# Darwin Plus Main & Strategic: Annual Report

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

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

**Submission Deadline: 30th April 2025**

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

## 1. Darwin Plus Project Information

| | |
|---|---|
| Scheme (Main or Strategic) | Main |
| Project reference | DPLUS185 |
| Project title | Safeguarding Antarctic Krill Stocks for Baleen Whales |
| Territory(ies) | British Antarctic Territory |
| Lead Organisation | University of Southampton |
| Project partner(s) | British Antarctic Survey, Scottish Association for Marin Science |
| Darwin Plus grant value | £630,031 |
| Start/end dates of project | 01/04/2023 - 31/03/2026 |
| Reporting period (e.g. Apr 2024-Mar 2025) and number (e.g. Annual Report 1, 2) | April 2024 – March 2025<br>Annual Report 2 |
| Project Leader name | Ryan Reisinger |
| Project website/blog/social media | https://www.bas.ac.uk/project/safeguarding-antarctic-krill-stocks-for-baleen-whales/ |
| Report author(s) and date | Ryan Reisinger<br>22 May 2025 |

## 2. Project summary

**Krill are central to Antarctic marine ecosystems but are subject to a fishery managed with insufficient spatiotemporal resolution or species representation. There is an urgent need to elucidate the spatiotemporal characteristics of interactions among krill, baleen whales and the krill fishery and to develop our capacity to forecast these interactions. This project aims to provide this information by collecting and analysing fine-scale data on krill and whale distribution, to improve krill fishery management and conserve krill-based Antarctic marine ecosystems.**

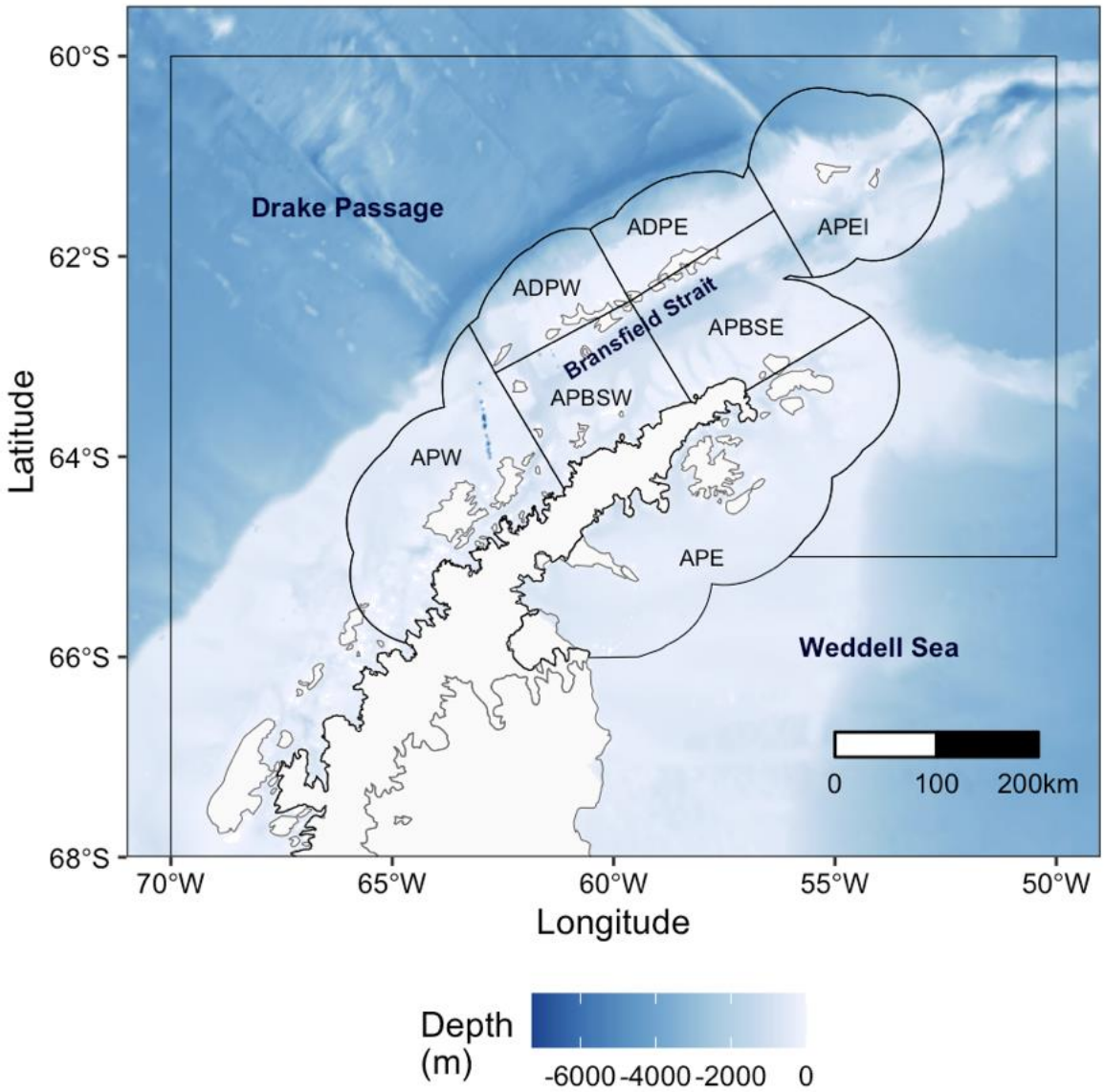



*Figure 1. Map of the Western Antarctica Peninsula in the British Antarctic Territory, where the project is being conducted. Black lines indicate the CCAMLR Area 48.1, used for krill fishery management, and 'Small Scale Management Units', which have been proposed for management. These are: Antarctic Peninsula West (APW), Antarctic Peninsula East (APE), Antarctic Drake Passage West (ADPW), Antarctic Drake Passage East (ADPE), Antarctic Peninsula Elephant Islands (APEI), Antarctic Peninsula Bransfield Strait West (APBSW), Antarctic Peninsula Bransfield Strait East(APBSE).*

Antarctic krill (*Euphausia superba*) are food for numerous natural consumers, including birds and marine mammals. Interactions between krill and its consumers structure Antarctic marine ecosystems [1]. However, krill are also subject to a commercial fishery operating in the British Antarctic Territory (BAT) (Figure 1) and elsewhere [2], which overlaps in time and space with foraging consumers. Competition between fisheries and consumers is thus a major concern [e.g., 3, 4], especially given i) long-term krill abundance and distribution changes, attributed to climate change, ii) predator population changes post historical overexploitation, and iii) likely expansion of the krill fishery.

The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) manages the fishery with an ecosystem approach, according to which fishing should not interfere with krill population growth, or krill-dependent consumers [5]. Yet catches have become concentrated in a few coastal hotspots, raising concerns about how local depletion of krill impacts its natural consumers [e.g., 3, 6]. There is currently a mismatch between the scales at which krill fisheries are managed, and that at which they operate and at which consumers forage [3]. Moreover, baleen whales - now recovering from historical overexploitation - are not

explicitly included in CCAMLR's management approach, even though they consume more than 50% of krill eaten by all air-breathing predators [7].

To conserve biodiversity and improve protection of natural environments, better understanding is urgently needed about the spatiotemporal characteristics of interactions among krill, baleen whales and the fishery, so we can develop our capacity to forecast such interactions.

*This project aims to provide such information to CCAMLR to improve krill fishery management and better conserve krill-based ecosystems. This is being achieved by analysing the contemporaneous fine-scale spatiotemporal distribution of krill, baleen whales and fisheries in the BAT.*

Our project has relevance to the Government of South Georgia and the South Sandwich Islands (SGSSI) and to the Member states of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). The krill fishery primarily operates in the southwest Atlantic including within the BAT. Our project addresses various BAT management themes, importantly, that relate to environmental challenges and development of mitigation measures. We also address Darwin Plus themes on Biodiversity, Climate change and Environmental quality.

[1] Trathan, P. N., and Hill, S. L. (2016). "The Importance of Krill Predation in the Southern Ocean," in Biology and Ecology of Antarctic Krill, ed. V. Siegel (Cham: Springer), 321–350. doi:10.1007/978-3-319-29279-3_9.

[2] Nicol, S., Foster, J., and Kawaguchi, S. (2012). The fishery for Antarctic krill - recent developments. Fish Fish. 13, 30–40. doi:10.1111/j.1467-2979.2011.00406.x.

