Annual Report 2022

Securing Antarctica's Environmental Future

SAEF Securing Antarctica's Environmental Future

Australian Research Council
Special Research Initiative

Acknowledgement of Country

In the spirit of reconciliation, we acknowledge the Traditional Custodians of the lands throughout Australia. We recognise their continuing connection to the land and water, and their deep and enduring understanding of how to care for Country. We are committed to learning from Aboriginal and Torres Strait Islander peoples and building a brighter future together.

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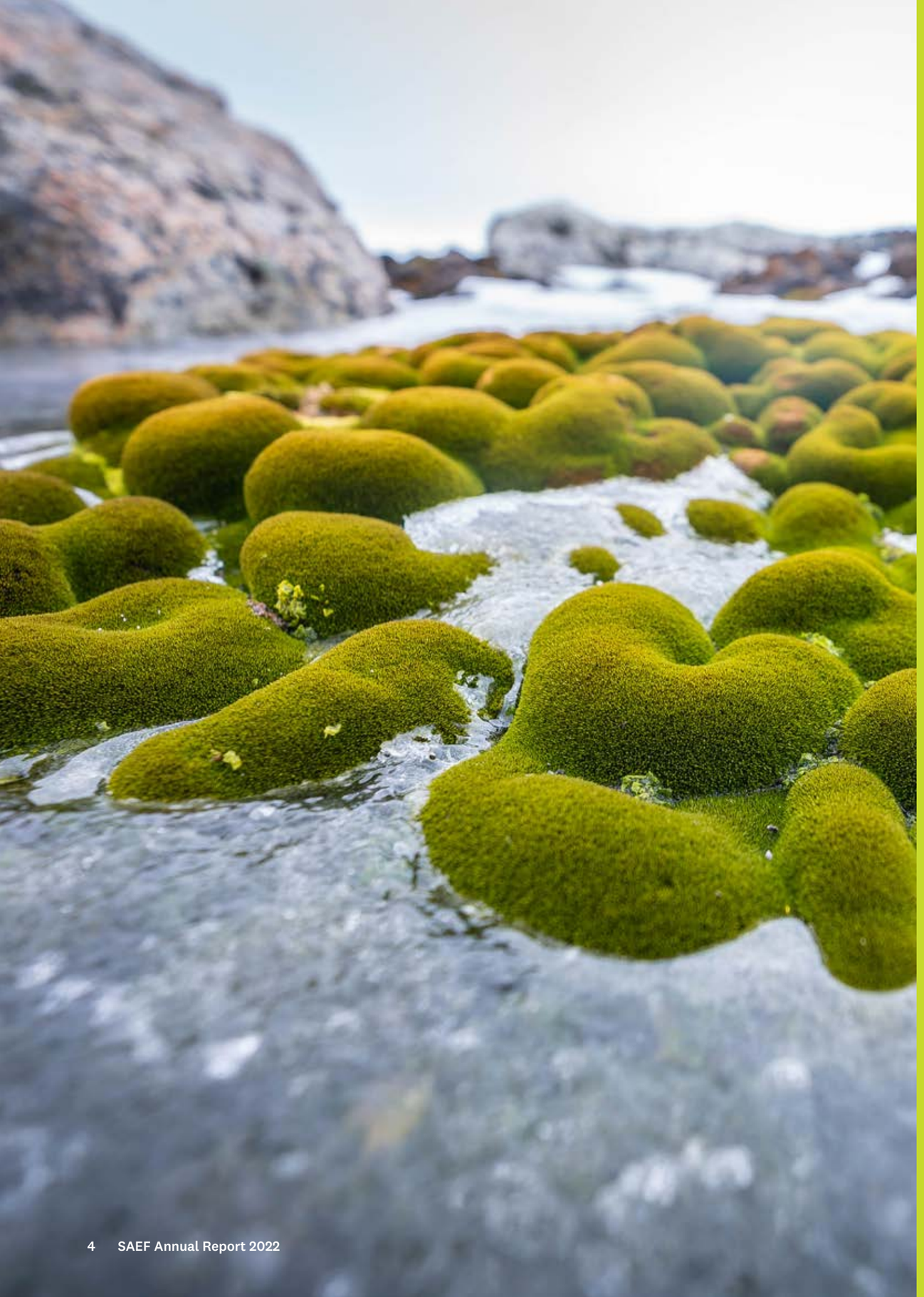

Introduction

Director’s Report

Professor Steven Chown FAA

The past year has been an especially important one for Antarctica and the Southern Ocean. Significant and substantial changes continue unabated, with their anthropogenic fingerprints becoming clearer. Projections continue to be more negative than positive for the region, both from global and regional change. The importance of science for risk management and of decision-makers for both mitigation and adaptation have grown more pressing. They do with every year of insufficient action to mitigate change.

SAEF is delivering science that helps manage risk and that is facilitating evidence-informed policy decisions. Our activities, while concentrated in Australia and East Antarctica, have global connectivity and reach. In this Annual Report, we emphasise our global connections and benefits. Most notably our collaborative research and the discoveries we have made, but also the work we have done to facilitate evidence-informed policy for the Antarctic region in the context of its role in the Earth System.

Notable among the contributions we have made is leadership of the *Antarctic Climate Change and the Environment Decadal Synopsis*, published by the Scientific Committee on Antarctic Research, and presented both at the XLIV Antarctic Treaty Consultative Meeting and at the 41st Meeting of the Commission for the Conservation of Antarctic Marine Living Resources. Parties to both agreements have formally recognised their critical role in both mitigation and adaptation.

What is most clear from the ACCE Decadal Synopsis, as it is now known, is the urgent need for collaborative, international research in three areas. First, the timing and extent of change expected for the Antarctic Ice Sheet. Second, the drivers of sea ice change. Third, the impacts of global and regional change on Antarctic and Southern Ocean biodiversity and appropriate mitigation and adaptation to minimise the impacts of both. These challenges are too large for any single research program or country. Only multinational, transdisciplinary collaborations will succeed.

SAEF has been established to contribute to, and in some areas to lead, such endeavours. This report showcases the way we are doing so, both at home and abroad.

Deputy Director, Science Implementation Report

Distinguished Professor Sharon Robinson

At the start of 2022, I was in quarantine in Hobart in preparation for SAEF's first Antarctic field season. Together with six early career researchers, I flew to Wilkins Aerodrome, close to Casey Station. It was wonderful to collaborate with these SAEF researchers in work on glacial dynamics, lake geochemistry and the long-term changes in moss beds in the region. Sensors in the moss beds recorded the extraordinary heatwave in March 2022. Comparison of our surveys with the long-term record we hold will reveal the consequences of this heatwave for local moss communities. The outcomes will have broader consequences for understanding changes to continental biodiversity and its implications for retaining the values of the region.

These outcomes alone highlight the importance of getting to the field, and the disruptive consequences the pandemic and other factors have had for our work by reducing our field access. The fact that critical components of SAEF's marine research have been unable to commence has been a major setback for the program.

SAEF researchers have, nonetheless, pivoted their attention innovatively and swiftly to develop the foundations for the research SAEF is undertaking, with tremendous outcomes. As a program, SAEF has revealed:

- how the Antarctic ice sheet has retreated and advanced over the past twelve thousand years, what that meant for global sea level rise, and the coming consequences of current ice loss for the Earth System.
- what expansion of ice-free areas in Antarctica means for Antarctic biodiversity and how the proposed consequences can be assessed within a rigorous hypothesis-testing framework.
- the most significant threats to Antarctic biodiversity and what actions will produce the most cost-effective conservation outcomes.
- how useful a suite of biological proxies is for unveiling the secrets of Antarctica's past. On their own, each proxy only tells us some of the story, but together they provide a quantitative, spatially and temporally explicit narrative of Antarctica's past climate. Such synthesis is only possible with interdisciplinary collaboration of the type SAEF encourages and supports.

This report details many more examples of SAEF's important research and how its outcomes are already informing environmental stewardship, especially via domestic and international collaborations.

These collaborations are now accelerating, with many new postgraduate students and staff joining SAEF and, importantly, being able to meet in person again. These in-person meetings have initiated new and exciting research, stimulating the kinds of thinking that SAEF has been established to deliver. I am really looking forward to our first full workshop in 2023 when we will finally all be able to meet, share our research, and plan for a brighter future for Antarctica.

Deputy Director, Career Development Report

Professor Kerrie Wilson

Many new staff and students from around the world joined SAEF throughout 2022, as we continued to build a supportive and inclusive culture. Having developed our Leadership, Mentoring and Career Development Plan and Equity, Diversity and Inclusion Plan in 2021, we started implementing many aspects of them in 2022. We created a range of programs and procedures designed to give every member of SAEF a sense of belonging and the support they need to advance their careers.

One of our main priorities was establishing the SAEF Mentoring Program, which is open to all SAEF researchers, students and professional staff. Twenty-two mentees and 20 mentors participated in the program in 2022. In addition to the many one-on-one interactions between mentors and mentees, there were two networking sessions for the whole group, with inspiring keynote talks from Drew Clarke AO FTSE FRGS, who is also the Chair of SAEF's Governance Advisory Board, and Professor Nicole Webster, Chief Scientist of the Australian Antarctic Division.

We also focused on developing and delivering career development opportunities in 2022. Our first professional development workshop, *Building Strong Collaborations and Difficult Conversations*, was delivered simultaneously across the SAEF nodes at Queensland University of Technology, Monash University and the University of Wollongong. In addition, we distributed funding to support the individual professional development needs of SAEF's early- and mid-career researchers.

The SAEF Equity, Diversity, and Inclusion Plan outlines how our recruitment practices, program management approach and professional development opportunities will provide equal opportunities to all participants and equitable access to groups who are currently underrepresented in the STEM disciplines. We took the opportunity to discuss the plan and share our experiences and ideas at the Scientific Committee on Antarctic Research (SCAR) 2022 Conference.

I am very grateful to the whole SAEF community for their willingness to contribute to these programs and generally for making SAEF such a positive and dynamic research and working environment. A special thanks to SAEF Space, our network of research students and early career researchers, for contributing to the planning of the mentoring and professional development activities.

I look forward to extending and improving our plans and programs in 2023. As well as continuing our mentoring and training programs, we will be developing support mechanisms to promote the mental and physical wellbeing of all SAEF members and working on strategies to encourage participation of underrepresented groups in Antarctic science.

Governance Advisory Board Chair Report

Mr Drew Clarke AO FTSE FRGS

The SAEF Governing Board has continued to provide advice and support to the Director through 2022. Our agenda over the year has included consideration of engagement, impact and risk. The formal launch event was a highlight for stakeholder engagement.

This Annual Report outlines the many areas in which SAEF has continued to develop and has commenced delivering impactful outcomes. In that context, I have selected a number of examples, beyond the core research work, that provide insights into SAEF progress.

First, the preparation of the *Antarctic Climate Change and the Environment (ACCE) Decadal Synopsis*, and its presentation to the Antarctic Treaty Consultative Meeting by Professor Chown. This work exemplifies the SAEF commitment to policy impact, with its concise and coherent analysis being presented to the peak Antarctic Treaty body. High-quality synthesis reports play a critical role in the nexus between science and policy.

SAEF's commitment to developing its people and culture is a major theme. The work on mentoring, career development, equity, diversity and inclusion underpin the Antarctic science workforce of the future. Beyond these fundamentals, the experience of working in interdisciplinary teams and the development of skills in preparing policy advice, are investments in our future Antarctic science capability.

The Annual Report appendices list the journal papers, data sets, presentations, briefings, media features and advisory roles (Australian and international) over the year. Collectively, they illustrate the scope of SAEF's engagement and focus on impact. They underpin the SAEF value of 'ambition' – for the planet, for our science and for change. While individual items will be of interest to readers, it is the commitment to both depth and breadth of engagement that will deliver the ambition.

Finally, a significant risk to the success of SAEF has materialised during the year. Access to Antarctica is fundamental for much of the SAEF research program, but has been impeded by some setbacks in Australian Antarctic Division (AAD) logistics. SAEF has mitigated some of the impact, and is working with AAD and other stakeholders to address the issues. The Board will be closely monitoring this critical matter.

I thank Board members and management for their continuing support and commitment to the SAEF values and objectives.

International Science Advisory Panel Chair Report

Professor Nancy Bertler

The future of our world depends on and influences the future of Antarctica and the Southern Ocean. International collaborative research programs like SAEF are essential for revealing the ways in which these feedbacks work, what they imply for our future, and how mitigation plans have to be developed to ensure safeguards for the future of the Antarctic.

The International Science Advisory Panel commenced this year a process of examining the work of each of SAEF's themes in detail, exploring their interconnections and dependencies. Doing so is revealing the parallels between SAEF's work and other large international research programs, in turn enabling further collaborations and recommendations about fit to international Antarctic and Southern Ocean research priorities.

Our advice to SAEF recognises two exceptional current opportunities. The first, international one, is the focus that the Antarctic Treaty Consultative Parties and the Members of the Convention for the Conservation of Antarctic Marine Living Resources have on means to mitigate and adapt to the impacts of climate change on the region. The most notable example being the coming discussions about climate change in the region to be held at the 2023 Antarctic Treaty Consultative Meeting.

The second, domestic opportunity, is the ongoing development of a decadal Antarctic Science Plan. Led by the Australian Antarctic Division, and involving the entire Australian Antarctic research community, the planning process provides an unparalleled prospect for the kinds of integrated research society needs now to secure its future and the future of Antarctica's environments and life.

Rarely are such important and societally significant opportunities aligned in the domestic and international spheres. They offer great potential to deliver the outcomes and benefits society most needs, while enabling the kinds of innovation that great research is best known for.

The members of the International Science Advisory Panel are already immersed in our role to advise SAEF on ways to take advantage of its tremendous potential and especially in the context of these current opportunities. SAEF science outputs and policy advice have already demonstrated realisation of the potential. We stand ready to help further do so.

Official Launch of SAEF

"It is more important than ever for Australia to be a leader in Antarctic research and to be supporting global efforts to understand the changes occurring in Antarctica. Producing world-class science to support decision-making will give us the best chance at protecting our planet and our livelihoods, now and into the future."

Mr Josh Burns MP,
Member for Macnamara

"The launch epitomized what we hope to achieve in SAEF – having leaders and experts in the same room with a focus on securing Antarctica's future – decision makers from government and civil society, national and international, politics and science, career stages from PhD to Professor, and expertise across climate, nature and stewardship."

Professor Melodie McGeoch FAAS,
Chief Investigator, La Trobe University

"I am thrilled that SAEF is collaborating with the Australian Antarctic Division, universities, government and international partners to identify conservation priorities and inform policy-making decisions for the benefit of Antarctica's future."

"As a major contributor to the Special Research Initiative in Excellence in Antarctic Science, SAEF will not only deliver high-quality research to the benefit of the community but will also play a key role in developing the science workforce of the future."

Ms Judith Zielke PSM,
CEO, Australian Research Council

"SAEF embodies the colour and shape of everything we aim to do here at Monash University. It is an ambitious, large-scale research program addressing climate change impacts on the Antarctic region. It addresses how those impacts affect livelihoods in Australia, the Asia-Pacific and globally. The benefits of this program cross science, defence, environment, education and natural disasters.

At Monash, we are convinced that Australian leadership in Securing Antarctica's Environmental Future is essential for delivering a sustainable future for society and for the Earth System – our only home."

Professor Rebekah Brown,
Deputy Vice-Chancellor (Research) and Senior Vice-President, Monash University

"Our launch warmly connected us to the community we serve, showcasing why we are here, what we can do for people across the Australian and international communities, and why we are so passionate about our endeavours."

Professor Steven Chown FAA,
SAEF Director

"As we were reminded by the Welcome to Country at the SAEF Launch, humans and nature are inextricably linked. Antarctica's future is our future. It was therefore so inspiring to meet the SAEF scientific team who are working to help us understand what's happening in Antarctica, and what we can best do to protect its unique environment and animals."

Dr Jane Rumble OBE FRSG,
SAEF Goverance Advisory Board Member

PHOTOGRAPHS

1. Professor Rebekah Brown, Deputy Vice-Chancellor (Research) and Senior Vice-President, Monash University

   Mr Josh Burns MP, Member for Macnamara

   Ms Judith Zielke PSM, CEO, Australian Research Council

2. Ms Judith Zielke PSM, CEO, Australian Research Council

   Professor Melodie McGeoch FAAS, Chief Investigator, La Trobe University

3. Professor Steven Chown FAA, SAEF Director

   Dr Jane Rumble OBE FRGS, SAEF Governance Advisory Board Member

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“Meeting in person at the launch provided the invaluable opportunity to establish connections with other SAEF researchers – to discuss ideas and opportunities for future collaborations; to be creative in approaching problems, especially by working across themes and disciplines. I personally gained a lot by meeting the Governance Advisory Board and having the chance to discuss research-to-policy and impact, and thinking bigger than my individual research questions.”

Dr Felicity McCormack,
Chief Investigator, Monash University

“It was a privilege to attend the launch of SAEF. While many years of hard work have already gone into creating SAEF, this launch signifies the start of an intergenerational journey, led by Monash, to protect this incredibly fragile and precious part of planet Earth, the fate of which is inextricably tied to our own fate as a species. It was reassuring to see such high-powered representatives from government, academia, climate diplomacy and science in the one room supporting this significant initiative.”

Mr Paul Hameister OAM,
Jade Hameister’s Dad

“The launch event emphasised both the importance of SAEF’s mission, and the interdisciplinary nature of the research program. It was very pleasing to see the degree of alignment and commitment from SAEF’s participants and stakeholders.”

Mr Drew Clarke AO FTSE FRGS,
SAEF Governance Advisory Board Chair

“Our work in SAEF is helping to understand and manage environments that are linked with the entire globe. SAEF’s launch was a wonderful opportunity to bring people together under the singular goal of protecting Antarctica. What an exciting program and event to be a part of.”

Associate Professor Kate Helmstedt,
Chief Investigator, Queensland University of Technology

“It has never been more urgent to understand climate change consequences to help policy makers, communities and industry to make informed decisions and enable change. SAEF is well placed to understand and help manage climate change impacts on Antarctica and I feel hugely privileged to contribute to this team that has the commitment, expertise and track record to have critical impact.”

Professor Nancy Bertler,
SAEF International Science Advisory Panel Chair

PHOTOGRAPHS

4. Dr Felicity McCormack, Chief Investigator, Monash University

   Mr Drew Clarke AO FTSE FRGS, SAEF Governance Advisory Board Chair

5. Ms Romana Pomering, Assistant Director, Department of Foreign Affairs and Trade

   Mr Paul Hameister OAM, Jade Hameister’s Dad

6. Ms Rhonda Bartley, Manager, Science Planning and Coordination, Australian Antarctic Division

   Professor Nancy Bertler, SAEF International Science Advisory Panel Chair

7. Dr Mark Stevens, Partner Investigator, South Australia Museum

   Distinguished Professor, Sharon Robinson, SAEF Deputy Director, Science Implementation, University of Wollongong

   Associate Professor Kate Helmstedt, Chief Investigator, Queensland University of Technology

"I come from a small-scale laboratory, which was composed of less than 10 people. Being part of SAEF is exactly the opposite, which is why at the launch I was shocked: I saw a massive interdisciplinary enterprise, with parts from completely different areas pushing together, in the same direction, to cause change at a planetary scale."

Mr Martin Iglesias,
PhD student, Monash University

"Our understanding of the Antarctic, and our conservation of it, are vital in this time of rapid change. It's so exciting to see people from all sorts of fields and backgrounds come together for this common purpose."

Ms Laura Phillips,
Research Officer, Monash University

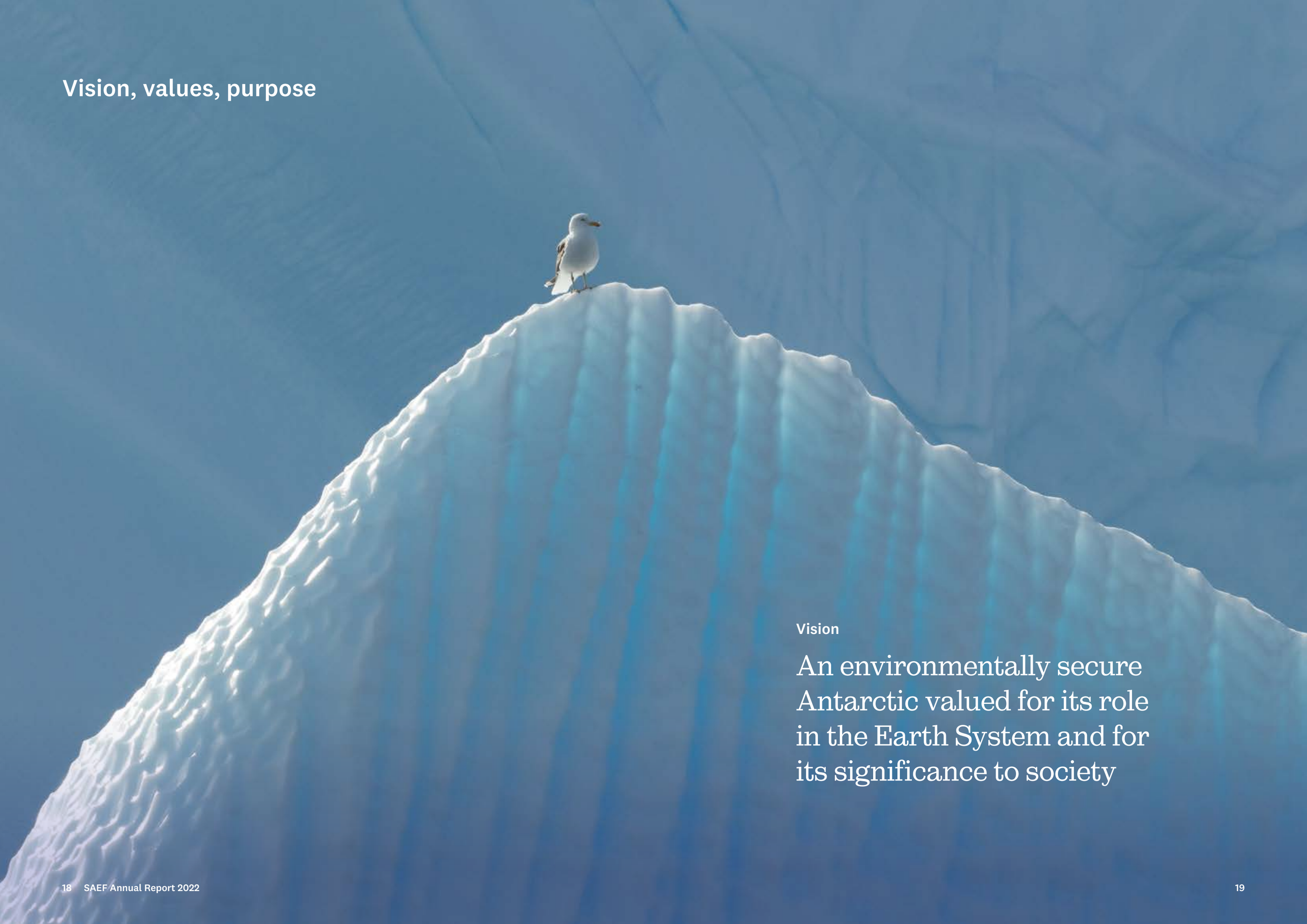
PHOTOGRAPHS

8. Ms Laura Phillips, Research Officer, Monash University
   Ms Lucy Klein, Monash Univeristy
   Mr Ian Aitkenhead, Research Officer, Monash University
9. Mr Martin Iglesias, PhD student, Monash University
   Mr Thomas Friere, Honours student, Monash University
   Ms Annabelle Smith, Honours student, Monash University
10. Dr Ariaan Purich, Research Fellow, Monash University
    Professor Julie Arblaster, Chief Investigator, Monash University
    Dr Sean Bay, Research Fellow, Monash University

"It's critical we secure Antarctica's environmental future, both for the intrinsic value of Antarctica, and for the far-reaching influences it exerts on global sea level and climate."

Dr Ariaan Purich,
Research Fellow, Monash University

Vision, values, purpose



Vision

An environmentally secure Antarctic valued for its role in the Earth System and for its significance to society

Values

In addition to the values that lie at the heart of our institutions and that are characteristic of a joint research endeavour – such as curiosity, respect and openness, values that underpin SAEF are:

Collaboration

Interdisciplinary | innovative | inspirational

Ambition

For the planet | for our science | for change

Diversity

Of membership | in approach | of benefit

Community

Considered | inclusive | transformational

Purpose

SAEF delivers globally valued, collaborative, interdisciplinary research to:

1. Understand the Antarctic region's changing biodiversity and role in the Earth System
2. Reconstruct and forecast environmental change across the Antarctic and Southern Ocean
3. Deploy effective environmental stewardship strategies to mitigate and adapt to change
4. Deliver the diverse Antarctic science workforce of the future

Foundations

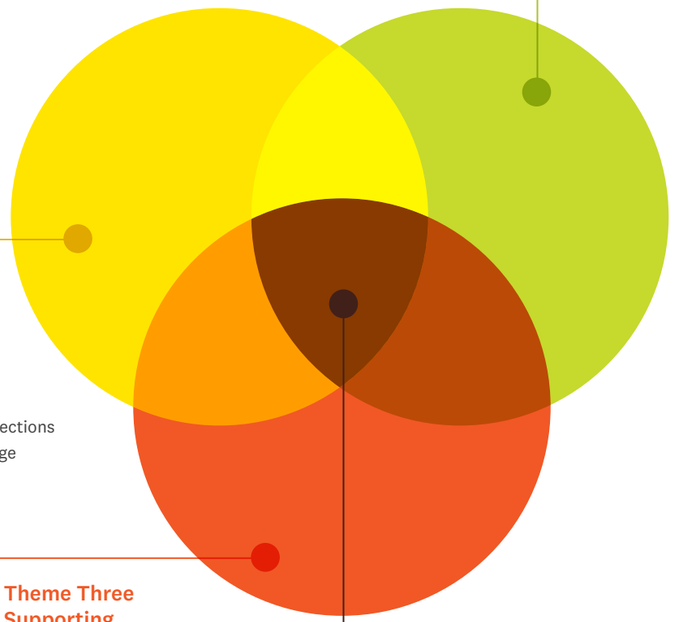
SAEF is founded on the idea that social and ecological systems are inseparable. The future of the Antarctic and of the Earth System depend on understanding social-ecological systems, communicating the research outcomes from considering them together, and deploying stewardship strategies that recognise their inseparability.

SAEF's Social-Ecological Systems Foundational Framework

Science strategy

SAEF research is being delivered through three interconnected themes. These themes enable discipline-specific excellence and innovation, while promoting collaboration and the flow of ideas among our researchers, international colleagues and others seeking to protect the Antarctic region. This approach reflects the interconnected nature of evidence and decision-making in social-ecological systems.

