Applicant: **Fretwell, Peter**
Organisation: **British Antarctic Survey**
Funding Sought: **£489,579.00**

DPR11S2\1016

Using satellite technology to monitor seabird populations at South Georgia

Globally-important populations of seabirds breed at South Georgia, but because of the size and remoteness of these islands, monitoring is limited to few locations. This project will assess the feasibility of using satellite imagery to monitor the status of seabirds across the island group, provide baselines to showcase the recovery of burrowing petrels following the eradication of rodents and reindeer in the mid-2010s, and develop methods that could replace expensive and logistically challenging ground surveys across numerous remote islands worldwide.
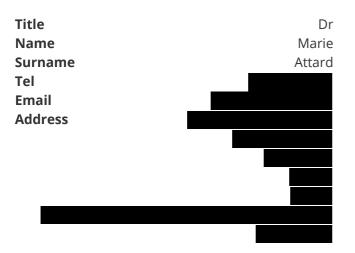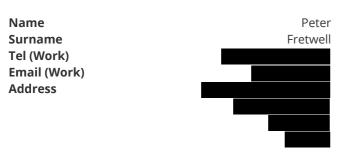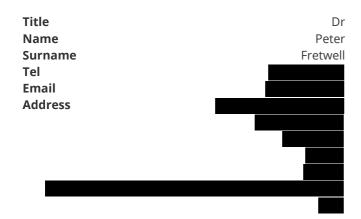
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Section 1 - Contact Details

PRIMARY APPLICANT DETAILS

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GMS ORGANISATION

Type	Organisation
Name	British Antarctic Survey
Phone	███████
Email	███████
Website	███████
Address	███████

Section 2 - Title & Summary

Q3. Project Title:

Using satellite technology to monitor seabird populations at South Georgia

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

DPR11S1\1042

Q4. Summary of project

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

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

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

The broad themes of Darwin Plus Main are:

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

Please write this summary for a non-technical audience.

Globally-important populations of seabirds breed at South Georgia, but because of the size and remoteness of these islands, monitoring is limited to few locations. This project will assess the feasibility of using satellite imagery to monitor the status of seabirds across the island group, provide baselines to showcase the recovery of burrowing petrels following the eradication of rodents and reindeer in the mid-2010s, and develop methods that could replace expensive and logistically challenging ground surveys across numerous remote islands worldwide.

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

Q5. UKOT(s)

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

☑ South Georgia and The South Sandwich Islands (SGSSI)

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

No Response

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

⊙ No

Q6. Project dates

Start date:	End date:	Duration (e.g. 2 years, 3 months):
01 April 2023	31 March 2026	3 years

Q7. Budget summary

Year:	2023/24	2024/25	2025/26	Total request
Amount:	£134,950.00	£206,772.00	£147,857.00	**£** 489,579.00

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

Q9a. Do you have matched funding arrangements?

⊙ Yes

What matched funding arrangements are proposed?

BAS will co-finance this project by waiving the majority of the usual overheads on salaries, and providing a laptop and software licences for the project leader. BAS fieldworkers at Bird Island will carry out ground surveys for burrowing petrels and other species, and take spectrometer measurements of vegetation in occupied habitat.

Q9b. Total confirmed & unconfirmed matched funding (£) ▮▮▮▮

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

BAS will provide matched funding (see answer to Q9a) if our application is successful.

Section 4 - Problem statement

Q10. Problem the project is trying to address

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

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

attached PDF document).

South Georgia supports one of the world's most abundant and diverse seabird communities, including seven species listed under the Agreement on the Conservation of Albatrosses and Petrels (ACAP) [1,2]. All four species of albatrosses, and white-chinned petrels have shown persistent long-term declines, largely because of incidental mortality (bycatch) by fisheries [3]. South Georgia shags have also declined due to climate climate and decreased abundance of demersal fish prey [4]. Formerly-abundant burrowing petrels were extirpated from many sites across the mainland because of predation or habitat degradation by rodents and reindeer [5–7]. However, these invasive mammals were eradicated in the mid-2010s in a £10M campaign [7]. Rigorous monitoring is now required to assess the status of the threatened species, and to showcase the recovery of burrowing petrels.

Ground and boat-based surveys are expensive and logistically challenging, and access is difficult or impossible for many areas [8]. This project aims to assess the viability of using VHR satellite imagery to survey mollymawks (black-browed and grey-headed albatrosses), giant petrels and shags at South Georgia. We will also develop textural and spectral methods to map vegetation richness, and hence the distribution and abundance of burrow-nesting petrels. If successful, we will apply these approaches within the 3-year project to complete the first remote censuses of the entire island group for selected species.

This project addresses two main Darwin Plus themes: i) "conserving biodiversity" by developing novel survey methods to better understand and mitigate seabird population decline, and ii) "enhancing the capacity" for South Georgia to support the local environment in the long-term, by providing protocols and training on satellite survey methods. The satellite survey methods proposed also align with net-zero targets, offering an alternative to high-emission field, boat or aerial surveys. The results will inform conservation policy or provide fundraising opportunities for GSGSSI, ACAP, SGHT and RSPB. In addition, the methodological framework can readily be applied to other islands in the Southern Ocean, including the Falklands and Tristan da Cunha.

Section 5 - Environmental Conventions, Treaties and Agreements

Q11. Environmental Conventions, Treaties and Agreements

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

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

Our project will enable cheaper and more widespread monitoring of flying seabirds at South Georgia, and test new methodologies for species for which there are few, if any data on population trends. This includes burrowing petrels, which are presumed to be expanding in distribution following the rodent and reindeer eradications. This project will contribute to the ACAP Implementation Plan [2] by providing data on seabird population status and trends, including of wandering, black-browed and grey-headed albatrosses at South Georgia, which are among nine global High-Priority populations for ACAP. This can be achieved whilst ensuring minimal disturbance to wildlife and the environment, contributing to net-zero targets by offering a low-carbon alternative to field, boat-based and aerial surveys.

We will assess different remote-sensing techniques for long-term monitoring, addressing key objectives in the GSGSSI Conservation Action Plans for albatrosses [9]. Count data from satellite imagery will be used to: (1) "fill in current gaps in the current monitoring effort", (2) "determine if management measures at breeding sites are achieving their objectives", and (3) establish whether additional demographic studies are required "if monitoring of population trends at other breeding sites on South Georgia indicate different trends to those shown at Bird Island".

This project aligns with several Guiding Values in GSGSSI's new 5-year stewardship framework "Protect Sustain Inspire", including "integrating new technologies and innovation for data collection with expertise and interpretation as drivers for evidence-based decision making" and to "minimise environmental impact". In addition, it directly addresses two of the

main objectives of the earlier South Georgia Biodiversity Action Plan. Objective 4: Develop standardised environmental assessment procedures, which are scalable and commensurate with the potential impact the activity, may have on the environment, and Objective 5: Enhance knowledge of the biodiversity and habitats of SGSSI through research, monitoring and review, including the establishment of scientific baselines from which to assess environmental change, including the potential effects of climate change.

