Biodiversity Challenge Funds Projects

Darwin Initiative, Illegal Wildlife Trade Challenge Fund, and Darwin Plus

Half Year Report

Note: If there is any confidential information within the report that you do not wish to be shared on our website, please ensure you clearly highlight this.

Submission Deadline: 31st October 2023

Project reference	DPLUS132
Project title	Monitoring albatrosses using Very High Resolution Satellites and citizen science
Country(ies)/territory(ies)	South Georgia and South Sandwich Island and Tristan da Cuhna
Lead partner	British Antarctic Survey
Partner(s)	RSPB
Project leader	*British Antarctic Survey, Peter Fretwell*
Report date and number (e.g. HYR1)	*April 2023 – October 2023*
Project website/blog/social media	Website: [Albatrosses from Space - British Antarctic Survey (bas.ac.uk)] *Twitter: @AlbatrossBAS*

Outline progress over the last 6 months (April – Sept) against the agreed project implementation timetable (if your project has started less than 6 months ago, please report on the period since start up to end September).

Although we are not looking for specific reporting against your indicators, please use this opportunity to consider the appropriateness of your M&E systems (are your indicators still relevant, can you report against any Standard Indicators, do your assumptions still hold true?). The guidance can be found on the resources page of the relevant fund website.

Project progress for the Wandering Albatross crowdsourcing campaign

1. There were 47 satellite images across 24 breeding sites included in the crowdsourced campaign. The image quality of all satellite images was reviewed after the campaign to determine which images to include in the crowd counts (see Figure 1 for details).

