared to the 2017/18 season (703 submissions), while submissions for other cetaceans rose from 85 to 111. This suggests that the distribution of the placards had a positive impact on photo-ID collection by tour operators and citizens.

The impetus created by the photo-ID placards has also led to a new initiative to build a humpback whale photo-ID catalogue for South Georgia, using the Happywhale website as the catalogue sharing repository, and comparing these photo-IDs with the Brazilian wintering ground to look for matches. So far, 258 South Georgia humpback fluke photo-IDs have been collected (including 89 from the four BAS whale expeditions associated with DARWIN, more detail evidencing this activity in Section 3.2). Four individuals feeding at South Georgia have been matched with Brazilian catalogues to date, supporting the hypothesis that these grounds are connected (see Annex 6.7.3).

We are now in discussion with Antarctic Tour Operators about voluntary measures to reduce ship speeds in South Georgia waters, with Tour Operators provided an advance copy of our 2021 IWC report on ship strike risks for review and comment (Annex 6.3.3).

3 Project Achievements

3.1 Outputs

Output 1. Report to GSGSSI on (i) status assessment of SG whale distribution, habitat use and recovery patterns in the southwest Atlantic, (ii) risks to the populations, (iii) recommended actions to mitigate risks

At the project start, there was no baseline information on the distribution, habitat use or abundance of whales in South Georgia waters, nor the potential impact of their numbers on ship strike risk or MPA planning. By the end of the project, we have made a series of public presentations on our results to partners, stakeholders and public, and delivered a report to the GSGSSI summarising the results of our surveys (Activity 1.13, Annex 6.5.2), and identifying (i) that humpback whales have recovered from whaling at South Georgia, with abundance close to pre-whaling levels in South Georgia and South Sandwich Islands waters (Annex 6.7.1), while Antarctic blue whales are also showing evidence of return (Annex 6.6.4), and all species show inter-annually variable use of South Georgia habitat. We also reported on SRW health condition to the IWC (Annex 6.3.2) (ii) Using ship traffic data, we have identified the risk of ship strikes to be relatively high in coastal waters for humpback whales, and suggest appropriate mitigation measures, of which the most effective is likely to be an agreed reduction in ship speeds in coastal areas (Annex 6.3.3). Using satellite tracking data, we identify the patterns of MPA usage by humpback whales between seasons, finding that most of the population feeds within the MPA area in the summer, but that more work is required to identify MPA habitat use at times concurrent

with the krill fishery in winter (Annex 6.7.2). Using our sighting surveys to estimate baleen whale abundance, we have also estimated the amount of krill that baleen whales consume in the South Georgia and South Sandwich Islands waters (Annex 6.7.1). Our recommended actions to mitigate risks are summarised in the report to GSGSSI (Annex 6.5.2) and also outlined in Annex 6.7.2 and 6.3.3. We had insufficient satellite tracking data to measure right whale habitat use patterns with the same approach, but are preparing an analysis of the habitat use patterns of the two species which will complete after the lifetime of this project.

One of the main problems encountered by the project was that southern right whales, initially the main focus of the project and field surveys, were rarely encountered during the 2019 and 2020 surveys, despite substantial visual survey and acoustic effort (Annex 6.3.1, 6.3.2), suggesting that their presence at South Georgia varies with local prey availability and is not currently predictable. Consequently, we never encountered enough right whales to be able to measure their feeding ground abundance with precision, and collected datasets (e.g. photogrammetry, genetic, satellite tracking, photo-ID) that were much smaller in size than originally anticipated (Activities 1.4.1-1.4.6). In our original log-frame, we identified that poor weather could hinder data collection (and this was certainly the case in 2018, Annex 6.6.2), but did not anticipate that southern right whales would not be present during surveys in 2019 and 2020.

Since we were not able to deliver southern right whale results as originally anticipated, we broadened our focus to opportunistically collect and analyse sightings, photo-ID, satellite tracks and biopsy samples from other species (Annex 6.1.1, 6.1.1b, 6.3.1, 6.2.1, 6.7, 6.6.4), which enabled us to provide a broader overview of whale habitat use and recovery in South Georgia than anticipated at the start of the project.

Output 2. Report key whale habitat use data to CCAMLR through a scientific paper to the EMM Working Group for consideration within spatial management proposals for regional krill fishery development.

At the start of the project, whale habitat use data were rarely provided to CCAMLR Scientific Committee, since whales are not formally part of its remit. However during the project period, CCAMLR began to progress regional krill risk assessments for each of its Southern Ocean management areas in order to identify the risks of krill fishing on regional predators, and identified a need to include cetacean data in those risk assessments, given their increasing abundance and potential impact on regional krill consumption (Section 3.2.8, CCAMLR 2019). These risk assessments require information on predator density and habitat use patterns. Cetacean abundance estimates generated by the project were provided to CCAMLR EMM in 2019 (Annex 6.2.1) and are now being used as the basis for the CCAMLR krill risk assessment in the South Georgia (48.3) and South Sandwich Islands (48.4) management area. This work will be reported to the CCAMLR Scientific Committee as part of the krill risk assessment progress update in September 2021.

In the original logframe, we anticipated that the joint IWC/CCAMLR meeting in 2017 would be used to develop a recommendation for the planned work. However this meeting has been postponed indefinitely (Item 15.2.3, IWC In press), so communications with CCAMLR have proceeded through PP Trathan, who submitted Annex 6.2.1 on our behalf in 2019 and initiated the use of our sighting survey data in the upcoming krill risk assessment for 48.3. As the satellite tracking dataset that we collected was significantly smaller than anticipated for right whales (Activity 2.1), we broadened the scope to include humpback whales (tracking two animals, (Activity 1.4.4), enlarged the available dataset through collaboration with PP Zerbini and Andriolo to include whales that were satellite tracked in Brazil, and were ultimately able to conduct a habitat use analysis for humpback whales (Annex 6.7.2) which can also be used for the upcoming krill risk assessment.

Output 3. Report right whale connectivity and health assessment data to the IWC to address multiple scientific recommendations and concerns regarding threats and data gaps and contribute to the IWC Conservation Management Plan for this population.

At the start of the project, right whale migratory connectivity with low-latitude wintering grounds was only known between Peninsula Valdes, Argentina and South Georgia, via photo-identifications of the same whale in both regions (Best *et al.*, 1993; Moore *et al.*, 1999) and satellite tracking of right whales in Peninsula Valdes, showing migratory movements towards the region (Zerbini *et al.*, 2016). There was no published data on genetic connectivity, but a PhD

thesis using samples collected during the 1997 expedition by Moore and colleagues (Ott 2002) suggested no population structuring between South Georgia and Argentina; these earlier data were combined with samples collected by the South Georgia right whale project to measure population differentiation (see below). At the start of the project, right whale health at South Georgia had never been investigated, and there was no information from the feeding ground at South Georgia included in the southwest Atlantic Conservation Management Plan².

Connectivity

Over the course of the project, we delivered to the IWC Scientific Committee (Carroll *et al.*, 2019) and subsequently published (Annex 6.6.1) the first published work showing that at the scale of the South Atlantic, the South Georgia feeding ground is most closely connected to the calving grounds of Brazil and Argentina. Subsequently, through photo-ID matching, we identified the first evidence of a direct migratory connection with Brazil (Annex 6.3.2) and with the Antarctic Peninsula, an area where right whales are occasionally seen feeding. Finally, we confirmed a migratory connection with all three southwest Atlantic countries (Brazil, Uruguay and Argentina) in one season by direct satellite tracking of the whale “Braveheart” (<https://www.bas.ac.uk/project/south-georgia-right-whale-project/south-georgia-right-whale-project-whale-tracking/>).

Health

We conducted the first health assessment of right whales at South Georgia, firstly using side-on images to conduct a visual health assessment (Activity 3.1 and 3.2, reported to the IWC and published, Annex 6.3.2, 6.6.2). The results of this assessment suggested that southern right whales are in relatively good condition at South Georgia, compared to grounds in the North Atlantic.

One major challenge encountered during fieldwork was that weather conditions at South Georgia (and latterly the scarcity of right whales) gave us limited opportunities to get a UAV over whales in order to get calibrated estimates of body condition and to collect whale blow. This was a problem that was anticipated in the log-frame, but was more profound than we had anticipated, particularly in 2018 when we sent in a UAV (the standard UAV used for photogrammetry) which required optimal weather conditions and did not have a long battery life. We learned from this and took a more versatile UAV in 2020, with some adaptations to ensure it could also collect calibrated images (Annex 6.4.1). A small dataset of overhead images was collected in 2020 (Activity 1.4.6) and subsequently used to measure body condition using quantitative approaches; these data were then compared with similarly calibrated images from Argentina and show that the South Georgia whales were in similar body condition (relatively good), reported to the IWC in Annex 6.3.2.

In 2020, the biopsy samples collected from southern right whales did not contain much blubber, so only one sample could be used for hormone analysis (Annex 6.3.1, 6.3.2). However samples collected from humpback and blue whales yielded larger quantities of blubber for preliminarily analysis (n=13 and n=7 respectively), and were used to identify that at least one blue whale was pregnant (see <https://www.youtube.com/watch?v=kOaFdtVJRC0&t=6014s>). With pandemic laboratory closures, the blubber analysis could not be completed prior to the end of the project, but is anticipated to complete in 2021.

Whale blow samples were sent to Project Partners in WHOI for microbiome analysis, but due to the COVID-19 pandemic there were significant shipment delays as well as institute closures in 2020, and the planned microbiome analysis could not be completed within the lifetime of the project. An update on the planned work was provided by WHOI collaborator Dr Carolyn Miller during the final project webinar (<https://www.youtube.com/watch?v=LaZa9wCXIdw&t=1834s>).