The project will test whether burrowing petrels and other flying seabirds have benefited from the rodent and reindeer eradications. There is currently little monitoring of petrels even though they were extirpated from many sites by invasive species. It will also provide evidence of effectiveness of efforts to reduce fisheries bycatch of albatrosses and giant petrels. We will coordinate with other on-going projects using UAVs at South Georgia, and stakeholders from NGOs (RSPB, BirdLife International and SGHT) and GSGSSI to provide a report on the health of all the seabird populations at South Georgia by the end of the project, hopefully showcasing the benefits of the rodent and reindeer eradications a decade ago.

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

Q12. Methodology

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

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

Our recent studies show that 31cm very-high-resolution (VHR) satellite imagery can be used to count Diomedea albatrosses [10,11], and preliminary analyses indicate that 15cm-HD (High Definition) uplifted imagery is suitable for detecting smaller-bodied species (Figure 1). Our team have developed automated approaches for counting [11,12], and we will build on lessons learnt in our ongoing project on wandering and Tristan albatrosses (DPLUS132), combined with automated detection methods to establish best approaches for determining abundance and distribution of many more species.

We will assess the usefulness of a range of different remote sensing approaches for censusing seabird. Each species or species group will warrant a slightly different automated methodology depending on whether we can make direct counts of individuals (e.g. wandering albatrosses), count areas of birds (e.g. black browed and grey-headed albatrosses) or make indirect assessment of the extent of breeding areas (e.g. burrowing petrels). For direct counts, some work has already been done to automate counting using convoluted-neural-networks and we will further develop these methodologies. For area-based counts we will develop algorithms based on guano extent using spectral characteristics, or use texture-based or Object Based Analysis to detect bird aggregations. For indirect counts we will assess the changed in verdancy of vegetation, from guano fertilization around burrows. For more detail of suggested methods for each species see Table 1.

This study is timely as up to 30 new 31cm-VHR satellites are planned for launch over the next two years, which should provide easy access to cloud-free imagery for all South Georgia. We will develop new methods to address monitoring gaps for a range of threatened seabirds, as well as showcase the recovery of burrowing petrels following the alien species eradication programmes, contributing to the current SG Conservation Action Plan. Our study complements two ongoing Darwin Plus projects: DPLUS109, which involves unmanned aerial vehicle (UAV) surveys of penguins and seals, and DPLUS120 which involves tracking of seabirds to understand the drivers of spatial variation in population trends. In addition, we have just submitted a PhD outline proposal to the Centre for Doctoral Training in Sustainable Management of UK Marine Resources (CDT SuMMeR); if successful, this would be a complementary project involving the development of Artificial Intelligence (AI) methods to automate image analysis.

Q13. Project Stakeholders

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

GSGSSI is the primary UKOT stakeholder; they have been consulted on the project plan and are supportive of the research, which aligns closely with their 5-year stewardship plan (see letter of support). GSGSSI will support the project by providing expertise, fieldwork permits and by disseminating project findings among relevant partners. Project engagement will come through twice-annual stakeholder meetings (organised by project lead Marie Attard), as well as email correspondence and meetings as required.

The UK government is also a stakeholder; as a signatory to ACAP, the UK is obliged to report progress to meetings of the ACAP Advisory Committee on research and management of ACAP-listed species, and particularly those populations identified as global priorities for conservation.

The South Georgia Heritage Trust (SGHT) implemented the rodent eradication program on South Georgia in the mid-2010s. SGHT are supportive of the project and enthusiastic about producing a report on the outcome of the eradication program after 10 years, based on the outputs of our project. SGHT will engage with stakeholder meetings throughout our project.

Other project stakeholders include the Royal Society for the Protection of Birds (RSPB), BirdLife International, and other countries and territories which host populations of the seabird species targeted in the proposed project. The project will engage with them through stakeholder meetings where appropriate, attendance at national and international conferences, and publication of peer-reviewed papers

Q14. Gender equality

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

We do not consider this project to be at risk of increasing gender inequality. All key project staff are employed by the British Antarctic Survey, which has rigorous standards in employment equality and inclusivity. There is a 50/50 gender balance among investigators, with both female co-investigators having leading roles and opportunities for authorship and career progression. Work on SGSSI will be conducted mostly remotely using satellite technology and computer analysis, with fieldwork carried out by BAS staff who are selected with equal opportunity. The survey methods developed could be adopted by any individuals in organisations with access to sufficient funding and computer hardware, regardless of gender.

Q15. Change expected

Detail the expected changes this work will deliver. You should identify what will change and who will benefit a) in the short-term (i.e. during the life of the project) and b) in the long-term (after the project has ended) and the potential to scale the approach. Please describe the changes for the environment and, where relevant, for people in the OTs, and how they are linked.

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

Currently on South Georgia, annual surveys are restricted to few sites despite indications from decadal counts of albatrosses that population trends differ across the island group [20]. More frequent and wider monitoring is required to understand population dynamics, particularly of threatened species, and to monitor potential recovery and re-establishment of burrowing petrels on the mainland following the rodent and reindeer eradications [2]. Limited current information on the population status of burrowing petrel species constrains the abilities of stakeholders (ACAP/RSPB /SGHT/GSGSSI) to implement targeted conservation plans and showcase the benefits of the £10M alien-species eradication

programme. The capability of VHR satellites for monitoring wandering albatrosses has been established [10,11], but its viability for counting other species is uncertain.

In the short-term, we will establish methods appropriate for each species of interest to obtain accurate estimates of population sizes or distributions at Bird Island (see Table 1). The suite of methods will then be used to obtain population estimates for as many species as possible across the island group. This will change our ability to monitor species across the archipelago, providing a baseline for novel VHR satellite survey methods as an alternative or supplement to ground, boat-based and aerial counts. Distribution and abundance data will benefit stakeholders including ACAP, RPSB, SGHT and GSGSSI, who can use the data to inform conservation management strategies. For instance, our burrowing petrel satellite survey method will be the first attempt to map their distribution following the two alien-species eradication programmes. Our project will also align closely with ongoing Darwin Plus project DPLUS109, which uses UAVs to survey penguins, wandering albatrosses and seals at a limited number of sites on South Georgia. UAVs record high-resolution imagery that will provide excellent calibration data for our satellite-based analyses over a far wider area (all of South Georgia), and we are already in discussion with the scientists involved for a collaboration that will greatly benefit both projects.

