

Government of South Georgia & the South Sandwich Islands

Marine Protected Area 5-Year Review Science Symposium



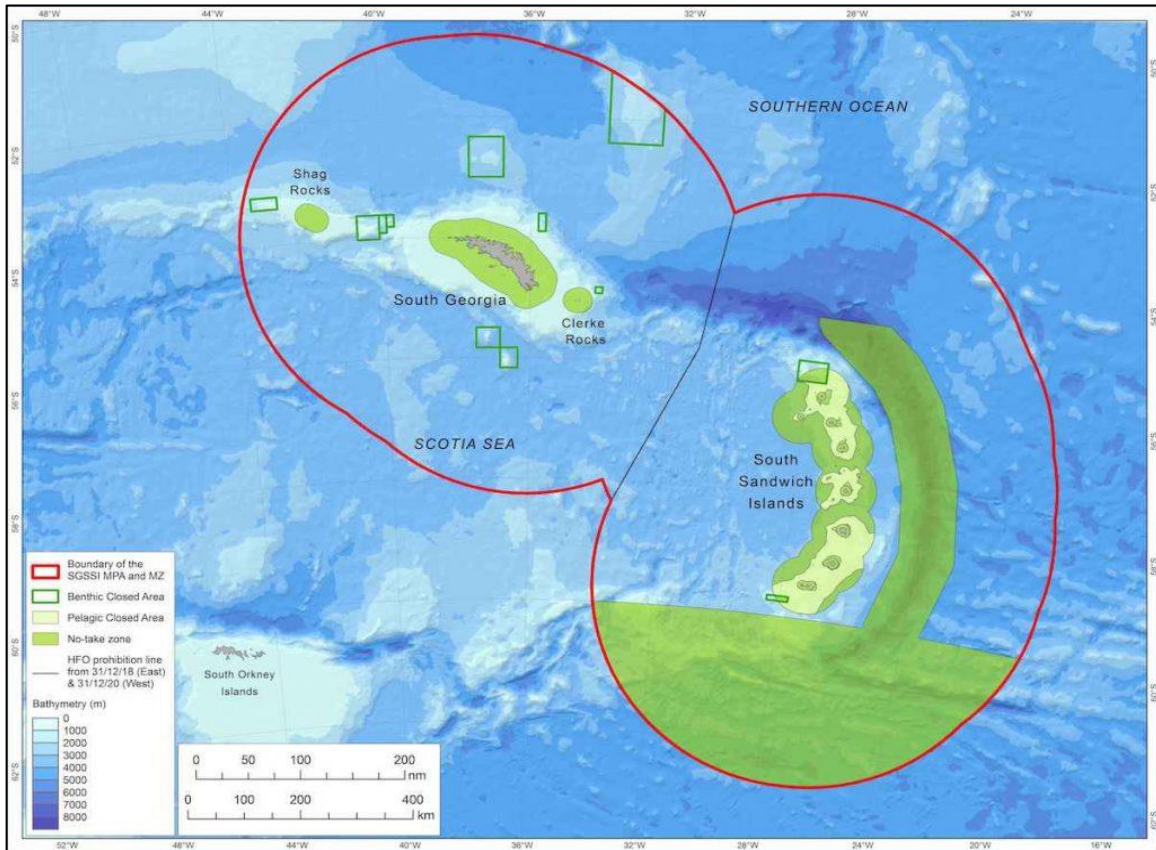
**Aurora Innovation Centre
British Antarctic Survey
Cambridge, UK**

13th – 14th June 2023



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This symposium has been funded by the [UK Government Blue Belt Programme](#) and we thank them for their ongoing support of marine management at South Georgia & the South Sandwich Islands.

Foreword



A very warm welcome to the South Georgia & the South Sandwich Islands MPA 5-Year Review Science Symposium. We are delighted that you can join us for what should be a very interesting two days.

When the Government of South Georgia & the South Sandwich Islands (GSGSSI) designated the entire Maritime Zone as a Marine Protected Area (MPA) back in 2012, marine protection didn't have the same high profile that it has seen in recent years.

At that time, the UN Convention on Biological Diversity had only just pledged to protect 10% of the world's oceans by 2020, a goal which has subsequently increased to 30% by 2030. The global coverage of MPA's has more than doubled in the intervening decade and at the recent International MPA Congress (IMPAC5) in Vancouver, over 3,000 marine professionals came together to share knowledge, successes, and best practice. It's hard to believe that we have recently celebrated the tenth birthday of our MPA, and how much the world has changed since our last 5-year review, but one constant has been the commitment of GSGSSI to world-leading environmental management and protection, based on a solid foundation of scientific evidence. Sir David Attenborough recently described South Georgia as 'an ecosystem in recovery' and we feel a great sense of responsibility to ensure that recovery continues in the face of increasing global environmental pressures.

I'd like to take this opportunity to thank the UK Government Blue Belt Programme for their support in funding this event. Many of the presentations during the symposium will be based on research funded by both the Blue Belt Programme and the Darwin Plus scheme, and we greatly appreciate the wide-ranging assistance these organisations offer the Overseas Territories in managing and protecting their marine environments. In addition, I would also like to thank colleagues at the British Antarctic Survey for their dedicated research including the long-term monitoring programmes which underpin so much of our knowledge, and to acknowledge the significant role that Cefas and the MMO play in supporting our MPA management, it really is a team effort. Finally, a big thank you to Sue Gregory for all her hard work in arranging this celebration of SGSSI science!

I hope you thoroughly enjoy the symposium; I think you will be pleasantly surprised to learn of both the breadth and depth of science that is undertaken within the MPA. As evidence-based decision making is at the core of GSGSSI's environmental management, we look forward to discussing how the science which has already been carried out has contributed to our aims and objectives, and to hearing your thoughts on what steps could be considered in terms of future research and management.

I look forward to seeing you all in Cambridge, be that in-person or online.

A handwritten signature in blue ink, appearing to read 'Mark Belchier'.

Dr Mark Belchier
Director of Fisheries and Environment, GSGSSI

1. SGSSI MPA Review and the Science Symposium in brief

The South Georgia and South Sandwich Islands Marine Protected Area (SGSSI MPA) was established in 2012 to protect and conserve the region's rich and diverse marine life, whilst allowing sustainable and carefully regulated fisheries, and a set of objectives was established against which the effectiveness of the MPA could be assessed. Following a scientific workshop and public consultation, further protection measures were introduced in 2013 and the SGSSI [MPA Management Plan](#) was published.

The objectives of the SGSSI MPA are to:

- conserve marine biodiversity, habitats, and critical ecosystem function.
- ensure that fisheries are managed sustainably, with minimal impact on associated and dependent ecosystems.
- manage other human activities including shipping, tourism and scientific research to minimise impacts on the marine environment.
- protect the benthic fauna from the destructive effects of bottom trawling.
- facilitate recovery of previously over-exploited marine species.
- increase the resilience of the marine environment to the effects of climate change.
- prevent the introduction of non-native marine species.

The Government of South Georgia and the South Sandwich Islands (GSGSSI) has committed to undertake a review of the effectiveness of the SGSSI MPA every 5 years. In 2017/18 an ad-hoc Advisory Group of experts oversaw the first review and agreed that the MPA was achieving its intended objectives, but also made a number of [recommendations](#). GSGSSI subsequently implemented a range of [enhancements](#) to the MPA, and took forward the advice to develop an MPA [Research and Monitoring Plan](#).

This science symposium marks the start of the second 5-year MPA review. Over 300 peer-reviewed papers relating to the marine environment at South Georgia & the South Sandwich Islands have been published since 2018, many of which address knowledge gaps identified in the first review. The purpose of the symposium is to showcase the research which has been carried out within the MPA since the last review and to consider how this science has contributed to the research and monitoring themes within the MPA Research & Monitoring Plan. In addition, there will be an opportunity for in-person attendees to discuss whether the research needs identified in the 2017/18 review are being met, and if there are additional knowledge gaps that need to be addressed.

Following the review of scientific research within the MPA during this symposium, GSGSSI will be conducting a complementary review of the MPA management measures by undertaking a Protected Area Management Effectiveness (PAME) assessment. The two strands of science and management will then be brought together in an overarching evaluation to assess whether the MPA is continuing to meet its objectives, and to enable GSGSSI to make evidence-based decisions on whether any further enhancements to the MPA are required.

2. Programme

Day One – 13 th June 2023, am			
Time	Title	Speaker	Page
Welcome			
09:30	Housekeeping & Introduction	Mark Belchier, GSGSSI	-
Session 1: The Current SGSSI MPA			
09:35	Current status of the SGSSI MPA and its relationship with wider Southern Ocean marine management	Mark Belchier, GSGSSI	8
09:45	Research and Monitoring in support of the SGSSI Marine Protected Area	Susie Grant, BAS	8
09:55	South Georgia Marine Protected Area Data Portal	Helen Peat, BAS	9
10:05	Q&A		-
Session 2: South Sandwich Islands			
10:10	The South Sandwich Islands – an understudied isolated Southern Ocean archipelago	Martin Collins, BAS	9
10:20	Spatial and temporal variability and connectivity of the marine environment of the South Sandwich Islands	Sally Thorpe, BAS	9
10:35	Plankton and nekton community structure around the South Sandwich Islands and the influence of environmental variables	Cecilia Liszka, BAS	10
10:50	HOT: Hadal Zones of our Overseas Territories - the South Sandwich Trench (<i>pre-recorded presentation</i>)	Heather Stewart, BGS	10
11:05	Tea & coffee break , including SGSSI MPA Data Portal Demonstration		
11:25	Summary of the RRS Discovery DY99 Research Cruise to the South Sandwich Islands in 2019	Oliver Hogg, Cefas	11
11:35	Expedition Penguin	Ruth Peacey, Talesmith TV	11
11:45	A Seabird Survey of the South Sandwich Islands post-Eruption	Tom Hart, Oxford Brookes University	12
12:00	Q&A		-
Session 3: Pelagic & Benthic Ecosystems, Part 1			
12:10	Temporal patterns in South Georgia zooplankton: insights from a moored echosounder	Tracey Dornan, BAS	12
12:25	Cephalopods of the South Georgia & South Sandwich Islands regions: relevance from a MPA perspective	José Quieros, University of Coimbra	13
12:35	Biodiversity of South Georgia's seaweeds: unique, charismatic and essential	Juliet Brodie, Natural History Museum	13
12:45	Connectivity patterns are species dependent in Southern Ocean deep-sea corals (<i>online presentation</i>)	Michelle Taylor, Essex University	14
12:55	Q&A		-
13:05	Lunch		

Day One – 13 th June 2023, pm			
Time	Title	Speaker	Page
Session 4: Pelagic & Benthic Ecosystems, Part 2			
14:00	Overview and first results of RV <i>Polarstern</i> expedition PS133-2 “Island Impact” to South Georgia in Nov/Dec 2022 (<i>online presentation</i>)	Sabine Kasten, AWI	14
14:15	From Bubbles to Biology: South Georgia’s Methane Seep Communities	Madeline Anderson, BAS	15
14:25	Q&A		-
Session 5: Krill			
14:35	Modelling Antarctic krill distribution at South Georgia: from physics to fisheries management	Emma Young, BAS	15
14:50	Resolving ecosystem effects of the South Georgia winter krill fishery	Cecilia Liszka, BAS	16
15:05	Krill & Climate Change	Simeon Hill, BAS	16
15:20	Q&A		-
15:25	Tea & coffee break		
15:45	Using the best available science to set revised fishery catch limits for Antarctic krill within the South Georgia and South Sandwich Islands Marine Protected Area	Philip Trathan, University of Southampton	16
16:00	Setting Focus on CCAMLR Article II	Inigo Everson, University of East Anglia	17
16:15	Q&A		-
Session 6: Fisheries, Part 1			
16:25	The South Georgia groundfish survey: using long term data to assess the population dynamics and ecology of historically exploited fish species	Phil Hollyman, BAS	17
16:40	The use of miniature cameras to monitor the behaviour and benthic impact of longline fishing gear at South Georgia	Chris Darby, Cefas	18
16:55	Spatial, temporal and demographic variability in Patagonian toothfish (<i>Dissostichus eleginoides</i>) spawning from twenty-five years of fishery data	Connor Bamford, BAS	18
17:05	The use of electronic monitoring to assess the risks of using net monitoring cables	James Moir Clark, MRAG	19
17:15	Oceanographic Variability in Cumberland Bay: implications for glacier dynamics and transport of mackerel icefish larvae	Joanna Zanker, BAS	19
17:25	Q&A		-