IWC Conservation Management Plan

The Darwin project contributed to multiple areas of the IWC Conservation Management Plan via their 2021 workshop. Summaries of these can be found in the Report of the Workshop (Annex 6.8.1), sections 4.1.1(II), 4.1.2(V), 4.1.3(III), 4.2.1 (III), 4.2.3 (III), 4.3.1 (I).

Output 4. Calculate right whale depletion levels in the southwest Atlantic

² <https://iwc.int/south-atlantic-southern-right-whale>
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At the start of the project, estimates of historical right whale depletion were not known for the southwest Atlantic. Calculation of right whale exploitation patterns was achieved via an in-depth analysis of whalship logs, providing estimates of catch impact and whaling efficiency (Activity 4.1, Annex 6.6.3). This provided important data which will be used within the IWC's southwest Atlantic right whale population assessment.

Output 4 (Activity 4.2) originally also aimed to measure right whale population abundance at South Georgia, using re-sightings of whales between years to measure abundance using mark recapture, and latterly anticipated to use sightings or acoustic detections to help to estimate density. However there were insufficient right whales sighted or acoustically detected to make this analysis possible (Annex 6.3.1). Over the lifetime of the project, we collected 77 photo-identifications of this species through direct encounters and citizen science contributions, of which 71 were photo-identified in South Georgia (Annex 6.3.2). Within this catalogue, one whale was re-sighted feeding in the western Antarctic Peninsula in a different year (Annex 6.3.2) suggesting this may be at the western edge of the feeding range for southwest Atlantic right whales, and one whale was re-sighted to its natal calving ground in Brazil, but no photo-identified whales were re-sighted in South Georgia waters (Activity 4.3). A total of 11 whales were also identified using microsatellite genotypes, but there were no genetic resightings between years (Annex 6.6.1 and 6.5.1). Consequently it was never possible to use mark recapture or sightings data for abundance estimation with the data we collected (Activity 4.4).

Our original log-frame did not anticipate that there might be insufficient data (either photo-ID or sightings data) to measure local abundance, as the lack of right whales (compared to other species such as humpback whales) was not foreseen. We therefore requested a change in focus, to generate estimates of overall baleen whale abundance and humpback whale abundance in South Georgia using sightings from surveys conducted over the project lifespan (Annex 6.7.1). These data could not therefore contribute to the assessment of right whale recovery from exploitation but were useful for Output 2 of the project (see above), providing information about likely levels of krill consumption by baleen whales to CCAMLR.

Output 5. Create strong collaborative network of stakeholders to sustain project results, assist with further monitoring and broaden scope of baseline surveys to other whale species

Through the DARWIN project and companion EU BEST project we have built a strong network of stakeholders, which enabled us to broaden the number and scope of baseline surveys (e.g. Annex 6.2.1), providing a useful review on the presence of other species (e.g. Annex 6.6.3) and conducting a successful pilot season in 2019 doing locally-based surveys at King Edward Point base. The principal project stakeholder is the GSGSSI, who have provided us significant ongoing logistical support for this research. In return we will provide the GSGSSI with whale habitat use maps for South Georgia (for MPA planning and ship strike assessment) and estimates of whale abundance (to inform the krill risk assessment, Annex 6.7.1). The GSGSSI have indicated that they are keen to support future whale surveys on a broader range of species and have already committed their Fishery Patrol Vessel to a new upcoming project conducting winter cetacean surveys at South Georgia (DPLUS149, Section 10.2) and identified whales and their ship strike threats and habitat restoration in their 2021 Stewardship Framework for the next five years (<https://www.gov.gs/docsarchive/Environment/Protect%20Sustain%20Inspire.pdf>).

The pilot season we conducted at King Edward Point (KEP) in 2019 demonstrated that whale research is feasible from small local vessels. With GSGSSI approval, whale photo-ID and observation was added into the KEP Science Plan in 2020 (Annex 6.8.2) as a regular science activity to be conducted by the South Georgia science team. This monitoring has been conducted for nine months now and indicates that very few whales were present in South Georgia waters during 2020/21 (Project talk by Professor Martin Collins, <https://www.youtube.com/watch?v=LaZa9wCXldw&t=5341s>). The KEP science team can reference our whale photo-ID catalogues in order to match photographs of any newly sighted animals with the catalogue (e.g. Annex 6.5.3).

All right whale photo-ID images collected by the project have been archived at the IWC Secretariat where they are accessible on request to www.iwc.int. Humpback and right whale

images have also been submitted to happywhale where they are open-access, and the latter have also been submitted to Flukebook to assist a new AI initiative for auto-matching right whales. Humpback whale photo-ID images can be seen here: <https://happywhale.com/org/609;svy=22043> and <https://happywhale.com/org/696>.

We aim to create a sustainable legacy from these surveys by providing the South Georgia museum, local SG scientists and visiting tour vessels with a reference photo-ID catalogue for the key cetacean species regularly encountered at South Georgia (humpbacks, right whales and killer whales), which is updated by local SG scientists as part of their annual work. An example of the humpback photo-ID catalogue can be found in Annex 6.5.3.

We have engaged regularly with IAATO members about South Georgia whale research (both through our PP Cheeseman and via many talks given on IAATO vessels, and research slides presented by South Georgia museum during their vessel outreach). In particular we have highlighted the value of tourists collecting good quality photo-ID images to find out about whale movements. This led to the development of a photo-ID placard that is open access for download and was widely circulated during the 2018/19 season (www.iwc.int/sorp), and to a collaborative initiative with Happywhale to match humpback whale photo-IDs across the South Atlantic, involving multiple IAATO members and Brazilian scientists, of which the first publication is in review (Annex 6.7.3). IAATO members have also been consulted over our ship strike risk paper (Annex 6.6.3) and are currently considering potential tour vessel mitigation measures in response to these findings.

During the pandemic, the South Georgia museum are working on a new display of information about current whale recovery at South Georgia alongside the whaling artefacts, a display which will increase understanding of the population recovery of whales at South Georgia and also ensure enduring visibility of our project work to visitors to South Georgia. We are contributing to this and helping to advise the new artistic commission for a sculpture at South Georgia commemorating the loss of whales and celebrating their recovery (<https://www.sght.org/news/artistic-commission-winner-announced/>).

3.2 Outcome

The project outcome: To establish and publish baseline data on the status and recovery levels of whales on South Georgia feeding grounds, post whaling. Characterise abundance, distribution, diversity, habitat use, health and calving ground connections for conservation management.

The South Georgia right whale project has delivered on the main elements of this outcome. While the project obtained substantially less right whale data than originally anticipated, it has adapted significantly in order to gather meaningful habitat use and occurrence data from other species (e.g. humpback and Antarctic blue whales), and has been able to contribute to all of the key indicators. These were:

- (1) To contribute to GSGSSI marine management through publicly available reports (such as Annex 6.3.3, 6.7.2) and direct recommendations (Annex 6.5.2), both in relation to MPA monitoring (with all data publicly available for the next MPA review) and in relation to threat mitigation to whales (e.g. Annex 6.3.3). While there have not been any policy changes in relation to Annex 6.3.3 at the end of this project, the GSGSSI have committed to acting on the problem of ship strike risk to whales at South Georgia and IAATO are currently considering their best response to the findings of Annex 6.3.3 in relation to tour vessel behaviour. This collaboration between GSGSSI and IAATO to manage the issue is explicitly mentioned in the new GSGSSI Stewardship Framework (p15, Annex 6.8.4, <https://www.gov.gs/docsarchive/Environment/Protect%20Sustain%20Inspire.pdf>).
- (2) To contribute to the CCAMLR krill spatial management modelling framework through provision of whale sightings and habitat use data. Our work has been contributed to CCAMLR EMM (e.g. Annex 6.2.1) and our dataset is now being used in the CCAMLR krill risk assessment for Area 48.4. Funding is now secured (Section 10.2) to provide cetacean sightings as a data layer into this krill risk assessment (to be presented to CCAMLR-SC in autumn 2021). Data are available open access here <https://data.bas.ac.uk/full-record.php?id=GB/NERC/BAS/PDC/01546>. This outcome was not fully met within the lifetime of the project due to the small satellite tracking datasets that were collected in the field

(<https://www.bas.ac.uk/project/south-georgia-right-whale-project/south-georgia-right-whale-project-whale-tracking/>). Our original logframe had identified poor weather as a factor potentially limiting our capacity to do close-up work on whales- this assumption was correct, but the scarcity of right whales in the subsequent 2020 survey was also a significant and unanticipated factor. Consequently we re-focussed habitat use analyses towards humpback whales and have delivered information on habitat use and density patterns for use in the upcoming CCAMLR krill risk assessment.

- (3) In 2021, project members reported on data and provided management recommendations as part of an IWC Scientific Committee virtual workshop on the IWC Conservation Management Plan of southwest Atlantic right whales (Annex 6.8.1 and 6.8.3). More details on this outcome can be found in Section 3.1.

3.3 Monitoring of assumptions

Outcome and Output level assumptions were monitored throughout the course of this project and discussed extensively in each annual report to Darwin. There were two major assumptions that were not met over the course of the project: the first that right whales would be present in Jan/Feb 2020 at sufficient densities to enable an assessment of their habitat use as well as data collection of ~50 skin samples, photogrammetry of >10 animals and satellite tracking of up to 10 animals. Stemming from this assumption, the second major assumption was that we would be able to obtain sufficient right whale sightings to measure their abundance at South Georgia. When it became clear that these assumptions could not be met, we changed our project logframe to enable us to deliver information on baleen whale recovery at South Georgia more broadly, including abundance for humpback whales and all baleen whales, as well as density patterns, habitat use and ship strike risks for humpbacks.

