SGSSI MPA Review Science Symposium

13-14 June 2023
Aurora Conference Centre
Cambridge, UK

Hosted by the Government of South Georgia & the South Sandwich Islands

Future Work

- **South Georgia island wide decadal albatross survey.** *Jennifer Black (GSGSSI)*
- **Why is the grass greener on the other side? Using satellite technology to monitor seabird populations at South Georgia.** *Richard Phillips (BAS)*
- **Evidence-based conservation of biodiversity in the South Sandwich Islands.** *Norman Ratcliffe (BAS)*
- **Characterising the pelagic community of South Georgia through novel sampling methods.** *Cecilia Liszka (BAS)*
- **Improving identification of fish bycatch in the Antarctic krill fishery.** *William Reid (Newcastle University)*
- **Evaluating climate change risks to Patagonian and Antarctic toothfish.** *Rachel Cavanagh (BAS)*
- **Development of alternative population assessment models for Patagonian toothfish in Subareas 48.3/48.4.** *Lisa Readdy (Cefas)*
- **Mitigating the spread of marine invasive non-native species (INNS) to SGSSI.** *Paul Brickle (SAERI)*
- **Hungry Humpbacks: measuring seasonal foraging intensity at South Georgia.** *Stephanie Martin (BAS)*
- **Acoustic monitoring of whales and vessels in Cumberland Bay, South Georgia.** *Susannah Calderan (SAMS)*

Jennifer Black

Government of South Georgia & the South Sandwich Islands


ESA


Sue G

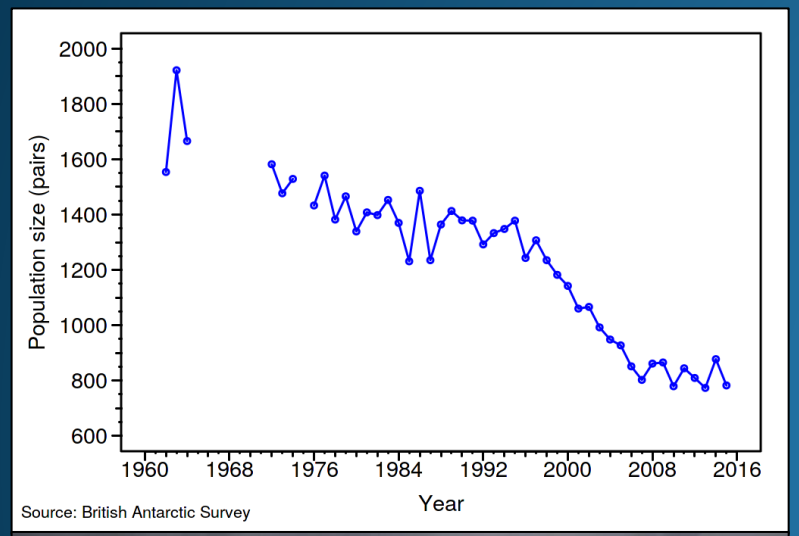

Judith Brown

South Georgia island wide decadal albatross survey

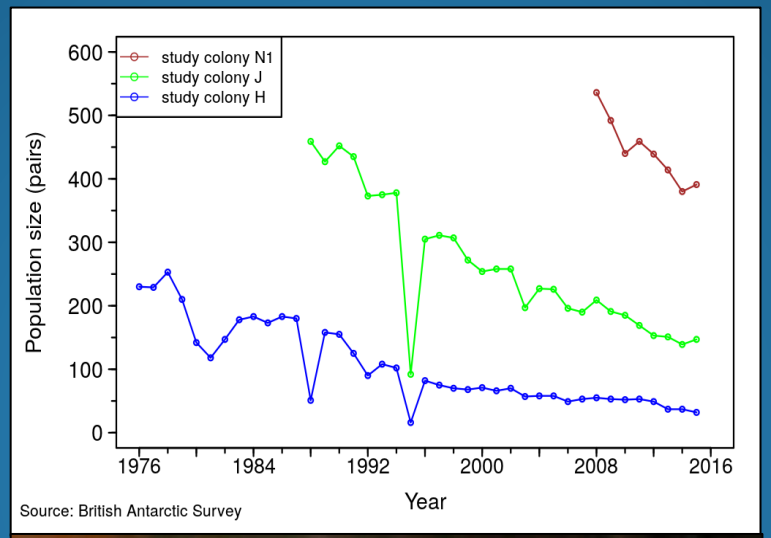
Jennifer Black
Government of South Georgia & the South Sandwich Islands

- Globally important breading site for albatrosses
  - **Wandering albatross** – 1,300 pairs. Second largest global population
  - **Black-browed albatross** – 56,000 pairs. Third largest global population
  - **Grey-headed albatross** – 47,700 pairs. Largest global population

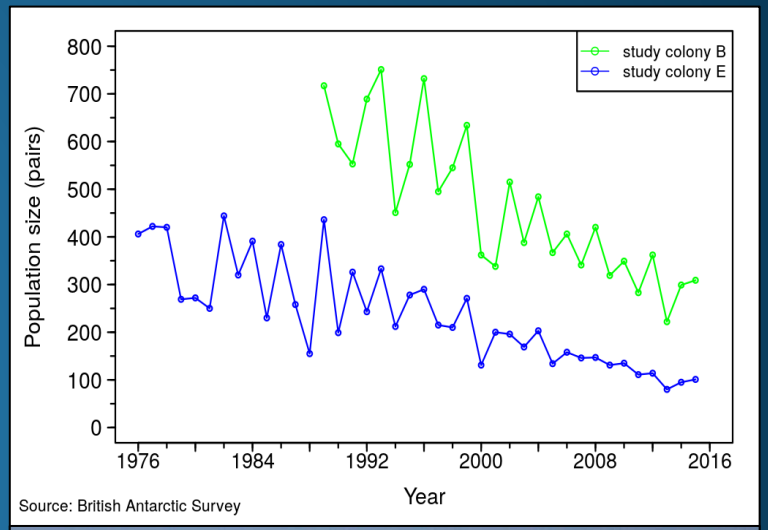
Poncet et al (2017)



1.5 % decline p.a.

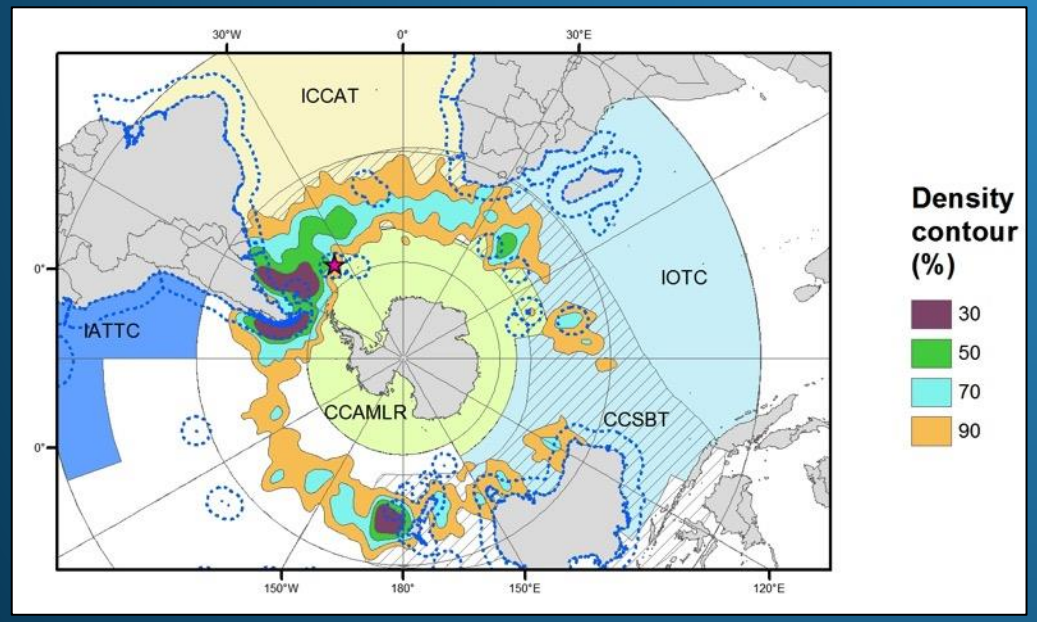


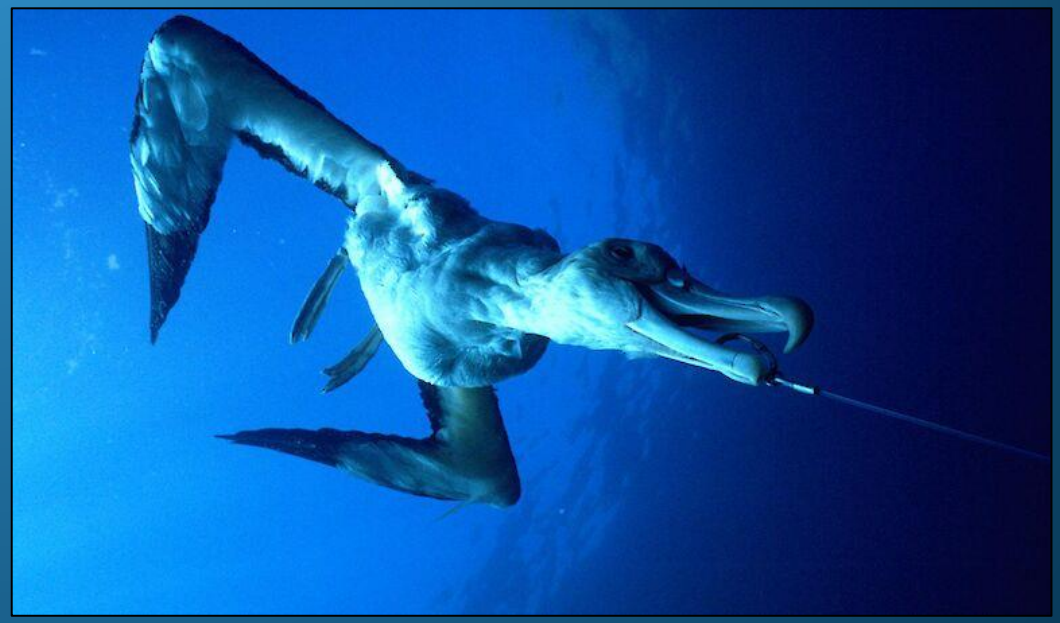
1.9 % decline p.a.



5 % decline p.a.

- No evidence for land based threats or disease affecting South Georgia albatrosses
- Bird-by catch principal cause of population decline
  - Only 3 albatrosses killed in SGSSI fisheries since MPA came into force
  - By-catch data from many RFMOs limited but likely significant
  - Tracking shows overlap / vulnerability

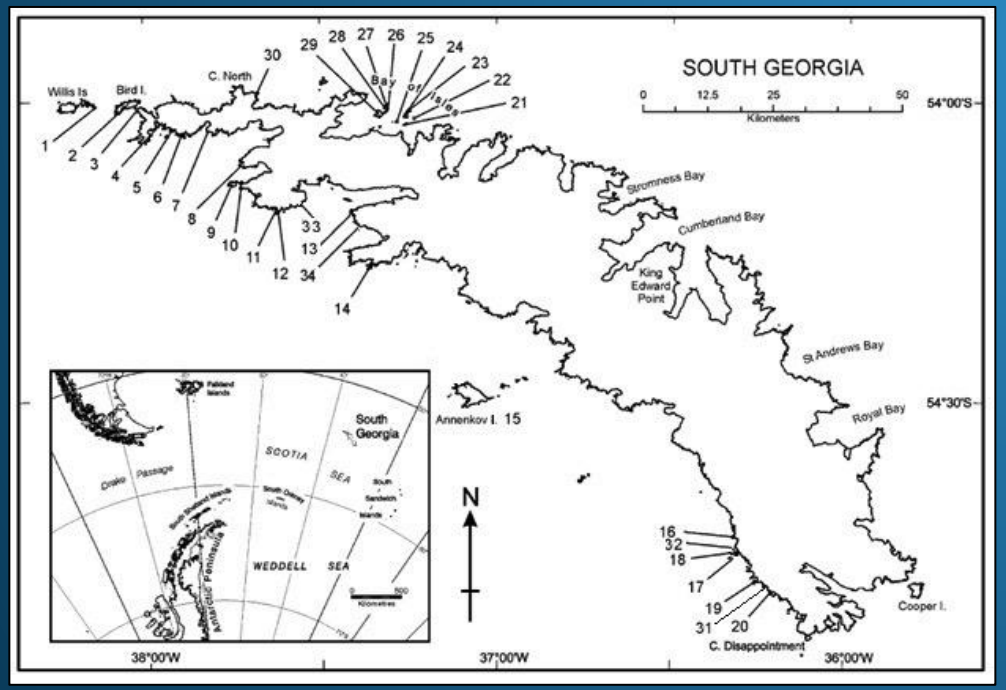




- Agreement on Conservation for Albatross and Petrels 'Priority Populations'
- Albatross action plans
  - Targeted research to understand threats
  - Identify conservation actions
- Monitoring
  - Annual surveys at selected sites, decadal island wide survey

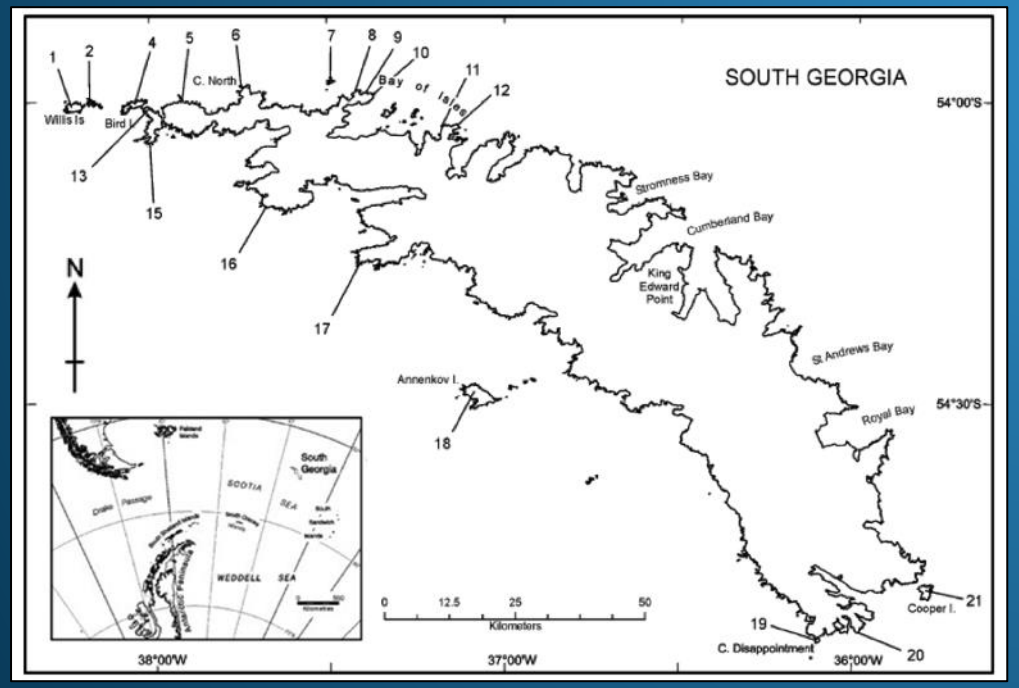
Wandering albatross survey January 2024

- Yacht based, to include Annenkov Island, ground truth for ‘albatross from space’ satellite counts in future.
- Multi-disciplinary team



Grey-headed and black-browed albatross survey November 2023

- *Pharos SG* based, comparison of photo count and drone count methodologies
- In collaboration with British Antarctic Survey



Outputs

- Revised population estimate and trends > review progress, update albatross action plans, evidence base for conservation advocacy
- Improved, updated, comparable survey methodologies > aid future monitoring
- HPAI surveillance

