

2024

ANNUAL REPORT



Climate
Change
Cluster (C3)





Image: Westville Room

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Acknowledgement of Country

C3 acknowledges the Gadigal People of the Eora Nation, the Boorooberongal people of the Dharug Nation, the Bidiagal people and the Gamaygal people upon whose ancestral lands our university stands.

We would also like to pay respect to the Elders both past and present, acknowledging them as the traditional custodians of knowledge for these lands



Director's Address

As we tackle the challenges posed by climate change, it's clear that university research plays a vital role in creating practical solutions for industry, government, and community stakeholders. At the Climate Change Cluster (C3), we're dedicated to turning our research into real-world applications that help adapt to and mitigate the effects of climate change on marine ecosystems.

Our research is driven by collaboration. By working hand-in-hand with industry partners, government bodies, and community groups, we're making sure our findings don't just stay in academic journals but are used to promote sustainable practices and inform smart policymaking.

Our 2024 successes are a testament to years of hard work and collaboration with our partners, and I'm incredibly proud of the achievements highlighted in this report.

These achievements include

- Recognition of our outstanding early and mid-career researchers, with Dr JB Raina receiving the 2024 Alma Dal Co award for his innovative approaches to uncovering crucial microbial interactions in marine environments and Dr Elliot Scanes being awarded an NSW Young Tall Poppy.
- The launch of Algenie, the first UTS spinout since 2015. Algenie's proprietary photobioreactor system addresses long-standing challenges in algae production, paving the way for economically competitive algae-based solutions.
- Expanding our influence on policymaking through contributions to intergovernmental and UNESCO working groups and the UN's 4th Assessment of the State of the Ocean.

- Continued advancement of our prototyping capabilities with the Modular Multi-Taxa Phenolate (MTP) prototype, which allows for precise temperature control and rapid assessment of coral populations' resilience to future ocean conditions.

As we move forward, our goal is to keep strengthening these partnerships and expanding the reach of our research. I'm excited about the continued impact of our work in 2024 and beyond as we strive for a sustainable future for our marine ecosystems.

Prof. Peter Ralph
Executive Director,
Climate Change Cluster, UTS



About the Climate Change Cluster

The Climate Change Cluster (C3) is a dynamic multidisciplinary research institute, bringing together over 100 experts and support staff. Our research spans a diverse range of fields, including oceanography, coastal productivity, climate change, environmental microbiology, and algal biotechnology.

As the leading hub of aquatic research in the Asia-Pacific region, C3 is home to an unparalleled concentration of interdisciplinary specialists. Our team has consistently demonstrated excellence in research, industry collaboration, and securing funding. We are dedicated to advancing knowledge of aquatic ecosystems, which play a vital role in global environmental health. By generating innovative insights, we aim to address the complex challenges of human and ecological interactions with climate change.

Our vision

To be globally recognised for transforming society through scientific discovery, and provide meaningful strategies for climate adaptation by deepening our understanding of the impacts of climate change on ecosystems, and climate mitigation via innovations to Australia's bioeconomy.

Our mission

To drive high-impact interdisciplinary research that creates a deeper understanding of the influence of climate change on ecosystems and society, and thereby develop meaningful strategies to combat major global issues including food and energy security, sustainability, ecological resilience and global health.

Our research is aligned with the following UN Sustainable Development Goals:

SUSTAINABLE DEVELOPMENT GOALS



C3 Research Groups

An underwater photograph of a coral reef. The water is clear blue, and the reef is composed of various types of coral, including branching and table corals. The lighting is bright, suggesting a shallow depth.

Future Reefs

Dr. Emma Camp

The team

A diverse group of passionate biogeochemists, coral biologists, and marine ecologists.

Research strength

Fostering innovative, robust, and effective collaborations to build restoration programs that facilitate collective community action.

Impact

Research that directly informs how reefs will look and function in the future, and how to better preserve and rebuild “healthy reefs” of tomorrow.

A close-up, microscopic view of green algae. The image shows the intricate, branching structure of the algae, with a vibrant green color. The background is a soft, out-of-focus light green.

Algae Biosystems and Biotechnology

Professor Peter Ralph

The team

A multi-disciplinary group of scientists and engineers accelerating the use of algae and algal-based bioproducts to decarbonise industry biomaterials.