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

As a result of this project, the GSGSSI now have baseline data on whale occurrence (in particular that of humpback, blue, right and fin whales) collected in Jan/Feb 2019 and 2020, as well as detailed information on humpback whale habitat use, suggesting that the north coast region is a particularly important area for this species, with high densities seen (Annex 6.3.3). These data can now be used (i) in all future marine protected area reviews of the region (which previously did not include cetacean information) and (ii) to ensure that visitor traffic has minimal impact on recovering whale populations. Our findings of whale recovery in South Georgia waters are also highlighted within “Protect Sustain Inspire”, the Stewardship framework for SGSSI recently developed by GSGSSI (<https://www.gov.gs/protect-sustain-inspire-news/>).

Of the five strategic objectives of our UKOT (South Georgia), our project aimed to address three of these, as follows, with our contribution to these described.

Objective 2: To conserve the Territory’s environment, minimise human impacts and, where practicable, restore the native biodiversity and habitats

We aimed to ensure whale distribution and habitat use would be taken into account in Marine Protected Area (MPA) reviews for the OT, therefore contributing to conservation decisions that are made. To date during the project lifetime we have now generated whale distribution data from two sightings surveys (Annex 6.7.1 and 6.3.1), analysed humpback whale habitat use in GSGSSI in relation to the MPA using satellite tracking data (Annex 6.7.2) and developed an analysis of summertime ship strike risks to whales, based on humpback whale density patterns (Annex 6.3.3). As a result of this work we have provided specific recommendations to the GSGSSI in relation to MPA planning for the next review and in relation to mitigation of ship strike risks to whales in future (Annex 6.5.2). These data will be used to help the OT decide appropriate mitigation to minimise risks of ship strikes on whales and can be incorporated in the next MPA review in 2023.

Objective 3: To manage SGSSI fisheries to the highest international standards of operation, stewardship and sustainability

In relation to fisheries sustainability, we used whale sightings data to estimate regional densities of whales and calculated annual krill consumption by baleen whales in South Georgia and South Sandwich Islands waters (Annex 6.7.1). This information will be used by CCAMLR in their upcoming krill risk assessment for these two areas (e.g. funding secured in Section 10.2), providing a measure of the likely impact of whales on krill, and therefore informing krill quota setting.

In relation to fisheries operation and stewardship: the analysis of humpback whale densities and ship strike risks (see Objective 2 above) are helping the GSGSSI determine appropriate mitigation measures to minimise risks of fishery vessels striking whales, and minimise negative vessel interactions. Through this approach, we are helping to embed an environmental issue (increasing whale abundance and recovery) into GSGSSI and IAATO decision making at South Georgia.

Objective 5: To preserve where practicable, and bring to a wider international audience, the heritage of South Georgia

Our work has brought significant international attention to South Georgia, through multiple BBC articles, including global reporting about the discovery of blue whales), and inclusion of the South Georgia right whale story in the recent Seven Worlds One Planet series (references in Annex 6.9.1). Through our partnerships with South Georgia Heritage Trust and Friends of South Georgia Island (see Section 2.2 for details), we are using the whale story to help the Trust raise further funds to preserve South Georgia heritage, while also building the visibility of whale research in these waters <http://www.sght.org/the-story-of-the-whale-at-south-georgia/>. The South Georgia right whale project results are also being featured in a new GSGSSI stamp series in 2021, further highlighting how centrally important the recovering whale populations are to the South Georgia marine ecosystem.

5 Gender equality

The leadership of this project (PI Jackson, Co-I Carroll 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 and over 50% of the project outputs (Annexes 6.2, 6.3, 6.6, 6.7) were led by females.

6 Sustainability and Legacy

The immense visibility given to the discovery of Antarctic blue whale whales returning to South Georgia waters is realistically likely to be the most enduring memory of this project for the public (see Annex 6.9.1). However the project can also report a number of enduring achievements, having delivered baseline information on the abundance (Annex 6.7.1) and habitat use patterns (Annex 6.7.2) of humpback whales in these waters, providing new baleen whale sighting and habitat use datasets that will be embedded into the CCAMLR krill risk assessments to assist future krill quota setting by GSGSI, and identifying the risk of ship strikes to these recovering whales through a joint analysis of humpback whale density and shipping traffic data (Annex 6.3.3). Whale recovery at South Georgia, as demonstrated by our project, is now common knowledge and also referenced in the new Stewardship Framework for SGSSI for future management of the territory. Already, funding has been secured to build further on some elements of the current projects, for example translating sighting data into a data layer for direct application within the CCAMLR krill risk assessment, and supporting further cetacean surveys during winter in order to assess the direct overlap between recovering whale populations and the winter krill fishery at South Georgia (Section 10.2). Datasets generated by the project have been archived with the BAS Polar Data Centre, to enable future researchers to access baseline data and compare with future surveys.

One very positive legacy of this project has been the increased collaboration and regular communication between: (i) the OT and other OTs (for example collaboration on two DPLUS grants, with the latest grant comparing right whale photo-ID datasets between South Georgia and the Falkland Islands); (ii) the OT and other South Atlantic countries, including Brazil, Argentina, Uruguay and South Africa. Presentations from representatives of each of these

regions were made at the 2021 project workshop, and a follow-up workshop is planned for November 2021. Project members are actively contributing to a new South-Atlantic wide humpback whale photo-ID initiative to match images through Happywhale (e.g. Annex 6.7.3, led by Brazilian colleagues) and to a new Southern Ocean-wide right whale consortium, led by South African collaborator Els Vermeulen (Vermeulen *et al.*, 2021).

This project provided temporary funding support to a large number of collaborators and sub-contractors in order to deliver on its various elements, as well as supporting a % of time for three BAS staff to deliver elements of the project. The only individual funded at 100% of time for a significant period was PP Morgana Vighi: this funding period ended in 2019. The end of the project therefore does not impact the project staff significantly. In relation to resources, some are being used in future cetacean survey work at South Georgia (for example the upcoming DPLUS winter cetacean surveys at South Georgia will utilise the acoustic equipment, cameras, laptop and associated field equipment). Other items have been made available to project partners who need them (for example the project crossbow is being provided to project partners Riet and Passadore in Uruguay to support their biopsy sampling of right whales) and to collaborators in the Falkland Islands (the satellite tags not used in this study will now be utilised in project DPLUS126, and the project bowsprit from the 2019 surveys has also been offered as a loan to this project). We are also retaining enough equipment at BAS to support future surveys at South Georgia, including PPE and safety clothing as well as biopsy sampling equipment.

7 Lessons learned

One significant lesson learned during the duration of the project was that inter-annual whale occurrence is highly variable at South Georgia (see our report to GSGSSI Annex 6.5.1), and we do not yet know enough about the environmental drivers of the occurrence of each whale species to be able to predict this variation or identify whether it will be a good or poor summer for particular species. Right whales were rarely seen during the January/February 2019 and 2020 surveys (Annex 6.3.1, 6.7.1), and were never encountered during the two months of coastal surveys from King Edward Point station, so limited right whale data were collected relative to our initial predictions at the start of the project. Consequently we broadened our objectives to include other species (e.g. humpback, blue and fin whales). The main lesson from this was that any whale research conducted at South Georgia needs to be highly adaptive and to allow for a significant amount of opportunistic data collection, although this will always be in tension with the limited time and weather windows available to do close-up cetacean work in this area.

Weather conditions were often poor and whales were often encountered solo or in pairs, in which conditions they are very boat-aware and can be difficult to approach closely, for example for satellite tagging. We tried to adapt to this limitation by extending the period of survey to increase encounter opportunities (e.g. working from KEP base throughout January & February 2019, and extending the 2020 Braveheart vessel charter period with additional funding provided by Friends of South Georgia Island), ultimately making four successful satellite tag deployments. Satellite tagging has been the most challenging of our field operations due to weather conditions and whale behaviour. This challenge is very difficult to fully mitigate due to the costs required, particularly for offshore charter vessels. For future working from KEP base, we would recommend extension of the field season through March in order to increase data collection opportunities.

If we were to repeat the project, given that we were conducting work in an area where very little systematic surveys have taken place, we would not have focussed the project so closely on one species, and allowed for some adaptation in the planning which could allow for project deliverables to be less species-specific. The lack of right whale sightings was a surprise, but the lack of data was not down to a failure to adequately survey for them. If right whales had been at similar or even half the densities of humpbacks in South Georgia waters in 2019 and 2020, we would have been able to deliver on both the habitat use analysis and abundance estimates anticipated in the project. We did not foresee the southern right whales being so flexible in their seasonal use of feeding grounds; there were no other southern right whale feeding ground studies that could have informed us of this, and our prior information suggested they were the most abundant species. Hence, we took the more viable approach of estimating habitat use patterns of krill feeding whales in general at South Georgia, rather than specifically right whales.

With respect to satellite tracking, we suggest that the most productive way to tag whales at South Georgia is to do this working from small boats at King Edward Point station; this provides a lower-cost and logistically simpler way to work in South Georgia for an extended period, reducing the costs and risks associated with vessel charter and increasing the opportunity of good weather periods in which tagging is possible. On the downside, the area that can be safely surveyed with this approach is limited to a small area along the north coast, and it has only proven feasible to study humpback whales within this area; very few other species were encountered so close to the coast in 2019.

A final lesson was that it would not have been possible to realise the aims of this project within the original timeframe of the Darwin project, as there were significant challenges to conducting surveys at South Georgia which needed to be overcome. We were working in a remote, poor weather polar location, using tools that had never previously been tried in that region (e.g. UAV photogrammetry and satellite tagging of whales). The January/February 2018 expedition was instructive that a yacht-based platform, while good for acoustics, was challenging for other types of data collection (biopsy, satellite tagging, surveying further offshore), and confirmed our assumption that the weather was a major factor influencing our field success. The January/February 2019 KEP surveys demonstrated that it is possible to do in-depth cetacean work at local scales at South Georgia using local powerboats, but never encountered right whales over this period, while the offshore Discovery survey similarly encountered right whales very rarely. Finally, the January/February 2020 survey was able to incorporate the learning from the previous surveys, with a larger vessel chartered to enable more offshore work and line transect surveying, and increased opportunistic data collection on other species. The team were travelling home from South Georgia when the COVID-19 pandemic began, so have been working on project outputs in often challenging circumstances in the last 15 months. We are therefore very grateful to Darwin for their flexibility in allowing this project to be so extended in length, and acknowledge that if the project time-period had not been so long, we would not have been able to deliver the planned Outcomes.

