Darwin Plus Main: Annual Report

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

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

Submission Deadline: 30th April 2024

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

Darwin Plus Project Information

Project reference	DPLUS166
Project title	Improving identification of fish bycatch in the Antarctic krill fishery
Territory(ies)	British Antarctic Territory and South Georgia and The South Sandwich Islands
Lead Partner	BAS-British Antarctic Survey
Project partner(s)	Newcastle University, Royal Botanic Garden Edinburgh, MRAG, Government of South Georgia and the South Sandwich Islands,
Darwin Plus grant value	£308,263
Start/end dates of project	01/11/2022 to 16/06/2025
Reporting period (e.g. Apr 2023-Mar 2024) and number (e.g. Annual Report 1, 2)	April 2023-April 2024, Annual Report 2
Project Leader name	Philip [redacted] & Martin [redacted]
Project website/blog/social media	https://www.bas.ac.uk/project/fish-by-catch-in-the-antarctic-krill-fishery/
Report author(s) and date	Philip [redacted], Lorena [redacted] [redacted], Martin [redacted] (BAS), William [redacted] (NCU), William [redacted] (RBGE), Benedict [redacted] (MRAG), Susan [redacted] (GSGSSI)

1. Project summary

Within the Antarctic krill fishery, fish and larval fish are regularly observed as bycatch. Improved understanding of where, when and which fish are caught is essential. This project will develop enhanced identification material for scientists on board fishing vessels and refine our knowledge of fish species distributions at different life stages. It will translate into improved fisheries management for the benefit of BAT and GSGSSI.

The territories covered in this project are in Area 48 of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) (Figure 1), where krill is actively fished over three sub-areas (48.1 to 48.3) extending from the Antarctic Peninsula and South Shetland Islands (48.1), South Orkney Islands in the Southern Scotia Sea (48.2) and South Georgia in the Northern Scotia Sea (48.3).

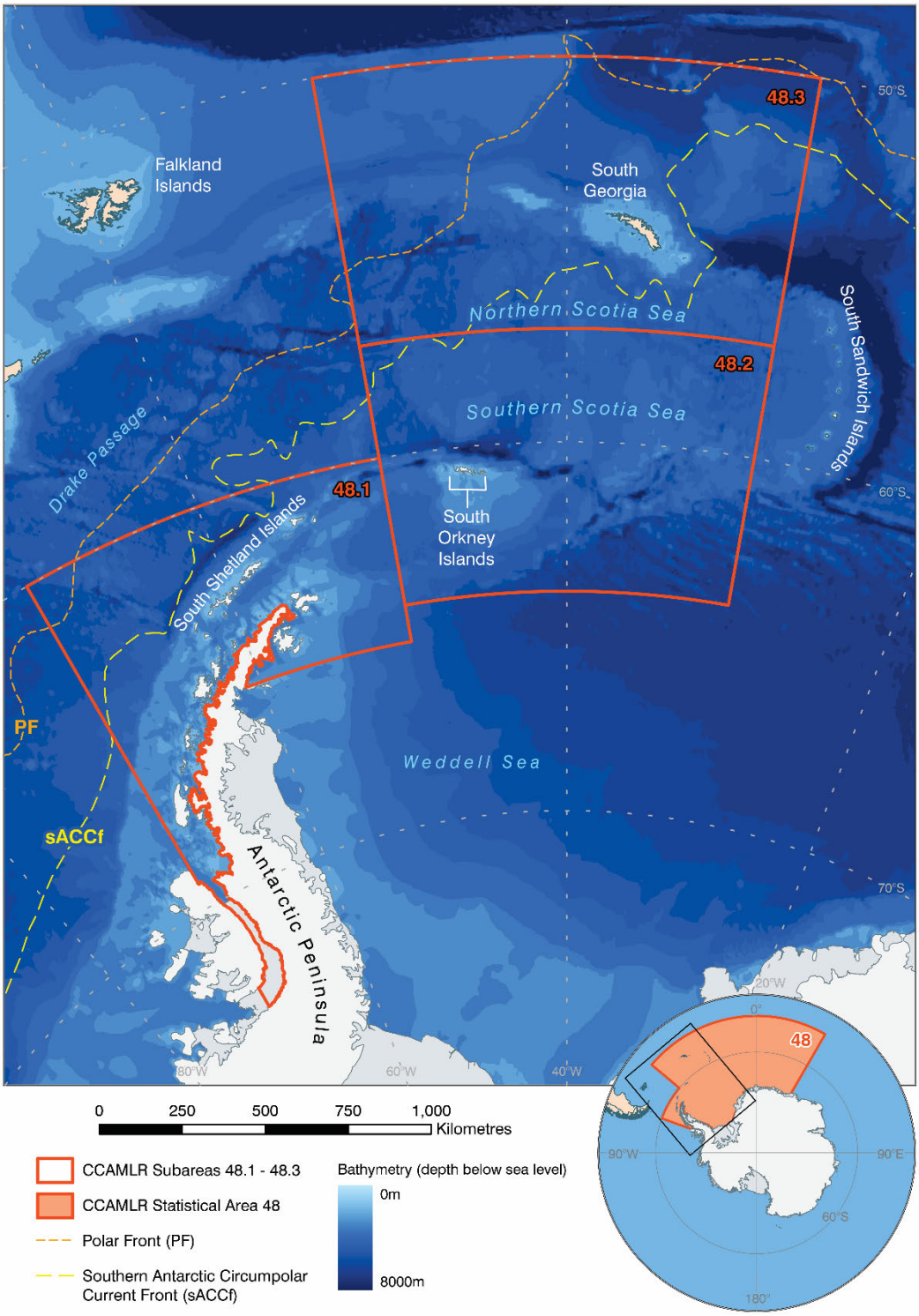


Figure 1: CCMALR statistical area 48 showing statistical subareas (48.1-48.3) where the krill fishery operates. Produced by the Mapping and Geographic Information Centre©, British Antarctic Survey, UK. Research and Innovation, 2023.

2. Project stakeholders/partners

Through the project we have engaged with our key stakeholders and partners strengthening the working relationships. Sharing all relevant information and progress on the different outcomes. During the second year, we have held two in person meetings and one virtual meeting. In the first meeting in June 2023, we discussed progress on outputs one and two, as well as the cost and benefits of using the nanopore sequencing device-MinION to sequence the mitochondrial control region of the bycatch fish species found in area 48. On November 20th we met online to discuss the progress over the past 6 months. Here we introduced the project to the new collaborator from MRAG (Benedict Viney), showed preliminary results presented at the

FSBI conference and the article presented at the CCAMLR Fish Stock Assessment working group (WG-FSA) in October 2023 (Annex 4.5). On the 23rd of January 2024 we held an in-person meeting in Newcastle, where we discussed preliminary results for output one and two, planned activities for the next six months of work including publication of the literature review, modelling of bycatch data (from the CCAMLR data request), sequencing of new samples and conferences to be attended to present the work (Annex 4.6).

3. Project progress

Pertaining output 1, a total of 418 genomic DNA samples have been obtained following the subsampling for DNA of selected ichthyological samples held at BAS and samples collected from the 2022-2023 krill fishing season. This includes DNA extracted from otolith samples of key species that were not found as whole specimens at BAS or collected as bycatch. It is expected that a further 300 samples could be added to the genomic DNA bank established for the project as more samples from the 2023 season are arriving in to BAS Cambridge in June 2024.

For the genetic identification of the available fish materials, the development and testing of 20 primers for the amplification of the mitochondrial gene COX 1 resulted in successful amplification and sequencing of 320 samples. We encountered a setback during the testing period for the primers developed for the amplification of the control region, between October and November 2023. Following a month-long period of troubleshooting it was agreed that the best course of action would be to develop a new set of primers tailored to each of the species. 58 primers were designed in December 2024 and tested in January 2024, and a further 7 primers were designed in January. Following the successful amplification of 149 amplicons from 27 species, the library preparation for sequencing with the minion was started in late February. A total of 4 libraries were prepared and frozen at -20C awaiting sequencing by late march-early April.

Regarding output 2, the systematic literature search for life history information, biological traits and key developmental timings for the bycatch species was undertaken between April and July 2023. Key search terms were employed to extract biologically relevant information. Working in a systematic manner, we will use a list of key life history traits developed specifically for extracting information pertaining biological traits, developmental timings, and reproduction.

For output 3, the request for bycatch data was put forward to CCAMLR in November 2023. The data was released on January 18th 2024, and during our annual meeting we planned to tackle the data analysis by splitting the data set into a multivariate analysis and a spatial modelling. This will result in an extra output to the one originally planned, as we are in the process of developing a peer reviewed manuscript describing the diversity and spatial variability in the fish bycatch within the Antarctic krill fishery before the spatiotemporal analysis is completed.