SAEF's activity is structured into 17 major, integrated objectives across three themes.



Theme One Climate Processes and Change

- Large-scale Antarctic climate dynamics: past, present and future
- Constrained climate projections
- Drivers of ice sheet change
- Precipitation processes

Theme Two Biodiversity Status and Trends

- Environmental characterisation and climate downscaling
- Biodiversity dynamics and biogeography
- Climate change consequences for living systems
- Antarctic life's future energy budget

Theme Three Supporting Environmental Stewardship

- Conservation planning
- Strategic monitoring frameworks and technology
- Visualising geopolitics
- Optimal monitoring

Across all themes

- Quantifying uncertainty
- Sensing platform technologies
- Rapid information deployment
- Skills development in an interdisciplinary setting
- Workforce evolution

SAEF projects

SAEF's science is further structured into projects designed to ensure visibility of research across the program and to promote further interdisciplinary collaboration. These projects also ensure that field logistics are supported at the scale required to ensure the desired science outcomes.

At the heart of SAEF's approach lies collaboration—among disciplines, national researchers, international colleagues, and others seeking the maintenance of the Antarctic region for peace and science through research and its application to inform policy.

SAEF's projects cover all the program's objectives and often span multiple themes.

Project List

Key	Title
	Variability, trends and remote drivers of Antarctica's past climate: Southern Hemisphere synthesis and assimilation
	Variability in Southern Ocean upwelling
	Past westerly wind variability as a context for understanding present-day mid-high latitude Southern Hemisphere climate
	Modelling and understanding climate interactions between the Antarctic region and the globe
	East Antarctic ice sheet-climate interactions: a strategic modelling analysis of multi-scale variability and change
	Canary in the coalmine: the vulnerability of Vanderford Glacier, East Antarctica to climate change
	Statistical methods for making inference on climate, ice sheet, and ecological processes in the cryosphere
	Are East Antarctic Ice Sheet and Heard Island glacier mass losses unprecedented in recent millennia?
	Precipitation Processes over Antarctica and the Southern Ocean
	A novel, integrative approach to modelling and monitoring Antarctic biodiversity
	A predictive framework for the impacts of climate change on biodiversity across the Antarctic
	AIoT Sensing Platform for Antarctica – Application to hydrology and microclimate models
	Antarctica – the chemosynthetic continent

Key	Title
	Spatial and temporal trends in isotopic signatures in sub-Antarctic and Antarctic lakes
	Connectivity in the Southern Ocean through space and time
	Past climates from living mosses
	UAS remote sensing for vegetation cover, health and drivers
	Climate change in Antarctic coastal ecosystems
	Preventing biological Invasions of Antarctica and the sub-Antarctic
	Drivers of Antarctic marine biodiversity
	Value of Information for effective stewardship
	Conservation planning in Antarctica
	Strategic Decision Support for Antarctic governance
	Law and policy link to Antarctic science
	Classifying, analysing and modelling regime shifts: Antarctica as a case study

SAEF in numbers 2022

50
investigators

19
postdoctoral researchers

26
PhD and MSc Students

5
honours students

11
research officers and assistants

2
volunteers

24
university and partner organisations

6
program collaborators

$1.7 million
participating organisation cash contributions

$6.7 million
ARC funding

$4.8 million
participating organisation in-kind funding

$5.9 million
associated additional grant funding

SAEF around the world

Flying across the pages of this report, you will notice an Arctic tern. If you're wondering why we have chosen this particular bird, given our focus on the opposite polar region, it's because Arctic terns unite the polar regions. They fly from their breeding grounds in the Arctic down to Antarctica for the southern summer and back again several months later. The Arctic tern reflects the unity of the Earth System, illustrating global connections such as those of SAEF's activities in 2022.

SAEF IN

Antarctica

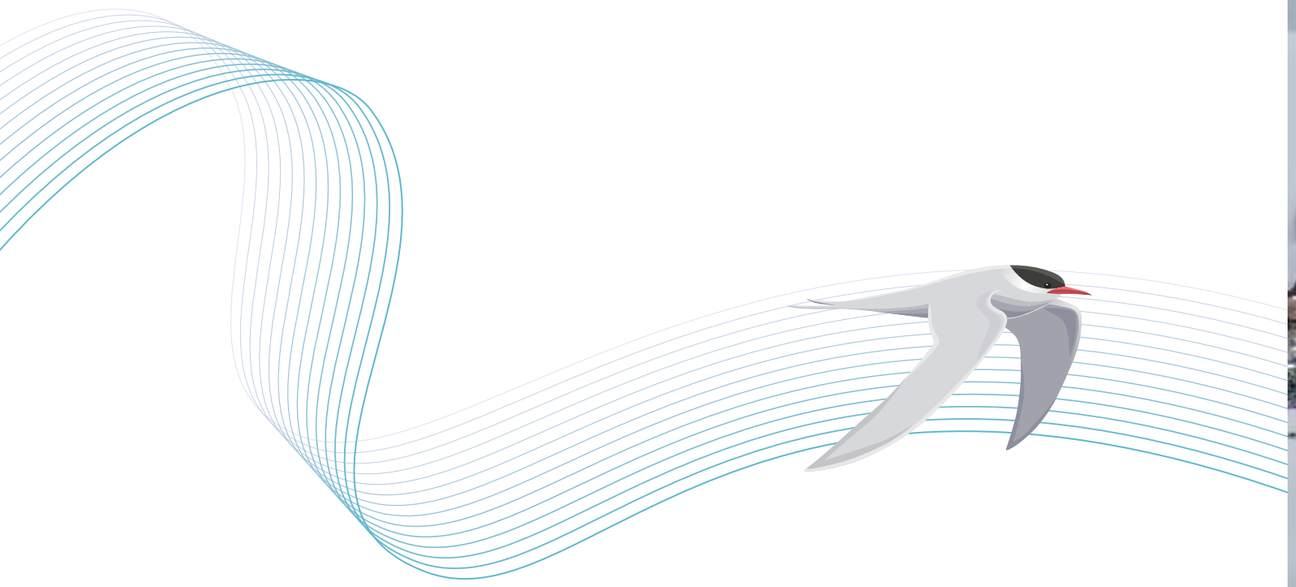
Casey Fieldwork

In 2022, SAEF's journey started in Antarctica, where, in February, a team of seven SAEF scientists spent three weeks at Casey Station undertaking the program's first season of fieldwork. The team completed fieldwork in several interrelated areas of science to generate new insights into past, present and future change occurring across the Antarctic region. Leading the team was one of SAEF's deputy directors, Distinguished Professor Sharon Robinson, who first visited the region 21 years ago, and was especially excited to be heading south with a team of enthusiastic, early- and mid-career researchers.

Building a picture of Vanderford Glacier

Dr Felicity McCormack and Dr Richard Jones from Monash University are seeking to understand the impact of climate change on the Vanderford Glacier. This glacier is at risk of rapid retreat with the potential to contribute to multiple metres of sea level rise. The pair completed fieldwork at Browning Peninsula, where they spent several weeks hiking along the peninsula collecting rock samples.

In all they brought back almost 300 kg of rock samples. The team will study them using a method called cosmogenic nuclide dating, to extract the chemical isotopes (or cosmogenic nuclides), which in these samples are forms of beryllium and carbon. These can tell us how long the rocks have been exposed to cosmic rays from the sun and, therefore, when the rocks were last covered in ice. The data will be used to build a picture of how the Vanderford Glacier has retreated and advanced over time as changes have occurred in the climate, and will help us predict how future warming will impact the glacier and contribute to sea level rise.



Monitoring the moss

Distinguished Professor Sharon Robinson, Ms Krystal Randall and Ms Georgia Watson, from the University of Wollongong, completed fieldwork in the moss beds around Casey Station, which are some of the most extensive in East Antarctica. Sharon has been monitoring these moss beds since 2000 and this expedition was her first opportunity in 8 years to get back to collect data to understand how the moss is changing in response to climate change and ozone depletion. Meanwhile Krystal set up a network of sensing equipment to collect data for her research into moss microclimates. This sensing equipment will continuously monitor the variations in temperature, light and moisture conditions across the moss beds and be used to understand moss health. It will also generate highly sought after surface-climate data for researchers studying plants and animals in ice-free areas, which are not currently available. This will provide a more accurate alternative to weather station data which does not accurately represent the temperature that is experienced on the ground.

This year there was a lot of snow covering the moss beds which made them difficult to access, so the team planned their days around when the sun had its greatest melting potential, often leading to work from 2 pm – 10 pm in the field, before heading back to the lab to store their samples.

Through a bit of ingenuity, the team were able to complete their data and sample collection, as well as install the sensor system. Once back in the laboratory, the team was able to commence their analysis and start preparing for the 2022/23 field season, which includes work to install a new *'Artificial Intelligence of Things'* (AIoT) sensor system which will have the capability to transmit data in real time back to Australia.

The team visited as many lakes as they could get to around Casey Station, which varied from small shallow lakes with open water to expansive deep lakes covered in thick ice.

Windows into Antarctic life

Aimee Bliss and Toby Travers, from Monash University, collected samples for two perspectives on the response of life to changing Antarctic conditions. Soils samples to unveil the extent to which Antarctic life is dominated by the process of chemosynthesis, and lake water samples for insights into how life in lake settings is responding to the changing Antarctic environment.

The team visited as many lakes as they could get to around Casey Station, which varied from small shallow lakes with open water to expansive deep lakes covered in thick ice. Meanwhile the sites where they collected soil samples were chosen based on having no water or nutrient inputs and no visible signs of life.

Once collected, the samples passed through biosecurity and were sent on to laboratories at the Australian Nuclear Science and Technology Organisation (ANSTO) and Monash University to be unfrozen, processed and analysed using a range of novel approaches.

Study of how the Antarctic Ice Sheet advanced and retreated over 10,000 years holds warnings for the future

The contribution the Antarctic Ice Sheet will make to global sea level rise beyond 2100 is highly uncertain. Understanding how the Antarctic Ice Sheet changed in the past offers opportunities to predict how it might change in the future, thus helping to reduce that uncertainty.

Dr Richard Jones, from Monash University, led a review published in *Nature Reviews Earth & Environment* examining how the ice sheet evolved from the pre-industrial Holocene, 11 700 years ago until 1850.

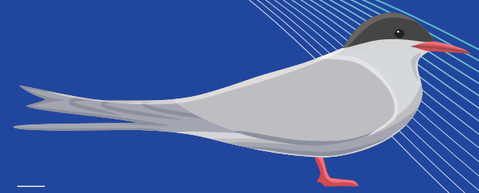
The work identified three main phases of change. The first phase, which took place around 10 000 to 5 000 years ago, saw a period of rapid ice loss across all regions of Antarctica and resulted in 2.4 – 12 m of sea level rise around the world.

The second phase occurred during the past 5 000 years, and saw a period of ice gain, and corresponding sea level fall, as the ice sheet margin advanced to where it is today. The third phase, which has happened in the past few millennia, has seen the return of ice loss to several parts of Antarctica.

The first and third phases offer warnings for what may happen in the future. The rapid ice loss that occurred 10 000 years ago happened at a similar pace to the fastest changing parts of the ice sheet today. In the past, this was caused by warm ocean water melting the ice shelves from underneath. These ice shelves act like a cork in a wine bottle, and once removed cause the ice to flow faster into the ocean. The ice loss that we're seeing today is driven by similar processes, suggesting that the ice sheet is poised to continue losing more ice and raising sea levels beyond 2100.

The second phase of change, involving readvancing of the ice sheet, has two likely explanations, both of which are informative in the context of current change. The first is that as the ice began to melt away, the ice sheet became lighter, enabling the uplift of land which would have raised the ice out of the ocean. The second is that climate change caused more snowfall and a temporarily cooler ocean.

This paper is an important contribution to reducing uncertainty about how the Antarctic Ice Sheet will respond to future change.



Read more

Jones, R.S., Johnson, J., Lin, Y., **Mackintosh, A.**, Sefton, J., Smith, J., Thomas, L. and Whitehouse, P. (2022) Stability of the Antarctic Ice Sheet during the pre-Industrial Holocene. *Nature Reviews Earth & Environment* **3**, 500-515. DOI: https://doi.org/10.1038/s43017-022-00309-5

Note for readers: Authors with SAEF attribution are listed in bold throughout the report.

SAEF IN THE

Sub-Antarctic

A summer of science on Macquarie Island

In late October, four SAEF scientists departed Hobart for Macquarie Island, swapping an Australian summer for the rare opportunity to spend six months on the sub-Antarctic island. The expedition team includes research officer Dr Jez Bird (Monash University), PhD student Sam Beale (La Trobe University), PhD student Caitlin Selfe (QUT) and Masters student, Maggie Smith (QUT). Their mission is to help us better understand how climate change and the eradication of invasive species are impacting the island's environment and biodiversity.

Jez and Maggie are both doing work to determine how the island's biodiversity is recovering following the eradication of rabbits, rats and mice in 2014. Jez is resurveying three invasive plant species across the island to see how their distribution and abundance are changing following the removal of introduced mammals, particularly rabbits, which had such a dramatic impact on vegetation across the island.

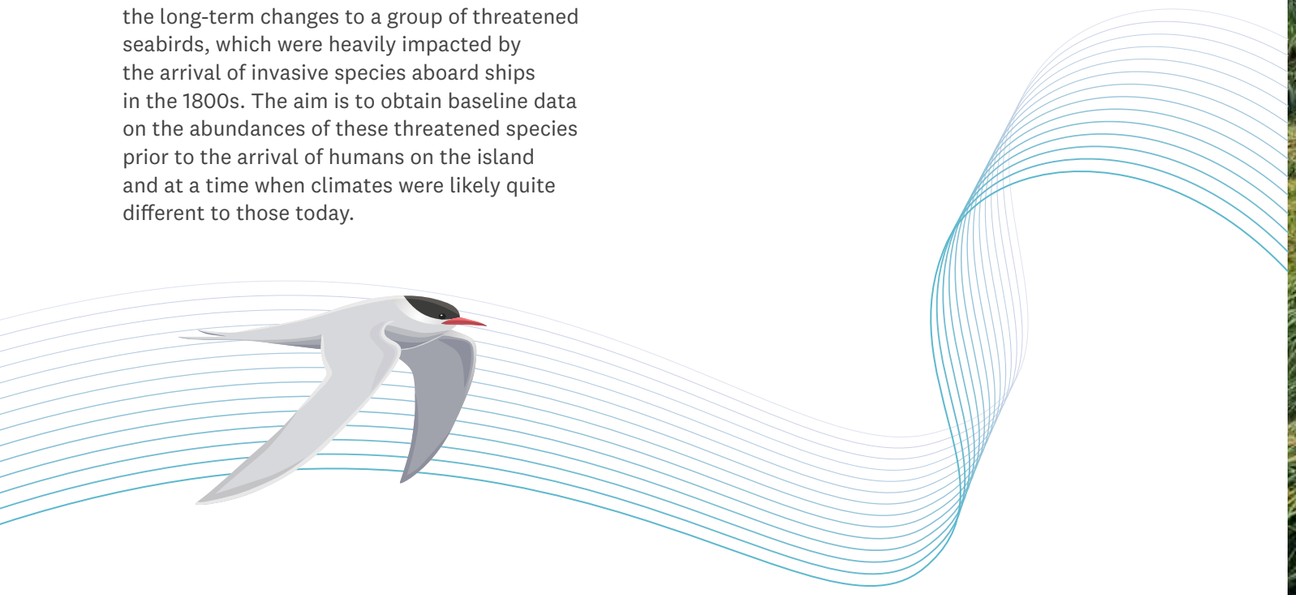
Maggie is collecting peat cores that, through chemical analysis, will provide information on the climatic and ecological changes that have occurred over thousands of years, including on seabird presence. Back in the laboratory, she'll use these field-collected data to examine the long-term changes to a group of threatened seabirds, which were heavily impacted by the arrival of invasive species aboard ships in the 1800s. The aim is to obtain baseline data on the abundances of these threatened species prior to the arrival of humans on the island and at a time when climates were likely quite different to those today.

Indeed, much of the team's work is also focussed on collecting information to provide further detail on the way climate change has progressed on the island.

Caitlin and Maggie are collecting lake water samples and extracting sediment cores from lake beds across the island. These samples will feed into their work studying historic climate change by analysing long-term changes in lake chemistry linked to climatic variability.

Their fieldwork involves conducting three laps of the island collecting water samples from 44 lakes on the island's plateau. They will collect and filter water from each lake for subsequent chemical analysis in the lab when they are back in Tasmania.

Meanwhile, Sam is surveying the Critically Endangered cushion plant *Azorella macquariensis* to investigate the rate and causes of ongoing dieback. He is also measuring plant traits such as leaf size in native species to investigate how these are determined by climate and therefore how species might respond and adapt to future climate change. All going well this will make up the main part of his PhD project.



Their fieldwork involves conducting three laps of the island collecting water samples from 44 lakes on the island's plateau.

The lessons we can learn from Sub-Antarctic lakes

On Macquarie Island it rains an average of 316 days a year. Modelling projections for scenarios of 1.5 – 4°C of global warming indicate that precipitation could increase between 10% and 60% across the island. How such increased rainfall might impact the island's environment and biodiversity is a key question for securing the island's environmental future.

Dr Karina Meredith, Dr Krystyna Saunders and Dr Liza McDonough, from the Australian Nuclear Science and Technology Organisation (ANSTO) and Professor Melodie McGeoch, from La Trobe University, are looking to the island's lakes for answers. An early outcome from the research is the first, comprehensive, island-wide survey of the water chemistry of the island's lakes providing insights into the processes that sustain the lake environments.

The team investigated the stable isotope ratios of carbon, oxygen, hydrogen and strontium within the lake water samples. These isotopes provided baseline data for hydrological, biological and geochemical lake processes, and help the team to understand how the lakes formed. It also enables them to interpret the roles rainfall, sea spray aerosols and groundwater play in governing lake properties.

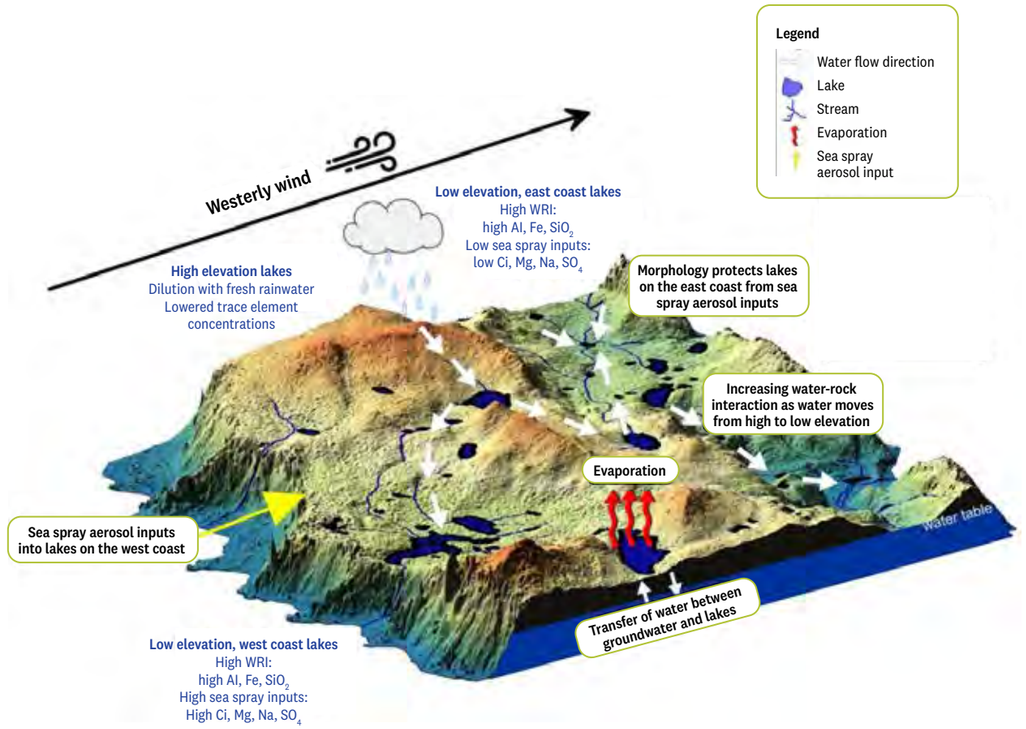
Once all the data were analysed the team were able to group the lakes into three clusters that highlighted the role that geology plays in controlling the movement of water across the island (shown in the figure on page 53).

Sub-Antarctic lakes reflect changes in their surrounding environment resulting from shifts in rainfall, winds and temperature so they can be used as early indicators of climate change. This baseline study can be used to compare future lake water chemistry compositions, as well as palaeo proxy data such as lake sediment cores, to understand the cause, rate and extent of past and future changes.

Read more

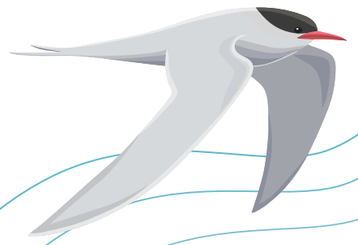
Meredith K.T., **Saunders K.M.**, **McDonough L.K.** and **McGeoch M.A.** (2022) Hydrochemical and isotopic baselines for understanding hydrological processes across Macquarie Island. *Scientific Reports* **12**, 21266. DOI: https://doi.org/10.1038/s41598-022-25115-3

Conceptual synthesis of the hydrochemical processes affecting lake water chemistry on Macquarie Island



SAEF IN THE

Southern Ocean



One Antarctic slug to confuse them all

***Doris 'kerguelenensis'* is a group of small, mostly white sea slugs that live on the ocean floor around Antarctica. Until recently, their commonness right around the Antarctic has been a mystery to marine biologists. In the early days of Antarctic exploration, these slugs were collected on many expeditions, but named different species by taxonomists working in different countries. In 1990, an expert on sea slugs re-examined the material from many of these expeditions and concluded that just one name, *Doris kerguelenensis*, should be used. Recently, however, DNA sequencing has called into question the extent to which single species are distributed right around Antarctica.**

Partner Investigator Dr Nerida Wilson and her PhD student Paige Maroni, from the Western Australian Museum, and a series of other collaborators therefore decided to put *Doris* to the same DNA-based test.

They studied over 1 000 *Doris 'kerguelenensis'* specimens collected over many years in different parts of the Southern Ocean. Using DNA barcoding they established that *Doris 'kerguelenensis'* comprises at least 59 species, with likely more species within this species-cloud still to be discovered.

Equally curious is the fact that although these sea slugs are small, slow growing and spend their entire life cycle on the seafloor, the 59 species are spread throughout the Southern Ocean. Some individual species were found living side-by-side, rather than in separate regions, while within other species, individuals were separated by as much as 11 000 km. Four of these species have also dispersed across the Antarctic Polar Front, a formidable ocean barrier.

A first step in securing the biodiversity of Antarctica's environments is to know what's there in the first place. Fundamental biodiversity research in systematics is essential for providing that knowledge. It also draws attention to the fact some regions are poorly known and require more attention. In the case of *Doris 'kerguelenensis'*, focussed attention on East Antarctica and the Kerguelen Plateau is likely to pay dividends.

Read more

Maroni P.J., Baker B.J., Moran A.L., Woods H.A., Avila C., Johnstone G.J., Stark J. S., Kocot K.M., Lockhart S., Saucède T., Rouse G.W. and **Wilson N.G.** (2022) One Antarctic slug to confuse them all: the underestimated diversity of *Doris kerguelenensis*. *Invertebrate Systematics* **36**, 419-435. DOI: https://doi.org/10.1071/IS21073

Maroni P.J. and **Wilson N. G.** (2022) Multiple *Doris kerguelenensis* (Nudibrachia) species span the Antarctic Polar Front. *Ecology and Evolution* **12**, e9333. DOI: https://doi.org/10.1002/ece3.9333

SAEF IN

Australia

AUSTRALIA

Accessing Earth's Memories

An absolutely critical task in understanding the likely future of any environment, is providing insight into its past and what processes may have driven change in the past. Proxies are useful for doing so. Antarctic and sub-Antarctic organisms are sensitive to their surrounding environment and climate and they can integrate information about past environments and climates in their structure throughout their lives. Among the best known, for example, are tree rings. Such biological archives are widely used globally, but the variety of approaches available for use in the Antarctic has not been considered comprehensively. Until now.

Professor Jan Strugnell led a team of SAEF researchers to deliver a comprehensive assessment of biological proxies available for the Antarctic. The published research explores the use of moss and peat, lake and marine sediments, marine and terrestrial animals, and remains from animal colonies, as paleoproxies, elucidating the ways in which traditional and emerging technologies and techniques can be applied to gain the most benefit from them.

The study brought together a multi-disciplinary team of eight SAEF researchers from five program partners. This offered opportunities to review archives and techniques from diverse fields of science, and how they might complement each other and provide richer reconstructions.

Jan's research group specialises in studying the evolution of marine organisms using genetics. They are taking advantage of recent revolutions in genomics which have opened up many exciting opportunities to apply biological archives. The group is currently sequencing the genomes of Antarctic animals, such as brittle stars and octopus, to investigate their evolutionary history and understand how they have been shaped by past environmental and climatic change. This could provide insights into the past advance and retreat of ice sheets, and allow scientists to date when adaptations have arisen in response to large-scale environmental changes, such as changes in salinity and temperature.

Read more

Strugnell, J.M., McGregor, H.V., Wilson, N.G., Meredith, K., Chown, S.L., Lau, S.C.Y., Robinson, S.A. and Saunders, K.M. (2022) Emerging biological archives can reveal ecological and climatic change in Antarctica. *Global Change Biology* **28**, 6483-6508. DOI: https://doi.org/10.1111/gcb.16356

Improving our ability to predict sea level rise

Our ability to predict the contribution of ice sheet melt to sea level rise is only as good as the accuracy of the data which scientists use in ice sheet models.

One factor creating uncertainty is the heat that emanates from deep within the Earth's core to the surface. This so-called geothermal heat flow is important in controlling the ice temperature and contributes to ice melt at the base of the Antarctic Ice Sheet. It impacts how quickly the ice flows towards the ocean and contributes to sea level rise.