7.1 Monitoring and evaluation

The most significant change in the project design came at the start, when we were awarded an EU BEST Medium grant at the same time as the Darwin grant. We worked with EU BEST and Darwin to revise both projects so that they complemented each other in terms of objectives and deliverables, and to extend the lifetime of the Darwin grant so that the main expedition funded by this grant could take place after the EU BEST funded expedition. This additional funding significantly enhanced the capacity of both projects, in particular enabling multiple right whale field surveys to be conducted, and the capacity for the team to gain from significant learning experiences in the first field season, when poor weather limited most planned activities.

The second major change was the shift in focus from exclusively right whales to include other baleen whale species, enabling us to deliver on the main outcomes of the project for the stakeholders and OT government, despite the limited data we had collected from the focal species.

Over the project period, the M&E system was helpful for keeping partners involved in the project and keeping stakeholders informed. There was no internal or external evaluation of the work carried out over the project lifetime.

7.2 Actions taken in response to annual report reviews

We have responded to all issues raised in the annual report reviews. Where significant issues were raised, they were discussed with the relevant project partners in order to determine the best course of action.

8 Darwin Identity

- We have used the Darwin Initiative logo on the front page of all project presentations, and advertising for our talks, on the posters that we presented on our work, in the South Georgia Grytviken Museum and South Georgia Association meetings (e.g. Annex 6.9.1, 6.9.5). We mention the Darwin project on our website and in the Facebook page (www.facebook.com/SGwhale) and in all press releases (see Press Release list in Annex

6.9.1) and authored articles about our work (e.g. April 2020 edition of <https://southgeorgiaassociation.org/newsletters/>).

- While the DARWIN element of the project has formed part of a larger program, it has been very clearly associated with the 2020 South Georgia expedition as the main funder, and with the recent catch series development. DARWIN is highlighted in all expedition stories (e.g. <https://www.bas.ac.uk/blogpost/blue-whale-comeback-at-south-georgia/> and <https://www.bas.ac.uk/blogpost/bas-south-georgia-whale-expedition-in-full-swing-a-season-of-humpbacks-and-blue-whales/>) and acknowledged in all reports and publications arising from this work (Annex 6.3, 6.5, 6.6, 6.7).
- There is a good understanding of the Darwin Initiative in the South Georgia region as Darwin funded projects have made a substantial contribution to our understanding of regional biodiversity and has underpinned multiple conservation management projects.
- The project Facebook page (www.facebook.com/sqwhale) notes DARWIN as a key funder and provides links to DARWIN in blog posts. This page has >1,167 followers. DARWIN is referenced in blog posts on the BAS website (see above) and in Twitter outreach about the expedition, both by @BAS_News (44,800 followers), @polarbiome (the PI, 1297 followers) and project partners like @EmziCarroll (488 follower)

9 Impact of COVID-19 on project delivery

COVID-19 caused delays to shipment of samples and equipment needed for our project (e.g. genetic samples to New Zealand and microbiome samples to the USA) and in some cases institute closures delayed laboratory work and analysis which was planned to occur in the final year of the project (in particular, the genotyping of new samples in New Zealand and microbiome analysis). It also meant that the planned workshop at the end of the project was first delayed, and then held virtually rather than in-person (Activity 1.13), with a lot of work for example on recommendations done by email with project partners. Ultimately, these delays meant that some activities could not be completed, but did not impact the overall outcomes of the project, which were met (see Section 3.2).

The project staff employed on this grant since March 2020 were all able to work from home on the outputs required, with the exception of the genetic work (which was conducted in New Zealand, which has remained largely free of COVID-19, with minimum health and safety risks for labwork) and the microbiome analysis (which has been significantly delayed by lab closures, and is being conducted in accordance with the safety standards of the WHOI).

The remote attendance to our end of project workshop highlighted the opportunity for greater outreach afforded by Zoom, also evidenced by the amount of online outreach conducted in the last year, which easily matches outreach in earlier years, but in an online and therefore more internationally accessible format. Consequently the project team agreed to hold a second public webinar about our research results this November 2021, to keep both team and the general public updated about our progress, and expand the meeting to include other groups working on relevant whale recovery questions across the southwest Atlantic (Annex 6.1.3).

10 Finance and administration

10.1 Project expenditure

Project spend (indicative) since last annual report	2020/21 Grant (£)	2020/21 Total actual Darwin Costs (£)	Variance %	Comments (please explain significant variances)
Staff costs				
Consultancy costs				
Overhead Costs				
Travel and subsistence				

Project spend (indicative) since last annual report	2020/21 Grant (£)	2020/21 Total actual Darwin Costs (£)	Variance %	Comments (please explain significant variances)
Operating Costs				
Capital items				
Others				
TOTAL				

Staff employed (Name and position)	Cost (£)
Karina Rejane Groch	
Russell Leaper	
Susannah Calderan Marine Research	
Amy Sorenson Kennedy	
V Rowntree	
Other Contractor	
Phil Trathan	
Jen Jackson	
Gabriele Stowasser	
TOTAL	

Consultancy – description and breakdown of costs	Other items – cost (£)
TOTAL	

Capital items – description	Capital items – cost (£)
TOTAL	

Other items – description	Other items – cost (£)

DNA sequencing	
Right whale genotyping	
Stable Isotope analysis	
Hormone assay kit	
Audit	
TOTAL	

10.2 Additional funds or in-kind contributions secured

Source of funding for project lifetime	Total (£)
EU BEST Medium Grant	
South Georgia Heritage Trust and Friends of South Georgia Island (secured during the project period)	
WWF UK (secured during the project period)	
Government of South Georgia and the South Sandwich Islands (in-kind, secured during the project period, 100 hours boat time at £/hr)	
TOTAL	

Source of funding for additional work after project lifetime	Total (£)
DPLUS149 "Resolving ecosystem effects of the South Georgia winter krill fishery". Includes funding for two winter cetacean surveys at South Georgia.	
FCDO Overseas Territories Blue Belt program. "Analysis of krill and whale survey data in support of a risk assessment for the South Sandwich Islands"	
TOTAL	

10.3 Value for Money

With Darwin support to enable this project initiation, we were able to leverage significant additional funding from other sources (Section 10.2), to build a project that was significantly broader in scope than that originally anticipated in the project application.

All equipment purchased for the project accorded with UK government rules for procurement, with multiple quotes obtained from charterers, equipment suppliers and contractors where costs were over £. Furthermore, the equipment purchased during this project will continue to be used in future surveys, made available on loan, or gifted, to other conservation focussed projects in the OTs, or to project partners who are developing similar projects in their own territories (Section 6).

Projects operating within the UKOTs are often expensive due to the remoteness and difficult of access of the UKOT locations. For the most part we kept our project economic (relative to the costs of employing full-time staff members) by sub-contracting multiple project partners or technical experts with short-term contracts to deliver focussed work addressing specific aims of the fieldwork or project analysis. Significant in-kind contributions were also made into this project in terms of the time of the project partners, for example delivering multiple papers, datasets and reports towards the project outputs (Annex 6.3, 6.5 and 6.6).

11 Outstanding achievements of your project. This section may be used for publicity purposes

I agree for the Darwin Secretariat to publish the content of this section.

Our Darwin funded project has discovered that whale populations are recovering strongly at South Georgia island, a former epicentre of commercial whaling, with humpback whales now the most abundant species seen, and critically endangered Antarctic blue whales now regularly present during the summer months. Our project provides the first evidence of a strong migratory link between southern right whales feeding at South Georgia and wintering in low-latitude waters off Brazil and Uruguay (as well as adding to prior evidence of a link to Argentina) .We also provide baseline data on the abundance of humpback whales as well as baleen whales overall at South Georgia, and highlight the critical need to explicitly consider whales, their densities and habitat use patterns and ship strike risks, in marine protected area planning and environmental management of the region.

Photograph 1: Antarctic blue whale at South Georgia, DPLUS057. Image: Amy Kennedy.

Photograph 2: Humpback whale at South Georgia, DPLUS057. Image: John Dickens.