Richard Phillips

British Antarctic Survey

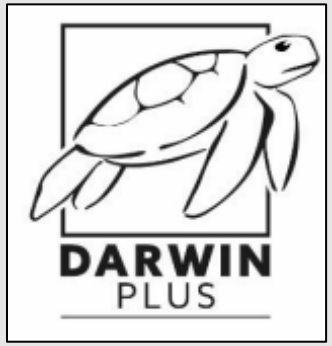

ESA


Sue G


Judith Brown

Why is the grass greener on the other side?
Using satellite technology to monitor seabird populations at South Georgia

Peter Fretwell, Richard Phillips, Marie Attard, Ellie Bowler



AIMS

- Assess the feasibility of using satellite imagery to monitor the status of seabirds across the island group
- Provide baselines to showcase the recovery of burrowing petrels following the eradication of rodents and reindeer in the mid-2010s
- Develop methods that could replace expensive and logistically challenging ground surveys across remote islands worldwide

APPROACH

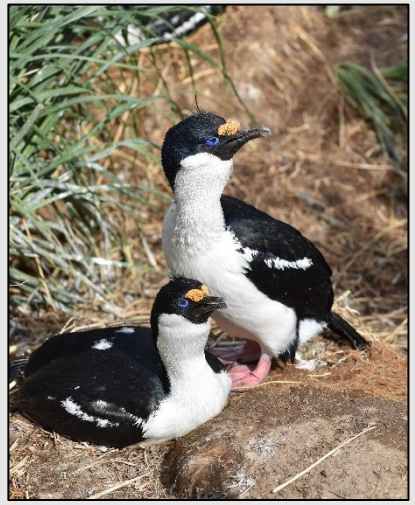
Species	Validation sites (BI/KEP)	Direct detection of individuals possible?	Target detection method	Automated detection method	Potential
White-chinned petrels, Antarctic prion, blue petrel, common diving petrel	BI, KEP (some sp.), elsewhere	No	Greener vegetation due to higher nutrients from guano	Spectral classification of vegetation	high
Northern and southern giant petrels	BI, KEP, All-islands survey	?	Direct detection of contrasting pixels	Manual counts/convolutional neural network?	moderate
Wilson's storm petrel, South Georgia diving petrel, Antarctic tern	BI, KEP (some sp.)	No	Guano on scree	Spectral classification of guano	low
South Georgia shag	BI	?	Direct detection of contrasting pixels	Manual counts/convolutional neural network?	high
Wandering albatross	BI, All-islands surveys	Yes	Direct detection of contrasting pixels	Manual counts/convolutional neural network?	high
Black-browed and grey-headed albatrosses	BI, All-island surveys	?	Area pattern-based analysis, or colony extent	Object Based Image Analysis	moderate

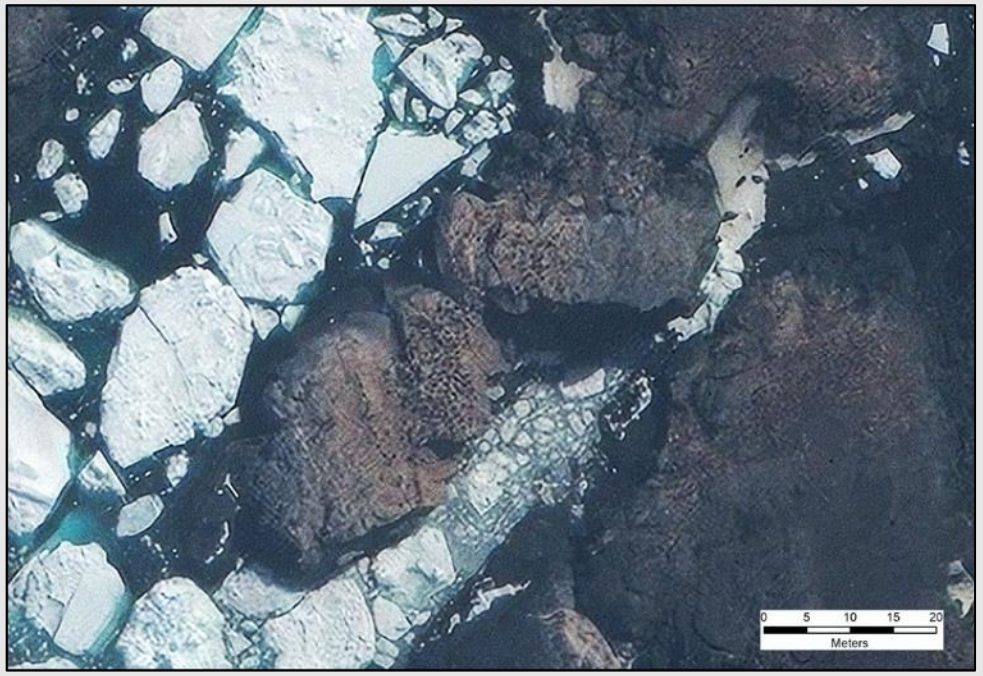
IMAGERY

- Will task satellite provider to collect cloud-free mosaic of 30/50cm VHR satellite imagery of SG coastal strip
- Future resource for other studies (within license agreement)

Example study species: South Georgia shag

- Can we discriminate shags from penguins?
- Can we count accurately?
- Test manual and AI methods





Example study species group: Burrowing petrels

- Can we discriminate guano-enriched (burrowing petrels) from scat-enriched (seals)?
- Take slope, aspect, height etc. into account in habitat models.
- Map recolonisation process (at least); occupation of new habitat, increasing densities

Norman Ratcliffe

British Antarctic Survey


ESA


Sue G


Wolfgang Kaehler

Evidence-based conservation of biodiversity in the South Sandwich Islands

Norman Ratcliffe, Gemma Clucas, John Dickens, Tom Hart

Study Site


Blag Rock
Shag Rocks
Grytviken/
King Edward Point
South Georgia
Island
Annenkov
Island
Clerke Rocks
SOUTH ATLANTIC OCEAN
Scotia Sea
TRAVERSAY ISLANDS
Leskov I.
Visokoi I.
Vindication I.
Candlemas I.
SOUTH
SANDWICH
ISLANDS
CENTRAL ISLANDS
Saunders I.
Montagu
Island
Bristol I.
SOUTHERN THULE
Morrell I./
Thule I.
Bellingshausen I.
Cook I.

Study Site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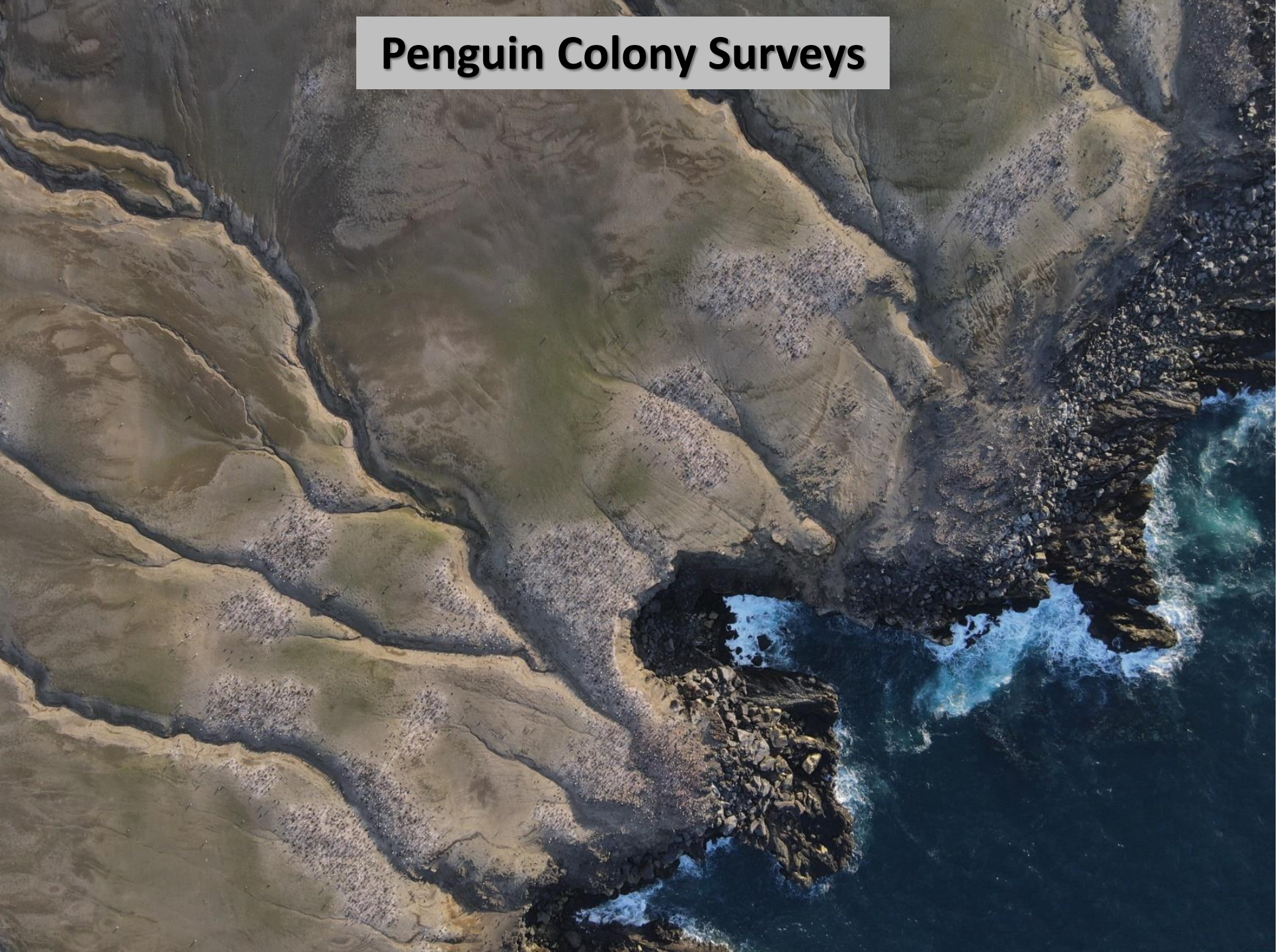
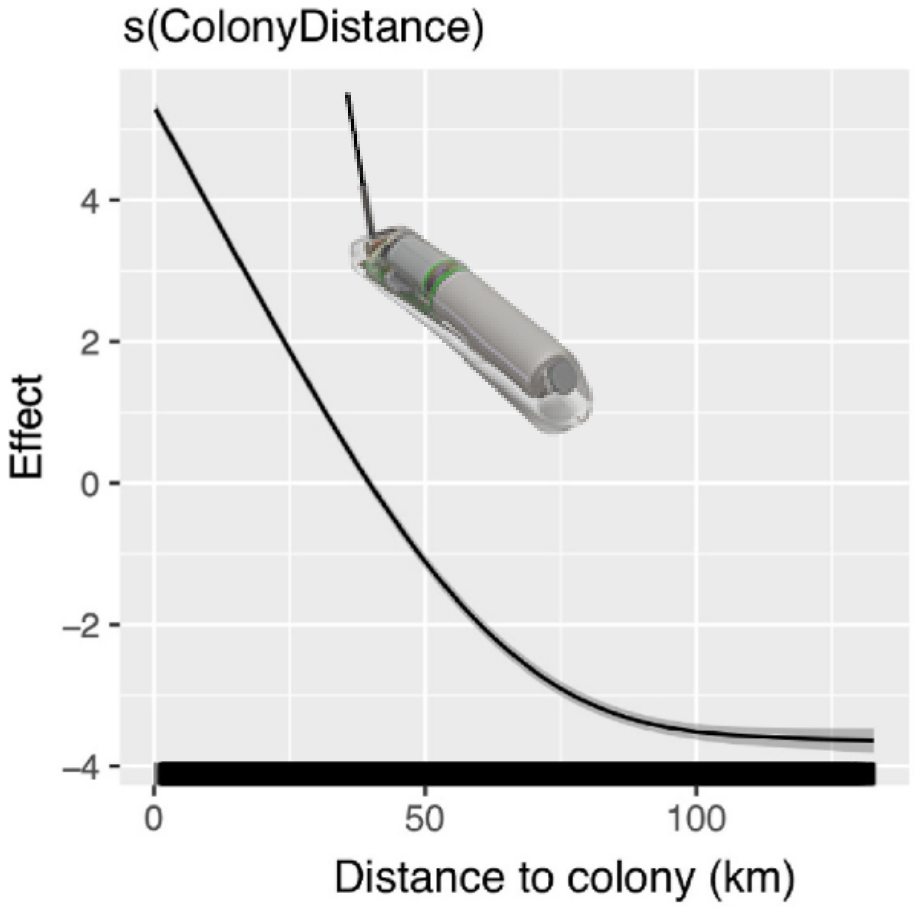
Visokoi I.

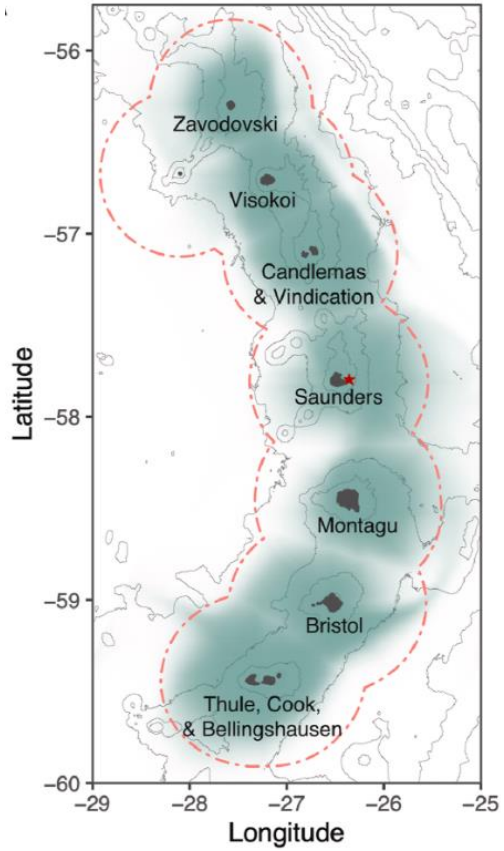

SOUTHERN THULE
Morrell I./
Thule I.
Bellingshausen I.
Cook I.