In the long-term, the methods will be integrated into seabird monitoring programmes on South Georgia, allowing stakeholders to monitor populations more frequently, over larger spatial extents, and with lower financial and environmental costs. The potential to scale the approaches are enormous. The methods will be usable for any species that may be detectable by VHR satellites on other subantarctic islands with similar vegetation, and can potentially be adapted for use elsewhere. Our vision is to develop repeatable protocols that can be used for satellite-based censuses of albatrosses, petrels and shags across the Southern Ocean. Our methods will be complemented by the rapid expansion of VHR satellite coverage, with the number of 30cm resolution sensors projected to increase from one to thirty in the next three years. The methods developed in this project will allow this more frequent cloud-free imagery to be used efficiently and effectively, enabling monitoring at finer temporal scales. Long-term satellite monitoring programmes will contribute useful information on the status and trends of ACAP species and possible reasons for population changes, leading to improved management.

Q16. Pathway to change

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

(Max 200 words)
This project will substantially increase the frequency and span of albatross, petrel and shag surveys, using innovative remote-sensing techniques developed in project Outputs 1 and 3. In Outputs 2 and 4, we will apply these new methods to map species abundance and distribution across South Georgia. These data will help identify high priority sites (where declines are steeper), with the outcome of improved management practices to safeguard species of conservation concern. Our findings will be used to advise management bodies, governments and ACAP on population status. The methodologies developed for this study can be applied at other colonies and territories (Australia, New Zealand, France and South Africa), fostering collaborations among OTs and improve monitoring at a global scale. To ensure this, results will be disseminated through attendance at meetings and conferences (output 5). To ensure the new methods are integrated into long-term monitoring programs, in line with our desired Impact, we will engage closely with key stakeholders, we will present at the ACAP Advisory Committee Populations working group meeting in 2024, annual CCAMLR IMAF working group and GSGSSI stakeholder meetings. We will also publish two papers in scientific journals to highlight the findings

Q17. Exit Strategy

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

During the project, we will develop a methodological framework that can readily be applied to other islands in the Southern Ocean. Remote sensing provides a potentially cost-effective way of monitoring seabirds over large areas and remote island groups. At the end of the project, when we have robust results, we will also discuss options with RSPB, SGHT and GSGSSI for setting up long-term satellite monitoring for selected species and sites. As part of this, we may be able to negotiate discounts for imagery from satellite providers, for instance including repeated speculative tasking of South Georgia in summer months. Resources would be required for any ongoing monitoring, hence one of the outputs of the project will be a report on the health of the seabird populations at South Georgia, showcasing the benefits of the rodent

and reindeer eradications a decade ago and providing opportunities for fundraising. Knowledge gained will be made available in scientific papers and stakeholder reports, and code and data will be made open access.

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

- ⤓ <u>supporting documents table 1 and figure 1</u>
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- ▤ pdf 668.26 KB

Section 7 - Risk Management

Q18. Risk Management

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

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

Risk Description	Impact	Prob.	Inherent Risk	Mitigation	Residual Risk
Fiduciary (Financial) Travel and subsistence budget for international conferences claimed incorrectly by staff or used inappropriately	Insignificant	rare	insignificant	All travel and subsistence claims will be made through the NERC SBS system, which requires all employee and non-employee claims to be submitted with receipts	Insignificant
Safeguarding As South Georgia has no indigenous population and all work is desk based at a well regulated UK government institution we believe there are no safeguarding risks.	NA	NA	NA	na	nil
Delivery Chain Cloud cover means that VHR satellite imagery may not be available for all sites on South Georgia within the December-January 23/24 timeline	Minor	Likely	Major	We will task all island imagery for a two month window (** December 2023 - ** January 2024) to maximise chance of cloud free image capture. If certain sites have persistent cloud, credit with the satellite image provider can be carried over until the 2024/2025 season.	Minor

Risk 4 Associated fieldwork: Severe weather can impact ability to carry out fieldwork, so timing of work may be affected	Minor	Possible	Minor	If ground truth data is not collected at optimal times then the validation of the satellite data will be less precise. However, there are other sources of data so this should not have a major impact	Minor
Risk 5 Methods prove ineffective: This project tests several new methods with new technology. Some may not prove effective and if so, some goals may not be achieved. This is implicit within the project; however, with multiple methods available and goals the majority should still be possible.	minor	moderate	moderate	Multiple methods will be tested for each species to find the best approach. Several methods are already proven. If counts have a large error, we will still obtain valuable data on distribution, which is unknown for many species. Even if a method fails, that in itself is still useful information.	minor
Risk 6 na	na	na	na	na	na

Section 8 - Implementation Timetable

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

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

Implementation Timetable Template

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

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Section 9 - Monitoring and Evaluation (M&E)

Q20. Monitoring and evaluation (M&E) plan

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

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

The project leader (Peter Fretwell) and lead researcher (Marie Attard) will be responsible for project M&E. The project implementation timeline and logframe will be reviewed regularly by the PI and lead researcher, and assessed at weekly meetings to keep track of progress and the day-to-day running of the project. All project staff will meet monthly, where progress will be assessed and outputs, short and long-term objectives, challenges and budgeting will be reviewed. Formal meetings with all project partners and stakeholders will be arranged half annually, and will be written up and reported. Stakeholders will additionally be updated when necessary by email, online meetings or in person, as appropriate. Their feedback will be requested, and incorporated into analysis to ensure engagement with the project outputs.

All scientific outputs of the project will be formalised as either reports to working groups of ACAP and CCAMLR, or as manuscripts submitted to scientific journals. These results will be communicated to the wider network of overseas groups and NGOs though email and attendance at one national and two international conferences.

Financial monitoring of the project will be carried out by the BAS Finance Office, and the project will be audited in the final year. Since all main project staff are based at BAS, and stakeholders can largely be engaged through virtual meetings, costs of M&E will be low.

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

Section 10 - Logical Framework

Q21. Logical Framework (logframe)

Darwin Plus projects will be required to monitor and report against their progress towards their Outputs and Outcome. This section sets out the expected Outputs and Outcome of your project, how you expect to measure progress against these and how we can verify this.

<u>Stage 2 Logframe Template</u>

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

Please upload your logframe as a PDF document.

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Impact:

Impact: New methodologies enable cost-effective, long-term satellite remote sensing of population status and trends of albatrosses, petrels and shags at South Georgia, leading to informed conservation actions.

Outcome:

Baseline abundance data, distribution maps, and new satellite-monitoring protocols are established for multiple species of seabirds across the entire South Georgia (SG) archipelago, improving species management and advocacy.

Project Outputs

Output 1:

An assessment of whether burrowing petrels can be detected using satellite imagery based on spectral analysis of vegetation colour at Bird Island.

Output 2:

An assessment of long-term changes in the distribution and densities of burrowing petrels across SG using satellite imagery.

Output 3:

An assessment of whether VHR satellite imagery can be used to count mollymawks (black-browed and grey-headed albatrosses), SG shags and giant petrels, and to identify colonies of Wilsons' storm petrels and SG diving petrels at Bird Island and elsewhere at SG where ground-truthing data available.