Annex 1 Project's full current logframe as presented in the application form (unless changes have been agreed)

Project summary	Measurable Indicators	Means of verification	Important Assumptions
<p>Impact:</p> <p>Integrate whale abundance, status and habitat use data into GSGSSI MPA planning, CCAMLR krill management models, IWC Conservation Management Plan, supporting objectives of the Conventions on Biological Diversity and on Conservation of Migratory Species, and to IUCN Cetacean Specialist Group</p>			
<p>Outcome:</p> <p>To establish and publish baseline data on the status and recovery levels of whales on South Georgia feeding grounds, post whaling. Characterise abundance, distribution, diversity, habitat use, health and calving ground connections for conservation management.</p>	<p>The project will provide the first baseline data on the feeding ground abundance and recovery population status of southwest Atlantic whales.</p> <p>This data will contribute to (i) the GSGSSI's marine management through interim and final publicly available reports, in particular to inform MPA monitoring and review processes, (ii) CCAMLR krill spatial management modelling framework, (iii) the IWC Conservation Management Plan for this population</p>	<p>0.1 Five week field survey</p> <p>0.2 Satellite tracking of ten whales</p> <p>0.3 Photo-identification and microsatellite genotype matching between South Georgia over two field seasons and with Argentine and Brazilian calving grounds</p> <p>0.4 Stable isotope data from up to 20 whales and 100 zooplankton samples to determine whale prey</p> <p>0.5 Collation of all available right whale sightings data</p> <p>0.6 Hormone assays and body condition photographs from up to 20 whales.</p> <p>0.7 Collation of oceanographic data associated with SG marine ecosystem</p> <p>0.8 Calculate abundance and feeding ground connectivity with Argentina and South Africa</p> <p>0.9 Collate right whale catch history data from southwest Atlantic</p> <p>0.10 Conduct population modelling of the historical trajectory of right whales in</p>	<p>Requires that fieldwork is successfully achieved. Two possible hindrances:</p> <ol style="list-style-type: none"> 1. Equipment failure (data cannot be collected). To mitigate against this at least two items of all equipment required for conducting the fieldwork will be carried, including cameras, biopsy rifles, hexacopters, multiple sonobuoys, hydrophones, tag deployment systems. All equipment is well maintained and serviced. 2. Bad weather (data cannot be collected). The 40-day length of the survey is designed to minimise the impact of bad weather on data collection. We take into account 3 bad weather days in 10 to give 21 survey days, and use acoustic localisation to maximise data collection opportunities when weather permits. 3. Personnel injury. All personnel are highly experienced with working on small boats and with fieldwork of this nature. The vessel will remain close to the north coast of South Georgia for the duration of the

Project summary	Measurable Indicators	Means of verification	Important Assumptions
		the southwest Atlantic to measure population status and recovery levels.	<p>survey, within one day's sailing of King Edward Point station if urgent medical assistance is required. All personnel have first aid training.</p> <p>Mark resight abundance estimation requires that there are resightings of whales between years. To maximise resight opportunities we will (1) acoustically localise whales using sonobuoys to maximise encounter rates, (2) encourage tourist photo-ID submissions via Project Partner Cheeseman (www.happywhale.com), (3) use microsatellite genotypes to identify siblings and parents and conduct mark recapture using very close-kin. We will also minimise risk by using alternate means of measuring abundance, through analysis of (i) sightings data, (ii) acoustic detection densities and (iii) quantifying connectivity with SG calving ground (where abundance estimates are available)</p>
<p>Outputs:</p> <p>1. Report to GSGSSI on (i) status assessment of SG whale distribution, habitat use and recovery patterns in the southwest Atlantic, (ii) risks to the populations, (iii) recommended actions to mitigate risks</p>	<p>Data compiled from cruise and combined with other sightings, incorporated into a single document available externally for viewing on the website of the GSGSSI.</p> <p>Provides a baseline for measuring change in species characteristics in response to impacts, including climate change.</p>	<p>1.1 Achievement of 0.1-0.6 above</p> <p>1.2 Report for future MPA planning</p> <p>1.3 Falklands based workshop on project plans and feedback with stakeholders including GSGSSI in Feb 2020</p> <p>1.4 UK based workshop in Nov 2020 with stakeholders including GSGSSI to share results and agree report recommendations</p>	None envisaged

Project summary	Measurable Indicators	Means of verification	Important Assumptions
<p>2. Report key whale habitat use data to CCAMLR through a scientific paper to the EMM Working Group for consideration within spatial management proposals for regional krill fishery development.</p>	<p>Whale habitat use patterns in SG waters provided in 2019 scientific report to CCAMLR EMM group. This group has never previously considered information on whale habitat use in relation to krill fishery discussions. This is therefore a precedent breaking initiative.</p>	<p>2.1 Information from 0.2, 0.4, 0.5 and 0.7 integrated into ARC GIS database and made publicly accessible through www.bas.ac.uk</p> <p>2.2 Report for CCAMLR prepared and publicly available through www.ccamlr.org</p>	<p>Assumes that a CCAMLR report on whale habitat use will be acceptable for discussion by the CCAMLR Scientific Committee who do not traditionally consider whales in their ecosystem management discussions.</p> <p>To address the risk that this information is rejected, we will seek recommendation for this work during the delayed 2018 joint IWC/CCAMLR meeting on ecosystem modelling through multiple IWC and CCAMLR Project Partners who will be involved in this joint meeting.</p>
<p>3. Report right whale connectivity and health assessment data to the IWC to address multiple scientific recommendations and concerns regarding threats and data gaps and contribute to the IWC Conservation Management Plan for this population.</p>	<p>Right whale health and connectivity parameters will be provided in a 2019 scientific report to IWC Scientific Committee. The GSGSSI final report (output 1) will also be submitted as further information. A series of recommendations and ways in which this work addresses Conservation Management Plan concerns will also be drafted for endorsement by the IWC Scientific Committee.</p>	<p>3.1 Information from 0.3, 0.4 and 0.6 collated into summary of population connectivity, diversity and health status which will be provided in a report to IWC, publicly available through www.iwc.int</p>	<p>None envisaged</p>
<p>4. Calculate right whale depletion levels in the southwest Atlantic</p>	<p>4.1 Complete population abundance and catch series summary for endorsement by the IWC scientific committee. Contribute to IUCN Cetacean Specialist Group for next threat status determination for southern right whales.</p>	<p>4.1 Catch series to be provided to the IWC Secretariat for databasing where it will be publicly accessible.</p> <p>4.2 Abundance to be estimated if SG whales have sufficient connectivity with low-latitude calving grounds to permit calculation.</p>	<p>Abundance and connectivity measurement may require application of a variety of approaches. For example there is a risk that no whales are resighted between years for mark-recapture analysis. However two field seasons of data collection means estimation of connectivity with Brazil/Argentina will be more robust. Without resights we will use the connectivity estimate to derive a measure of the proportion of whales</p>

Project summary	Measurable Indicators	Means of verification	Important Assumptions
			using SG from those grounds, and use established abundance estimates from breeding grounds to estimate the likely abundance of SRW at South Georgia.
<p>5. Create strong collaborative network of stakeholders to sustain project results, assist with further monitoring and broaden scope of baseline surveys to other whale species</p>	<p>5.1 Collaborative workshop at the close of the project involving all stakeholders in Stanley, Falkland Islands in order to communicate results and agree final recommendations arising from project and future work.</p> <p>5.2 All whale photos made open access through public databases including through Antarctic tour industry portal happywhale.com and results promoted through stakeholder linkages to encourage future submission of right, blue and humpback whale photographs for identification and matching.</p>	<p>5.1 Workshop report publicly available (output 1),</p> <p>5.2 Press release and news report about workshop generated by BAS and through Project Partner press teams.</p> <p>5.3 happywhale.com tracks photo submissions during and after project to evaluate impact of project awareness on tourist interest in the project.</p>	<p>Through engagement with OT stakeholders throughout the project period, and including stakeholder-assisted development of conservation management recommendations, we hope to maximise chances of sustainability following this baseline work. Feedback into key scientific bodies (IWC and CCAMLR) as well as the IWC Conservation Management Plan will also provide internationally recognised recommendations which will provide additional impetus for assisting development of a South Georgia and South Sandwich Islands whale monitoring program in the future.</p>
<p>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)</p> <p>Activity 1.1 Virtual project planning meeting with all project partners and key stakeholders in GSGSSI in May 2017 with subsequent M&E meetings every six months.</p> <p>Activity 1.2.1 Obtain permits from GSGSSI and Animal Ethics approvals for fieldwork and scientific procedures.</p> <p>Activity 1.2.2 Equipment purchase, permit applications, shipping of equipment to Falkland Islands as British Antarctic Survey cargo.</p> <p>Activity 1.3 Travel to Falkland Islands for pre-cruise workshop in Stanley, Falkland Islands to discuss cruise details and expected outcomes with OT government officials, NGOs and Antarctic tour operators.</p> <p>Activity 1.4 Survey embarks from Stanley, Falkland Islands for 5 weeks</p> <p>Activity 1.4.1 Deploy DiFAR sonobuoys and use sonobuoy transmissions and sightings to locate whales</p> <p>Activity 1.4.2 Skin samples collected from all encountered whales (50)</p> <p>Activity 1.4.3 Photographs collected of all encountered whales (50-60, head shots collected via hexacopter)</p> <p>Activity 1.4.4 Satellite tracking of up to 10 whales (PP Zerbini and Andriolo)</p> <p>Activity 1.4.5 Blubber samples collected from 10-20 whales (PP Carroll)</p> <p>Activity 1.4.6 Photogrammetry measurements taken by hexacopter from 10-20 whales</p>			