[3] Trathan, P. N., Warwick-Evans, V., Young, E. F., Friedlaender, A., Kim, J. H., and Kokubun, N. (2022). The ecosystem approach to management of the Antarctic krill fishery - the 'devils are in the detail' at small spatial and temporal scales. J. Mar. Syst. 225, 103598. doi:10.1016/j.jmarsys.2021.103598.

[4] Reisinger, R. R., Trathan, P. N., Johnson, C. M., Joyce, T. W., Durban, J. W., Pitman, R. L., Friedlaender, A. S. (2022) Spatiotemporal overlap of baleen whales and krill fisheries in the Antarctic Peninsula region. Front. Mar. Sci. 9, 914726. doi: https://doi.org/10.3389/fmars.2022.914726

[5] Constable, A. J., De LaMare, W. K., Agnew, D. J., Everson, I., and Miller, D. (2000). Managing fisheries to conserve the Antarctic marine ecosystem: Practical implementation of the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR). ICES J. Mar. Sci. 57, 778–791. doi:10.1006/jmsc.2000.0725.

[6] Santa Cruz, F., Krüger, L., and Cárdenas, C. A. (2022). Spatial and temporal catch concentrations for Antarctic krill: Implications for fishing performance and precautionary management in the Southern Ocean. Ocean Coast. Manag. 223, 106146. doi:10.1016/j.ocecoaman.2022.106146.

[7] Warwick-Evans, V., Fielding, S., Reiss, C. S., Watters, G. M., and Trathan, P. N. (2022b). Estimating the average distribution of Antarctic krill Euphausia superba at the northern Antarctic Peninsula during austral summer and winter. Polar Biol. 45, 857–871. doi:10.1007/s00300-022-03039-y.

## 3. Project stakeholders/partners

*Project partners*

The project's formal partners are the University of Southampton (UoS) (lead), British Antarctic Survey (BAS), and the Scottish Association for Marine Science (SAMS). The University of California Santa Cruz (UCSC) was a formal project partner until beginning 2024, when a

change request was approved to change UCSC to an informal project partner since UCSC could not agree to the flow-through terms of the grant's funding agreement.

All partners are involved in project planning, monitoring, evaluation and decision making through involvement of a co-investigator from each partner (Ryan Reisinger at UoS, Sophie Fielding at BAS, Phil Anderson at SAMS, Ari Friedlaender at UCSC, and Phil Trathan at BAS and UoS). These project members, as well as the project's postdoctoral research fellows (Tracey Dornan at BAS, Julie Mestre at UOS) and PhD students involved with some aspects of the project (Natalie Nickells at BAS/UoS, Amy Feakes at UoS) met approximately monthly over the year, online (list of meetings and meeting notes in Annex 8; some of these meetings are recorded and since 2025/04/28 all meetings will be recorded as possible). Fieldwork was intended to include team members from UoS and BAS, but BAS personnel unexpectedly withdrew from fieldwork days before our annual fieldwork campaign in March 2025. Nonetheless, UoS, BAS and SAMS were involved in fieldwork planning and support. One-to-one meetings between PI Reisinger and postdoctoral research fellow Mestre have taken place approximately weekly since her appointment. This does highlight a challenge of the partnerships: that each organisation has its own processes, policies and procedures around fieldwork, despite the fieldwork being undertaken jointly.

*Stakeholders*
The Government of the British Antarctic Territory (BAT) recognises the environmental challenges facing the Antarctic region and is committed to developing appropriate mitigation measures. Similarly, the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) shares these objectives, aiming to ensure that harvesting activities do not cause long-term damage to the marine ecosystem. Our project thus has relevance to the Government of the BAT and to the Member states of CCAMLR. Our project has further relevance to the Government of South Georgia and the South Sandwich Islands (SGSSI).

These stakeholders will be engaged through a stakeholder meeting planned for the next year of the project, reports to CCAMLR in project year 3 (see Activities 1.3, 2.3, 3.2, 4.4 in the logframe Annex 2) and participation in CCAMLR workshops in project year 3. CCAMLR has clearly identified the need for better information fine scale spatiotemporal interactions between krill predators and the krill fishery. Our team includes scientists (Trathan) that helped CCAMLR develop the current Risk Assessment Framework, including the collation of relevant biomass estimates of krill (Fielding, Dornan), we are therefore well-placed to influence CCAMLR's management strategy.

Dornan et al. presented a report "Krill for whales – Fine scale acoustic krill surveys in Area 48.1" to the CCAMLR Working Group on Acoustic Survey and Analysis Methods(20-24 May, 2024: https://meetings.ccamlr.org/en/wg-asam-2024) document WG-ASAM-2024/09. Dornan also presented the project at the Scientific Committee on Antarctic Research Krill Expert Group (SKEG) meeting 10-12 March 2025 (https://scarkrillexpertgroup.org/2025-skeg-symposium/).

## 4. Project progress

### 4.1 Progress in carrying out project Activities

**Activities 1**

*1.1 Deployment of tracking tags on whales in the Western Antarctic Peninsula region.*

*1.2 Analyse whale tracking data and develop models which produce spatiotemporally explicit predictions of whale foraging presence within the BAT.*

*1.3 Prepare data layers of these predictions for presentation to CCAMLR as Working Papers.*

Our annual fieldwork cruise took place during March 2025 (see Annex 4 for cruise report).

In project year 1 no tagging took place since UCSC personnel unexpectedly did not join the fieldwork. To supplement whale occurrence data from tagging, on the 2024 cruise we conducted standardised marine mammal observations while conducting krill surveys.

In project year 2, tagging of fin whales was attempted at Elephant Island in March 2025. Extremely poor weather conditions severely hampered fieldwork, giving us very little time (and poor conditions for tagging). One tag was deployed on a fin whale, but did not transmit data, and two tags were lost. The attached cruise report (Annex 4) provides more detail. We have discussed with two other research groups the possibility of using their limited tracking data for fin whales, and we are looking at the possibility of sending the remaining three tags to one of these research groups for deployment.

Mestre has been analysing existing humpback and minke whale tracking data: she is currently (May 2025) presenting these results at the European Cetacean Society conference in a poster entitled “Spatiotemporal overlap of minke and humpback whales with krill fishing vessels in the Western Antarctic Peninsula” (Annex 6). The results are also being prepared for a working paper for submission to CCAMLR’s Working Group on Ecosystem Monitoring and Management 2025 meeting (https://meetings.ccamlr.org/en/wg-emm-2025). This includes preparation of data layers of these predictions.

**Activities 2**

*2.1 Final trials of ImpYak survey system and training field personnel on system.*
*2.2 Conduct acoustic surveys of krill abundance nearshore at the Western Antarctic Peninsula during two fieldwork periods in the project.*
*2.3 Produce spatially-explicit krill abundance estimates from these survey data and submit estimates to the CCAMLR Acoustic Survey and Assessment Methods Working Group.*

The ImpYak system was trialled during the 2024 field season, and has undergone refinement based on several issues identified (see 2024 annual report and 2024 cruise report). Further trials of the system were conducted in Scotland and BAS staff have undergone training on deployment and piloting of the system. Due to the withdrawal of BAS staff from the 2025 field season, the ImpYak could not be further trialled on our cruise. However, Dornan has taken the system on a BAS logistics cruise to Rothera station in May 2025, in the hopes of trialling the ImpYak. On 18 May Dornan et al. managed a short trial of the Impyak from the vessel rrr1Sir David Attenborough (SDA). They were supported by the SDA captain and crew and used the cargo tender 'Terror' for the launch. This was a very short deployment as time and daylight were limited and there was a lot of ice around so had to scout for an ice free patch. That said, ImpYak sailed well and the echosounder collected data, all controlled over radio link comms. The data will be analysed for quality later.

Acoustic surveys for krill were conducted in the 2024 season. Withdrawal of BAS staff from the 2025 field season meant that the ImpYak could not be used to conduct krill surveys, nor could the pole-mounted echosounder. Further, the poor weather that limited our working time meant we prioritised tagging work. We did, however, opportunistically collect acoustic data using the vessel Hans Hansson’s echosounder: this can only serve as a relative index of krill abundance, not the calibrated abundance measures produced using our 2024 equipment and methodology.

Dornan presented these results at a May 2024 meeting of the CCAMLR Acoustic Survey and Assessment Methods Working Group.

Additional data on krill distribution and abundance are being sought from other research groups by Dornan and Fielding.