Output 4:

An archipelago-wide VHR satellite survey of wandering albatrosses, mollymawks and SG shag breeding colonies on SG using methods developed in Output 3.

Output 5:

Dissemination and application.

Do you require more Output fields?

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

◉ No

Activities

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

1.1 Collate existing data on burrowing petrel distribution and abundance at Bird Island.
1.2 Organise collection of new data on burrowing petrel distribution and abundance at Bird Island.
1.3 (and 3.2) Task 31-cm image of Bird Island for December 2023.
1.4 Arrange measurements of within-season changes in spectral profiles of vegetation in areas occupied by different species of burrowing petrels at Bird Island using hand-held spectrometer.
1.5 Model relationships between spectral profiles from hand-held spectrometer and satellite imagery, and breeding-habitat preferences to predict presence/absence and relative abundance of burrowing petrels at Bird Island.

2.1 Collate existing data on burrowing petrel distribution and abundance across SG.
2.2 Organise collection of presence-absence data of burrowing petrels in habitat around KEP, and in 2023/24 all-islands albatross census.
2.3 (and 4.2) Task collection of VHR satellite imagery of the entire SG archipelago for December 2024 - January 2025 window.
2.4 Produce habitat suitability models using elevation, slope and aspect to highlight suitable burrowing petrel nesting areas
2.5 Purchase tasked VHR satellite imagery of SG archipelago
2.6 Apply models using relationships between spectral profiles in satellite imagery, and breeding-habitat preferences (developed in Output 1), to predict presence/absence and relative abundance of burrowing petrels across SG.
2.7 Validate distribution models for areas away from Bird Island using available ground-truthing data from elsewhere at South Georgia.

2.8 Compare predicted distributions with presence-absence at 5km-scale across SG mapped in the 1980s.

3.1 Collate data on abundance or distribution of mollymawks, SG shags, giant petrels, Wilsons' storm petrels and SG diving petrels at Bird Island.
3.2 (See activity 1.3)
3.3 VHR satellite images assessed for presence of each species by experts. Annotations of seabird species are produced either as point markers on individuals, or polygons outlining presence and extent.
3.4 Compare expert annotations to ground and UAV survey data to validate results
3.5 For species which are detectable as individual birds (potentially mollymawks, SG shags and giant petrels), use expert annotations to develop automated detection methods
3.6 For species where individuals are not detectable (e.g Wilson's storm petrel, SG diving petrels), test the use of indirect methods such as spectral classification of guano and texture analysis of burrows

4.1 Collate data on abundance or distribution of mollymawks, SG shags, giant petrels, Wilsons' storm petrels and SG diving petrels across South Georgia, including in 2023/24 all-islands albatross census.
4.2 (see activity 2.3)
4.3 Apply methodologies developed as part of 3.3 and 3.4, and in DPLus132 for wandering albatrosses, to count individuals or detect colonies of wandering albatrosses, mollymawks, SG shags, giant petrels, Wilsons' storm petrels and SG diving petrels across South Georgia.
4.4 Validate all island survey results by comparing to existing data on abundance and distribution, and to 2023/2024 all-island albatross surveys.

5.1 Share results and recommendations with stakeholders.
5.2 Deposit data in open access web portals.
5.3 Prepare reports for working groups and stakeholders.
5.4 Prepare manuscripts for publication in peer-reviewed journals.
5.5 Attend national and international conference to present results.
5.6 Make results available via websites for public dissemination

Section 11 - Budget and Funding

Q22. Budget

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

Budget form for projects over £100k

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

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

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

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

⤓ R11_DPlus_St2_BCF_Budget_over_100k_final_approved
🗓 13/10/2022
🕐 11:45:44
🗎 xlsx 93.84 KB

Q23. Funding

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

⊙ New Initiative

Please provide details:

This work builds on Darwin Plus project DPLUS132, which focusses on satellite surveys of wandering albatross on South Georgia using citizen science. In that project previous work on wandering albatross detection had already been developed by BAS (Fretwell et al. [10]) and Bowler at al. [11] (through a NERC funded PhD). In the proposed work, detection of a range of new species will be tested and validated using ground truth data. We will build on existing links with key stakeholders from DPLUS132 to carry out this project. The proposed work will build on the considerable expertise of the BAS Wildlife from Space group (lead by PI Dr Peter Fretwell), who have developed similar techniques for monitoring species such as penguins, whales and walrus. It will also build on a long history of seabird research at South Georgia, in particular long-term monitoring from the BAS research station at Bird Island, where co-PI Prof Richard Phillips has extensive knowledge. The project will integrate with the whole-island albatross survey planned for 20223/24. It will also complement the ongoing Darwin Plus project DPLUS179 at BAS which uses UAVs to monitor several species, including albatrosses.

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

⊙ No

Q24. Balance of budget spend

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

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

Aside from staff salaries, project funds will primarily be spent on purchasing satellite imagery. In general, this imagery can be used to conduct surveys at reduced cost in comparison to boat, ground or aerial surveys. The vast majority of research will be conducted remotely from BAS offices, with no logistical implications for GSGSSI. Fieldwork for this project will be conducted using existing funding, so no extra budget is requested. Although the funding will not be spent in territory, GSGSSI will see significant benefits from the project and purchased VHR imagery. 31-cm resolution imagery of the entire island chain will be valuable baseline data, with the potential to be used in other research projects requiring fine spatial resolution. For instance, it can be used to validate studies using free lower resolution satellite imagery or to map vegetation extent. Budget associated with dissemination of results and stakeholder engagement (e.g for conference attendance and open-access publications) will also benefit GSGSSI, raising awareness and advocacy for resident seabird species.

Q25. Capital items

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

No capital items are requested.

Q26. Value for Money

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

We have considered value for money throughout the project design. We will build on previous analysis for certain species (for example wandering albatross), which will lower development costs and associated risks. Our ground truth validation will tie in with existing field campaigns, meaning no extra cost for this project. The cost of purchasing imagery is the largest factor aside from staff salaries; however, this will be vital for establishing new techniques. Once developed, monitoring with VHR satellite imagery can reduce costs considerably in comparison to field surveys, and enable more frequent monitoring over larger spatial extents. Staff costs are based on standard organisational pay scales, and BAS will complement support with waived overheads and resources necessary for the project.

Section 12 - Safeguarding and Ethics

Q27. Outputs of the project and Open Access

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

All spatial and analytical results will be published through the NERC Polar Data Centre. VHR satellite imagery, is not purchased but leased and is subject to copyright, it is generally not made available for open access data repositories. While the images themselves cannot be published, the unique image IDs will be made available, so that interested parties can purchase the relevant images directly from the provider. We will also make all annotations and spectral signatures available openly, which can be matched with VHR satellite images when acquired. We will provide full open-access to any developed analytical framework, code and software routines. We will ensure to document code in detail, so the analysis can be easily replicated by interested parties. Additional papers and reports submitted to working groups will also be made available if the organisation permits it. We have requested funding to cover the costs of two open access journal publications to disseminate the results.