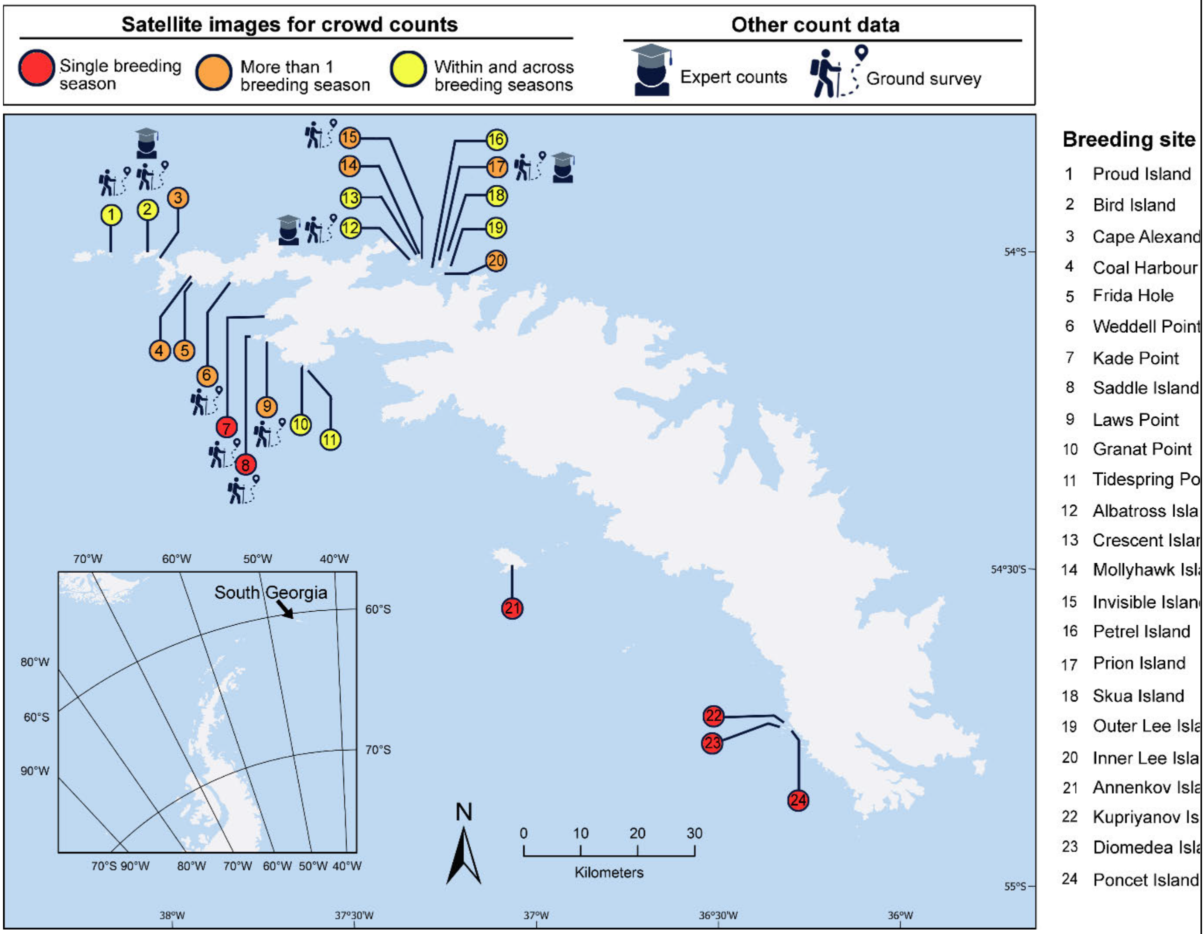

Figure 1. *Locations of the breeding sites across South Georgia where satellite images from 2015 to 2022 were obtained for the Albatrosses from Space crowd campaign. These breeding sites held ≥ 5 breeding pairs in previous censuses, but most have not been monitored since the last (2014/15) census. Breeding sites are categorised based on the availability of bright, cloud-free satellite imagery (red circle = captured from single breeding season, orange = captured over more than one breeding season, yellow = captured more than once within and across breeding seasons) and whether there was ground-truthed data available (ground survey symbol). A private campaign was conducted by experts (expert symbol) for satellite images from three intensely studied breeding sites where ground surveys were conducted.*

2. The raw tagged features (i.e., presumed albatrosses) from the campaign were filtered based on agreement of a feature between observers to produce the final dataset. Two surveyors agree on a feature if their tags are placed within a set distance of each other. We compared counts based on different cluster distances (1 m, 2 m, 3 m, 5 m and 10 m diameter) for breeding sites with ground survey data from the same year , with the proviso that a cluster can only contain one tag per surveyor. Bird counts based on tags agreed by at least 3 observers in 2 m clustered data were the closest to adjusted bird counts from ground surveys . This filtered dataset was used in all subsequent analysis.

3. Satellite counts reflect the total number of adult birds present at the colony, whereas ground surveys count the number of nests where an egg has been laid to estimate the number of breeding pairs at the colony. For ground surveys, we inflated the number of breeding pairs by 26.7% for small colonies (≤40 breeding pairs; see Figure S3) and 11.1% for large colonies (>40 breeding pairs; Fretwell et al. 2017) to obtain an estimated total bird count to compare with satellite counts. Different correction factors were applied because smaller colonies tend to have a higher proportion of non-breeders in the colony than larger colonies.

4. Satellite-based counts from the crowdsourced campaign were compared to ground counts from the same breeding season to assess their accuracy. There was a strong, positive correlation (r=0.98, df=16, *P*<0.001) between adjusted ground and satellite-based bird counts, with 4.5 to 30.9% percent deviation for colonies with over 100 breeding pairs .

5. A satellite image of Prion Island from 2022 has been acquired to compare with UAV imagery from the same breeding season to assess counting accuracy. The satellite image has been counted by the crowd and one expert. Satellite counts will be completed by 4 more experts.

   The satellite and UAV imagery of Prion Island has been included in a Review paper titled "Review of Satellite Remote Sensing and Unoccupied Aircraft Systems for Counting Wildlife on Land" (see Figure 1) to demonstrate differences in the quality of the image between each remote technique. This manuscript was submitted to the journal *Remote Sensing*.