**Activities 3**

*3.1 Analyse whale tracking data and krill abundance data to characterise spatiotemporal interactions between krill and predators on foraging grounds in the BAT.*

*3.2 Write up the results from these analyses and submit 1) for peer-reviewed publication and 2) as a Working Paper for CCAMLR.*

Preliminary analysis of existing whale tracking data, whale observation data and krill abundance data are ongoing by Dornan, Mestre and Nickells. These will be submitted as peer-reviewed publications and CCAMLR working papers in the coming project year.

**Activities 4**

*4.1 Collate krill fishery data, obtained from CCAMLR, for the Western Antarctic Peninsula region.*
*4.2 Analyse whale tracking data, krill abundance data, and krill fishery data together to characterise function overlap among krill, their predators and the fishery.*
*4.3 Produce data layers for spatiotemporally explicit maps of potential interactions among krill, whales and fisheries.*
*4.4 Write up the results from these analyses and submit 1) for peer-reviewed publication and 2) as a Working Paper for CCAMLR.*

Mestre has collated fishing vessel AIS data from Global Fishing Watch and is analysing these data together with existing whale tracking data for humpback and minke whales: she is currently (May 2025) presenting these results at the European Cetacean Society conference in a poster entitled “Spatiotemporal overlap of minke and humpback whales with krill fishing vessels in the Western Antarctic Peninsula” (Annex 6). The results are also being prepared for a working paper for submission to CCAMLR’s Working Group on Ecosystem Monitoring and Management 2025 meeting (https://meetings.ccamlr.org/en/wg-emm-2025). This includes preparation of data layers of these predictions. Additional fishery data (‘C1 data’ reporting effort and catch) will be requested from CCAMLR in the coming project year.

**Activities 5**

*5.1 Develop habitat models for different baleen whale species to determine where interactions with fishing vessels will be most predictable and most intense.*

*5.2 Create a Shiny prediction application that produces seasonal forecasts of interactions for CCAMLR Statistical Subarea 48.1 in the BAT.*

Preliminary habitat models for whales were developed in 2024 by Burleigh (see 2024 report). These analyses will be extended by Mestre in the coming project year. Further, habitat models for fisheries will be developed in the coming project year. Regional Oceanographic Model forecasts will be sought in the coming project year.

Once these two sets of analyses are complete, the Shiny prediction application will be developed.

## 4.2 Progress towards project Outputs

*Output 1. Whales. Spatiotemporally explicit predictions of whale foraging presence.*

Mestre has been analysing existing tracking for humpback and minke whales to produce these predictions. Preliminary results are being presented by her in a poster at the European Cetacean Society conference (https://www.europeancetaceansociety.eu/36th-annual-conference-ponta-delgada-azores-portugal). The results are also being prepared for a working paper for submission to CCAMLR’s Working Group on Ecosystem Monitoring and Management 2025 meeting (https://meetings.ccamlr.org/en/wg-emm-2025). This extends previous preliminary analyses (Hutchinson dissertation, Burleigh dissertation, see 2024 annual report).

Means of verification: Data layers are not yet published in a publicly accessible repository, and working papers have not yet been submitted to CCAMLR or IWC.

Highly likely to be achieved by project end.

*Output 2. Krill. Spatiotemporally explicit nearshore krill abundance information.*

Novel acoustic survey data were collected using the pole-mounted echosounder during the March 2024 cruise. These new data have undergone preliminary analyses and were presented to the CCAMLR Acoustic Survey and Assessment Methods Working Group in May 2024 by Dornan. Opportunistic acoustic data collected during the 2025 cruise are yet to be analysed, however it remains to be seen how robust these data are, given they were collected using the vessels own echosounder (not calibrated) and were collected along non-specific routes while tagging was being conducted.

Means of verification: Results have been communicated to CCAMLR ASAM at their 2024 meeting, as noted in the meeting report: https://meetings.ccamlr.org/en/wg-asam-2024/09

Achieved, but further analyses of these data will take place.

*Output 3. 3D predator-consumer interactions.*

While data for humpback and minke whales are already available, data for fin whales has not been collected. We are seeking data from other research groups, and other research groups may be able to deploy our remaining three tags in March 2026. Simultaneous prey mapping of krill alongside tracking data has not been achieved, but we have collected marine mammal observation data simultaneously with krill data, and we are identifying whether other simultaneous data may be available.

Means of verification: Not yet applicable—data layers, peer-reviewed manuscript and working paper not yet produced.

Reasonably likely to be achieved.

*Output 4. Integrated krill-consumer-fisheries interactions.*

Preliminary work on this output has started (see Activities 4), but this output will be produced in the coming project year, with high likelihood.

*Output 5. 5. Forecasting.*

Work on this output takes place in the coming project year, with medium to high likelihood of being achieved by project end.

### 4.3 Progress towards the project Outcome

Our stated outcome is to provide to CCAMLR Working Papers, data and information to help ensure krill fishery management occurs at ecologically relevant spatial and temporal scales.

Indicators 0.1 and 0.2: We have collected and started analyses the data to be used in the reports and publications that are the major driver for CCAMLR to (Indicator 0.1) review the small-scale management units used to set krill catch limits in the BAT and (Indicator 0.2) consider sensitive time periods for krill-dependent predators, especially baleen whales, within each fishing season, and manage catches temporally within such seasons rather than only annually, as is the baseline at present.

Indicator 0.3 (By March 2026, the project has demonstrated, through two field seasons and peer-reviewed publication of results, a new method for low-cost, near-shore acoustic surveys in areas where research vessels currently do not operate): In 2024 we conducted in-situ testing of the low-cost nearshore survey system. This revealed technical issues that were addressed before the second field season in 2025, but withdrawal of BAS staff meant the system was not

tested in our last cruise. However, Dornan has taken the system on a BAS logistics voyage to Rothera station in the hopes of further testing of the system in-situ. Further, Dornan et al. are currently drafting a manuscript (for a peer-reviewed journal) reviewing autonomous systems for krill surveying.

We are confident that the indicators are adequate to measure the intended outcome. For indicators 0.1 and 0.2 we are progressing towards the outcome. For 0.3 the significant technical issues in the first field season and staffing issues in the second field season were unexpected, and have hampered our progression towards this outcome.

### 4.4 Monitoring of assumptions

**Assumption 0.1:** CCAMLR reviews the information provided by this project and considers it as part of a future revision and designation of small-scale management units and adoption of krill fishery catch limits.

This assumption still holds in general. Working papers submitted to CCAMLR must be considered and discussed. The issue of spatiotemporal scale and overlap with predators in relation to krill fishery management is high on its agenda. However, in 2024, CCAMLR failed to renew Conservation Measure 51-07, which previously subdivided the krill catch limit across four subareas within Area 48. This measure was designed to distribute fishing pressure and reduce the risk of concentrated harvesting in ecologically sensitive regions. Its expiration means that the entire precautionary catch limit of 620,000 tonnes could now be taken from a single subarea (e.g., Subarea 48.1, where our project is based, previously at 155,000 tons). The lapse of CM 51-07 was widely regarded as a significant setback for Antarctic marine conservation. While other conservation measures remained in force for the 2024/25 season, the failure to renew CM 51-07 underscores the difficulties in achieving consensus on key management strategies within CCAMLR (https://www.ark-krill.org/news/qkmcp91kxyd366cskvorldk1a3y910).

**Assumption 1.1:** Tags are able to be deployed on fin whales.

In 2024 we were not able to deploy tags on fin whales. This season (March 2025), our fieldwork was plagued by bad weather. We deployed one tag (which did not transmit) any data, and lost two others. We will seek existing fin whale tracking data from another research group and will look at sending the remaining three tags to another research group to deploy. Functionally, therefore, this assumption has not held.

**Assumption 2.1:** Krill is able to be surveyed using yacht-mounted echosounders or the ImpYak system.

This assumption holds partially. In 2024, we were able to survey krill using a pole-mounted echosounder. In 2024, we had some technical problems with the ImpYak during in-situ trials, but technical issues were addressed. In 2025, however, the BAS team responsible for surveys could not join the expedition, and no boat-(pole-)mounted surveys were done, nor ImpYak surveys.

**Assumption 3.1:** CATS tags are able to be deployed in foraging aggregations of whales, and simultaneous prey mapping can be undertaken.

To date this assumption has not held. We have not been able to deploy tags (neither CATS nor LIMPET tags) with simultaneous prey mapping.