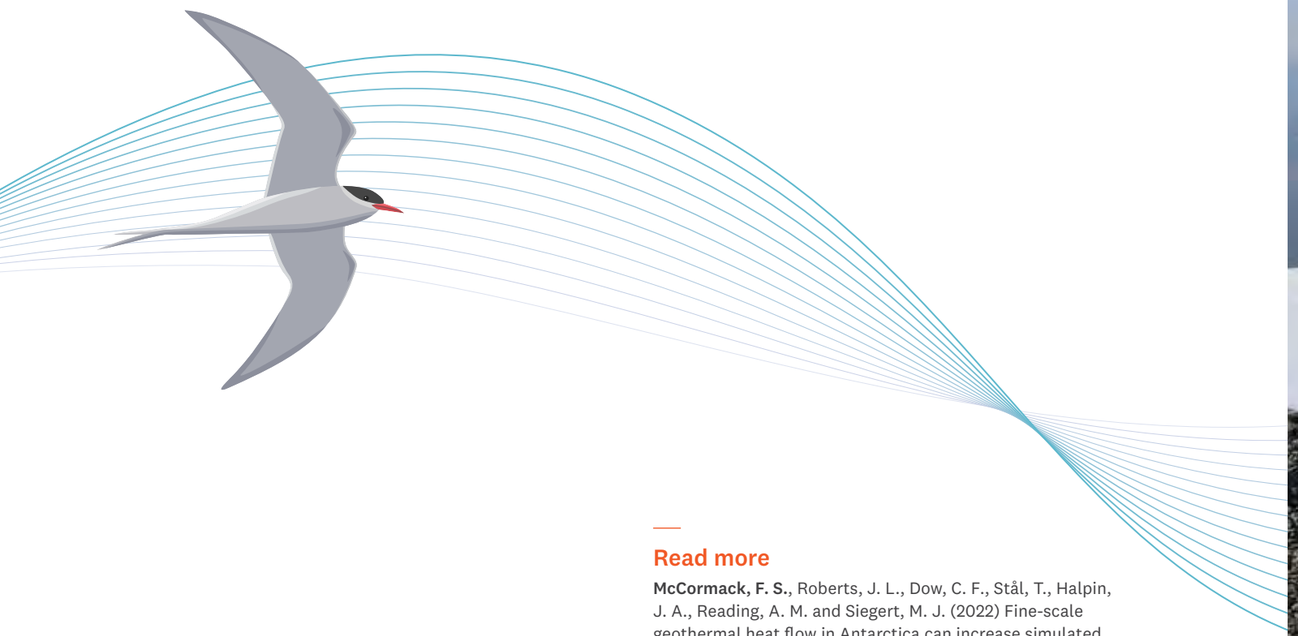
Accurate data about geothermal heat flow in Antarctica is difficult to gather due to the challenges of making measurements from beneath the ice. As a result, the data currently used by most ice sheet models is based on scientists' best estimates. The resolution is low, and there is a high level of uncertainty about it, which reduces confidence in the results of the model simulations.

To improve confidence in the contribution of geothermal heat flow to ice melt, Dr Felicity McCormack from Monash University and her team used hypothetical geothermal heat variability to test how it contributes to ice melt in the Aurora Subglacial Basin, which is located near Casey Station in Antarctica.

As Felicity explains, the team found that where there are larger variations in geothermal heat flow, there is consistently higher melting at the base of the ice sheet than if the geothermal heat flow varies smoothly – as in the datasets that most modellers are currently using.

For a region like the Aurora Subglacial Basin, which contains enough ice to raise the global sea levels by 7 m and is the fastest thinning region in all of East Antarctica, this has significant implications for how fast it's flowing, and how it will respond to climate change.

This research identified the minimum heat at the base of the Aurora Subglacial Basin that could lead to melt, and where in this region small variations in geothermal heat flow will have the largest impacts on ice melt. This will help us to target these locations for further observations.



Read more

McCormack, F. S., Roberts, J. L., Dow, C. F., Stål, T., Halpin, J. A., Reading, A. M. and Siegert, M. J. (2022) Fine-scale geothermal heat flow in Antarctica can increase simulated subglacial melt estimates. *Geophysical Research Letters* **49**, e2022GL098539. DOI: https://doi.org/10.1029/2022GL098539

Islands in the ice: potential impacts of habitat transformation on Antarctic biodiversity

Permanently ice-free areas cover less than 1% of the Antarctic continent, but are where most of Antarctica's terrestrial species live. These ice-free areas mainly occur along the coast and as nunataks, and often form as small islands of rock and soil in a sea of ice or snow.

As temperatures rise, ice-free areas are predicted to expand by nearly 25% by 2100, with the largest expansion predicted to occur along the Antarctic Peninsula. While uncertainty surrounds how biodiversity will be affected as habitats transform, there are many competing ideas about what will occur.

SAEF Deputy Director, Distinguished Professor Sharon Robinson, University of Wollongong, and postdoctoral researchers Dr Jasmine Lee (who led the study), Queensland University of Technology, Dr Melinda Waterman, University of Wollongong, and Dr Justine Shaw, Queensland University of Technology, joined an international team of scientists to outline four of these hypotheses, and put forward 10 key research questions to facilitate understanding of the impacts of the new ice-free areas.

Hypothesis 1

New ice-free areas with warmer temperatures and higher water availability will create new habitats for colonisation, which will benefit some species, but not others. Two factors crucial to whether species can make a home on newly exposed land are water availability and whether soil has enough nutrients to support vegetation, microfauna and microbes.

Hypothesis 2

The expansion of ice-free areas will lead to increasing environmental connectivity and reduce some structural barriers to species dispersal. However, while many species will have the potential to reach newly ice-free areas, whether they can establish themselves will depend on the species and the suitability of the habitat.

Hypothesis 3

Warmer climates combined with new habitats and expanding science and tourism activity will increase the likelihood of the establishment of invasive species. Antarctica's greatest barriers to invasive species colonisation are its remoteness and extreme climatic conditions, but as climate conditions become milder, this barrier will weaken and species previously unable to establish may take hold.

Hypothesis 4

Habitat transformation will benefit some species and not others, possibly resulting in increased homogeneity of biodiversity. Increased competition for space and resources may lead to a loss of local endemism and the emergence of more similar communities across regions.

Under warmer climate conditions, Antarctic specialists, such as the Emperor penguin and endemic moss *Schistidium antarctici*, will show significant population decline, while the species with broader climatic tolerances are likely to be best able to capitalise on newly suitable conditions.

Read more

Lee, J.R., **Waterman, M.J.**, **Shaw, J.D.**, Bergstrom, D.M., Lynch, H.J., Wall, D.H. and **Robinson, S.A.** (2022) Islands in the ice: Potential impacts of habitat transformation on Antarctic biodiversity. *Global Change Biology* **28**, 5865– 5880. DOI: https://doi.org/10.1111/gcb.16331

As temperatures rise, ice-free areas are predicted to expand by nearly 25% by 2100, with the largest expansion predicted to occur along the Antarctic Peninsula.

Testing, testing: getting a strong signal that invasive species indicators are weak

Invasive species are one of the top five threats to biodiversity and ecosystems around the world. With a changing climate and an increasingly connected world, the number of introduced and potentially invasive species is in the tens of thousands and is predicted to grow. In recognition of the impacts and costs of invasive species, they have been placed on the agenda of major global initiatives, including the 1992 Convention on Biological Diversity and the 2030 Agenda for Sustainable Development of the United Nations. These initiatives include specific policy targets aimed at reducing the prevalence and impact of invasive species.

However, monitoring the progress on meeting these targets requires adequate indicators, and questions have been raised about whether existing indicators are fit-for-purpose.

A team, including Chief Investigator Professor Melodie McGeoch and Research Fellow Dr David Clarke, from La Trobe University, set out to undertake an analysis to assess existing indicators, including their strengths and weaknesses for reporting against policy targets.

In all, a total of 61 indicators were identified across 27 publications, including ones that provide information on pathways (e.g. trade or transport), change (e.g. number or abundance of the invasive species), impacts (e.g. number of impacted native species) and responses (e.g. actions to control the invasive species). This included 7 indicators specifically developed for reporting on Antarctic invasions.

The team found that most indicators were inadequate when assessed against the desirable properties for measuring and reporting progress on reaching targets. They suggest that there are three possible reasons for this, including that 1) not enough attention has been paid to the requirements of an effective indicator, 2) there is insufficient data to populate and inform policy-relevant indicators, and 3) there is not enough investment in the development and maintenance of indicators. In the Antarctic specifically, ongoing data collection to update the indicators and to increase their spatial coverage are essential to support evidence-based decisions on the biosecurity of the region.

In response, the team provided a list of recommendations for the development of indicators capable of measuring progress made towards mitigating and halting biological invasions, including continued investment in indicators for regional and global reporting and including measures of uncertainty alongside indicators.

These outcomes are critical in an Antarctic context. Biological invasions are a primary threat to the region and a major management concern for the Committee for Environmental Protection of the Antarctic Treaty System. Excellent indicators for reporting progress are as critical here as they are elsewhere.

Read more

Vicente, J. R., Vaz, A. S., Roige, M., Winter, M., Lenzner, B., **Clarke, D. A.**, and **McGeoch, M. A.** (2022) Existing indicators do not adequately monitor progress toward meeting invasive alien species targets. *Conservation Letters* **15**, e12918. DOI: https://doi.org/10.1111/conl.12918

Investigating the evolution of Antarctica's ancient tardigrades

Tardigrades are microscopic invertebrates, colloquially known as "water bears" that are found all over the world and are well known for their ability to survive in extreme environments.

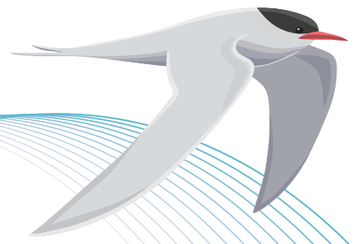
Antarctica's tardigrades include the genus *Mesobiotus* which is globally distributed and has been further classified morphologically into two groups, '*harmsworthi*' and '*furciger*' which are also found in Antarctica and globally. But an international team of taxonomists, systematists and ecologists wanted to test the theory that Antarctica's tardigrades have evolved and speciated *in situ*. This has occurred in some other invertebrates, in part due to their isolation on the continent for 30 million years following the breakup of Gondwana and their survival through repeated periods of glacial maxima.

The team of scientists, including Partner Investigator, Dr Mark Stevens, from the South Australian Museum, tested their theory by extracting the DNA from tardigrade samples (collected from mosses) from across the Antarctic region, and tardigrade samples from Europe, Asia, Africa and North America. They then sequence targeted gene regions to clarify the relationships of Antarctic *Mesobiotus* species.

They found strong support for their proposal. That is, all the Antarctic tardigrades they sampled belong to a single evolutionary lineage, evolving separately from all non-Antarctic tardigrades. They found that this Antarctic lineage predated the final separation of the Antarctic continent from other landmasses, some 30 million years ago.

Antarctica's tardigrades are likely to be a remnant fauna that has successfully survived the continent's changing conditions and has diversified following isolation. This means that the Antarctic lineage of *Mesobiotus* should be considered an independently evolving group, and the classification into the '*harmsworthi*' and '*furciger*' groups based on morphology is in error.

Knowing the precise taxonomic placement and evolution of tardigrades provides insight into the unique character of Antarctic biodiversity in a global context, further justifying a focus on its conservation.



Read more

Short, K. A., Sands, C. J., McInnes, S. J., Pisani, D., **Stevens, M.I.** and Convey, P. (2022) An ancient, Antarctic-specific species complex: large divergences between multiple Antarctic lineages of the tardigrade genus Mesobiotus. *Molecular Phylogenetics and Evolution* **170**, 107429. DOI: https://doi.org/10.1016/j.ympev.2022.107429

Antarctic Futures

Antarctic Futures was an exhibition, seminar series and early learning program that was presented by the University of Wollongong Gallery and Art Collection in partnership with the Early Start Discovery Space and Global Challenges program.

Curated by SAEF Deputy Director, Distinguished Professor Sharon Robinson, Research Fellow, Dr Melinda Waterson and Research Officer, Ms Georgia Watson, alongside Associate Professor Brogan Bunt, it opened during National Science Week and ran from 15 August until 19 October.

The program brought together the work of scientists and artists who have visited Antarctica to consider the nature and future of the continent. It sought to combine both creative and conceptual aspects of environmental understanding to reflect upon potential futures for Antarctica under various climate, biodiversity and tourist scenarios.

“The artworks in the exhibition highlight the beauty and magnificence of the place, the seminars will lead you to new ideas and inspiration, and the children’s workshops will engage our next generation of artists and scientists to be curious about Antarctica,” Georgia said.

“This series of events aims to spark curiosity and inspire creative problem-solving by exploring the links between artistic and scientific practices and perspectives. It poses the view that such a holistic approach is essential to comprehending and addressing wicked problems, of which Antarctica has many.”

As part of the program, the curatorial team collaborated with the early learning team at the Early Start Discovery Space to create a program of play-based experiences about Antarctica for babies to 10-year-olds.

Children were guided by early-learning educators through a program that includes a ‘Draw what you hear’ experience, interactive book readings and a play about tardigrades delightfully called ‘We’re going on a waterbear hunt!’ Children were also encouraged to create artworks that reflect their interpretation of the theme “Antarctic futures” which were incorporated into the exhibition over the course of its showing.

During its run, the Antarctic Futures seminar series also teamed up with the SAEF Seminar Series on a couple of occasions to host “Big Crazy Ideas: The Value of Science Fiction For Conceiving Antarctic Futures” and an Antarctic Futures Q&A Session.

Overall the team believes that the program got people to engage with the idea that Antarctica is everyone’s responsibility to protect.

“Antarctic science has so many opportunities for exploration, new discoveries and a system where management is always being reviewed and adapted for best practice. This means you can make a real difference to the global community by learning about, advocating for and sharing your knowledge of Antarctica,” said Georgia.

Visit to SAEF's South Australian Partners

In July, SAEF Director, Professor Steven Chown, and Program Manager, Ms Jodie Weller, travelled to Adelaide to visit investigators at the program's South Australian partners, the University of Adelaide and the South Australian Museum. Steven and Jodie met with Chief Investigator, Associate Professor Phill Cassey and Partner Investigator, Dr Mark Stevens, and with other collaborators to discuss opportunities and research areas within SAEF. Steven also gave a presentation, about connecting science to policy in the Antarctic governance arena, within the University of Adelaide's Faculty of Science, Engineering and Technology's seminar series.

1. Ms Jodie Weller, Associate Professor Phill Cassey, Professor Steven Chown and Dr Mark Stevens in Adelaide.
2. Associate Professor Phill Cassey and Professor Steven Chown during Steven's seminar about connecting science to policy at the University of Adelaide.

Highlights of Awards and Recognition

Professor Emma Johnston AO FAA FTSE *elected Fellow of the Australian Academy of Science*

Emma was elected a Fellow of the Australian Academy of Science, which recognises the country's most distinguished scientists for their ground-breaking research and contributions to science that have a clear impact. This fellowship recognises Emma as a leader in the field of marine ecology, whose research has been widely adopted into policy by governments in Australia and internationally. Emma has also been actively involved in the development of international and national research strategies and plans, including as Co-Chief Author of the most recent *Australian State of the Environment Report*. This year, Emma commenced in the role of Deputy Vice-Chancellor Research at the University of Sydney. Emma is a Chief Investigator within SAEF focused on understanding Antarctic marine communities and how they respond to environmental stressors.

Professor Chris Greening *awarded Fenner Medal*

Chris was awarded the prestigious Fenner Medal by the Australian Academy of Science, which celebrates outstanding research in biology by a scientist who has completed their PhD within the last 10 years. The award recognises Chris's work leading the One Health Microbiology Group within the Biomedicine Discovery Institute at Monash University. During this time, he and his research group have made the incredible discovery that bacteria can "live on air", which has redefined our understanding about the minimum requirements for life on Earth. Chris is a Chief Investigator within SAEF where his work focuses on using microbiology to understand the extent to which chemosynthetic processes dominate in Antarctica.

Professor Melodie McGeoch FAAS *elected to the African Academy of Sciences*

Melodie's election by the Governing Council of the African Academy of Sciences as a Fellow recognises her as one of Africa's most distinguished researchers based on her publication record, innovation, leadership and contribution to policy. Melodie is based at La Trobe University where her research focuses on the ecology and conservation of populations and communities. Her interests extend from quantifying and modelling the abundance and distribution of species to the impact of environmental change on protected areas. Melodie is a Chief Investigator with SAEF where her work is focused on the measurement of biodiversity status and trends in Antarctica and the sub-Antarctic.

Associate Professor Andrew Zammit-Mangion *awarded by the American Statistical Association*

The 2022 ENVR Early Investigator Award of the American Statistical Association is a prestigious, early-career award recognising outstanding work in environmental statistics, including the development of statistical methods for modelling and analysing environmental data. The award committee was impressed by Andrew's highly impactful methodological and interdisciplinary research in spatio-temporal statistics, applied to investigating the causes and effects of a changing climate. Andrew is a Chief Investigator based at the University of Wollongong, where his work is focused on using statistical methods for making inferences on climate, ice sheet and ecological processes.

Dr Jodie Smith *promoted to Branch Head at Geoscience Australia*

In July, Jodie was promoted to Branch Head of Oceans, Reefs, Coasts and the Antarctic Branch at Geoscience Australia. She leads the team responsible for advising on the geology of Australia's ocean environments and ensuring that high-quality seafloor data are publicly available to support scientific, strategic and operational applications. Jodie is a SAEF Governance Advisory Board member and Partner Investigator, where she applies her expertise in bathymetry, geomorphology and seabed mapping to a range of research.

Associate Professor Kate Helmstedt *awarded QLD Young Tall Poppy Award*

Kate was awarded a Queensland Young Tall Poppy Science Award by the Australian Institute of Policy and Science, which recognises excellence in research and enthusiasm for science communication. The award acknowledges Kate's work at Queensland University of Technology, where she uses maths and data science to better understand and manage threatened ecological systems and species. Kate is Theme 3 Mentee and a Chief Investigator with SAEF. She is leading a project which uses Value of Information Theory to support improved environmental management practices.

Career development highlights

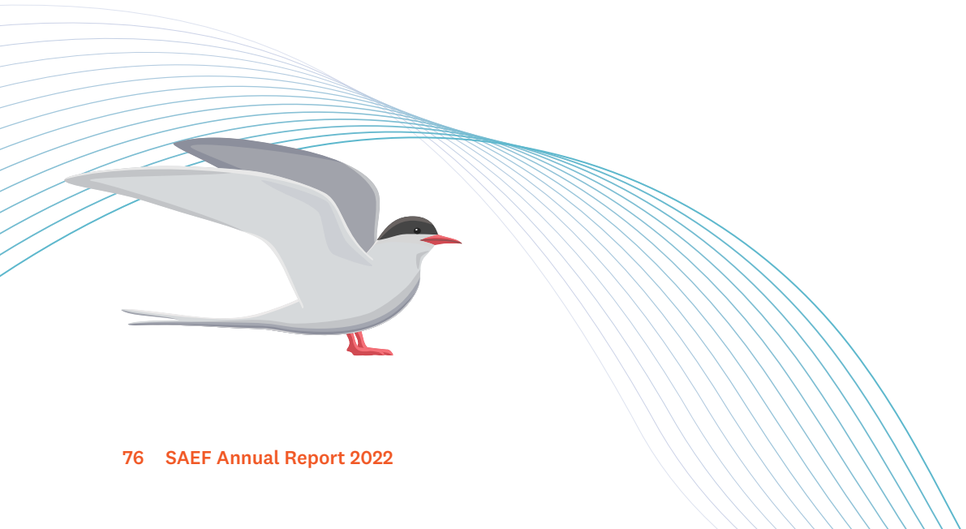
Briefing on preventing and responding to sexual harassment and violence in the field

SAEF is committed to ensuring that all SAEF expeditioners have the knowledge and skills to prevent and respond to sexual harassment and violence while in the field. As part of this commitment, ahead of the 2022/23 field season, the program engaged Ms Hannah Jay, an expert in providing practical advice in the areas of sexual harassment and gender-based violence. Hannah provided briefings to three teams of SAEF expeditioners which were tailored specifically for the scenarios that they may encounter while in Antarctica or on Macquarie Island.

NVIDIA Sponsorship

This year SAEF was awarded an NVIDIA Strategic Research Engagement sponsorship in the form of 10 state-of-the-art GPUs for accelerating AI, simulation, digital twins and scientific visualisations. In addition, Dr Johan Barthélemy, a Senior Research Fellow at University of Wollongong took up a new role of Developer Relations Manager at NVIDIA. As part of this role, Johan now provides dedicated technical support to scientists within SAEF who are interested in using the GPUs in their research. This included delivering an NVIDIA Deep Learning Institute workshop on the Fundamentals of Deep Learning, which supported attendees to develop their skills so they can make use of the GPUs to process their data. Johan also joined four other SAEF members to travel south to Casey Station in late December to set up a world-first Artificial Intelligence of Things (AIoT) smart sensor system which will provide scientists with continuous images and data of the Antarctic environment. Once they return, the GPUs that NVIDIA has donated to the program will be used to process the large amount of data the team collects using specialised drones and the new AIoT platform.

This sponsorship corresponds to $290,000 AUD.



Introduction to Developing Successful Policy Papers for the Antarctic Treaty System

SAEF is committed to ensuring that the program's science and expertise reaches policy forums to support decision-makers. As part of this commitment, SAEF hosted a workshop which sought to introduce SAEF members to developing evidence-informed policy papers. The session was presented by Distinguished Professor Stuart Kaye, Director of the Australian National Centre for Ocean Resources at the University of Wollongong and a SAEF Chief Investigator, and Mr Ewan McIvor, Senior Environmental Policy Adviser from the Australian Antarctic Division. It was arranged by Monash University and facilitated by SAEF Deputy Director Professor Kerrie Wilson from the Queensland University of Technology. An invitation to attend was also extended to everyone at the ARC SRIEAS Australian Centre for Excellence in Antarctic Science. The session covered insights into the workings of the Committee for Environmental Protection and the Commission for the Conservation of Antarctic Marine Living Resources. It also covered the process for developing policy papers for Antarctic Treaty System meetings, particularly in relation to the language required for maximum efficacy.

Mentorship Program

As part of our commitment to developing the careers of SAEF members, the program established the inaugural SAEF Mentoring Program. The program was facilitated by Ms Linda Betts, an organisational consultant with expertise in delivering mentoring, change management and leadership programs for researchers at all career levels. It sought to support participants to develop industry-specific work skills and knowledge, and to improve connections amongst participants across all career-stages and SAEF partners.

Twenty-three mentor and mentee pairs completed the program, including investigators, research fellows, students and professional staff. A highlight of the program was the two networking sessions which featured presentations from Mr Drew Clarke AO FTSE FRGS and Professor Nicole Webster, both members of the SAEF Governance Advisory Board.

The program is guided by a team of SAEF investigators and professional staff including Professor Kerrie Wilson, Dr Justine Shaw, Associate Professor Phill Cassey, Dr Nerida Wilson, Ms Joanna Burrows and Ms Jodie Weller.

Feedback from attendees who completed the program was positive:

"I learned to expand my horizons and not stick to a default career path, but to take steps to veer towards that which I am most passionate about"
SAEF mentee

"Having someone you can trust and can discuss challenges with outside your day to day work is useful as it provides an opportunity to really tease issues out and get a fresh perspective on things"
SAEF mentee

Early career development

Funding for Early- and Mid-Career Researchers

In line with SAEF's priority to provide early- and mid-career researchers (EMCR) with professional development opportunities so that they can go on to lead successful careers in Antarctic research, and beyond, SAEF opened two funding opportunities to our EMCR community.

These included:

- Two PhD Project Scholarships to support our EMCRs to become PhD supervisors and build their research training skills.
- EMCR Professional Development Funding to support career development and progression.

Funds were awarded to:
PhD Project Scholarships

- Dr Krystyna Saunders (and co-supervisors Dr Justine Shaw and Dr Karina Meredith)

  Project: Aquatic and terrestrial ecosystem responses to climate on World Heritage sub-Antarctic Islands.

- Dr Justine Shaw (and co-supervisors Dr Jonny Stark and Dr Kate Helmstedt)

  Project: Environmental Management in Antarctica

Krystyna engaged Ms Caitlin Selfe in her successful PhD scholarship and Caitlin had the opportunity to travel to Macquarie Island for six months to complete fieldwork. The second awardee will start in 2023.

The personal development funds were awarded to Dr Ariaan Purich, Dr David Clarke, Dr Juan Sandino Mora, Dr Justine Shaw and Dr Sean Bay for a range of professional development activities, including courses to improve skills across media engagement, remote sensing, AI and machine learning, leadership and professional coaching. One awardee also used these funds to obtain their remote pilot licence to operate drones.

Cross Node Supervision

As part of SAEF's efforts to foster interdisciplinary collaboration between our partners the program encourages cross-node supervision of PhD and Honours students. 33% of the program's students have cross-node supervision, including supervision across Australian Antarctic Division, Australian Nuclear Science and Technology Organisation, Bureau of Meteorology, James Cook University, Queensland University of Technology, Monash University, University of Wollongong and Western Australia Museum.

ECR and Student Professional Development Workshop

In October, a hybrid professional development workshop was held for approximately 20 SAEF early- and mid-career researchers. The session was led by Ms Cassandra Levin, a certified leadership coach and registered psychologist at Queensland University of Technology who specialises in organisational psychology, alongside Dr Justine Shaw and Ms Sharon Athanasois who facilitated activities at Monash University and the University of Wollongong respectively. The workshop focused on two key topics: building strong collaborations and difficult conversations. Skills development in these two areas will support more effective work by fostering trust, building an understanding of individual differences, and encouraging courageous leadership behaviours.

SAEF Space

What is SAEF Space?

Early-career researchers (ECRs) are essential for SAEF's success, and require nurturing environments to flourish. In 2021, members of SAEF's initial higher degree research (HDR) cohort identified an opportunity to unite and leverage the Australia-wide SAEF ECR community to enhance their experience and promote a culture of connection, safety, and support. In 2022, SAEF Space was established: a community of SAEF ECRs (including HDR students and early-career research and professional staff) with the purpose of:

- Developing professional and personal connections among peers;
- Seeking and providing support regarding early-career experiences; and
- Supporting collaboration and skill development across SAEF.

2022 Highlights

SAEF Space officially launched in July 2022 following the election of its inaugural Management Committee, comprising Ms Jo Burrows (Chair), from Queensland University of Technology, Ms Georgia Watson (Vice-Chair for Social Engagement), from the University of Wollongong, and Ms Charlotte Patterson (Vice-Chair for Professional Development), from Queensland University of Technology. In 2022, SAEF Space had approximately 50 members. Highlights from its first six months include:

- **SAEF Space Welcome & Member Workshop – August 2022** At this first official event, the committee welcomed SAEF Space members and collaborated to brainstorm activities, events, and other opportunities for professional development and social engagement, supporting present and future committee members in planning for the years ahead.
- **Launch of SAEF Space website & Slack group** The SAEF Space website, housed within the SAEF Intranet, supports ECR connection and collaboration by profiling each of its members, including their research themes, topics to 'ask me about', and personal interests. The website also includes a calendar for staying up-to-date with professional and social events for SAEF Space members. The dedicated SAEF Space Slack group offers a space for socialising, seeking and providing support, and celebrating wins.
- **Ecological Society of Australia – Society for Conservation Biology 2022 Conference – December 2022** Several SAEF Space members attended and presented at the ESA-SCBO 2022 Conference in Wollongong, where they gathered socially, met some of their peers for the first time, and leveraged connections to network with others in Polar and Southern Ocean science.