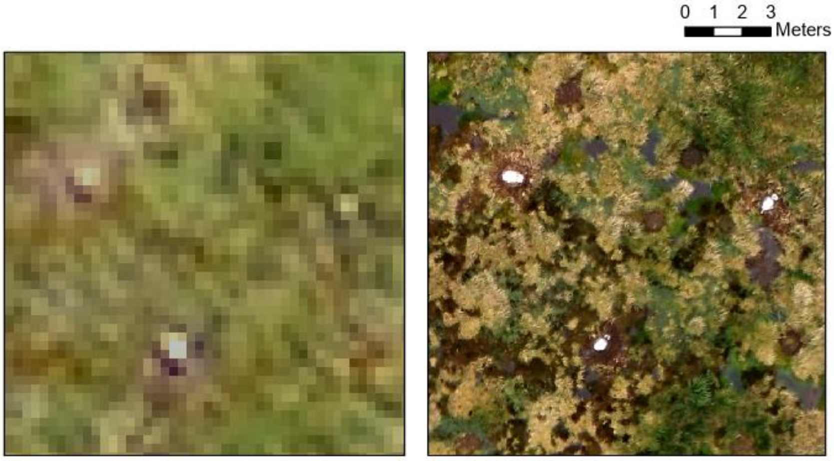

Figure 2. *Comparison of satellite remote sensing and UAV imagery of wildlife in remote locations. These two images show the same three nesting wandering albatross at Prion Island, South Georgia. (a) Individual albatrosses appear as several white-cream coloured pixels in 31-cm resolution satellite imagery, while (b) UAV provide finer details, including the bird's body shape and whether they are sitting on a nest or displaying. UAS image taken with AgEgle eBee X fixed-wing UAS using the Aeria X RGB sensor © 2023 Nathan Fenney.*

6. Ground and crowd satellite counts have been plotted for the 24 breeding sites (Figure S4-S7; Figure 3). Only tags within the breeding boundary were included in the crowd counts.
7. Breeding pair estimates were calculated based on crowd counts from a 2017 satellite image of Annenkov Island. All nest GPS co-ordinates from the last census (2003/04) and satellite annotations were plotted on a map of Annenkov Island (Figure 3A). These were compared to expert counts from the same satellite image published by Bowler *et al.* 2020 and predicted number of breeding pairs based on the average annual decline of Wandering albatrosses among large colonies in South Georgia (Figure 3B).