Q28. Safeguarding

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

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

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

We have a safeguarding policy, which includes a statement of our commitment to safeguarding and a zero tolerance statement on bullying, harassment and sexual exploitation and abuse	Checked
We have attached a copy of our safeguarding policy to this application (file upload on certification page)	Checked
We keep a detailed register of safeguarding issues raised and how they were dealt with	Checked
We have clear investigation and disciplinary procedures to use when allegations and complaints are made, and have clear processes in place for when a disclosure is made	Checked
We share our safeguarding policy with all partners	Checked
We have a whistle-blowing policy which protects whistle blowers from reprisals and includes clear processes for dealing with concerns raised	Checked

	Checked
We have a Code of Conduct for staff and volunteers that sets out clear expectations of behaviours - inside and outside the work place - and make clear what will happen in the event of non-compliance or breach of these standards	

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

> This project will be conducted solely by British Antarctic Survey, and as such will adhere strictly to the UKRI safeguarding policy https://www.ukri.org/wp-content/uploads/2020/10 /UKRI-081020-SafeguardingPolicy.pdf. We will provide this guidance to the downstream partners and ensure it is embedded within M&E. The project is largely desk based within BAS offices, with some fieldwork on SG being carried out by BAS staff also under the UKRI safeguarding policy.

Q29. Ethics

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

> BAS and GSGSSI have a long history of collaboration, and have always and will continue to meet all legal and ethical obligations when conducting research. We will follow access and benefit sharing best practice, and ensure strong participation through stakeholder meetings and sharing of results and data. Since the proposed work is focussed on remote satellite survey methods, and there is no resident population on SG, no individuals on the UKOT will have their rights, privacy or safety affected by the project. We will uphold the credibility of evidence by publishing results journals which are subject to thorough peer-review. All project staff will be protected under the BAS rigorous health and safety procedures. Since there is no permanent community on our stakeholder UKOT (GSGSSI), key principles relating to prior informed consent with communities and value of traditional knowledge are not relevant to this project.

Section 13 - Project Staff

Q30. Project staff

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

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

Name (First name, Surname)	Role	% time on project	1 page CV or job description attached?
Peter Fretwell	**Project Leader**	15	Checked
Marie Attard	Joint lead applicant	100	Checked
Richard Phillips	Co-investigator	15	Checked
Ellen Bowler	Co-investigator	15	Checked

Do you require more fields?

⊙ No

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

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

⤓ darwin-stage-2-all-cvs
🗓 13/10/2022
🕓 11:42:56
📄 pdf 373.83 KB

Have you attached all project staff CVs?

⊙ Yes

Section 14 - Project Partners

Q31. Project partners

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

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

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

Lead partner name:	British Antarctic Survey
Is the Lead Partner based in a UKOT where the project is working?	⊙ No
Please explain why this project is led from outside the UKOT	There is no resident population at South Georgia, and the expertise on remote sensing is at British Antarctic Survey.
Website address:	https://www.bas.ac.uk/

Details (including roles and responsibilities and capacity to engage with the project):	BAS has well-established management, operations, finance infrastructure, and extensive logistics capability to support Antarctic fieldwork. BAS will provide ground truthing on Bird Island.

Dr Attard will have responsibility for developing and implementing the project. She will oversee the fieldwork and lead analysis of the counts. She currently leads the Albatrosses from Space project and has postdoctoral experience in WV-3 analysis of wandering and Tristan albatrosses.

Dr Fretwell and Professor Phillips will be involved in project management and provision of expertise. Dr Fretwell is an expert in remote sensing, and leads the Wildlife From Space group at BAS. Professor Phillips has extensive experience in seabird ecology and conservation, and is closely involved with ACAP and other seabird conservation.

Dr Ellen Bowler specialises in remote sensing, computer vision and deep-learning and has worked on automated detection of wandering albatrosses. She will advise on AI methods to automatically detect and count birds.

Professor Phillips has engaged extensively with GSGSSI on seabird research and conservation at South Georgia for over two decades, and acts as a scientific adviser on seabird biology and interactions with fisheries. Regular engagement will ensure the work proposed here fits with the priorities outlined in the GSGSSI Albatross Conservation Plans. |
Allocated budget (proportion or value):	███
Representation on the Project Board (or other management structure)	⊙ No
Have you included a Letter of Support from this organisation?	⊙ No
Please provide details	There are no other formal partners, but we will be engaging closely with the main stakeholders (GSGSSI, RSPB, ACAP, SGHT). We have included a letter of support from the lead organization and the main stakeholder GSGSSI.
Have you provided a cover letter to address your Stage 1 feedback?	⊙ Yes

Do you have partners involved in the Project?

⊙ No

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

⬇ <u>DPLUS ST2 all letters of support revised</u> 📅 17/10/2022 🕐 16:23:55 📄 pdf 614.03 KB	⬇ <u>R11_DPlus_St2_DPR11S1-1042_ response to reviewers final draft</u> 📅 17/10/2022 🕐 16:21:28 📄 pdf 724.36 KB

Section 15 - Lead Partner Capability and Capacity

Q32. Lead Partner Capability and Capacity

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

◉ Yes

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

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

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

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

◉ Yes

Section 16 - Certification

Certification

On behalf of the

Company

of

British Antarctic Survey

I apply for a grant of

██████████

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

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

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

Checked

Name	MARGARET CLARK
Position in the organisation	Head of Finance
Signature (please upload e-signature)	⤓ certification page DPLUS PTF 🗓 17/10/2022 🕐 16:14:20 📄 pdf 25.48 KB
Date	17 October 2022

Please attach the requested signed audited/independently examined accounts.

⤓ Please note UKRI accounts exceed the 5mb download limit of the web portal
🗓 13/10/2022
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📄 pdf 197.23 KB

⤓ UKRI accounts
🗓 13/10/2022
🕐 12:06:37
📄 pdf 374.04 KB

Please upload the Lead Partner's Safeguarding Policy as a PDF

⤓ UKRI-081020-CodeOfConduct
🗓 13/10/2022
🕐 12:09:46
📄 pdf 218.17 KB

Section 17 - Submission Checklist

Checklist for submission

	Check
I have read the Guidance, including the "Darwin Plus Guidance**", "**Monitoring Evaluation and Learning Guidance**", "Risk Guidance" and "**Financial Guidance**".**	Checked
I have read, and can meet, the current Terms and Conditions **for this fund.**	Checked
I have provided actual start and end dates for the project.	Checked
I have provided my budget based on UK government financial years i.e. 1 April – 31 March and in GBP.	Checked

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

We would like to keep in touch!

