Resolving ecosystem effects of the South Georgia winter krill fishery
Update for stakeholders: October 2022

Project Background

The Winter Krill project is a Darwin Plus project, funded by Defra, led by the British Antarctic Survey (BAS) in partnership with the Government of South Georgia and the South Sandwich Islands (GSGSSI) and the Antarctic Research Trust (ART). Its objectives are to obtain information on i) the distribution and abundance of *Euphausia superba* (Antarctic krill) during the winter; and ii) overlap between the distribution of krill-dependent predators and krill in the fishery area (see graphical description in Fig. 5). The motivation for this work is that the commercial krill fishery around SG operates exclusively during the winter period, yet information on the stock dynamics and distribution of krill during this period are sparse.

Although MPA restrictions include a 30 km no-take zone around the SG coast, there is evidence to suggest that the foraging habits of krill-dependent predators such as penguins and seals vary depending on the abundance of krill, and that this may result in overlap between them and the krill fishery, particularly during low krill years. There is also evidence of baleen whales returning to SG in large numbers during the summer and of some remaining during the winter, with the increased prey demand potentially further increasing competition for krill resources.

The project can be followed here: https://www.bas.ac.uk/project/winter-krill-at-south-georgia/

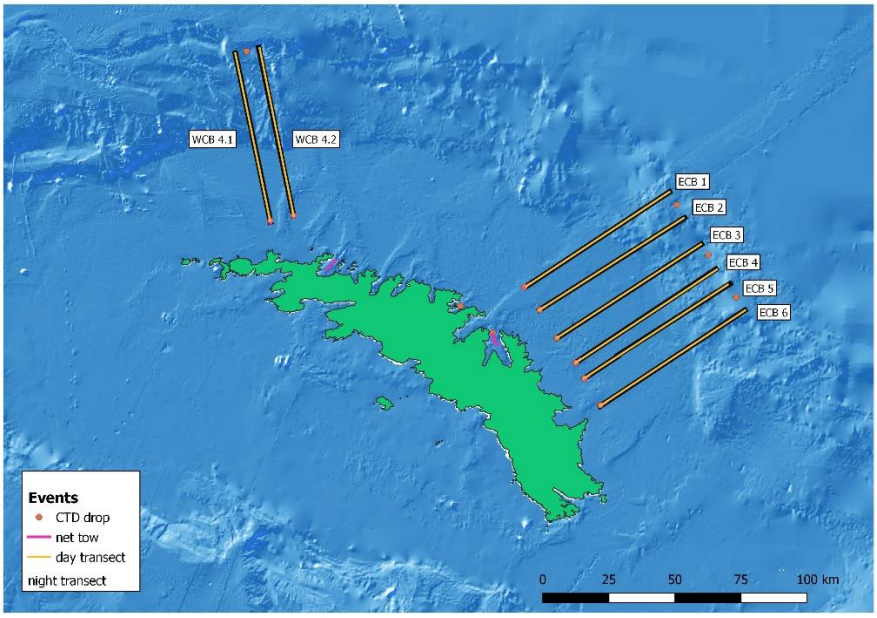

Figure 1: Map of the Eastern Core Box (ECB) and Western Core Box (WCB) transects occupied during the survey. Core transects are ECB 1-4. ECB 5-6 and WCB 4.1 and 4.2 are time and weather dependent additional transects, but were able to be carried out in all 3 surveys this year. *Credit: Kate Owen*

Update on recent activity

The project is centred around winter surveys of krill and predators in the austral winter, taking place in two consecutive years, to gather information on the distribution and overlap between krill, the fishery and krill-dependent predators. The first year of these surveys has now been completed and planning is underway for the second.