Next steps regarding output 4 were also discussed in the annual meeting, we brain stormed ideas to make the guide a practical tool for observers in the field, including a more interactive approach, whereby instructional videos on how to identify groups of species, larvae and difficult-to-ID species can be produced, as well as coloured coded maps showing spatial and temporal patterns in the presence of each species (following the spatiotemporal modelling in output 3).

3.1 Progress in carrying out project Activities

Output 1: (activities 1.1,1.2,1.3,1.4)

Following sub-sampling and DNA extraction of fish samples found in the archives at BAS as well as samples collected between 2019-2023, species-specific primers for the amplification of both cox1 and control region were designed in late-June, early July, respectively. The testing phase for primers began in September and by late October the cox1 gene was successfully amplified for all sub-samples. A total of 351 COX1 amplicons were obtained. Each amplicon

was cleaned and prepared for sanger sequencing. Cleaned amplicons were sent for sequencing between November 2023 and January 2024. For each amplicon a forward and a reverse sequence was produced.

Following sequencing, the bioinformatic work began in late February 2024. Each sequence was manually scanned for base-quality score, sequencing primers were trimmed and cleaned sequences were map to a reference sequence, when available, to create a contig from which a consensus sequence for each of the species could be extracted. The consensus sequence was then compared against GenBank database by means of the Basic Local Alignment Search Tool (BLAST).

A total of 64 consensus sequences were produced, representing 62 species within 36 genera and 16 families. For each of the sampled sequences a contig was created with the forward and reverse sequences. Sample sequence information, together with the consensus sequence per species and metadata have been clearly logged and linked to the tissue and gDNA bank established for the project. Currently, we are in the process of putting together the genetic data with the photographic material, once finished, this will be submitted to the Polar Data Centre (NERC data repository) and GenBank.

The amplification of the mitochondrial control region was slightly different, given the structural complexity of the region and the targeted sequence length we aimed to amplify. The primers designed during July 2023 failed to amplify the targeted region (Annex 4.7). Following a month-long troubleshooting effort between Oct-Nov 2023, it was considered best to redesign the primers. By mid-December, a total of 58 new primers were designed based on available reference sequences. Primer testing was planned for early January 2024 as the sequencing and primer synthesis services experienced a major disruption in their import/export system during December 2023 which delayed our timeline. A further seven primers were designed in early January. By mid-January 2024, the control region was successfully amplified for 25 species with a total of 149 amplicons. These amplicons were used for preparing sequencing libraries that will be sequenced with the Oxford nanopore technology MinIon by mid-April 2024 (4.1).

Lastly, we are waiting on extra samples collected by the fishery observers during the 2023 season. These samples will arrive in June 2024 (when the RSS Sir David Attenborough returns to the UK) and will be immediately processed and sequenced.

We have also contacted other institutions such as the Natural History Museum (NHM) in London, for species that were not found during our sample collection and collating. An application form to access the archived material at the NHM was submitted on February 9th2024, and by early April we will have access to tissue samples collected by the curators at the NHM (Annex 4.9).

The project team submitted an abstract to the ICES conference to highlight the fundings of Output 1 and 4, this was led by, and will be presented by Dr Romero Martinez (Annex 4.2).

Output 2 (activity 2.1)

We have made good progress towards this output, following the visit by Dr Romero Martinez to Dr Reid in March 2023. We put together a list of 42 biological and ecological traits and definitions that covered development, reproduction, and habitat, to efficiently extract the relevant information from selected papers. A database has been developed to store the information extracted from papers (Annex 4.3). Dr Reid created a library of selected papers using Rayyan, a web-based platform that helps conducting systematic reviews. During our in-person meeting in January 2024, Dr Reid explained the use of the platform and gave access to the library to all the collaborators involved with the review. Several members of the team spent an extra day following our annual meeting working with Dr Reid, selecting the top 20 most common bycatch species for which we will extract the relevant information on life history stages.

The literature search produced 1435 publications. 948 of these publications were duplicates which have now been removed. This left 514 publications for review. Of these 328 have been excluded based on the inclusion/ exclusion criteria written as part of the review protocol. This

has left 186 for more in-depth reading and so far 52 publications have been read and information extracted. The other 134 publications have been shared among three collaborators to extract relevant information. Dr Reid prepared a protocol for selecting, annotating, and naming file extensions to process all the selected articles systematically as well as several video guides for other members of the team to repeat his methods. On March 19th we had a team meeting to discuss this protocol and the next steps towards completing output 2.

Dr Reid has also submitted an abstract to the ICES conference to showcase the findings of Output 2 (Annex 4.2).

Output 3 (activities 3.1 and 3.2)

We are steadily progressing towards Output 3. The request to CCAMLR for the observer and fishery bycatch data was put forward in November 2023. Data was released to Dr Reid and Dr Hollyman on the 18th of January 2024. During our annual meeting it was agreed that Dr Hollyman will conduct a descriptive analysis of the observer data split by area. While Dr Reid will focus on further multivariate analysis and modelling bycatch per unit effort.

Dr Hollyman has already produced preliminary maps depicting the distribution of bycatch species for several major fish groups, whilst Dr Reid is working on standardising the dataset to a format that can facilitate the data extraction for the modelling process.

Output 4 (activities 4.1, 4.1.1)

Progress on this output is parallel to the progress of outputs 1, as for all sub-sampled specimens a photographic record was created.

During our in-person meeting we discussed the style and content of the identification guides in detailed. We considered including relevant ecological traits and expected occurrence of all life history stages. Considerable attention will also be given to difficult to identify species, particularly, at larval stages. This information together with the photographs will facilitate the identification process and will made the guides an easy to use tool in the field.

The next steps for this output are:

Purchase the photo-stacking software Helicon focus that will help to produce high quality photographs.

Produce and collate more photographic material for all the species. This work will start in May and will continue until all new samples arriving in June have been photographed.

3.2 Progress towards project Outputs

Output 1 and 2 are developing well and on time in line with the project's log frame. Preliminary results from both outputs have already been summarised into a short publication presented by Dr Hollyman in October 2023 to the CCAMLR Working group FSA (Annex 4.8); we took this opportunity to put a call for samples that were not found in the biological archives at BAS or were not collected by the fishery observers.

Progress on output 3 is being led by Dr Reid and it is progressing well. We expect to produce two publications with the findings from this output as outlined in section 3.1.

Overall, we are confident that all outputs will be completed within the time allocated for the project.

3.3 Progress towards the project Outcome

There has been great progress towards the overall outcome of this project. With the morphological and genetic identification of bycatch samples and larval fish samples we have endeavoured to have the best possible coverage of bycatch species found in the Antarctic krill fishery. Similarly, with the development of output 2 we strive to provide a comprehensive summary of the life history strategies in bycatch fish species. As the project develops over this second year, our focus lies on merging and summarising our results from the different outputs

to produce a peer review publication and improved ID guides. As well as the analysis of spatial and temporal trends in bycatch species (output 3).

3.4 Monitoring of assumptions

Assumption 3: Bycatch data is released by CCAMLR after a data request.

The fisheries bycatch data was released by CCAMLR in January 2024. The current objective is to standardise the two datasets obtained, vessel and observers, prior to analysing the data.

Assumption 4: Genetic analysis has successfully improved species assignments in the original (morphology only) identification materials.

Thus far the bioinformatic analysis of COX-I sequences has help to clarify ambiguous identifications of nototheniidae and myctophidae larvae and juveniles. We expect that with more samples arriving in June we will develop carefully curated identification material.

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

Over the last reporting period, the project has made good progress to deliver the agreed impact: 'Improved understanding of where, when and which fish are caught as bycatch in the krill fisheries, translating into improved species monitoring practice for the benefit of SGSSI and BAT'. Given this impact is contingent on outputs expected later on in the project, we cannot add more detail here or evidence of progress beyond that described in the sections above and appendices. However, we would like to emphasise that there have been no major deviations to outcome expectations. Accordingly, we anticipate that GSGSSI and BAT will uphold their commitments to CCAMLR by improving the management of the Antarctic krill fishery within their waters. Furthermore, improved data reporting from scientific observers in the fishery will result in improved data for fishery managers, enabling the ecosystem-based approach to fisheries employed by CCAMLR to be delivered.

5. Gender Equality and Social Inclusion (GESI)

Please quantify the proportion of women on the Project Board[1].	33%
Please quantify the proportion of project partners that are led by women, or which have a senior leadership team consisting of at least 50% women[2].	25%

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	X
Sensitive	The GESI context has been considered and project activities take this into account in their design and implementation. The project	

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

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

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

6. Monitoring and evaluation

Regular meetings held with all the team members have helped to monitor and assess possible risks. Full team meetings are held on a monthly basis with members of the core team meeting every two weeks. Meetings and visits by Dr Romero-Martinez to the collaborators have helped to progress towards completion of outputs 1 and 2, ensuring that all partners are involved and aware of the progress made. Moreover, all the information and data generated by the different outputs has synthesised in a shared folder accessible to all collaborators.