**Assumption 4.1:** CATS tags are able to be deployed in foraging aggregations of whales, and simultaneous prey mapping can be undertaken using yacht-mounted echosounders or the ImpYak system.

While we did observe aggregations of fin whales during both field seasons, we have not been able to deploy tags (neither CATS nor LIMPET tags) with simultaneous prey mapping.

**Assumption 4.2:** Fishery data is made available.

This assumption should hold. We have previously successfully requested fishery data. We have also started using publicly available Global Fishing Watch data: AIS data on the movements of fishing vessels.

**Assumption 5.1:** CATS tags are able to be deployed in foraging aggregations of whales, and simultaneous prey mapping can be undertaken.

As for Assumptions 3.1 and 4.1

**Assumption 5.2:** Interactions can be forecast based on their correlations with oceanographic covariates for which forecasts exist.

This assumption should still hold. Work in other marine fisheries indicates that this should work.

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

Among the British Antarctic Territory's stated objectives is to "protect the Territory's environment, on the basis of thorough science and research (British Antarctic Territory Strategy 2019-2029). In support of this objective, the BAT states it will "2.4 support efforts to protect and study the marine environment around BAT. 2.5 encourage activity, funded by the UK Government or through philanthropic means, which increases understanding of BAT's environment and assists in its protection." The BAT falls within the jurisdiction of the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR), "and UK scientists have worked closely through CCAMLR to ensure that the BAT marine environment is managed under CCAMLR measures to the highest international standards, with effectively regulated marine activities underpinned by robust science" (https://www.britishantarcticterritory.org.uk/research/environmental-protection/).

Our outcome to provide information to CCAMLR to improve krill fishery management thereby supports BAT strategy. As detailed in other sections of the report, the second project year has focusses on data collection through fieldwork and data analyses in support of the outcome. Communication of results and stakeholder engagement takes place in project year 3.

## 6. Gender Equality and Social Inclusion (GESI)

| GESI Scale | Description | Put X where you think your project is on the scale |
|---|---|---|
| **Not yet sensitive** | The GESI context may have been considered but the project isn't quite meeting the requirements of a 'sensitive' approach | |
| **Sensitive** | The GESI context has been considered and project activities take this into account in their design and implementation. The project addresses basic needs and vulnerabilities of | X |

| | | |
|---|---|---|
| | women and marginalised groups and the project will not contribute to or create further inequalities. | |
| **Empowering** | The project has all the characteristics of a 'sensitive' approach whilst also increasing equal access to assets, resources and capabilities for women and marginalised groups | |
| **Transformative** | The project has all the characteristics of an 'empowering' approach whilst also addressing unequal power relationships and seeking institutional and societal change | |

The University of Southampton, British Antarctic Survey and Scottish Association of Marine Science are committed to equality, diversity and inclusion with all three institutes awarded either bronze or silver Athena Swan awards.

The project team includes senior and junior female scientists (Fielding, Dornan and Mestre). University of Southampton policies ensured that equal opportunities were promoted during recruitment for the PDRA position in project year 2 and a female scientist was appointed (Mestre). In the 2025 fieldwork campaign, half (2/4) of the science team were women. We promote gender equality in our project culture and operation through: promoting a positive working environment (especially fieldwork), enabling personal and professional development; and, in future, inspiring females to pursue STEM subjects through public engagement.

## 7. Monitoring and evaluation

Monitoring and evaluation is conducted by reading CCAMLR meeting reports and by project members attending CCAMLR meetings and CCAMLR working group meetings. Monitoring and evaluation work is shared by UoS and BAS. The activities and processes of CCAMLR are well recorded/documented, making close monitoring and evaluation of progress towards the outcome feasible. Our project contributions to CCAMLR meetings are similarly recorded in meetings, allowing us to demonstrate links between the project activities, and outcomes.

## 8. Lessons learnt

The project partner-composition broadly worked well, however that BAS personnel could not join fieldwork was unexpected.

Budget management and reporting has again been challenging because fieldwork, in the austral autumn, takes place near the end of the financial year. This is unavoidable in this case as it is the most appropriate time of year for us to collect data.

Our project uses a small flexible platform (the 28 m long Hans Hansson), which allows us to direct where and when to collect data, and to be more responsive to ecological and weather conditions, but does come with high logistical overheads related to contract negotiations, transport, T&S for field personnel, etc. Further, institutions may be reluctant to send staff on a smaller research vessel, as was the case this year with BAS. We still think this is preferable to working with a platform (e.g., Sir David Attenborough) run by a national operator (e.g., British Antarctic Survey), mainly because it is difficult to secure science time on these national vessels, but we recommend that projects operating in the same geographic area carry out a careful cost-benefit analysis. We would also recommend a higher budget for conducting fieldwork—our current budget tightly constrains how long we can conduct fieldwork, and this season (March 2025) the risk of poor weather severely curtailing fieldwork materialised.

Challenging weather and personnel unavailability significantly impacted the fieldwork, preventing dedicated krill surveys, limiting whale tagging opportunities, and hindering marine

mammal observations. An increased fieldwork budget would allow longer time in the field, mitigating against poor weather. It must be noted, however, that weather conditions this season were unusually bad. Despite these setbacks, passive acoustic moorings were successfully deployed and recovered, with some left for long-term monitoring, and seven fin whale biopsy samples were collected. Both of these data sources can complement the tagging data.

A positive element of our project is that it aims to feed into a well-established organisation and process for sustainable environmental management—CCAMLR. This does require a detailed understanding of CCAMLR's workings, however, and in that regard our inclusion of team members with long experience with CCAMLR (Trathan, Fielding) is critical. However, the lapse of CCAMLR's CM 51-07, which previously subdivided the krill catch limit across four subareas within Area 48, was widely regarded as a significant setback for Antarctic marine conservation. Despite ongoing efforts to develop a revised krill fishery management approach and establish new Marine Protected Areas (MPAs), CCAMLR members were unable to reach consensus on these initiatives. This impasse reflects broader challenges within the Commission in balancing conservation objectives with fishing interests. the failure to renew CM 51-07 underscores the difficulties in achieving consensus on key management strategies within CCAMLR. For us, this has also highlighted the potential role of advocacy and stakeholder engagement through other routes, something we will explore in the coming project year.

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

2024 Annual Report:

1. It is very useful for reviewers to be able to read management meeting minutes, which the AR states are available on request. Reviewers have a limited time to review project documents which means additional document requests cannot be made. In future please attach management meeting minutes (and any other useful material) to your reporting. **Attached (Annex 8).**
2. It would be useful if future reporting could briefly outline the existence and nature of health and safety procedures and training, given that fieldwork in the Southern Atlantic is an inherently risky endeavour. **University of Southampton Risk Assessments (Annex 10) and BAS Risk Assessments (Annex 11) attached. Further, all fieldwork personnel have undergone Personal Survival at Sea Training through MCA approved training providers.**

## 10. Risk Management

Annex 7 – Risk Register

It was not anticipated that BAS would not be able to join the 2025 research cruise. This was due to BAS not being willing to allow their personnel to sign the personal waivers required by the charter provider of the Hans Hansson. The risk of poor weather materialised during our 2025 cruise. Consequently, we did not successfully deploy tags. We are a) looking to source available data and b) discussing another research group deploying our remaining tag. There was an unanticipated major increasing in the cost of chartering the vessel Hans Hansson. We addressed this through an approved change request to use unspent tag money for current financial year to finance additional charter costs.

## 11. Scalability and durability

The project design considered long-term sustainability, scalability, and knowledge transfer. Stakeholders critical to the uptake and scaling of project outputs—particularly CCAMLR—are to be actively engaged through targeted mechanisms such as submission of Working Papers to CCAMLR, participation in Scientific Committee Working Group meetings where possible, and a proposed dedicated virtual workshop for stakeholders. This should ensure early awareness and understanding of the project's tools and findings, including their potential benefits (e.g. more

ecologically informed krill management) and practical considerations for adoption. Peer-reviewed publications and CCAMLR submissions provide a credible, transparent basis for this influence.

To enhance the durability of the project's impacts, we would like to design the predictive application to be user-friendly and future-proof, allowing new krill and whale data to be easily incorporated by member states with minimal training or resources. Importantly, forecasts could also update semi-automatically when core environmental data (e.g. oceanographic model outputs) are refreshed, reducing reliance on manual input. This design would directly support institutional mainstreaming within CCAMLR, meaning the project's scientific outputs could be incorporated into ongoing operations with little further external funding or support (beyond development of the application, a medium to high likelihood output of our project). In parallel, the project's open science ethos ensures all tools, data, and methods are publicly available and well-documented, enabling external projects or national monitoring programmes to build upon them.