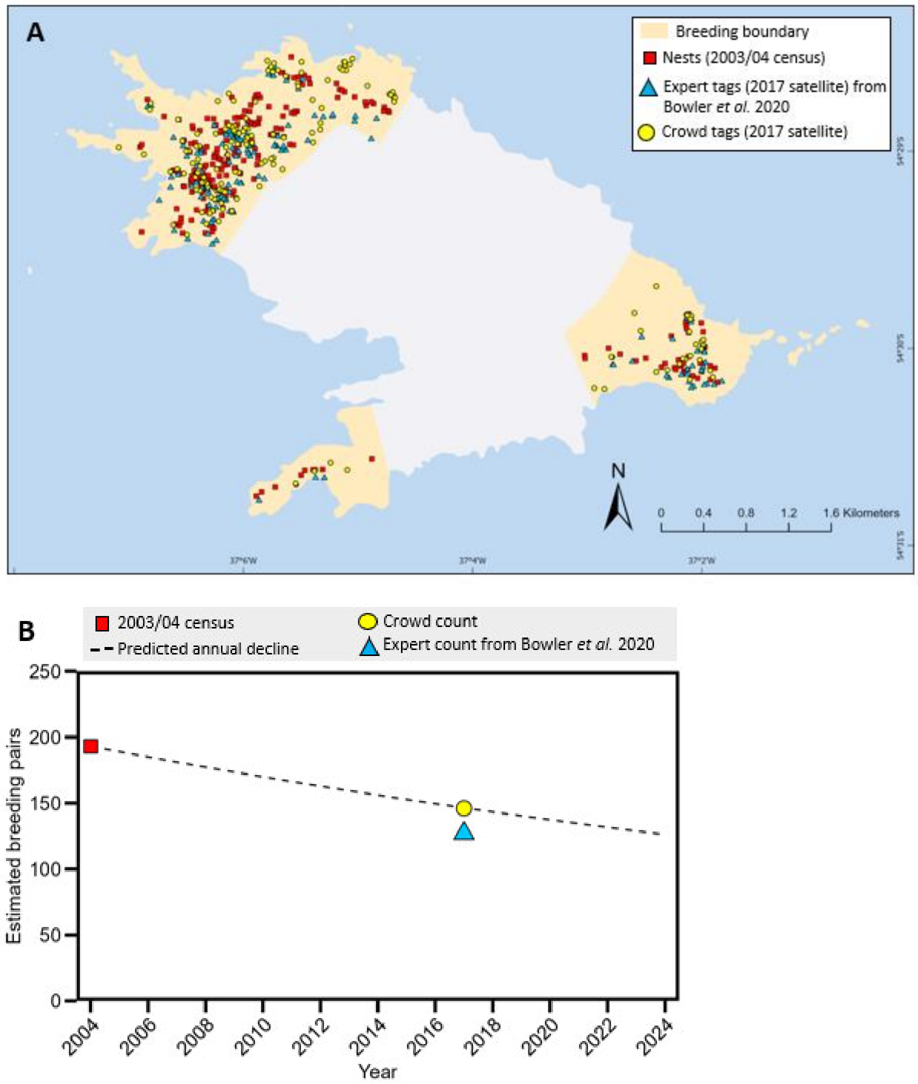

Figure 3. *Wandering albatross breeding boundary and estimated number of breeding pairs at Annenkov Island, South Georgia. (A) Map of Annenkov Island showing the breeding boundary and nest locations from the 2003/04 census (red squares), and location of each presumed albatross from crowd (yellow circle) and expert (blue triangle) tags in a cloud-free satellite image (cat ID: 1040010029A18200) from 3 February 2017. Expert tags were from Bowler et al. 2020. (B) Estimated breeding pairs at Annenkov Island plotted as a function of breeding year using satellite and ground counts. The satellite counts are from the 2 m clustered crowd dataset (yellow circle) and one expert (blue triangle) from Bowler et al. 2020. The 2003/04 and 2014/15 census data were used to calculate the average annual decline for breeding pairs for larger (≥ 15 breeding pairs) colonies. The average annual decline was used to predict the number of breeding pairs at Annenkov Island each year (dotted line) since it was last surveyed (red square).*

8. We organised a private campaign on the GeoHIVE platform in September 2023 to count wandering albatrosses in satellite images of Prion Island, Albatross Island and Bird Island. We recruited 7 experts (i.e., individuals with expertise in counting wildlife in satellite imagery) to complete the counts. The campaign consists of 542 image chips. The expert counts will be compared to counts from the crowd and ground surveys.
9. Three presumed albatrosses were tagged on Hall Island in the crowdsourced campaign. As no albatrosses have previously been reported here, confirmation of Wandering albatrosses on this island will be confirmed in the 2023/24 census.
10. The analysis of results is nearly complete for this project. Findings of this project will be published as one paper, which we are aiming to submit by April 2022.

Project progress for monitoring Tristan albatrosses using satellite remote sensing

1. Expert counts of Tristan albatrosses were completed for a 31-cm satellite image showing a cloud-free region of their breeding area on Gough Island (Figure 4). Ground surveys indicate 152 nesting birds in the area overlapping with the satellite image. Only 84 nesting birds (55.3%) were visible in the satellite image, in addition to 4 presumed non-breeders.