Research strength

Incorporation of algae and their derivatives in innovative green and clean technologies.

Mission

Delivering sustainable climate change mitigation solutions by replacing fossil-based raw materials with solar-based and sustainable algal products.

C3 undertakes integrated and interdisciplinary research at the intersection of the physical, chemical, and life sciences.

Professor Martina Doblin

The team

A dedicated team of researchers striving to better ocean health for future generations.

Research strength

Developing and utilising leading-edge technologies to determine cellular and population level responses, and examine processes that impact water and sediment quality.

Impact

Informing policy, investment, and regulation to deliver sustainable solutions to the global challenges of climate change and coastal development.



Professor Justin Seymour

The team

A diverse team of oceanographers, microbial ecologists, and marine ecologists.

Research strength

Designing and developing innovative microbial tools and methodologies to study the influence of shifting environmental conditions on aquatic micro-organisms.

Mission

Tools and knowledge to sustain and maximise marine ecosystems, while conserving biodiversity and reducing environmental impacts.



Awards and Achievements



2024 NSW Young Tall Poppy | Dr Elliot Scanes

The Young Tall Poppy Science Award is presented by the Australian Institute of Policy and Science and celebrates outstanding early-career researchers who excel in both scientific achievement and communication. Elliot's research addresses significant challenges in marine food security and emphasises the significance of aquaculture as sustainable food source as we head toward a climate change affected future.

UNESCO Global Ocean Oxygen Network (GO2NE) working group | Dr Ariel Pezner

As a member of the GO2NE working group, Ariel is contributing to the development of scientific knowledge regarding the impacts of increased deoxygenation in marine ecosystems.

2024 Alma Dal Co award | Dr Jean-Baptiste Raina

The Alma Dal Co award recognises early career researchers who have made significant contributions to microbial ecology, with JB recognised for his innovative approaches to uncovering crucial microbial interactions in marine environments.

4th Assessment of the State of the Ocean, UN Report | Dr Emma Camp

Emma's contribution as an author on the Coral Reef chapter offered a brief, accessible, one-stop overview of the current state of the worlds coral reefs. This flagship report provides a comprehensive and evidenced based assessment of the challenges they face and what action is needed to secure their future.

UTS Global Game Changers - The Big Carbon Rethink | Dr Alex Thomson & Prof. Peter Ralph

A panelist alongside Craig Reucassel (ABC), Gunter Beitinger (Siemens), Amy Low (Piping Hot), and Julia Reisser (Uluu), Alex and Peter discussed how we are repurposing carbon into stuff that we want and use every day; reaching an audience across 50+ countries.

Intergovernmental Oceanographic Commission Working Group on Climate Change and Global Trends of Phytoplankton in the Ocean | Prof. Martina Doblin

As a member of the working group, Martina is contributing to the global effort to understand phytoplankton responses to climate change and other stressors such as anthropogenic activities, ocean acidification, climate change and their interactions.

Finalist for the Collaborative Research Award with Anindilyakwa Land Council Land and Sea Rangers | Dr Emma Camp, Hadley England, Dane Wattle

The award recognises C3's partnership with the Anindilyakwa Land Council Land and Sea Rangers in the Northern Territory, exploring coral diversity and resilience around Groote Island.

Jean-Baptiste Raina Recognised with the 2024 Alma Dal Co Award

Jean-Baptiste (JB) Raina, ARC future fellow and Deputy Team Leader of the Ocean Microbiology Group at the UTS Climate Change Cluster (C3), has been honoured with the 2024 Alma Dal Co Award from the International Society for Microbial Ecology (ISME).



The **Alma Dal Co** award champions early career researchers who have made significant contributions to microbial ecology.

To elucidate crucial microbial interactions in marine environments, JB has developed a custom made in-situ device to analyse symbiotic microbial interactions at spatiotemporal scales relevant to microbial cells. This new methodology has been widely adopted by the microbial community worldwide, leading to major breakthroughs which include:

- In situ chemotaxis assay: a groundbreaking platform enabling the study of microbial behaviour directly in the ocean

- Micro-volume DNA Extraction: a technique that allows for an accurate characterisation of microbial communities from minimal seawater samples
- Single-cell Nutrient Exchange Quantification: providing detailed insights into microbial interactions at the cellular level.