Day Two – 14 th June 2023, am			
Time	Title	Speaker	Page
Welcome			
09:00	Recap	Mark Belchier, BAS	-
Session 1: Fisheries, Part 2			
09:05	The South Georgia risk tool - a bespoke and interactive management tool	Oliver Hogg, Cefas	19
09:20	Q&A		-
Session 2: Long Term Monitoring Sites			
09:25	King Edward Point Science	Martin Collins, BAS	20
09:35	Long Term Monitoring of Higher Predators at Bird Island	Ash Bennison, BAS	20
Session 3: Higher Predators			
09:45	Albatross and Petrel research at Bird Island, South Georgia	Richard Phillips, BAS	21
10:00	Spatial Segregation of Wandering Albatrosses at South Georgia	Vicky Warwick-Evans, BAS	21
10:15	Q&A		-
10:25	Tea & coffee break , including Risk Tool Demonstration		
10:45	Ecological monitoring in a changing world - how remote cameras, citizen science and AI are supporting research in the SGSSI MPA	Tom Hart, Oxford Brookes University	21
11:00	Fixed Wing Wildlife Surveys at South Georgia	Nathan Fenney, BAS	22
11:15	Baleen whale recovery and habitat use in South Georgia waters	Jennifer Jackson / Stephanie Martin, BAS	23
11:30	Q&A		
Session 4: Human Impacts			
11:40	An Update on Marine Debris in South Georgia: emerging awareness of microplastic pollution	Jack Buckingham, University of Hull / BAS	23
11:50	Identifying risks and management priorities through marine invasion pathway analysis in the sub-Antarctic	Dan Bayley, Flora & Fauna International	24
12:00	Ship strike risk to whales in South Georgia waters (<i>online presentation</i>)	Russell Leaper IFAW	24
12:10	What goes thump at night: managing bird-strike in South Georgia (<i>online presentation</i>)	Megan Tierney, JNCC	25
12:20	Q&A		-
12:30	Lunch		

Day Two – 14th June 2023, pm

Time	Title	Speaker	Page
Session 5: Climate Change			
13:30	MCCIP: Key climate change effects on the coastal and marine environment around the Polar UK Overseas Territories	Oliver Hogg, Cefas	25
13:40	'Megaberg' impacts at South Georgia: the collapse of iceberg A68a in a sensitive marine ecosystem	Geraint Tarling, GSGSSI	25
13:50	5-years on: Assessing the Efficacy of the SGSSI MPA under Shifting Biological, Climatic & Geopolitical Conditions	Johnny Briggs, Great Blue Ocean Coalition	26
14:00	Q&A		-
Session 6: Future Work			
14:10	South Georgia All-Island Decadal Albatross Survey	Jennifer Black, GSGSSI	26
14:15	Why is the grass greener on the other side? Using satellite technology to monitor seabird populations	Richard Phillips, BAS	27
14:20	Seasonal use of the SGSSI MPA by penguins from Zavodovski Island, South Sandwich Islands	Norman Ratcliffe, BAS	27
14:25	Characterising the pelagic community of South Georgia through novel sampling methods	Cecilia Liszka, BAS	27
14:30	Improving identification of fish bycatch in the Antarctic krill fishery	William Reid, Newcastle University	28
14:35	Evaluating climate change risks to Patagonian and Antarctic toothfish	Rachel Cavanagh, BAS	28
14:40	Development of alternative population assessment models for Patagonian toothfish in Subareas 48.3/48.4	Lisa Readdy, Cefas	29
14:45	Mitigating the spread of marine invasive non-native species (INNS) to SGSSI	Paul Brickle, SAERI	29
14:50	Hungry Humpbacks: measuring seasonal foraging intensity at South Georgia	Stephanie Martin, BAS	30
14:55	Acoustic monitoring of whales and vessels in Cumberland Bay, South Georgia (<i>online presentation</i>)	Susannah Calderan, SAMS	30
15:00	Q&A		-

3. Abstracts

The Current SGSSI MPA

Current status of the SGSSI MPA and its relationship with wider Southern Ocean marine management

Mark Belchier & Sue Gregory

When the South Georgia & the South Sandwich Islands (SGSSI) MPA was first designated in 2012 it was a relatively simple design and which enshrined into law a number of measures that had previously been applied under fisheries licensing conditions. The first scientific workshop in 2013 produced a range of spatial and temporal enhancements, and following the first 5-year MPA review in 2017/18, further evidence-based management measures were passed into legislation to further conserve the region's marine biodiversity. In addition, the review led to the publication of the MPA research and monitoring plan (RMP) and launch of an interactive 'data-portal'.

This presentation considers the current SGSSI-MPA measures and how they contribute to the wider network of MPAs under development through the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) within the Southern Ocean. Although not a 'CCAMLR designated' MPA there are strong linkages between the marine protection and sustainable fisheries management measures of the SGSSI-MPA and CCAMLR's Conservation Measures and MPA proposals.

Research and Monitoring in support of the SGSSI Marine Protected Area

Susie Grant & Marta Soeffker

The design of the SGSSI MPA and subsequent enhancements to its conservation measures have been supported by the best available scientific information. Science continues to be at the centre of evidence-based management of this MPA, with an established review process including detailed consideration of new scientific findings relevant to the MPA objectives, as well as the identification of additional science needs.

The MPA Research and Monitoring Plan is key to ensuring that new scientific information can be made available to decision-makers. It aims to guide scientific activities that will continue to improve understanding of the SGSSI marine ecosystem, assess the nature and extent of change, provide information to evaluate the effectiveness of the MPA and inform the development of responsive management as required. The RMP is organised into 10 research themes, aligned with the objectives of the MPA, and identifies current and required monitoring activities that will provide information on the status of key features protected by the MPA, particularly on monitoring environmental change and the impact of human activities. The RMP also identifies new research that could provide additional understanding of key features within the MPA.

Since the designation of the MPA in 2012, over 400 peer-reviewed articles have been published, demonstrating a significant increase in scientific understanding of the region's physical characteristics, species and habitats. In demonstrating the pathways and processes from scientific information and data through to management decisions, the SGSSI MPA is an exemplar for science-led management in large, multi-use MPAs worldwide.

South Georgia Marine Protected Area Data Portal

Helen Peat & Susie Grant

Review and ongoing management of the SGSSI MPA requires accessible and comprehensive data on the status and trends of marine biodiversity, ecosystem features and human activities. The MPA Data Portal (<https://www.mpa-dataportal.gs>) provides a platform for managers, scientists and stakeholders to access the latest information on the status and trends of marine biodiversity, environmental conditions and human activities, as well as updates on scientific research and monitoring. Development of the Data Portal was part of a Darwin Plus funded project on 'Building data resources for managing the SGSSI Marine Protected Area', undertaken by BAS and the UK Polar Data Centre in partnership with GSGSSI, and with input from other scientific experts and stakeholders. It contains over 150 interactive maps and data summaries, which are linked directly to the [South Georgia online GIS](#) and the [UK Polar Data Centre Discovery Metadata System](#). The Data Portal also contains a [Research and Monitoring Plan](#) for the MPA, developed in collaboration with scientists and stakeholders to guide future scientific activities that will contribute to an increased understanding of the SGSSI marine ecosystem, assess the nature and extent of future change, and provide information to evaluate the effectiveness of the MPA.

The South Sandwich Islands

South Sandwich Islands – an understudied isolated Southern Ocean archipelago

Martin A. Collins, Tom Hart, Oliver T. Hogg, Philip R. Hollyman, Cecilia M. Liszka, Heather A. Stewart, Philip N. Trathan

The South Sandwich Islands are an isolated, oceanic, volcanically formed archipelago in the Atlantic sector of the Southern Ocean. The complex bathymetry, coupled with the location in the marginal sea-ice zone and the relationship with the ACC makes the region both productive and biodiverse. Although remote, the region is not pristine and has been subject to historic exploitation of cetaceans and currently supports small, sustainably managed fisheries for two species of toothfish. A special issue, in *Deep Sea Research Part II: Topical Studies in Oceanography*, brought together a suite of papers that further our knowledge of the region and will contribute to the next review of the South Georgia and South Sandwich Islands Marine Protected Area, which is due in 2023. The ten papers published within the special issue cover a broad range of subjects, adding to our knowledge of oceanography, pelagic and benthic ecology and of habitat use by mobile vertebrate predators such as cetaceans and penguins. Whilst the papers address some important knowledge gaps, they also highlight how little is known about this region and provide pointers to future research priorities.

Spatial and temporal variability and connectivity of the marine environment of the South Sandwich Islands

Sally Thorpe & Eugene J. Murphy

The South Sandwich Islands have a complex marine environment that is influenced by the major oceanographic systems of the Antarctic Circumpolar Current and the Weddell Gyre as well as seasonal sea ice. Here we present recent research into the dynamics and variability of the marine environment, and the local and regional connectivity of the South

Sandwich Islands arc. Using satellite-based data from a 20-year period, we illustrate the mean seasonal cycle in sea surface temperature, sea ice distribution and chlorophyll a concentration and the associated temporal and spatial variability in these key environmental properties. The timing and pattern of sea ice retreat exhibits large interannual variability and appears to be a key driver in the formation of chlorophyll blooms with bloom propagation affected by local circulation, though additional local processes are also important. Trajectories of surface ocean drifters and deeper-floating Argo floats together with model output demonstrate the connectivity within the South Sandwich Islands arc and to the wider regional marine system. This includes connections from the Antarctic Peninsula, the Scotia Sea and South Georgia to the South Sandwich Islands, and onwards to islands and seamounts such as Bouvet, Crozet and Kerguelen Islands. The potential for return flow to the South Sandwich Islands exists via the Weddell Gyre. Our analyses indicate that accounting for the complexity and variability in the South Sandwich Islands marine environment will be critical in the development of conservation and fisheries management procedures.

Plankton and nekton community structure around the South Sandwich Islands (Southern Ocean) and the influence of environmental variables

Cecilia M. Liszka, Sally E. Thorpe, Marianne Wootton, Sophie Fielding, Eugene J. Murphy, Geraint A. Tarling

The South Sandwich Islands (SSI) are a biologically diverse and productive archipelago of eleven islands in the eastern Scotia Sea, located to the south of the Antarctic Circumpolar Current (ACC). The islands support important populations of higher predators, including penguins, seals and whales. However, the plankton that underpins this biodiverse region, including its ecology and environmental drivers, has been little studied to date. During the CCAMLR Area 48 Survey in January/February 2019, we conducted a comprehensive net and bottle sampling campaign incorporating three trophic levels: phytoplankton, mesozooplankton and macrozooplankton/nekton. We conducted multivariate analyses to examine the biogeographic structure of the three different plankton communities, and potential congruence between them. We also collected simultaneous oceanographic and satellite data to investigate the environmental controls driving the observed community structure.

Our results revealed distinct mesoscale structure within the plankton communities, with four spatially defined groups of phytoplankton and macrozooplankton/nekton, and three cluster groups of mesozooplankton. We observed some spatial congruence between the plankton communities related to the position of the Southern Boundary of the SACCF and, to some degree, the development of a phytoplankton bloom on the eastern edge of the archipelago, yet we also observed some trophic mismatch, particularly between the meso- and macrozooplankton. In this talk I will present the results and implications of this work, discuss the drivers of the observed structure, along with potential explanations for the trophic mismatch.

HOT: Hadal zones of Our Overseas Territories – the South Sandwich Trench

Heather A. Stewart & Alan J. Jamieson (pre-recorded presentation)

HOT: Hadal zones of our Overseas Territories was a multi-disciplinary Darwin Plus funded project that delivered a step-change in our understanding of the fundamental ecological and geological processes in the South Sandwich Trench (SST) to fill an identified knowledge gap within the existing MPA. The SST reaches water depths of 8266 m \pm 13m

and uniquely is the only sub-zero hadal environment on Earth, with a recorded bottom temperature of between -0.34°C at 3500 m and 0.01°C at 7442 m depth with average water temperatures of -0.09°C in waters >6000 m. The previously unknown seafloor morphology of the SST reveals a complex network of fault escarpments, with vertical offsets of up to 500 m, several confined basins created by the presence of fracture zones on the subducting plate, submarine landslide scars, seamounts, the remnants of mass transport deposits, and slumps. Video data observed high densities of brittle stars (Ophiuroidea) seen on the upper trench slopes, and dense aggregations of holothurians (Elpididae) observed along the deep trench axis suggest a significant energy input from the surface. Additionally, gastropods, sponges, and stalked crinoids were observed. Three species of hadal fish (Liparidae), were observed at depths 1000 m shallower than expected, likely due to the piezo-thermal effect decreasing their depth range. Four species of scavenging amphipods were recovered, extending the known distribution of *Eurythenes andhakarae*, *Hirondellea dubia*, and *Bathycallisoma schellenbergi* to the SST. Importantly, this study highlights the endemic community present at hadal depth within this somewhat unique high pressure-low temperature environment.

Summary of the RRS Discovery DY99 Research Cruise to the South Sandwich Islands in 2019

Oliver T. Hogg & Chris Darby

The South Sandwich Islands forms a significant proportion of the SGSSI MPA. Despite this, very little was known about the region's benthic environment and the species that inhabit it, particularly the distribution of vulnerable marine ecosystems (VME). Funded by the UK Government Blue Belt Programme, the Cefas RRS Discovery 2019 survey (DY99) undertook a systematic survey of the region's benthic biodiversity. Five islands along the South Sandwich Islands archipelago were sampled. At each island, a deep-water camera system and benthic trawls were used to survey epifaunal species distribution and diversity from 200m to 2,200m. The survey focused on determining trends in distribution and diversity across both latitudinal and depth gradients to analyse the influence of topography and environment on benthic fauna and community structure. The analysis presented represents the first attempt to bio-physically characterise this region providing biogeographical context to the South Georgia and South Sandwich Islands Marine Protected Area.