2023 and Beyond

In 2023 and in the years ahead, the SAEF Space Management Committee will continue to deliver enjoyable and engaging social and professional development activities for SAEF ECRs, including its first official in-person event at the SAEF Annual Conference in Adelaide in May 2023. It will also provide advice to the SAEF PEG and advisory bodies on matters related to the ECR community, such as career development and inclusion aspects of the broader SAEF program and opportunities to enhance collaboration across SAEF nodes.

1

2

1. SAEF representatives, including SAEF Space members, and peers gathered at ESA-SCBO 2022 in Wollongong. L-R: Zach Carter, Justine Shaw, Martín Iglesias, Ellie Hay, David Clarke, Georgia Watson, Fern Hames, Matthias Dehling, Jennie Wardle, Kate Helmstedt, Charlotte Patterson, Benjamin Viola, Pennie Pascoe. Image credit: Georgia Watson.

2. The SAEF Space logo, designed by Jo Burrows, portrays the Emperor Penguin ensuring the safety and wellbeing of its young.

SAEF IN

New Zealand

Antarctic Science Platform Meeting

SAEF Director, Professor Steven Chown and Program Manager Jodie Weller attended the Antarctic Science Platform (ASP) meeting in Wellington, New Zealand. Steven attended as a member of the ASP International Science Panel, and to present the Scientific Committee on Antarctic Research's (SCAR) *Antarctic Climate Change and the Environment Decadal Synopsis.* His presentation not only conveyed the report's findings, but also brought new interest to the report as a valuable resource to share the current understanding of change in the region, and the research and polices required to mitigate or adapt to it.

While in the country, Steven and Jodie met with the Chair of the SAEF International Science Advisory Panel, Professor Nancy Bertler, with researchers at the New Zealand Department of Conservation, and with a range of Antarctic researchers and colleagues from SCAR.

1. SAEF Director, Professor Steven Chown and Professor Tim Naish from the Victoria University of Wellington and a Co-Author on the *Antarctic Climate Change and the Environment Decadal Synopsis*.
2. Mr Enrique Pardo, Science Advisor, Marine Ecosystems Group and Professor Steven Chown following a meeting at the New Zealand Department of Conservation.

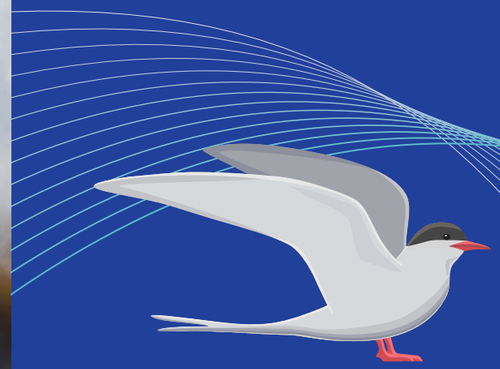
Spotlight on our International Investigators

Professor Margaret Barbour

Professor Margaret Barbour is the Dean of Science at the University of Waikato. Margaret pioneered novel stable isotope techniques to study the exchange of carbon and water between plants and the atmosphere. This research led to a new understanding of how plants regulate carbon and water exchange, which has been applied to managed ecosystems (such as cereal and legume crops) and natural ecosystems (such as old-growth forests). She has also applied these techniques to reconstruct past climates and plant responses using tree rings.

In October, SAEF participants benefited from Margaret's expertise when she presented at the SAEF Seminar Series. Her seminar showed how scientists can use oxygen isotopes preserved in plant tissue and ice cores as proxies to reconstruct past climates and plant physiological responses to environmental change.

Within the SAEF research program, Margaret is part of a project looking to understand past climates using Antarctic moss. The project uses moss shoots as indicators of how ecosystems are affected by environmental change in Antarctica.



SAEF IN

Europe

Antarctic Climate Change and the Environment Decadal Synopsis

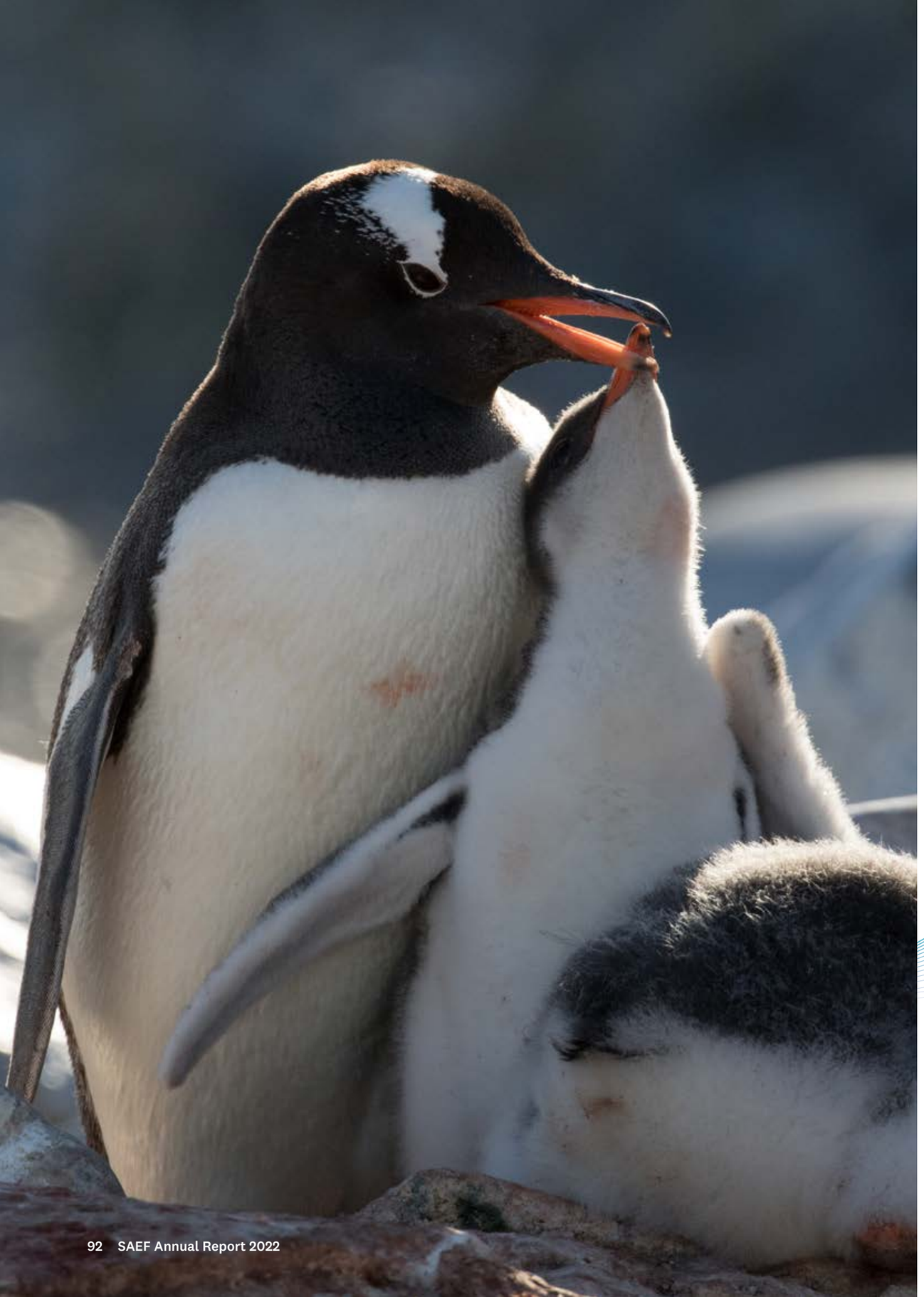
This year the Scientific Committee on Antarctic Research (SCAR) worked with scientists around the world to produce the *Antarctic Climate Change and the Environment: A Decadal Synopsis and Recommendations for Action* report. The development of this landmark report was led by SAEF Director, Professor Steven Chown FAA, and included contributions by fellow SAEF investigators, Professor Andrew Mackintosh, Assistant Professor Cassandra Brooks, Dr Benjamin Henley, and Ms Laura Phillips.

The ACCE Decadal Synopsis, as it is now known, was presented at the XLIV Antarctic Treaty Consultative Meeting (ATCM) and the 41st Meeting of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). Despite the complexities of international conflict impacting both meetings, the report helped to galvanise further commitment to action and was constantly referred to in the formal business of and reports from both meetings. Unanimous agreements were reached at both meetings to focus on climate change in the region, including ways to mitigate and adapt to the impacts.

The Antarctic Treaty Consultative Parties issued a Resolution on Climate Change and agreed to dedicate a special full-day session at the XLV ATCM in Helsinki in 2023 to discuss the implementation of the report's recommendations. The CCAMLR Commissioners similarly agreed to a Resolution on Climate Change to take further action on the matter.

Professor Chown was present at both meetings, and presented the SCAR Lecture at the 41st Meeting of CCAMLR, which focussed on the findings and recommendations of the report.

The report is now featuring in discussions around the globe on research to address the region's most pressing questions and ways to advise policymakers.



Type localities for Antarctic area protection

New research led by Monash University research officer Ms Laura Phillips, alongside Professor Steven Chown, and Dr Rachel Leihy, previously a postdoctoral researcher at Monash University, is supporting Parties to the Antarctic Treaty to fulfil a major conservation goal, the continent-wide protection of Antarctic species.

One of the requirements of the Protocol on Environmental Protection to the Antarctic Treaty for protected areas is the inclusion of 'type localities' in the Antarctic Specially Protected Area (ASPA) network. Type localities are locations where the characteristic (or type) specimen(s) of a species were collected from and on which the species' description is based in the taxonomic literature. Types are essentially the representative individual or individuals of a species, and are avidly protected by museums. Yet until this work, little was known about where such type localities are in Antarctica and what proportion of them lie within ASPAs.

To address these questions, the team produced the first comprehensive inventory of over 1 100 Antarctic species and their type localities. The team mapped the type localities across the continent to determine how many of the sites are currently protected within ASPAs. They found that more than a quarter (28%) of all species already have their type localities protected. The remaining 72% of the continent's type localities require special protection.

There is now a great opportunity to protect these localities. The team estimate that 105 new protected areas would cover all remaining type localities and if focus is placed on areas with multiple localities first, Parties could rapidly protect many more species. The network could then be expanded to achieve a major conservation goal of the Antarctic Treaty – the continent-wide protection of Antarctic species.

This paper was submitted by Australia as a Working Paper on Type Localities to the XLIV Antarctic Treaty Consultative Meeting (ATCM). It was well received and agreement was reached by members of the Committee for Environmental Protection to consider the information when planning for or reporting on Antarctic Specially Protected Areas.

Read more

Phillips L.M., Leihy R.I. & **Chown S.L.** (2022) Improving species-based area protected in Antarctica. *Conservation Biology* 36, e13885. DOI: https://doi.org/10.1111/cobi.13885

World Economic Forum Strategic Intelligence Platform

The World Economic Forum (WEF) has created a platform which provides strategic insights and contextual intelligence on the forces driving transformational change across economies, industries and global issues. The information is presented in a series of Transformation Maps that help people to explore and make sense of connections that relate to a topic such as climate change, artificial intelligence or, in this case, Antarctica.

WEF approached SAEF Director, Professor Steven Chown to co-curate a map on Antarctica. This was produced alongside Chief Investigator Professor Andrew Mackintosh and Research Fellow Dr Felicity McCormack at Monash University, and Dr Rachel Leihy, at Monash University at the time. The map highlights the links between Antarctic ice sheets and sea level, environmental risk, climate change science, infrastructure, natural resources, governance and tourism, and other major global issues.

The platform is aimed not only at regular attendees of the annual WEF meetings, but the general public more broadly, thus reaching a broad cross-section of society. It's an extraordinary resource and an innovative way of demonstrating the global significance of Antarctica.

View the platform

https://intelligence.weforum.org/topics/a1G680000004CswEAE

French-Australian cooperative research grant for Antarctica and the Southern Ocean

In collaboration with the Embassy of France, SAEF initiated a new scheme aimed at fostering collaboration between Australia and France on Antarctic and Southern Ocean research.

The $20,000 grant scheme is jointly funded by the Embassy of France, the Australian French Association for Research and Innovation (AFRAN), and Monash University, through SAEF.

The Embassy of France's science and higher education attaché, Professor Thierry Corrège, said that the grant offers opportunities to foster new science collaborations between Australia and France.

"The response to this new grant has been excellent, with 15 high-quality proposals covering many areas of polar science. It undoubtedly shows the need for such tools to encourage collaboration between our two countries."

SAEF Director, Professor Steven Chown has made clear that:

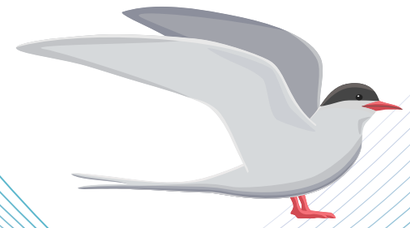
"This grant is an exciting opportunity to facilitate scientific exchange between Australia and France. Both of the successful projects will support global efforts to safeguard Antarctica and the Southern Ocean against the impacts of climate change."

Two teams were awarded the grant funding, including:

- Dr Felicity McCormack (Monash University) and Professor Olivier Gagliardini (Université Grenoble Alpes) *Towards an ANISOtropic ice flow Model Intercomparison Project*
- Dr Linda Armbrecht (University of Tasmania) and Dr Johan Etourneau (Université de Bordeaux) *Interpaleogens – Intercalibrating new paleogenomic methods to investigate the vulnerability of the Antarctic trophic levels to past climate change*

Dr McCormack and Professor Gagliardini are leading developers of flow laws for anisotropic ice in their respective ice sheet models, the Ice-sheet and Sea-level System Model and Elmer/Ice. This grant funding will support work to improve understanding of flow laws, by enabling Dr McCormack to visit Prof Gagliardini at the Institut des Géosciences de l'Environnement at the Université Grenoble Alpes. There they will collaborate on work to develop a new international initiative, the ANISOtropic ice flow Model Intercomparison Project.

The second successful project, led by Dr Armbrecht and Dr Etourneau, will further their research into the use of palaeogenomic techniques to reconstruct past climates and ecosystems to better predict how they will respond in the future. This funding will support Dr Etourneau's PhD student, Ms Mathilde Bourreau, to travel to the University of Tasmania. There she will work with Dr Armbrecht's PhD student, Ms Prashasti Singh to compare several palaeogenomic techniques to extract, purify and amplify DNA in marine sediment samples. The project will enable them to better understand and improve the efficiency of these techniques and help better understand the response of past Antarctic ecosystems to climate change.



Threat management priorities for conserving Antarctic biodiversity

New research published in *Plos Biology* identifies 10 conservation strategies that could benefit up to 84% of Antarctic life. The research involves SAEF Director, Professor Steven Chown and SAEF Deputy Director, Sharon Robinson, alongside collaborators who have become SAEF investigators since the study commenced including Dr Jasmine Lee (who led the study), Dr Aleks Terauds, Dr Justine Shaw and Professor Donald Cowan.

Antarctic terrestrial biodiversity faces multiple threats. Yet no large-scale assessments of threat management strategies have been made. This study does so, demonstrating that existing conservation efforts are insufficient in a changing world. At least 65% (at best 37%, at worst 97%) of native terrestrial taxa and land-associated seabirds are likely to decline by 2100 under current trajectories.

The study finds that implementing 10 key threat management strategies in parallel, at an estimated present-day equivalent annual cost of US$23 million, could benefit up to 84% of Antarctic taxa. Climate change is identified as the most important threat to Antarctic biodiversity. Thus, influencing global policy to effectively limit climate change is the most beneficial conservation strategy. Minimising impacts of human activities, including through improved planning and management of new infrastructure projects, are also cost-effective potential measures to limit impact and threat.

What this work shows is that the most effective threat management strategies are those that simultaneously include both global and local actions. It will be foundational to additional work that the program does in the Antarctic conservation space.

Read more

Lee J.R., Terauds A., Carwardine J., Shaw J.D., Fuller R.A., Possingham H.P., **Chown S.L.**, Convey P., Gilbert N., Hughes K.A., Ivor E., **Robinson S.A.**, Ropert-Coudert Y., Bergstrom D.M., Biersma E.M., Christian C., Cowan D.A., Frenot Y., Jenouvrier S., Kelley L., Lee M.J., Lynch H.J., Njastad B., Quesada A., Roura R.M., Shaw E.A., Stanwell-Smith D., Tsujimoto M., Wall D.H., Wilmotte A. and Chades I. (2022) Threat management priorities for conserving Antarctic biodiversity. *PLoS Biology* **20**, e3001921. DOI: https://doi.org/10.1371/journal.pbio.3001921

Scientific assessment of ozone depletion report

The ozone layer is the shield in the Earth's atmosphere that absorbs almost all of the Sun's ultraviolet radiation. In the 1980s, scientists discovered that due to the emission by humans of chlorofluorocarbon (CFC) chemicals in the atmosphere, ozone was being destroyed. This was particularly pronounced over Antarctica, especially in spring. In response, governments around the world established the Montreal Protocol in 1987, a global agreement committing signatories to protect the ozone layer by phasing out the production and use of ozone-depleting chemicals.

As part of this agreement, every four years the World Meteorological Organisation and the United Nations Programme gather an international team of scientists to assess the state of the ozone layer and produce the Scientific Assessment of Ozone Depletion. This report is an overview of the current scientific understanding of ozone depletion and information to support policymakers in their decision-making around its protection.

Two SAEF researchers were involved in the development of the 2022 report. SAEF Chief Investigator Professor Julie Arblaster, from Monash University, was a member of the Scientific Steering Committee and SAEF Research Fellow Dr Ariaan Purich, from Monash University, assessed all the recent literature on the influence of ozone depletion on the ocean, sea ice and ice sheets reported in Chapter 5.

The report states that the ozone layer is recovering following collaborative efforts of governments to phase out ozone-depleting substances and is on track to be completely recovered by 2040, except in the polar regions. In Antarctica, the ozone layer is likely to recover by 2066. Ozone-depleting substances are also strong greenhouse gases, so by restricting their abundance in the atmosphere the Montreal Protocol is helping to avoid global warming of approximately 0.5—1.5°C by mid-century compared to extreme scenarios with an uncontrolled increase in ozone-depleting substances.

The Montreal Protocol was the first global agreement to address an environmental issue through coordinated international regulatory change. It has been unparalleled in its global uptake, and is protecting the global and Antarctic atmosphere. Thanks to the collaborative effort of nations around the world, the ozone layer is well on its way to recovery.

Read more

https://csl.noaa.gov/assessments/ozone/2022/

Antarctic tourism – developing methods to minimise cumulative impacts

With more than 100,000 tourists expected to visit Antarctica in the forthcoming seasons travelling on one of more than 50 cruise ships, greater understanding of the impacts that increased tourism will have on the continent is required.

SAEF Director, Professor Steven Chown, and Associate Investigator, Dr Jasmine Lee, from the University of Queensland, are both part of an international project that was awarded funding by the Dutch Research Council to explore this issue. The project "Antarctic tourism – developing knowledge and tools to minimise cumulative impacts on biodiversity and wilderness values in Antarctica" will be led by Professor C.J. (Kees) Bastmeijer Director of the Arctic Centre at the University of Groningen.

Dr Jasmine Lee and Distinguished Professor Sharon Robinson at King's College in Cambridge. They collaborated on the Islands in the Ice paper on page 64 and discussed ideas for future papers while Sharon was visiting.

SAEF IN

Chile

Project with BASE Millenium Institute

The BASE Millennium Institute is a not-for-profit foundation created in 2021 which studies the past, present and future of Antarctic and sub-Antarctic biodiversity. It brings together specialists in biodiversity, conservation and international law to integrate their knowledge in interdisciplinary projects. Like SAEF, the BASE Millennium Institute seeks to contribute research for decision-making in relation to Antarctic governance and to generate new ideas and projects which will support protecting Antarctica and its unique ecosystems.

Professor Chown is an international collaborator on the project.

Dr Marcelo Leppe appointed Vice-President of SCAR

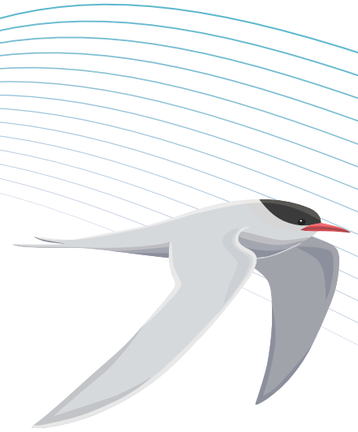
Dr Marcelo Leppe, the Director of the Chilean Antarctic Institute (INACH) has been appointed the new Vice-President for Administration within the Scientific Committee on Antarctic Research (SCAR). Professor Leppe has been involved in SCAR since 2006, first as an Alternate Delegate and then as the Delegate for Chile from 2010. He participated in the first SCAR Antarctic and Southern Ocean Science Horizon Scan, an international forum which analysed the priorities for Antarctic science in 2020.

As the Director of one of SAEF's program collaborators this appointment will support the continued strong links between SAEF and SCAR.

Dr Marcelo Leppe with a copy of the Antarctic Climate Change and the Environment Decadal Synopsis.

SAEF IN THE

United States



Protecting the global values of the Southern Ocean

The Southern Ocean plays a critical role in the stability of the Earth System, but it is threatened by climate change and by commercial fishing. Ahead of the annual CCAMLR meeting in Hobart, SAEF Director Steven Chown from Monash University collaborated with Assistant Professor Cassandra Brooks and colleagues to publish a paper in *Science* calling for improved management practices in the Southern Ocean. The paper outlines a range of measures that could be put in place to balance commercial fishing with the protection of the Southern Ocean ecosystem, while also taking into consideration the current and future impacts of a changing climate.

Today Southern Ocean fisheries are conducted by only 12 countries which primarily target toothfish, the region's top fish predator, and krill, which is a critical part of the Antarctic food web. Toothfish is mainly sold in high-end restaurants, while krill is primarily used as fishmeal for farmed salmon and in krill oil supplements. The paper points out that neither activity contributes to global food security and comes at too high a cost to the Southern Ocean ecosystem which contributes so much to the world.

The impacts of fishing are further compounded by climate change. Krill in particular is seen as extremely high risk due to its dependence on sea ice and vulnerability to ocean acidification.

Read more

Brooks, C.M., Ainley, D.G., Jacquet, J., **Chown, S.L.**, Pertierra. L.R., Francis, E., Roger, A., Chavez-Molina, V., Teh, L. and Sumaila, U.R. (2022) Protect global values of the Southern Ocean ecosystem. *Science* **378**, (6619) 477–479. DOI: https://doi.org/10.1126/science.add9480

Spotlight on International Investigators

Assistant Professor Cassandra Brooks

Assistant Professor Cassandra Brooks has been active in the Antarctic science-policy space since 2012, participating in CCAMLR meetings as part of the delegation from SCAR. As an accomplished researcher and science communicator based at the University of Colorado, Boulder, her contributions in this forum helped to drive consensus on the adoption of the world's largest Marine Protected Area (MPA) in the Ross Sea – one of the healthiest and most productive marine ecosystems left on Earth. It's also the area where most of the Antarctic toothfish are caught. This fish, the Southern Ocean's top predator and one of its most sought-after catches, is one of Cassandra's key areas of research.

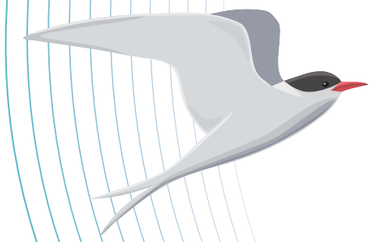
This year the National Science Foundation awarded Cassandra a Faculty Early Career Development (CAREER) award to study the ecology of the Antarctic toothfish. She will use a large collection of otoliths, or ear bones, of the fish to create a time series of its life history and migration patterns. She expects that the study will also provide insights into the health of the Ross System ecosystem and how it is being impacted by climate change. Ultimately, it will help to evaluate whether the boundaries of the Ross Sea are sufficient or need to be changed.

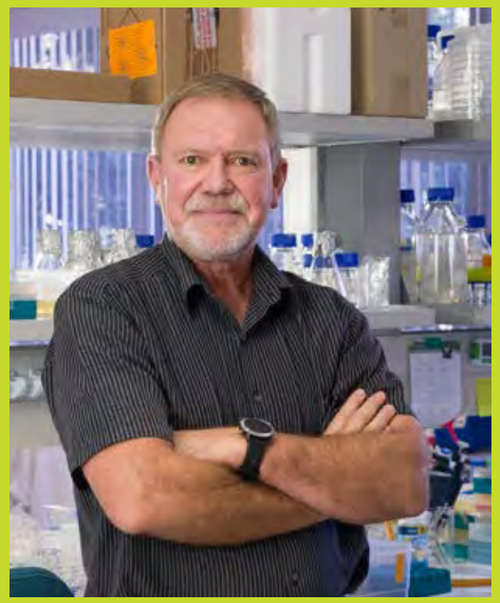
Her work was further acknowledged this year when she was awarded the Edith "Jackie" Ronne Award for Antarctic Research by the Society of Woman Geographers. This award, which honours early to mid-career researchers, recognises the outstanding research and conservation work Cassandra has accomplished in Antarctica and the Southern Ocean.

The Southern Ocean plays a critical role in the stability of the Earth system, but it is threatened by climate change and by commercial fishing.

SAEF IN

Africa





Spotlight on our International Investigators

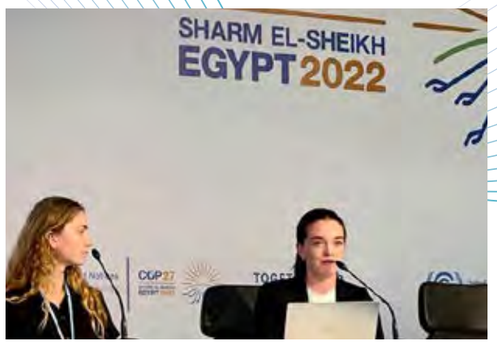
Professor Donald Cowan

Professor Donald Cowan is the Director of the Genomics Institute and Director of the Center for Microbial Ecology and Genomics at the University of Pretoria. He and his team seek to understand the diversity, functions and adaptations of microorganisms in extreme environments; particularly in hot and cold desert soils. Don is highly experienced in Antarctic fieldwork and has been on 15 expeditions to the McMurdo Dry Valleys to investigate its microbial communities.