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

Checked

Data protection and use of personal data

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

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

Project Title: Using satellite technology to monitor seabird populations at South Georgia

Guidance – please delete before submitting

Provide a **Project Implementation Timetable** that shows the key milestones in project activities. Complete the following table as appropriate to describe the intended workplan for your project. Quarters are based on UK FYs (**1 April – 31 March** - Q1 therefore starts April 2023).

Please add/remove columns to reflect the length of your project. For each activity (add/remove rows as appropriate) indicate the number of months it will last, and shade only the quarters in which an activity will be carried out. The activity numbers should correspond to the activities in your logical framework (logframe). The workplan can span multiple pages if necessary.

This template covers multiple Biodiversity Challenge Funds schemes, so ensure you check the eligible dates/project length for the scheme you are applying to and feel free to delete later years if not applicable for your project.

	Activity	No. of months	Year 1 (23/24)				Year 2 (24/25)				Year 3 (25/26)			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Output 1	An assessment of whether burrowing petrels can be detected using satellite imagery based on spectral analysis of vegetation colour at Bird Island.													
1.1	Collate existing data on burrowing petrel distribution and abundance at Bird Island.	2	▓	▓										
1.2	Organise collection of new data on burrowing petrel distribution and abundance at Bird Island.	1	▓	▓										
1.3 (and 3.2)	Task 31-cm image of Bird Island for December 2023.	<1	▓	▓										

Biodiversity Challenge Funds Implementation Timetable Template

Project Title: Using satellite technology to monitor seabird populations at South Georgia

	Activity	No. of months	Year 1 (23/24)				Year 2 (24/25)				Year 3 (25/26)			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1.4	Arrange measurements of within-season changes in spectral profiles of vegetation in areas occupied by different species of burrowing petrels at Bird Island using hand-held spectrometer.	1	▓	▓										
1.5	Model relationships between spectral profiles from hand-held spectrometer and satellite imagery, and breeding-habitat preferences to predict presence/absence and relative abundance of burrowing petrels at Bird Island.	4			▓	▓	▓	▓						
Output 2	**An assessment of long-term changes in the distribution and densities of burrowing petrels across SG using satellite imagery.**													
2.1	Collate existing data on burrowing petrel distribution and abundance across SG.	2	▓	▓	▓									
2.2	Organise collection of presence-absence data of burrowing petrels in habitat around KEP, and in 2023/24 all-islands albatross census.	2	▓	▓										

Biodiversity Challenge Funds Implementation Timetable Template

Project Title: Using satellite technology to monitor seabird populations at South Georgia

	Activity	No. of months	Year 1 (23/24)				Year 2 (24/25)				Year 3 (25/26)			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
2.3 (and 4.2)	Task collection of VHR satellite imagery of the entire SG archipelago for December 2024 - January 2025 window.	<1						▓	▓					
2.4	Produce habitat suitability models using elevation, slope and aspect to highlight suitable burrowing petrel nesting areas	4					▓	▓	▓					
2.5	Purchase tasked VHR satellite imagery of SG archipelago	<1								▓				
2.6	Apply models using relationships between spectral profiles in satellite imagery, and breeding-habitat preferences (developed in Output 1), to predict presence/absence and relative abundance of burrowing petrels across SG.	4								▓	▓			
2.7	Validate distribution models for areas away from Bird Island using available ground-truthing data from elsewhere at South Georgia.	4									▓	▓		
2.8	Compare predicted distributions with presence-absence at 5km-scale across SG mapped in the 1980s.	4										▓	▓	

Biodiversity Challenge Funds Implementation Timetable Template

Project Title: Using satellite technology to monitor seabird populations at South Georgia

	Activity	No. of months	Year 1 (23/24)				Year 2 (24/25)				Year 3 (25/26)			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Output 3	An assessment of whether VHR satellite imagery can be used to count mollymawks (black-browed and grey-headed albatrosses), SG shags and giant petrels, and to identify colonies of Wilsons' storm petrels and SG diving petrels at Bird Island and elsewhere at SG where ground-truthing data available.													
3.1	Collate data on abundance or distribution of mollymawks, SG shags, giant petrels, Wilsons' storm petrels and SG diving petrels at Bird Island.	2	▓	▓										
3.2	(See activity 1.3)	<1	▓	▓										
3.3	VHR satellite images assessed for presence of each species by experts. Annotations of seabird species are produced either as point markers on individuals, or polygons outlining presence and extent.	2				▓								
3.4	Compare expert annotations to ground and UAV survey data to validate results	4				▓	▓	▓						

Biodiversity Challenge Funds Implementation Timetable Template

Project Title: Using satellite technology to monitor seabird populations at South Georgia

	Activity	No. of months	Year 1 (23/24)				Year 2 (24/25)				Year 3 (25/26)			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
3.5	For species which are detectable as individual birds (potentially mollymawks, SG shags and giant petrels), use expert annotations to develop automated detection methods	6					▓	▓	▓					
3.6	For species where individuals are not detectable (e.g Wilson's storm petrel, SG diving petrels), test the use of indirect methods such as spectral classification of guano and texture analysis of burrows	6						▓	▓	▓				
Output 4	**An archipelago-wide VHR satellite survey of wandering albatrosses, mollymawks and SG shag breeding colonies on SG using methods developed in Output 3**													
4.1	Collate data on abundance or distribution of mollymawks, SG shags, giant petrels, Wilsons' storm petrels and SG diving petrels across South Georgia, including in 2023/24 all-islands albatross census.	3	▓	▓	▓									
4.2	(See activity 2.3)	<1						▓	▓					
4.3	Apply methodologies developed as part of 3.3 and 3.4, and in DPLus132 for wandering albatrosses, to count individuals or detect colonies of wandering albatrosses, mollymawks, SG shags, giant petrels, Wilsons' storm petrels and SG diving petrels across South Georgia.	6									▓	▓	▓	

Biodiversity Challenge Funds Implementation Timetable Template

	Activity	No. of months	Year 1 (23/24)				Year 2 (24/25)				Year 3 (25/26)			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
4.4	Validate all island survey results by comparing to existing data on abundance and distribution, and to 2023/2024 all-island albatross surveys.											■	■	
Output 5	**Dissemination and application**													
5.1	Share results and recommendations with stakeholders.	4									■	■	■	
5.2	Deposit data in open access web portals.	2											■	■
5.3	Prepare reports for working groups and stakeholders.	4					■						■	■
5.4	Prepare manuscripts for publication in peer-reviewed journals.	6						■	■	■	■	■	■	
5.5	Attend national and international conference to present results.	2					■			■			■	
5.6	Make results available via websites for public dissemination	1					■				■	■	■	■

Project Title: Using satellite technology to monitor seabird populations at South Georgia