Project summary	Measurable Indicators	Means of verification	Important Assumptions
<p>Activity 1.4.7 Blog about survey on British Antarctic Survey website, using blog, twitter and media outlets to share photos and videos from the voyage.</p> <p>Activity 1.5 Biological samples shipped from the Falkland Islands to UK as British Antarctic Survey cargo in April 2019, transported at appropriate storage temperature.</p> <p>Activity 1.6.1 Provide photo-ID catalogue to regional associates in Brazil and Argentina, also IWC secretariat for open access hosting and happywhale.com. Circulate copies of catalogue to tour operators working in the South Georgia region in order to encourage crowd-sourced photo submissions</p> <p>Activity 1.6.2 Project Partners (Rowntree, Groch and Passadore/Dimitriadis) conduct photo-ID matching with Argentine and Brazilian calving grounds and the Uruguayan socialising ground. Project Partner Kennedy will also conduct photo-ID matching between the two South Georgia survey years to identify any resights.</p> <p>Activity 1.7.1 Compile acoustic and sightings data from cruise years 1 and 2 (PP Leaper and PL Jackson)</p> <p>Activity 1.7.2 Compile oceanographic data over two years of surveys to put sightings and satellite tracks in oceanic context (Trathan at BAS)</p> <p>Activity 1.7.3 Construct right whale habitat models (PP Zerbin)</p> <p>Activity 1.8.1 Provide cruise report, distribution patterns and habitat use analysis to International Whaling Commission (June 2020)</p> <p>Activity 1.8.2 Report on right whale habitat use patterns from two years of surveys to South Georgia government (Sept 2020)</p> <p>Activity 1.9.1 Zooplankton and whale isotope analysis (Stowasser at BAS)</p> <p>Activity 1.9.2 Whale prey identification (Stowasser at BAS)</p> <p>Activity 1.10.1 DNA extraction, microsatellite genotyping & mitochondrial DNA sequencing (PL Jackson, PP Carroll)</p> <p>Activity 1.10.2 Measure population diversity of South Georgia and differentiation from calving ground, as well as matching microsatellite genotypes of individuals with those available from Península Valdés calving ground and with the 2019 SG survey (PP Carroll)</p> <p>Activity 1.10.3 Measure assignment of South Georgia whales to calving grounds using global dataset held (PP Carroll)</p> <p>Activity 1.11.1 Assay stress hormones in blubber samples e.g. cortisol (PP Hall)</p> <p>Activity 1.11.2 Assay progesterone to measure pregnancy in blubber-sampled whales identified as female (PP Hall)</p> <p>Activity 1.12 Photogrammetry analysis of whale body condition from photos (PP Moore)</p> <p>Activity 1.13 Organise UK workshop in Nov 2020 with project partners and stakeholders to present science outputs from SG field surveys, conclude population recovery status of southwest Atlantic right whales and write conservation management recommendation report to GSGSSI.</p> <p>Activity 2.1 Summarise results from Activities 1.4 and 1.7 to prepare CCAMLR scientific report on right whale habitat use</p> <p>Activity 2.2 Project member (Trathan) present report to CCAMLR EMM meeting discussing the relative consumption of krill by penguins, seals and whales and the necessity for considering cetaceans in krill fisheries management</p> <p>Activity 3.1 Summarise results from activities 1.4, 1.6, 1.9, 1.10, 1.11 and 1.12 into IWC scientific report on right whale connectivity and health status on SG feeding grounds using all SG data collected to date.</p> <p>Activity 3.2 Present report to IWC Scientific Committee meeting</p>			

Project summary	Measurable Indicators	Means of verification	Important Assumptions
<p>Activity 4.1 PDRA Vighi to conduct in-depth review of southwest Atlantic right whale catches using historical material, including logbooks and import records. Generate a catch series (or series of catch series to capture the catch uncertainty).</p> <p>Activity 4.2 PL Jackson, PP Carroll, PP Zerbini and PP Leaper to measure SG right whale abundance using mark recapture information from two seasons of surveys, also considering estimates derived from density data obtained from acoustic monitoring and sightings.</p> <p>Activity 4.3 PL Jackson, PP Carroll and PP Zerbini use connectivity data (Activity 3.1) to quantify the degree of connection between SG and PV and measure abundance as proportion of PV abundance.</p> <p>Activity 4.4 PL Jackson to estimate right whale abundance, if possible from connectivity data above.</p> <p>Activity 4.5 Present report to IWC Scientific Committee meeting for feedback</p> <p>Activity 5.1 Organise a 3 day project summary workshop in UK, with 1 day open to all, presenting science summaries, and 2 day open to steering group and OT representatives to discuss and agree conservation recommendations, including South Georgia Government, key Falkland Islands environmental research institutes and NGOs and Antarctic tour operators. Krill fishery representatives will also be invited.</p> <p>Activity 5.2 Compile conservation recommendations from steering group and stakeholders into project summary report</p> <p>Activity 5.3 Write Darwin summary project report</p> <p>Activity 5.4 Audit of project expenditure</p>			

Annex 2 Report of progress and achievements against final project logframe for the life of the project

Project summary	Measurable Indicators	Progress and Achievements for the life of the project
<p>Impact:</p> <p>Integrate whale abundance, status and habitat use data into GSGSSI MPA planning, CCAMLR krill management models, IWC Conservation Management Plan, supporting objectives of the Conventions on Biological Diversity and on Conservation of Migratory Species, and to IUCN Cetacean Specialist Group</p>		<p>The main positive impact on biodiversity from our project is the work showing that there is a significant risk of ship strikes on whales at South Georgia in summer (Annex 6.3.3). GSGSSI and IAATO are now working together to mitigate this risk and enhance environmental protection of whales in South Georgia waters (p15, https://www.gov.gs/docsarchive/Environment/Protect%20Sustain%20Inspire.pdf).</p>
<p>Outcome</p> <p>To establish and publish baseline data on the status and recovery levels of whales on South Georgia feeding grounds, post whaling. Characterise abundance, distribution, diversity, habitat use, health and calving ground connections for conservation management.</p>	<p>The project will provide the first baseline data on the feeding ground abundance and recovery population status of southwest Atlantic whales.</p> <p>This data will contribute to (i) the GSGSSI's marine management through interim and final publicly available reports, in particular to inform MPA monitoring and review processes, (ii) CCAMLR krill spatial management modelling framework, (iii) the IWC Conservation Management Plan for this population</p>	<p>The South Georgia right whale project has delivered on the main elements of this outcome. While the project obtained substantially less right whale data than originally anticipated, it has adapted significantly in order to gather meaningful habitat use and occurrence data from other species, and has been able to contribute to all of the indicators originally envisaged, e.g. (i) Annex 6.5.1, (ii) sightings data used in krill spatial management modelling by CCAMLR (https://data.bas.ac.uk/full-record.php?id=GB/NERC/BAS/PDC/01546), (iii) contributing data and recommendations to the IWC Conservation Management Plan, see Annex 6.8.1, 6.8.3 and Section 2.3.</p>
<p>Output 1.</p> <p>Report to GSGSSI on (i) status assessment of SG whale distribution, habitat use and recovery patterns in the southwest Atlantic, (ii) risks to the populations, (iii) recommended actions to mitigate risks</p>	<p>Data compiled from cruise and combined with other sightings, incorporated into a single document available externally for viewing on the website of the GSGSSI.</p> <p>Provides a baseline for measuring change in species characteristics in response to impacts, including climate change.</p>	<p>Status report, summarising assessment results, risks and recommendations, has been completed and provided to the GSGSSI for review and publication (Annex 6.5.1).</p>
<p>Activity 1.1 Virtual project planning meeting with all project partners and key stakeholders in GSGSSI in May 2017 with subsequent M&E meetings every six months.</p>		<p>Meeting minutes and reports available in Annex 6.1.</p>

Project summary	Measurable Indicators	Progress and Achievements for the life of the project
<p>Activity 1.2.1 Obtain permits from GSGSSI and Animal Ethics approvals for fieldwork and scientific procedures.</p> <p>Activity 1.2.2 Equipment purchase, permit applications, shipping of equipment to Falkland Islands as British Antarctic Survey cargo.</p>		<p>Actions completed. GSGSSI Permits and Ethics approvals provided and cited in publications associated with each survey (Annex 6.3.1, 6.3.2, 6.6.1, 6.6.2, 6.6.4, 6.6.5,</p>
<p>Activity 1.3 Travel to Falkland Islands for pre-cruise workshop in Stanley, Falkland Islands to discuss cruise details and expected outcomes with OT government officials, NGOs and Antarctic tour operators.</p>		<p>Action differed from original proposal, due to flight schedules leaving insufficient time for workshop. Cruise plan provided to all stakeholders ahead of time for review and comment (Annex 6.4.1), and a short meeting with GSGSSI was held on the day of departure in order .</p>
<p>Activity 1.4 Survey embarks from Stanley, Falkland Islands for 5 weeks</p> <p>Activity 1.4.1 Deploy DiFAR sonobuoys and use sonobuoy transmissions and sightings to locate whales</p> <p>Activity 1.4.2 Skin samples collected from all encountered whales (50)</p> <p>Activity 1.4.3 Photographs collected of all encountered whales (50-60, head shots collected via hexacopter)</p> <p>Activity 1.4.4 Satellite tracking of up to 10 whales (PP Zerbinini and Andriolo)</p> <p>Activity 1.4.5 Blubber samples collected from 10-20 whales (PP Carroll)</p> <p>Activity 1.4.6 Photogrammetry measurements taken by hexacopter from 10-20 whales</p> <p>Activity 1.4.7 Blog about survey on British Antarctic Survey website, using blog, twitter and media outlets to share photos and videos from the voyage.</p>		<p>Actions completed.</p> <p>Activity 1.4.1: 31 DiFAR sonobuoys deployed (see Annex 6.3.1 and 6.6.4)</p> <p>Activity 1.4.2: Southern right whales: 7 skin samples collected (see Annex 6.5), humpback whales: 17 skin samples collected, blue whales: 9 skin samples collected (Annex 6.3.1)</p> <p>Activity 1.4.3: Southern right whales: 11 photographs collected, along with photo-IDs of humpback, blue, fin and killer whales (Annex 6.3.1)</p> <p>Activity 1.4.4: two right whales and two humpback whales satellite tracked (https://www.bas.ac.uk/project/south-georgia-right-whale-project/south-georgia-right-whale-project-whale-tracking/)</p> <p>Activity 1.4.5: 11 blubber samples collected (Annex 6.3.1 and Annex 6.3.2)</p> <p>Activity 1.4.6: six photogrammetry measurements (Annex 6.3.1 and Annex 6.3.2)</p> <p>Activity 1.4.7 see https://www.bas.ac.uk/project/south-georgia-right-whale-project/#blog and www.facebook.com/sgwhale for project outreach.</p>
<p>Activity 1.5 Biological samples shipped from the Falkland Islands to UK as British Antarctic Survey cargo in April 2019, transported at appropriate storage temperature.</p>		<p>Action completed. Evidenced by return of samples to UK and reporting of outcomes from samples in Annex 6.5 and 6.3.2.</p>
<p>Activity 1.6.1 Provide photo-ID catalogue to regional associates in Brazil and Argentina, also IWC secretariat for open access hosting and happywhale.com. Circulate copies of catalogue to tour operators working in the South Georgia region in order to encourage crowd-sourced photo submissions</p>		<p>Action completed. Matching with Brazil, Argentina, Uruguay and South Africa reported in Annex 6.3.2. IWC Secretariat is now hosting this catalogue at www.iwc.int (available on request) and photo-IDs are available on happywhale.com</p>