Penguin Colony Surveys

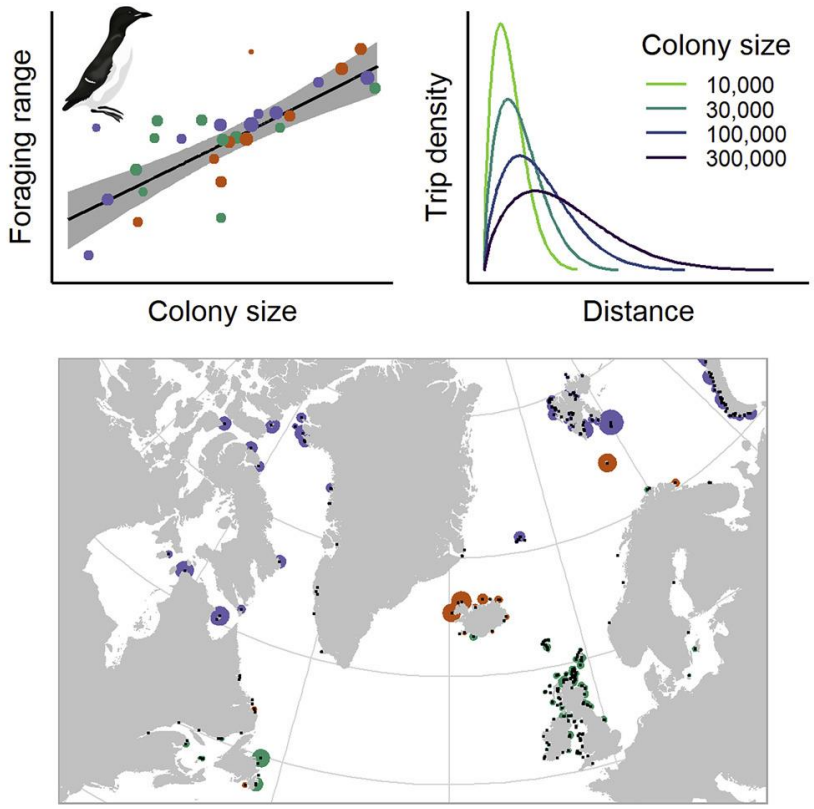


Penguin Movements



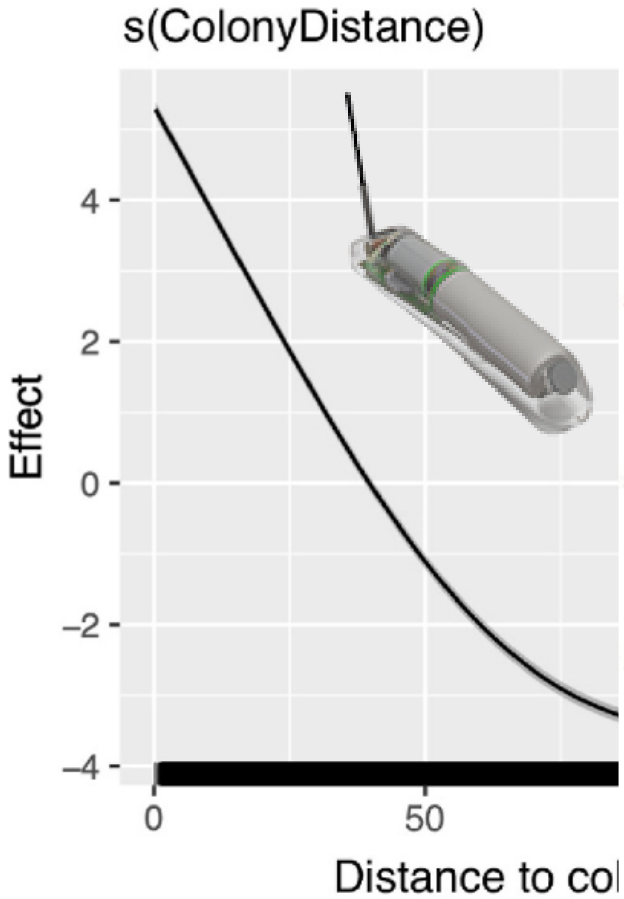


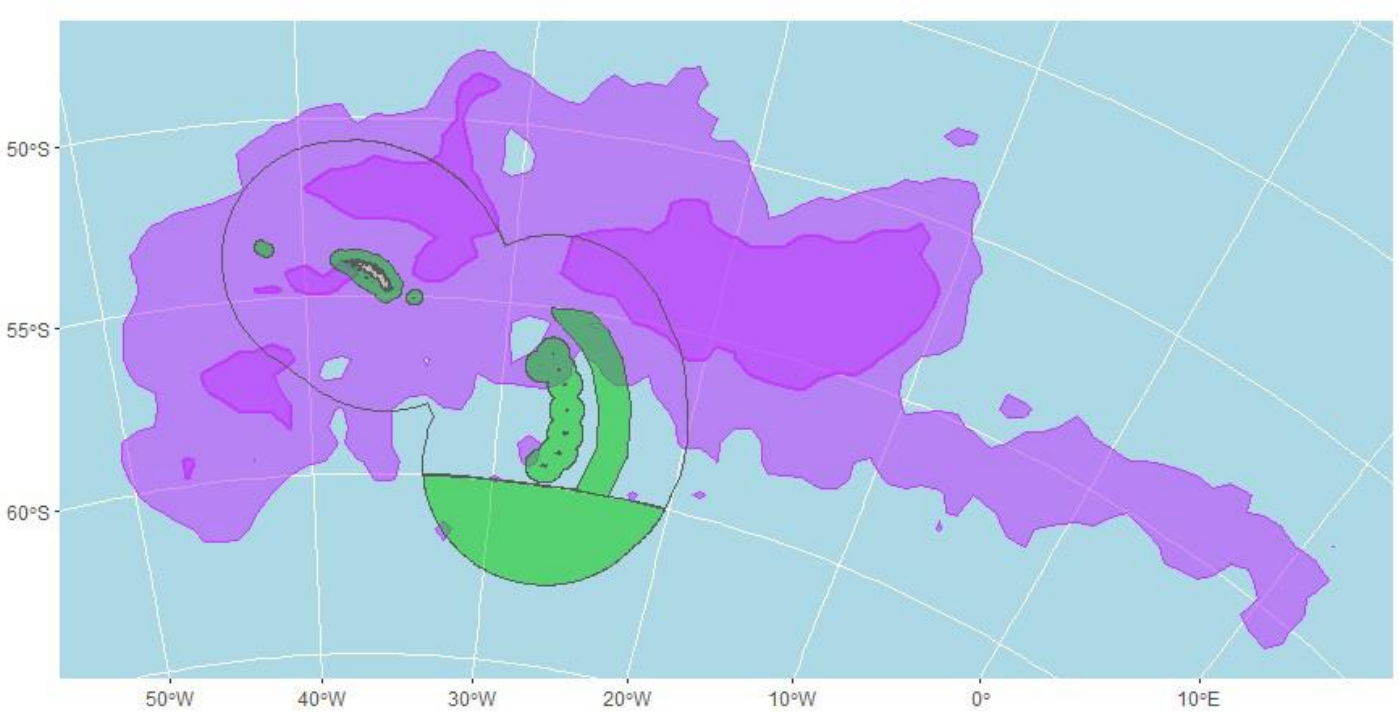
Clucas *et al*. 2022
Deep Sea Research II 199: 105093

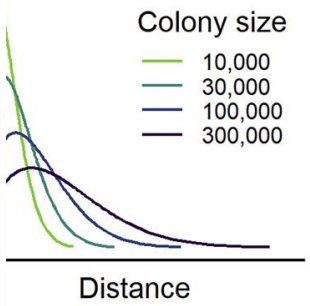


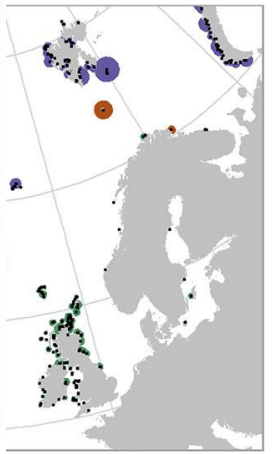
Patterson *et al*. 2022.
Current Biology 17: 3800-3807.e3

Penguin Movements









Deep

2022.
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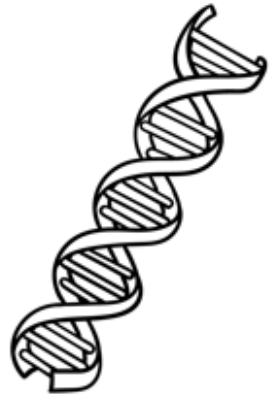
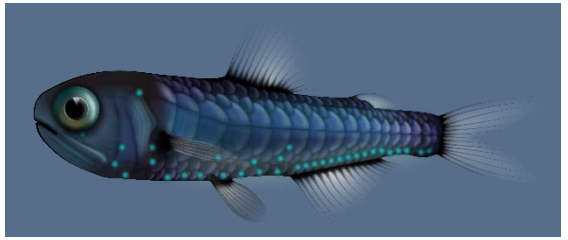
Penguin Diets



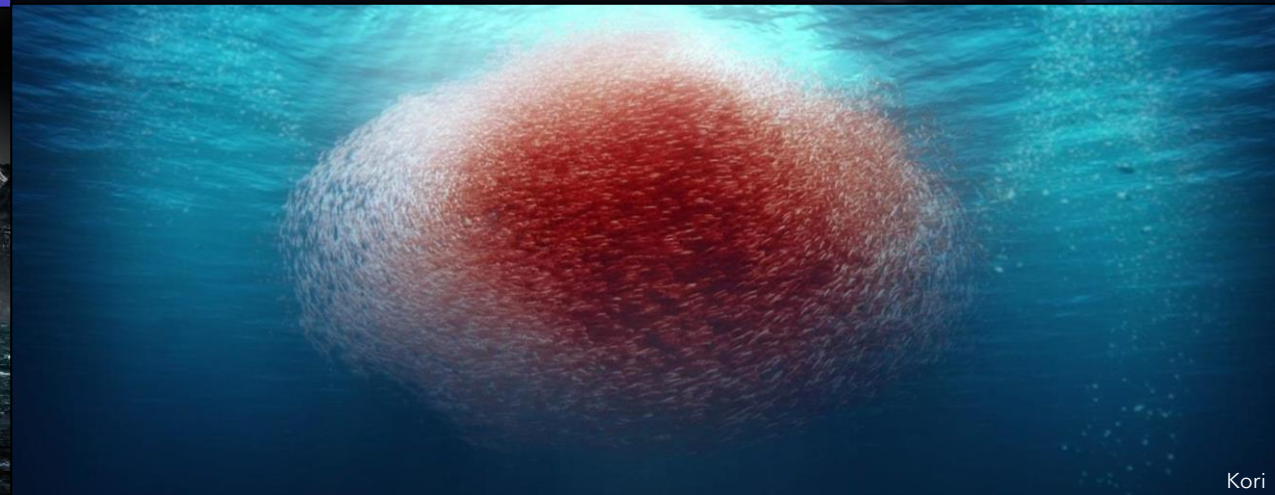


Cecilia Liszka

British Antarctic Survey


ESA


Sue G


Kori

Characterising pelagic biodiversity at South Georgia through novel sampling methods

Cecilia Liszka, Vicky Fowler, Geraint Tarling, Sophie Fielding, Ryan Saunders, Alison Cleary, Phil Hollyman, Maz Wootton, Mark Belchier Vicki Foster and others…

DARWIN INITIATIVE

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

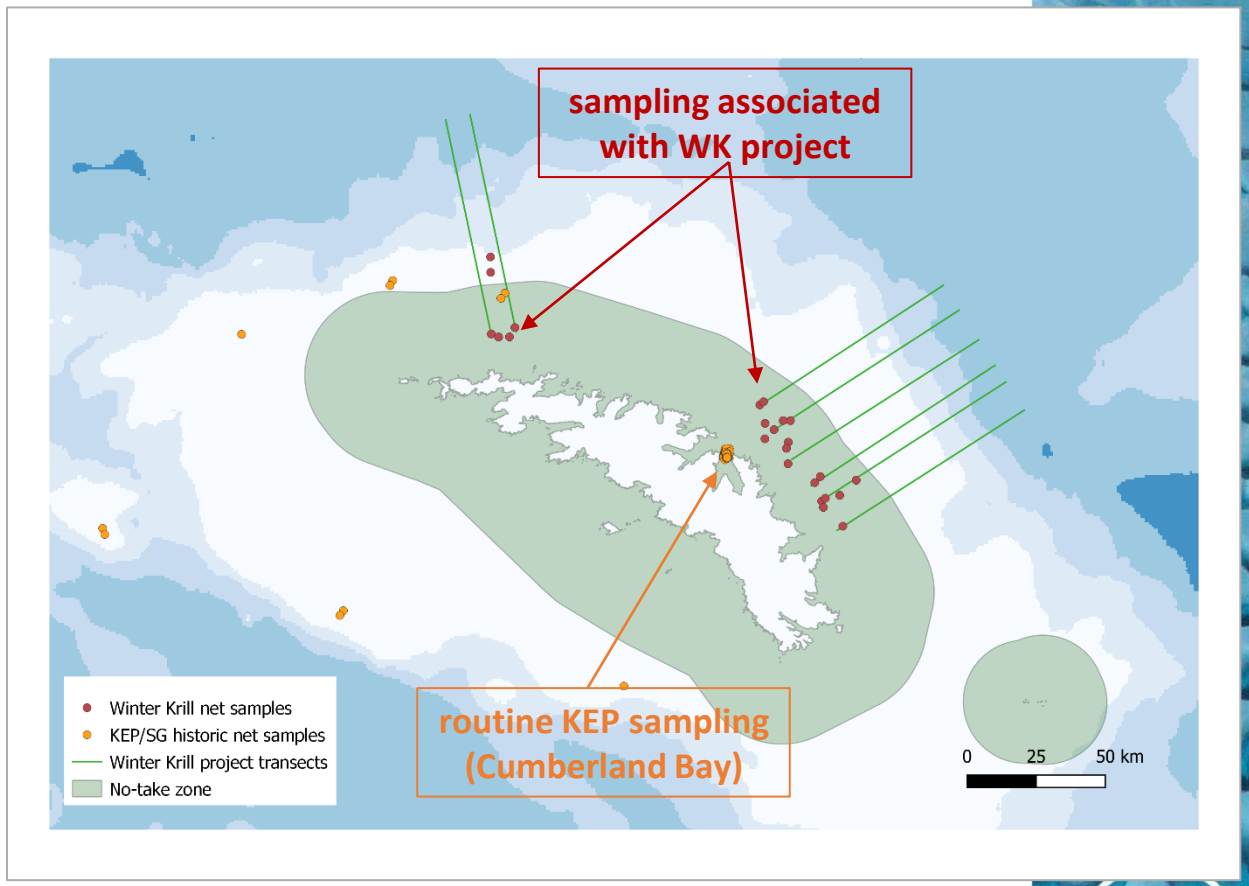
Marine Biological Association

Government of South Georgia & the South Sandwich Islands

Background

- Pelagic ecosystem supports fisheries & higher predators
- Baseline needed for monitoring & management
- Net samples exist - KEP & other sources
  - Only partially analysed – not zooplankton
  - Time consuming, costly, requires ships…
- Challenges: £, carbon, environmental change, invasive species…

→ Rationale for project – zooplankton baseline, new method development, build capacity



Net sampling

- Sampling mainly from MV *Pharos SG*
- RMT1 nets
  - routine KEP trawls (Cumberland Bay) + Winter Krill transects
  - 610 µm cod-end mesh, 1 m^2 mouth area
  - top 20-25 m
- miniBongo
  - additional for this project
  - 53 µm mesh, 0.8 m mouth diameter, 2.3 m long

➢ Image analysis (all samples)

➢ Detailed microscopy by MBA (selected samples)

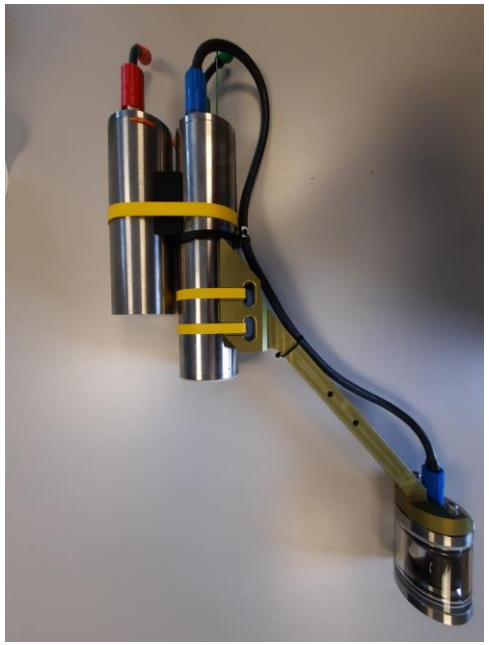
➢ ID of ‘voucher specimens’ by MBA for imaging

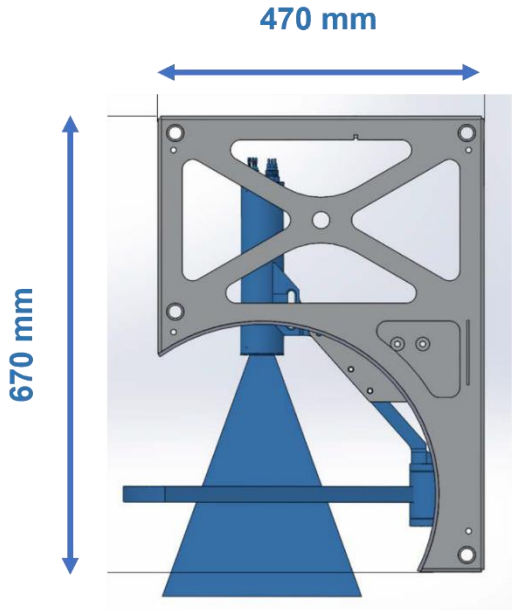
Optical profiling – UVP6 HF

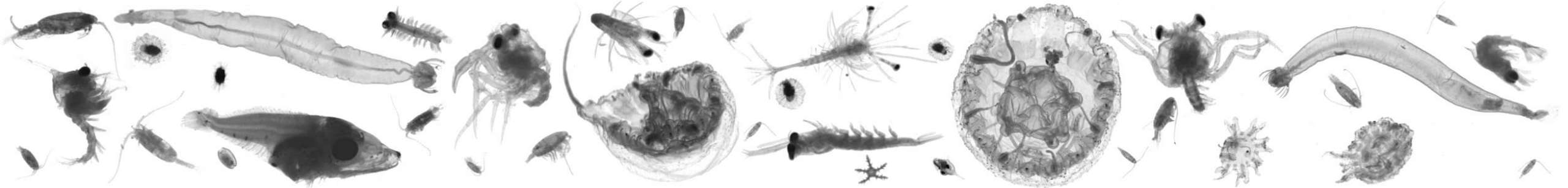
- Underwater Vision Profiler – new for this project
- Standalone deployment from Pharos
- Profiles to ~10 m above bottom

➢Image analysis via Ecotaxa software e.g., size spectra

➢ML/AI opportunities?