Project Summary	SMART Indicators	Means of Verification	Important Assumptions
Impact: New methodologies enable cost-effective, long-term satellite remote sensing of population status and trends of albatrosses, petrels and shags at South Georgia, leading to informed conservation actions. (Max 30 words)			
Outcome: (Max 30 words) Baseline abundance data, distribution maps, and new satellite-monitoring protocols are established for multiple species of seabirds across the entire South Georgia (SG) archipelago, improving species management and advocacy.	0.1 Counts from VHR satellite imagery provide specific abundance estimates for multiple seabirds across the entire SG archipelago by the project end date. 0.2 By combining spectral classification of vegetation colour and habitat characteristics, maps of areas occupied by burrowing petrels at high densities will be available for the entire SG archipelago by the project end date. 0.3 New satellite remote-sensing methods will be developed and assessed for each seabird species. Data and methods will be published to ensure long-term uptake and facilitate use elsewhere. 0.4 Engagement with stakeholders (GSGSSI, ACAP, SGHT and RSPB) throughout the project will lead to a commitment to improve the frequency and coverage of seabird population	0.1 Data on counts of species in satellite images; results published in peer-reviewed journal; data added to open access portal (e.g. GBIF https://www.gbif.org/). 0.2 Maps added as layers to interactive SG map (https://www.sggis.gov.gs/); results published in peer-reviewed journal. 0.3 Data made open access; methods written up in peer-reviewed journal; code published on open-source repository; independent meeting reports will mention the results of the project and commitment to future satellite surveys. 0.4 Stakeholder meeting minutes and reports; report text to include next steps for updated management recommendations based on new abundance and distribution data.	Cloud-free satellite imagery will be available in 2023/24 and 2024/25. Images will be tasked in 2025/26 for sites that require additional imagery. Fieldwork will be undertaken at Bird Island and around KEP for ground truthing (Outputs 1 and 2). Stakeholders will engage with the project and attend project meetings. We are confident of strong stakeholder engagement, as this project builds on existing partnerships, and addresses a priority objective outlined by ACAP and GSGSSI. We will ensure stakeholders are consulted and involved via emails and regular meetings (hosted remotely to ensure maximum attendance).

Project Title: Using satellite technology to monitor seabird populations at South Georgia

	surveys on SG using satellite remote-sensing.		
Outputs: **1**. An assessment of whether burrowing petrels can be detected using satellite imagery based on spectral analysis of vegetation colour at Bird Island.	1.1 Existing information on burrowing petrel distribution and abundance collated from previous surveys at Bird Island during Y1Q1/2, supplemented by new data collection in December 2023/ January 2024. 1.2 Measurements recording spectral profiles of vegetation in areas occupied by different species of burrowing petrels are collected on Bird Island using hand-held spectrometers in December 2023 to March 2024. 1.3 Hand-held spectrometer data compared with online spectral libraries to determine if they produce a noticeable difference in reflectance by Y2Q1. 1.4 Geographic object-based analysis (GEOBIA) methods are developed to identify petrel breeding areas on Bird Island by classifying bright green vegetation (resulting from improved growth because of the nutrients in the guano) by Y2Q2.	1.1 Literature review and list of data sources; maps showing distribution based on current data. 1.2 Data from hand-held spectrometers; correspondence with field researchers on Bird Island. 1.3 Data files containing spectral readings of vegetation; plots comparing spectral signatures. 1.4 Algorithm results assessed using test images; consult expert opinion and peer review process; publication of manuscript detailing the methods and results of study.	Fieldwork will go ahead in 2023/24 and 2024/25. There will be a unique spectral signature for vegetation surrounding seabird burrows, which in combination with data on elevation, aspect and slope can be used to develop automated methods for detecting breeding areas. High classification accuracy and reproducibility to allow burrowing petrel nesting areas to be distinguished from areas used by seals at lower elevations. Existing 31cm-resolution archival imagery of Bird Island, previously purchased by BAS, will also be used. These are clear cloud-free images of the island taken during the breeding season in 2014/15, 2019/20 and 2021/22, and a 15cm-HD uplifted image in 2021/22.
2. An assessment of long-term changes in the distribution and	2.1 VHR satellite imagery of the entire SG archipelago tasked for	2.1 and 2.2 List of archival images compiled and	Output 1 will have been achieved, i.e., similar

Biodiversity Challenge Funds Stage 2 & Single Stage Logical Framework Template

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densities of burrowing petrels across SG using satellite imagery.	December 2024/ January 25. Imagery successfully obtained and purchased by end of Y2. 2.2 Habitat suitability models incorporating elevation, slope and aspect are produced, to highlight areas of SG away from Bird Island that may be suitable for nesting by burrowing petrels by Y2Q2. 2.3 Methods validated at other sites on SG based on existing knowledge of burrowing petrel distribution at KEP and elsewhere, and new survey data collected during 2023/24 albatross census. 2.4 Habitat models applied across SG using tasked VHR imagery to map distribution of burrowing petrels at high densities by Y3Q1. 2.5 Comparison of distributions of burrowing petrels in VHR imagery with presence-absence at 5km-scale across SG mapped in the 1980s [17] by Y3Q3. 2.6 Habitat models made available on open access portals and results disseminated at conferences, through peer-	downloaded; models produced; baseline data assessed by experts. 2.2 to 2.4 Map showing distribution; verified at ground survey locations; results assessed by experts.. 2.5 Map data showing the 1980s presence-absence survey; satellite derived map data; comparison statistics; peer review from stakeholders. 2.6 Published papers; conference proceedings; data visible and available to download on open access sites.	methodology is successful at Bird Island. Cloud-free imagery at potential burrowing petrel breeding sites will be obtained in 2024/25. Images will be tasked in 2025/26 for sites that require additional imagery. Cloud-free archived imagery will also be purchased. Albatross census in 2023/24 will go ahead. If not, existing data will be sufficient for validation.

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	reviewed papers and media outreach by project end date.		
3. An assessment of whether VHR satellite imagery can be used to count mollymawks (black-browed and grey-headed albatrosses), SG shags and giant petrels, and to identify colonies of Wilsons' storm petrels and SG diving petrels at Bird Island and elsewhere at SG where ground-truthing data available.	3.1 VHR satellite imagery of Bird Island and elsewhere at SG where colony locations are known, supplemented by new imagery collected in December 2023/ January 2024.	3.1 Images downloaded from Maxar; image quality verified by experts.	Cloud-free imagery will be available from Bird Island and elsewhere at SG where ground-truthing data are available. A cloud-free 15cm-HD uplifted imagery of Bird Island from 2021/22 is already available.
	3.2 Satellite images of breeding areas for each species are assessed and annotated by experts, and results compared with known distributionsby Y2Q2.	3.2 Scientists receive image data; digitized annotation files (point markers and polygons);analysis comparing satellite and ground counts	For SG shags and giant petrels, individuals can be detected and counted or estimated using VHR satellite imagery. Our preliminary work show that shags can be seen individually in 15cm-HD uplifted satellite imagery and differentiated from penguins by spectral colour based on diet.
	3.3 For each species which is detectable as individual birds, expert annotations will be used to develop and compare different automated detection methods (e.g. spectral classification, texture analysis, CNNs) by end of Y2.	3.3 and 3.4 Automated method results assessed using test data; consult expert opinion and peer review; publication of results.	Mollymawks mainly breed in single-species colonies. This is correct at Bird Island.
	3.4 For each species which are detectable, but resolution restricts accurate counting, the feasibility of different approaches (e.g., spectral classification, texture analysis, CNNs) will be assessedby end of Y2. Texture analysis will be used on mollymawks, SG shags and giant petrels. Spectral analysis will be used to detect guano from SG diving petrels in fine scree and		Texture analysis can be used to assess colony sizes of mollymawks, SG shags and giant petrels.