Don is involved in a SAEF project exploring the use of trace-gas scavenging as a form of energy and carbon acquisition for the microbes that live in Antarctic soils. The team is seeking to understand Antarctic microbial ecosystems, relative to microbial ecosystems in other parts of the globe. Don's particular interest in this project relates to the potential contribution of trace-gas scavenger microbes to microbial community energy and water production.

He is also interested in the broader conservation of Antarctica. "As the last uninhabited and unmodified landmass on Earth, and given its critical role in global processes, in my mind the protection of the Antarctic continent is an absolute necessity," says Don.

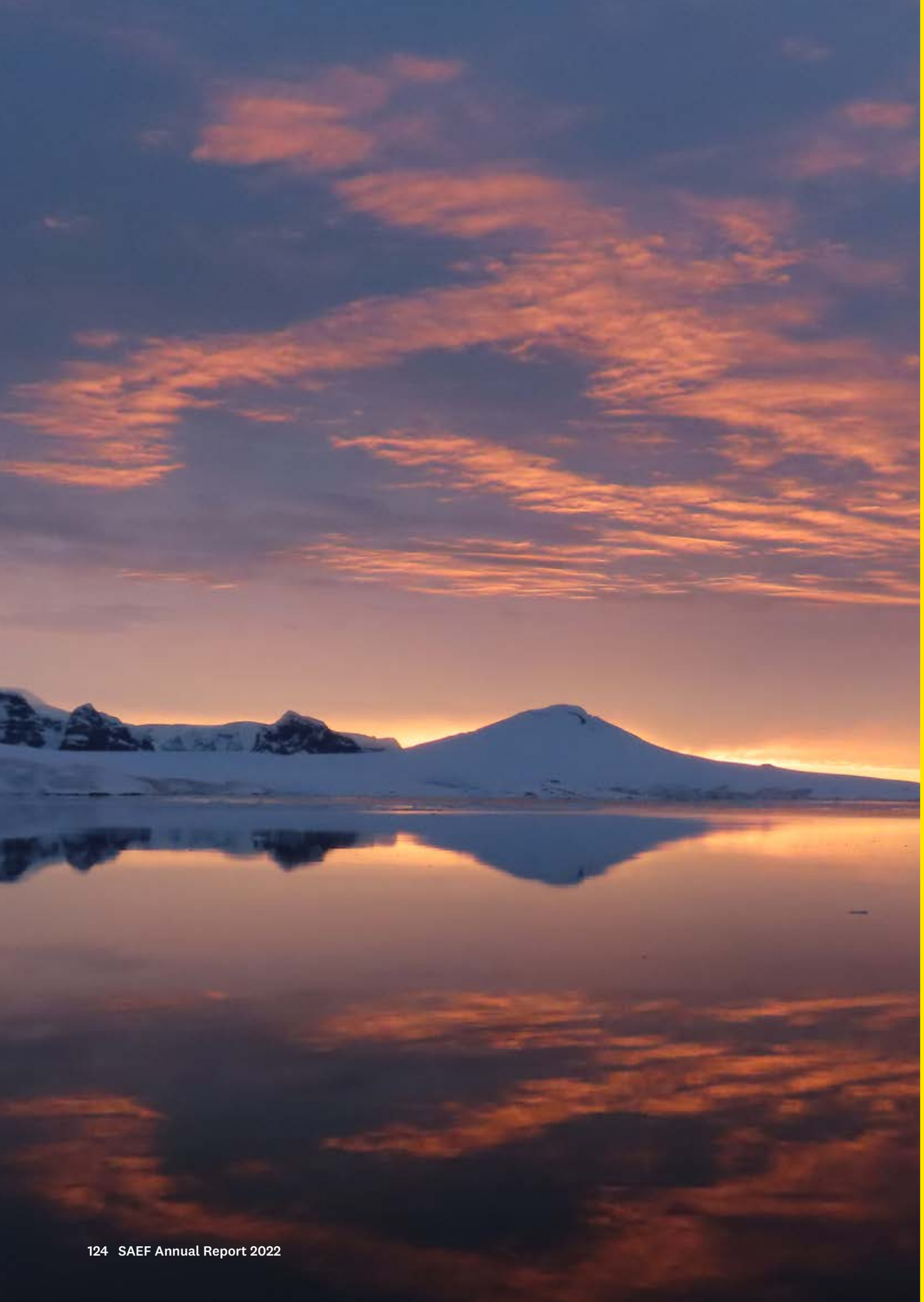
Polar Explorer and SAEF Volunteer Jade Hameister OAM attends COP27



SAEF is fortunate to have Ms Jade Hameister OAM as a volunteer with the program. Jade has set a number of world records including becoming the youngest human to complete the Polar Hat-Trick, which is to ski unsupported to the North Pole, the South Pole and complete the Greenland Crossing. She is currently undertaking a Bachelor of Commerce and Bachelor of Global Studies at Monash University. Drawing upon her experiences visiting polar regions, Jade works to raise awareness about climate change and advocate for a better future for the planet.

This year, she attended COP27 in Sharm El-Sheikh, Egypt as part of the Monash University delegation of staff and students. While attending the conference Jade was part of a youth-led press conference sharing the personal experiences of young people advocating for climate action. Alongside sharing her experiences during her polar expeditions, she also highlighted the work of SAEF.

Jade's enthusiasm and concern for the polar regions and her advocacy for a better future for both her generation and others that will have to face an altered Earth System is well articulated in her contribution to SAEF's introductory video and in other material available through her personal website.



Performance

2023 Activity Plan

JANUARY

FEBRUARY

Expeditioners return from Casey Station 2022/2023

MARCH

Expeditioners return from Macquarie Island 2022/2023

Field and Science Planning commences – Heard Island (2025/26)

JULY

The New Zealand – Australia Antarctic Science Conference – Christchurch NZ

AUGUST

Scientific Committee on Antarctic Research, XIII Biology Symposium 2023 – Christchurch, New Zealand

SEPTEMBER

APRIL

MAY

Inaugural SAEF Conference – Adelaide

Antarctic Treaty Consultative Meeting – Helsinki, Finland

JUNE

OCTOBER

Commission for the Conservation of Antarctic Marine Living Resources – Hobart, Australia

NOVEMBER

Final preparations Denman Terrestrial Field Campaign commences (with SAEF ACEAS, AAPP, AAD)

Antarctic (Casey, Davis, Mawson) and Sub-Antarctic (Macquarie Island) field seasons commence.

DECEMBER

Performance

34
peer reviewed journal articles
26 in the top quartile in article's primary Clarivate InCites JCR category

8
non-traditional research outputs

2
data sets

4
new investigators

1
new research organisation

12
roles members hold in SCAR

1
Antarctic Treaty System Workshop

4
Antarctic Treaty System Papers

1
field program successfully completed

155
LinkedIn followers

834
Twitter followers

202
Instagram followers

1
book
1 book chapter

18
awards and recognition

33%
cross node student supervision

2
mentoring programs

4
Antarctica and Australia engagement event with a Museum

124
presentations
- 32 to public
- 2 to 'Women in STEM' events
- 11 to government
- 3 to end users
- 5 to non government
- 71 to professional bodies

43:49:02
man:woman:non-binary/gender diverse/alternate self-entered
program members

52:47:01
man:woman:non-binary/gender diverse/alternate self-entered
researchers (incl students)

Key Performance Indicators

Performance Measure	KPI	Actual
Number of research outputs		
Journal articles (Referred articles)	40	34
Data sets	5	2
Books	0	1
Book Chapters	1	1
Conference Publications	1	0
Non-Traditional Research Outputs	0	8
Quality of research outputs		
Journal articles in top quartile in article's primary Clarivate InCites JCR category	10	26
Journal articles with 2.5 x median annual citation rate in article's primary Clarivate InCites JCR category	N/A	N/A
H-index distributions (Scopus) (SAEF researchers) >80:>70:>50:>40:>20	0:2:3:9:17	2:0:7:6:26
Annual research prizes/awards/recognition	1	18
Percentage cross-node student supervisions	10%	33%
Percentage of multidisciplinary, cross-node research papers	30%	13%
Number of workshops / conferences held / offered by the SRI		
National workshops including SAEF team symposia	6	6
National decision-support workshops	1	1
International workshops	2	2
Number of training courses held / offered by the SRI		
Quantitative skills development workshops (ECRs)	1	1
Science policy and/or Antarctic policy interactive training (also open to ACEAS/AAPP/etc.)	2	1
SAEF CI/PI/Researcher/Student bottom-up driven training requests	2	3
Media and social media engagement	1	1
Success in interdisciplinary and transdisciplinary research	1	0

Performance Measure	KPI	Actual
Number of additional ARC-funded researchers working on the SRI		
Postdoctoral researchers	10	19
Honours students	5	5
PhD Students	15	23
Masters by research students	1	3
Number of postgraduate completions		
PhD	0	0
Masters by Research	0	0
Number of mentoring programs offered by the SRI		
Professional development	1	1
Research leadership	1	1
ARC and additional grant application mentoring and review	30	104
International PO-directed collaboration/mentorship events	5	3
Writing for evidence-based policy documents	1	1
Number of presentations / briefings		
To the public	20	32
To Women in STEM events (in keeping with Decadal Plan and School Programs)	2	2
To government (parliamentarians and department /agencies at either State or Federal level)	4	11
To industry/business/end users	2	3
To non-government organisations	2	5
To professional organisations and bodies (includes conference presentations)	2	71
Number of new organisations collaborating with, or involved in, the SRI		
National Polar Programs or Equivalent	1	1
Research Organisations	1	1
Researchers	2	4

Performance Measure	KPI	Actual
Diversity of personnel (self-declared) (% Man:Woman:non-binary/gender diverse/alternate self-entered)		
Researchers (incl. PhD students)	40:40:20	52:47:01
Professional staff	40:40:20	20:80:00
Program Executive Group Members	40:40:20	31:69:00
Governance Advisory Board Members	40:40:20	38:62:00
International ScienceAdvisory Panel Members	40:40:20	39:61:00
Centre-specific KPIs		
Antarctic Treaty System workshops and/or discussions (with decision makers)	2	1
Visualisation products (for research or policy insights)	0	4
Antarctic Treaty System proposed papers	1	4
SCAR roles	2	12
International and national science advisory roles (e.g. IPCC/UN/ISC/Gov Advisory)	4	58
Cross-sector events (open to Australian Antarctic Science Program and others)	1	1
Field programs successfully concluded	2	1
Short films for engagement	6	5
Antarctica and Australia engagement events with museums/State-Territory partners	0	4
Low SES and diversity program to offer better access to students	1	0
Social Media (posts across Twitter, LinkedIn and Instagram, plus Twitter mentions)	50	1368
Print media features	5	61
Radio features	2	20
TV features	2	8

Finance

2022 SAEF Finance Statement	
Opening Balance 2021	**$6,869,168**
Closing Balance 2021 Adjustments	$1,166
Opening Balance 2022	**$6,870,334**
Closing Balance 2022	**$9,889,453**
Income	
ARC Funding (including indexation)	$6,707,496
Organisation Cash Contribution	$1,680,057
Total Income	**$8,387,553**
Expenditure	
Salaries	$2,758,288
Stipends	$79,263
Travel	$112,367
Equipment	$102,725
Consumables	$245,222
Other Direct Expenses	$6,283
Logistics	$37,327
Total Expenditure	**$3,341,474**
Net Result	**$5,046,079**

Budget Notes:

The closing balance 2021 adjustments are for 2021 logistics charges and Organisation cash contributions that were not reported in the 2021 Finance Report.

Challenges and Mitigation

Challenges	Mitigation
Fieldwork	
Reduced and cancelled expeditions have resulted in limited, or in some cases no field opportunities for SAEF Researchers to collect data and samples, putting projects and the interdisciplinary nature of the program at risk.	• Continuing to work closely with the Australian Antarctic Division (AAD) Science Branch and Operations Branch. • Exploring options for field logistics support with other national partners and polar programs. • Subsampling existing stored samples collected by the Australian Antarctic Division, other international organisations and research providers.
Coordination of logistics requirements and permitting, particularly researchers that are new Antarctic research.	• Additional SAEF resourcing has been requested to support SAEF Expeditioners.
Personnel – Recruitment and Turnover	
Timeframes and processes for recruitment of staff and students have been impacted by the pandemic.	• Understanding the current timelines and processes well in advance to allow for extended processing times, particularly for international recruitment.
Recruiting suitable candidates, in particular PhD students in some disciplines, continues to be challenging.	• Broader advertising of available positions through networks and other means.
Staff and collaborator turnover resulting in lost project momentum and likely changes to project expertise.	• As possible, alternates are identified to replace the departed staff.

Challenges	Mitigation
Antarctic research capacity and workforce development	
SAEF participating organisations and members that have not had previous Antarctic research experience have been impacted by COVID 19 travel restrictions and limited field opportunities.	• Scheduling in person meetings with SAEF members with Antarctic experience to share knowledge and insights. • Enabling experienced and inexperienced SAEF researchers to participate in fieldwork.
Developing connections with SAEF members across all nodes	
Limited opportunities for SAEF member travel, particularly in the first half of 2022 due to COVID 19 concerns.	• Workshops and meetings have been held on line, and in hybrid formats as is feasible. • Encourage members to attend the weekly “Huddle Live” to meet and connect with other SAEF members from other Nodes.
The Program Executive Group (PEG) has not been able to hold in person meetings.	• SAEF’s first in-person Conference is scheduled for May 2023 in Adelaide. • SAEF (PEG) Members to travel to other Nodes as is possible.

Appendix

SAEF Participating Organisations 2022

Australian Universities	Australian Partner Organisations	International Partner Organisations	Program Collaborators
Monash University	Australian Antarctic Division	Auckland University of Technology	Australian Antarctic Division
Queensland University of Technology	Australian Nuclear Science and Technology Organisation	Berkeley Geochronology Centre	British Antarctic Survey
University of Wollongong	Bureau of Meteorology	King Juan Carlos University	Chilean Antarctic Institute
University of Sydney	Geoscience Australia	Tulane University	Norwegian Polar Institute
James Cook University	South Australian Museum	University of Colorado Boulder	International Association of Antarctica Tour Operators
La Trobe University	Western Australian Museum	University of Exeter	New Zealand Department of Conservation
University of Adelaide		University of Balearic Islands	
		University of Otago	
		University of Pretoria	
		University of Santiago	
		University of Waikato	
		Victoria University of Wellington	

SAEF Member List 2022

Name	Organisation
Chief Investigators	
Professor Julie Arblaster	Monash University
Professor Steven Chown FAA	Monash University
Professor Christopher Greening	Monash University
Dr Richard Jones	Monash University
Professor Andrew Mackintosh	Monash University
Dr Felicity McCormack	Monash University
Professor Steven Siems	Monash University
Dr Matthew Adams	Queensland University of Technology
Professor Michael Bode	Queensland University of Technology
Distinguished Professor Peter Corke FAA	Queensland University of Technology
Professor Matthew Dunbabin	Queensland University of Technology
Professor Felipe Gonzalez	Queensland University of Technology
Associate Professor Kate Helmstedt	Queensland University of Technology
Distinguished Professor Kerrie Mengersen FAA FASSA	Queensland University of Technology
Professor Kerrie Wilson	Queensland University of Technology
Dr Johan Barthélemy	University of Wollongong
Distinguished Professor Noel Cressie FRSN FAA	University of Wollongong
Distinguished Professor Stuart Kaye	University of Wollongong
Professor Helen McGregor	University of Wollongong
Senior Professor Pascal Perez	University of Wollongong
Distinguished Professor Sharon Robinson	University of Wollongong
Dr Andrew Zammit-Mangion	University of Wollongong
Associate Professor Graeme Clark	University of Sydney
Professor Emma Johnston AO FAA FTSE	University of Sydney
Professor Jan Strugnell	James Cook University
Professor Melodie McGeoch FAAS	La Trobe University
Associate Professor Phillip Cassey	University of Adelaide

Name	Organisation
Partner Investigators	
Dr Jonathon Stark	Australian Antarctic Division
Dr Aleks Terauds	Australian Antarctic Division
Dr Quan Hua	Australian Nuclear Science and Technology Organisation
Dr Karina Meredith	Australian Nuclear Science and Technology Organisation
Dr Krystyna Saunders	Australian Nuclear Science and Technology Organisation
Dr Eun-Pa Lim	Bureau of Meteorology
Dr Matthew Wheeler	Bureau of Meteorology
Dr Jodie Smith	Geoscience Australia
Dr Stephanie McLennan	Geoscience Australia
Dr Mark Stevens	South Australian Museum
Dr Nerida Wilson	Western Australian Museum
Associate Professor Barbara Bollard	Auckland University of Technology
Dr Greg Balco	Berkeley Geochronology Centre
Dr Miguel Ángel Olalla Tárraga	King Juan Carlos University
Dr Brent Goehring	Tulane University
Dr Cassandra Brooks	University of Colorado Boulder
Professor Dan Charman	University of Exeter
Dr Ilya Maclean	University of Exeter
Dr Jaume Flexas	University of Balearic Islands
Associate Professor Ceridwen Fraser	University of Otago
Professor Donald Cowan	University of Pretoria
Professor Gustavo Emilio Zúñiga Navarro	University of Santiago
Professor Margaret Barbour	University of Waikato
Dr Kevin Norton	Victoria University of Wellington

Name	Organisation
Associate Investigators	
Dr Mehrdad Amirghasemi	University of Wollongong
Dr Grant Duffy	University of Otago
Dr Jasmine Lee	Queensland University of Technology
Dr Thomas Roland	University of Exeter
Dr Melinda Waterman	University of Wollongong
Dr Ross Whitmore	Monash University
Senior Research Fellows, Research Fellows and Post Doctoral Research Associates	
Dr Morenikeji (Deborah) Akinlotan	Queensland University of Technology
Dr Sean Bay	Monash University
Dr Zachary Carter	Queensland University of Technology
Dr David Clarke	La Trobe University
Ms Ruth Davis	University of Wollongong
Dr Matthias Dehling	Monash University
Dr Stephanie Gardner	University of Sydney
Dr Benjamin Henley	University of Wollongong
Dr Oakes Holland	Queensland University of Technology
Dr Umair Iqbal	University of Wollongong
Dr Sally Lau	James Cook University
Dr Liza McDonough	Australian Nuclear Science and Technology Organisation
Dr Ariaan Purich	Monash University
Ms Krystal Randall	University of Wollongong
Dr Juan Sandino	Queensland University of Technology
Dr Justine Shaw	Queensland University of Technology
Dr John Turnbull	University of Sydney
Dr Laura Woods	Monash University
Dr Xiaotian Zheng	University of Wollongong

Name	Organisation
Research Officers and Assistants	
Sophie Allen	Monash University
Jeremy Bird	Monash University
Stewart Bisset	La Trobe University
Aimee Bliss	Monash University
Rebecca Hallas	Monash University
Elise Mills	Queensland University of Technology
Zoe Nay	Queensland University of Technology
Laura Phillips	Monash University
Meghan Porteous	La Trobe University
Luke Stockholm	Queensland University of Technology
Toby Travers	Monash University
Georgia Watson	University of Wollongong

Name	Organisation	Supervisors	Project Title
Students – PhD			
Tahereh Alinejadtabrizi	Monash University	Steven Siems	Wet deposition over the Southern Ocean
Lawrence Bird	Monash University	Andrew Mackintosh Felicity McCormack Richard Jones	Controls on East Antarctic Ice Shelf stability: how ocean and subglacial hydrology interactions impact ice shelf melt
Martin Iglesias	Monash University	Steven Chown Matthias Dehling	Mechanisms, consequences and restoration: an innovative view on invasions in the sub-Antarctic region.
Arathy Kurup	Monash University	Steven Siems	Understanding biases in satellite retrievals of clouds over Antarctica and the Southern Ocean.
Jess Macha	Monash University	Andrew Mackintosh Felicity McCormack Richard Jones Ben Henley Helen McGregor	Decadal to centennial-scale climate drivers of Antarctic Ice Sheet mass changes; a multi proxy approach
Cari Rand	Monash University	Andrew Mackintosh	Post-last-glacial-maximum Lambert-area glacial history
Raina Roy	Monash University	Julie Arblaster Matthew Wheeler	MJO Teleconnections to the SH
Dominic Saunderson	Monash University	Andrew Mackintosh	Investigating surface melt on East Antarctic ice shelves
Larissa Lubiana Botelho	Queensland University of Technology	Michael Bode	Structure and Dynamics of Antarctic Governance
Joanna Burrows	Queensland University of Technology	Kerrie Wilson Michael Bode	The effectiveness of Antarctica's terrestrial protected areas
Oakes Holland	Queensland University of Technology	Kerrie Wilson Kate Helmstedt Justine Shaw Jonny Stark	Assessing the risk of marine invasive species to nearshore marine ecosystems of Australia's Antarctic research stations and sub-Antarctic islands
Charlotte Patterson	Queensland University of Technology	Kate Helmstedt Justine Shaw	Predicting the Future of Antarctica's Under-Represented Biodiversity to Inform Conservation Decision Making
Caitlin Selfe	Queensland University of Technology	Justine Shaw Krystyna Saunders	A quantitative record of Southern Hemisphere westerly wind behaviour and its ecological implications
Kita Williams	Queensland University of Technology	Justine Shaw	Ecological interactions in terrestrial Antarctic ecosystems
Andrea Johansen	University of Wollongong	Sharon Robinson Krystyna Saunders	Understanding the Contribution of Dust to Ecosystem Fertilisation in the South Pacific and the Southern Ocean
Constance Johnson	University of Wollongong	Stuart Kaye	Challenges and Solutions for the Effective Governance and Regulation of the Southern Oceans Areas Beyond National Jurisdiction
Krystal Randall	University of Wollongong	Sharon Robinson	Modelling centimetre scale variation in surface temperatures for vegetated regions in Antarctica

Name	Organisation	Supervisors	Project Title
Thea Stoneman	University of Wollongong	Stuart Kaye	Antarctic Marine Protected Areas: The legal underpinnings, enforcement, and effectiveness
Bao Vu	University of Wollongong	Andrew Zammit-Mangion Noel Cressie Felicity McCormack	Statistical Calibration of Ice Sheet Models
Yifan Wu	University of Wollongong	Sharon Robinson	The impact of climate change on the biodiversity of Antarctic vegetation
Hao Yin	University of Wollongong	Sharon Robinson	The responses of Antarctic vegetation to changing ultraviolet regimes
Nicola Rodewald	James Cook University	Jan Strugnell Nerida Wilson Sally Lau	Population Connectivity of Antarctic Marine Invertebrates
Samuel Beale	La Trobe University	Melodie McGeoch Justine Shaw	Predicting climate change impacts on the vascular flora of the sub-Antarctic Islands

Students – Masters

Douglas Henness	University of Wollongong	Johan Barthelemy	AIoT (Artificial Intelligence of Things) Sensing Platform for Antarctica – Application to hydrology and microclimate models
Maggie Smith	Queensland University of Technology	Justine Shaw Krystyna Saunders	Ecosystem responses to invasion and management on a subantarctic island
Xiang Zhao	Queensland University of Technology	Kerrie Wilson	Assessing the costs of biodiversity monitoring and surveying in terrestrial Antarctica

Students – Honours

Thomas Freire	Monash University	Steven Chown	Phylogenetic diversity in sub-Antarctic insects and its change with invasion
Amanda Hollenkamp	Monash University	Steven Chown	Pollution as an environmental change driver in Antarctica: a meta-analysis
Lou Peak	La Trobe University	Melodie McGeoch	Global invasive species trends in richness, abundance, and geographic spread
Anabelle Smith	Monash University	Steven Chown	Antarctic Mosses: Biogeography and Conservation
Samantha Swift	Queensland University of Technology	Felipe Gonzalez	UAVs, Multispectral Remote Sensing, and Machine Learning for Antarctica Monitoring

Name	Organisation	Role
Internships and Vacation Research Students		
Eliza Domann	Queensland University of Technology	Matthew Adams
Lou Peake	La Trobe University	Melodie McGeoch
Volunteers		
Jade Hameister OAM	Monash University	
Shannon Hubert	Monash University	
SAEF Program Team		
Andy Cianchi	Monash University	Senior Logistics Coordinator
Angela Firth	Monash University	Senior Program Officer
Bronte Glancy	University of Wollongong	Program Administrative Support
Diana King	University of Wollongong	Deputy Program Manager
Nzie Okpokam	Queensland University of Technology	Data Management Specialist
Anna Quinn	Monash University	Senior Communications Adviser
Kian Rayner	University of Wollongong	Program Administrative Support
Ilva Sporne	Queensland University of Technology	Deputy Program Manager
Jodie Weller	Monash University	Program Manager

Governance Committees

Governance Advisory Board

Mr Drew Clarke AO FTSE FRGS	Board Chair
Professor Nancy Bertler	International Science Advisory Panel Chair Victoria University of Wellington and GNS New Zealand
Mr Andrew Grant	Tasman Environmental Investments
Ms Marie-Charlotte McKenna	Department of Foreign Affairs and Trade
Dr Jane Rumble OBE FRGS	UK Foreign, Commonwealth and Development Office
Dr Jodie Smith	Geoscience Australia, SAEF EMCR Representative
Professor Nicole Webster	Australian Antarctic Division
Professor Steven Chown FAA	SAEF Director, *ex officio*
Ms Jodie Weller	SAEF Program Manager, Board Secretary

International Science Advisory Panel

Professor Nancy Bertler	International Science Advisory Panel Chair Victoria University of Wellington and GNS New Zealand
Professor Maria Dornelas FRSE	University of St Andrews
Dr Peter Fretwell	British Antarctic Survey
Professor Michael Runge	US Geological Survey, Eastern Ecological Science Center
Professor Frank Pattyn	Université Libre de Bruxelles
Dr Cassandra Brooks	University of Colorado Boulder, SAEF ECR Representative
Dr Sally Lau	James Cook University SAEF ECR Representative
Ms Jessica Macha	Monash University PhD Student Representative
Mr Drew Clarke AO FTSE FRGS	Governance Board Chair, *ex officio*
Professor Steven Chown FAA	SAEF Director, *ex officio*
Distinguished Professor Sharon Robinson	SAEF Deputy Director, Science Implementation, *ex officio*
Professor Kerrie Wilson	SAEF Deputy Director, Career Development and Mentoring, *ex officio*
Ms Jodie Weller	SAEF Program Manager, ISAP Secretary

Program Executive Group

Member	Organisation	Role
Professor Steven Chown FAA	Monash University	Director
Distinguished Professor Sharon Robinson	University of Wollongong	Deputy Director, Science Implementation
Professor Kerrie Wilson	Queensland University of Technology	Deputy Director, Career Development and Ment
Ms Jodie Weller	Monash University	Program Manager
Professor Andrew Mackintosh	Monash University	Theme 1 Lead
Professor Melodie McGeoch FAAS	La Trobe University	Theme 2 Lead
Professor Michael Bode	Queensland University of Technology	Theme 3 Lead
Professor Helen McGregor	University of Wollongong	Theme 1 Mentee
Professor Jan Strugnell	James Cook University	Theme 2 Mentee
Associate Professor Kate Helmstedt	Queensland University of Technology	Theme 3 Mentee
Professor Emma Johnston AO FAA FTSE	University of Sydney	USYD Representative
Associate Professor Phillip Cassey	University of Adelaide	UoA Representative
Dr Aleks Terauds	Australian Antarctic Division	AAD Representative
Dr Jodie Smith	Geoscience Australia	GA Representative
Dr Krystyna Saunders	Australian Nuclear Science and Technology Organisation	ANSTO Representative
Dr Mark Stevens	South Australian Museum	SAM Representative
Dr Nerida Wilson	Western Australia Museum	WAM Representative
Ms Angela Firth	Monash University	PEG Secretary

Outputs

Journal Articles – Peer reviewed

1. Audet, A., Putnam, A, Russell, J., Lorrey, A., Mackintosh, A., Anderson, B. and Denton, G. (2022). Correspondence among mid-latitude glacier equilibrium line altitudes, atmospheric temperatures, and westerly wind fields. *Geophysical Research Letters* **49** (23) e2022GL099897. DOI: https://doi.org/10.1029/2022GL099897

2. Barnes, P.W., Robson, T.M., Neale, P.J., Williamson, C.E., Zepp, R.G., Madronich, S., Wilson, S.R., Andrady, A.L., Heikkilä, A.M., Bernhard, G.H., Bais, A.F., Neale, R.E., Bornman, J.F., Jansen, M.A.K., Klekociuk, A.R., Martinez-Abaigar, J., Robinson, S.A., Wang, Q.-W., Banaszak, A.T., Häder, D.-P., Hylander, S., Rose, K.C., Wängberg, S.-Å., Foereid, B., Hou, W.-C., Ossola, R., Paul, N.D., Ukpebor, J.E., Andersen, M.P.S., Longstreth, J., Schikowski, T., Solomon, K.R., Sulzberger, B., Bruckman, L.S., Pandey, K. White, C.C., Zhu, L., Zhu, M., Aucamp, P. J., Liley, J.B., McKenzie, R.L., Berwick, M., Byrne, S.N., Hollestein, L.M., Lucas, R.M., Olsen, C.M., Rhodes, L.E., Yazar, S. and Young, A.R. (2022) Environmental effects of stratospheric ozone depletion, UV radiation, and interactions with climate: UNEP Environmental Effects Assessment Panel, Update 2021. *Photochemical & Photobiological Sciences* **21**, 275-301. DOI: https://doi.org/10.1007/s43630-022-00176-5

3. Brooks, C.M., Ainley, D.G., Jacquet, J., Chown, S.L., Pertierra. L.R., Francis, E., Roger, A., Chavez-Molina, V., Teh, L. and Sumaila, U.R. (2022) Protect global values of the Southern Ocean ecosystem. *Science* **378**, (6619) 477-47. DOI: https://doi.org/10.1126/science.add9480.