Expedition Penguin

Ruth Peacey

At the start of 2020, a multidisciplinary team of scientists, led by Dr Tom Hart, undertook an epic voyage to the South Sandwich Islands to gather data about this unique archipelago. Film maker Ruth Peacey joined the team to create a documentary about the penguins found here and the work scientists are doing that will hopefully ensure continued protection of this important habitat.

A hostile environment is not an easy place to work. The last expedition was in 2016 to Zavodovski to film the world's largest penguin colony and, months later, a huge volcanic eruption took place there.

Did the multi-million colony of chinstrap penguins survive the eruption? And what can we learn from the South Sandwich Islands, an ecosystem that is virtually pristine?

It was a great privilege to be part of such an important expedition and to record the scientists carrying out extraordinary research in such a remarkable place. It is my dream that the footage our team gathered will bring about awareness of these islands and the MPA, and demonstrate why this part of the world deserves to be protected for generations to come.

The documentary is due to be released later this year. I'm delighted to share a teaser with this symposium.

A Seabird Survey of the South Sandwich Islands post-Eruption

Tom Hart, Sarah Manthorpe, Nicole Richter, Gemma V. Clucas, Heather J. Lynch

The South Sandwich Islands (SSI) contain globally important populations of chinstrap penguins as well as large numbers of Adélie and macaroni penguins. At last count, it was estimated that Zavodovski Island alone contained 600,000 breeding pairs of chinstrap penguins, making it the largest bird colony on Earth. Volcanoes on three of the archipelago's islands (i.e., Zavodovski, Saunders and Bristol) erupted in close succession in 2016, with elevated volcanic activity during penguins fledgling/moult period (March-April) when birds were not able to escape the islands and go to sea. Historically, volcanic eruptions elsewhere in the Antarctic have caused mass mortality in penguin colonies. Using unmanned aerial vehicle (UAV) surveys, we surveyed key colonies on Zavodovski and Saunders Island, two of the islands that had recently erupted, as well as control colonies at Candlemas, Bellingshausen and Thule islands all islands were surveyed in January 2020, with repeats of Zavodovski in January 2022 and 2023. We report declines in chinstrap penguin colonies but small or undetermined change in Adélie penguin abundance. These trends are comparable between sites that have experienced recent volcanism and those that have not. We find small declines on Zavodovski Island that may partially be due to methodology, although it remains the largest single penguin colony in the Southern Ocean. Volcanic activity is a natural disturbance phenomenon and the population decline is not significant in the larger context of their global abundance.

Pelagic & Benthic Ecosystems

Temporal patterns in South Georgia zooplankton: insights from a moored echosounder

Tracey Dornan, Sophie Fielding, Geraint A. Tarling

Antarctic krill (*Euphausia superba*) are a key zooplankton species in the Southern Ocean ecosystem, supporting large populations of marine mammals and seabirds, and contributing to the sequestration of carbon to the ocean interior. Krill are also the focus of a commercial winter fishery at South Georgia. These stocks are routinely monitored using ship-based acoustic surveys, typically restricted to the summer months as a result of the remoteness and challenging sampling conditions of this region. This leaves key knowledge gaps regarding inter- and intra-annual patterns in krill distribution and abundance. Here we detail the deployment and results from 4 years of moored echosounder 120 kHz acoustic backscatter data from South Georgia. These data indicate considerable seasonal and interannual variability in krill swarm presence, size and shape. We present these results in the context of challenges and opportunities for the increased use of moored instruments to monitor krill abundance and behaviour.

Cephalopods of the South Georgia and South Sandwich Islands regions: relevance from a MPA perspective

José P. Queirós, José Abreu, Lucas Bastos, Débora Carmo, Joana Fragão, Hugo R. Guimarães, Mariana Quitério, Sara Santos, José Seco, José C. Xavier

Cephalopods (squid and octopods) play an important role in South Georgia and South Sandwich Islands (SGSSI) food-webs. Thus, it is crucial to understand how they contribute to the diet of the different top predators and also their distribution, life cycle, trophic ecology and ecotoxicology. This presentation reviews the contribution of our team to understanding the role of cephalopods in the SGSSI regions. Recent predators' diet studies confirmed that some squid species are important in the diet of different predators (e.g. *Moroteuthopsis longimana*), in different life-stages, and that squid can face increased predation by typical krill-feeders in years of low krill abundance, e.g. squid *Slosarczykovia circumantarctica* by Antarctic fur seals. Our results also showed that SGSSI's predators feed on squid distributed from Subtropical to Antarctic waters, and despite some species spending their entire life in SGSSI waters, climate change may induce changes to their distribution. Stable isotopic analysis confirmed that cephalopods increase their trophic level throughout their life, which is accompanied by an increase in Hg concentrations. Future studies will focus on the biogeography of cephalopods at SSI, cephalopod biomass estimates within SGSSI, the importance of cephalopods in the diet of poorly study deep-sea fish predators, and assess cephalopods as vectors of emergent pollutants and microplastics in the SGSSI region.

Biodiversity of South Georgia's seaweeds: unique, charismatic and essential

Juliet Brodie & Rob Mrowicki

South Georgia supports a rich seaweed flora that is essential to the functioning of coastal marine ecosystems. The seaweeds provide food, shelter and foraging habitats for many species, while maintaining inshore productivity and contributing substantially to nutrient and carbon cycling. In 2021, as part of a Darwin Plus project *Biodiversity discovery and the future of South Georgia's seaweed habitats*, we undertook an expedition to South Georgia which resulted in the collection of c. 727 seaweed specimens. Prior to our research, South Georgia seaweeds had been poorly studied, and identification was based on morphological identification and outdated species concepts. Our work, using a molecular-assisted taxonomic approach, suggests that many species remain undescribed. Potential endemics are being revealed, e.g. probably a new giant brown *Himantothallus* species. There are biogeographic signals with related areas in the Southern Ocean and South Atlantic, and evidence for the first time of the presence of a non-native seaweed, the green Sea Lettuce *Ulva fenestrata*, in South Georgia. Phylogenetic analysis of key seaweed groups indicates the immense task to document their diversity, and an effort is underway by the seaweed community to develop robust global phylogenies that will provide the basis for identification, diversity, application and evolution. There is also evidence of structural colour in seaweeds in South Georgia, including the red Funky Jazz Weed, *Myriogramme manginii*. This presentation will summarize our findings and highlight the need for more collections and intensive work to be undertaken on South Georgia seaweeds to fully realise their diversity.

Connectivity patterns are species dependent in Southern Ocean deep-sea corals

Michelle L. Taylor, María Belén Arias, Kerry-Lee Etsebeth, Rui Vieira, Andrea M. Quattrini, Jessica Gordon, Alice Malcolm-McKa (online presentation)

Primnoidae is a dominant family of cold-water corals present in both deep-sea and polar regions. The Southern Ocean is one of the most rapidly warming global regions, threatening sessile organisms, such as corals. Despite their ecological role, little is known about their genetic diversity, dispersal, gene flow, and population connectivity, all of which are important information to consider in the design of ecologically-relevant networks of Marine Protected Areas.

We used Ultra Conserved Elements to isolate single nucleotide polymorphisms (SNPs) and investigate the genetic diversity, structure, and connectivity of four cold-water corals: *Primnoella chilensis*, *Dasystenella acanthina*, *Thouarella viridis* and *Thouarella nov. sp.* Over 300 specimens were collected from six areas covering different bathymetrical ranges, spanning ~9,000km of the sub-Antarctic.

Across the four species, samples collected below 900m presented the highest genetic diversity; consequently, they might cope better with future impacts. Genetic structure was identified in *P. chilensis* and *D. acanthina* with two distinct genetic clusters segregated by depth. Specimens inhabiting 320-800m formed a single cluster, those at 900-1,200m forming another. Conversely *T. viridis* and *T. nov. sp.* revealed connectivity patterns across ~9,000km around Antarctica.

Our results highlight species level variation in connectivity. Some species have genetic differences and limited gene flow occurring between isobaths (shallow vs deep). Panmixia was identified among distant locations, supporting the idea of a large open circumpolar population in the Southern Ocean for other species. Essential information on reproductive strategies for these species is unclear, thus, further studies are needed to understand drivers influencing these genetic differences.

Overview and first results of RV *Polarstern* expedition PS133-2 “Island Impact” to South Georgia in Nov/Dec 2022

Sabine Kasten & all the participants of expedition PS133-2 (online presentation)

The main goal of expedition PS133-2 "*Island Impact*" on board RV *Polarstern* in November/December 2022 was to understand the sources and transport pathways of iron (Fe), other nutrients (both macronutrients and trace elements/metals) and carbon compounds into the shelf waters of South Georgia and further downstream in the Southern Antarctic Circumpolar Current (ACC). We investigated the main island-derived (shelf) sources of Fe, nutrients and other trace elements including the impact of injection of these compounds by glacial melt water, groundwater seepage and methane bubble ebullition. Work also included the study of how methane seepage controls benthic faunal communities as well as material turnover and element fluxes. We further investigated how the local island-derived Fe and other potential Fe sources contribute to the downstream biogeochemistry and ecosystem structure in the Atlantic sector of the Southern Ocean. The main study areas of the cruise were King Haakon Bay and Cumberland Bay. We performed extensive water column, sediment and air sampling onboard the RV *Polarstern* and additionally conducted sampling of water and sediments close to shore and in front of the Nordensköld Glacier (Cumberland Bay East) from onboard zodiacs as well as sampling on land – including meltwater, groundwater, sediments, soil and vegetation.

From Bubbles to Biology: South Georgia's Methane Seep Communities

Madeline P.B.C. Anderson, Gerhard Bohrmann, Philip R. Hollyman, Sabine Kasten, Jason Newton, William D.K. Reid, Ben D. Wigham, Katrin Linse

In the past 10 years, more than 3,000 flares indicating active methane seeps have been discovered on the shelf around the sub-Antarctic island of South Georgia. Methane seeps are points on the seafloor where previously buried carbon is released into the sediment and water column. Methane is a greenhouse gas, with a much higher warming potential than carbon dioxide. Despite marine methane in the Southern Ocean being estimated to comprise about a quarter of the Earth's marine methane, research on methane as a climate change gas has mostly focused on terrestrial methane. It is crucial for us to understand the impact of marine methane on seafloor biology, particularly in the rapidly warming shelf around South Georgia.

While methane seeps or methane-saturated sediments are not suitable environments for some benthic organisms (animals who live on, or in, the sediment), they can act as a hub of life for others. The impact of methane seeps on Antarctic or sub-Antarctic benthic organisms is yet to be explored. This project investigates how the abundances and diversity of benthic organisms in methane seep communities around South Georgia differ from those in non-seep ecosystems, as well as the functioning and food webs of the community.

Our initial findings indicate that the methane seep communities around South Georgia have lower species diversity but higher abundances, suggesting that only certain species are able to thrive in these environments.

Krill

Modelling Antarctic krill distribution at South Georgia: from physics to fisheries management

Emma Young, Sally Thorpe, Eugene Murphy

Antarctic krill (*Euphausia superba*) is a key species in the highly productive marine ecosystem of South Georgia and is also the focus of a winter-only fishery that operates in localised areas of the northern shelf of the island. The distribution of krill on the shelf around South Georgia is spatially and temporally variable, relying on influx of krill from upstream of the island. We present results from a modelling study that aims to understand the processes driving the transport and retention of Antarctic krill to and around the northern shelf of South Georgia. We use output from a 20-year run of a high resolution (~3 km) regional ocean model to provide quantitative information on the connections (pathways and timescales), retention (rates and spatial variability) and fluxes in the main areas of fishing and predator demand around South Georgia. We find that temporal variability in transport from upstream of South Georgia is linked to variability in the local ocean flows, which in turn is linked to the regional winds. The probability of transport to the northwestern South Georgia shelf region from the winter krill fishing grounds is high, with seasonal and interannual variability in local circulation and retention affecting connectivity. The results of this study further our understanding of krill transport and retention and will contribute to the development of the management framework for the krill fishery at South Georgia.

Resolving ecosystem effects of the South Georgia winter krill fishery

Cecilia M. Liszka, Sophie Fielding, Norman Ratcliffe, Jennifer A. Jackson, Geraint A. Tarling, Tracey Dornan, Russell Leaper, Susannah Calderan, Paula Olson, Ryan Irvine, Klemens Pütz, Mark Belchier, Susan Gregory, Vicki Foster, Martin A. Collins

The fishery for Antarctic krill is concentrated in the Atlantic sector of the Southern Ocean and, with the advent of new trawling technology, is increasing. Around South Georgia (SG), the fishery is restricted to winter to avoid competition with krill-eating predators, particularly those constrained in their foraging range whilst provisioning young. Nevertheless, the winter fishery may still impact krill predators through direct spatio-temporal overlap during winter or by carry-over effects into spring and summer. To date, understanding this has been hampered by a lack of winter data on both krill and krill-dependent predators (e.g. seals, penguins & whales). To address this gap, we are carrying out krill acoustic surveys focused on the area where the fishery is most concentrated, to the north-east and north-west of SG, at the start, middle and end of the winter season. This is combined with marine mammal and seabird observations, and satellite tracking of penguins.