7. Lessons learnt

Over the past year we have encountered minor issues, but these were swiftly resolved by working as a team and clearly communicating the issues. For example, the initial unsuccessful amplification of the control region, that was resolved by holding a meeting where we discussed the most efficient approach to overcome the technical difficulties of amplifying the targeted region. Other issues in procurement lead to an overspend on a budget line relating to the molecular work as a procurement was unintentionally placed in the wrong financial year (see section 13); however, we have discussed this issue with BAS procurement and are certain that this will not affect the outputs of the project as we made sure to purchase enough consumables to cover the proposed number of samples.

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

One main request from the last annual report was for evidence to be provided of activities.

'*No evidence was provided with the AR. Please consider whether evidence is available to support every statement made in the report. In particular, MoV will be highly likely to generate outputs that can be provided. Please do not, however, put any extra effort into generating evidence. Think of evidence as illustrative. Some examples of material might be: meeting minutes; agreements, contracts, MoU; lab protocols; field manuals; training manuals; slide decks; posters; photos (of equipment, meetings, fieldwork, labs, samples, anything); species assessments; management plans; drafts of articles and reports; internal reports; policy recommendations; databases (perhaps screenshots); maps; data record sheets; risk assessments.*'

Within this report we have provided a range of evidence from meeting minutes to conference abstracts and scientific posters to address this issue. As the project progresses, we will begin to generate more outputs which will be included in future reports.

9. Risk Management

No new risks have been identified over the last 12 months.

10. Sustainability and legacy

We have had the opportunity to present the project at the South Georgia & the South Sandwich Islands Marine Protected Area (MPA) Science Symposium in June 2023 (Annex 4.4). As well as to the Fishery Society of the British Isles (FSBI) conference in July 2023 (Annex 4.5).

We also ensure the legacy of the project by submitting and presenting a short summary of preliminary results to the CCAMLR WG-FSA in October 2023 (Annex 4.8).

As we come into the final year of the project we hope to develop several legacy outputs, including peer reviewed publications as well as improved identifications guides for the fishery observers (Output 4).

11. Darwin Plus identity

Over the reporting period we have taken the opportunity to present the project in two different academic symposia as well as a publication, as such we have ensure to show the Darwin logo on all presentation materials. Over the next six months we planned to present our findings at the ICES Annual Science Conference in September 2024 through two presentations (Annex 4.2).

12. Safeguarding

Has your Safeguarding Policy been updated in the past 12 months?		No
Have any concerns been reported in the past 12 months		No
Does your project have a Safeguarding focal point?	*Yes we have a safeguarding lead across BAS*	
Has the focal point attended any formal training in the last 12 months?	*Yes the lead has attended a formal training session on her role and responsibilities as safeguarding lead*	
What proportion (and number) of project staff have received formal training on Safeguarding?		Past: 50% [and number] Planned: 100% [and number]
Has there been any lessons learnt or challenges on Safeguarding in the past 12 months? No		
Does the project have any developments or activities planned around Safeguarding in the coming 12 months? If so please specify. No		

Please describe any community sensitisation that has taken place over the past 12 months; include topics covered and number of participants.
Have there been any concerns around Health, Safety and Security of your project over the past year? If yes, please outline how this was resolved. No

13. Project expenditure

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

Project spend (indicative in this financial year	2023/24 D+ Grant (£)	2024/25 Total actual D+ Costs (£)	Variance %	Comments (please explain significant variances)
Staff costs	[redacted]			
Consultancy costs				
Overhead Costs				
Travel and subsistence				A number of in-person team meetings were held in Cambridge where two of the team lived. This meant that the spend against T&S for the lead partner was less than expected.
Operating Costs				
Capital items				
Others (Please specify)	[redacted]	[redacted]		This variance is down to a single requisition that was placed in the financial year 22/23. It was used to purchase credit with a molecular analysis company. Unbeknownst to us, or the lead partner finance team, this cost was not levied until the first purchase was made on the account 2 months later, pushing the cost into the next financial year (23/24), which we did not find out until organising the accounts for this report. Whilst frustrating, we do not anticipate any further impacts on the deliverables for this project.
TOTAL	112052.123	113477.953		

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

	Secured to date	Expected by end of project	Sources

Matched funding leveraged by the partners to deliver the project (£)	[redacted]		British Antarctic Survey Newcastle University Scottish Association for Marine Science GSGSSI
Total additional finance mobilised for new activities occurring outside of the project, building on evidence, best practices and the project (£)			

14. Other comments on progress not covered elsewhere

A change request was submitted to change two partner institutions, the first for Dr. Goodall-Copestake moving from SAMS to the RBGE. The second for two MRAG representatives that left their post in 2023 and were replaced by Mr. Benedict Viney and James Moir Clark. Lastly a change request was submitted by the PL to change institutions from BAS to Bangor University.

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

I agree for the Biodiversity Challenge Funds to edit and use the following for various promotional purposes (please leave this line in to indicate your agreement to use any material you provide here).

File Type (Image / Video / Graphic)	File Name or File Location	Caption including description, country and credit	Social media accounts and websites to be tagged (leave blank if none)	Consent of subjects received (delete as necessary)
				Yes / No
				Yes / No
				Yes / No
				Yes / No
				Yes / No

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

Project summary	Progress and Achievements April 2023 - March 2024	Actions required/planned for next period
Impact The ecosystem-based management and conservation of biodiversity within SGSSI and BAT waters is enhanced by an improvement in the precision of reporting of Antarctic krill fishery bycatch.		[redacted]
Outcome Improved understanding of where, when and which fish are caught as bycatch in the krill fisheries, translating into improved species monitoring practice for the benefit of SGSSI and BAT		
Outcome indicator 0.1 Baseline assessment of fish bycatch in the krill fishery occurring in SGSSI and BAT waters completed by October 2024	Ongoing molecular analysis of bycatch and archival samples reported in section 3.1	Processing of new samples arriving in June 2024 Analysis of new sequencing data Spatial and temporal analysis of bycatch data
Outcome indicator 0.2 Fisheries observers better informed on bycatch identification by March 2025		Write up of review on life history stages of top 20 bycatch fish species Collation of all photographic material to develop the ID guide
Output 1 Identification of which life history stages of which fish species are present in SGSSI and BAT waters and potentially caught by the krill fishery		

Output indicator 1.1 Genetically underpinned taxonomic designations available for all fish life history stages stored in BAS archives for specimens collected in GSGSSI and BAT waters by July 2023	The BAS archives were extensively searched for larval and adult fish. A catalogued of this samples was created to facilitate the sample processing. All samples collected by the observers between 2022 and 2023 were also included into this catalogue. Collation and cataloguing of larval fish samples held at BAS was completed in February 2023 Development of mitochondrial DNA genetic identification toolbox has been completed and resources are in place for the analysis of new samples arriving in June 2024. The amplification, cleaning, sequencing and quality editing of mitochondrial DNA has been completed for the samples thus far collected.	Sub-sampling for DNA and photographing new material arriving in June 2024 Amplification and sequencing of COX1 and Control region for this samples Analysis of sequencing and cross check of morphological IDs with genetic IDs for these new samples. Collate all reference sequences obtained from all samples and formatting for submission to the Polar Data Centre and other publicly available databases.
Output indicator 1.2 Genetically underpinned taxonomic designations available for newly acquired samples collected by observers in the krill fishery by October 2024	DNA and amplification of COX1 region were successfully performed in all sub-samples thus far. Sequencing of COX1 for all these samples have been completed and a consensus sequence for each species have been produced. Sample collection has been completed; the last set of samples is due to arrive in June 2024.	
1.3 Resource archives are established to ensure post-project longevity of collected materials and data by December 2024	A tissue/fin clip bank, as well as genomic DNA bank for the samples has already been established and it is stored at -20 ˚C. Both sample banks are link to a metadata spreadsheet that will be uploaded to the polar data centre by the end of the project.	Sample and genomic DNA banks are already in place and will be completed once the last set of samples arrive.
1.4 Data generated submitted to publicly accessible databases by December 2024	The curation process of the genetic data has been completed for all samples available thus far.	The genetic data will be submitted to Genbank once all the new samples have