4. Chown, S.L., Bergstrom, D.M., Houghton, M., Kiefer, K., Terauds, A. and Leihy, R.I. (2022) Invasive species impacts on sub-Antarctic Collembola support the Antarctic climate-diversity-invasion hypothesis. *Soil Biology and Biochemistry* **166**, 108579. DOI: https://doi.org/10.1016/j.soilbio.2022.108579

5. Chuter, S.J., Zammit-Mangion, A., Rougier, J., Dawson, G. and Bamber, J.L. (2022) Mass evolution of the Antarctic Peninsula over the last 2 decades from a joint Bayesian inversion. *The Cryosphere* **16**, 1349–1367. DOI: https://doi.org/10.5194/tc-16-1349-2022

6. Czechowski, P., de Lange, M., Knapp, M., Terauds., A. and Stevens, M.I. (2022) Antarctic biodiversity predictions through substrate qualities and environmental DNA. *Frontiers in Ecology and the Environment* **20**(10): 550– 557. https://doi.org/10.1002/fee.2560

7. Escribano-Álvarez, P., Pertierra, L.R., Martínez, B., Chown, S.L. and Olalla-Tárraga, M.Á. (2022) Half a century of thermal tolerance studies in springtails (Collembola): A review of metrics, spatial and temporal trends. *Current Research in Insect Science* **2**, 100023. DOI: https://doi.org/10.1016/j.cris.2021.100023

8. Greening, C., Grinter, R. (2022) Microbial oxidation of atmospheric trace gases. *Nature Reviews Microbiology* **20**, 513 – 528. DOI: https://doi.org/10.1038/s41579-022-00724-x

9. Greening, C., Islam, Z.F., and Bay, S.K. (2022) Hydrogen is a major lifeline for aerobic bacteria. *Trends in Microbiology* **30**, 330–337. DOI: https://doi.org/10.1016/j.tim.2021.08.004

10. Hughes, K., Santos, M., Caccavo, J., Chignell, S., Gardiner, N., Gilbert, N., Howkins, A., Van Vuuren, B. J., Lee, J., Liggett, D., Lowther, A., Lynch, H., Quesada, A., Chul Shin, H., Soutullo, A. and Terauds, A. (2022) Ant-ICON – 'Integrated Science to Inform Antarctic and Southern Ocean Conservation': A new SCAR Scientific Research Programme. *Antarctic Science* **34**(6), 446–455. DOI: https://doi.org/10.1017/S0954102022000402

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Lembrechts, J.J., van den Hoogen, J., Aalto, J., Ashcroft, M.B., De Frenne, P., Kemppinen, J., Kopecky, M., Luoto, M., Maclean, I.M.D., Crowther, T.W., Bailey, J.J., Haesen, S., Klinges, D.H., Niittynen, P., Scheffers, B.R., Van Meerbeek, K., Aartsma, P., Abdalaze, O., Abedi, M., Aerts, R., Ahmadian, N., Ahrends, A., Alatalo, J.M., Alexander, J.M., Allonsius, C.N., Altman, J., Ammann, C., Andres, C., Andrews, C., Ardo, J., Arriga, N., Arzac, A., Aschero, V., Assis, R.L., Assmann, J.J., Bader, M.Y., Bahalkeh, K., Barancok, P., Barrio, I.C., Barros, A., Barthel, M., Basham, E.W., Bauters, M., Bazzichetto, M., Marchesini, L.B., Bell, M.C., Benavides, J.C., Benito Alonso, J.L., Berauer, B.J., Bjerke, J.W., Bjork, R.G., Bjorkman, M.P., Bjornsdottir, K., Blonder, B., Boeckx, P., Boike, J., Bokhorst, S., Brum, B.N.S., Bruna, J., Buchmann, N., Buysse, P., Camargo, J.L., Campoe, O.C., Candan, O., Canessa, R., Cannone, N., Carbognani, M., Carnicer, J., Casanova-Katny, A., Cesarz, S., Chojnicki, B., Choler, P., Chown, S.L., Cifuentes, E.F., Ciliak, M., Contador, T., Convey, P., Cooper, E.J., Cremonese, E., Curasi, S.R., Curtis, R., Cutini, M., Dahlberg, C.J., Daskalova, G.N., de Pablo, M.A., Della Chiesa, S., Dengler, J., Deronde, B., Descombes, P., Di Cecco, V., Di Musciano, M., Dick, J., Dimarco, R.D., Dolezal, J., Dorrepaal, E., Dusek, J., Eisenhauer, N., Eklundh, L., Erickson, T.E., Erschbamer, B., Eugster, W., Ewers, R.M., Exton, D.A., Fanin, N., Fazlioglu, F., Feigenwinter, I., Fenu, G., Ferlian, O., Fernandez Calzado, M.R., Fernandez-Pascual, E., Finckh, M., Higgens, R.F., Forte, T.G.W., Freeman, E.C., Frei, E.R., Fuentes-Lillo, E., Garcia, R.A., Garcia, M.B., Geron, C., Gharun, M., Ghosn, D., Gigauri, K., Gobin, A., Goded, I., Goeckede, M., Gottschall, F., Goulding, K., Govaert, S., Graae, B.J., Greenwood, S., Greiser, C., Grelle, A., Guenard, B., Guglielmin, M., Guillemot, J., Haase, P., Haider, S., Halbritter, A.H., Hamid, M., Hammerle, A., Hampe, A., Haugum, S.V., Hederova, L., Heinesch, B., Helfter, C., Hepenstrick, D., Herberich, M., Herbst, M., Hermanutz, L., Hik, D.S., Hoffren, R., Homeier, J., Hortnagl, L., Hoye, T.T., Hrbacek, F., Hylander, K., Iwata, H., Jackowicz-Korczynski, M.A., Jactel, H., Jarveoja, J., Jastrzebowski, S., Jentsch, A., Jimenez, J.J., Jonsdottir, I.S., Jucker, T., Jump, A.S., Juszczak, R., Kanka, R., Kaspar, V., Kazakis, G., Kelly, J., Khuroo, A.A., Klemedtsson, L., Klisz, M., Kljun, N., Knohl, A., Kobler, J., Kollar, J., Kotowska, M.M., Kovacs, B., Kreyling, J., Lamprecht, A., Lang, S.I., Larson, C., Larson, K., Laska, K., le Maire, G., Leihy, R.I., Lens, L., Liljebladh, B., Lohila, A., Lorite, J., Loubet, B., Lynn, J., Macek, M., Mackenzie, R., Magliulo, E., Maier, R., Malfasi, F., Malis, F., Man, M., Manca, G., Manco, A., Manise, T., Manolaki, P., Marciniak, F., Matula, R., Mazzolari, A.C., Medinets, S., Medinets, V., Meeussen, C., Merinero, S., Mesquita, R.C.G., Meusburger, K., Meysman, F.J.R., Michaletz, S.T., 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Journal Articles – Editorials and Reviews

1. Lau, S.C.Y. and Strugnell, J.M. (2022) Is the Southern Ocean ecosystem primed for change or at the cliff edge? *Global Change Biology* **28**:4493–4494. DOI: https://doi.org/10.1111/gcb.16224

2. Mackintosh, A. (2022) Thwaites Glacier and the bed beneath. *Nature Geoscience* **15**, 687–688. DOI: https://doi.org/10.1038/s41561-022-01020-2

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4. Robinson, S.A. (2022) Climate change and extreme events are changing the biology of Polar Regions. *Global Change Biology* **28**, 5861–5864. DOI: https://doi.org/10.1111/gcb.16309

5. Smith, P., Beaumont, L., Bernacchi, C.J., Byrne, M., Cheung, W., Conant, R.T., Cotrufo, F., Feng, X., Janssens, I., Jones, H., Kirschbaum, M.U.F., Kobayashi, K, LaRoche, J. Luo, Y., McKechnie, A., Penuelas, J.,Piao, S., Robinson, S., Sage, R.F., Sugget, D.J., Thackery, S.J., Way, D. and Long, S.P. (2022). Essential outcomes for COP26. *Global Change Biology* **28**, 1–3. DOI: https://doi.org/10.1111/gcb.15926

Data Sets

1. Phillips, L.M., Leihy, R.I, and S. L. Chown (2022) Data files associated with: Phillips, L. M., Leihy, R. I, & S. L. Chown. Improving Species-Based Area Protection in Antarctica. Conservation Biology. https://doi.org/10.26180/16601006

2. Chown, S.L., Bergstrom, D.M., Houghton, M., Kiefer, K., Terauds, A. and Leihy, R.I. (2022) Data and R code for Chown et al. Soil Biology & Biochemistry, Invasive species impacts on sub-Antarctic Collembola support the Antarctic climate-diversity-invasion hypothesis. https://doi.org/10.26180/18379727

Books and Book Chapters

1. Robinson, S. (2022) Griffith Review 77 Real Cool World. *Among ancient moss forests – Observing a quarter-century of change*. (ed Ashley Hay), pp numbers Griffith University Press https://www.griffithreview.com/articles/among-ancient-moss-forests/

2. S. Kaye, C. Schofield & G. Till (eds), *Maritime Cooperation in the Indo-Pacific Region* (Leiden: Brill, 2022) ISBN:978-90-04-53284-7

Non – Traditional Research Outputs

Reports

1. Arblaster, J (Member of Assessment Scientific Steering Committee) (2022) World Meteorological Organization (WMO). *Executive Summary. Scientific Assessment of Ozone Depletion: 2022*, GAW Report No. 278, 56 pp.; WMO: Geneva, 2022. https://ozone.unep.org/system/files/documents/Scientific-Assessment-of-Ozone-Depletion-2022-Executive-Summary.pdf

2. Barnes, P.W., Bornman, J.F., Pandey, K. (co-chairs) Bernhard, G.H., Neale, R.E., Robinson, S.A., Neale, P.J., Zepp, R.G., Madronich, S., White, C.C., Andersen, M.P.S., Andrady, A.L., Aucamp, P. J., Bais, A.F., Banaszak, A.T., Berwick, M., Bruckman, L.S., Byrne, S.N., Foereid, B., Häder, D.-P., Heikkilä, A.M., Hollestein, L.M., Hou, W.-C., Hylander, S., Jansen, M.A.K., Klekociuk, A.R., Liley, J.B., Longstreth, J., Lucas, R.M., Martinez-Abaigar, J., McKenzie, R.L., McNeill, K., Olsen, C.M., Ossola, R., Paul, N.D., Rhodes, L.E., Robson, T.M., Rose, K.C., Schikowski, T., Solomon, K.R., Sulzberger, B., Ukpebor, J.E., Wang, Q.-W., Wängberg, S.-Å., Williamson, C.E., Wilson, S.R., Yazar, S., Young, A.R., Zhu, L., Zhu, M. (2022) *Summary Update 2021 for Policymakers. UNEP Environmental Effects Assessment Panel, United Nations Environment Programme, Nairobi, Kenya*. https://ozone.unep.org/sites/default/files/assessment_panels/EEAP-summary-update-2021-for-policymakers.pdf

3. Chown, S.L., Leihy, R.I., Naish, T.R., Brooks, C.M., Convey, P., Henley, B.J., Mackintosh, A.N., Phillips, L.M., Kennicutt, M.C. II and Grant, S.M. (Eds.) (2022) *Antarctic Climate Change and the Environment: A Decadal Synopsis and Recommendations for Action*. Scientific Committee on Antarctic Research, Cambridge, United Kingdom. https://www.scar.org/policy/acce-updates/

4. Constable, A.J., Harper, S., Dawson, J., Holsman, K., Mustonen, T., Piepenburg, D., Rost, B., Bokhorst, S., Boike, J., Cunsolo, A., Derksen, C., Feodoroff, P., Ford, J.D., Stephen E.L. Howell, S.E.L ., Katny, A.C., MacDonald, J.P., Pedersen, A.O., Robinson, S., Sambo Dorough, D., Shadrin, V., Skern-Mauritzen, M., Smith, S., Streletskiy, D., Tsujimoto, M., Van Dam, B. (2022) Cross-Chapter Paper 6: Polar Regions. *IPCC WGII Sixth Assessment Report*. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 2319–2368, DOI:10.1017/9781009325844.023 https://www.ipcc.ch/report/ar6/wg2/

5. Janssen, A.R., Badhe, R., Bransome, N.C., Bricher, P., Cavanagh, R., de Bruin, T., Elshout, P., Grant, S., Griffin, E., Grilly, E., Henley, S.F., Hofmann, E.E., Johnston, N.M., Karentz, D., Kent, R., Lynnes, A., Martin, T., Miloslavic, P., Murphy, E., Nolan, J.E., Sikes, E., Sparrow, M., Tacoma, M., Williams, M.J.M., Arata, J.A., Bowman, J., Corney, S., Lau, S.C.Y., Manno, C., Mohan, R., Nielsen, H., van Leeuwe, M.A., Waller, C., Xavier, J.C., Van de Putte, A.P. (2022) *The Southern Ocean Action Plan*. United Nations Decade of Ocean Science for Sustainable Development. https://www.sodecade.org/action-plan/southern-ocean-action-plan/

Other Non Traditional Research Outputs

6. Watson, G. (2022) *The Bright Continent*. [Artwork – Digital inkjet print].

7. Waterman, M., Bunt, B., Robinson, S., Watson, G. (2022) *Antarctic Futures Exhibition*. UOW Gallery, University of Wollongong, Wollongong Australia, 15/8/2022 – 19/10/2022 [Exhibition].

8. Watson, G., Waterman, M. (2022) *What will Antarctica be like in 50 years? Antarctic futures*. [Website] https://www.uowblogs.com/eco-antarctica

Antarctic Treaty System Papers

1. Anonymous. (2022) *Type Localities in Antarctica*. Working Paper 20 to the XLIV Antarctic Treaty Consultative Meeting, Berlin, Germany, May 2022 [submitted by Australia, co-contributions by Phillips, L.M., Leihy, R.I. & Chown, S.L.].

2. Anonymous. (2022) *Antarctic Climate Change and the Environment: A Decadal Synopsis*. Findings and Policy Recommendations. Working Paper 30 to the XLIV Antarctic Treaty Consultative Meeting, Berlin, Germany, May 2022 [submitted by SCAR, co-contribution from Chown, S.L.].

3. Anonymous. (2022) *Antarctic Climate Change and the Environment: A Decadal Synopsis*. Research Imperatives. Working Paper 31 to the XLIV Antarctic Treaty Consultative Meeting, Berlin, Germany, May 2022 [submitted by SCAR, co-contribution from Chown, S.L.].

4. Anonymous (2022) *Research to inform CEP discussions about further development of the Antarctic protected area system*. Information Paper 47 to ATCM XLIV – CEP XXIV 2022 [submitted by Australia, contribution by Terauds, A]. https://www.ats.aq/devAS/Meetings/Documents/94

Presentations and Briefings

To public

1. Akinlotan, M.D*, Warne, D.J., Helmstedt, K.J., Adams, M.P. (2022) *Beyond expected values: Making environmental decisions using value of information analysis when measurement outcome matters.* Presentation given at the Centre for Data Science showcase, 20 September 2022, Queensland University of Technology.

2. Bode, M. (2022) *Decision-making in island eradication*. Presentation to the QUT Centre for the Environment, 14 July 2022, Brisbane.

3. Hallas, R. (2022) *Antarctica, Systems and Cycles, – life cycles, biomes, earth and space sciences, climate, weather and sustainability*. Grade 3 and 4 students, Richmond Primary School, 4 August 2022 [online]

4. Chown, S.L. (2022) Panel Discussion contributor at the Melbourne International Film Festival on *The Endangered Generation*, Federation Square, Melbourne, 17 August 2022.

5. Helmstedt, K.J. (2022) *Raising the Bar for Australian Data Science*. The public Women in Data Science Network panel, 7 March 2022.

6. Helmstedt, K.J. (2022), invited research talk and video for Tall Poppy award, 1 August 2022

7. Helmstedt, K.J. (2022) *Inspiring Lives of Mathematicians*. Outreach presentation to high school students from mixed Brisbane high-schools, July 2022, Brisbane.

8. Holland, O. (2022) Antarctic marine ecology. Meet a scientist program at Mansfield State High School, 26 May 2022, Mansfield.

9. Holland, O. (2022) *What is the risk of marine invasive species to the nearshore environments of Australia's Antarctic research stations?* Centre for the Environment, 7 October 2022, Queensland University of Technology, Brisbane.

10. Janssen, A.R., Badhe, R., Bransome, N.C., Bricher, P., Cavanagh, R., de Bruin, T., Elshout, P., Grant, S., Griffin, E., Grilly, E., Henley, S.F., Hofmann, E.E., Johnston, N.M., Karentz, D., Kent, R., Lynnes, A., Martin, T., Miloslavich, P., Murphy, E., Nolan, J.E., Sikes, E., Sparrow, M., Tacoma, M., Williams, M.J.M., Arata, J.A., Bowman, J., Corney, S., Lau, S.C.Y.*, Manno, C., Mohan, R., Nielsen, H., van Leeuwe, M.A., Waller, C., Xavier, J.C., Van de Putte, A.P. (2022) *Launch of the Southern Ocean Action Plan webinar, in support of the United Nations Decade of Ocean Science for Sustainable Development*. Webinar, 12 April 2022 [Panelist]

11. Xavier, J.C., Lau, S.C.Y.*, Constable, A., Bombosch, A., Njåstad, B., Arata, J. (2022) Satellite Activity at the Healthy & Resilient Ocean Laboratory 'Achieving A Healthy and Resilient Ocean in the Southern Ocean Region', *in support of the United Nations Decade of Ocean Science for Sustainable Development*, Webinar. 10 March 2022 [Co-chair]

12. Lee, J. (2022) *What can we learn about climate change from Antarctic soil biodiversity.* Invited panel member to Global Soil Biodiversity Initiative (GSBI) webinar series, 25 May 2022.

13. Lee, J. (2022) *Conserving Antarctic biodiversity in an era of rapid global change.* Invited talk to King's College legators, 7 May 2022, King's College, Cambridge.

14. McCormack, F. (2022) *Antarctica and its role in Earth systems: a sleeping giant starting to wake*. Bendigo Naturalist Society. 11 May 2022

15. Mills, E.*, Adams M., Clarke, G. (2022) *Mathematical modelling of ecosystem steady states in Antarctica.* Digital Poster for QUT Mathematical Sciences Vacation Research Experience Scheme, 18 February 2022, Queensland University of Technology.

16. Meredith, K. (2022) National Science Week Talk, Newtown Primary School. 16 August 2022

17. Robinson, S. (2022) *The Brand Education Impact case study: Using Twitter to promote research and broaden interdisciplinary focus.* Wollongong, 8 April 2022. [online]

18. Robinson, S. (2022) *Antarctica's old growth moss forests reveal their secret history*. Howard Griffith Symposium. University of Cambridge, UK, 14 April 2022 [in person]

19. Robinson, S. (2022) *From Cornwall to Antarctica*. Jacobstow County Primary School, Cornwall, UK 5 May 2022 [in person]

20. Robinson, S. (2022) *Antarctica Biodiversity Under a Changing Climate.* UOW Knowledge Series lecture. University of Wollongong, Wollongong, Australia. 6 June 2022 [in person and online] https://youtu.be/SXCRMC5Ymvc

21. Robinson, S. (2022) *Climate Change in Antarctica.* Public Lecture, Dunedin NZ. 4 August 2022 [in person]

22. Robinson, S. (2022) *Among Antarctica's ancient moss forests: Observing 25 years of change*, Antarctic Futures Seminar, University of Wollongong. 7 September 2022 [in person and online]

23. Robinson, S. (2022) *Old growth moss forests reveal Antarctica's history*. Joe Berry Symposium. Stanford University, CA, USA. 15 September 2022 [in person]

24. Robinson, S. (2022) *Antarctica's ancient moss forests reveal environmental change.* University of Cambridge, UK, 14 October 2022 [in person]

25. Robinson, S. (2022) *Climate change, ozone depletion and Antarctic biodiversity – understanding the future for ice free areas.* School of Earth, Atmosphere and Environment Seminar Series, Monash University. 20 October 2022 [in person]

26. Stockham, L.*, Adams, M., Helmstedt, K., Holland, O. (2022) *Modelling and managing uncertain Antarctic species networks*. Digital Poster for QUT Mathematical Sciences Vacation Research Experience Scheme, 18 February 2022, Queensland University of Technology.

27. Waterman, M; Bunt, B; Johnston, C; Henley, B and Randall, K. (2022) Antarctic Futures Q&A Panel on global climate and Antarctica. Antarctic Futures, October 2022, https://www.youtube.com/watch?v=1CJtpHDE7wQ.

28. Wilson, K. (2022) *Advancing Data-Intensive Research in Australia.* invited panel member to Australian Data Science Network's webinar, 10th June 2022

29. Wilson, K. (2022) keynote speaker at the University of Queensland, Cromwell College Academic Dinner, May 2022

30. Wilson, N.G. (2022) *Why species delimitation matters – a cold case uncovered*. Live Q&A, Zoom, University of Aberdeen, Scotland, 10 March 2022

31. Wilson, N.G. (2022) *Marine Conservation Systematics*. Guest lecture, Wildlife Conservation & Management, University of Western Australia, 27 September 2022

32. Zhao, X. (2022). *Pandas, Koalas, and Penguins: the power of cuteness and beyond*. Pint of Science Australia,11 May 2022, Brisbane.

To Women in STEM events

1. Wilson, K. (2022) *Changing climates: Equality today for a sustainable tomorrow*. Invited local keynote address at UN Women International Women's Day. 4 March 2022.

2. Helmstedt, K.J. (2022) *New Frontiers in Data Science*. Women in Data Science Network panel (host). 15 June 2022.

To government

1. Chown, S.L. (2022) *Antarctica on the brink – science for societal certainty*. Australian Antarctic Science Symposium. Morning Panel Discussion – University Research Collaborations: 7 September 2022. Facilitator: Lyn O'Connell Deputy Secretary, Panel Members: Prof Nerilie Abram, Prof. Matt King, Prof. Steven Chown, Prof. Nathan Bindoff

2. Chown, S.L. (2022) *Presentation of the Antarctic Climate Change and the Environment: A Decadal Synopsis and Recommendations for Action Report* Working Papers (WP30, WP31) to the Antarctic Treaty Consultative Parties and the Committee for Environmental Protection at the XLIV Antarctic Treaty Consultative Meeting being held in Berlin. May 2022. https://atcm44-berlin.de/en/0_atcm-xliv-english/ 23/5/2022 – 2/6/2022

3. Chown, S.L., Robinson, S., Wilson, K., Weller, J., Quinn, A. (2022) ARC, SRIEAS, AAD, Policy and Communications Workshop. 8 September 2022 (in person)

4. Chown, S.L. (2022) *Antarctic Climate Change and the Environment Decadal Synopsis*. SCAR Lecture to the 41st Meeting of the Commission for the Conservation of Antarctic Marine Living Resources, Hobart, October 2022. https://meetings.ccamlr.org/en/ccamlr-41

5. Clarke, D (2022) Science & Technology Australia's Science meets Parliament 2022. 28 February – 4 March 2022.

6. Mackintosh, A (2022) *SAEF Theme 1: Climate Processes and Change.* Australian Antarctic Division Science Branch, Monday 14 November 2022.