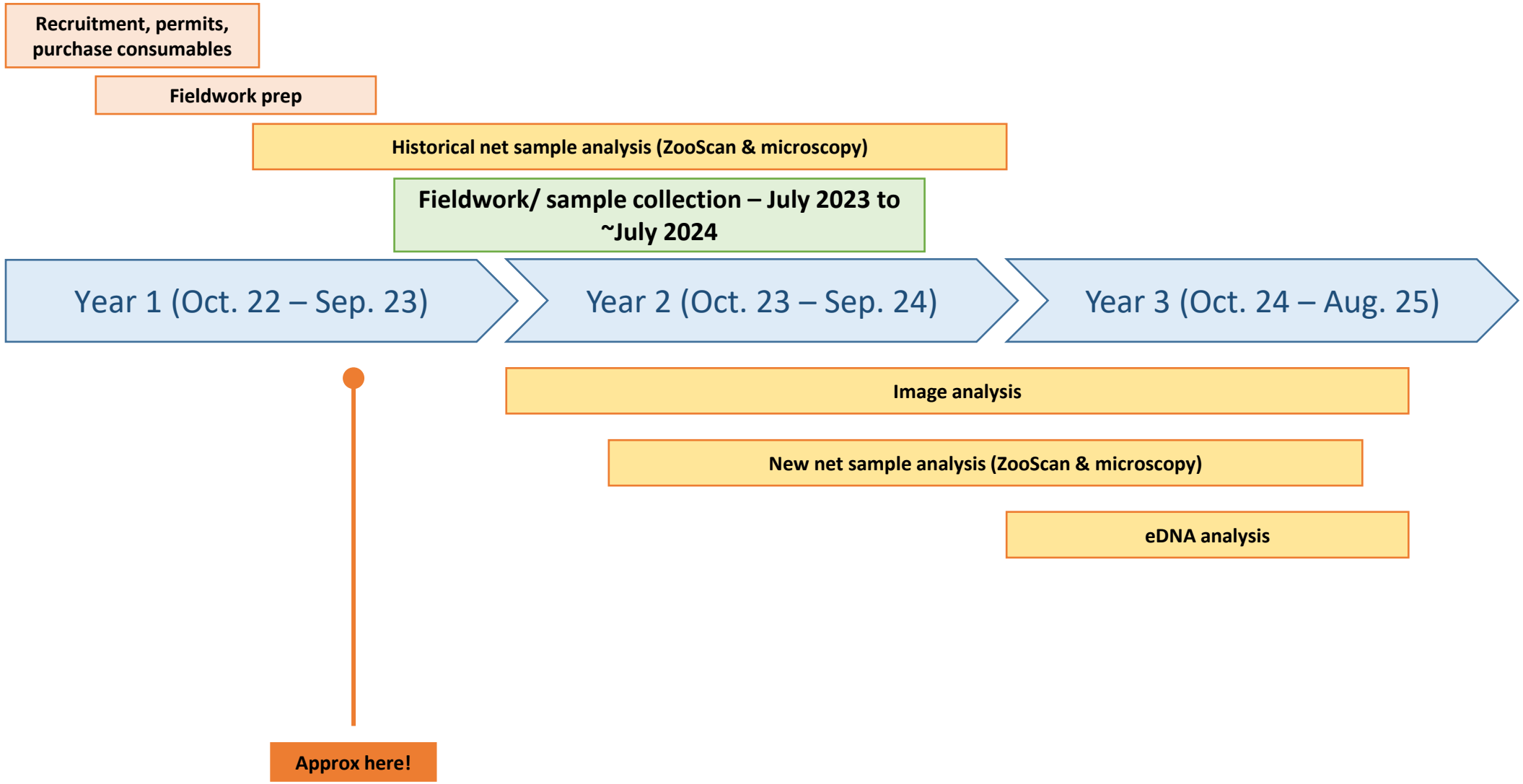
eDNA

- Water samples (~5 L) – 2 depths per station
  - 20-25 m
  - 100 m
- Filtered & frozen on board (0.2 µm, ø 25 mm Whatman filters, -20 °C)
- Transfer to -80 °C at KEP

➢ DNA metabarcoding (18S, COI…) & bioinformatics

➢ Species ID using existing reference databases

Fieldwork & analysis timeline



Further information

https://www.bas.ac.uk/project/south-georgia-pelagic-biodiversity/

Contact:

Cecilia ceclis56@bas.ac.uk or Vicky vicwle19@bas.ac.uk

William Reid

Newcastle University


ESA


Sue G


Pete Lens

Improving identification of fish bycatch in the Antarctic krill fishery

William D K Reid, Philip R Hollyman, Will Goodall-Copestake, James Moir Clark, M Lorena Romero-Martinez, Martin A Collins and Susan Gregory

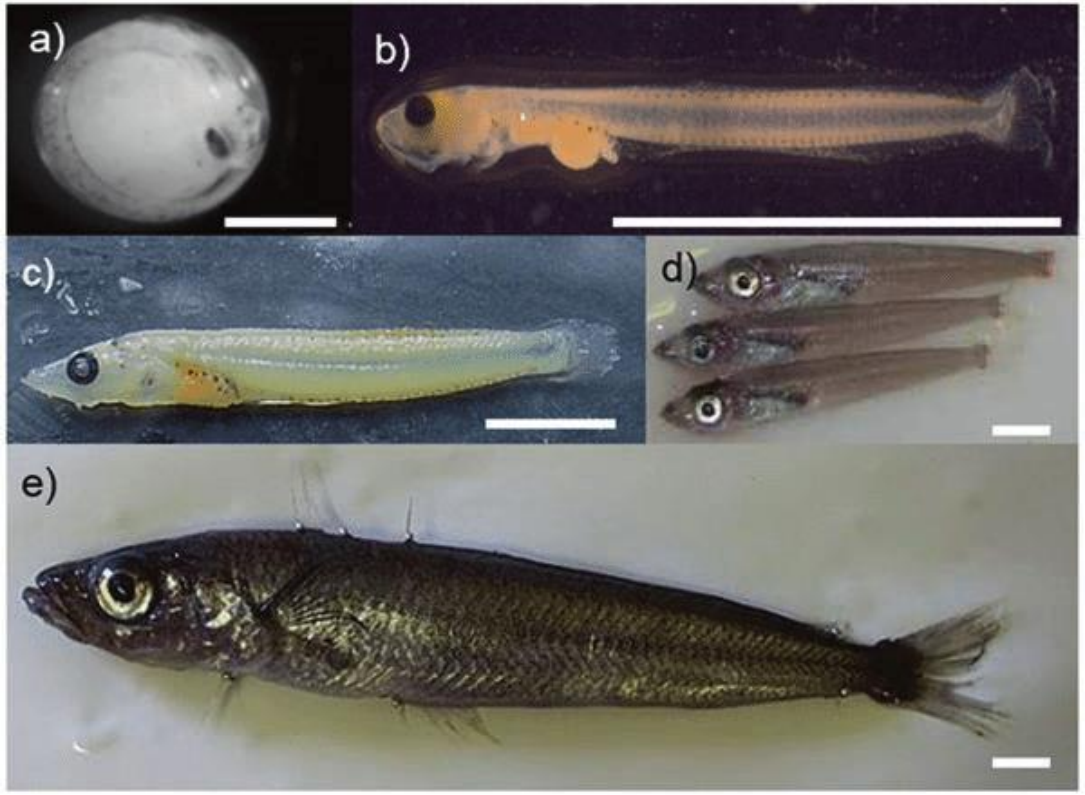
Where, when and which fish are caught

Project aims to identify which life stages are caught by the fishery using:

(1) morphological and molecular identification of by-catch

(2) review current information on specific life history traits and model spatial and temporal by-catch

(3) production of identification and training tools for international fisheries observers.

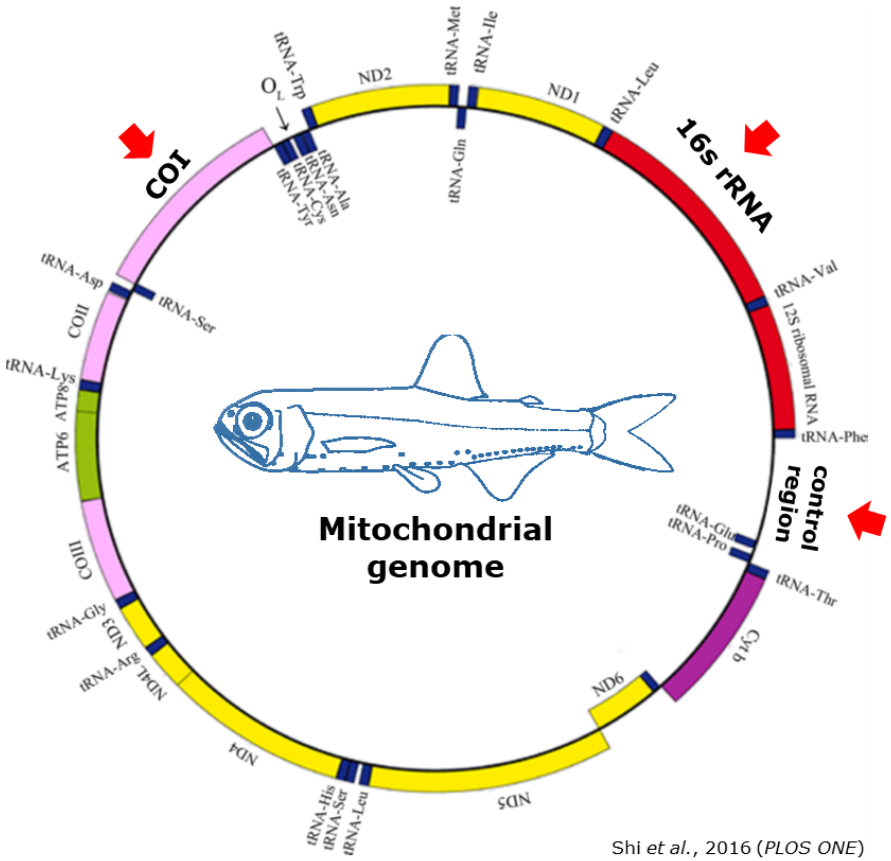


Pleuragramma antarcticum

(Tavernier & Giraldo 2017 10.1007/978-3-319-55893-6_6)

Which fish are caught

- Integrative taxonomic methods by pairing molecular and morphological data.
- ~1000 samples will be examined
- Samples being provided by fisheries observers and BAS archives.
- Sampled fish will be photographed
- ~30 species have where DNA has been extracted



Shi *et al.*, 2016 (*PLOS ONE*)

When and where are fish caught

Systematic literature search of life history strategies and events

Hatching times

Egg duration/ dispersal

Larval duration

Larval growth rate

→ Understand development and life history stage in space and time

Spatio-temporal modelling of fish bycatch

CCAMLR bycatch data

BAS historical sampling

KEP fish larvae sampling

+ season, depth, gear, position, time of day

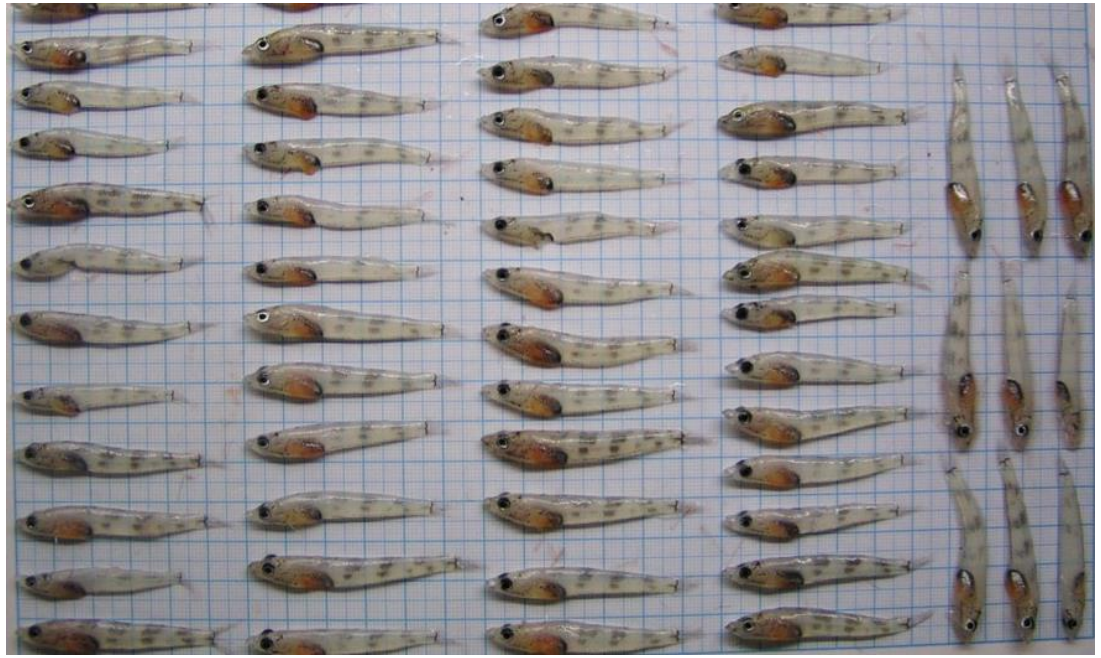
→ Understand potential bycatch in space and time

→ Understand interaction with fisheries in space & time

British Antarctic Survey NATURAL ENVIRONMENT RESEARCH COUNCIL
Newcastle University
Royal Botanic Garden Edinburgh
MRAG
DARWIN PLUS

Improving by-catch identification

- Production of multi-life history stage ID guides for krill observers.
- Development of new training materials for krill observers.