Results from the first three surveys revealed large aggregations of generally small krill (10-35 mm TL), often in association with seabirds and foraging humpback, fin and southern right whales, in the area normally occupied by the fishery. We present evidence of diurnal variability in krill distributions during winter, and of a potential westward movement of krill throughout the season. Penguins spent 83.5% of their activity within the no-take zone. A second year of surveys is underway. Data will help quantify krill biomass throughout the area/season; characterise diurnal patterns of krill distribution; help understand the winter demand of krill-eating predators; and contribute to management by CCAMLR and GSGSSI.

Project website: <https://www.bas.ac.uk/project/winter-krill-at-south-georgia/>

Krill and Climate Change

Simeon Hill

Antarctic krill is a cold-water species which is vulnerable to the effects of climate change. It is also ecologically and economically important, supporting abundant wildlife and a valuable fishery at South Georgia. This presentation will review evidence of climate-driven changes in the krill population in the Southwest Atlantic. It will also discuss research into potential future changes in krill populations and the effects on krill-dependent wildlife. Finally, it will consider the implications for fishery management, including whether current measures are as robust as originally intended and what steps might be necessary in future.

Using the best available science to set revised fishery catch limits for Antarctic krill within the South Georgia and South Sandwich Islands Marine Protected Area

Philip N. Trathan

In recent decades the marine ecosystem across the Scotia Sea has changed, both physically and biologically. Ocean temperatures have continued to warm, whilst the abundance of various krill-dependent predator populations have altered, including through both population increases and decreases. Such factors suggest that the future state of the Scotia Sea ecosystem remains uncertain, meaning that managers need to be aware of differing potential future states. In this context, perhaps the most important issue is to

ensure that ongoing management of commercial fisheries remains precautionary, particularly that for Antarctic krill, although probably all fisheries should now be reviewed.

In 2009, CCAMLR set precautionary fishery catch limits for Antarctic krill of 279,000t and 93,000t, respectively, in the waters around South Georgia and the South Sandwich Islands; these should now be reviewed following the recent development of CCAMLR's revised krill fishery management framework.

Here, I review different aspects of the recent scientific literature that should be evaluated when setting revised management conditions for the krill fishery. At South Georgia, the fishery generally aggregates around a series of submarine banks over the eastern shelf, occasionally extending along the northern shelf, but hardly ever off-shelf, and virtually never close to the South Sandwich Islands. Although krill is more abundant in off-shelf waters, it is less predictable and at lower density, so remains unattractive to fishers. As such, assumptions at the heart of CCAMLR's revised management framework, coupled with ecological conditions that lead to fishing aggregations at South Georgia, lead inevitably to various management implications.

Setting Focus on CCAMLR Article II

Inigo Everson

In the 1970s CCAMLR's ecosystem approach was unique, but, after forty years, beyond simple precautionary measures remains virtually undeveloped. Information from krill surveys and foraging methods of dependent species have been used to provide guidance on understanding some ecosystem components that would lead to revised Conservation Measures. Outline plans are presented for augmenting this information through sampling from modern commercial krill fishing vessels in the hope that a significant programme can be organised.

Fish

The South Georgia groundfish survey: using long term data to assess the population dynamics and ecology of historically exploited fish species

Philip R. Hollyman, Simeon L. Hill, Vladimir V. Laptikhovsky, Mark Belchier, Susan Gregory, Alice Clement, Martin A. Collins

Twenty-six dedicated groundfish surveys have been carried out at South Georgia and Shag Rocks since 1987. These random stratified bottom trawl surveys have principally been designed to assess the stock status of the commercial finfish species *Champsocephalus gunnari* (mackerel icefish) and also to provide an index of abundance of pre-recruit Patagonian toothfish (*Dissostichus eleginoides*). In addition they have provided information on the relative abundance and ecology of many demersal fish species at South Georgia, including previously over-exploited species. This sampling allows for community-based and time-series analyses of the fish assemblage on the South Georgia shelf.

We examine how the community has changed over the last 36-years, specifically regarding populations of key species and discuss the wider ecosystem effects which may be driving these changes. As an example of this, the survey has resulted in evidence of a sustained

increase in the marbled rockcod (*Notothenia rossii*) population, starting two decades after the prohibition of targeted fishing in 1985. The way species respond to change is mediated in part by trophic relationships with other organisms; life history factors and possible heavy predation on early life stages might have delayed their recovery while diet plasticity potentially supported recent population growth. Due to the dynamic ecosystem at South Georgia and questions over catch reports from the period of heaviest exploitation, it is unlikely the current ecosystem could support a recovery to estimated pre-exploitation levels. This raises important questions when we consider what an 'ecosystem in recovery' may actually look like.

The use of miniature cameras to monitor the behaviour and benthic impact of longline fishing gear at South Georgia

Chris Darby & Oliver T. Hogg

In order to investigate and monitor the potential ecological impact of longline fishing gear on the deep-water benthic environment at South Georgia and the South Sandwich Islands, the Centre for Environment, Fisheries and Aquaculture Science (Cefas) is conducting a series of research projects, funded by the UK Blue Belt programme and in collaboration with the South Georgia fishing industry. During the 2018 and 2019 seasons, cameras were deployed on 642 of the 2,403 lines set by six fishing vessels, recording 529 video observations of the benthic environment. The presentation will outline the equipment utilised and the enhanced understanding gathered on the benthic environment and the processes occurring during longline fishing interactions with the benthic ecosystems.

Spatial, temporal and demographic variability in Patagonian toothfish (*Dissostichus eleginoides*) spawning from twenty-five years of fishery data

Connor Bamford

Patagonian toothfish (*Dissostichus eleginoides*) are a commercially important species that support a longline fishery at the subantarctic island of South Georgia. Understanding the life history of Patagonian toothfish is key to the successful management and sustainability of this fishery. Using catch data from the past 25-years, 1997 to 2021, we provide an updated assessment of the spatial, temporal, and demographic variability of Patagonian toothfish spawning at South Georgia. Our findings confirm that spawning occurs in the vicinity of the shelf-break of South Georgia, with significant spawning hotspots detected at Shag Rocks, midway along both the northern and southern shelf breaks, and at the eastern end of the island. The location of these hotspots are consistent over the 25-years examined. Based on data between 1997 to 2007, when fishing occurred routinely throughout the entire Maritime Zone, 40% of detected hotspot locations overlapped with regions where Benthic Closed Areas (BCAs) were subsequently established in 2008. With this, we can estimate that approximately 40% of spawning hotspots are located within, and already protected by, the existing network of BCAs. There was evidence that the timing of toothfish spawning exhibited bimodality at South Georgia with a peak in April being observed in the first two years of the time series. This peak fell outside the licensed fishing season for many subsequent years. These findings are discussed in the context of both historic, current and possible future regulatory changes to this longline fishery.

The use of electronic monitoring to assess the risks of using net monitoring cables

James Moir Clark

In 1991, CCAMLR adopted Conservation Measure (CM) 25-03, which prohibited the use of net monitoring cables in the Convention Area following concerns over potential seabird mortalities. However, technology has developed since the introduction of this CM and the trawlers currently involved in the krill fishery that use continuous pumping methods differ operationally from the fisheries that initially led to the prohibition. The use of a monitoring cable allows for an increased data flow helping to improve fishing efficiency and catch reporting resulting in a reduction in ecosystem impact. Being able to reduce the number of times the net has to be set and hauled also increases crew safety. Vessels that use continuous pumping technology were permitted a derogation of the CM, allowing net monitoring cable trials for the 2019/20 and 2020/21 seasons. This presentation summarises the results from this trial and how electronic monitoring was used to increase the levels of observation to around 20% (of fishing time) through a combination of at sea and on shore monitoring to better assess the risks of using the cable.

Oceanographic Variability in Cumberland Bay: implications for glacier dynamics and transport of mackerel icefish larvae

Joanna Zanker

Cumberland Bay is the largest fjord on the sub-Antarctic island of South Georgia and is situated on the northeast coast. The fjord is split into two arms, Cumberland West Bay and East Bay, each with a large marine-terminating glacier at the head. These glaciers have shown markedly differential rates of retreat over the past century. Cumberland Bay is an important spawning ground for the commercially fished mackerel icefish which have a history of severe overfishing. A new high-resolution simulation of the fjord water circulation in Cumberland Bay has been built using the NEMO4 modelling framework to investigate the oceanographic variability. The model is used to help determine the dominant physical drivers of variability in our changing climate, such as freshwater runoff, bathymetric sills, and winds. A shallow bathymetric sill near the head of one fjord arm is identified as a potential driver of rapid glacier retreat. Model flow fields drive an Individual Based Model to investigate the transport and retention of mackerel icefish larvae, finding sensitivity to the rapidly changing glacier dynamics. Effective management of the mackerel icefish fishery requires an understanding of the processes driving variability in larval retention.

The South Georgia risk tool - a bespoke and interactive management tool

Oliver T. Hogg, Matthew Kerr, Lenka Fronkova, Roi Martinez, William Procter, Lisa Readdy, Chris Darby

The South Georgia risk tool is a bespoke and interactive model which utilises current and historic fisheries data to quantify the impact of longline fishing within the South Georgia and South Sandwich Islands MPA. The tool offers the functionality to simulate changes in risk to the region's ecosystems as a consequence of theoretical spatial and temporal changes to the MPA. Here we present a background to the tool, within the context of the management of the SGSSI MPA, outline the methodology used in developing the tool, provide a step-by-step guide to the tool's user interface and identify aspects of the tool for which there is scope for future refinements and development. It is intended that the risk tool will contribute to current and future reviews of the SGSSI MPA and assist in the management of the islands' waters.

Long Term Monitoring Sites

King Edward Point Science

Martin A. Collins, Carrie Gunn, George Perry & Philip R. Hollyman

The research station at King Edward Point is operated by BAS on behalf of the Government of South Georgia & the South Sandwich Islands (GSGSSI) and the Foreign, Commonwealth & Development Office (FCDO) under a tripartite MoU. In accordance with the MoU, the purpose of the KEP Research Station is to carry out an agreed scientific programme focused principally on the continued management and development of sustainable fisheries in the South Georgia Maritime Zone. The current 5-yr science programme is focussed on research associated with the toothfish, icefish and krill fisheries, and marine ecosystem (MPA) monitoring, including monitoring of predators that may be impacted directly or indirectly by fisheries. Toothfish science includes age-determination studies using otoliths and ecological studies of toothfish and by-catch species, such as grenadier. Icefish related research is focussed on the ecological role of icefish as a krill dependent predator. Krill related research includes recently initiated acoustic surveys of krill in the main fishery area, studies on larval fish by-catch in the krill fishery and monitoring of krill-eating predators (fur seals and gentoo penguins). In addition, the breeding success of elephant seals and giant petrels is undertaken in the Cumberland Bay area. KEP also supports the biennial bottom trawl surveys, that provide biomass estimates for the icefish stock assessment, information on juvenile toothfish abundance and ecological data on many other species.

Long Term Monitoring of Higher Predators at Bird Island

Ash Bennison

Higher predators at Bird Island have been monitored since 1957, though initially for albatross – the project has grown to include penguins, petrels, skuas, and fur seals. Data collected at Bird Island provides a key picture of the population trends and trajectories of higher predators and their ecology at South Georgia. This monitoring collects information population size, breeding success, and diet to inform our knowledge of local ecology. Here, we detail the methods used to monitor higher predators at Bird Island and present results from the long-term monitoring programme. Wandering albatross, black-browed albatross, and grey-headed albatross populations are in decline though variation in breeding success between the species suggests this may be due to food availability. Northern giant petrels are increasing and other species such as gentoo and macaroni penguins remain stable. Fur seals on Bird Island are currently also experiencing a decline in breeding numbers, possibly linked to food availability also. Higher predators can often be thought of as sentinels of larger ecosystem change, and the population trends associated with these species are often indicative of challenges in the surrounding ecosystem.

Project website: <https://www.bas.ac.uk/project/higher-predators-long-term-science/>

Higher Predators

Albatross and Petrel Research at Bird Island, South Georgia

Richard Phillips

The talk will be an overview of current albatross and petrel research at Bird Island, South Georgia. This research addresses diverse questions about ecology and life history, including: the roles of competition and habitat/diet specialisation in structuring seabird communities; intrinsic and extrinsic drivers of movements and behaviour; pollutants; links between foraging success, physiology and life history; pollutants and their effects, and; the implications of incidental mortality (bycatch) in fisheries, potential competition with fisheries, and changing environmental conditions on population dynamics and conservation.