Our alignment with current CCAMLR priorities—especially the development of a revised krill fishery management framework—should increase receptivity among key stakeholders (bearing in mind the issues noted above regarding consensus decision making in CCAMLR).

The project will ideally shift norms within the CCAMLR community, particularly around the need to better account for recovering whale populations and the dynamic nature of predator–prey–fishery interactions. Looking ahead, we are actively exploring ways to integrate project tools into other initiatives such as ARK (the Antarctic for Responsible Krill Harvesting Companies) and would like to brief national delegates on potential applications. This, together with our focus on open-access outputs and integration into existing decision-making frameworks, positions the project for long-term legacy and practical impact beyond its formal end date.

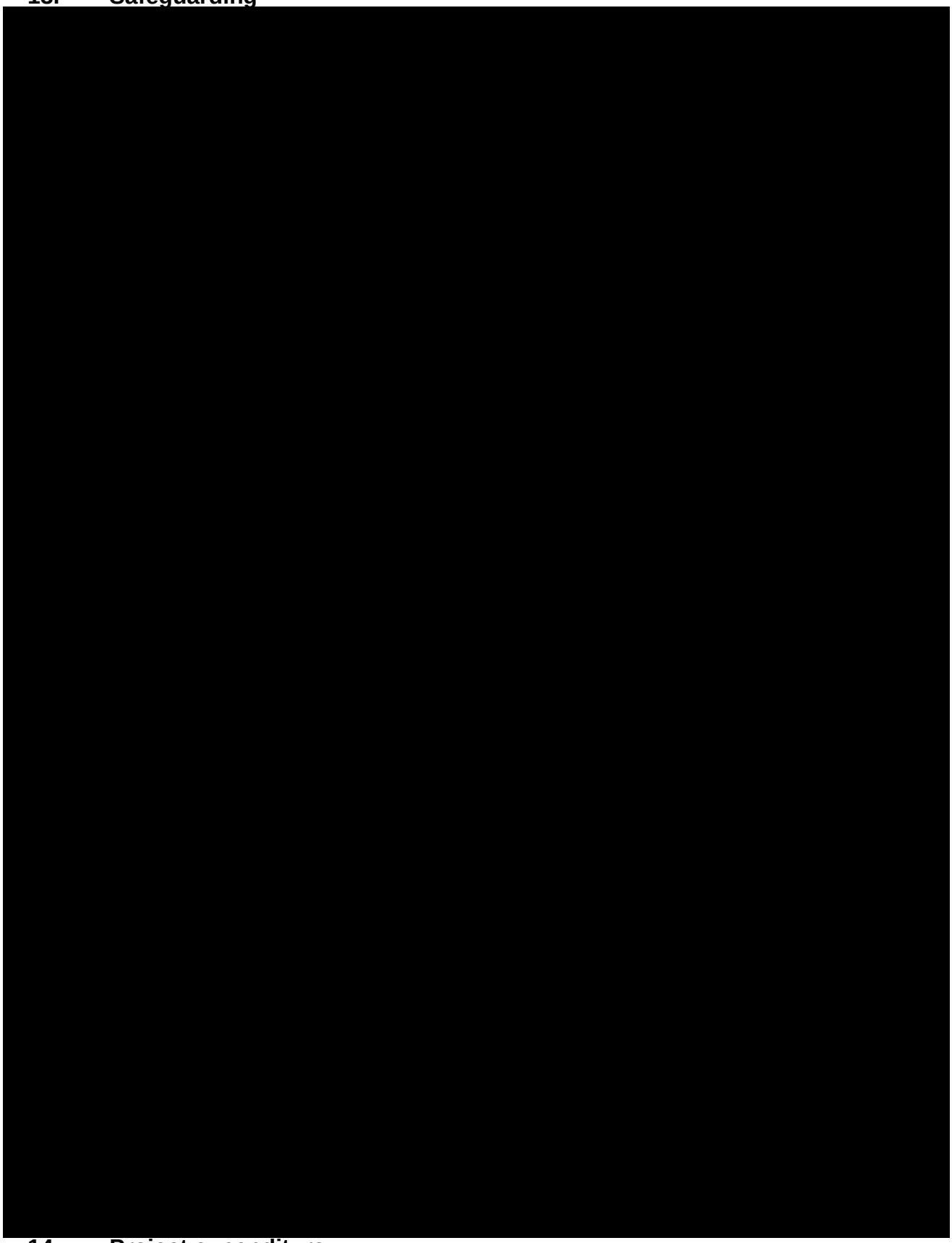
## 12. Darwin Plus identity

The work has been featured in Reisinger's interviews Inside Climate News (Scientists Call for More Marine Protected Areas in the Southern Ocean. https://insideclimatenews.org/news/11012025/southern-ocean-antarctic-krill-marine-protected-areas/) and Swoop Antarctica (Is commercial krill fishing a danger to Antarctica's whales? https://www.swoop-antarctica.com/blog/is-commercial-krill-fishing-a-danger-to-antarcticas-whales/) and Trathan and Reisinger's interview with the Daily Maverick (The Krill Catastrophe https://www.dailymaverick.co.za/article/2025-04-15-how-the-crucial-antarctic-krill-are-being-doomed-by-geopolitics-and-overfishing/). In these media pieces we always request that our funding source is stated, but this is not always added.

The Darwin Plus name and logo has been used in all presentations by Reisinger (Winchester Cathedral, Stanley Infant and Junior School, Barton Peveril College, Oxford University Museum of Natural History, Exeter University, Durham University, British Antarctic Survey). Similarly, in Mestre's conference poster (Annex 6) and Dornan's presentation to the SCAR Krill Expert Group.

Tweets by the 'Ocean Predator Lab (OPEL)' at the University of Southampton, tag the Biodiversity Challenge Funds X account. The project's page on the BAS website states that the project is funded by the UK Government through Darwin Plus.

## 13. Safeguarding



## 14. Project expenditure

**Table 1: Project expenditure <u>during the reporting period</u> (1 April 2024 – 31 March 2025)**

| Project spend (indicative) in this financial year | 2024/25 D+ Grant (£) | 202/25 Total actual D+ Costs (£) | Variance % | Comments (please explain significant variances) |
|---|---|---|---|---|
| Staff costs | [redacted] | | | |
| Consultancy costs | | | | |
| Overhead Costs | | | | |
| Travel and subsistence | | | | |
| Operating Costs | | | | |
| Capital items | | | | |
| Others (Please specify) | | | | |
| **TOTAL** | **262,695** | **262,69[redacted]** | | |

**Table 2: Project mobilised or matched funding during the reporting period (1 April 2024 – 31 March 2025)**

| | Secured to date | Expected by end of project | Sources |
|---|---|---|---|
| Matched funding leveraged by the partners to deliver the project (£) | [redacted] | [redacted] | 1. UC Santa Cruz: in-kind contribution to the value of [redacted] time on the project<br>2. University of Southampton: [redacted] contribution to vessel charter costs, to deploy and retrieve hydrophones at Elephant Island.<br>3. BBC: [redacted] contribution to vessel charter costs to allow one BBC camera person to join the expedition in an attempt to film fin whales. |
| Total additional finance mobilised for | - | - | - |

| | | | |
|---|---|---|---|
| new activities occurring outside of the project, building on evidence, best practices and the project (£) | | | |

## 15. Other comments on progress not covered elsewhere

In the current project year, we have prepared two peer-reviewed papers: one published in Frontiers in Marine Science, and the other accepted for publication.