		been processed and sequences analysed.
Output 2. Baseline information assembled for fish life history stages caught as bycatch during krill fishery operations		
Output indicator 2.1. Baseline information on life history stages of 20 fish species caught in GSGSSI and BAT waters established via a systematic review, completed by September 2024.	The objectives and data extraction protocol has been written. The top 20 bycatch species have been identified. The search and collation of peer reviewed scientific papers has been completed. The selection of relevant papers for data extraction process has been completed by Dr Reid.The papers have been divided among collaborators to facilitate the data collection and has started	Collaborators will extract the relevant information from all the papers assigned to them. The data will be uploaded to a shared document for Dr Reid to analyse once the extraction process has been completed. Write up of the review paper for the life history stages of the top 20 bycatch fish species.
Output 3. Statistical analysis of CCAMLR bycatch and BAS larval and juvenile fish data and assessment of overlap between fish life history stages and krill fishing operations		
3.1 Location characteristics and fisheries operational variables assessed to understand fish bycatch and abundance in space and time from CCAMLR and BAS data, completed by August 2024.	Bycatch data has been obtained through CCAMLR data request. Database of metadata definitions created to assist in modelling exercise. Dr Hollyman has tidied and organised data set for preliminary analyses on community composition of catch.	Split analysis for each of the datasets available, observer and fisheries data sets. Descriptive analysis to be performed by Dr. Hollyman.
3.2 Statistical analysis results and archived and current samples integrated into baseline information and assessment made of life history stage overlap with the krill fisheries that indicates risk of capture, completed by September 2024.		
Output 4. Updated species identification materials for fisheries observers, vessel operators and other end users		

4.1 Morphological and genetics results from output 1 used to update identification materials prior to MRAG observer training in 2025	All samples selected for genetic identification have been photographed except for tissue or otolith samples. A photographic library has been created and will be completed with the new samples. Photographic material will be curated to be included in the ID guides.	Collection of photographic material from new samples Curation of photographic material Create a draft for the ID guide
Output 5. Training event for identification materials end users		
5.1 All krill observers employed by MRAG ahead of fishing activities in 2025 trained to use updated identification materials in March 2025.		This output will be addressed once all the material produced from Outputs 1 to 3 have been summarised into an enhanced ID guide for the fishery observers.

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: The ecosystem-based management and conservation of biodiversity within SGSSI and BAT waters is enhanced by an improvement in the precision of reporting of Antarctic krill fishery bycatch.			
Outcome: Improved understanding of where, when and which fish are caught as bycatch in the krill fisheries, translating into improved species monitoring practice for the benefit of SGSSI and BAT	0.1 Baseline assessment of fish bycatch in the krill fishery occurring in SGSSI and BAT waters completed by October 2024 0.2 Fisheries observers better informed on bycatch identification by March 2025	0.1 Results fed to GBAT/GSGSSI for annual stakeholder meeting review 0.1.1 Results communicated to GSGSSI and GBAT via CCAMLR working group papers and Darwin Plus reports 0.1.2 Results undergo peer review as part of scientific publication process 0.2 Implementation of new fish bycatch identification materials by MRAG, which will be used by fisheries observers in BAT and SGSSI waters	Data generated at an appropriate resolution to understand spatial and temporal as well as species level differences for bycatch to allow for informed management As data are collected on a haul-by-haul basis within the fishery, we don't anticipate this will be a large issue.
Output 1 Identification of which life history stages of which fish species are present in SGSSI and BAT waters and potentially caught by the krill fishery	1.1 Genetically underpinned taxonomic designations available for all fish life history stages stored in BAS archives for specimens collected in GSGSSI and BAT waters by July 2023 1.2 Genetically underpinned taxonomic designations available for newly acquired samples collected by observers in the krill fishery by October 2024 1.3 Resource archives are established to ensure post-project	1.1, 1.2 and 1.3 Database of metadata and morphological data lodged in BAS Polar Data Centre for samples that have been identified to species 1.1, 1.2 and 1.3 Physical DNA bank established for successfully extracted DNA samples 1.1, 1.2 and 1.3 Database of DNA sequences established for all successfully sequenced samples 1.1 and 1.2 Submitted working group paper containing details on the diversity of finfish bycatch to	New samples successfully shipped to UK in good enough condition for integrative taxonomy. There are several options available for sample preservation including conventional freezing, blast freezing and ethanol. We are confident that with the breadth of sample collection options and preservation methods we will obtain enough samples in good condition.

Project summary	SMART Indicators	Means of verification	Important Assumptions
	longevity of collected materials and data by December 2024 1.4 Data generated submitted to publicly accessible databases by December 2024	CCAMLR working group in September 2024 (WG-FSA) 1.4 Species abundances submitted to GBIF 1.4 DNA sequence data submitted to GenBank 1.4 All specimen images and metadata submitted to the Polar Data Centre	
Output 2 Baseline information assembled for fish life history stages caught as bycatch during krill fishery operations.	2.1 Baseline information on life history stages of 20 fish species caught in GSGSSI and BAT waters established via a systematic review, completed by September 2024.	2.1 Submitted working group paper containing the results of the systematic review to GSGSSI and CCAMLR working groups in June and September 2024	**Sufficient baseline information is available for collation.** This relies on the depth of the existing literature. As studies of fish ecology in this region have been conducted for several decades we anticipate that sufficient data should exist, if not for all species, then at least for the most abundant bycatch species.
Output 3 Statistical analysis of CCAMLR bycatch and BAS larval and juvenile fish data and assessment of overlap between fish life history stages and krill fishing operations	3.1 Location characteristics and fisheries operational variables assessed to understand fish bycatch and abundance in space and time from CCAMLR and BAS data, completed by August 2024. 3.2 Statistical analysis results and archived and current samples integrated into baseline information and assessment made of life history stage overlap with the krill fisheries that indicates risk of capture, completed by September 2024.	3.1 Submitted working group paper containing the results of statistical analysis to GSGSSI and CCAMLR working groups in September 2024 or June 2025. 3.2 Submitted open access peer reviewed scientific paper (by March 2025)	Bycatch data is released by CCAMLR after a data request. Should any CCAMLR member state refuse to release its data, we will simply run the same analysis with a reduced data set (CCAMLR will still release the data of all countries that do agree). As vessels tend to all operate in similar areas we don't anticipate any issues with this.

Project summary	SMART Indicators	Means of verification	Important Assumptions
Output 4 Updated species identification materials for fisheries observers, vessel operators and other end users	4.1 Morphological and genetics results from output 1 used to update identification materials prior to MRAG observer training in 2025	4.1 Identification materials freely available via the Polar Data Centre 4.1.1 Submitted working group paper containing details of the identification materials submitted to CCAMLR working group in June 2025 (WG-EMM)	**Genetic analysis has successfully improved species assignments in the original (morphology only) identification materials.** We are aware of several instances where morphological identification is extremely difficult, and where previous molecular work has revealed incorrect species assignments. Accordingly, we believe the molecular work proposed in output 1 will successfully improve species assignments.
Output 5 Training event for identification materials end users	5.1 All krill observers employed by MRAG ahead of fishing activities in 2025 trained to use updated identification materials in March 2025.	5.1 Training attendance list compiled by MRAG 5.2 Checklist of learning outcomes completed by krill observers 5.3 Training summary report completed by June 2025.	**All observers will be able to attend training sessions given international travel restrictions due to the COVID-19 pandemic.** Should travel to MRAG be unfeasible, the training will be moved to a virtual format

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)

1.1 Collation and cataloguing of all currently archived fish and larval fish samples held at BAS by Dr Hollyman, Prof. Collins and the PDRA.

1.1.1 Training of PDRA in morphological identification of available fish material by Dr Hollyman and Prof. Collins.

1.1.2 Development of mitochondrial DNA genetic identification toolbox for fish bycatch species by Dr Goodall-Copestake with training for PDRA.

1.1.3 DNA extraction from tissue sub-samples by PDRA and Dr Goodall-Copestake also providing training as required.

1.1.4 Amplification, cleaning, sequencing and quality editing of mitochondrial DNA by PDRA and Dr Goodall-Copestake (providing training as required).

1.1.5 DNA sequence database cross referencing and species assignment by PDRA and Dr Goodall-Copestake (providing training as required).

1.1.6 Collation of sample morphological and meta- data, formatting and submission for archiving in the Polar Data Centre by PDRA, Dr Hollyman, Dr Goodall-Copestake.