Spatial Segregation of Wandering Albatrosses at South Georgia

Vicky Warwick-Evans, Elizabeth Pearmain, Andy Wood, Richard Phillips

Seabirds are amongst the most globally threatened birds, often as a consequence of incidental mortality (bycatch) in fisheries. Several species of albatrosses and petrels at South Georgia are declining, but there is marked variation in the rates of decline across breeding sites. This could reflect differences in foraging areas, which might affect the availability of natural resources or discards, or the relative overlap with different fishing fleets and hence bycatch rates. Until now, the only tracking of flying seabirds around South Georgia has been at Bird Island. We deployed satellite transmitters (PTTs) and GPS loggers on breeding wandering albatrosses at Prion Island (PTTs) and at Bird Island (GPSs). Our results indicate a surprising degree of spatial segregation of foraging distributions. Wandering albatrosses at Prion Island are more likely to forage as far as 1000-2000 km to the east of South Georgia than those breeding at Bird Island, even though the breeding populations are only c. 50km apart.

We discuss the results in terms of the potential differences in habitat utilisation and preference, as well as the relative overlap and impacts of fisheries, and whether repercussions for foraging and breeding success, or survival, may explain variation in population declines around South Georgia. The results have important conservation implications given the steep population declines of these highly threatened species.

Project website: <https://www.bas.ac.uk/project/spatial-segregation-of-seabirds-at-south-georgia/>

Ecological monitoring in a changing world - how remote cameras, citizen science and AI are supporting research in the SGSSI MPA

Tom Hart

Penguins are used as indicators of change within their ecosystem because any changes in their breeding performance, or population size and distribution are likely to reflect changes to species lower down the food chain, or in the Antarctic environment as a whole. Therefore, monitoring these species will provide valuable insight into the large-scale changes occurring. We have spent the last 10 years putting out cameras around Antarctica and the Southern Ocean, including at South Georgia and the South Sandwich Islands, to

monitor penguin annual breeding and reproductive success. We also use drones to count colonies and collect biological samples to monitor disease, diet and stress.

Images taken throughout the year at multiple locations provide the ability to answer a range of questions. Specifically, we aim to determine chick survival and breeding success, and how this varies across species ranges and between years; identify the causes of chick mortality (e.g. predation in the colony versus parents abandoning chicks); and record changes in the timing of breeding (e.g. arrival date, fledging date) and how this is affected by environmental conditions.

The remote camera network generates a phenomenal amount of data. By utilising citizen science through the Zooniverse platform, Penguin Watch volunteers have annotated images on a scale that would have been impossible for individual scientists to achieve. In addition to the benefits for ecological monitoring, such as easy detection of animal attendance patterns, this type of annotated time-lapse imagery can be employed as a training tool for machine learning algorithms to automate data extraction.

Project website: <https://www.zooniverse.org/projects/penguintom79/penguin-watch>

Fixed Wing Wildlife Surveys at South Georgia

Nathan Fenney, Philip R. Hollyman, Adrian Fox, Martin A. Collins, Philip N. Trathan, Jamie Coleman

At South Georgia, the climate is changing. Further, species abundances are changing with the recovery of historically depleted species of seal, whale and finfish. In addition, the eradication of introduced non-native mammals from South Georgia is likely to lead to changes in terrestrial habitats, with consequent changes in species diversity. Taken together, these changes mean that large ecological changes are to be anticipated as species populations (and diets) alter.

In this Darwin Plus funded project, we proposed to initiate monitoring for a range of species in order to document change. Remotely piloted aerial systems (RPAS) offer practical cost-effective solutions. This project introduced the use of new-generation fixed-wing RPAS, coupled with sophisticated automated analyses and will provide a step-change in ability for multi-species baseline reference surveys, while providing an established workflow into the South Georgia and the South Sandwich Islands Marine Protected Area (SGSSI MPA) Research and Monitoring Plan. The resulting sample data will provide direct counts and trend information. They will also help ground-truth satellite remote-sensing data that cover a wider perspective than is feasible from traditional ground surveys.

Future use of ground-truthed remote-sensing will ensure a lifetime beyond the scope of the current project. Such future-proofing, and legacy outputs will be vital for the SGSSI MPA Research and Monitoring Plan.

Project website: <https://www.bas.ac.uk/project/fixed-wing-wildlife-surveys-at-south-georgia/>

Baleen whale recovery and habitat use in South Georgia waters

Stephanie Martin, Jennifer A. Jackson, Mick Baines, Connor C. G. Bamford, Ashley Bennison, Susannah V. Calderan, Martin A. Collins, Amy S. Kennedy, Sarah Klusendorf, Russell Leaper, Sarah Marley, Paula A. Olson, Philip N. Trathan, Alexandre N. Zerbini, Emma L. Carroll

We summarise the status of baleen whale recovery and habitat use in South Georgia (SG) waters following the end of whaling, using data from four summer research expeditions and offshore acoustic monitoring year-round. Humpback, southern right, Antarctic blue and fin whales are regularly detected by passive acoustic monitoring in western shelf waters. Humpback whales are the most common visually detected species, with summer abundance estimated at 12,103 whales (CV = 0.27) from a 2019 ship-based survey, suggesting they are close to recovery from whaling. The species is concentrated in shelf waters, and locally present in summer, autumn and winter, with peak calling rates detected in winter. Southern right whales are the second most commonly seen species in coastal waters. Satellite tracking and sightings suggest they also have extended residency, using SG in summer, autumn and winter, and potentially at higher densities toward the west of the island. Both species show fluctuating occurrence at SG over time, associated with different phases of the Southern Annular Mode. Endangered Antarctic blue whales are increasingly sighted and acoustically detected in SG waters; further research is required to understand their habitat use patterns. Fin whales are now abundant in the Scotia Arc in summer, but mainly located south of SG. Overall, 43,824 (CV=0.15) baleen whales are now estimated to use SG and South Sandwich Islands waters in summer, consuming 4.8-7.2 million tonnes of krill, highlighting the importance of continuing to monitor recovery and to understand the role and impact of foraging whales within the ecosystem.

Human Impacts

An Update on Marine Debris in South Georgia: emerging awareness of microplastic pollution

Jack Buckingham, Claire Waluda, Cath Waller

This work describes the first comprehensive assessment of microplastics in the nearshore environment of South Georgia. Samples were collected and analysed for their microplastic contents in: seawater sampled from the coast and offshore, wastewater from land-based human habitation, precipitation, zooplankton, nototheniid and myctophid fish, and in the scats of Antarctic fur seals and gentoo penguins.

The concentration of microplastic in seawater was 0.58 ± 5.17 particles L⁻¹, higher than many other records of microplastics in surface seawater from the Southern Ocean. The microplastic concentration in zooplankton was 1.6 ± 1.6 particles per 15 g, and microplastic was found in every year examined (alternate years, 2009 - 2019) with no significant change in concentration over time. Two microplastics were retrieved from fish (*Lepidonotothen larseni* and *Patagonotothen guntheri*), and the concentration in higher predators was 0.04 ± 0.05 particles g⁻¹ of scat (fur seals) and 0.08 ± 0.09 particles g⁻¹ of scat (gentoo penguin), greater than abundances recorded from the Antarctic Peninsula, but lower than reports from lower latitudes.

This work contributes to our knowledge of the scale of anthropogenic stress on the South Georgia ecosystem and provides a baseline, in terms of findings and best methodological practices, for any future research or monitoring of microplastics in this region. Although wider ecological questions remain, the extent of microplastic in South Georgia nearshore waters has been quantified for the first time.

Identifying risks and management priorities through marine invasion pathway analysis in the sub-Antarctic

Dan Bayley, Paul Brewin, Ross James, Arlie McCarthy, Paul Brickle

The threat from novel marine species introductions is a global issue. Non-native species can become invasive, affecting biodiversity, industry, ecosystem function, and the health of both humans and wildlife. Isolated areas with sensitive or highly specialised endemic species can be particularly impacted. The global increase in the scope of tourism activities and a rapidly changing climate, make previously isolated ecosystems now at risk. The SGSSI archipelago has high biodiversity and endemism, and no non-native species are known to have yet established. This is likely because the islands are remote and sit below the Polar Front, affording some protection against historical introductions. However, the region is rapidly warming and SGSSI increasingly acts as a gateway for vessel traffic into the wider Antarctic, amplifying invasion likelihood.

We analysed Automatic Identification System (AIS) vessel-tracking data over a two-year period and assessed multiple risk factors from invasion pathways across the 'Scotia Sea', 'Magellanic', and northern 'Continental High Antarctic' ecoregions. We show that multiple vessel types from locations across the globe frequently now enter shallow inshore waters and stop for prolonged periods (weeks/months) at anchor. Vessels are active throughout the year and stop at multiple ports, frequently crossing international waters and ecoregions. The majority of vessels then passage to the Antarctic Peninsula as their next port-of-call. Within SGSSI, management recommendations include beginning benthic and hull monitoring at the identified areas of peak activity and dispersion, alongside regional collaboration and coordination at neighbouring international ports to pre-emptively manage this risk.

Ship strike risk to whales in South Georgia waters

Russell Leaper, Manuela Basso, Danielle L. Buss, Susannah V. Calderan, Emma L. Carroll, Martin A. Collins, Paul Ensor, Amy S. Kennedy, Paula A. Olson, Jennifer A. Jackson (online presentation)

Whale sightings at South Georgia (SG) have recently been increasing as they recover from severe depletion by industrial whaling. As cruise ship traffic around SG has also increased, there is a need to address the risk of collisions between ships and whales. We used sightings data collected during a SG research survey in summer 2020 to calculate whale density, together with AIS data on shipping traffic to estimate shipping density (km travelled per km²), examining ship strike risk and possible mitigation options. Humpback and blue whale average estimated density was 0.089 individuals.km⁻² and 0.009 individuals.km⁻² respectively. Humpback densities were particularly high in shelf waters north of SG, corresponding to the area most used by cruise ships. A simple encounter model was used to estimate a risk index based on whale and cruise ship densities in summer 2020. This index was the estimated annual number of lethal ship strikes from cruise ships assuming no avoidance by vessel or whale, and was estimated at 28 humpback and 1.5 blue whales. These should not be considered as estimates of likely mortality but show that in a global

context, SG should be considered a high-risk area based on whale densities observed in 2020. As it is unlikely that there would be any particularly important areas for humpback whales that could be avoided by simple routing measures, we suggest speed restrictions for vessels in SG waters to 10 knots, reducing ship strike risk and providing other environmental benefits including lower emissions and reduced underwater noise.

What goes thump at night: managing bird-strike in South Georgia

Megan Tierney, Matt Parsons, Hannah Wheatley, Elinor Grant, Helen Baker, Susan Gregory, Jennifer Black, Amanda Lynnes, Peter Thomson (online presentation)

Seabird population declines on South Georgia and South Sandwich Islands (SGSSI) may be attributed to factors including bird-strike – the collision of birds in flight with vessels resulting in physical injury or death. Basic bird-strike reporting protocols for SGSSI do exist, but data collection is not standardised, making robust analysis challenging. Consequently, factors leading to bird-strike events and the magnitude of the problem in SGSSI waters are poorly understood. This presentation will outline the steps taken by the partners involved with the Darwin Plus funded project that aims to improve the bird-strike reporting system for all vessels operating in the SGSSI Maritime Zone, and which will ensure practical, standardised data collection and robust analysis to inform future management practices. We will also showcase the revised bird-handling guidelines which are hoped will enhance the chances of survival of landed birds.

Climate Change

MCCIP: Key climate change effects on the coastal and marine environment around the Polar UK Overseas Territories

Oliver T. Hogg, Rachel Cavanagh, Susie Grant, Mark Belchier, Susan Gregory, Martin A. Collins

The UK Overseas Territories (UKOTs) constitute a small land area with large marine provinces, which collectively represent the 5th largest marine estate in the world. Focusing on six key regions (Polar, Pacific, South Atlantic, Mediterranean, Caribbean and Mid-Atlantic, and Indian Ocean), the Marine Climate Change and Impact Partnership (MCCIP) brought together more than 60 leading experts from all 14 UKOTs. The aim of this initial piece of MCCIP polar work was to help prioritise and highlight the most important ecological and societal climate challenges facing SGSSI and the British Antarctic Territory.

'Megaberg' impacts at South Georgia: the collapse of iceberg A68a in a sensitive marine ecosystem

Geraint A. Tarling speaking on behalf of the A68a Team

In April 2021, the last remnants of giant iceberg A68a were officially declared too small to remain classified as an iceberg, and so came to an end one of the most surveyed and reported upon icebergs in recent history. A68 began its life as one of the largest icebergs ever recorded and ended up perilously close to running aground on the South Georgia shelf, at which point it became a sensation in the world's media. A UK research vessel (RRS *Discovery*) visiting the region to collect samples and data for a number of sustained observation programmes was diverted to the iceberg for 3 days to collect as much in situ information as possible. At the point when the vessel arrived, the iceberg had already

started to collapse into a complex assemblage of smaller icebergs. The observations made provide a unique insight into the physical, biogeochemical and biological impacts of an iceberg during its terminal phase. Additional data were obtained from underwater gliders which were able to traverse under icebergs, and analyses of satellite data have provided further wider-scale perspectives. Encroachment of giant icebergs into the South Georgia region may become more common given that ice shelf calving is predicted to increase in frequency. Research on the collapse of A68a provides a valuable insight into the likely impacts this will have on this sensitive marine ecosystem.