7. Mackintosh, A (2022) *What is driving glacier and ice sheet mass loss? The role of climate variability and climate change.* Bureau of Meteorology Research and Development Workshop: Water in the Earth System, Melbourne 7 November 2022.

8. McCormack, F (2022) *Antarctica and the anthropocene: coupled ice sheet-Earth systems modelling in a changing climate.* Bureau of Meteorology Research and Development Workshop: Water in the Earth System, Melbourne 7 November 2022.

9. McCormack, F. (2022) *Canary in the coalmine: the vulnerability of the Vanderford Glacier, East Antarctica, to climate change*. Casey Station Research Seminar, February 2022.

10. McGeoch, M.A. (2022) *Invasion Indicators.* Research-Stakeholder Workshop, iDiv, Leipzig, Germany, September 2022.

11. Shaw, J. (2022) *Post eradication monitoring on Macquarie Island*. Australian Antarctic Science Symposium, invited speakers to address government scientists at the Australian Academy of Science Shine Dome. 7 September 2022.

To industry, business or end users

1. Wilson, K. (2022) *Research strengths and collaborative opportunities at QUT*. Presentation to The Ambassador of Brazil, September 2022

2. Robinson, S. (2022) SAEF briefing to Amazon Web Services (AWS). Wollongong, Australia, 1st June 2022 [Oral presentation].

3. Robinson, S. (2022) SAEF briefing to Titan Class. Wollongong, Australia, 23rd August 2022 [Oral presentation].

To non-government organisations

1. Chown, S.L. (2022) *Science, Diplomacy and Science Diplomacy. Science diplomacy and international linkages.* Australian Academy of Science, National Committees for Science Chairs Meeting. 27 September 2022, online.

2. McGeoch. M.A. (2022) *How open, checklist data on invasive alien species can support policy and management.* Regional Engagement Meeting and Symposium on Open Science and Data Use, November 2022. https://www.gbif.org/event/1S51uST0VKKxu5T062iVFU/asia-regional-engagement-meeting-and-symposium-on-open-science-and-data-use

3. Terauds, A. (2022). *Integrated Digital East Antarctica*. SAEF and AAD Science Workshop. 14 November 2022

4. Wilson, K. (2022), Opening Address at the IUCN Academy of Environmental Law International Colloquium, July 2022, https://consol.eventsair.com/iucn-academy-colloquium-2022/program

5. Wilson, K. (2022), Opening Address at SeventeenX Brisbane – 2022, 9 August 2022 https://www.seventeensdg.com/seventeenx-brisbane-2022

To professional bodies and conference presentations

Scientific Committee on Antarctic Research (SCAR)

1. Botelho, L.*, Bode, M., Helmstedt, K., Wilson, K. (2022). *Structure and Dynamics of Antarctic Governance*. 10th SCAR Open Science Conference, August 2022 [Online]. https://scar2022.org/

2. Burrows, J.* and Wilson, K. (2022) *Evaluating the conservation impact of Antarctica's protected areas*. 10th SCAR Open Science Conference, August 2022 [Online]. https://scar2022.org/

3. Greening, C (2022) *Antarctica: evidence of a chemosynthetically driven continent*. Scientific Committee on Antarctic Research Conference, 5 August 2022 [Online] [Keynote Speaker]

4. Johansen, A. (2022) *High-resolution palaeoclimate archive from Macquarie Island*. 10th SCAR Open Science Conference. August 2022 [Online]. https://scar2022.org/

5. King, D*, Sporne, I. and Wilson, K.A. (2022) *Diversity Equity and Inclusivity – core principles for Securing Antarctica's Environmental Future* . 10th SCAR Open Science Conference, August 2022. [Online] https://scar2022.org/

6. McCormack, F (2022) *Bed bumps and ice flow: modeling the Antarctic Ice Sheet*. SCAR RINGS Action Group meeting, Tromsø, Norway, 27 June 2022.

7. McCormack, F (2022) *Hotspots in cold places: the importance of scale in Geothermal Heat Flow anomalies on East Antarctic subglacial melt*. SCAR INSTANT, [Online] 8 November 2022.

8. Meredith, K. (2022) *Impacts of sea-spray aerosols and water-rock interactions on lake water chemistry across Macquarie Island*. 10th SCAR Open Science Conference. August 2022. [Online] https://scar2022.org/

9. McDonough, L. (2022) *Antarctic Lakes*. 10th SCAR Open Science Conference. August 2022. [Online] https://scar2022.org/

10. Phillips, L.M. (2022) *Improving species-based area protection in Antarctica*. 10th SCAR Open Science Conference, 4 August 2022 [Online] https://scar2022.org/

11. Purich, A. (2022) *Projected impacts of Antarctic meltwater anomalies over the 21st Century*. 10th SCAR Open Science Conference. August 2022 [Online]. https://scar2022.org/

12. Rand, C. (2022) *Ice was thicker than present surrounding Lambert Glacier, East Antarctica, during the Last Glacial Maximum*. 10th SCAR Open Science Conference. August 2022. [Online] https://scar2022.org/

13. Saunders, K.M. (2022) *Sulphur as a proxy for Southern Hemisphere westerly wind strength on sub-Antarctic Macquarie Island*. 10th SCAR Open Science Conference. August 2022. [Online] https://scar2022.org/

14. Saunders, K.M. (2022) *First evidence of atmospheric nuclear weapons testing fallout on a Southern Ocean Island*. 10th SCAR Open Science Conference. August 2022. [Online] https://scar2022.org/

15. Shaw J. (2022) Session chair. 10th SCAR Open Science Conference, August 2022 [Online] https://scar2022.org/

16. Siems, S. (2022) Multi-layer clouds over the high-latitudes of the Southern Ocean. 10th SCAR Open Science Conference. August 2022. [Online] https://scar2022.org/

17. Xiang Zhao*, Bode, M., Wilson, K. (2022) *Patterns of humans' preferences for choosing a place to survey biodiversity in terrestrial Antarctica*. 10th SCAR Open Science Conference, August 2022 [Online] https://scar2022.org/

Conference plenary and keynote presentations

1. Arblaster, J. (2022) *Tropical to polar interactions in the Southern Hemisphere.* International Conference for Southern Hemisphere meteorology and oceanography 8–12 February 2022 [invited plenary]

2. Chown. S.L (2022) *What microbial ecology can offer all of ecology.* Opening Address to the Third Australian Microbial Ecology (AusME) Conference, Melbourne, Australia, November 2022. 7 November 2022 [invited speaker]

3. Chown, S.L. (2022) *Antarctic Climate Change and the Environment – An update on Antarctica's current and future global impact.* Antarctic Science Platform New Zealand Hui, Plenary Talk, Science to Policy, 31 August 2022 [in person]

4. Cressie, N. (2022) *Adapting statistical science for a fast-changing climate.* American Statistical Association Inaugural IDEA Forum (2022): Climate Change. 18 November 2022 [Online presentation, Plenary].

5. Greening, C. (2022). *Atmospheric carbon monoxide oxidation: from enzymes to ecosystems.* Microbial Cycling of Volatile Organic Compounds Symposium, Norwich, United Kingdom. 25 May 2022 [Keynote Speaker]

6. Wilson, N.G. (2022) *Antarctic biodiversity in peril*. Australian Marine Sciences Association (AMSA), Cairns, Australia. 8–11 August 2022 [Keynote]

7. McGeoch, M.A. (2022) *Antarctic biodiversity past, present and future.* Victorian Biodiversity Congress, Melbourne, February 2022 [Keynote]

8. Purich, A. (2022) *Antarctica's global connectivity.* Australian Meteorological and Oceanographic Society Annual Conference, Adelaide, 28 Nov – 03 Dec 2022 [invited plenary]

9. Robinson, S.A. (2022) *Basking in the sun: How mosses photosynthesise and survive the coldest continent on Earth*. International Congress on Photosynthesis Research (2022) Dunedin, NZ. 4th August 2022 [in person, plenary]

10. Strugnell, J.M. (2022) *Genomics for exploring change and connections through space and time.* Australian Marine Sciences Association (AMSA), Cairns, Australia. 8–11 August 2022. [Invited Plenary]

Conference Presentations and Posters

1. Alinajadtabrizi, T. (2022) *Wet deposition in shallow convection over the Southern Ocean*. Australian Meteorological and Oceanographic Society Annual Conference, Adelaide, 28 Nov – 03 Dec 2022 [in person presentation]

2. Burrows, J., * Lee, J., Wilson, K.A. (2022) *Challenges and opportunities for conserving Antarctic environments.* ESA-SCBO 2022 Conference, Wollongong, Australia. December 2022 [poster]

3. Clarke, D. (2022) *Implementing site-based prioritisation for invasive alien species management.* Ecological Society of Australia and the Society for Conservation Biology Oceania, 29 November 2022 [in person, presentation]

4. Cressie, N., Zhang, Bohai (2022) *Rapid spatio-temporal changes in Arctic sea ice over the last quarter century.* Institute of Mathematical Statistics World Conference, London, UK. June 2022 [Oral presentation, Invited]

5. Cressie, N. (2022) *Accelerated spatio-temporal changes in Arctic sea ice from remote sensing data*. NASA Workshop on Uncertainty Quantification for Remote Sensing Inverse Problems, Pasadena, CA. October 2022 [Oral presentation, Invited]

6. Vu, Quan, Cressie, N. (2022) *Constructing Large Nonstationary Spatio-Temporal Covariance Models via Compositional Warpings.* Australasian Applied Statistics Conference, Inverloch, VIC, Australia. December 2022 [Poster]

7. Cressie, N. (2022) *Effects of climate change action through a NIASRA lens.* Global Climate Change Week Welcome Event: Planet Positive Partnerships, University of Wollongong, Australia. 11 October 2022 [Oral presentation, Invited]

8. Dehling, M. (2022) *Quantifying the contribution of species and species assemblages to functional and phylogenetic diversity.* Conference of the Ecological Society of Australia and the Society for Conservation Biology Oceania (ESA-SCBO 2022). Wollongong, NSW. 28 November to 2 December 2022 [in person presentation]

9. Greening, C. (2022). *Atmospheric trace gases: hidden energy sources enabling extreme life.* NASA's Network for Life Detection Series, Virtual, 23 February 2022 [Invited Speaker]

10. Greening, C (2022) *Biochemical basis of atmospheric H2 and CO oxidation.* Gordon Research Conference in One Carbon Metabolism, Southbridge MA, United States. 9 August 2022 [Invited Speaker]

11. Greening, C. (2022) *Microbial oxidation of atmospheric trace gases: from enzymes to ecosystems.* MicroSeminar Series, Virtual, 31 March 2022 [Invited Speaker]

12. Greening, C. (2022) *Shift from heterotrophy to autotrophy underlies carbon cycling in desert ecosystems.* International Society for Microbiology Ecology Conference, Lausanne, Switzerland 15 August 2022 [Invited Replacement Speaker]

13. Greening C. (2022) *Welcome and Closing Statements.* Third Australian Microbial Ecology (AusME) Conference, Melbourne, Australia. 7th and 9th November 2022 [Chair]

14. Fisher, J., Henley, B*., Purich, A., Thomas, E. and Abram, N. (2022) *Characterising the relationship between the Interdecadal Pacific Oscillation and El Niño Southern Oscillation diversity.* The Australian Meteorological and Oceanographic Society (AMOS) 29th Annual Conference, Adelaide, South Australia, 28 Nov – 1 Dec 2022 [Oral presentation].

15. Helmstedt, K.J. (2022) *Developing new technologies for biodiversity conservation*. Ecological Society of Australia, Society for Conservation Biology joint conference, November 2022

16. Holland, O.*, Stark, J., Wilson, K., Shaw, J. and Helmstedt, K. (2022) E*nsemble ecosystem modelling to predict impacts of marine invasive species in an Antarctic coastal ecosystem*. Australian Marine Science Association conference, 8 August 2022, Cairns [in person presentation]

17. *Iglesias, M. Dehling, D.M., Sgrò, C. M., Chown, S.L. *Sub-Antarctic native avifauna diversity patterns: contributions from each island*. Conference of the Ecological Society of Australia and the Society for Conservation Biology Oceania (ESA-SCBO 2022). Wollongong, NSW. 28 November to 2 December 2022.

18. Johansen A*, Saunders, K. (2022) *High-resolution palaeodust archive from Macquarie Island peat*. 19th Australian and New Zealand Geomorphology Group Biennial Conference. https://www.anzgg.org/anzgg2022.html

19. Johansen A. (2022) *High-resolution palaeodust archive from sub-Antarctic Macquarie Island*. Australasian Quaternary Association annual conference. https://aqua.org.au/conference/aqua-2022/

20. Jones, R. (2022) *Stability of the Antarctic Ice Sheet during the pre-industrial Holocene*. Australasian Quaternary Association conference, December 2022

21. King, D. (2022) *Technology Advances to Expand Participation in Polar Research*. National Academies Sciences Engineering Medicine. 5th May 2022 [Oral presentation, Invited]

22. Lau, S.C.Y (2022) *Evolutionary divergence and innovations driven by a historical warm interglacial: Genomic insights from Antarctic brittle stars*. Australian Marine Sciences Association (AMSA), Cairns, Australia. 8–11 August. [in person presentation]

23. Lee, J. (2022) *Impacts of Antarctic habitat transformation on biodiversity*. UK Antarctic Science Conference. September 2022, Edinburgh, United Kingdom.

24. McCormack, F (2022) *Modelling the Antarctic Ice Sheet: recent progress and opportunities.* ACCESS-NRI Community Workshop Science Talks, Canberra, 22nd June 2022. https://www.anu.edu.au/events/access-nri-2022-community-workshop [in person]

25. McCormack, F. (2022) *Creeping and sliding: the flow regime of Antarctic glaciers.* AMSI-AustMS Workshop on Mathematics of Sea Ice and Ice Sheets. University of Adelaide, 7th November 2022.

26. McGeoch, M.A. (2022) *Discussion of Antarctic occurrence data and new biodiversity informatics data model with GBIF Secretariat*. Global Biodiversity Information Facility Secretariat, Copenhagen, 11–12 April 2022.

27. McGeoch, M.A. (2022) *Scale-sensitive governance of biological invasions – community matters.* Invited Speaker, New perspectives on biodiversity dynamics and stewardship under future global change. BioChange Symposium, Aarhus University, Denmark, September 2022.

28. McGregor H*., Wilcox P., Fischer M., Phipps S., Gagan M., Wittenberg A., Felis T., Kölling M., Wong H., Devriendt L., Woodroffe C., Zhao J.-X., Fink D., Gaudry J., Chivas A. (2022) Millennial to seasonal scale views of El Niño-Southern Oscillation from central Pacific corals. The 14*th International Conference on Palaeoceanography (ICP14), Bergen, Norway, 29 Aug – 2 Sep 2022 [Poster presentation]

29. McGregor, H., Wilcox, P., Fischer, M., Phipps, S., Gagan, M., Wittenberg, A., Felis, T., Kölling, M., Wong, H., Devriendt, L., Woodroffe, C., Zhao, J.-X., Fink, D., Gaudry, J. and Chivas, A. (2022) *Millennial to seasonal scale views of El Niño-Southern Oscillation from central Pacific corals*. The Australasian Quaternary Association (AQUA) 2022 Conference, Adelaide, South Australia, 6–8 Dec 2022 [Oral presentation]

30. Patterson, C. (2022) *How biased and uncertain is our knowledge of Antarctic biodiversity?* ESA-SCBO Conference, November 2022, Wollongong. https://www.esascbo2022.org.au/

31. Phillips. L.M., Leihy, R.I.& Chown, S.L. (2022) *Improving species-based area protection in AntarcticaSociety for Conservation Biology.* Society for Conservation Biology Emerging Issues in Conservation Seminar Series. 23 March 2022 [online]

32. Purich, A. (2022) *Projected impacts of Antarctic meltwater anomalies over the 21st Century.* ACCESS-NRI Community Workshop Science Talks.Canberra 22 June 2022 https://www.anu.edu.au/events/access-nri-2022-community-workshop [in person]

33. Purich, A. (2022) *Remote and local drivers of East Antarctic sea ice variability and change.* Australian Meteorological and Oceanographic Society Annual Conference, Adelaide, 28 Nov – 03 Dec 2022 [in person presentation]

34. Purich, A. (2022) *Projected impacts of Antarctic meltwater anomalies over the 21st Century.* International Conference for Southern Hemisphere meteorology and oceanography 8–12 February 2022 [online presentation]

35. Robinson, S.A. (2022) Monitoring species on the move in Antarctic terrestrial communities. Scottish Association of Marine Science, Oban, Scotland. 22 April 2022 [in person]

36. Robinson, S.A. (2022) *Healthy People, Healthy Planet, Social Justice: Universities a Force for Change and Social Good, Conference Panel*. Consortium for Universities on Global Health (CUGH 2022) 1 April 2022 [online]

37. Robinson, S.A. (2022) *The Ozone hole drives climate change in the Southern Hemisphere.* Congreso Futuro, January 2022 [online]

38. Robinson, S.A. (2022) *Impacts of Climate Change on Antarctic Species & Ecosystems*. Congreso Futuro Magallanes Region January 2022 [online]

39. Robinson, S.A. (2022) *Climate Change & Ozone Depletion in Antarctica*. Congreso Futuro Los Rios Region January 2022 [online]

40. Rodewald, N. (2022) How do direct developing benthic invertebrates disperse in the Southern Ocean? Australian Marine Sciences Association (AMSA), Cairns, Australia. 8–11 August [in person poster presentation]

41. Roy, R. (2022) *MJO Teleconnections during ENSO years*. Australian Meteorological and Oceanographic Society Annual Conference, Adelaide, 28 Nov – 03 Dec 2022 [in person poster presentation]

42. Siems, S. (2022) A precipitation event over the high-latitudes of the Southern Ocean. Australian Meteorological and Oceanographic Society Annual Conference, Adelaide, 28 Nov – 03 Dec 2022 [in person presentation]

43. Watson, G (2022) *Climate change and ozone depletion are affecting moss beds in East Antarctica*. ESA-SCBO 2022: Ecological Society of Australia and the Society for Conservation Biology Conference, Species Response to Climate Change Symposium, Wollongong, NSW. 28/11/2022 – 2/12/2022 [Oral presentation]

44. Wilson, K. (2022) *Advancing Data-Intensive Research in Australia*. Invited panel member to Australian Data Science Network's webinar, 10 June 2022.

Awards and Recognition

1. Arblaster, J. (2022) Australian Meteorological and Oceanographic Society (AMOS) Fellows 2022. https://www.amos.org.au/amos-announcement-new-fellows-2022/

2. Brooks, C. (2022) The Society of Women Geographers – Ronne Award for Antarctic Research or Exploration http://www.iswg.org/awards/ronne-award

3. Brooks, C.(2022) The Explorer's Club 50 https://www.explorers.org/the-explorers-club-50/

4. Carter, Z.T. (2022) Research Communication Award. University of Auckland School of Biological Sciences. 16th November 2022.

5. Cressie, N. (2022) Ranked 4th in Australia in ranking of Best Scientists–Mathematics, from Research.com: https://research.com/scientists-rankings/mathematics/au

6. Gonzalez, F. (2022) Fellow of the Royal Aeronautical Society (FRAeS), Royal Aeronautical Society. https://research.qut.edu.au/qcr/2022/11/07/felipe-gonzalez-elected-fellow-of-the-royal-aeronautical-society/

7. Greening, C. (2022) Australian Academy of Science, Fenner Medal, https://www.science.org.au/supporting-science/awards-and-opportunities/fenner-medal

8. Greening, C. (2022) Australian Museum Eureka Prizes, Finalist for Eureka Prize, https://australian.museum/get-involved/eureka-prizes/2022-eureka-prizes-finalists/

9. Helmstedt, K. (2022) Queensland Young Tall Poppy Science Award 2022. Australian Institute of Policy and Science (AIPS) in partnership with the Office of the Queensland Chief Scientist. 30th August 2022. https://www.chiefscientist.qld.gov.au/science-comms/programs-events/science-celebration

10. Johnston, E.L. (2022) Fellow of the Australian Academy of Science (FAA) https://www.science.org.au/profile/emma-johnston

11. Lau, S.C.Y. (2022) AMSA-NQ conference award, Australian Marine Sciences Association. https://www.amsa.asn.au/2022-cairns

12. McGeoch, M.A. (2022) Fellow of the African Academy of Sciences.

13. Mengersen, K. (2022) 2022 Technologist of the Year Award sponsored by The University of Queensland. Women in Technology Awards, 16th September 2022

14. Patterson, C. (2022) Second Place for Outstanding Student Spoken Presentation. ESA-SCBO Conference, Wollongong, November 2022.

15. Purich, A. (2022) Australian Meteorological and Oceanographic Society (AMOS), Meyers Medal for high-quality and innovative contributions by early career researchers.

16. Robinson, S. (2022) Top biophysicist of the year. The Australian Research Magazine 2023. https://www.uow.edu.au/media/2022/uow-researchers-named-australias-best-in-14-fields-.php,https://www.theaustralian.com.au/special-reports/amphibians-are-endangered-and-not-yet-well-understood/news-story/788f9d180eb8288326f25f3fff7948b7

17. Wilson, K. (2022) 2022 Research Leader Science Award sponsored by The University of Southern Queensland, Women in Technology Awards. 16th September 2022

18. Zammit-Mangion, A. (2022), 2022 ENVR Early Investigator Award. Section on Statistics and the Environment of the American Statistical Association (ASA). https://community.amstat.org/envr/recognitionandawards/distinguishedachievementawards

Advisory Roles

1. **Arblaster, J.**
   - Member of the World Climate Research Programme's Coupled Model Intercomparison Project (CMIP) panel, (2020 –)
   - Scientific steering committee member, 2022 World Meteorological Organization (WMO)/United Nations Environment Programme (UNEP) Scientific Assessment of Ozone Depletion (2019 – 2022)
   - Member, Australian Academy of Science (AAS) National Committee for Earth System Science (2016 –)
2. **Bode, M.**
   - Awards Committee for Fenner Medal, Australian Academy of Science (2021 –)
   - Scientific advisory committee of the National Red Imported Fire Ant Eradication Program (2021 –)
3. **Chown, S.L.**
   - International Science Panel New Zealand Antarctic Science Platform (2020 –)
   - National Committee for Antarctic Research (Australian Academy of Science) (2020 –)
   - Max Day Fellowship Award Committee (Australian Academy of Science (2022 –)
4. **Clarke, D.**
   - Co-Chair of the Policy Working Group of the Ecological Society of Australia
5. **Cressie, N.**
   - Independent member of the Australian Antarctic Science Council (2019 – 2022)
   - Scientific Reviewer of report from the International Science Council of the United Nations, 2023 Global Sustainable Development Report (2022)
6. **Davis, R.**
   - Participant in Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) Meeting attached to Antarctic and Southern Ocean Coalition delegation (2022)
7. **Gonzalez, F.**
   - Member of the Board, Civil Aviation Safety Authority (CASA), (2022 –)
8. **Helmstedt, K.**
   - Women In Data Science (WiDS) international network ambassador (2022)
9. **Henley, B.**
   - Member of PAGES 2k Phase 4 International Coordination Team (2021 – 2024)
   - Member of Past Global Changes (PAGES) 2k Phase 4 Network Committee overseeing global efforts to synthesise paleoclimate data (2022 – 2025)
10. **Jones, R.**
    - Steering committee member (Governing Council observer), Australian and New Zealand International Ocean Discovery Program Consortium (ANZIC) (2021 – 2024).
11. **King, D.**
    - Australian Antarctic Division Diversity, Equity and Inclusion Action Plan Engagement with Program Partners (2022 –)
12. **Lim, E-P.**
    - Member of SPARC-Stratospheric Network for the Assessment of Predictability (SNAP) activity committee, (2021 –)
    - Member of Stratosphere-troposphere Processes And their Role in Climate (SPARC)-Dynamical Variability (DynVar) activity committee, (2020 –)
    - Member of the Australian Meteorological and Oceanographic Society (AMOS) Expert Group on Climate Variability, (2017 –)
13. **Mackintosh, A.**
    - Committee Member, Union Commission on Climate and Environmental Change, International Union of Geodesy and Geophysics (IUGG). (2019 – 2023)
    - Vice President, International Association of Cryospheric Sciences (2019 – 2023)
    - Representative of the International Science Council on the Planning Task Force for the next International Polar Year (2032).
14. **McCormack, F.**
    - Co-Chair of the International Union of Geodesy and Geophysics (IUGG) Joint Commission on Ice-Ocean Interactions (2021 – 2024)
    - Co-Chair of the Australian Earth System Simulator – National Research Infrastructure (ACCESS-NRI) Land Ice Community Group (2022 –)
    - Project partner of OCEAN:ICE Horizon Europe Programme (2021 –)
15. **McGeoch, M.A.**
    - Science Committee of the Global Biodiversity Information Facility (GBIF), 1st Vice-Chair, International
    - Science and Management Advisory Committee, Parks Victoria
16. **McGregor, H.**
    - University of Wollongong representative on the Australia-New Zealand International Ocean Discovery Program Governing Council (2022 –)
    - Member of the Scientific Committee, International Conference on Paleoceanography (ICP) XIV, Bergen (2020 – 2022)
    - Member of Past Global Changes (PAGES) 2k Phase 4 Network Committee overseeing global efforts to synthesise paleoclimate data (2022 – 2025)
17. **Mengersen, K.**
    - National Committee for Mathematical Sciences, Australian Academy of Science (AAS) (2020 – 2023)
18. **Purich, A.**
    - Co-Chair of the Climate and Ocean: Variability, Predictability and Change (CLIVAR) and Climate and Cryosphere (CliC) and the Scientific Committee on Antarctic Research (SCAR) Southern Ocean Region Panel (2022 – 2026)
19. **Robinson, S.**
    - Member of the Australian Academy of Science, National Committee for Antarctic Research (2021 –)
    - Member of US National Academies, Committee on Technology Developments to Advance Antarctic Research (2021 – 2022)
    - Member of the Max Day Environmental Science Fellowship Award Committee (2021 –)
    - Chair, Excellence in Research Australia (ERA) Engagement and Impact Cluster (2021 – 2022)
    - Member of UN Environment Programme (UNEP) Environmental Effects Assessment Panel (2009 –)
    - Antarctic Science Foundation Member of Science Sub-Committee
    - Homeward Bound Faculty member (2018 –)
    - Custodian of Antarctic State of the Environment Indicator (2002 –)
    - Australian Antarctic Science Program, Decadal Plan Coordinator – Climate change Impacts Working Group (2022)
    - Member Antarctic Near shore and Terrestrial Observing System (ANTOS) Expert Group (2017 –)
20. **Shaw, J.**
    - Chair of the working group on Antarctic Biosecurity for the Australian Antarctic Science Decadal Plan
    - Board director of Homeward Bound Pty Ltd (2021 –)
21. **Smith, J.**
    - Member of SAEF GAB – EMCR Rep (2021 – 2024)
22. **Turnbull, J.**
    - Branch President, AMSA NSW and Advisory Committee, Reef Life Survey
23. **Wheeler, M.**
    - Member of the World Meteorological Organization (WMO) Research Board, (2020 –)
    - Member of the WMO-Intergovernmental Oceanographic Commission (IOC) Joint Collaboration Board, (2020 –)
24. **Wilson, K.**
    - Leadership Council of the Sustainable Development Solutions Network (SDSN) Regional Network for Australia, New Zealand & Pacific SDSN AusNZPac Leadership Council (2022 –)
    - Board member of Ecofutures (2022 –)
    - Invited Member – Advisory Committee on the Environmental Management of Industrial Chemicals (IChEMS) (2022 –)
    - Reef 2050 Plan Independent Expert Panel (2017 –)
    - Australian Heritage Council (AHC), Natural Heritage expert (2019 –)
    - Australia's Man and the Biosphere (MAB) National Committee (2020 – March 2022)
    - Awards Committee (Fenner Conference on the Environment and Nancy Millis Medal), Australian Academy of Science (2019 – March 2022)
    - Natural Sciences Commissioner of the Australian National Commission for UNESCO (2018 – March 2022)