The 2024 Frontiers in Marine Science paper highlights the critical need to fully integrate baleen whales into the management of the Antarctic krill fishery, the largest commercial fishery in the Southern Ocean. Despite being major krill consumers, baleen whales are not explicitly considered in current monitoring or management frameworks under CCAMLR. We argue that whales face both direct threats (e.g. ship strikes, entanglement) and indirect impacts (e.g. reduced prey availability, increased energetic costs), which can affect population recovery—especially for still-depleted blue, fin, and sei whales. The paper stresses that CCAMLR's krill fishery management is based on outdated data and static assumptions about a dynamic and changing ecosystem. It calls for a precautionary approach: catch levels should not increase without improved, up-to-date data on krill and baleen whales. We recommend enhanced monitoring and close collaboration between CCAMLR and the International Whaling Commission to ensure the krill fishery does not hinder whale population recovery.
In the second (accepted) paper, we outline the urgent need for progress in reforming the management of the Antarctic krill fishery under CCAMLR. Krill are a key species in the Antarctic marine ecosystem, supporting numerous predators and playing a major role in carbon cycling. While historical krill catches declined after the Soviet era, they are now increasing again. In response, CCAMLR has been developing a revised management framework to reduce ecosystem risks by better distributing fishing effort in space and time. However, at its 2024 meeting, CCAMLR failed to advance the revised framework. As a result, a key spatially distributed management measure was not renewed. This creates a significant risk: the current interim catch limit of 620,000 tonnes can now be harvested without spatial or temporal restrictions, including in ecologically sensitive areas and seasons. While voluntary efforts by industry to spread catches remain in place, they are not a substitute for formal regulatory measures. The paper warns that this lack of formal control poses risks not only to the Antarctic ecosystem but also to the legitimacy of CCAMLR and the long-term interests of fishing nations. Re-establishing consensus and making swift progress on the revised management framework is now essential.

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

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

Antarctic krill are one of the most abundant animals on earth and are a major food source for many predators, including fish, penguins, seals and baleen whales. Antarctic krill also send carbon to the deep ocean through the sinking of their faeces and by moulting their exoskeletons. The small crustaceans are the focus of a commercial fishery and are being caught at an increasing rate to be processed into feed for fish farms (e.g. salmon) and oils for nutritional supplements.

At the same time, populations of baleen whales, a major consumer of krill, are in recovery. Fin whales - the second largest baleen whale after the blue whale, had been hunted to near extinction. Now they are growing in number, returning to historic feeding grounds, and finding themselves in competition with fishing vessels.

The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) is the international body which sets limits on how much Antarctic krill can be caught, where and when. These catch limits are measured in thousands of tonnes across vast swathes of ocean, but krill are particularly concentrated in smaller shelf areas close to land which are frequented by both predators and fishing vessels.

To address this mismatch in scales, CCAMLR plans to implement finer scale management procedures. To inform this, the researchers from the University of Southampton, the British

Antarctic Survey, the University of California Santa Cruz, and the Scottish Association for Marine Science are collecting data to better understand the distribution of foraging fin whales, Antarctic krill and fishing vessels.

Funded by the UK Government through Darwin Plus, the team conducted an expedition to the Antarctic Peninsula in March 2024 to survey Antarctic krill and the baleen whales that feed upon them. The expedition will provide data to assess whether the current fishery management framework is sufficient to safeguard krill stocks, which underpin the unique Southern Ocean ecosystem.

“The risk is that fishing becomes concentrated in krill-rich predator feeding spots and then depletes them, leaving nothing behind for the marine animals that rely on them to survive,” says Dr Ryan Reisinger from the University of Southampton, who led the expedition.

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

## 17. Annex 1: Report of progress and achievements against logframe for Financial Year 2024-2025

## 18.

| Project summary | Progress and Achievements April 2024 - March 2025 | Actions required/planned for next period |
|---|---|---|
| ***Impact***<br>The krill fishery is managed sustainably by CCAMLR in the BAT to safeguard Antarctic krill-based ecosystems, especially including baleen whales, and especially in autumn when relevant ecological data are sparse. | None yet. Progress towards the impact relies on outcomes indicated below. Analytical activities required for all outputs have commenced in year 2, tied to the appointment of a second postdoctoral researcher in 2024. | |
| ***Outcome***<br>Provision to CCAMLR of Working Papers, data and information to help ensure krill fishery management occurs at ecologically relevant spatial and temporal scales. | | |
| Outcome indicator 0.1<br>By end 2027, CCAMLR has reviewed the small-scale management units used to set krill catch limits in the BAT. | We have presented one paper to CCAMLR's Working Group on Acoustic Survey and Analysis Methods (https://meetings.ccamlr.org/en/wg-asam-2024/09)<br>We have produced two peer-reviewed papers: one published (https://www.frontiersin.org/journals/marine-science/articles/10.3389/fmars.2024.1458042/full) and one accepted for publication.<br>Project year 3 focusses on further working papers and publications. These outputs are expected to generate Outcomes 1 and 2.<br>Project year 2 has focussed on data collection, collation, and analyses as well as further development and testing of the ImpYak system. | Data collation and analysis of whale tracking, krill abundance and fishery data.<br>Preparation of CCAMLR working papers and peer-reviewed journal papers. |
| Outcome indicator 0.2<br>By end of 2027, CCAMLR has taken into account sensitive time periods for krill-dependent predators, especially baleen whales, within each fishing season, and catches are managed temporally within such seasons rather than only annually, as at present. | We have presented one paper to CCAMLR's Working Group on Acoustic Survey and Analysis Methods (https://meetings.ccamlr.org/en/wg-asam-2024/09)<br>We have produced two peer-reviewed papers: one published (https://www.frontiersin.org/journals/marine-science/articles/10.3389/fmars.2024.1458042/full) and one accepted for publication. | Data collation and analysis of whale tracking, krill abundance and fishery data.<br>Preparation of CCAMLR working papers and peer-reviewed journal papers. |

| | | |
|---|---|---|
| | Project year 3 focusses on further working papers and publications. These outputs are expected to generate Outcomes 1 and 2.<br><br>Project year 2 has focussed on data collection, collation, and analyses as well as further development and testing of the ImpYak system. | |
| Outcome indicator 0.3<br><br>By March 2026, the project has demonstrated, through two field seasons and peer-reviewed publication of results, a new method for low-cost, near-shore acoustic surveys in areas where research vessels currently do not operate. | Development and field testing (in Scotland) of the ImpYak system took place during project year 1, culminating in the ImpYak system being tested in-situ in the Western Antarctic Peninsula in 2024, where several critical issues were identified. The system was not able to be tested on our 2025 cruise, although there is a current potential opportunity to test the system on a BAS logistics voyage to Rothera Station. Dornan et al. have already made a short deployment of the ImpYak on this cruise (18 May 2025). Dornan has been preparing a review of autonomous methods for krill surveying. | Final testing of ImpYak system.<br><br>Preparation of peer-reviewed papers on autonomous krill surveying methods, and ImpYak system. |
| **Output 1**<br><br>**Whales.**<br>Spatiotemporally explicit predictions of whale foraging presence. | | |
| Output indicator 1.1<br><br>1.1 Data layers of spatiotemporally explicit predictions of humpback, minke and fin whale foraging presence within the BAT (CCAMLR Subarea 48.1) are produced for each month in the CCAMLR fishing season, and presented as information papers to CCAMLR and the IWC (International Whaling Commission) by end of 2025. | Tagging data exist for humpback and minke whales through UCSC, but we were unable to collect new tagging data for fin whales. Preliminary analyses have been conducted to make some preliminary spatiotemporal predictions of whale foraging. | Collation and analysis of tagging data.<br><br>Investigate opportunities to deploy remaining tags.<br><br>Produce final monthly predictions of humpback, minke and fin whale presence.<br><br>Prepare information papers for CCAMLR and IWC. |
| **Output 2**<br>**Krill.**<br>Spatiotemporally explicit nearshore krill abundance information. | | |

| | | |
|---|---|---|
| Output indicator 2.1.<br><br>Novel acoustic survey data, to calculate krill abundance, are collected nearshore in the Western Antarctic Peninsula during two fieldwork periods in the project: January-April 2023 and January-April 2024. | While we could not collect acoustic data with the ImpYak system in the 2024 or 2025 field season, we did conduct acoustic surveys using a ship-mounted echosounder, following standard CCAMLR protocols, to collect novel acoustic data during March 2024, and opportunistically collected acoustic data in 2025. | Analyse acoustic data.<br><br>Source additional acoustic data from collaborators. |
| Output indicator 2.2.<br><br>Novel spatially-explicit krill abundance estimates are produced for nearshore regions in the Western Antarctic Peninsula, by the end of 2024. | While we could not collect acoustic data with the ImpYak system in the 2024 or 2025 field season, we did conduct acoustic surveys using a ship-mounted echosounder, following standard CCAMLR protocols, to collect novel acoustic data during March 2024, and opportunistically collected acoustic data in 2025. Preliminary analyses of these data, to estimate krill abundance, has started and will be continued this project year. | Analysis of acoustic data to estimate krill abundance. |
| **Output 3.**<br><br>**3D predator-consumer interactions.**<br>Publication of 3D models of whale-krill interactions. | | |
| Output indicator 3.1<br><br>By March 2026, information on 3D spatiotemporal characteristics of the interactions between krill and baleen whale predators on their foraging grounds in the BAT will be published as a peer-reviewed paper and reported to CCAMLR. | This output relies on data and analyses that will go into outputs 1 and 2. Thus, work towards this output takes place mainly in the coming project year. | Analyse whale tracking data and krill abundance data to characterise spatiotemporal interactions between krill and predators on foraging grounds in the BAT.<br><br>Write up the results from these analyses and submit 1) for peer-reviewed publication and 2) as a Working Paper for CCAMLR. |
| **Output 4**<br><br>**Integrated krill-consumer-fisheries interactions.**<br>Temporally explicit maps of potential interactions among krill, whales and fisheries. | | |