Krill acoustics

In May, July and September 2022 the first three winter surveys were carried out, and full reports for each of the surveys are available on our website. These surveys were carried out on the GSGSSI fisheries patrol vessel, the *MV Pharos SG*, with logistical support from the GSGSSI. To fully equip the *MV Pharos SG* to be able to undertake these surveys, the vessel was fitted with a scientific echosounder system (Simrad EK80) with 38 and 120 kHz transducers in March 2022 (Fig. 2, left panel), which was subsequently calibrated off the Falklands in April 2022. As well as supporting the science for this project, this provides additional capacity for both the vessel and future GSGSSI monitoring work.

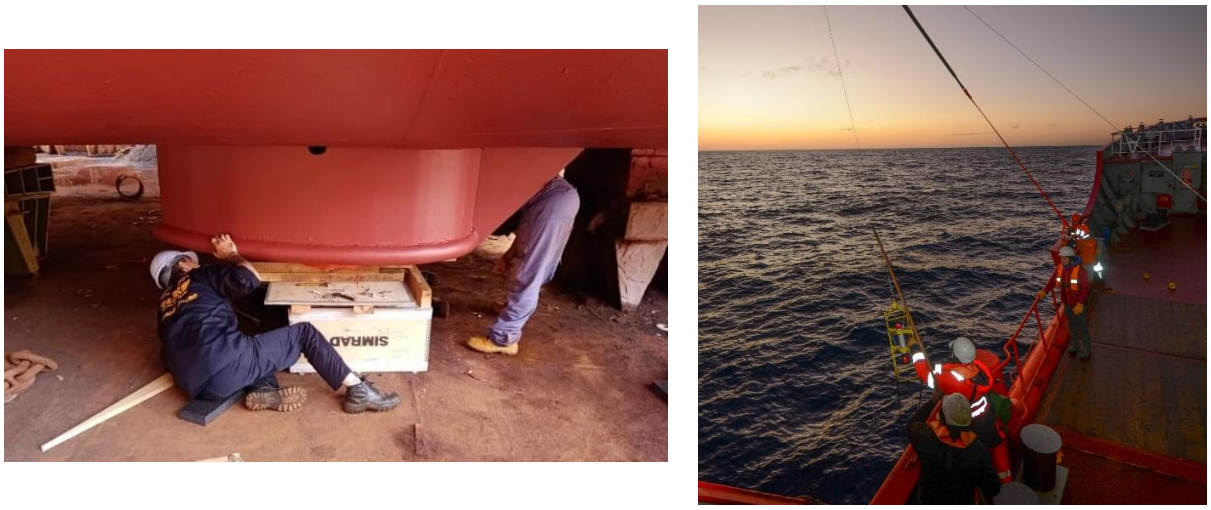

Figure 2. Acoustic echosounder being fitted to the vessel (left) and CTD being deployed from the vessel (right). *Credits: Steve Brown and Martin Collins*

Information about krill density and distribution was gathered acoustically (e.g., Fig. 3) during each survey along transects in the area currently targeted by the commercial krill fishery (the Eastern Core Box, ECB, Fig. 1). The 6 westernmost transects of the ECB were occupied in each survey, with almost all surveyed during both day and night. At the start and end of each acoustic transect, plankton trawls were carried out, and a sub-sample of krill were measured. This provides information on krill length-frequency required for determining krill biomass from the acoustic data, and helps to ground-truth the acoustics. CTDs were also deployed in order to calibrate the acoustic data (Fig. 2, right panel).

As well as the ECB, the two easternmost transects of the Western Core Box (WCB, Fig. 1) were also surveyed. This is part of a long-term time-series, operated by BAS, that collets krill acoustic data. This

will provide a useful comparison to the data obtained in the ECB, and further insight into connectivity and krill dynamics around the region.