Spectral analysis can be used to detect guano and hence identify colonies of SG diving petrels in fine scree and Wilson's storm petrels in rocky scree. |

	Wilson's storm petrels in rocky scree.		
4. An archipelago-wide VHR satellite survey of wandering albatrosses, mollymawks and SG shag breeding colonies on SG using methods developed in Output 3.	4.1 VHR satellite imagery of the entire SG archipelago tasked for December 2024/ January 2025. 4.2 Collate data on abundance and distribution of target species across SG archipelago by Y1Q3. 4.3 For species which can be counted individually, use methods developed in output 3.3 to count species across SG by Y3Q2.. 4.4 For species which can be detected indirectly (e.g through detection of guano), use methods developed in output 3.4 to count species across SG by Y3Q2 4.5 Validate all island survey results using known distribution data and 2023/2024 all-island albatross census, by Y3Q3. 4.6 Results and data from the satellite surveys published and made open source by project end date.	4.1 List of purchased imagery; images checked and verified by experts; results of past surveys shared with project team. 4.2 Data showing distribution information; literature review; correspondence with SG research groups 4.4 and 4.5 Results assessed on test images; statistics showing accuracy for each species; report and publish estimated population counts. 4.6 Share point shapefiles (identifying location of each individual bird) and satellite image IDs on open access portals and digital repositories; add data to SGGIS.	Shags and mollymawks are visible in 15cm-HD uplifted or 31cm-resolution imagery and AI or image analysis methods can be applied to these species. Previous studies confirm that wandering albatrosses can be counted using WV-3 imagery. Mollymawks mainly breed in single-species colonies at SG. Can apply species ratios from previous all-islands ground surveys to the few mixed-species colonies, or calculate trends from single-species colonies. Crowdsourced counts of wandering albatross at SG as part of current research project (DPLUS132) using archived imagery are accurate and can be incorporated in training data. This will be confirmed using multiple observers and expert counts.
5. Dissemination and application.	5.1 Results and recommendations shared with stakeholders to inform their conservation and management frameworks, shared throughout the project at stakeholder	5.1 Text from independent meeting reports, and meeting minutes will discuss the results and plants to implement changes to management frameworks; a paper detailing results will be	Outputs will be discussed at relevant stakeholder meetings. The decline in populations of ACAP-listed seabirds is a recognised conservation issue for all stakeholders. As such any

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	meetings and summarised at end of project meeting. 5.2 Data deposited in global databases by project end date. 5.3 Communication of results at two international conferences during Y2 and Y3.	submitted to working group meetings of ACAP and CCAMLR. 5.2 Datasets made available online in SGGIS. 5.3 Abstracts presented in conference programs; results published in peer-reviewed journals.	measures to mitigate further declines in these populations are a priority for many stakeholders, and a consideration for fisheries management bodies.

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

1.1 Collate existing data on burrowing petrel distribution and abundance at Bird Island.

1.2 Organise collection of new data on burrowing petrel distribution and abundance at Bird Island.

1.3 (and 3.2) Task 31-cm image of Bird Island for December 2023.

1.4 Arrange measurements of within-season changes in spectral profiles of vegetation in areas occupied by different species of burrowing petrels at Bird Island using hand-held spectrometer.

1.5 Model relationships between spectral profiles from hand-held spectrometer and satellite imagery, and breeding-habitat preferences to predict presence/absence and relative abundance of burrowing petrels at Bird Island.

2.1 Collate existing data on burrowing petrel distribution and abundance across SG.

2.2 Organise collection of presence-absence data of burrowing petrels in habitat around KEP, and in 2023/24 all-islands albatross census.

2.3 (and 4.2) Task collection of VHR satellite imagery of the entire SG archipelago for December 2024 - January 2025 window.

2.4 Produce habitat suitability models using elevation, slope and aspect to highlight suitable burrowing petrel nesting areas

2.5 Purchase tasked VHR satellite imagery of SG archipelago

2.6 Apply models using relationships between spectral profiles in satellite imagery, and breeding-habitat preferences (developed in Output 1), to predict presence/absence and relative abundance of burrowing petrels across SG.

2.7 Validate distribution models for areas away from Bird Island using available ground-truthing data from elsewhere at South Georgia.

2.8 Compare predicted distributions with presence-absence at 5km-scale across SG mapped in the 1980s.

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3.1 Collate data on abundance or distribution of mollymawks, SG shags, giant petrels, Wilsons' storm petrels and SG diving petrels at Bird Island.

3.2 (See activity 1.3)

3.3 VHR satellite images assessed for presence of each species by experts. Annotations of seabird species are produced either as point markers on individuals, or polygons outlining presence and extent.

3.4 Compare expert annotations to ground and UAV survey data to validate results

3.5 For species which are detectable as individual birds (potentially mollymawks, SG shags and giant petrels), use expert annotations to develop automated detection methods

3.6 For species where individuals are not detectable (e.g Wilson's storm petrel, SG diving petrels), test the use of indirect methods such as spectral classification of guano and texture analysis of burrows

4.1 Collate data on abundance or distribution of mollymawks, SG shags, giant petrels, Wilsons' storm petrels and SG diving petrels across South Georgia, including in 2023/24 all-islands albatross census.

4.2 (see activity 2.3)

4.3 Apply methodologies developed as part of 3.3 and 3.4, and in DPLus132 for wandering albatrosses, to count individuals or detect colonies of wandering albatrosses, mollymawks, SG shags, giant petrels, Wilsons' storm petrels and SG diving petrels across South Georgia.

4.4 Validate all island survey results by comparing to existing data on abundance and distribution, and to 2023/2024 all-island albatross surveys.

5.1 Share results and recommendations with stakeholders.

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5.2 Deposit data in open access web portals.

5.3 Prepare reports for working groups and stakeholders.

5.4 Prepare manuscripts for publication in peer-reviewed journals.

5.5 Attend national and international conference to present results.

5.6 Make results available via websites for public dissemination