Acknowledgements

- Darwin Plus for funding the research (DPLUS166)
- AKER Biomarine and Fujian Zhengguan Fishery Development Co., Ltd
- Fisheries observers for collecting samples

Rachel Cavanagh

British Antarctic Survey


ESA


Sue G


Katie Brigden

Evaluating climate change risks to Patagonian and Antarctic toothfish

DARWIN PLUS

Cefas

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

- Climate change is altering marine ecosystems and fisheries
- Climate change effects on toothfish are largely unknown

- Synthesise relevant environmental, biological and fishery information
- Undertake risk assessment of climate change to toothfish in SGSSI
- Recommendations for management

Knowledgebase and approach will be applicable to other species and areas, addressing the challenge of integrating climate change into fisheries management and MPA design more widely

- June 2023-2025
- Project kick-off workshop 15th June, BAS

Project Team

BAS: Otis Brunner, Rachel Cavanagh, Martin Collins, Jen Freer, Simeon Hill Phil Hollyman, Helen Peat, Sally Thorpe, Claire Waluda, Mari Whitelaw

Cefas: Oli Hogg, Marta Soeffker

GSGSSI: Mark Belchier, Sue Gregory

Many others from BAS and Cefas will be involved

Stakeholders include South Georgia toothfish operators, Marine Stewardship Council, WWF, Antarctic & Southern Ocean Coalition (ASOC)

Outputs will inform the SGSSI Toothfish Fishery Management Plan and MPA Plan, and feed into CCAMLR particularly via Working Group on Fish Stock Assessment

Please get in touch if interested: rcav@bas.ac.uk

Lisa Readdy

Centre for Environment, Fisheries and Aquaculture Science


ESA


Sue G


Katie Brigden

South Georgia and South Sandwich Islands Patagonian toothfish population

Alternative assessment methods

Lisa Readdy

Together we are working for
a sustainable blue future

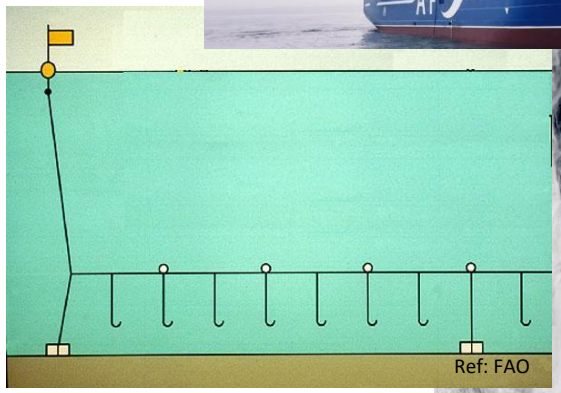
Centre for Environment Fisheries & Aquaculture Science

Cefas

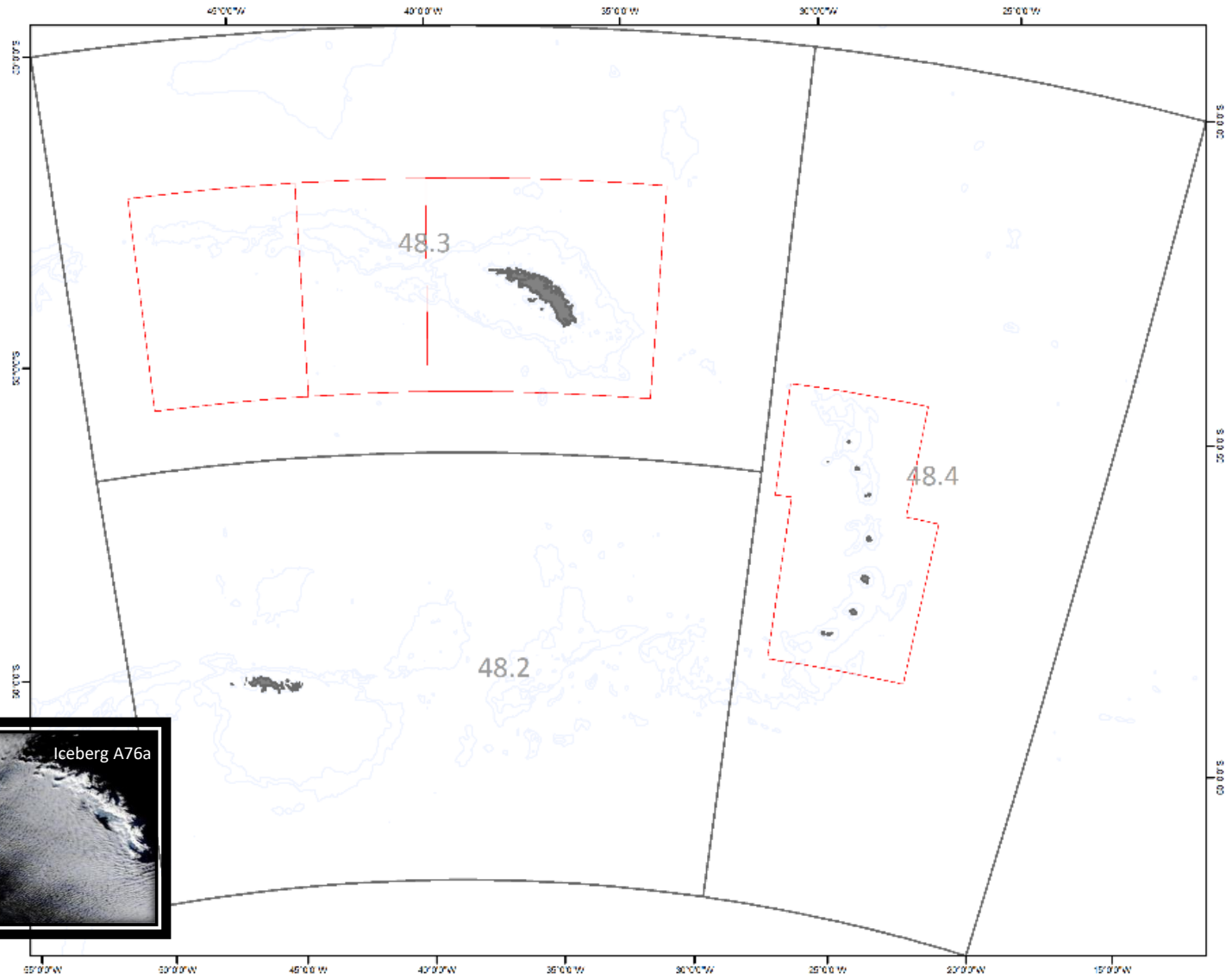
University of York

Background

Anthropogenic induced changes and activities



Natural biological and ecosystem fluctuations

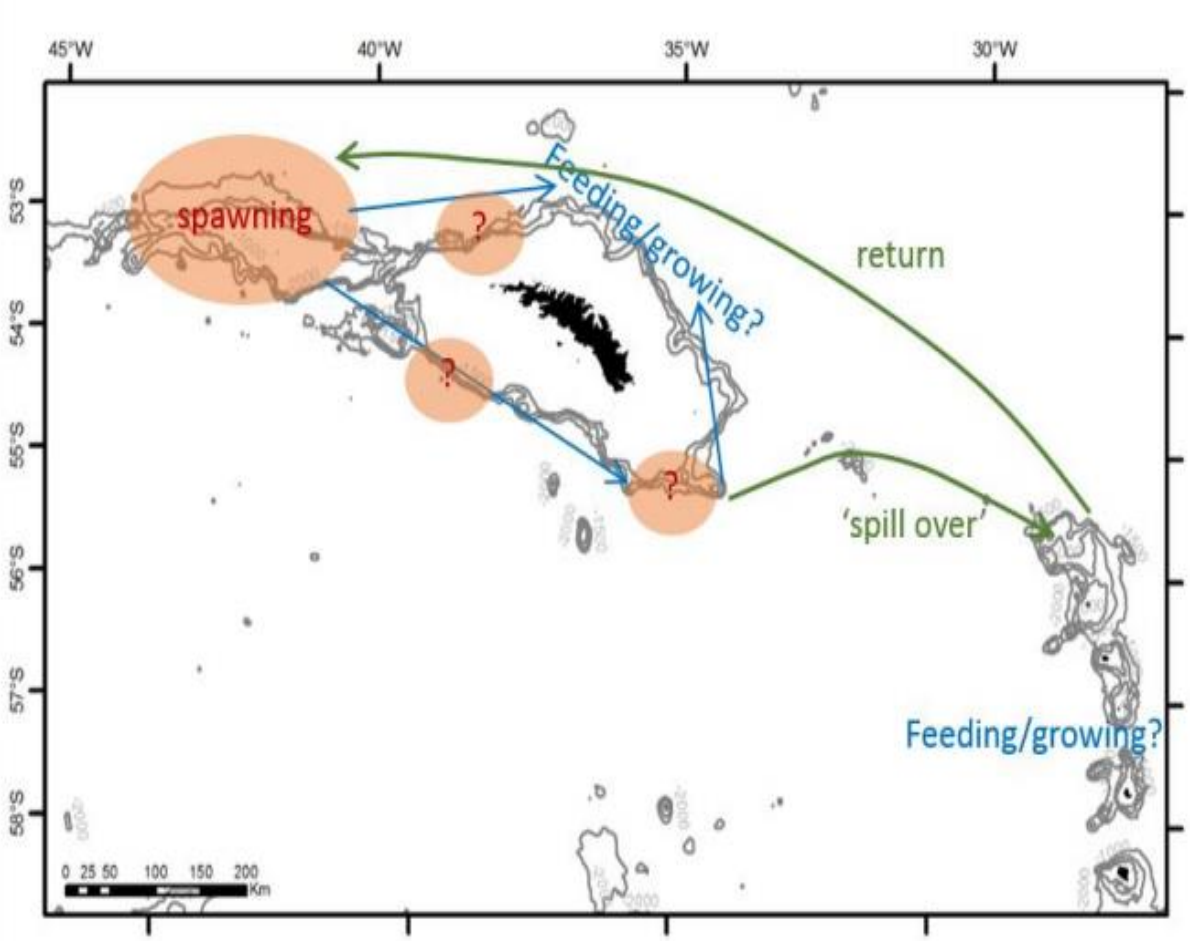


Centre for Environment Fisheries & Aquaculture Science

Cefas

Stock hypothesis

- Genetics suggest one stock
  - 48.4 as overspill for 48.3
  - Tag recaptures show movement across 48.3 and 48.4.
- Ontogenetic movement
  - As fish grow/age they move into deeper water further offshore.
- Some spawning observed around Shag Rocks
  - Females in spawning condition and smallest fish observed here.



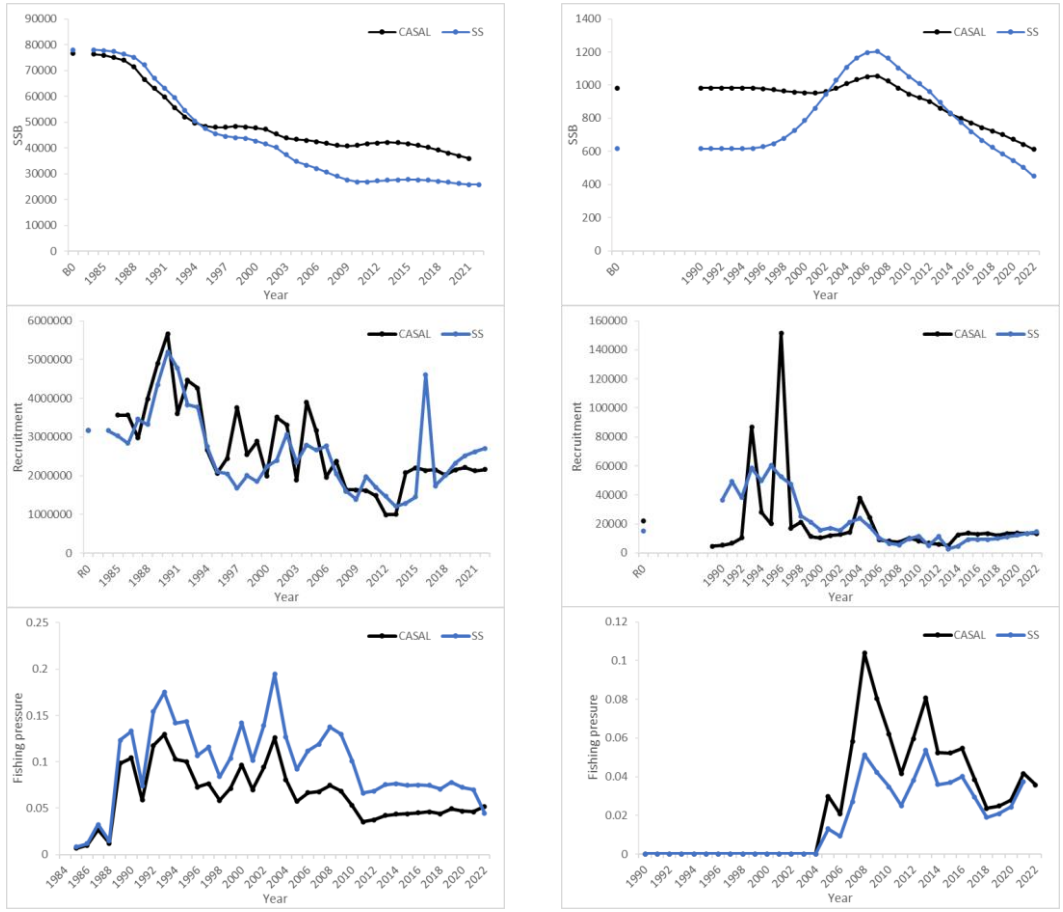
Integrated populations models

The data:

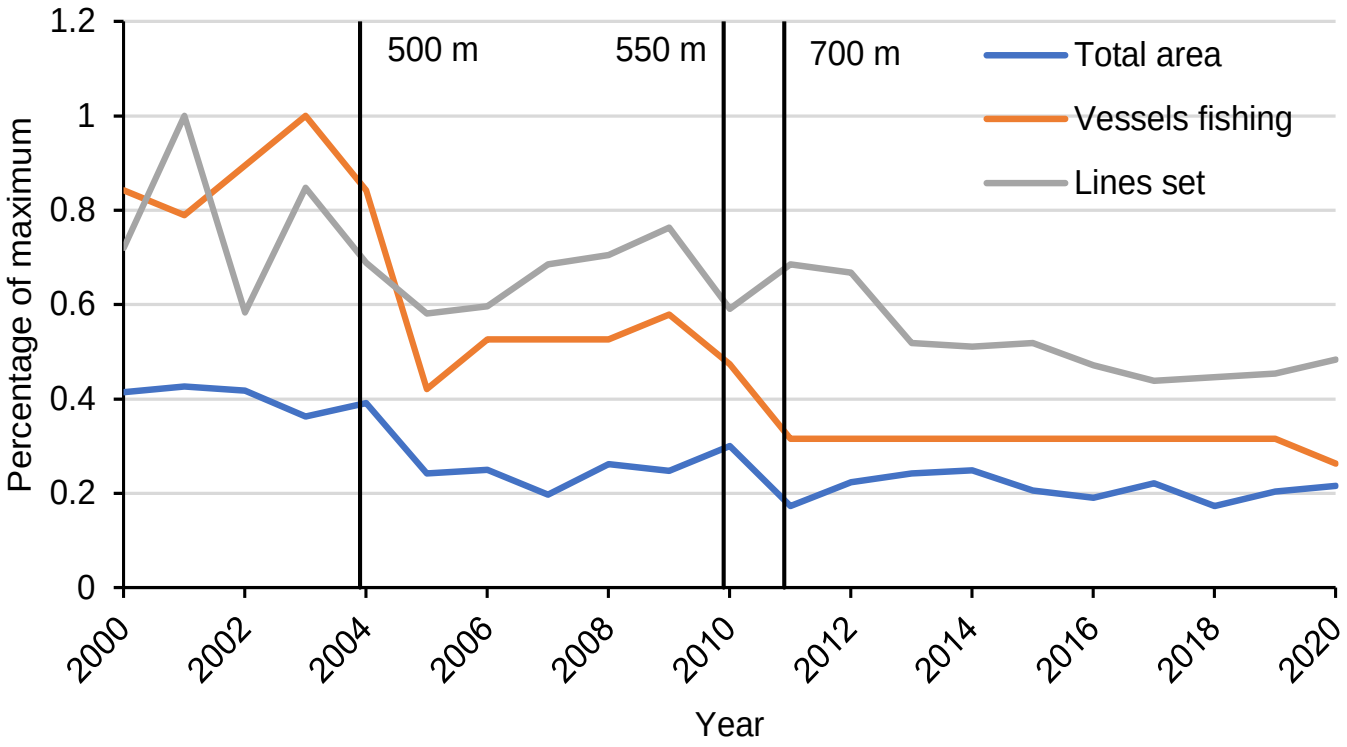
- Catch
- Catch age and length compositions
- Catch per unit of effort (CPUE)
- Survey data
  - Survey length compositions
- Tag release and recaptures
  - Length compositions