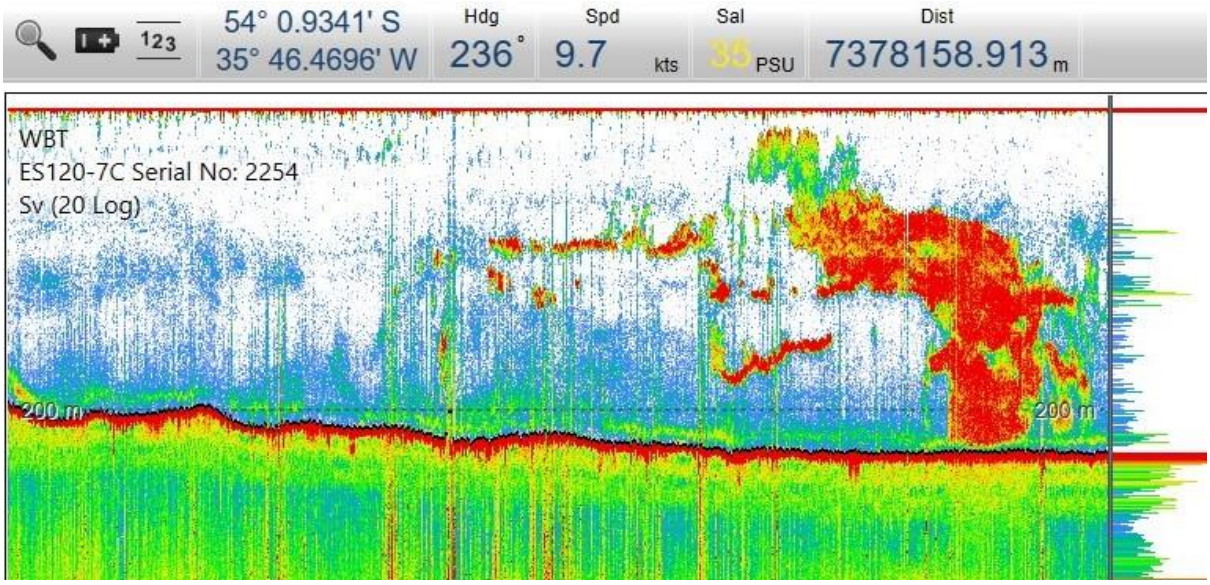

Figure 3. Example image of acoustic data gathered during the surveys.

Krill-dependent predators

We also wanted to be able to understand how krill-dependent predators interact with their prey during winter, and to determine potential overlap between predators and the krill fishery.

Penguins

Working with the ART, who provided the project with 12 Wildlife Computers SPOT-367A PTT tags for the 2022 season, we deployed 6 satellite tracking tags on gentoo penguins at both Bird Island and Maiviken (South Georgia, Fig. 4, left panel). Four tags were deployed at each site during the May survey, and a further 2 were deployed at each site in July. At the time of writing in October 2022, 5 tags were still transmitting data. A map showing the real-time tracking data is available on the 'About' page of our website. The ART will provide a further 12 tags to repeat this work in 2023.

In addition, 8 remote-download GPS tags were deployed on gentoo penguins at Bird Island, relaying information to a temporary local base-station. One has already been retrieved and redeployed, providing us with information on a total of 9 additional birds in the 2022 season.

Seabirds and cetaceans

On each survey, cetacean and seabird observations were also carried out, concurrently with the daytime acoustic transects, in order to estimate their abundance and distribution.

A specialist seabird observer working in accordance with the JNCC Seabirds at Sea methodology joined the vessel for all three surveys, recording detailed seabird sightings data from the centre of the bridge. Cetacean observations were also taken in order to maintain consistency between all three surveys; however more detailed observations were also taken during the July survey.

During the July survey, a team of 3 cetacean experts joined the vessel to carry out detailed sightings data for whales, seals and dolphins. Where possible, cetacean photo identification was also gathered

to provide information on residency, movement patterns and population identity (e.g., Fig. 4, right panel). Photographs are also being uploaded to https://happywhale.com/home for comparison to other Southern Hemisphere images. Twelve passive acoustic DIFAR sonobuoys (Ultra Electronics HIDAR units) were also deployed on daytime transects in order to acoustically locate whales in real time, and record their vocalisations. These work best at lower wind speeds, so were only deployed in winds up to 35 knots.