Project summary	Measurable Indicators	Progress and Achievements for the life of the project
Activity 1.6.2 Project Partners (Rowntree, Groch and Passadore/Dimitriadis) conduct photo-ID matching with Argentine and Brazilian calving grounds and the Uruguayan socialising ground. Project Partner Kennedy will also conduct photo-ID matching between the two South Georgia survey years to identify any resights.		for future matching (also see Annex 6.7.3 for progress on humpback whale catalogue matching).
Activity 1.7.1 Compile acoustic and sightings data from cruise years 1 and 2 (PP Leaper and PL Jackson) Activity 1.7.2 Compile oceanographic data over two years of surveys to put sightings and satellite tracks in oceanic context (Trathan at BAS) Activity 1.7.3 Construct right whale habitat models (PP Zerbin)		Activity 1.7.1. Acoustic data published in Annex 6.6.4 and 6.6.5, sighting data published in Annex 6.3.1 and 6.6.2. Datasets available through BAS Polar Data Centre. Activity 1.7.2 this work was done by PhD student Connor Bamford rather than PP Trathan as part of our work identifying the drivers of humpback whale habitat use (Annex 6.7.2). Activity 1.7.3 habitat use models too limited for right whales due to small dataset size, so conducted for humpback whales instead (Annex 6.7.2).
Activity 1.8.1 Provide cruise report, distribution patterns and habitat use analysis to International Whaling Commission (June 2020) Activity 1.8.2 Report on right whale habitat use patterns from two years of surveys to South Georgia government (Sept 2020)		Activity 1.8.1 completed see Annex 6.3.1 Activity 1.8.2 not possible (see Activity 1.7.3) so reported humpback whale habitat use patterns instead (Annex 6.7.2). Both species are krill feeding specialists so their movement patterns are relevant to Marine Protected Area planning and krill quota assessments (see Annex 6.5.2).
Activity 1.9.1 Zooplankton and whale isotope analysis (Stowasser at BAS) Activity 1.9.2 Whale prey identification (Stowasser at BAS)		Activity 1.9 completed, see Annex 6.3.2.
Activity 1.10.1 DNA extraction, microsatellite genotyping & mitochondrial DNA sequencing (PL Jackson, PP Carroll) Activity 1.10.2 Measure population diversity of South Georgia and differentiation from calving ground, as well as matching microsatellite genotypes of individuals with those available from Península Valdés calving ground and with the 2019 SG survey (PP Carroll) Activity 1.10.3 Measure assignment of South Georgia whales to calving grounds using global dataset held (PP Carroll)		Activity 1.10.1 completed, see Annex 6.5.1. Activity 1.10.2 and 1.10.3 completed, see Annex 6.5.1 and 6.6.1.
Activity 1.11.1 Assay stress hormones in blubber samples e.g. cortisol (PP Hall) Activity 1.11.2 Assay progesterone to measure pregnancy in blubber-sampled whales identified as female (PP Hall)		Activity 1.11 completed, see Annex 6.3.2.
Activity 1.12 Photogrammetry analysis of whale body condition from photos (PP Moore)		Activity 1.12 completed, see Annex 6.3.2.

Project summary	Measurable Indicators	Progress and Achievements for the life of the project
Activity 1.13 Organise UK workshop in Nov 2020 with project partners and stakeholders to present science outputs from SG field surveys, conclude population recovery status of southwest Atlantic right whales and write conservation management recommendation report to GSGSSI.		Activity 1.13 moved to March 2021 and held as a public webinar series, available here: https://www.youtube.com/watch?v=kOaFdtVJRC0&t=40s and https://www.youtube.com/watch?v=LaZa9wCXldw Conservation management recommendation report, see Annex 6.5.2.
Output 2. Report key whale habitat use data to CCAMLR through a scientific paper to the EMM Working Group for consideration within spatial management proposals for regional krill fishery development.	Whale habitat use patterns in SG waters provided in 2019 scientific report to CCAMLR EMM group. This group has never previously considered information on whale habitat use in relation to krill fishery discussions. This is therefore a precedent breaking initiative.	Report on South Georgia whale abundance and habitat use provided to CCAMLR – EMM in 2019 (Annex 6.2.1). Whale sightings data obtained from this project (https://doi.org/10.5285/5F1E349B-6665-4617-9BF7-EE5C8CBCDD54) are now being used as the primary whale dataset in the CCAMLR krill risk assessment for South Georgia and the South Sandwich Islands (Areas 48.3 and 48.4). Results will be presented to CCAMLR – SC in 2021.
Activity 2.1 Summarise results from Activities 1.4 and 1.7 to prepare CCAMLR scientific report on right whale habitat use		There was insufficient data available from right whales to present a scientific report on right whale habitat use.
Activity 2.2 Project member (Trathan) present report to CCAMLR EMM meeting discussing the relative consumption of krill by penguins, seals and whales and the necessity for considering cetaceans in krill fisheries management		PP Trathan has been instrumental in getting cetacean data explicitly considered within the new krill fisheries risk assessment. As an example, this topic was covered in a paper presented virtually to the CCAMLR-EMM working group in 2020 (Warwick-Evans et al. 2020 Spatially-explicit estimates of consumption of Antarctic krill by a suite of seabird and marine mammal predators in the north-west Antarctic Peninsula), and a paper on developing an ecosystem approach for managing the krill fishery at South Georgia, presented to CCAMLR-EMM in 2020 and now published: Trathan P. N, et al., (2021). Enhancing the ecosystem approach for the fishery for Antarctic krill within the complex, variable and changing ecosystem at South Georgia. ICES J. Mar. Sci.: fsab092. doi: 10.1093/icesjms/fsab092. Available at: https://academic.oup.com/icesjms/advance-article/doi/10.1093/icesjms/fsab092/6295716
Output 3 Report right whale connectivity and health assessment data to the IWC to address multiple scientific recommendations and concerns regarding threats and data gaps and contribute to the IWC Conservation Management Plan for this population.	Right whale health and connectivity parameters will be provided in a 2019 scientific report to IWC Scientific Committee. The GSGSSI final report (output 1) will also be submitted as further information. A series of recommendations and ways in which this work addresses Conservation Management Plan concerns will also	Output 3 successfully completed and delivered to IWC (Annex 6.3.1), while project results were reported in detail to a workshop of the IWC Conservation Management Plan for this population (Annex 6.8.1 and see Section 2.3 above).

Project summary	Measurable Indicators	Progress and Achievements for the life of the project
	be drafted for endorsement by the IWC Scientific Committee.	
Activity 3.1 Summarise results from activities 1.4, 1.6, 1.9, 1.10, 1.11 and 1.12 into IWC scientific report on right whale connectivity and health status on SG feeding grounds using all SG data collected to date.		Activity 3.1 completed, see Annex 6.3.1.
Activity 3.2 Present report to IWC Scientific Committee meeting		Activity 3.2 completed, see Annex 6.3.1.
Output 4 Calculate right whale depletion levels in the southwest Atlantic	Complete population abundance and catch series summary for endorsement by the IWC scientific committee . Contribute to IUCN Cetacean Specialist Group for next threat status determination for southern right whales.	A right whale catch series was developed (Annex 6.6.3). An abundance estimate could not be made for southern right whales due to insufficient sightings or re-sightings. Instead we provided abundance estimates for humpback and baleen whales, providing a broader understanding of whale recovery at South Georgia (Annex 6.7.1) as well as identifying risks to the populations (Annex 6.3.3 and 6.5.2). The last IUCN threat status determination for southern right whales concluded in 2018, prior to our completion of the current work (https://www.iucnredlist.org/species/8153/50354147). Therefore our findings on right whale population diversity, connectivity and health (Annex 6.6.1-6.6.3, 6.3.2) and threats (Annex 6.3.3) will be contributed to the next IUCN assessment, after the project lifetime.
Activity 4.1 PDRA Vighi to conduct in-depth review of southwest Atlantic right whale catches using historical material, including logbooks and import records. Generate a catch series (or series of catch series to capture the catch uncertainty).		Activity 4.1 completed, see Annex 6.6.3.
Activity 4.2 PL Jackson, PP Carroll, PP Zerbinini and PP Leaper to measure SG right whale abundance using mark recapture information from two seasons of surveys, also considering estimates derived from density data obtained from acoustic monitoring and sightings.		Activity 4.2 not possible due to insufficient sightings of right whales.
Activity 4.3 PL Jackson, PP Carroll and PP Zerbinini use connectivity data (Activity 3.1) to quantify the degree of connection between SG and PV and measure abundance as proportion of PV abundance.		Activity 4.3 not possible due to insufficient re-sightings of right whales between South Georgia and low-latitude calving sites (one re-sighting only).
Activity 4.4 PL Jackson to estimate right whale abundance, if possible from connectivity data above.		Activity 4.4 not possible, see above. However we have been able to provide estimates of abundance for humpback and baleen whales instead (Annex 6.7.1)
Activity 4.5 Present report to IWC Scientific Committee meeting for feedback		Insufficient data to present a report to IWC on this topic.
Output 5 Create strong collaborative network of stakeholders to sustain project results, assist with further	5.1 Collaborative workshop at the close of the project involving all stakeholders in Stanley, Falkland Islands in order to	This workshop has been held (Activity 5.1) and recommendations provided to GSGSSI (Activity 5.2).