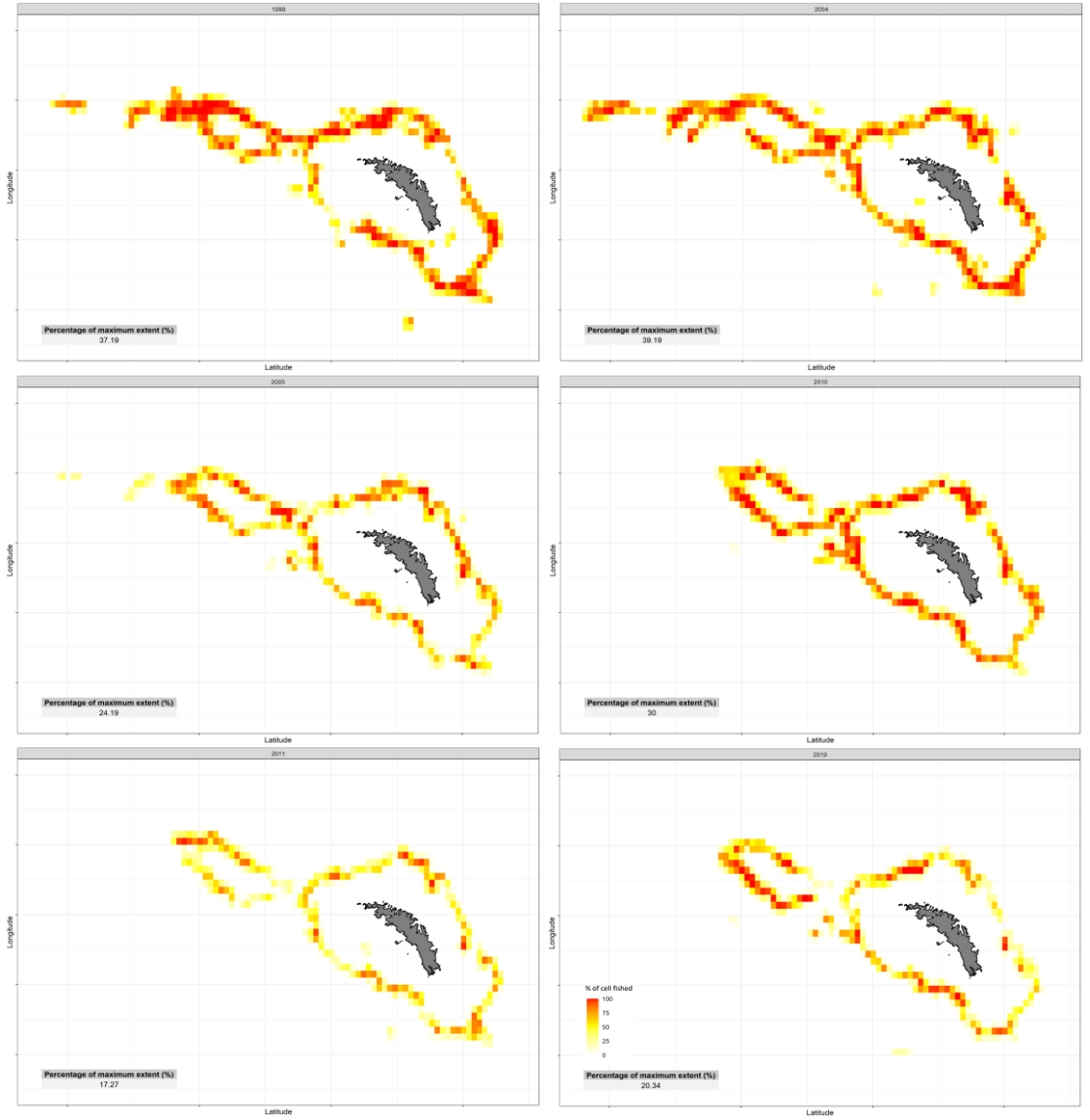
The assumptions:

- Mortality
  - Natural
  - Fishery induced
- Growth
- Stock and recruit
- Maturity
- Length-weight
- Gear selectivity



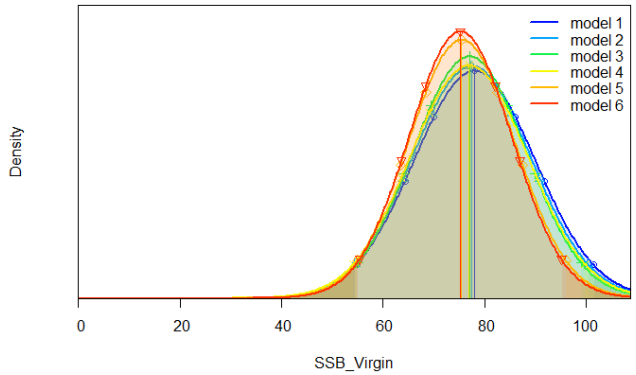
Fishery dynamics

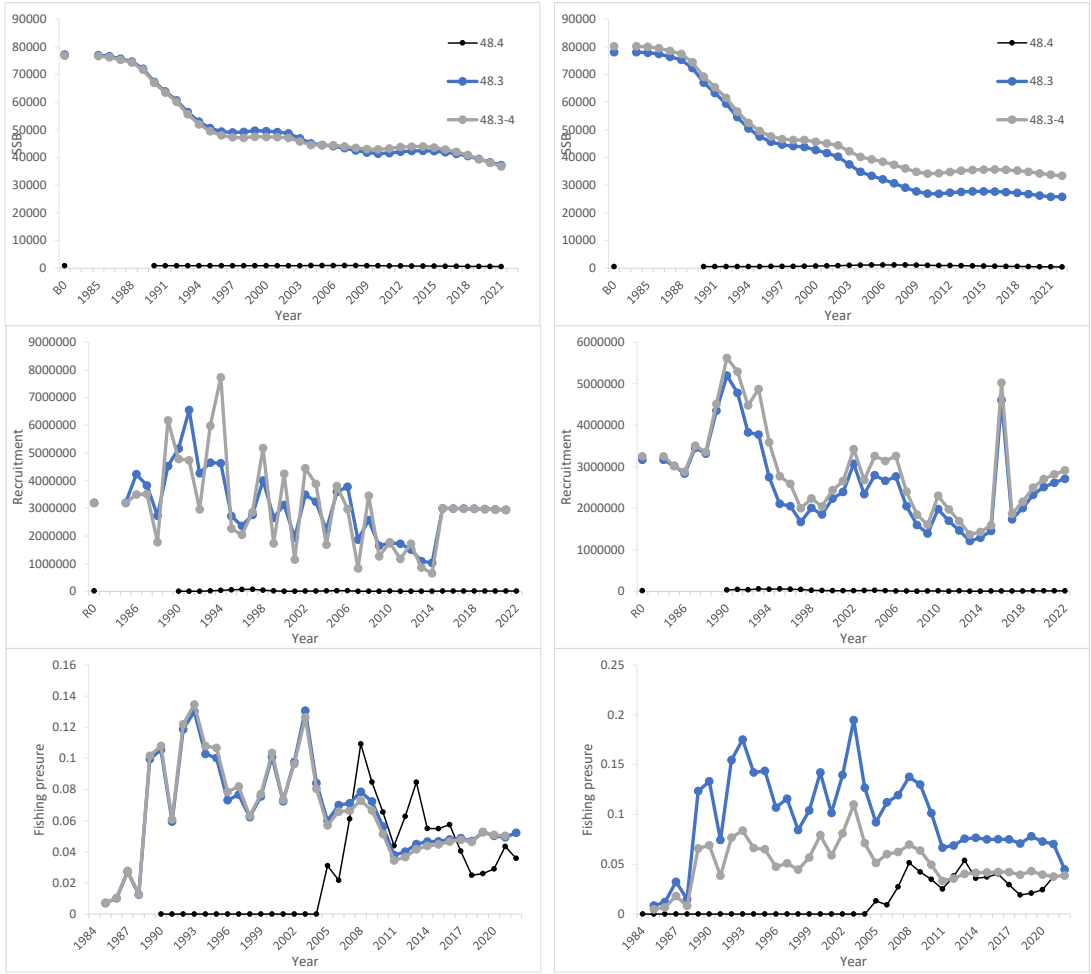




Next steps

- Spatial resolution
  - Migration.
  - Ontogenetic movement.
  - Mixing of population size and age structure.
  - Spatial coverage of fishery
  - Introduction of closed areas
- Temporal change
  - Fishery dynamic
    - Change in fishery coverage
    - Introduction of closed areas
  - Environmental drivers on population life histories.





Paul Brickle

South Atlantic Environmental Research Institute

Improving risk understanding and protocols for inspection of vessels to mitigate the spread of marine non-native species to South Georgia & South Sandwich Islands

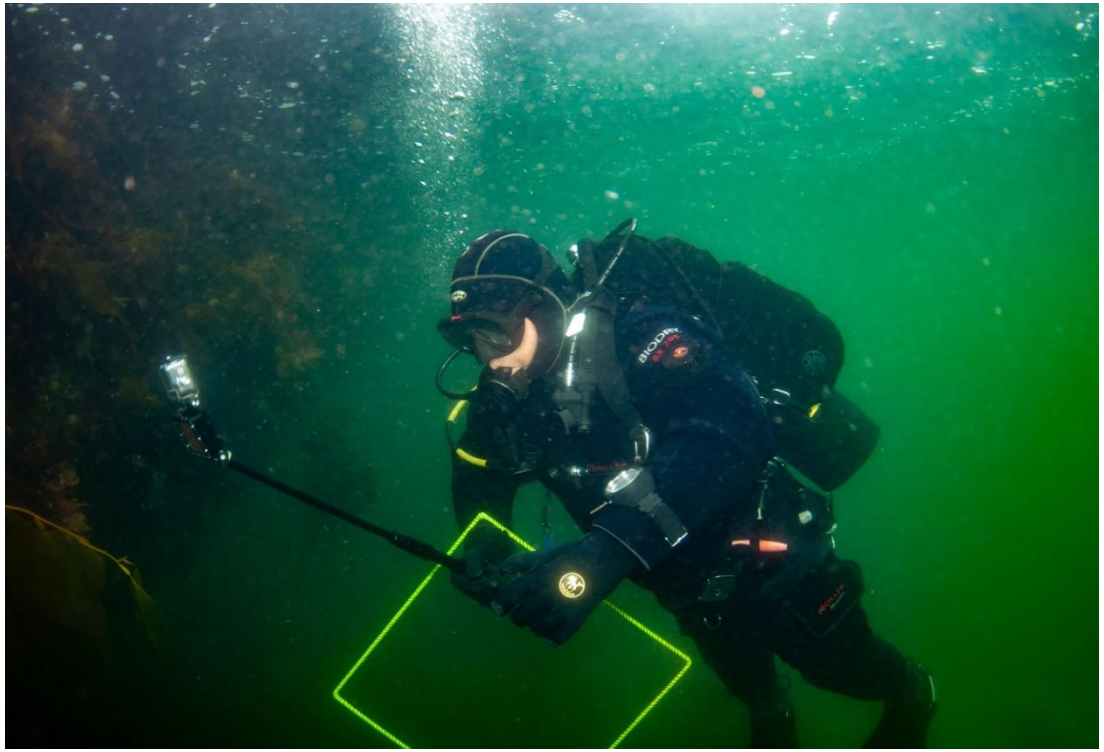
Paul Brickle

Background

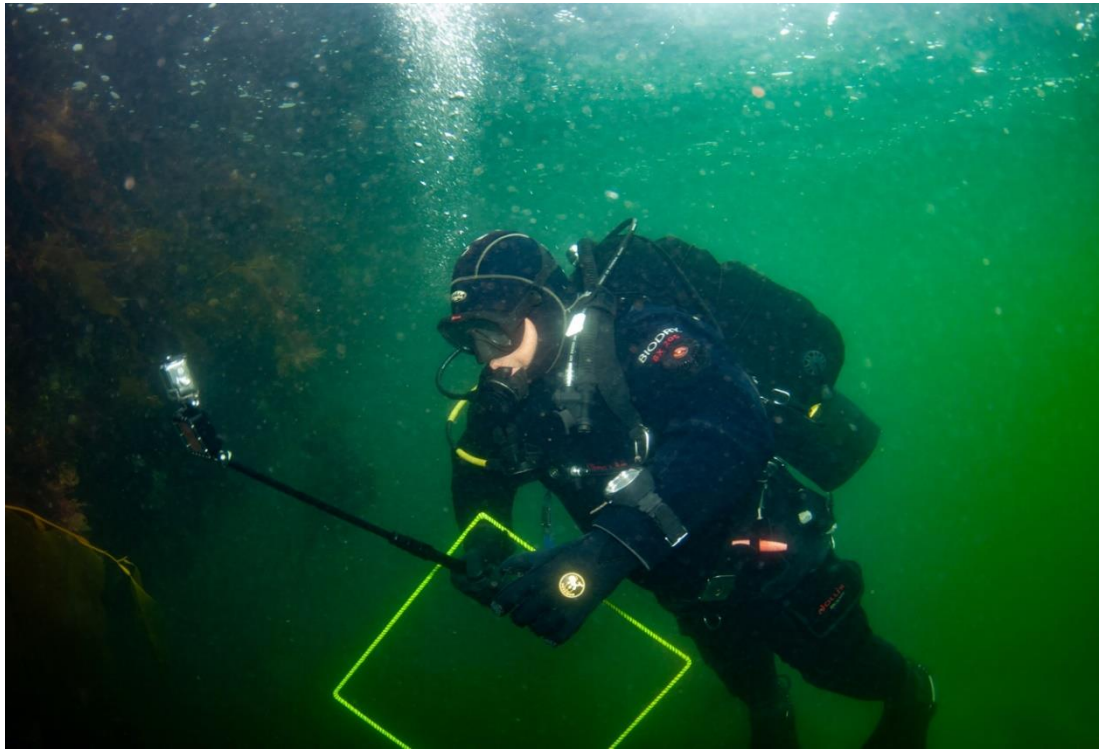
- This is a follow on study from the GSGSSI funded “Safeguarding South Georgia’s Blue Belt: Marine Invasives Mitigation”
- The study analysed the threat from marine invasive species introduced through vessel traffic (AIS) to South Georgia and the South Sandwich Islands, focusing on hull biofouling
- The vessel types identified as being ‘high risk’ and in need of priority monitoring and management included (in order of importance): passenger vessels, fishing vessels, survey / military vessels, and yachts
- They also typically originate from a range of international ports
- Highest risk location identified was King Edward Point (KEP) / Grytviken
- KEP also links out to 20 other ports/anchorages (i.e. next port of call), and is therefore an important dispersion hub for any potential invasives
- This project made a number of recommendations that are being taken forward with the current project