Five-years on: Assessing the Efficacy of the South Georgia and South Sandwich Islands Marine Protected Area under Shifting Biological, Climatic and Geopolitical Conditions

Johnny Briggs

Recognizing the unique biological significance of South Georgia and the South Sandwich Islands (SGSSI), the local government established a marine protected area (MPA) in 2012; this included no-take zones surrounding the islands, which collectively totalled approximately 20,000 km² (12,400 miles²) - or 2% of the exclusive economic zone (EEZ). Protections have subsequently been enhanced to the extent that today the fully protected areas total 283,000 km² (109,266 miles²), or 23% of the total maritime zone. Where feasible the best available science has been utilized to inform management decisions, although in 2018, the precautionary principle was also applied to enhance protection of the South Sandwich Trench and pelagic zone of the EEZ below 60 degrees south.

The Great Blue Ocean coalition (GBO) was honoured to contribute science to the 2018 review process – and has since continued to partner on innovative research projects over the following five years. This presentation will evaluate whether existing management provisions to protect marine biodiversity and manage fisheries sustainably are sufficient, under shifting biological and climatological conditions and increasingly complex regional management dynamics.

The presentation will focus upon climate impacts within SGSSI, protection of recovering species, the precedent of applying the precautionary principle, the interaction of local and regional governance, economics, and the global conservation context in 2023. The presentation will include GBO sponsored research completed since the 2018 review.

Future Work

South Georgia All-Island Decadal Albatross Survey

Jennifer Black

South Georgia is home to globally significant populations of wandering, black-browed and grey-headed albatross. Due to local declines, these populations have been designated as Priority Populations by the Agreement on the Conservation of Albatross and Petrels (ACAP). Monitoring of colonies at Bird Island and Prion Island is undertaken annually, but to determine if trends observed at these sites are representative, whole island surveys are undertaken every 10 years. The next such survey is due to take place in 2023/2024. Surveys of black-browed and grey-headed albatrosses will be undertaken from the GSGSSI fisheries patrol vessel and will use traditional boat-based photography techniques

alongside a drone survey to compare efficacy. Counts of wandering albatrosses will be taken from a charter yacht and will be undertaken in parallel with surveys for native and non-native plants. The output of these surveys will form the basis for updated Albatross Action Plans and will inform ongoing monitoring and management as part of the newly designated South Georgia Specially Protected Area.

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

Richard Phillips, Peter Fretwell, Ellie Bowler, Marie Attard

Globally important populations of seabirds breed at South Georgia, but because of the size and remoteness of these islands, monitoring is limited to few locations. This project will 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, and develop methods that could replace expensive and logistically challenging ground surveys across numerous remote islands worldwide. This project aims to assess the viability of using VHR satellite imagery to survey mollymawks (black-browed and grey-headed albatrosses), giant petrels and shags at South Georgia. We will also develop textural and spectral methods to map vegetation richness, and hence the distribution and abundance of burrow-nesting petrels. If successful, we will apply these approaches within the 3-year project to complete the first remote censuses of the entire island group for selected species.

Seasonal use of the SGSSI MPA by penguins from Zavodovski Island, South Sandwich Islands

Norman Ratcliffe, Tom Hart, Klemens Pütz

Zavodovski Island hosts the largest chinstrap penguin colony in the world and the largest macaroni penguin colony in the Scotia Arc outside of South Georgia. The use of the SGSSI MPA by these populations is unknown. This project aims to census the colonies using drones and track both species throughout their annual cycle using GPS, PTT and GLS loggers. We will model these data to estimate penguin densities through the four stages of the season (i.e. incubation, chick-rearing, pre-moult and winter migration) which will allow recognition of hotspots and the estimation of the proportions of time spent within the MPA and outside the 50 km No Take Zone around the coastline of the South Sandwich Islands. We will also collect scats to examine prey composition using DNA analysis. These data will allow development of a risk assessment for potential competition with krill fisheries, which will inform management decisions should the fishery start to extend its activities to the South Sandwich Islands.

Characterising the pelagic community of South Georgia through novel sampling methods

Cecilia M. Liszka, Vicky Fowler, Geraint A. Tarling, Marianne Wootton, Sophie Fielding, Ryan Saunders, Philip R. Hollyman, Alison Cleary, Mark Belchier, Vicki Foster

The plankton community of South Georgia is a critical component of the Scotia Sea ecosystem, connecting primary producers, supporting globally important populations of higher predators, and sustaining commercially valuable fisheries. Zooplankton and ichthyoplankton are also key bioindicators of environmental change since they are small, have short life-cycles and respond rapidly to environmental changes. Establishing a pelagic biodiversity baseline at South Georgia is crucial to assess the stability of this

system and its response to climate-related changes and species invasions. Whilst routine sampling of the plankton is carried out, analysis is currently limited to a small range of taxa such as euphausiids, fish and *Themisto* spp. Detailed monitoring through net sampling alone is costly, time-consuming and can miss important fractions of the plankton community. Through a new Darwin+ funded project, we plan to address this by using novel image and molecular analyses, validated by conventional net sampling. We aim to contribute to the management of the South Georgia and South Sandwich Islands Marine Protected Area (SGSSI MPA) by developing methods that enable the future collection and analysis of key zooplankton and ichthyoplankton biodiversity data, and metrics that will allow the monitoring of under-sampled and invasive taxa. In this talk we will present our project's key aims and objectives, provide an update on activities to date, and describe some of the potential applications of these methodologies in a monitoring and management context.

Project website: <https://www.bas.ac.uk/project/south-georgia-pelagic-biodiversity/>

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, Susan Gregory

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.

Project website: <https://www.bas.ac.uk/project/fish-by-catch-in-the-antarctic-krill-fishery/>

Evaluating climate change risks to Patagonian and Antarctic toothfish

Rachel Cavanagh, Martin A. Collins, Jennifer Freer, Simeon Hill, Oliver T. Hogg, Philip R. Hollyman, Marta Soeffker, Sally Thorpe, Claire Waluda

This presentation will provide an overview of a new Darwin Plus project to evaluate climate change risks to Patagonian and Antarctic toothfish in the waters surrounding South Georgia and the South Sandwich Islands (SGSSI). Climate change is altering ecosystems and fisheries around the world, affecting the ability of fisheries management to deliver their objectives, with consequences for the conservation and management of marine living resources. Patagonian and Antarctic toothfish (*Dissostichus eleginoides* and *D. mawsoni*) are high-value deep-water species caught by longline fisheries in the Southern Ocean,

including SGSSI. Given the longevity and complex life history of these species, their integral role in the ecosystem, and their value, understanding potential impacts of climate change on stocks, and developing management strategies and measures that take account of these, is essential. This project will synthesise relevant environmental, biological and fishery information and use this to undertake a risk assessment of climate-driven change to toothfish in SGSSI. The results will inform toothfish fishery management and the SGSSI Marine Protected Area.

Development of alternative population assessment models for Patagonian toothfish in Subareas 48.3 and 48.4

Lisa Readdy

This research examines the utility of integrated stock assessments to be used to assess the status of fish populations with migratory movements such as Patagonian toothfish (*Dissostichus eleginoides*) at South Georgia and the South Sandwich Islands (CCAMLR Subareas 48.3 and 48.4 respectively) where tag release and recapture data show strong connectivity between the two Subareas across different life phases as well as ontogenetic movement, movement to deeper water as fish age.

To date integrated assessment models, such as CASAL, have been used to assess the status of toothfish in the two Subareas as separate populations. More recent developments have indicated the importance of accounting for spatial location, movement and interaction of the fishery and fish population being targeted, suggesting that by including it uncertainty in model estimates of population status and exploitation rates is reduced and as a consequence provides more robust advice on sustainable catch limits. The research will investigate the importance and impact of including spatial components using available integrated stock assessment models where connectivity between two Subareas is observed, but where very different levels of fishery catch and estimated stock sizes are realised.

An initial comparison was carried out between the available integrated assessments, CASAL and stock synthesis, using data collected from the longline fishery and a biennial survey series. It showed differences in the absolute levels of estimated biomass, harvest rates and recruitment levels however, the trends were similar across the different modelling approaches. The comparisons showed the importance of the tag release and recapture data as although, the two frameworks are essentially similar, stock synthesis is unable to use the tag release and recapture data for model tuning and therefore, has less available information to inform the model and parameters.

Mitigating the spread of marine invasive non-native species (INNS) to South Georgia & South Sandwich Islands

Paul Brickle

Following on from the recent SAERI marine invasive pathway analysis, this project will establish strategic vessel hull inspections (based on high-risk vessels identified within the pathway analysis) at the highest risk ports of Stanley (FI). High-risk vessels such as yachts and fishing boats entering or transiting FI/SG will be subject to hull, and niche area inspection. Using an ROV and/or trained divers. Ballast water logbooks will also be inspected, in order to ascertain volumes and diversity of organisms being transferred, and to identify level of maintenance being undertaken by each vessel type. Protocols will be built from these data to ensure adequate monitoring is in place, and to inform vessel

owners on the risks and their responsibilities. The projects will also investigate the thermal tolerance of Falkland Islands species that are likely to arrive in SG and potentially be problematic. The project will review current hull clearing practice and regularly within fleets operating in SGSSI. In addition, the project will review standards for clean hull certification elsewhere in the world and through a workshop examine the feasibility pre-boarder clean hull certification and potential prior targeted inspection prior to entry into SG.

Hungry humpbacks: measuring seasonal foraging intensity at South Georgia

Stephanie Martin, Eduardo Camargo, Emma L. Carroll, Fredrik Christiansen, Martin A. Collins, Ari S. Friedlaender, Susan Gregory, Joanna L. Kershaw, Michael J. Moore, Rodrigo H. Tardin, Vicky Warwick Evans, Amy S. Kennedy, Alexandre N. Zerbini, Jennifer A. Jackson

Whales are the largest krill-predators at South Georgia (SG), yet their impacts on krill stocks are poorly understood. Recently, whale surveys revealed high summer abundance and extended use of SG waters into winter, coincident with a krill fishery. The Hungry Humpbacks project aims to measure 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, and inform krill quota-setting for the Subarea 48.3 CCAMLR krill risk assessment.

Acoustic monitoring of whales and vessels in Cumberland Bay, South Georgia

Susannah V. Calderan, Denise Risch, Russell Leaper, Jennifer A. Jackson (online presentation)

The CAM project (Cumberland Bay Acoustic Monitoring) aims to help the GSGSSI take proactive steps to minimise negative impacts to recovering whales in South Georgia waters by monitoring whale occurrence in the high traffic area around Cumberland Bay. This is a collaboration between the British Antarctic Survey and the Scottish Association for Marine Science. With funding from the Blue Belt Program, we have designed three underwater moorings to conduct passive acoustic monitoring (PAM) of whales and underwater noise in the vicinity of Cumberland Bay. Two moorings, with single PAM units (Soundtraps) are located in the eastern arm of the bay and close to the entrance of the western arm respectively. A third mooring, located outside the bay entrance, will be a PAM array containing three equally spaced Soundtraps. The mooring array is intended to provide information on locations of calling whales as well as species identity. Passive acoustic monitoring in Cumberland Bay will provide a multi-year measure of whale occurrence and densities. The data collected in this project will allow assessments of ambient noise levels in an area of concentrated traffic, track changes in relation to vessel type and densities, as well as estimate potential impacts on detected whales.

4. Speaker Biographies

Anderson, Madeline

British Antarctic Survey (BAS)

Mads Anderson is a PhD student at the British Antarctic Survey, Newcastle University and the University of Glasgow. Their research focuses on the impact of methane seepage on communities of organisms that live on, or in, the seafloor on the South Georgia shelf. In particular, they are examining the abundance, diversity, functioning and foodwebs of these methane seep communities, and how these differ to non-seep ecosystems. In November and December 2022, Mads participated in the PS133-2 “Island Impact” expedition on the RV *Polarstern* to study methane flare sites on the South Georgia shelf.

Bamford, Connor

British Antarctic Survey (BAS)

Connor Bamford is a marine ecologist specialising in geospatial analyses. He joined BAS in 2017 as a post-graduate modelling predator distribution around South Georgia. His doctoral research assessed the overlap between Antarctic fur seals and the krill fishery and examined how humpback whales use the MPA. As a Postdoc, he worked on reanalysing toothfish fishery data at South Georgia to investigate spawning locations. He is currently involved with a NERC/NSF project on crabeater seals on the Antarctic Peninsula. Connor is interested in ensuring that his research informs science policy and aids the ongoing conservation and management efforts in Antarctica.