Project summary	Measurable Indicators	Progress and Achievements for the life of the project
monitoring and broaden scope of baseline surveys to other whale species	<p>communicate results and agree final recommendations arising from project and future work.</p> <p>5.2 All whale photos made open access through public databases including through Antarctic tour industry portal happywhale.com and results promoted through stakeholder linkages to encourage future submission of right, blue and humpback whale photographs for identification and matching.</p>	<p>Whale photo-identifications have been made open access through www.iwc.int and www.happywhale.com.</p>
<p>Activity 5.1 Organise a 3 day project summary workshop in UK, with 1 day open to all, presenting science summaries, and 2 day open to steering group and OT representatives to discuss and agree conservation recommendations, including South Georgia Government, key Falkland Islands environmental research institutes and NGOs and Antarctic tour operators. Krill fishery representatives will also be invited.</p>		<p>Open access webinars were organised, summarising the results of the project, hosted by local stakeholder South Georgia Heritage Trust. All key stakeholders invited to attend. Attended by 408 and 250 individuals on each evening (not including panelists) and available for viewing here: https://www.youtube.com/watch?v=kOaFdtVJRC0&t=40s and https://www.youtube.com/watch?v=LaZa9wCXldw.</p> <p>Minutes of the steering group meeting can be found in Annex 6.1.3.</p>
<p>Activity 5.2 Compile conservation recommendations from steering group and stakeholders into project summary report</p>		<p>Report provided to the GSGSSI (Annex 6.5.2)</p>
<p>Activity 5.3 Write Darwin summary project report</p>		<p>Complete</p>
<p>Activity 5.4 Audit of project expenditure</p>		<p>In progress</p>

Annex 3 Standard Measures

Code	Description	Totals (plus additional detail as required)
Training Measures		
1	Number of (i) students from the UKOTs; and (ii) other students to receive training (including PhD, masters and other training and receiving a qualification or certificate)	(ii) 1
2	Number of (i) people in UKOTs; and (ii) other people receiving other forms of long-term (>1yr) training not leading to formal qualification	0
3a	Number of (i) people in UKOTs; and (ii) other people receiving other forms of short-term education/training (i.e. not categories 1-5 above)	0
3b	Number of training weeks (i) in UKOTs; (ii) outside UKOTs not leading to formal qualification	0
4	Number of types of training materials produced. Were these materials made available for use by UKOTs?	1 Laminated photo-ID placard, which was made available for use in the UKOT https://iwc.int/document_3662.download
5	Number of UKOT citizens who have increased capacity to manage natural resources as a result of the project	2 (KEP scientists who now regularly monitor whales and collate photo-ID catalogue)
Research Measures		
9	Number of species/habitat management plans/ strategies (or action plans) produced for/by Governments, public authorities or other implementing agencies in the UKOTs	1 Report to the GSGSSI
10	Number of formal documents produced to assist work in UKOTs related to species identification, classification and recording.	0
11a	Number of papers published or accepted for publication in peer reviewed journals written by (i) UKOT authors; and (ii) other authors	(ii) 6, see Annex 4
11b	Number of papers published or accepted for publication elsewhere written by (i) UKOT authors; and (ii) other authors	(ii) 6, see Annex 4
12b	Number of computer-based databases enhanced (containing species/genetic information). Were these databases made available for use by UKOTs?	5. Polar Data Centre (cetacean sightings data*), IWC* (right whale photo-ID database), Genbank* (South Georgia right whale DNA sequences and genome), Flukebook (right

Code	Description	Totals (plus additional detail as required)
		whale photo-IDs), Happywhale* (humpback and right whale photo-IDs). *open access
13a	Number of species reference collections established. Were these collections handed over to UKOTs?	0
13b	Number of species reference collections enhanced. Were these collections handed over to UKOTs?	0
Dissemination Measures		
14a	Number of conferences/seminars/workshops/stakeholder meetings organised to present/disseminate findings from UKOT's Darwin project work	4
14b	Number of conferences/seminars/workshops/stakeholder meetings attended at which findings from the Darwin Plus project work will be presented/disseminated	18
Physical Measures		
20	Estimated value (£s) of physical assets handed over to UKOT(s)	0
21	Number of permanent educational/training/research facilities or organisation established in UKOTs	0
22	Number of permanent field plots established in UKOTs	0
23	Value of resources raised from other sources (e.g., in addition to Darwin funding) for project work	£

Annex 4 Publications

Type * (e.g. journals, manual, CDs)	Detail (title, author, year)	Nationality of lead author	Nationality of institution of lead author	Gender of lead author	Publishers (name, city)	Available from (e.g. weblink, contact address, annex etc)
Conference paper	Jackson J. A., et al. 2018. Sightings and acoustic records of right whales collected in South Georgia (Islas Georgias del Sur) waters January-February 2018. Paper SC/67b/SH20 presented to the IWC Scientific Committee, May 2018 (unpublished). 12pp. [Available from www.iwc.int].	UK	UK	Female	International Whaling Commission, Cambridge, UK	https://archive.iwc.int/pages/view.php?ref=9357&k=14b502f0cf
Conference paper	Carroll E. L., et al. 2019. Genetic diversity and connectivity of southern right whales (<i>Eubalaena australis</i>) found in the Chilean wintering ground and South Georgia (Islas Georgias Del Sur) Feeding ground. Paper SC/68a/SH06	New Zealand	New Zealand	Female	International Whaling Commission, Cambridge, UK	https://archive.iwc.int/?r=12216&k=60150ac01a

	presented to the IWC Scientific Committee, May 2019 (unpublished). 19pp. [Available from www.iwc.int].					
Conference paper*	Baines M. E., et al. 2019. Density and abundance estimates of baleen whales recorded during the 2019 DY098 cruise in the Scotia Sea around South Georgia and the South Sandwich Islands. CCAMLR Document WG-EMM-2019/27. p. 21.	UK	UK	Male	CCAMLR, Hobart, Australia	Document available on request at: https://www.ccamlr.org/en/wg-emm-2019/27
Conference paper*	Kennedy A. S., et al. 2020. Whales return to the epicentre of whaling? Preliminary results from the 2020 cetacean survey at South Georgia (Islas Georgias del Sur). Paper SC/68b/CMP22 presented to the IWC Scientific Committee, May 2020 (unpublished). 28pp. [Available from www.iwc.int].	USA	USA	Female	International Whaling Commission , Cambridge, UK	https://archive.iwc.int/pages/view.php?ref=17235&k=e5b3702bb b

Journal*	Carroll E. L., et al. (2020). Genetic diversity and connectivity of southern right whales (<i>Eubalaena australis</i>) found in the Chile-Peru wintering grounds and South Georgia (Islas Georgias del Sur) feeding grounds. <i>Journal of Heredity</i> 111(3): 263-276.	New Zealand	New Zealand	Female	Oxford University Press, Oxford, UK	https://academic.oup.com/jhered/article/111/3/263/5826886
Journal*	Vighi M., Borrell A., Jackson J. A., Carroll E. L., Pennino M. G., Aguilar A. (2020). The missing whales: relevance of “struck and lost” rates for the impact assessment of historical whaling in the Southwestern Atlantic Ocean. <i>ICES Journal of Marine Sciences</i> fsaa205.	Italy	Spain	Female	Oxford University Press, Oxford, UK	https://doi.org/10.1093/icesjms/fsaa205
Journal*	Calderan S. V., et al. (2020). South Georgia blue whales five decades after the end of whaling. <i>Endangered</i>	UK	UK	Female	Inter-Research, Oldendorf, Germany	https://www.int-res.com/abstracts/esr/v43/p359-373/

	<i>Species Research</i> 43: 359-373.					
Journal*	Jackson J. A., et al. (2020). Have whales returned to a historical hotspot of industrial whaling? The pattern of southern right whale <i>Eubalaena australis</i> recovery at South Georgia. <i>Endang Species Res</i> 43: 323-339.	UK	UK	Female	Inter-Research, Oldendorf, Germany	https://www.int-res.com/abstracts/esr/v43/p323-339/
Conference paper*	Jackson J. A., et al. 2021. Southern right whale population connections, trophic ecology and health on their South Georgia (Islas Georgias del Sur) feeding ground. Paper SC/68c/CMP08 presented to the IWC Scientific Committee, April 2021 (unpublished). 18pp. [Available from www.iwc.int].	UK	UK	Female	International Whaling Commission, Cambridge, UK	https://archive.iwc.int/pages/view.php?ref=19176&k=b90b93a1de
Conference paper*	Leaper R., et al. 2021. Ship strike risk to whales around South Georgia (Islas Georgias del Sur). Paper SC/68c/HIM09 presented to the	UK	UK	Male	International Whaling Commission, Cambridge, UK	https://archive.iwc.int/pages/view.php?ref=19130&k=676b85cb16

	IWC Scientific Committee, April 2021 (unpublished). 18pp. [Available from www.iwc.int].					
Journal*	Calderan S. V., Leaper R. C., Miller B. S., Andriolo A., Buss D. L., Carroll E. L., Kennedy A. S., Stepien E. N., Jackson J. A. (2021). Southern right whale vocalizations on foraging grounds in South Georgia. <i>Journal of the Acoustical Society of America: Express Letters</i> 1(6).	UK	UK	Female	AIP Publishing	https://asa.scitation.org/doi/10.1121/10.0005433
Journal*	Baines M. E., et al. (In press). Population abundance of recovering humpback whales (<i>Megaptera novaeangliae</i>) and other baleen whales in the Scotia Arc, South Atlantic. <i>Mar. Ecol. Prog. Ser.</i> doi: 10.3354/meps13849	UK	UK	Male	Inter-Research, Oldendorf, Germany	https://www.int-res.com/prepress/m13849.html Sightings data accessible here: https://doi.org/10.5285/5F1E349B-6665-4617-9BF7-EE5C8CBCDD54

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