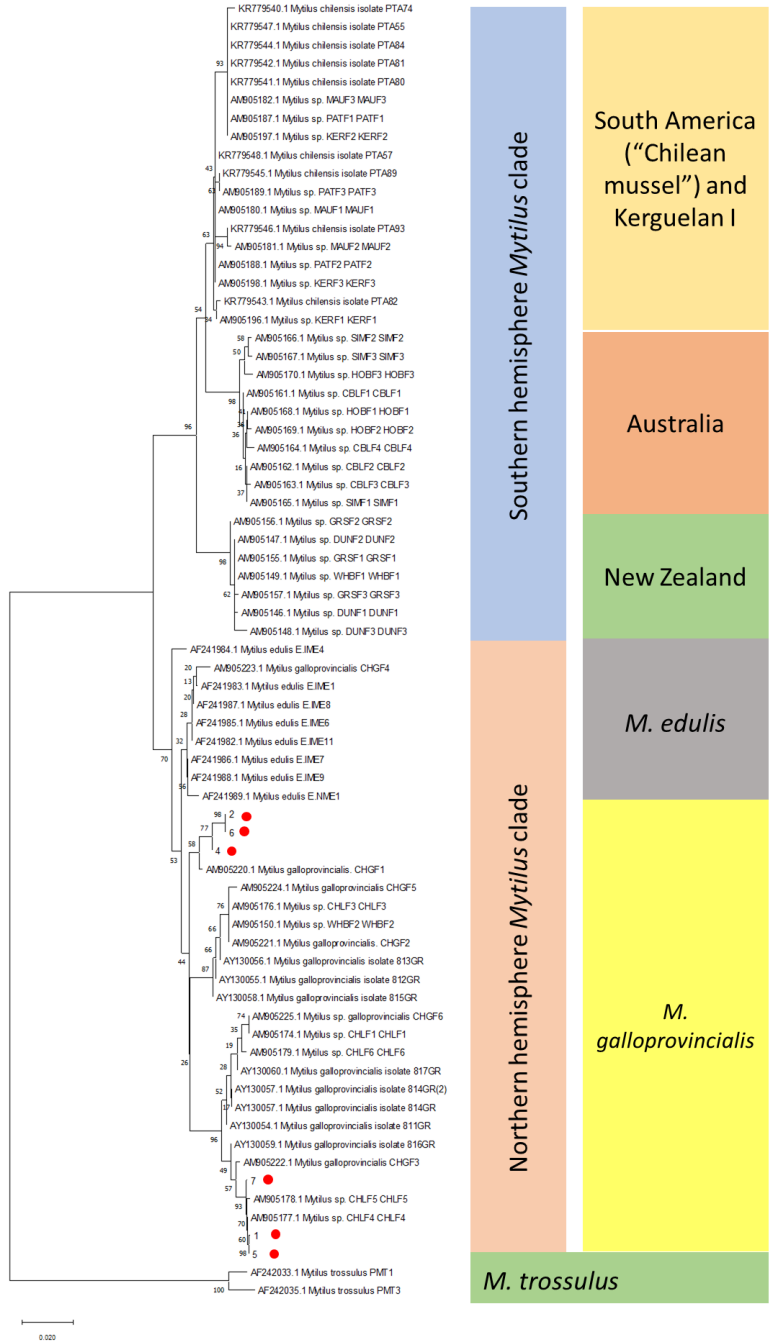
Improving risk understanding

- Underpinning of biosecurity surveillance of ships and yachts entering FI/SG or transiting between, using an ROV / divers for hull inspection, and DNA barcoding for species ID

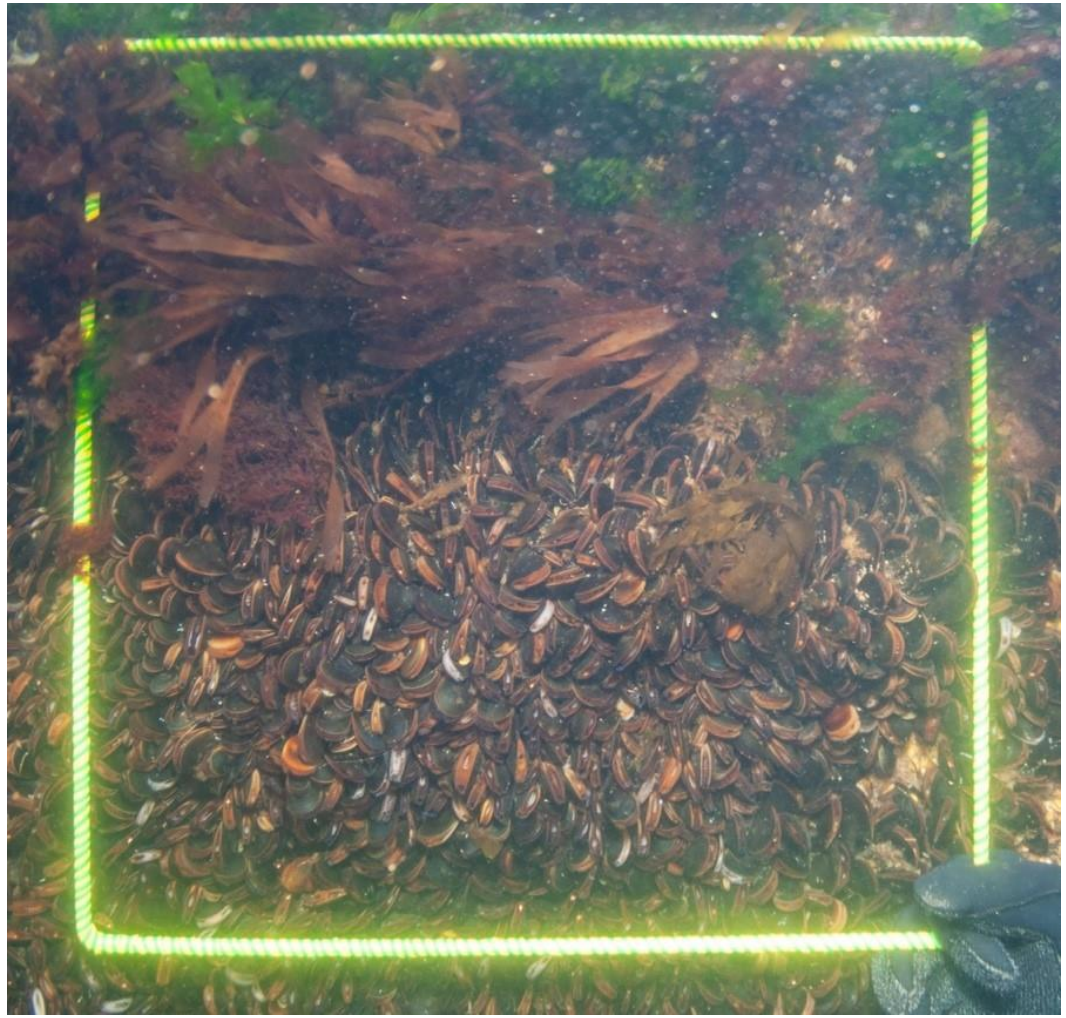


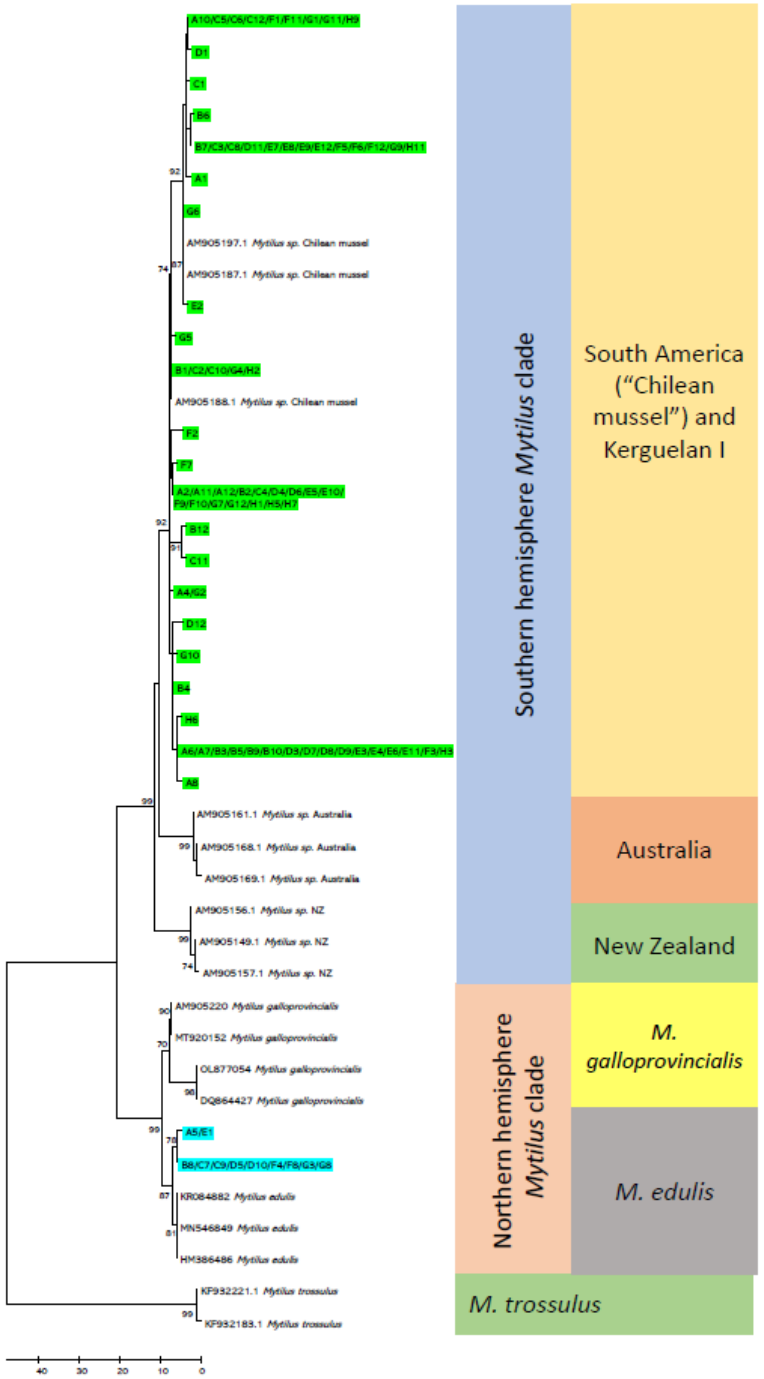
Improving risk understanding



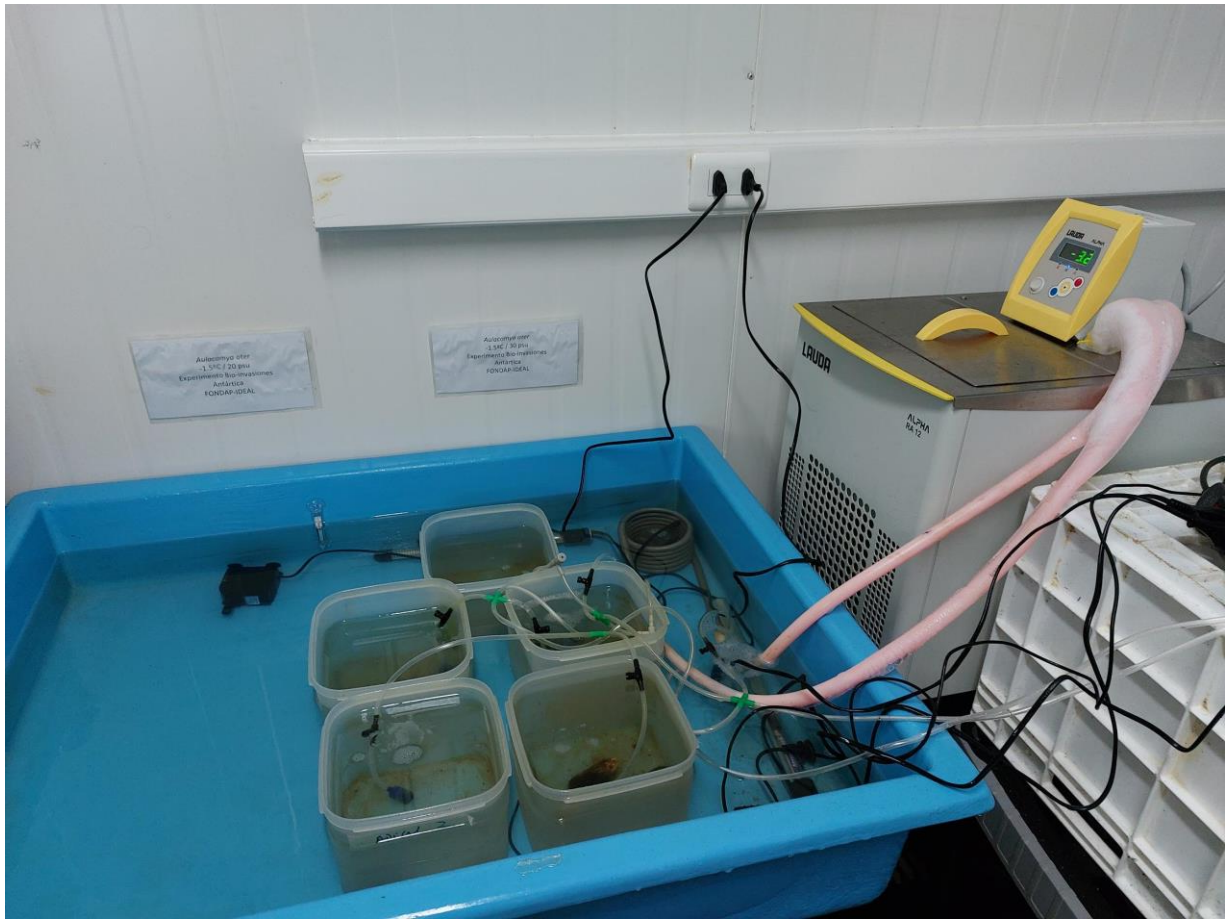


Improving risk understanding





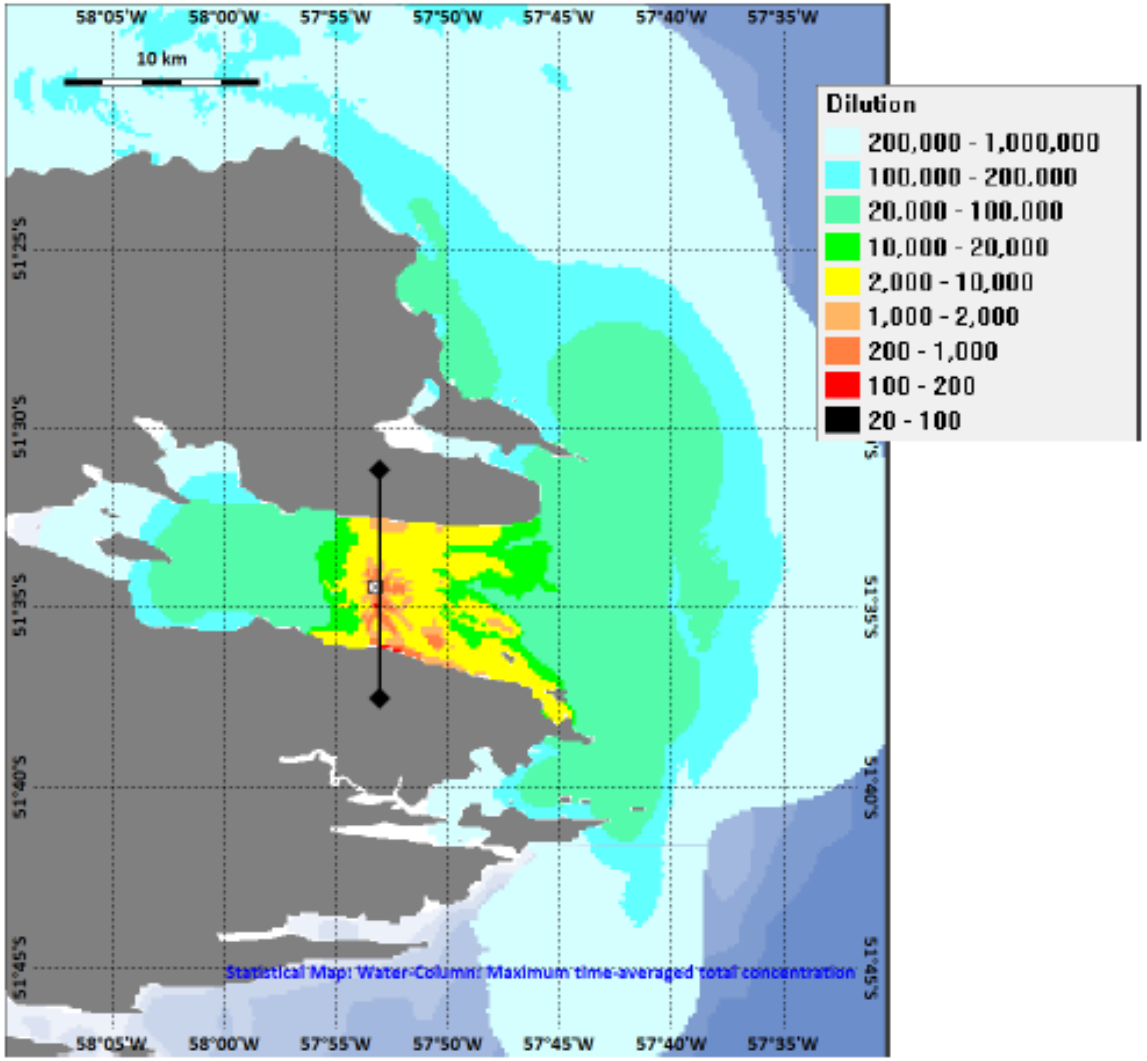
Assessment of the risk of identified ‘problematic species’ - physiology