Bayley, Dan

Flora & Fauna International

Dr Dan Bayley is a marine ecologist specialising in reef and kelp-dominated systems. His work focusses on biodiversity monitoring, habitat management, and technology development within both tropical and temperate systems. He is currently a Senior Technical Specialist in blue carbon at Fauna & Flora International in Cambridge, and an Honorary Senior Research Fellow at University College London.

Belchier, Mark

Government of South Georgia & the South Sandwich Islands (GSGSSI)

Dr Mark Belchier is the Director of Fisheries & Environment for GSGSSI. He joined the Government in 2018 on secondment from the British Antarctic Survey, where he had worked on South Georgia marine and fisheries science projects since 2000. Mark established the applied fisheries research laboratory at King Edward Point (KEP), as well as developing and managing the KEP research programme. He holds a PhD in marine fisheries ecology and has extensive fisheries research experience, including leading nine research surveys of fish resources at South Georgia. Mark is part of the UK Delegation to CCAMLR and has chaired many international conservation and fisheries treaty meetings.

Bennison, Ash

British Antarctic Survey (BAS)

Ash Bennison is the Bird Island Science Manager at the British Antarctic Survey. Ash is responsible for delivering the long-term research of albatrosses, penguins, petrels, and fur seals as well as facilitating other research projects on the island. Ash joined the British Antarctic Survey in January 2021 and prior to this worked in Ireland on a variety of seabird and marine mammal research projects.

Black, Jennifer***Government of South Georgia & the South Sandwich Islands (GSGSSI)***

Jennifer Black has a background in polar research and has been working with the Government of South Georgia & the South Sandwich Islands since 2012. She is currently Head of Environment and responsible for wide range of projects including: oversight of permitting and compliance with environmental legislation; invasive species management and biosecurity; oversight of reporting and actions under various multi-lateral environmental agreements including CBD, ACAP and CMS; terrestrial protection including lead on Environmental Impact Assessments and the Specially Protected Area programme; and the much envied task of coordinating the design of the Territories stamps and coins.

Brickle, Paul***South Atlantic Environmental Research Institute (SAERI)***

Paul Brickle is the Executive Director of the South Atlantic Environmental Research Institute (SAERI). Paul is an experienced marine ecologist with a great deal of South Atlantic expertise and he joined SAERI when it formed in 2012 after 15 years working as a Fisheries Biologist and Marine Ecologist with the Falkland Islands Government Fisheries Department. Paul has a BSc (Hons) in Marine Biology from the University of Newcastle upon Tyne. He also has an MSc and PhD from the University of Aberdeen, Scotland in fisheries biology and zoology respectively. His experience includes fisheries biology, marine biology and ecology, stock assessment methods, oceanography and modern statistical methods. He has led numerous research programmes and managed the performance of other scientists. Paul is also a Reader at the School of Biological Sciences, University of Aberdeen.

Briggs, Johnny***Great Blue Ocean Coalition (GBO)****

Johnny Briggs leads the Pew Bertarelli Ocean Legacy Project's international marine policy and science efforts and collaborates with governments around the world to improve marine conservation outcomes. In his role, he works across Pew's marine habitat group and supports international marine protection efforts through the Pew Bertarelli Ocean Legacy Project, Blue Nature Alliance, and Enduring Earth. He has also contributed towards the legal designation of large, ecologically significant, and effective marine protected areas in the United Kingdom Overseas Territories, including in the Pitcairn Islands, Ascension, and Tristan da Cunha. Before joining Pew, he worked for more than seven years on environmental policy and global advocacy projects at a consultancy in central London. He holds a master's degree in global energy and climate change policy from SOAS University of London and a doctorate in climate science from the University of Nottingham.

*Great Blue Ocean (GBO) is a coalition of six organisations - Blue Marine Foundation; Greenpeace UK; The Marine Conservation Society; The Pew Trusts; The Royal Society for the Protection of Birds; The Zoological Society of London. Representing over two million members, GBO work with partners in the UK OTs to enhance marine conservation in these exceptional places.

Juliet Brodie***Natural History Museum (NHM)***

Prof. Juliet Brodie is a Merit Researcher in Phycology at the Natural History Museum, London. She is an expert on seaweeds, notably red algae and specializes on seaweeds in a time of rapid environmental change. Research includes biodiversity discovery, taxonomy, phylogenetics, holobiontes, conservation, seaweed aquaculture and structural colour. Her research takes her to many parts of the world, including South Georgia. She was a

Scientific Advisory Panel member, Marine Conservation Zones, 2010-2013. Awards received include the 2020 Linnean Medal for Botany and Plantlife Award for Outstanding Contribution to Plant Conservation, 2007. She is currently the Phycological Society of America President-Elect.

Buckingham, Jack

University of Hull / British Antarctic Survey (BAS)

Jack Buckingham is a marine biologist with an interest in understanding the impacts of anthropogenic activities on the marine environment. He has experience and expertise in quantifying marine debris, including microplastic pollution, in a variety of coastal environments, with a particular passion for island locations having undertaken his MSc fieldwork in the Scottish Orkney Islands and his PhD fieldwork in South Georgia. Jack's PhD focused on analysing microplastic contamination in the nearshore environment of South Georgia. He is a member of the Association of Polar Early Career Scientists and of the SCAR Plastics Action Group.

Calderan, Susannah

Scottish Association for Marine Science (SAMS)

Susannah Calderan is a marine mammal ecologist and Research Fellow at the Scottish Association for Marine Science (SAMS). Her research interests focus on passive acoustic monitoring, in particular of large whales in the Antarctic and sub-Antarctic. Much of her work involves developing new visual and acoustic survey and analysis techniques for localising and tracking cetaceans at a range of spatial scales. Susannah also studies anthropogenic impacts on cetaceans, in particular underwater noise and fisheries bycatch.

Cavanagh, Rachel

British Antarctic Survey (BAS)

Rachel Cavanagh is a marine ecologist at the British Antarctic Survey. Rachel's work is multi-disciplinary, linking ecology, fisheries and climate science, and encompassing research, policy and stakeholder engagement, to improve the scientific basis to understand and manage changing marine ecosystems. Rachel is a member of the UK Delegation for the Commission for the Conservation of Antarctic Living Resources (CCAMLR), leading on climate change.

Collins, Martin

British Antarctic Survey (BAS)

Martin Collins is an experienced marine ecologist and is the science manager for the King Edward Point Research Station. Martin returned to BAS in 2019 after 10 years away, and during that time Martin served as the Chief Executive and Director of Fisheries for the GSGSSI (2009-2015) and also as the Director of the Blue Belt Programme at the Cefas (2016-2018). Martin has considerable experience of working on and around South Georgia and during his time with GSGSSI oversaw the creation of the Marine Protected Area, the eradication of reindeer from the island and was on the steering committee for the rodent eradication. Martin was awarded an OBE in the New Year Honours (2014) for services to science and conservation on South Georgia. Martin is also an Adjunct (Honorary) Professor at University College Cork, Ireland, and was recently appointed as Scientific Committee Representative on the UK delegation to CCAMLR.

Darby, Chris***Centre for Environment, Fisheries and Aquaculture Science (Cefas)***

Dr. Chris Darby is a Senior Fisheries Science Advisor to UK Defra and the UK FCDO, he has extensive experience of leading research teams in the provision of scientific analysis and advice direct to government advisors prior to and during fisheries negotiations. As Cefas Blue Belt science lead, Chris has been responsible for guiding the Blue Belt science teams providing advice to the UK FCDO and the UK Overseas Territories. Since 2012 Chris has coordinated Cefas research and advice within the South Georgia & South Sandwich Islands MPA.

Dornan, Tracey***British Antarctic Survey (BAS)***

Tracey Dornan is a fisheries acoustician with the British Antarctic Survey. She uses a combination of active acoustic methods, biological sampling and statistical modelling to study the distribution and behaviour of Southern Ocean micronekton, including fish and Antarctic krill. She is keen to understand how the spatial and temporal fluctuations in micronekton abundance affects the wider ecosystem, including higher predators. Tracey is particularly interested in applied research that has the capacity to inform sustainable fisheries management and develop sound conservation measures and is a UK delegate to the CCAMLR Working Group on Acoustic Survey and Analysis Methods.

Everson, Inigo***University of East Anglia (UEA)***

Inigo Everson is an Honorary Professor at the University of East Anglia where he actively continues research on fisheries issues. Whilst at FAO in 1976, he was a key scientific contributor to the negotiation of CCAMLR, an organisation in which he has chaired the Scientific Committee, along with the Working Groups on Fish Stock Assessment and Ecosystem Monitoring and Management. He was a member of the UK delegation to CCAMLR for 20 years. He has experienced Southern Ocean fisheries at first hand, having led a number of trawl and acoustic surveys as well as being an International CCAMLR Fisheries Inspector. His research, spanning over 40 years has resulted in over 100 peer reviewed papers mainly on Antarctic fish, krill and ecosystem interactions. Inigo's contributions to fisheries research at South Georgia were recognised when the main accommodation building at King Edward Point was named Everson House in his honour when the station reopened in 2001.

Fenney, Nathan***British Antarctic Survey (BAS)***

Nathan Fenney is a Geomatics Specialist with the Mapping and Geographic Information Centre (MAGIC) at the British Antarctic Survey. He is the technical lead for geomatics projects within MAGIC, with a focus on global navigation satellite systems (GNSS), aerial survey, 3D data collection (including photogrammetry and terrestrial laser scanning (TLS)) and 3D modelling. Nathan's work supports BAS science, operations and infrastructure modernisation and involves the use of terrestrial survey, aerial photography (including from remotely piloted aerial systems (RPAS)) and remote sensing using VHR (very high resolution) stereo satellite imagery.

Fretwell, Peter***British Antarctic Survey (BAS)***

Peter Fretwell is a Geographic Information Officer at the British Antarctic Survey. His work currently involves geospatial analysis and applied remote sensing across a range of

environmental fields. Recent emphasis has been on the use of very high-resolution satellite imagery to count and study wildlife, and the construction of digital elevation models such as the Bedmap2 project which mapped the bed topography of Antarctica. Additionally, his role includes supporting BAS science and logistics with mapping and geospatial analysis and updating the Antarctic Digital Database.

Grant, Susie

British Antarctic Survey (BAS)

Dr Susie Grant is a marine biogeographer at the British Antarctic Survey, with an interest in developing scientific advice for policymakers in the polar regions. Her research is focused on supporting the conservation of marine ecosystems and the sustainable use of marine resources, including the development of MPAs and spatial management, and the adaptation of management strategies in a changing climate. She has been a scientific advisor as part of the UK delegation to CCAMLR since 2005, and is currently the Chief Officer of the SCAR Standing Committee on the Antarctic Treaty System (SC-ATS).

Hart, Tom

Oxford Brookes University

Dr Tom Hart is a penguinologist and Senior Research Fellow at Oxford Brookes University. Tom's PhD focused on tracking macaroni penguins to understand their foraging behaviour; since then, he has diversified his research interests to integrate genetics and image analysis to provide long-term, large-scale monitoring of marine predators in remote places. His work has focused on penguins and seals along the coastline of the Scotia Arc, however he also works in the Palearctic region and along the coast of the UK for his research on seals and seabirds. Tom has developed semi-automated monitoring systems, deploying a network of remote cameras primarily from cruise ships and using citizen science and AI to assist in analysing the vast catalogues of time-lapse images. Tom's aim is to define biologically meaningful management units for policy makers and to help identify where best to place protected areas.

Hill, Simeon

British Antarctic Survey (BAS)

Simeon Hill is a marine and fisheries ecologist based at the British Antarctic Survey. His research explores stability and change in South Ocean ecosystems, with a major focus on the role of Antarctic krill. Simeon has also participated in groundfish surveys on commercial fishing vessels around South Georgia. He is a long-serving member of the UK delegation to CCAMLR, chairs an expert panel on fishing industry voluntary measures, and is a board member of an international scientific action group on krill. Before joining BAS he was a fishery management advisor.

Hogg, Oliver

Centre for Environment, Fisheries and Aquaculture Science (Cefas)

Dr Oliver Hogg is a benthic ecologist at the Centre for Environment, Fisheries & Aquaculture Science (Cefas) with expertise in modelling and mapping the distributions of habitats and species in support of area-based management of the marine ecosystems. Dr Hogg is currently a lead researcher on the UK Government funded Blue Belt Programme with responsibility for the South Georgia and South Sandwich Islands portfolio. A core part of this work is quantifying the impacts of fishing gear on non-target species and dependent ecosystems and providing scientific advice to support sustainable fisheries.

Hollyman, Philip***British Antarctic Survey (BAS)***

Phil Hollyman is a fisheries ecologist at the British Antarctic Survey, where he works on several aspects of the fisheries around South Georgia. His research is primarily focussed on how the information stored in age registering structures, such as shells and ear bones (otoliths), can be used to inform management of marine fisheries. Over the last 5 years Phil has worked on projects that used sclerochronology (the study of periodic growth rings in calcified structures) to improve the understanding of biological and ecological aspects of commercially important species. One of his main responsibilities is the Patagonian toothfish ageing program, where he works closely with the GSGSSI and Cefas to provide information for the long-term ecosystem-based management of this species. Since 2018, Phil has been a member of the UK delegation to CCAMLR and participates in the Working Groups on stock assessment and management (WG-SAM) and fish stock assessment (WG-FSA).