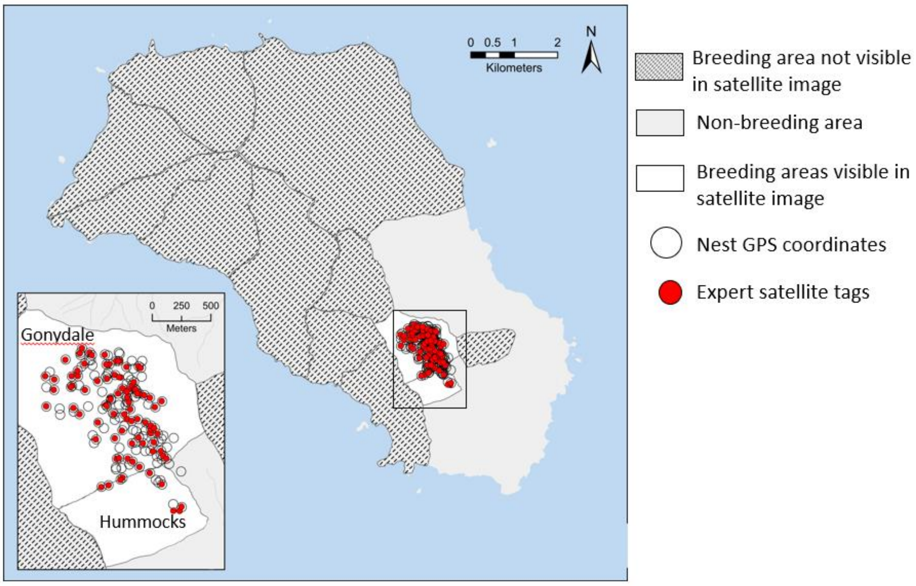

Figure 4. *Expert counts of Tristan albatrosses on Gough Island using a single satellite image of Gonydale and Hummocks from 1 February 2018. The map shows cloud-free area of the satellite image in white, non-breeding areas in light grey, and breeding areas not visible in satellite imagery in diagonal dashed lines. Red circles show tags marked by one expert (M. Attard), and large white circles show nest GPS coordinates from the same breeding season.*

2. We determined that the darker plumage of some individuals has contributed to the relatively low detectability of Tristan albatrosses in satellite imagery. Females are browner on their backs than males of the same age, and males tend to get whiter as they get older. As such, we predicted that breeding females will be more difficult to detect than males, and relatively young (and therefore darker) males will be more difficult to detect than older males. To test this, the sex and minimum age of the attending bird on each nest was determined based on ground survey data taken before and after the satellite image was taken. We found a significant difference in the minimum age of incubating males based on their degree of visibility in the satellite image ($F_{(2, 143)}$=4.06, p=0.02; Figure 5). Incubating males that were clearly defined in the satellite image (high visibility) tended to be older than incubating males that were more difficult to detect (low visibility) (Tukey HDS test: p=0.03, 95% C.I. = [0.28,7.99]) or were undetected (Tukey HDS test: p=0.04, 95% C.I. = [0.14,6.92]). The minimum age of female nesters had no significant influence on their degree of visibility in satellite image ($F_{(2, 148)}$=1.74, p=0.18). This suggests that older, and therefore probably lighter-coloured Tristan albatross males tend to be more clearly seen in satellite images.