Hull Cleaning and Ballast water

- Review what fleets do about hull cleaning and the periodicity of this during normal operations (e.g. dry docking). In addition, review standards for pre-boarder clean hull certification elsewhere in the world
- Ballast water logbooks will also be inspected, in order to ascertain volumes and diversity of organisms potentially being transferred, and to identify level of maintenance being undertaken by each vessel type.

Hull Cleaning and Ballast water

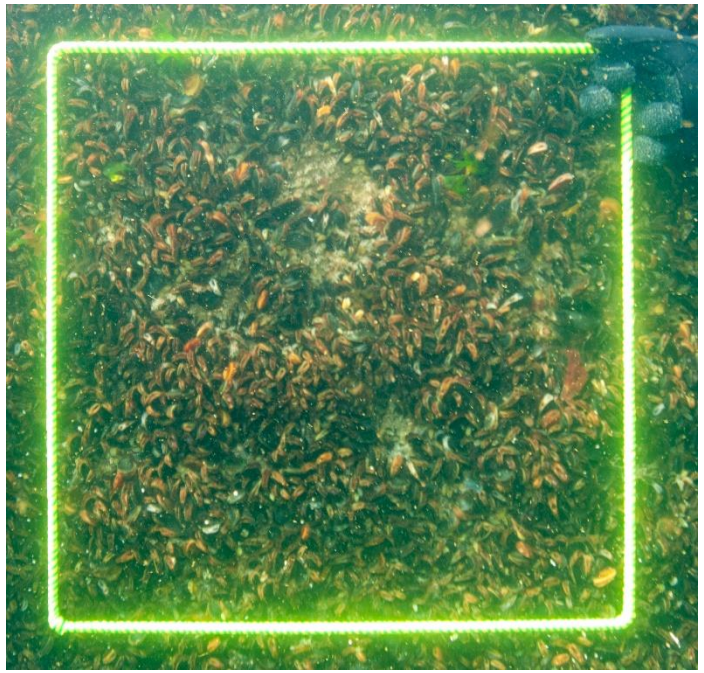


Workshops, education and outreach

- Though a workshop, examine the utility and practicality pre-boarder biosecurity protocols and pre-boarder clean hull certification or assurances.
- Increase awareness of marine non-native marine species and the potential risk they present for SG through outreach and educational materials.

Workshops, education and outreach

Risky invasives already in the Falkland Islands



Acknowledgements

Blue Belt Programme

UK Government

British Antarctic Survey

Stephanie Martin

British Antarctic Survey

Hungry Humpback Darwin Plus Project

DARWIN INITIATIVE

friends of South Georgia ISLAND SGHT

British Antarctic Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

This project measures how whale foraging intensity varies across the feeding season in SG, using UAV-based measurements of body condition and satellite-tracking of diving rates to measure season-specific krill consumption.

Susannah Calderan

Scottish Association for Marine Science

Acoustic monitoring of whales and vessels in Cumberland Bay South Georgia

Susannah Calderan, Denise Risch, Russell Leaper, Jen Jackson

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

friends of South Georgia ISLAND

South Georgia HERITAGE TRUST

DARWIN INITIATIVE

SAMS Scottish Association for Marine Science

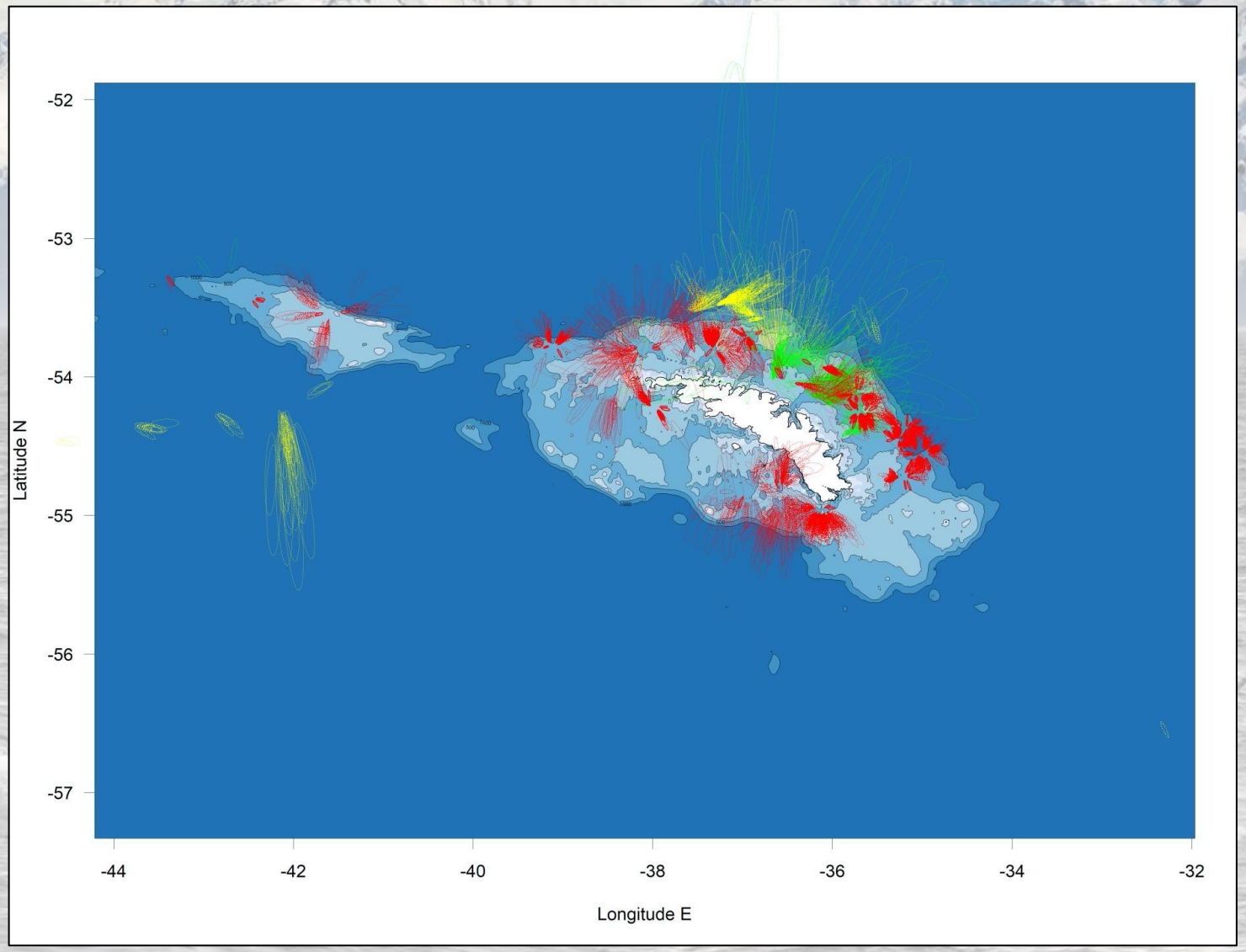
UK Government

Photo: Amy Kennedy

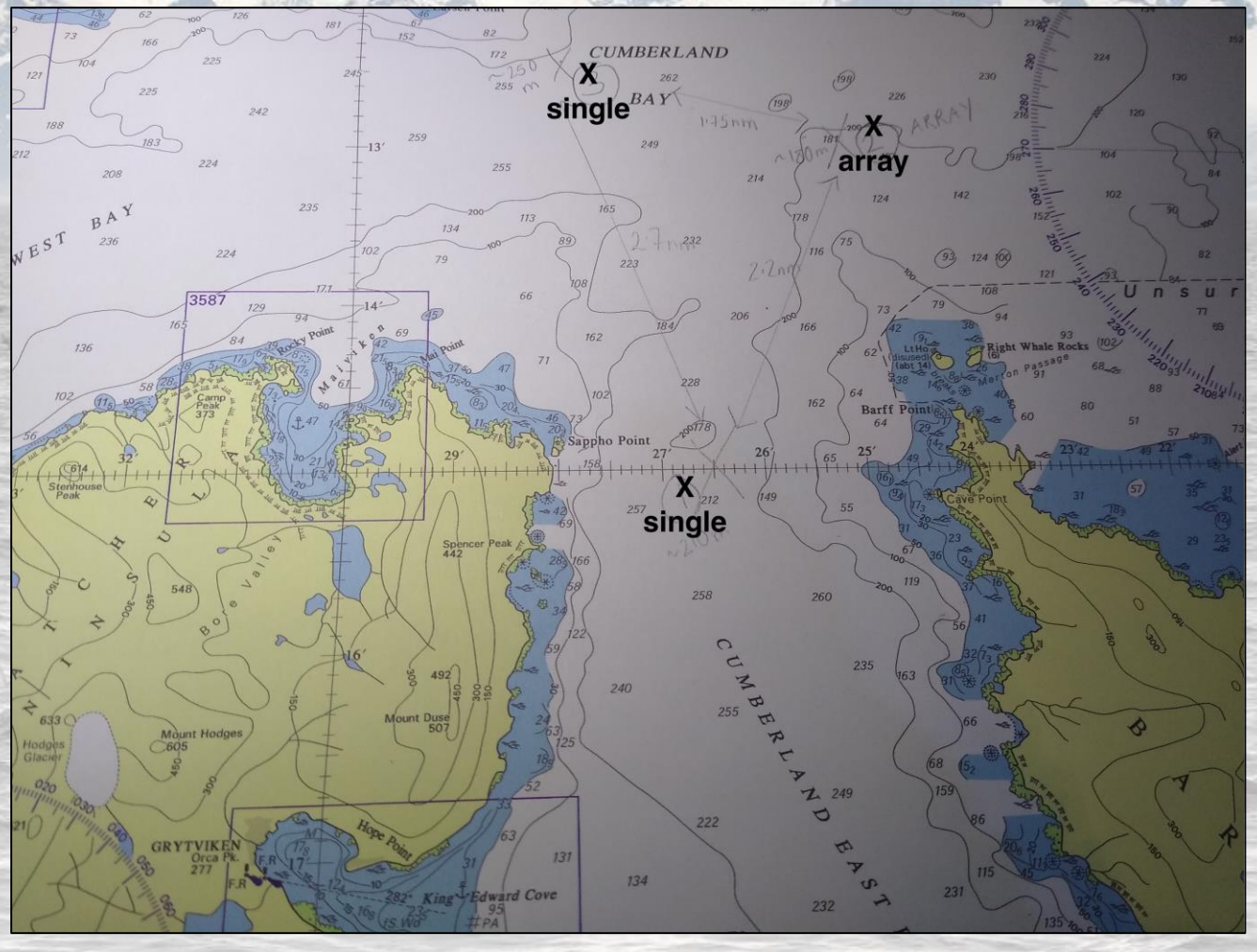
Cumberland Bay Acoustic Mooring (CAM) project

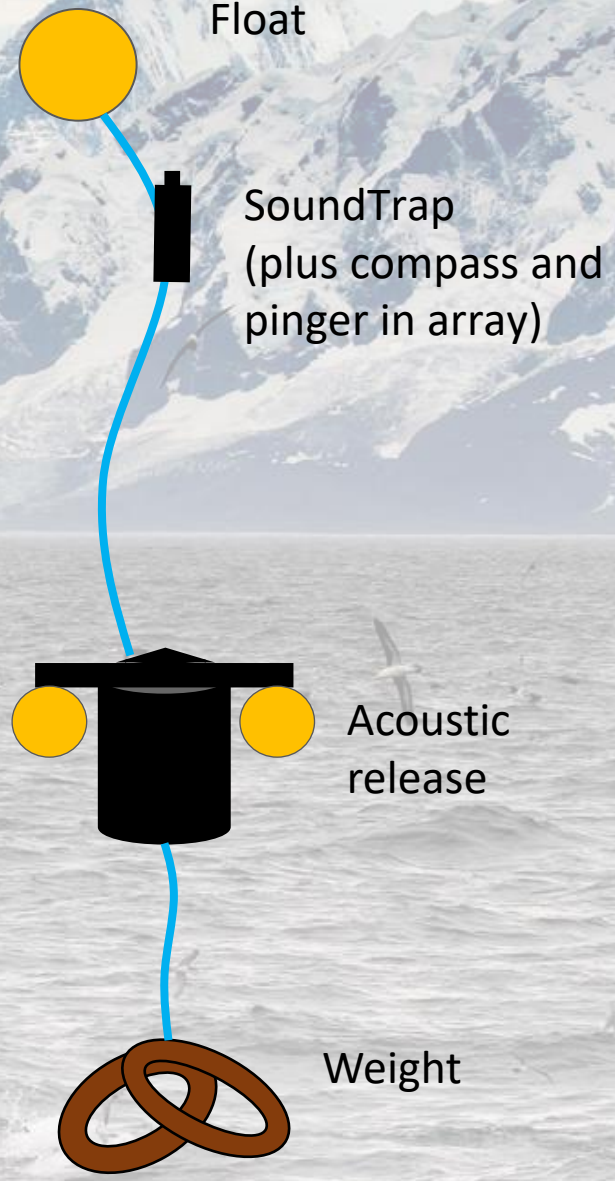
- Both whales and ships can be acoustically monitored year-round using moored passive acoustic monitoring systems
- Broadscale distribution of whales through the season which can be compared with sightings data from vessels
- Assessments of ambient noise levels and individual vessel measurements in an area of concentrated shipping traffic
- Will assist GSGSSI to monitor changes and minimise impacts on whales from shipping traffic

Blue whale D-call detections 2017-2020 (austral summer)



- 3 underwater moorings with broadband recorders (SoundTraps)
- 2 moorings: single SoundTrap units
- Third mooring: 3 SoundTrap units in an array
- Will enable localisation of calling whales and species ID





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