Jackson, Jennifer***British Antarctic Survey (BAS)***

Jennifer Jackson is a marine mammal ecologist and geneticist based at the British Antarctic Survey. She has a particular interest in whale population connectivity and recovery from whaling with a specialisation in Southern Hemisphere species, and has been leading research into whale recovery at South Georgia since 2017. For the last six years she chaired the Southern Hemisphere sub-committee at the International Whaling Commission, overseeing population assessments of Southern Hemisphere whale recovery.

Kasten, Sabine***Alfred-Wegener Institute (AWI)***

Prof Sabine Kasten is the Head of Marine Geochemistry at the Alfred-Wegener Institute in Germany, and a Professor of Sediment Diagenesis at the University of Bremen. Her research interests include geochemistry, biogeochemistry and early diagenesis in coastal and marine sediments; impact of transient sedimentary processes and redox environments on biogeochemical processes, element fluxes, signal formation and alteration of paleo-environmental and paleo-oceanographic proxies; geochemical processes and mineral authigenesis in methane-rich environments, deep subsurface sediments and carbon-starved deposits; diagenetic modelling. Sabine has participated in more than 35 seagoing expeditions on a range of research vessels, including as proponent and chief scientist on RV *Polarstern* and RV *Meteor* cruises to South Georgia & the South Sandwich Islands.

Leaper, Russell***International Fund for Animal Welfare (IFAW)***

Russell Leaper studied mathematics at Oxford University before starting research on marine mammals in 1988. He initially worked on developing acoustic methods to study and count whales. His subsequent research has covered a range of conservation and welfare issues with an emphasis on survey methods and population assessment. In addition to data analysis he has conducted extensive field work from a range of vessels including surveys around South Georgia and elsewhere in the Southern Ocean. Russell has been a member of the Scientific Committee of the International Whaling Commission since 1996 and attends as a member of the UK delegation.

Liszka, Cecilia***British Antarctic Survey (BAS)***

Dr Cecilia Liszka is a marine ecologist in the Ecosystems team at the British Antarctic Survey. Her research focuses mostly on the pelagic ecology of the Scotia Sea region, in particular zooplankton and krill. Interests include influences on community structure, role in carbon flux, ecosystem interactions, and applications to conservation and management. She is currently working on two Darwin+ funded projects focussed on the South Georgia region (Winter Krill and South Georgia Pelagic Biodiversity) and has recently published work on the structure of the planktonic environment of the South Sandwich Islands.

Martin, Stephanie***British Antarctic Survey (BAS)***

Stephanie Martin is a marine biologist who has worked around South Georgia and the Antarctic for over twenty years on expedition cruise ships as naturalist and expedition leader. She was also part of the 2018/2019 BAS KEP field team. Stephanie worked as Environment Officer for the Government of Tristan da Cunha for several years and was instrumental in the establishment of the TdC Marine Protection Zone, and as Overseas Territories (OT) representative on the UK Government's Blue Belt Programme, she represented the OT's at COP 26 in Glasgow in 2021, and at the UN Oceans Conference in Lisbon in 2022. Stephanie is currently project manager for Jen Jackson's BAS South Georgia Whale Projects.

Moir Clark, James***Marine Resources Assessment Group (MRAG)***

James Moir Clark has a Master's degree in environmental technology from Imperial College, where he specialised in fisheries and has since had 20 years' experience in fisheries management. He is a Director at MRAG with wide ranging experience in the field of monitoring, control and surveillance (MCS), in particular the management of observer programmes, including within ICCAT, IOTC and CCAMLR. More recently he has been involved in several programmes providing Safety Advisors and Auditors to monitor and improve vessel crew welfare at sea. He has been the Head of Delegation for UK(OT) at the IOTC Scientific Committee and the EU's Scientific Committee representative at CCAMLR. He has also sat on the UK delegation at CCAMLR and chaired the Workshop on SISO (WG-SISO) and the Working Group on Incidental Mortality Associated with Fishing (WG-IMAF).

Peacey, Ruth***Talesmith TV***

Ruth Peacey is a Producer Director specialising in penguins and conservation. When not standing knee deep in guano or sailing the Southern Ocean, she is most likely to be found using her film making skills to help tackle conservation issues, such as illegal bird persecution across Europe. Ruth has fulfilled her passion for remote places and wildlife whilst filming globally for productions including Planet Earth ii, Natural World and, most recently, A Year on Planet Earth. She is currently finishing her own documentary Expedition Penguin, which follows a team of scientists as they uncover the secrets of the South Sandwich Islands.

Peat, Helen***British Antarctic Survey (BAS)***

Helen Peat is Head of the UK Polar Data Centre which is the focal point for Arctic and Antarctic environmental data management in the UK. Her background is in biology and

she has managed many of BAS's long-term biological data sets and the BAS herbarium. She has worked with GSGSSI for a number of years managing a variety of fishery, tourism and environmental databases on their behalf.

Phillips, Richard

British Antarctic Survey (BAS)

Richard Phillips is leader of the Predators group, and Deputy Science Leader of the Ecosystems team at the British Antarctic Survey. He works mainly on the ecology and conservation of seabirds and is involved with international agreements that develop strategies to promote and apply research to understanding and managing marine and terrestrial threats. He is involved with the Agreement on the Conservation of Albatrosses and Petrels (ACAP) as vice-convenor of a working group, attends the CCAMLR Working Group on Incidental Mortality Associated with Fishing (IMAF) and is a member of the SCAR Expert Group on Birds and Marine Mammals.

Quieros, José

University of Coimbra

José Queirós is a PhD student at the University of Coimbra (Portugal). José focuses his research on the Southern Ocean deep-sea, being interested in the ecological interactions, species auto ecology and resources management. In his PhD, he studies the deep-sea food webs of the Southern Ocean, in particular those associated with the toothfish fisheries in the South Georgia and South Sandwich Islands. Before his PhD, José studied the habitat and trophic ecology of Southern Ocean's cephalopods in the Atlantic and Pacific sector and the ecotoxicology and trophic ecology of Antarctic toothfish in the Ross, Amundsen and Dumont D'Urville Seas.

Ratcliffe, Norman

British Antarctic Survey (BAS)

Norman Ratcliffe is a seabird ecologist working at British Antarctic Survey. His main research interests centre on the foraging ecology and movements of seabirds in relation to environmental and biotic variables, population ecology of seabirds and developing conservation measures that allow for sustainable exploitation of natural resources.

Readdy, Lisa

Centre for Environment, Fisheries and Aquaculture Science (Cefas)

Lisa Readdy has over 20 years analytical experience within Cefas and prior to that the Higher education funding council for England (Hefce), and has been a fisheries stock assessment scientist for over ten years with responsibility for providing assessment and advice to the UK and internationally on North-East Atlantic fish stocks and now toothfish in the Southern Oceans. She has developed a number of stock assessments using integrated assessment modelling frameworks and has chaired a number of ICES assessment working groups including the ICES working group for the Bay of Biscay and Iberic Waters Ecoregion (WGBIE) and three ICES stock assessment workshops (WKSOUTH, WKANGLERFISH, WKTADSA).

Reid, William

University of Newcastle

Will Reid's research focuses on understanding the structure and function of marine communities and the life histories of marine fishes, especially Southern Ocean and deep-sea systems. He is particularly interested in marine food webs and how different species interact and partition resources within a community; how individuals at different life history

stages and ecological communities respond to fluctuating environmental pressures; and ultimately what this means for regional scale biodiversity and ecosystem function. He does this by coupling field sampling with laboratory analyses (e.g. biochemical and sclerochronological techniques) and ecological modelling.

Stewart, Heather

British Geological Survey (BGS)

Heather Stewart is a Marine Geologist at the British Geological Survey. She specialises in characterising the geology and physical character of the seabed and sub-seabed. Heather applies expertise in a number of complementary fields including habitat mapping (in support of the UK & UK Overseas Territory Marine Protected Area network), offshore renewables (production of 3D geological models) and palaeoenvironmental research (to improve models of past and active environmental change). Her recent work has two themes: assessing the dynamics, configuration, and sedimentary record of former ice sheets through integration of geophysical and geological data from the UK continental shelf; and studying the geomorphology and sediments of hadal (>6000 m water depth) ecosystems like subduction trenches. Heather has extensive field experience carrying out research and commercial projects primarily in the NE Atlantic Ocean / North Sea but also including the Mediterranean Sea, Gulf of Mexico, Japan Sea, Pacific Ocean, Arctic Ocean and offshore Antarctica.

Tarling, Geraint

British Antarctic Survey (BAS)

Prof Geraint Tarling is a Biological Oceanographer and the Science Leader for the Ecosystems team at the British Antarctic Survey. Alongside Dr. Sally Thorpe, he co-leads the team examining data collected from iceberg A68a. Prof Tarling has been carrying out polar science for over 20 years, principally focussing on the behaviour and population dynamics of krill, zooplankton and mesopelagic fish.

Taylor, Michelle

University of Essex

Michelle Taylor is the Director of Marine Biology at the University of Essex. After gaining a PhD from Imperial College (2011) she spent 7 years at the University of Oxford undertaking postdoctoral research before moving to Essex in 2018. Her research interests span the molecular to the ocean-level and have included studies on shallow and deep-water coral reefs, mangroves, and seagrass. Michelle's main focus is the deep-sea and its many and varied benthic habitats, what drives their biodiversity, and how we can limit human impacts in vulnerable habitats such as coral reefs, hydrothermal vents, and seamounts etc. Genetics are her tool of choice for targeting questions about evolution and speciation. Her work so far has involved phylogenetics and barcoding and current work involves population genomics and phylogenomics using next-generation sequencing.

Thorpe, Sally

British Antarctic Survey (BAS)

Sally Thorpe is an ecosystem modeler in the Ecosystems science team at the British Antarctic Survey. Her research focuses primarily on the interactions of Southern Ocean species with their environment. She investigates how these interactions affect the distribution of the species and hence the ecosystem structure and function, and how variability in the environment affects the ecosystem dynamics. She does this using in situ and remotely sensed data and model output.

Tierney, Megan***Joint Nature Conservation Committee (JNCC)***

Dr Megan Tierney has a degree in Marine Biology and a PhD in Antarctic Marine Ecology. Her primary interests include seeing the fundamentals of science turn into policy actions on the ground. Megan feels this can be best achieved through the development of practical and relevant scientific programmes and data with which to create robust evidence bases that can be used to inform decisions at a range of levels. She had delivered projects detecting and minimising the impact of environmental change and/or resource exploitation on marine ecosystems, developed biodiversity and ecosystem service indicators, overseen the implementation of national ecosystem assessments, and developed regional capacity building programmes around these topics. Megan currently works with the Joint Nature Conservation Committee (JNCC) where she coordinates the UK's input to the Agreement on the Conservation of Albatrosses and Petrels (ACAP) and is the JNCC liaison officer for the South Atlantic Overseas Territories.

Trathan, Philip***University of Southampton***

For over 16 years, Philip N. Trathan was the UK's senior ecological advisor to CCAMLR, providing advice on management of the krill fishery, on the designation of Scientific Special Areas, on Marine Protected Areas, and on climate change. Though now retired, he is a Visiting Professor at Ocean and Earth Science, National Oceanography Centre, Southampton, he is a BAS Emeritus Fellow, and an Honorary Fellow of Bangor University. Phil remains interested in predator studies (primarily penguin species, but also marine mammals), particularly how marine predators utilize their available habitat and how this relates to their reproductive output and performance.

Warwick-Evans, Vicky***British Antarctic Survey (BAS)***

Vicky Warwick-Evans is a postdoc marine ecologist at the British Antarctic Survey. She specialises in the spatial ecology of higher predators, particularly seabirds and cetaceans. Vicky's research looks at interactions with humans with a particular focus on fisheries. Her research outcomes are directly applicable to conservation and management.

Young, Emma***British Antarctic Survey (BAS)***

Emma Young is an ocean and biophysical modeler interested in all aspects of interdisciplinary environmental science. She has a particular focus on the development and application of regional high-resolution oceanographic and Lagrangian transport models, focusing most recently on physical and biological interactions in the South Atlantic and Southern Ocean, from temperate regions to the Antarctic Peninsula, and how these may be impacted by ongoing climate change.

Joanna Zanker***British Antarctic Survey (BAS)***

Jo Zanker has an undergraduate degree in Mathematics from the University of Surrey, and an MSc in Pure Mathematics from the University of Manchester. She then undertook a second MSc in Polar and Alpine Change from the University of Sheffield where she developed a model for studying tidewater glacier dynamics. She is now in the final year of her PhD as an oceanographic modeller, combining skills in mathematics and glaciology to understand oceanographic variability in a sub-Antarctic Island fjord.