Figure 4. Tagged gentoo penguin (left) and humpback whale sighted from the vessel (right). *Credits: Martin Collins*

Next steps

The team are now working on analysing the first years' data and will review preliminary results at a project meeting in December. This will help inform the second year of survey work.

Planning is underway for the second year of surveys which will be carried out between May and September 2023.

Scientific papers and general interest articles are also being developed to share results of the project as they emerge.

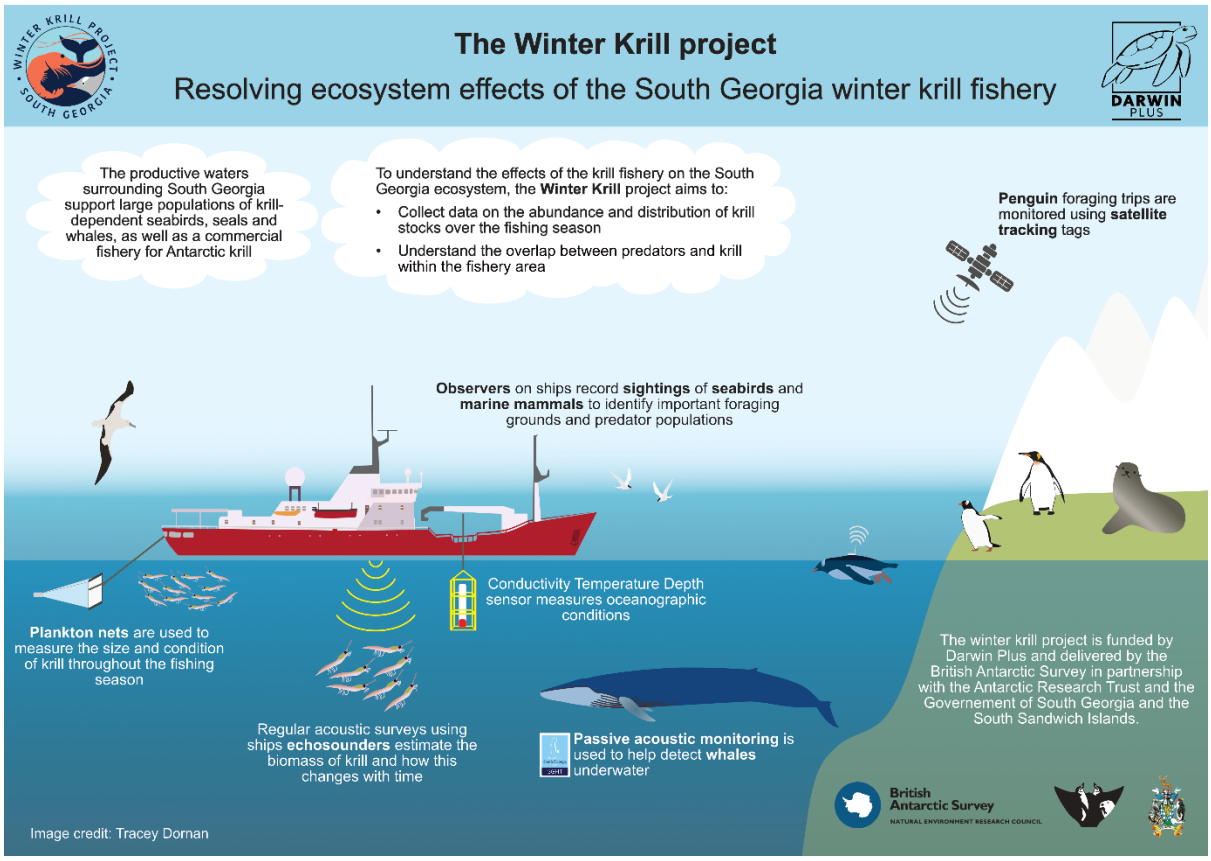

Figure 5. Infographic depicting the project. *Credit: Tracey Dornan*