| | | |
|---|---|---|
| Output indicator 4.1<br><br>A key unknown for predator-krill-fishery interactions, is whether fishing vessels compete with predators and reduce the available food resource within an area. By March 2026, we will have measured this for the first time, helping confirm the impacts of krill fishing are not simply spatial overlap, but also functional overlap, demonstrated through analyses published as peer-reviewed papers and reports. | We have obtained earlier krill fishery data and will in the coming year update this collation. Mestre has started preliminary analyses of overlap between whales and fisheries (e.g., maps of overlap)—we now need to source and add the krill distribution data. | Continue collating krill fishery data.<br><br>Analysis of functional overlap between whales, krill and the fishery. |
| Output indicator 4.2<br><br>By March 2026, produce data layers for spatiotemporally explicit maps of potential interactions among krill, whales and fisheries within the BAT. | We have obtained earlier krill fishery data and will in the coming year update this collation. Mestre has started preliminary analyses of overlap between whales and fisheries (e.g., maps of overlap). | Source tagging data for fin whales.<br><br>Update preliminary work and produce predictions for all three whale species being considered – humpback, minke and fin whales. |
| Output indicator 4.3<br><br>By March 2026, present data layers on spatiotemporal interactions as information papers to CCAMLR. | This output relies on data and analyses from other outputs and activity related to it takes place in the coming year. | Prepare results as a working paper to be submitted to CCAMLR. |
| **Output 5**<br><br>**Forecasting.**<br>Test our ability to make seasonal forecasts of krill-consumer-fisheries interactions using correlative spatial models in conjunction with oceanographic model forecasts. | | |
| Output indicator 5.1<br><br>By March 2026, development of habitat models for humpback, fin and minke whales, the output of which will allow us to determine, at monthly timescales during the krill fishing season, where interactions with fishing vessels will be most predictable and most intense. Such identified areas should be subject to detailed scrutiny, potentially for designation by CCAMLR as areas requiring enhanced management (e.g. temporal closures within the fishing season or reduced fishery impacts) compared with current management practices. | Work towards this output will take place mainly in the current year, led by Mestre. Humpback and minke whale habitat models have undergone preliminary development (e.g., Burleigh dissertation in project year 1). | Analysis of humpback, minke and fin whale data and development of habitat models.<br><br>Source and analyse Regional Oceanographic Model forecasts. |

| | | |
|---|---|---|
| Output indictor 5.2<br>By March 2026, create a Shiny prediction application that produces seasonal forecasts at a monthly resolution of potential interactions for CCAMLR Statistical Subarea 48.1 in the BAT. | Work towards this output will take place mainly in year 3, led by Mestre. | Start analysing data and building the analysis pipeline for the Shiny prediction app. |

**19.**

**20.**

**21.**

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

| Project summary | SMART Indicators | Means of verification | Important Assumptions |
|---|---|---|---|
| **Impact:**<br>The krill fishery is managed sustainably by CCAMLR in the BAT to safeguard Antarctic krill-based ecosystems, especially including baleen whales, and especially in autumn when relevant ecological data are sparse. | | | |
| **Outcome:**<br>Provision to CCAMLR of Working Papers, data and information to help ensure krill fishery management occurs at ecologically relevant spatial and temporal scales. | 0.1 By end 2027, CCAMLR has reviewed the small-scale management units used to set krill catch limits in the BAT.<br>0.2 By end of 2027, CCAMLR has taken into account sensitive time periods for krill-dependent predators, especially baleen whales, within each fishing season, and catches are managed temporally within such seasons rather than only annually, as at present.<br>0.3 By March 2026, the project has demonstrated, through two field seasons and peer-reviewed publication of results, a new method for low-cost, near-shore acoustic | 0.1 CCAMLR has reviewed the limits set for small-scale units, evidenced through CCAMLR meeting reports.<br>0.2 CCAMLR has reviewed the catch limits set for different time periods within each fishing season, evidenced through CCAMLR meeting reports.<br>0.3 Our CCAMLR working papers are recorded as submissions in meeting reports, with discussions also included in the reports. Our peer-reviewed journal papers will also demonstrate our autonomous vehicle acoustic surveying capability, and will be openly | CCAMLR reviews the information provided by this project and considers it as part of a future revision and designation of small scale management units and adoption of krill fishery catch limits. |

| Project summary | SMART Indicators | Means of verification | Important Assumptions |
|---|---|---|---|
| | surveys in areas where research vessels currently do not operate. | available for download from journal websites.<br>0.4 Verification will be available in the reports of the CCAMLR Scientific Committee and its Working Groups, (especially WG-Ecosystem Monitoring and Management, WG-Acoustic Survey Analysis Methods). | |
| **Output 1. Whales.**<br>Spatiotemporally explicit predictions of whale foraging presence. | 1.1 Data layers of spatiotemporally explicit predictions of humpback, minke and fin whale foraging presence within the BAT (CCAMLR Subarea 48.1) are produced for each month in the CCAMLR fishing season, and presented as information papers to CCAMLR and the IWC (International Whaling Commission) by end of 2025. | 1.1 Data layers are published to a publicly-accessible data repository.<br>1.2 Working Papers are recorded in the reports of the CCAMLR Scientific Committee and its Working Groups and in the report of the International Whaling Commission Scientific Committee. | Tags are able to be deployed on fin whales. |
| **2. Krill.**<br>Spatiotemporally explicit nearshore krill abundance information. | 2.1 Novel acoustic survey data, to calculate krill abundance, are collected nearshore in the Western Antarctic Peninsula during two fieldwork periods in the project: January-April 2023 and January-April 2024.<br>2.2 Novel spatially-explicit krill abundance estimates are produced for nearshore regions in the Western Antarctic Peninsula, by the end of 2024. | 2.1 Our spatially-explicit krill abundance estimates have been produced and have been communicated via Working Papers to the CCAMLR Acoustic Survey and Assessment Methods Working Group, and noted in reports from Working Group meetings. | Krill is able to be surveyed using yacht-mounted echosounders or the ImpYak system. |

| Project summary | SMART Indicators | Means of verification | Important Assumptions |
|---|---|---|---|
| **3. 3D predator-consumer interactions.**<br>Publication of 3D models of whale-krill interactions. | 3.1 By March 2026, information on 3D spatiotemporal characteristics of the interactions between krill and baleen whale predators on their foraging grounds in the BAT will be published as a peer-reviewed paper and reported to CCAMLR. | 3.1 Publication of data layers and peer-reviewed manuscript, which can be obtained from the journal website.<br>3.2 Working Paper submitted to CCAMLR, noted in meeting reports.<br>3.3 Copies of these papers provided as means of verification. | CATS tags are able to be deployed in foraging aggregations of whales, and simultaneous prey mapping can be undertaken. |
| **4. Integrated krill-consumer-fisheries interactions.**<br>Temporally explicit maps of potential interactions among krill, whales and fisheries. | 4.1 A key unknown for predator-krill-fishery interactions, is whether fishing vessels compete with predators and reduce the available food resource within an area. By March 2026, we will have measured this for the first time, helping confirm the impacts of krill fishing are not simply spatial overlap, but also functional overlap, demonstrated through analyses published as peer-reviewed papers and reports.<br>4.2 By March 2026, produce data layers for spatiotemporally explicit maps of potential interactions among krill, whales and fisheries within the BAT.<br>4.3 By March 2026, present data layers on spatiotemporal interactions as information papers to CCAMLR. | 4.1 Publication of data layers and peer-reviewed manuscript, which can be obtained from the journal website.<br>4.2 Working Paper submitted to CCAMLR, noted in meeting reports.<br>4.3 Copies of these papers provided as means of verification. | 4.1 CATS tags are able to be deployed in foraging aggregations of whales, and simultaneous prey mapping can be undertaken using yacht-mounted echosounders or the ImpYak system.<br>4.2 Fishery data is made available. |
| **5. Forecasting.**<br>Test our ability to make seasonal forecasts of krill-consumer-fisheries interactions using correlative spatial | 5.1 By March 2026, development of habitat models for humpback, fin and minke whales, the output of which will allow us to determine, at monthly timescales during the krill | 5.1 Shiny prediction application produced and accessible online.<br>5.2 Publication of peer-reviewed manuscript, which can be obtained from the journal website. | 5.1 CATS tags are able to be deployed in foraging aggregations of whales, and simultaneous prey mapping can be undertaken. |