Project summary	SMART Indicators	Means of verification	Important Assumptions
1.2 Collection of new fish and larval fish samples by observers within the krill fishery, observers to be briefed via MRAG. 1.2.1 Collation and cataloguing of all newly collected fish samples from the krill fishery by PDRA and KEP Biologist. 1.2.2 All unidentified specimens identified to the finest taxonomic level by Dr Hollyman and the PDRA. 1.2.3 Trialling of double staining using alcian blue and alizarin red as a tool to aid identification by PDRA and Dr Hollyman. 1.2.4 Photographs of all available specimens from 1.1 and 1.2 will be taken for activity 4.1 by PDRA and Dr Hollyman. 1.2.5 DNA extraction of samples by PDRA and Dr Goodall-Copestake. 1.2.6 Mitochondrial DNA amplification-cleaning-sequencing-editing by PDRA and Dr Goodall-Copestake. 1.2.7 DNA sequence database cross referencing and species assignment by PDRA and Dr Goodall-Copestake. 1.2.8 Collation of sample images (from 1.2.4), morphological and meta- data, formatting and submission for archiving in the Polar Data Centre by PDRA, Dr Hollyman, Dr Whitelaw and Dr Goodall-Copestake. 1.3 Samples used in activities 1.1.4 and 1.2.6 will be archived to produce a DNA bank by PDRA and Dr Goodall-Copestake. 1.4 Genetic data and metadata formatted for Genbank, and species identification and metadata formatted for GBIF by PDRA and Dr Goodall-Copestake. 1.4.1 Genetic data submitted to Genbank by PDRA and Dr Goodall-Copestake. 1.4.2 Species distribution data submitted to GBIF by PDRA and Dr Hollyman. 1.4.3 Submission of data collated in 1.2.8 submitted to the Polar Data Centre by Dr Whitelaw and the PDRA 1.5 Paper on fish bycatch diversity prepared for CCAMLR working groups by Dr Hollyman, Dr Goodall-Copestake, Prof. Collins and PDRA. 1.5.1 Papers submitted to and presented at WG-EMM (Y3) and WG-FSA (Y3) by Dr Hollyman. 2.1 Systematic review of all available literature (grey and peer-reviewed) focussed on early life history stages of known bycatch species within the krill fishery in order to make a baseline assessment of information by Dr Reid, Dr Hollyman and PDRA. 2.1.1 Define objectives and write protocol for systematic review by Dr Reid, Dr Hollyman and PDRA. 2.1.2 Search for scientific papers using a series of bibliographic databases by PDRA. 2.1.3 Collate relevant scientific papers and read by Dr Reid, Dr Hollyman and PDRA. 2.1.4 Extract information on larval hatching timings, larval duration, growth rates and spatial distribution of larvae and juvenile fish and create database to store data by Dr Reid, Dr Hollyman and PDRA. 2.1.5 Write review for CCAMLR working group (WG-FSA) by Dr Reid, Dr Hollyman and PDRA. 3.1 Statistical modelling of fish bycatch and fish larval data from CCAMLR and BAS archives by Dr Reid, Dr Hollyman and PDRA			

Project summary	SMART Indicators	Means of verification	Important Assumptions
3.1.1 Request fish bycatch and associated metadata data from CCAMLR by Dr Hollyman. 3.1.2 Extract fish larval and juvenile data from BAS databases by Dr Phil Hollyman and PDRA. 3.1.3 Undertake spatial and temporal modelling of CCAMLR fish bycatch data and BAS larval and juvenile data in association with other key variables including sea surface temperature, fishing depth, seafloor depth, season, time of day and catch location by Dr Reid. 3.1.4 Write CCAMLR working group paper Dr Reid, Dr Hollyman, Dr Young, Mr Chapman and PDRA. 3.2 Integrate data generated during Output 1 into the systematic review database generated during activity 2.1 by PDRA. 3.2.1 Use results of modelling exercise and systematic review to assess overlap of timings and life history stage of fish with krill fisheries operation to understand which species are at risk of being caught, when and at what stage by Dr Reid, Dr Hollyman, Prof. Collins and MRAG. 3.2.2 Write peer reviewed publication, Dr Reid assisted by all other team members. 4.1 Production of identification materials for fisheries observers. PDRA, assisted by all other team members 4.1.1 Visual identification aids developed by synthesising the information generated from all previous activities. These identification materials will cover the various early life history stages of each available fish, the location and month when fish may be found and subtleties of distinguishing between similar species that are often confused. PDRA, assisted by all other team members. 4.2 Paper summarising newly developed identification materials prepared for CCAMLR working groups by PDRA assisted by all investigators. 4.2.1 Papers submitted to and presented at WG-FSA (Y3) by PDRA and Dr Hollyman. 5.1 Deliver training on newly developed identification guides to observers at annual pre-season observer training at MRAG London. by Dr Young, Mr Chapman and Dr Hollyman 5.1.1 Production of training summary report by MRAG.			

Annex 3: Standard Indicators

Table 1 Project Standard Indicators

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-C09	1.3 Resource archives are established to ensure post-project longevity of collected materials and data.	Species reference collections made	Number			2		2
DPLUS-C16	1.4 Data generated submitted to publicly accessible databases by December 2024	Number of records added to accessible databases	Number					Dependant on final number of sequences processed.
DPLUS-C17	3.1 Location characteristics and fisheries operational variables assessed to understand fish bycatch and abundance in space and time from CCAMLR and BAS data	Number of unique papers submitted to peer reviewed journals	Number			2		0
DPLUS-C08	3.2 Statistical analysis results and archived and current samples integrated into baseline information and assessment made of life history stage overlap with the krill fisheries that indicates risk of capture,	Areas of importance for biodiversity identified	Number			3		

Table 2 Publications

Title	Type (e.g. journals, best practice manual, blog post, online videos, podcasts, CDs)	Detail (authors, year)	Gender of Lead Author	Nationality of Lead Author	Publishers (name, city)	Available from (e.g. weblink or publisher if not available online)
Improving identification of fish bycatch in the Antarctic krill fishery	CCAMLR WG-FSA-2023/4	M.L.Romero Martinez, P.R. Hollyman, W.D.K. Reid, W.P. Goodall-Copestake, J. Moir Clark & M.A. Collins. 2023	Female	British/Ecuadorian	CCAMLR, Hobart.	CCAMLR, Hobart.

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)

Annex 4: Onwards – supplementary material (optional but encouraged as evidence of project achievement)

Annex 4.1:

First sequencing experiment for the mitochondrial control region with the ONT MinIon device.

Figure 1: Set up for the sequencing of the first library of the control region samples, showing the MinIon device connected and running the experiment.

Annex 4.2:

Abstracts submitted to the International Council for the Exploration of the Sea (ICES) international conference 2024

Title 1: Investigating fish bycatch uncertainties to improve Antarctic Krill fishery management

Authors: Lorena Romero-Martínez[1], William D K Reid2, William Goodall-Copestake[3], Martin A Collins[1], Phil R Hollyman[1 & 4]

1. British Antarctic Survey, High Cross, Madingley Road, Cambridge, England, CB3 OET, UK

2. Modelling, Evidence and Policy, School of Natural and Environmental Sciences, Newcastle University, NE1 7RU, UK

3. Royal Botanic Garden Edinburgh, 20a Inverleith Row, Edinburgh, EH3 5LR, UK

4. School of Ocean Sciences, Bangor University, Bangor, Gwynedd, LL57 2DG, UK

Among the several threats faced by marine species, fishing poses a risk to both target and bycatch species. Fish bycatch can often be overlooked when compared to bycatch of higher predators. Moreover, reliable estimates of fish bycatch depend on accurate identification of the species caught.

The Southern Ocean is home to about 374 fish species, many of them endemic to the region. While a handful of species have been commercially harvested, many other fish species are increasingly at risk of being caught as bycatch; particularly in the Antarctic krill fishery, where larval and juvenile fish bycatch is frequently reported. The disparity between the lack of biological information for several species coupled with large seasonal catches of Antarctic Krill, highlight the need for monitoring tools that support accurate identification of fish species at all developmental stages.

Motivated by an ecosystem approach to fisheries management, this project aims to develop enhanced, easy to use identification guides to improve reporting of bycatch for the Antarctic krill fishery. We conducted an integrative taxonomic analysis, underpinning morphological identifications with genetic identifications based on two mitochondrial regions (COX-I and control region) and with group and/or species-specific primers; benefitting from the comprehensive biological archive at British Antarctic Survey (BAS), as well as samples collected by krill fishery observers between 2022 and 2024. This work will support the efforts of CCAMLR to safeguard Antarctic marine resources.

Annex 4.2 continued:

Title 2: Identifying gaps in life history traits of Southern Ocean fishes to improve ecosystem-based management.