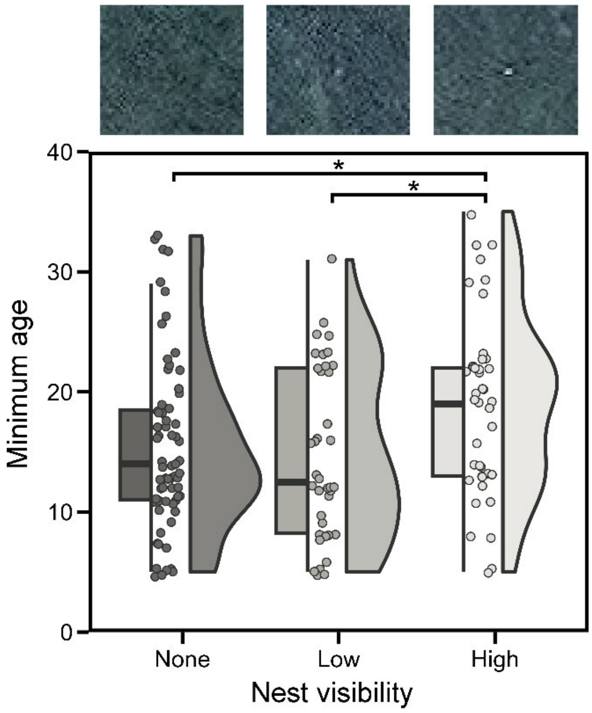

*__Figure 5.__ Minimum age of incubating male Tristan albatrosses on Gough Island as a function of nest visibility. In the satellite image, nest visibility was ranked as 'high visibility' if there was a clear large white dot, 'low visibility' for a smaller greyish dot, and 'not detected' where no light-coloured dot was seen where a nest was located according to the ground survey. The top three 31-cm satellite images (magnified to 50 m by 50 m) show a nesting male albatross in the centre, corresponding to each nest visibility score. In hybrid box plots, each incubating adult male is shown as filled circles, vertical line indicates the median, box shows the IQR and the whiskers are 1.5 × IQR and their distribution is shown as histograms. This figure only includes nests where the male was present during the visit before and after the satellite image was taken. Significant differences between categorical variables based on Turkey HD post-hoc tests are given in asterisks with *p < 0.05.*

3. We received slope and aspect values for all nests in cloud-free imagery. These will be analysed to assess whether some nests are concealed in satellite imagery due to shadowing.
4. A first draft is currently being written for the Tristan albatross project. We are aiming to submit the paper by April 2024.

2. Give details of any notable problems or unexpected developments/lessons learnt that the project has encountered over the last 6 months. Explain what impact these could have on the project and whether the changes will affect the budget and timetable of project activities.

None applicable

3. Have any of these issues been discussed with NIRAS and if so, have changes been made to the original agreement?

Discussed with NIRAS: Yes/No

Formal Change Request submitted:	Yes/No
Received confirmation of change acceptance	Yes/No
Change request reference if known:	

4a. Please confirm your actual spend in this financial year to date (i.e. from 1 April 2023 – 30 September 2023) **Actual spend:** £ [redacted] **4b. Do you currently expect to have any significant (e.g. more than £5,000) underspend in your budget for this financial year (ending 31 March 2024)?** **Yes** ☐ **No** x☐ Estimated underspend: £
4c. If yes, then you need to consider your project budget needs carefully. Please remember that any funds agreed for this financial year are only available to the project in this financial year. **If you anticipate a significant underspend because of justifiable changes within the project, please submit a re-budget Change Request as soon as possible. There is no guarantee that Defra will agree a re-budget so please ensure you have enough time to make appropriate changes if necessary. Please DO NOT send these in the same email as your report.** **NB: if you expect an underspend, do not claim anything more than you expect to spend this financial year.**
5. Are there any other issues you wish to raise relating to the project or to BCF management, monitoring, or financial procedures?
No

If you are a new project and you received feedback comments that requested a response, or if your Annual Report Review asked you to provide a response with your next half year report, please attach your response to this document.

All new projects (excluding Darwin Plus Fellowships and IWT Challenge Fund Evidence projects) should submit their Risk Register with this report if they have not already done so.

Please note: Any planned modifications to your project schedule/workplan can be discussed in this report but should also be raised with NIRAS through a Change Request. Please DO NOT send these in the same email.

Please send your **completed report by email** to BCF-Reports@niras.com. The report should be between 2-3 pages maximum. **Please state your project reference number, followed by the specific fund in the header of your email message e.g. Subject: 29-001 Darwin Initiative Half Year Report**