Scientific Committee on Antarctic Research (SCAR) Roles

1. Brooks, C. (2022) Standing Committee on the Antarctic Treaty System, (SCATS), Deputy Chief Officer
2. Brooks, C. (2022) Integrated Science to Inform Antarctic and Southern Ocean Conservation (Ant-ICON), Member and SC-ATS Steering Committee representative
3. Chown, S.L. (2022) SCAR Immediate Past-President (2021 – 2022), Honorary Life Member SCAR (2022 – ongoing)
4. Jones, R. (2022) Steering committee member of the 'Southern Ocean and Antarctic Chronology and Environmental Proxies' group (SCAR Instability and Thresholds in Antarctica program), (2021 – 2023)
5. King, D. (2022) SCAR Equity, Diversity and Inclusion Action Group
6. Lee, J. (2022) Member of the steering committee of the SCAR scientific research programme Ant-ICON (Integrated science to inform Antarctic and Southern Ocean conservation)
7. Mackintosh, A. (2022) SCAR Delegate for International Association of Cryospheric Sciences. Attended SCAR Delegates Meeting 5–7 September, 2022 as an observer.
8. Mackintosh, A. (2022) Nominated SCAR Delegate for the International Union of Geodesy and Geophysics (IUGG).
9. McCormack, F. (2022) Steering Committee member on the Antarctic RINGS Action Group (a SCAR Action Group), (2021 – 2023)
10. Robinson, S. (2022) SCAR Antarctic Nearshore Terrestrial Observing System (ANTOS) Expert Group Member Australian Antarctic Science Program
11. Stark, J. (2022) Member of Antarctic Nearshore Terrestrial Observing System (ANTOS) committee
12. Terauds, A. (2022) Co-Chief Officer, SCAR Scientific Research Program – Integrated Science to inform Antarctic and Southern Ocean Conservation

Grants awarded associated with SAEF

SAEF Member	Organisation	Grant Scheme	Amount	Title
Bay, S.	Monash University	ARC DECRA DE230101346	Cave microbial metabolism as a missing biogeochemical sink	$418,893
Brooks, C.	University of Colorado Boulder	National Science Foundation Career Grant	Using Otolith Chemistry to Reveal the Life History of Antarctic Toothfish in the Ross Sea, Antarctica: Testing Fisheries and Climate Change Impacts on a Top Fish Predator.	$ 801, 042 USD
		National Science Foundation	Planning: Formulating and Sustaining a System-Level Understanding of a Large Marine Ecosystem in the Ross Sea Region Marine Protected Area to Better Conserve and Guide Policy.	$99,999 USD
		Pew Charitable Trusts	Conserving the Southern Ocean: Informing the design, implementation and value of protecting the waters around Antarctica.	$141,000 USD
Chown, S.L.	Monash University	Dutch Research Council	Antarctic tourism: developing knowledge and tools to minimise cumulative impacts on biodiversity and wilderness values in Antarctica	AU$ 1,490,683 ($231,510 to Monash University)
Greening, C.	Monash University	ARC Discovery Project DP230103080	Extracting energy from air: mechanism of a bacterial hydrogenase	$694,096
		Human Frontiers Science Program Young Investigator Grant	The atmosphere: a living breathing ecosystem?	$1,876,155
Lappan, R.	Monash University	ARC DECRA DE230100542	Microbial life in the atmosphere	$454,741
Lau, S.	James Cook University	SCAR INSTANT Fellowship	Reconstructing past grounded ice extent over time around Wilkes Land margin, East Antarctica, using animal genomes	$5,000 USD
McCormack, F.	Monash University	Ambassade de France en Australie – Monash University Antarctic Cooperative Research Grant	Towards an Anisotropic ICE Flow Model Intercomparison Project (ANISOMIP)	$20,000
Patterson, C.	Queensland University of Technology	Australian Institute of Mathematical Science	Travel to Melbourne for AMSI summer school including accommodation	$1,551
Purich, A.	Monash University	ARC Discovery Project DP230102994	Southern Ocean Sea Ice – what happened and what happens next?	$404,000
Robinson, S.	University of Wollongong	NVIDIA	Strategic Research Engagement	$200,000 USD
Williams, K.	Queensland University of Technology	Heritage Expeditions True Young Explorer Scholarship	2022/23 True Young Explorer Scholarship	$9,186

Visualisation Products

1. Shaw J. (2022) Large banners presented at Australian Antarctic Science Symposium – showcasing SAEF & AAD research on subantarctic conservation and World Heritage Area restoration. Currently on display at the Australian Antarctic Division, Kingston.

2. Video associated with: Strugnell, J.M., McGregor, H.V., Wilson, N.G., Meredith, K., Chown, S.L., Lau, S.C.Y., Robinson, S.A. and Saunders, K..M. (2022) Emerging biological archives can reveal ecological and climatic change in Antarctica. *Global Change Biology*, 28: 6483-6508 DOI: https://doi.org/10.1111/gcb.16356 https://www.youtube.com/watch?v=YHAtRxEPeGo

3. Antarctic Climate Change and the Environment: A Decadal Synopsis and Recommendations for Action – Infographics. Created by Phillips, L.M. (2022) https://www.scar.org/scar-library/other-publications/occasional-publications/5775-acce-2022-infographics/

4. Video associated with: Chown, S.L., Leihy, R.I., Naish, T.R., Brooks, C.M., Convey, P., Henley, B.J., Mackintosh, A.N., Phillips, L.M., Kennicutt, M.C. II & Grant, S.M. (Eds.) (2022) Antarctic Climate Change and the Environment: A Decadal Synopsis and Recommendations for Action. Scientific Committee on Antarctic Research, Cambridge, United Kingdom. https://www.scar.org/policy/acce-updates/ *Our future depends on us: Antarctic Climate Change and the Environment* [Voice Over: Brooks, C.M.] 1 December 2022. https://www.youtube.com/watch?v=P07sDH-kmw0

Short Films for Engagement

1. Cowan, D. (2022) Research Matters with Prof Don Cowan. University of Pretoria. https://www.youtube.com/watch?v=2YwWPeaaBuQ

2. Chown, S.L. (2022) Participation as a person interviewed in *The Endangered Generation*. https://miff.com.au/program/film/the-endangered-generation

3. Chown, S.L., McCormack, F., Hamiester, J. (2022) *Securing Antarctica's Environmental Future*, Grassland Films, https://youtu.be/JQL9NiSsSvs

4. Morse, P and Terauds, A. (2022) *Islands to the Ice*. Virtual Macquarie Island. An installation at the Tasmanian Museum and Art Gallery permanent gallery. https://www.tmag.tas.gov.au/whats_on/exhibitions/longterm/islands_to_ice

5. Randall, K. (2022) Antarctic short film. Antarctic Futures short film festival. October 2022 https://www.youtube.com/watch?v=6nqbwjFfizo

Antarctica and Australia Engagement Events with Museum / State-Territory Partners

1. Chown, S.L. (2022) University of Adelaide, Department of Ecology and Evolutionary Biology Seminar 2022. *From Science to Policy for Antarctica* 24th June 2022 (in person) included South Australian Museum.

2. Morse, P and Terauds, A. (2022) Virtual Macquarie Island – an installation at the Tasmanian Museum and Art Gallery permanent gallery – "Islands to the Ice' https://www.tmag.tas.gov.au/whats_on/exhibitions/longterm/islands_to_ice

3. Stevens, M.I. (2022) Surviving climate extremes: biodiversity and evolutionary history. Journey Beyond (https://www.journeybeyondrail.com.au/), South Australian Museum, 12 May 2022, 4 Aug 2022, 8 and 15 Dec 2022.

4. Wilson, N.G. (2022) The high fashion of sea slugs. Meet the Museum, WA Museum Boola Bardip, 15 September 2022. https://visit.museum.wa.gov.au/boolabardip/high-fashion-sea-slugs

Print or Online Media Features

1. ANSTO Staff (2022) Helping to support the environmental future of Antarctica. *ANSTO Website* 27 October 2022, https://www.ansto.gov.au/news/helping-to-support-environmental-future-of-antarctica

2. Arblaster, J. (2022) Antarctic sea ice falls to lowest level since measurements began in 1979. *Guardian Australian* 23 February 2022, https://www.theguardian.com/world/2022/feb/23/antarctic-sea-ice-falls-to-lowest-level-since-measurements-began-in-1979

3. Brooks, C. (2022) New paper calls for immediate protection of the Southern Ocean. *Pew Charitable Trusts* 23 September 2022,

   https://www.pewtrusts.org/en/research-and-analysis/articles/2022/10/20/new-paper-calls-for-immediate-protection-of-southern-ocean

4. Brooks, C. & Chown, S.L. (2022) Report: Antarctic is changing dramatically, with global consequences. *Colorado Boulder Today* 13 June 2022, https://www.colorado.edu/today/2022/06/13/report-antarctic-changing-dramatically-global-consequences

5. Brooks, C. & Chown, S.L. (2022) Report: Antarctic is changing dramatically, with global consequences. *Environmental News Network* 14 June 2022, https://www.enn.com/articles/70547-report-antarctic-is-changing-dramatically-with-global-consequences

6. Chown, S.L. (2022) Un nuevo informe determinó cuáles serán las consecuencias del cambio climático. *Economia Sustenable* 30 May 2022, https://economiasustentable.com/noticias/un-nuevo-informe-determino-cuales-seran-las-consecuencias-del-cambio-climatico

7. Chown, S.L. (2022) Urgent need to mitigate climate impacts on Antarctica says report. *Eye on the Arctic* 26 May 2022, https://www.rcinet.ca/eye-on-the-arctic/2022/05/26/urgent-need-to-mitigate-climate-impacts-on-antarctica-says-report/

8. Chown, S.L. (2022) Antarctic marine life to bear brunt of climate change on the continent. *1 News Breakfast* 25 May 2022, https://www.1news.co.nz/2022/05/25/antarctic-marine-life-to-bear-brunt-of-climate-change-on-continent/

9. Chown, S.L. (2022) Antarctic marine life to bear brunt of climate change on the continent. *Hebden Bridge News* 25 May 2022, https://hebdenbridgenews.com/antarctic-marine-life-to-bear-brunt-of-climate-change-on-continent/

10. Chown, S.L. (2022) Emperor penguins face extinction in Antarctica, new report reveals. *Yahoo! News* 25 May 2022, https://au.news.yahoo.com/emperor-penguins-face-extinction-in-antarctica-most-unnerving-070738784.html

11. Chown, S.L. (2022) Monash University scientists star in documentary to premiere at the Melbourne International Film Festival. *Monash News* 13 July 2022, https://www.monash.edu/news/articles/monash-university-scientists-star-in-documentary-to-premiere-at-the-melbourne-international-film-festival

12. Chown, S.L.(2022) Antarctica is coming to a postcode near you. *Eco Voice* 25 May 2022, https://www.ecovoice.com.au/antarctica-coming-to-a-postcode-near-you/

13. Chown S.L. (2022) Antarctica is coming to a postcode near you. *Clarence Valley News*, 31 May 2022, https://clarencevalleynews.com.au/antarctica-coming-to-a-postcode-near-you-report-shows-dramatic-antarctic-change-with-global-consequences/

14. Chown S.L.(2022) Antarctica: A once quiet neighbour is now becoming unruly. *Monash Lens* 24 May 2022, https://lens.monash.edu/@science/2022/05/24/1384726/antarctica-a-once-quiet-neighbour-now-becoming-unruly

15. Greening, C. (2022) Biggest bacterium ever discovered shakes our view of the single-celled world. *National Geographic*, 24 June 2022, https://www.nationalgeographic.com/science/article/biggest-bacterium-ever-discovered-shakes-our-view-of-the-single-celled-world

16. Greening, C. (2022) Largest bacterium ever discovered has unexpectedly complex cells. *Science* 23 February 2022, https://www.science.org/content/article/largest-bacterium-ever-discovered-has-unexpectedly-complex-cells

17. Helmstedt, K.J. (2022) Researcher using maths to help Antarctica recognised in Young Tall Poppy STEM awards. *ABC* 31 August 2022, https://www.abc.net.au/news/2022-08-31/qld-tall-poppy-award-winner-combines-maths-antarctica-stem/101390348

18. Henley, B. (2022) 'Not something anyone wants to hear': Illawarra could get another big wet this spring. *The Illawarra Mercury* 16 August 2022, https://www.illawarramercury.com.au/story/7863016/not-what-we-want-to-hear-illawarra-could-be-in-for-another-big-wet-this-spring/

19. Henley, B. (2022) 'Not something anyone wants to hear': Illawarra could get another big wet this spring. *The Eden Magnet* 17 August 2022, https://www.edenmagnet.com.au/story/7863951/not-what-we-want-to-hear-another-wet-spring-on-the-cards/

20. Johnston E. (2022) From singing Abba for whales to conducting a $1b budget. *The Financial Review* 26 August 2022, https://www.afr.com/work-and-careers/leaders/from-singing-abba-for-whales-to-conducting-a-1b-budget-20220809-p5b8eg

21. Jones, R. (2022) We studied how the Antarctic ice sheet advanced and retreated over 10,000 years. It holds warnings for the future. *The Conversation* 13 July 2022, https://theconversation.com/we-studied-how-the-antarctic-ice-sheet-advanced-and-retreated-over-10-000-years-it-holds-warnings-for-the-future-185505

22. Jones, R. (2022) We studied how the Antarctic ice sheet advanced and retreated over 10,000 years. It holds warning for the future. *Philippine Canadian Inquirer* 13 July 2022, https://canadianinquirer.net/2022/07/13/we-studied-how-the-antarctic-ice-sheet-advanced-and-retreated-over-10000-years-it-holds-warnings-for-the-future/

23. Jones, R. (2022) New research shows how the Antarctic ice sheet retreated over 10,000 years. *Stuff.com.nz* 13 July 2022, https://www.stuff.co.nz/environment/climate-news/300636133/new-research-shows-how-the-antarctic-ice-sheet-retreated-over-10000-years

24. Jones, R. (2022) We studied how the Antarctic ice sheet advanced and retreated over 10,000 years. It holds warnings for the future. *Yahoo News Australia* 13 July 2022, https://au.news.yahoo.com/studied-antarctic-ice-sheet-advanced-200336836.html

25. Lee, J. & Shaw, J. (2022) Antarctica's emperor penguins could be extinct by 2100 and other species may follow if we don't act. *The Conversation* 23 December 2022, https://theconversation.com/antarcticas-emperor-penguins-could-be-extinct-by-2100-and-other-species-may-follow-if-we-dont-act-196563

26. Lee, J. (2022) Antarctica's biodiversity faces multiple threats, but this 10-step plan can help safeguard it: study. *ABC* 23 December 2022, https://www.abc.net.au/news/science/2022-12-23/antarctica-plan-safeguard-continent-biodiversity-climate-change/101789534

27. Lee, J. Terauds, A. (2022) Emperor penguin at risk of extinction, along with two-thirds of native Antarctic species, research shows. *Guardian Australia* 23 December 2022, https://www.theguardian.com/world/2022/dec/23/two-thirds-of-antarcticas-native-species-under-threat-of-extinction-from-global-heating-research-shows

28. Lee, J. (2022) 65% of Antarctica's plants and animals could disappear, scientists day. Its iconic penguins are most at risk. *CNN* 22 December 2022, https://edition.cnn.com/2022/12/22/world/antarctica-penguin-species-climate-threat-scn/index.html

29. Lee, J (2022) Most Antarctic animals and plants are set to decline by 2100. *New Scientist* 23 December 2022, https://www.newscientist.com/article/2353021-most-antarctic-animals-and-plants-are-set-to-decline-by-2100/

30. McCormack, F. (2022) Onboard the space station at the end of the world. *CNET* 2 May 2022, https://www.cnet.com/science/climate/features/onboard-the-space-station-at-the-end-of-the-world-rsv-nuyina-antarctica/

31. McCormack, F. & Jones, R. (2022) Truth washes away spurious sea level claim. *AAP, AAP Factcheck*, 28 July 2022. https://www.aap.com.au/factcheck/truth-washes-away-spurious-sea-levels-claim/

32. McCormack, F. & Jones, R. (2022) Cold Chisel: Antarctic rocks reveal glacial retreat. *Australian Antarctic Program website* 18 April 2022, https://www.antarctica.gov.au/news/2022/cold-chisel-antarctic-rocks-reveal-glacial-retreat/

33. Mackintosh, A. (2022) Antarctic ice shelf collapses after unprecedented heatwave. *Sydney Morning Herald*, 29 March 2022, https://www.smh.com.au/environment/climate-change/antarctic-iceshelf-collapses-after-unprecedented-heatwave-20220328-p5a8jx.html

34. Mackintosh, A. (2022), Black carbon pollution from tourism and research increasing Antarctic snow melt, study says. *Guardian Australia* 23 February 2022, https://www.theguardian.com/world/2022/feb/22/black-carbon-pollution-from-tourism-and-research-increasing-antarctic-snowmelt-study-says

35. Mackintosh, A. (2022), Satellite data shows entire Conger ice shelf has collapsed in Antarctica. *Guardian Australia*, 25 March 2022, https://www.theguardian.com/world/2022/mar/25/satellite-data-shows-entire-conger-ice-shelf-has-collapsed-in-antarctica

36. Mackintosh, A. (2022), Ô nhiễm 'carbon đen' khiến băng ở Nam Cực tan nhanh hơn. Nong Nghiep 23 February 2022, https://nongnghiep.vn/o-nhiem-carbon-den-khien-bang-o-nam-cuc-tan-nhanh-hon-d316324.html

37. Mackintosh, A. (2022), Rußverschmutzung durch Tourismus und Forschung, die die Schneeschmelze in der Antarktis erhöht, sagt eine Studie. *Nach Welt* 23 February 2022, https://www.nach-welt.com/rusverschmutzung-durch-tourismus-und-forschung-die-die-schneeschmelze-in-der-antarktis-erhoht-sagt-eine-studie-antarktis/

38. Mackintosh, A. (2022) Antarctic ice shelf almost as big as Los Angeles completely collapses. *CNET* 24 March 2022, https://www.cnet.com/science/climate/antarctic-ice-shelf-almost-as-big-as-los-angeles-completely-collapses/

39. Mackintosh, A. (2022), Antarctic ice shelf collapses after unprecedented heatwave. *stuff.co.nz* 29 March 2022, https://www.stuff.co.nz/environment/climate-news/300552395/antarctic-ice-shelf-collapses-after-unprecedented-heatwave

40. Mackintosh, A. (2022) Please stop calling it the Doomsday Glacier, *CNET*, 06 September 2022, https://www.cnet.com/science/climate/please-stop-calling-it-the-doomsday-glacier/

41. Mackintosh, A (2022) There's a fair chance Thwaites Glacier has passed its tipping point. But is it a 'doomsday' scenario? *ABC* 17 September 2022, https://www.abc.net.au/news/science/2022-09-17/thwaites-glacier-antarctica-doomsday-moniker-is-it-valid/101433974

42. Mackintosh, A and Arblaster, J. (2022) Extremes of 40C above normal: what's causing 'extraordinary' heating in polar regions?. *Guardian Australia* 21 March 2022. https://www.theguardian.com/environment/2022/mar/21/extremes-of-40c-above-normal-whats-causing-extraordinary-heating-in-polar-regions

43. Mackintosh, A. (2022) Fate of 'sleeping giant' East Antarctic ice sheet 'in our hands' – study. *Guardian Australia* 11 August 2022, https://www.theguardian.com/environment/2022/aug/10/east-antarctic-ice-sheet-in-our-hands-climate-action

44. Phillips, L. (2022) Toughness has limits: over 1,100 species live in Antarctica but they're at risk from human activity. *The Conversation* 4 May 2022, https://theconversation.com/toughness-has-limits-over-1-100-species-live-in-antarctica-but-theyre-at-risk-from-human-activity-181258

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46. Purich, A (2022) Strong Antarctic polar vortex adds to south-east Australian rainfall and flood risk, BOM says. *ABC* 23 October 2022, https://www.abc.net.au/news/2022-10-23/antarctic-winds-drive-rain-south-east-australian-flood/101537816

47. Randall, K. (2022) 100 Polar Women. *Women in Polar Science*, September 2022, https://womeninpolarscience.org/100polarwomen/.

48. Robinson, S. (2022) *Pioneer observatory making Chile a global detector of climate change. La Prensa Latina* 20 February 2022. https://www.laprensalatina.com/pioneer-observatory-making-chile-a-global-detector-of-climate-change/

49. Robinson, S. (2022) It is the poorest communities that experience the extreme conditions. *BCN Parliamentary Observatory*, 21 January 2022, https://www.bcn.cl/observatorio/asiapacifico/noticias/sharon-robinson-congreso-futuro-2022-antartica

50. Robinson, S. (2022) Answers lurk in mosses. *The Illawarra Mercury*, 18 March 2022.

51. Robinson, S.A. (2022) *Record-smashing heatwaves are hitting Antarctica and the Arctic simultaneously. Here's what's driving them and how they'll impact wildlife. The Conversation* 22 March 2022, https://theconversation.com/record-smashing-heatwaves-are-hitting-antarctica-and-the-arctic-simultaneously-heres-whats-driving-them-and-how-theyll-impact-wildlife-179659

52. Robinson, S.A. (2022) What's driving record heatwaves in Antarctica and the Arctic, and how they'll affect wildlife. *The New Daily* 22 March 2022, https://thenewdaily.com.au/life/science/environment/2022/03/22/record-heatwaves-antarctica-arctic/

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54. Robinson, S and Watson G. (2022) *Mosses hold climate clues. Illawarra Mercury* 2 April 2022,

55. Robinson, S., Randall, K. & Watson, G. (2022) Researchers return to Antarctic "Rainforest', *Australian Antarctic Program website* 24 April 2022, https://www.antarctica.gov.au/news/2022/researchers-return-to-antarctic-rainforest/

56. Robinson, S. (2022) Research 2023, *The Australian*, 9 November 2022.

57. Shaw, J., Lee J. & Wilson K. (2022) Biodiversity unbalanced as ice-free Antarctica areas grow. *Queensland University of Technology website* 1 December 2022, https://www.qut.edu.au/research/article?id=184434

58. Shaw, J (2022) Antarctica is changing, and wildlife and weeds could be on the way. *ABC Science* 1 December 2022, https://www.abc.net.au/news/science/2022-12-01/antarctica-is-changing-and-wildlife-and-weeds-are-on-the-way/101706746

59. Shaw, J. (2022) The end of the World. *Cosmos magazine* 17 June 2022, https://cosmosmagazine.com/nature/animals/antarctica-justine-shaw/

60. Waterman M. & Watson, G. (2022) Antarctic Futures. *Inspiring NSW* 9 August 2022, https://inspiringnsw.org.au/2022/08/09/antarctic-futures/

61. Vu, B.A. (2022) *AMSI scholarship recipient profile: Bao Anh Vu. Australian Mathematical Sciences Institute* 06 July 2022, https://rhed.amsi.org.au/bao-anh-vu/.

Radio Features

1. Chown, S.L. (2022) Interview with Steven Chown re: $800m for Australian Antarctic Program. *ABC Radio National*, PM 22 February 2022, https://www.abc.net.au/radio/programs/pm/$800m-for-antarctic-plan-as-nations-rush-to-assert-influence/13765788

2. Chown, S.L. (2022) Live interview with Steven Chown re: SAEF Launch. ABC Radio Melbourne, Breakfast with Sammy J, 21 October 2022

3. Chown, S.L. (2022) Interview with Steven Chown re: SAEF Launch. ABC Radio News, 21 October 2022, 9:45am.

4. McCormack, F. (2022) Interview with Felicity McCormack re: Casey field expedition. ABC Radio Melbourne, Afternoons with Brian Nankervis, 25 January 2022. https://www.abc.net.au/radio/melbourne/programs/afternoons/afternoons/13719740

5. Mackintosh, A. (2022) Interview with Andrew Mackintosh re: human carbon footprint research. *ABC Radio National, AM with Annie Guest*, 23 February 2022. https://www.abc.net.au/radio/programs/am/research-shows-human-carbon-footprint-on-antarctica/13766504

6. Mackintosh, A. (2022) Interview with Andrew Mackintosh re: collapse of the Conger ice shelf. *ABC Radio Melbourne, Mornings with Virginia Trioli*, 29 March 2022.

7. Phillips, L. (2022) Interview with Laura Phillips re: Antarctic type localities paper. *ABC Radio Sydney, Afternoons with Josh Szeps*, 4 May 2022. https://www.abc.net.au/sydney/programs/afternoons/afternoons/13857592

8. Purich, A. (2022) Interview with Ariaan Purich re: collapse of the Conger ice shelf. 3CR Community Radio, Wednesday Breakfast, 30 March 2022. https://www.3cr.org.au/wednesday-breakfast

9. Shaw, J (2022) Australia's leading women in STEM. ABC Radio National, The Roundtable with Julian Morrow, 13 February 2022, https://www.abc.net.au/radionational/programs/the-roundtable/australias-leading-women-in-stem/13751296

10. Helmstedt, K. (2022) Interview with Kate Helmstedt re: Tall Poppy Award. ABC Radio Brisbane, Mornings with Rebecca Levingston, 30 August 2022

11. Johnston, E.L. (2022) Interview with Emma Johnston re: Aussie Stem Stars series ABC Radio National, The Science Show with Robyn Williams, 30 July 2022. https://www.abc.net.au/radionational/programs/scienceshow/aussie-stem-stars---emma-johnston/13995058

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