Authors: William D K Reid[1], Lorena Romero Martinez[2], Huw James[1], Will Goodall-Copestake[3] & Phil Hollyman[4]

1. Modelling, Evidence and Policy, School of Natural and Environmental Sciences, Newcastle University, NE1 7RU

2. British Antarctic Survey, High Cross, Madingley Road, Cambridge, England, CB3 OET, UK

3. Royal Botanic Garden Edinburgh, 20a Inverleith Row, Edinburgh EH3 5LR, UK

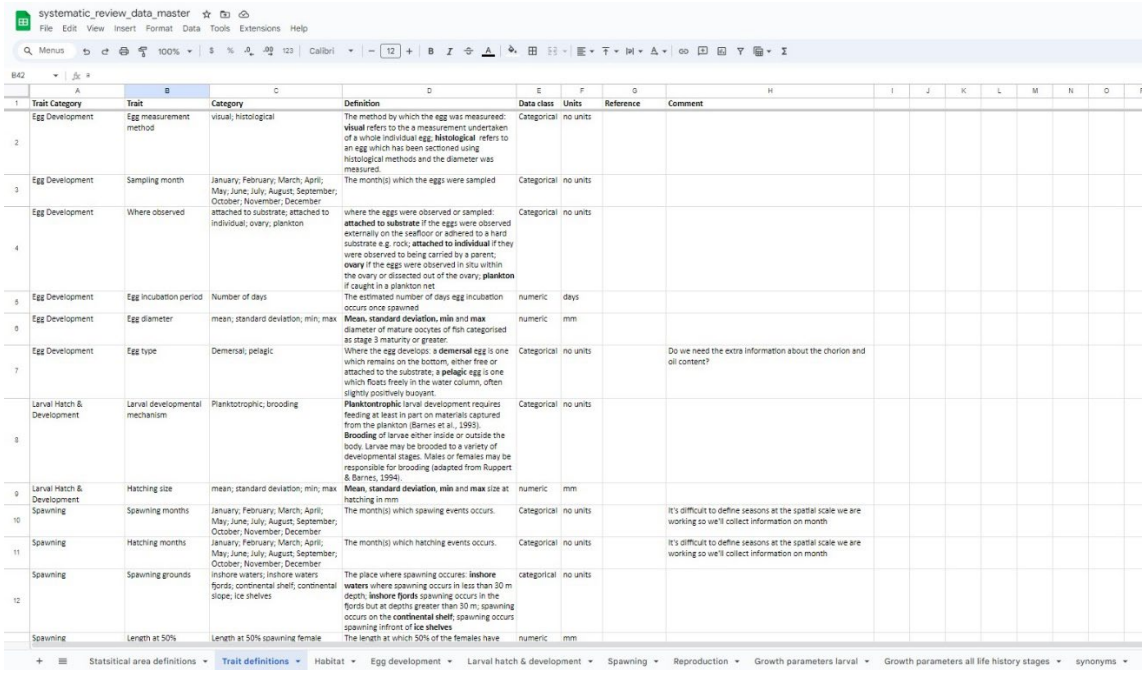
4. School of Ocean Sciences, Bangor University,

Abstract

Fish bycatch is a global problem requiring accurate life history information to develop conservation and management strategies in order to maintain populations against the dual impacts of exploitation and environmental change. In the Southern Ocean, human exploitation of fish has been occurring since the late 1960s and, in recent decades, Antarctic krill harvesting has risen steadily and is projected to do so into the future. This is set against the backdrop of a changing climate which is at odds with the evolutionary history of the endemic fish. Within the Antarctic krill fishery, adult and larval fish are regularly observed as bycatch. Improved understanding of where, when and which fish are caught is essential to manage fish populations in relation to ongoing exploitation and environmental change. Here, we have undertaken a systematic literature search focusing on key life history traits which form the basic biological information to understand population dynamics. We have synthesised information on distribution, age, growth (across life history stages), development and reproduction for fish species found as bycatch in the Antarctic krill fishery. We have discovered that key life history traits (e.g. growth and reproduction) for species that are regularly caught as bycatch are missing, meaning that the impact of unintentional extraction on the population of certain species will be difficult to quantify. Until we have better understanding and compilation of basic life history traits, it will be difficult to implement effective ecosystem-based management practices to understand and mitigate against the dual impacts of exploitation and environmental change for Southern Ocean fish fauna.

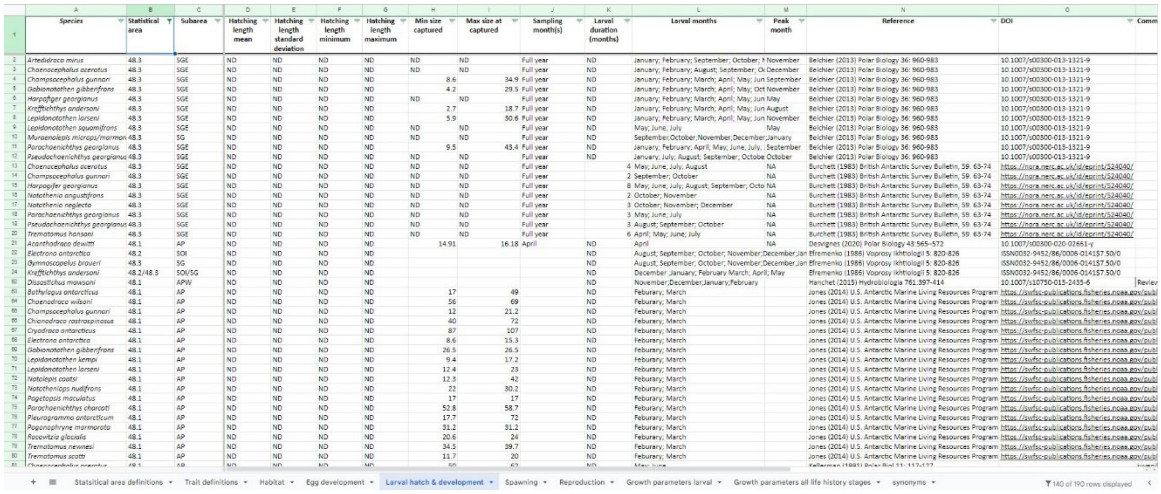
Annex 4.3:

Trait databased for output 2 and example of data extracted



Trait Category	Trait	Category	Definition	Data class	Units	Reference	Comment
Egg Development	Egg measurement method	visual; histological	The method by which the egg was measured: **visual** refers to the a measurement undertaken of a whole individual egg; **histological** refers to an egg which has been sectioned using histological methods and the diameter was measured.	Categorical	no units		
Egg Development	Sampling month	January; February; March; April; May; June; July; August; September; October; November; December	The month(s) which the eggs were sampled	Categorical	no units		
Egg Development	Where observed	attached to substrate; attached to individual; ovary; plankton	where the eggs were observed or sampled: **attached to substrate** if the eggs were observed externally on the seafloor or adhered to a hard substrate e.g. rock; **attached to individual** if they were observed to being carried by a parent; **ovary** if the eggs were observed in situ within the ovary or dissected out of the ovary; **plankton** if caught in a plankton net	Categorical	no units		
Egg Development	Egg incubation period	Number of days	The estimated number of days egg incubation occurs once spawned	numeric	days		
Egg Development	Egg diameter	mean; standard deviation; min; max	**Mean, standard deviation, min** and **max** diameter of mature oocytes of fish categorised as stage 3 maturity or greater.	numeric	mm		
Egg Development	Egg type	Demersal; pelagic	Where the egg develops: a **demersal** egg is one which remains on the bottom, either free or attached to the substrate; a **pelagic** egg is one which floats freely in the water column, often slightly positively buoyant.	Categorical	no units		Do we need the extra information about the chorion and oil content?
Larval Hatch & Development	Larval developmental mechanism	Planktotrophic; brooding	**Planktontrophic** larval development requires feeding at least in part on materials captured from the plankton (Barnes et al., 1993). **Brooding** of larvae either inside or outside the body. Larvae may be brooded to a variety of developmental stages. Males or females may be responsible for brooding (adapted from Ruppert & Barnes, 1994).	Categorical	no units		
Larval Hatch & Development	Hatching size	mean; standard deviation; min; max	**Mean, standard deviation, min** and **max** size at hatching in mm	numeric	mm		
Spawning	Spawning months	January; February; March; April; May; June; July; August; September; October; November; December	The month(s) which spawing events occurs.	Categorical	no units		It's difficult to define seasons at the spatial scale we are working so we'll collect information on month
Spawning	Hatching months	January; February; March; April; May; June; July; August; September; October; November; December	The month(s) which hatching events occurs.	Categorical	no units		It's difficult to define seasons at the spatial scale we are working so we'll collect information on month
Spawning	Spawning grounds	inshore waters; inshore waters fjords; continental shelf; continental slope; ice shelves	The place where spawning occures: **inshore waters** where spawning occurs in less than 30 m depth; **inshore fjords** spawning occurs in the fjords but at depths greater than 30 m; spawning occurs on the **continental shelf**; spawning occurs spawning infront of **ice shelves**	categorical	no units		
Spawning	Length at 50%	Length at 50% spawning female	The length at which 50% of the females have	numeric	mm		