| Project summary | SMART Indicators | Means of verification | Important Assumptions |
|---|---|---|---|
| models in conjunction with oceanographic model forecasts. | fishing season, where interactions with fishing vessels will be most predictable and most intense. Such identified areas should be subject to detailed scrutiny, potentially for designation by CCAMLR as areas requiring enhanced management (e.g. temporal closures within the fishing season or reduced fishery impacts) compared with current management practices.<br>5.2 By March 2026, create a Shiny prediction application that produces seasonal forecasts at a monthly resolution of potential interactions for CCAMLR Statistical Subarea 48.1 in the BAT. | 5.3 Working Paper submitted to CCAMLR, noted in meeting reports.<br>5.4 Copies of these papers provided as means of verification. | 5.2 Interactions can be forecast based on their correlations with oceanographic covariates for which forecasts exist. |

**Activities**

1.1 Deployment of tracking tags on whales in the Western Antarctic Peninsula region.
1.2 Analyse whale tracking data and develop models which produce spatiotemporally explicit predictions of whale foraging presence within the BAT.
1.3 Prepare data layers of these predictions for presentation to CCAMLR as Working Papers.

2.1 Final trials of ImpYak survey system and training field personnel on system.
2.2 Conduct acoustic surveys of krill abundance nearshore at the Western Antarctic Peninsula during two fieldwork periods in the project.
2.3 Produce spatially-explicit krill abundance estimates from these survey data and submit estimates to the CCAMLR Acoustic Survey and Assessment Methods Working Group.

3.1 Analyse whale tracking data and krill abundance data to characterise spatiotemporal interactions between krill and predators on foraging grounds in the BAT.
3.2 Write up the results from these analyses and submit 1) for peer-reviewed publication and 2) as a Working Paper for CCAMLR.

4.1 Collate krill fishery data, obtained from CCAMLR, for the Western Antarctic Peninsula region.
4.2 Analyse whale tracking data, krill abundance data, and krill fishery data together to characterise function overlap among krill, their predators and the fishery.

| Project summary | SMART Indicators | Means of verification | Important Assumptions |
|---|---|---|---|
| 4.3 Produce data layers for spatiotemporally explicit maps of potential interactions among krill, whales and fisheries.<br>4.4 Write up the results from these analyses and submit 1) for peer-reviewed publication and 2) as a Working Paper for CCAMLR.<br><br>5.1 Develop habitat models for different baleen whale species to determine where interactions with fishing vessels will be most predictable and most intense.<br>5.2 Create a Shiny prediction application that produces seasonal forecasts of interactions for CCAMLR Statistical Subarea 48.1 in the BAT. | | | |

## 23. Annex 3: Standard Indicators

### Table 1 Project Standard Indicators

Please see the Standard Indicator guidance for more information on how to report in this section, including appropriate disaggregation.

| DPLUS Indicator number | Name of indicator | Units | Disaggregation | Year 1 Total | Year 2 Total | Year 3 Total | Total to date | Total planned during the project |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| DPLUS-A03 (Core) | Number of local/national organisations with improved capability and capacity as a result of project. | Number of organisations | -- | 0 | 0 | | | 1 |
| DPLUS-A07 | Number of government institutions/departments with enhanced awareness and understanding of biodiversity and associated local community issues | Government institution | -- | 0 | 0 | | | 1 |
| DPLUS-B02 (Core) | Number of new/improved species management plans available and endorsed. | Number | -- | 0 | 0 | | | 1 |
| D-PLUS-B11 | Area identified as important for biodiversity. | Area (km2) | -- | 0 | 0 | | | 65,800 |
| DPLUS-D01 (Core) | Hectares of habitat under sustainable management practices. | Area (km2) | -- | 0 | 0 | | | 658,000 |
| DPLUS-C03 (Core) | New assessments of habitat conservation action needs published. | Number | -- | 0 | 0 | | | 1 |
| DPLUS-C05 (Core) | Number of projects contributing data, insights, and case studies to national Multilateral Environmental Agreements (MEAs) related reporting processes and calls for evidence. | Number | -- | 0 | 0 | | | 1 |
| DPLUS-C06 | Number of downloads of new peer reviewed publications. | Number | Downloads per year | 0 | 431 | | | 200 |
| DPLUS-C07 | Number of projects contributing evidence to biodiversity conservation or associated community benefits to policy/regulation/standards consultations. | Number | International | 0 | 0 | | | 1 |
| DPLUS-C15 | Number of media related activities | Number | Web | 3 | 3 | | | 10 |
| DPLUS-C17 | Number of unique papers submitted to peer reviewed journals16. | Number | -- | 0 | 2 | | | 5 |

| DPLUS Indicator number | Name of indicator | Units | Disaggregation | Year 1 Total | Year 2 Total | Year 3 Total | Total to date | Total planned during the project |
|---|---|---|---|---|---|---|---|---|
| DPLUS-C18 | Number of papers published in peer reviewed journals | Number | -- | 0 | 1 | | | 5 |
| DPLUS-C19 | Number of other publications produced | Number | Dissertations | 2 | 0 | | | 4 |
| DPLUS-C19 | Number of other publications produced | Number | Working papers | 0 | 1 | | | 4 |
| DPLUS-D01 (Core) | Hectares of habitat under sustainable management practices. | Area (km2) | -- | 0 | 0 | | | 658,000 |

## Table 2 Publications

| Title | Type (e.g. journals, best practice manual, blog post, online videos, podcasts, CDs) | Detail (authors, year) | Gender of Lead Author | Nationality of Lead Author | Publishers (name, city) | Available from (e.g. weblink or publisher if not available online) |
|---|---|---|---|---|---|---|
| *Safeguarding Antarctic krill stocks for baleen whales 2025 cruise report | Cruise report | Amy Feakes, Julie Mestre, Ryan Reisinger, 2025 | Female | UK | University of Southampton, Southampton | [redacted] Annex 4 |
| Integrating the needs of recovering populations of baleen whales into the revised management framework for the commercial fishery for Antarctic krill | Journal Article – Frontiers in Marine Science (11) | Philip N Trathan, Matthew S Savoca, Ari Friedlaender, Mick Baines, Elke Burkhardt, Ted Cheeseman, Luciano Dalla Rosa, Helena Herr, Eduardo R Secchi, Alexandre N Zerbini, Ryan R Reisinger, 2024 | Male | UK | Frontiers Media SA, Lausanne | [redacted] |

## 25. Checklist for submission

| | Check |
|---|---|
| Different reporting templates have different questions, and it is important you use the correct one. Have you checked you have used the **correct template** (checking fund, scheme, type of report (i.e. Annual or Final), and year) and **deleted the blue guidance text** before submission? | X |
| **Is the report less than 10MB?** If so, please email to BCF-Reports@niras.com putting the project number in the Subject line. | X |
| **Is your report more than 10MB?** If so, please consider the best way to submit. One zipped file, or a download option, is recommended. We can work with most online options and will be in touch if we have a problem accessing material. If unsure, please discuss with BCF-Reports@niras.com about the best way to deliver the report, putting the project number in the Subject line. | -- |
| **Have you included means of verification?** You should not submit every project document, but the main outputs and a selection of the others would strengthen the report. | X |
| **Have you provided an updated risk register?** If you have an existing risk register you should provide an updated version alongside your report. If your project was funded prior to this being a requirement, you are encourage to develop a risk register. | X |
| If you are submitting photos for publicity purposes, do these meet the outlined requirements (see section 15)? | -- |
| Have you involved your partners in preparation of the report and named the main contributors | X |
| Have you completed the Project Expenditure table fully? | X |
| Do not include claim forms or other communications with this report. | |