Figure 2: Example of traits categories and definitions of the trait database used to extract the relevant information for output 2



Species	Statistical area	Subarea	Hatching length mean	Hatching length standard deviation	Hatching length minimum	Hatching length maximum	Min size captured	Max size at captured	Sampling month(s)	Larval duration (months)	Larval months	Peak month	Reference	DOI
Artedidraco mirus	48.3	SGE	ND	ND	ND	ND	ND	ND	Full year	ND	January; February; September; October; N	November	Beichler (2013) Polar Biology 36: 960-983	10.1007/s00300-013-1321-9
Channocephalus aceratus	48.3	SGE	ND	ND	ND	ND	ND	ND	Full year	ND	January; February; August; September; Oc	December	Beichler (2013) Polar Biology 36: 960-983	10.1007/s00300-013-1321-9
Champsocephalus gunnari	48.3	SGE	ND	ND	ND	ND	8.6	34.9	Full year	ND	January; February; March; April; May; Jun	September	Beichler (2013) Polar Biology 36: 960-983	10.1007/s00300-013-1321-9
Gobionotothen gibberifrons	48.3	SGE	ND	ND	ND	ND	4.2	29.5	Full year	ND	January; February; March; April; May; Oct	November	Beichler (2013) Polar Biology 36: 960-983	10.1007/s00300-013-1321-9
Harpagifer georgianus	48.3	SGE	ND	ND	ND	ND	ND	ND	Full year	ND	January; February; March; April; May; Jun	May	Beichler (2013) Polar Biology 36: 960-983	10.1007/s00300-013-1321-9
Krefftichthys andersoni	48.3	SGE	ND	ND	ND	ND	2.7	18.7	Full year	ND	January; February; March; April; May; Jun	August	Beichler (2013) Polar Biology 36: 960-983	10.1007/s00300-013-1321-9
Lepidonotothen larseni	48.3	SGE	ND	ND	ND	ND	5.9	30.6	Full year	ND	January; February; March; April; May; Jun	November	Beichler (2013) Polar Biology 36: 960-983	10.1007/s00300-013-1321-9
Lepidonotothen squamifrons	48.3	SGE	ND	ND	ND	ND	ND	ND	Full year	ND	May; June; July	May	Beichler (2013) Polar Biology 36: 960-983	10.1007/s00300-013-1321-9
Muraenolepis microps/marmorata	48.3	SG	ND	ND	ND	ND	ND	ND	Full year	ND	September;October;November;December;January		Beichler (2013) Polar Biology 36: 960-983	10.1007/s00300-013-1321-9
Parachaenichthys georgianus	48.3	SGE	ND	ND	ND	ND	9.5	43.4	Full year	ND	January; February; April; May; June; July;	September	Beichler (2013) Polar Biology 36: 960-983	10.1007/s00300-013-1321-9
Pseudochaenichthys georgianus	48.3	SGE	ND	ND	ND	ND	ND	ND	Full year	ND	January; July; August; September; Octobe	October	Beichler (2013) Polar Biology 36: 960-983	10.1007/s00300-013-1321-9
Channocephalus aceratus	48.3	SGE	ND	ND	ND	ND	ND	ND	Full year		4 May; June; July; August	NA	Burchett (1983) British Antarctic Survey Bulletin, 59: 63-74	https://nora.nerc.ac.uk/id/eprint/524040/
Champsocephalus gunnari	48.3	SGE	ND	ND	ND	ND	ND	ND	Full year		2 September; October	NA	Burchett (1983) British Antarctic Survey Bulletin, 59: 63-74	https://nora.nerc.ac.uk/id/eprint/524040/
Harpagifer georgianus	48.3	SGE	ND	ND	ND	ND	ND	ND	Full year		8 May; June; July; August; September; Octo	NA	Burchett (1983) British Antarctic Survey Bulletin, 59: 63-74	https://nora.nerc.ac.uk/id/eprint/524040/
Notothenia angustifrons	48.3	SGE	ND	ND	ND	ND	ND	ND	Full year		2 October; November	NA	Burchett (1983) British Antarctic Survey Bulletin, 59: 63-74	https://nora.nerc.ac.uk/id/eprint/524040/
Notothenia neglecta	48.3	SGE	ND	ND	ND	ND	ND	ND	Full year		3 October; November; December	NA	Burchett (1983) British Antarctic Survey Bulletin, 59: 63-74	https://nora.nerc.ac.uk/id/eprint/524040/
Parachaenichthys georgianus	48.3	SGE	ND	ND	ND	ND	ND	ND	Full year		3 May; June; July	NA	Burchett (1983) British Antarctic Survey Bulletin, 59: 63-74	https://nora.nerc.ac.uk/id/eprint/524040/
Pseudochaenichthys georgianus	48.3	SGE	ND	ND	ND	ND	ND	ND	Full year		3 August; September; October	NA	Burchett (1983) British Antarctic Survey Bulletin, 59: 63-74	https://nora.nerc.ac.uk/id/eprint/524040/
Trematomus hansoni	48.3	SGE	ND	ND	ND	ND	ND	ND	Full year		6 April; May; June; July	NA	Burchett (1983) British Antarctic Survey Bulletin, 59: 63-74	https://nora.nerc.ac.uk/id/eprint/524040/
Acanthodraco dewitt	48.1	AP	ND	ND	ND	ND	14.91	16.18	April	ND	April	NA	Dervignes (2020) Polar Biology 43:565–572	10.1007/s00300-020-02651-y
Electrona antarctica	48.2	SOI	ND	ND	ND	ND				ND	August; September; October; November;December;Jan		Efremenko (1986) Voprosy ikhtiologii 5: 820-826	ISSN0032-9452/86/0006-014157.50/0
Gymnoscopelus braueri	48.3	SG	ND	ND	ND	ND				ND	August; September; October; November;December;Jan		Efremenko (1986) Voprosy ikhtiologii 5: 820-826	ISSN0032-9452/86/0006-014157.50/0
Krefftichthys andersoni	48.2/48.3	SOI/SG	ND	ND	ND	ND				ND	December ;January; February March; April; May		Efremenko (1986) Voprosy ikhtiologii 5: 820-826	ISSN0032-9452/86/0006-014157.50/0
Disostichus mawsoni	48.1	APW	ND	ND	ND	ND				ND	November;December;January;February		Hanchet (2015) Hydrobiologia 761:397–414	10.1007/s10750-015-2435-6
Bathyraja antarctica	48.1	AP	ND	ND	ND	ND	17	49		ND	Feburary, March		Jones (2014) U.S. Antarctic Marine Living Resources Program	https://swfsc-publications.fisheries.noaa.gov/pub
Chaenodraco wilsoni	48.1	AP	ND	ND	ND	ND	56	69		ND	Feburary, March		Jones (2014) U.S. Antarctic Marine Living Resources Program	https://swfsc-publications.fisheries.noaa.gov/pub
Champsocephalus gunnari	48.1	AP	ND	ND	ND	ND	12	21.2		ND	Feburary, March		Jones (2014) U.S. Antarctic Marine Living Resources Program	https://swfsc-publications.fisheries.noaa.gov/pub
Chionodraco rastrospinosus	48.1	AP	ND	ND	ND	ND	40	72		ND	Feburary, March		Jones (2014) U.S. Antarctic Marine Living Resources Program	https://swfsc-publications.fisheries.noaa.gov/pub
Cryodraco antarcticus	48.1	AP	ND	ND	ND	ND	87	107		ND	Feburary, March		Jones (2014) U.S. Antarctic Marine Living Resources Program	https://swfsc-publications.fisheries.noaa.gov/pub
Electrona antarctica	48.1	AP	ND	ND	ND	ND	8.6	15.3		ND	Feburary, March		Jones (2014) U.S. Antarctic Marine Living Resources Program	https://swfsc-publications.fisheries.noaa.gov/pub
Gobionotothen gibberifrons	48.1	AP	ND	ND	ND	ND	26.5	26.5		ND	Feburary, March		Jones (2014) U.S. Antarctic Marine Living Resources Program	https://swfsc-publications.fisheries.noaa.gov/pub
Lepidonotothen kempi	48.1	AP	ND	ND	ND	ND	9.4	17.2		ND	Feburary, March		Jones (2014) U.S. Antarctic Marine Living Resources Program	https://swfsc-publications.fisheries.noaa.gov/pub
Lepidonotothen larseni	48.1	AP	ND	ND	ND	ND	12.4	23		ND	Feburary, March		Jones (2014) U.S. Antarctic Marine Living Resources Program	https://swfsc-publications.fisheries.noaa.gov/pub
Notolepis coatsi	48.1	AP	ND	ND	ND	ND	12.5	42		ND	Feburary, March		Jones (2014) U.S. Antarctic Marine Living Resources Program	https://swfsc-publications.fisheries.noaa.gov/pub
Notothenia rudifrons	48.1	AP	ND	ND	ND	ND	22	30.2		ND	Feburary, March		Jones (2014) U.S. Antarctic Marine Living Resources Program	https://swfsc-publications.fisheries.noaa.gov/pub
Pagetopsis maculatus	48.1	AP	ND	ND	ND	ND	17	17		ND	Feburary, March		Jones (2014) U.S. Antarctic Marine Living Resources Program	https://swfsc-publications.fisheries.noaa.gov/pub
Parachaenichthys charcoti	48.1	AP	ND	ND	ND	ND	52.8	58.7		ND	Feburary, March		Jones (2014) U.S. Antarctic Marine Living Resources Program	https://swfsc-publications.fisheries.noaa.gov/pub
Pleuragramma antarcticum	48.1	AP	ND	ND	ND	ND	17.7	72		ND	Feburary, March		Jones (2014) U.S. Antarctic Marine Living Resources Program	https://swfsc-publications.fisheries.noaa.gov/pub
Pogonophryne marmorata	48.1	AP	ND	ND	ND	ND	31.2	31.2		ND	Feburary, March		Jones (2014) U.S. Antarctic Marine Living Resources Program	https://swfsc-publications.fisheries.noaa.gov/pub
Trematomus eulepidotus	48.1	AP	ND	ND	ND	ND	20.6	24		ND	Feburary, March		Jones (2014) U.S. Antarctic Marine Living Resources Program	https://swfsc-publications.fisheries.noaa.gov/pub
Trematomus newnesi	48.1	AP	ND	ND	ND	ND	34.5	39.7		ND	Feburary, March		Jones (2014) U.S. Antarctic Marine Living Resources Program	https://swfsc-publications.fisheries.noaa.gov/pub
Trematomus scotti	48.1	AP	ND	ND	ND	ND	11.7	20		ND	Feburary, March		Jones (2014) U.S. Antarctic Marine Living Resources Program	https://swfsc-publications.fisheries.noaa.gov/pub

Figure 3: Example of the type of data that has been extracted from the selected literature and using the trait database.

Annex 4.4:

Abstract presented to the South Georgia & the South Sandwich Islands Marine Protected Area (MPA) Science Symposium in June 2023

Title: Improving identification of fish bycatch in the Antarctic krill fishery

Authors: William D K Reid[1], Philip R Hollyman[2], Will Goodall-Copestake[3], Joe Chapman[4], M Lorena Romero-Martinez[2], Martin A Collins[2] and Susan Gregory[5]
Affiliations:

1. Newcastle University
2. British Antarctic Survey
3. Scottish Association for Marine Sciences
4. MRAG
5. Government of South Georgia and the South Sandwich Islands (GSGSSI)

Finfish bycatch is a global problem requiring accurate information to develop conservation and management strategies to preserve ecosystems. Bycatch can occur at different life history stages and spatial and temporal scales, meaning the risk of bycatch is not uniform across a species life or distributional range. The Antarctic krill fishery operates in British Antarctic Territory and South Georgia maritime waters and catches larval and juvenile fish as well as fish eggs. Fish by-catch in the krill fishery is often hard to identify to species level, which may influence the accuracy of taxonomic reporting by fisheries observers. Understanding which fish life history stages interact with the fisheries and making sure there is accurate identification of species is important for the successful implementation of ecosystem management measures by the Government of South Georgia and the South Sandwich Islands and the Commission of the Conservation of Antarctic Living Marine Resources. This project, funded by Darwin Plus, aims to identify which life stages are at greatest risk of being caught by the fishery and will (1) undertake a review of early life history stages of species caught by the krill fisheries; (2) undertake integrative taxonomy methods to identify fish bycatch and produce identification and training tools for international fisheries observers and (3) model the spatial distribution of larval and juvenile fish by-catch.

Figure 4: Dr. Will Reid presenting the project at the GSGSSI symposium.

Annex 4.5:

Abstract and poster presented to the Fisheries Society of the British Isles (FSBI) in July 2023

Title: Investigating by-catch uncertainties to improve Antarctic Krill fishery management

M.L. Romero Martínez1; P.R. Hollyman1; W. Reid2; W. Goodall-Copestake 3

1. The British Antarctic Survey, High Cross, Madingley Road, Cambridge, CB3 0ET, UK

2. School of Natural and Environmental Sciences, Newcastle University, NE1 7RU, UK

3. Royal Botanical Gardens Edinburgh, 20a Inverleith Row, Edinburgh, EH3 5LR, UK

The accrued commercial interest in Antarctic krill (Euphausia superba) over the past two decades has driven noticeable increases in seasonal catches in Area 48 (southwest Atlantic sector, Southern Ocean), where E. superba is actively fished over three statistical subareas (48.1 to 48.3). Seasonal catches of E. superba have reached more than 3 x 105 tonnes over the last decade, making this the largest volume fishery in the Southern Ocean. Larval and juvenile fish are frequently taken as bycatch in the krill fishery. Concerns related to the extent and detrimental impacts on fish populations call for sound management and monitoring tools supported by fisheries-independent scientific research.

Benefitting from the comprehensive biological archive at British Antarctic Survey (BAS), spanning over three decades of ichthyoplankton research, as well as samples collected between 2022 and 2024 from the krill fishery itself. We employ morphological and molecular methods to develop enhanced identification guides to improve reporting on by catch for the krill's fishery, which in turn will support CCAMLR efforts to safeguard Antarctic marine resources, utilising an ecosystem-based approach.

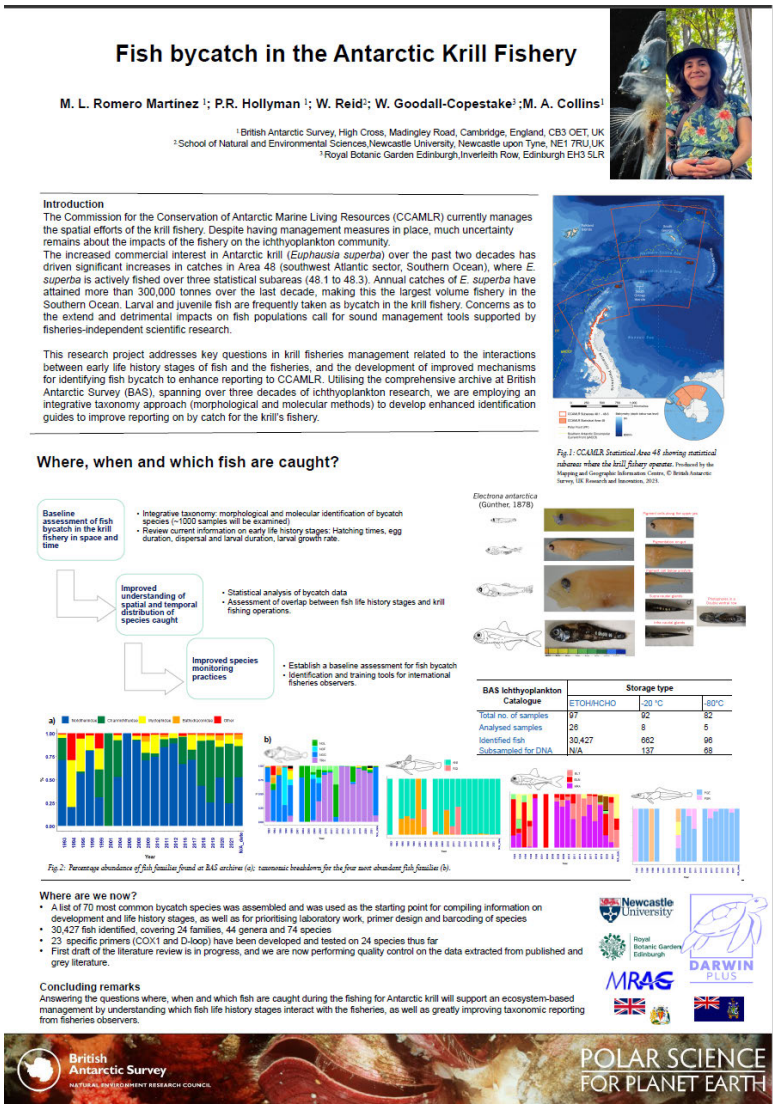


Figure 5: Poster presented at the FSBI 2023 conference.

Additional information submitted in addition to this report

Annex 4.6: Annual meeting minutes notes.

Annex 4.7: Report on control region troubleshooting.

Annex 4.8: Manuscript submitted and presented at the CCAMLR WG-FSA

Annex 4.9: Request for DNA samples to the NHM London.

Checklist for submission

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