As Deputy Team Leader in the Ocean Microbes group, JB has been an integral part of the Climate Change Cluster since 2014. His mentoring of our PhD and Early Career Researchers will continue to generate breakthrough results, continuing to establish C3's leadership within marine symbiosis research.

Algenie Teams Up with UTS to Launch Algae Biotech Innovation Aimed at Combating Climate Change



Built on cutting-edge research from C3 and the University of Technology Sydney (UTS), **Algenie**, a newly formed biotech startup, aims to commercialise an innovative algae cultivation platform with the potential to generate vital raw materials for sustainable plastics and biofuels.



With \$1.1 million in early-stage funding secured from strategic investors, Algenie is on track to launch its future production facility aimed at addressing climate change and replacing fossil fuels.

Algae absorbs carbon dioxide (CO₂) as it grows, outpacing all other organisms in carbon capture.

By harnessing the biology of algae as renewable energy-powered reactors, Algenie envisions a future where fossil fuels are replaced with algae-derived materials for plastics and fuels—significantly reducing greenhouse gases in the process.

In partnership with UTS, Algenie is working closely with the university's researchers, including Associate Professor Mathieu Pernice, to utilise its advanced biological resources and automation systems within the C3 facility. This collaboration will enable the rapid development and optimisation of algae strains for large-scale production.



Future Reef X UTS Rapido Team up to Develop Innovative Coral Testing System

The Future Reef team at C3 have partnered up with UTS Rapido to develop an innovative tech solution, designed to help to protect coral species from the effects of climate change - the fruits of a UTS collaboration grant.

As the threat of climate change looms, rising sea temperatures threaten the health and vitality of coral reefs worldwide. Understanding how thermal stress affects coral systems is a crucial factor in predicating the effects of climate change on coral reefs, and selecting for more resilient species.

In a vision to advance phenotyping and thermal resilience testing, C3's Future Reef group and UTS Rapido have designed a state-of-the-art modular coral bath system which can monitor coral health under a variety of environmental conditions.

The project to develop the Modular Multi-Taxa Phenolator (MTP) prototype was lead by Hadley England, a PhD student at C3. Recognising a gap in the field, Hadley noted that new tools were needed to adequately research thermal tolerance and select for resilient coral species in reef restoration.



With guidance from Dr Andrei Herdean, an expert in photosynthesis and temperature regulation, the MTP prototype operates using a technology popular in algae phenotyping that had not been applied to marine science in the past.

The system allows for precise temperature control and rapid assessment of coral populations' resilience to future ocean conditions, ensuring the team can identify and focus on those best suited to survive.

The UTS Rapido innovation hub was founded in 2016 as an incentive to build a stronger relationship between academia and industry, particularly across the healthcare, infrastructure and sustainability sectors.

The MTP system leverages the strengths of both entities. Rapido's mechatronics team excel in innovative engineering and, in collaboration with Future Reef's expertise in advanced marine science, the project is an exciting development in coral reef restoration efforts and is expected to have a significant impact on the future of marine sustainability and coral conservation in Australia.

Events

23rd
March

Volvo Ocean Lovers Festival - Can our Reefs Save Themselves?

As part of the 2024 Volvo Ocean Lovers Festival, Dr Elliot Scanes and Dr Emma Camp discussed the survival strategies and evolutionary traits that help reefs survive during ongoing climate change and rapid heating events, and conversely, how science and conservation need to intervene to help protect them.

24th
April

Algae Business Summit | White Paper Launch

The White Paper Launch marked the culmination of collaborative efforts aimed at exploring and advancing the potential of the Australian algae industry. The event served as a platform to unveil the insights gained from the Australian Algae Business Summit. Developed in close collaboration with industry stakeholders and summit attendees, the white paper titled "Unlocking the Growth and Innovation of the Australian Algae Industry" provided comprehensive documentation of findings, challenges, and recommendations to propel the industry forward.

13th
August

Impact Showcase: Future Reefs

This event presented the innovative work undertaken at UTS by the Future Reefs Team. Marine Biologist and Future Reefs Team Leader Dr. Emma Camp discussed how the team's groundbreaking efforts could help preserve and rebuild the "healthy reefs" of tomorrow. Dr. Christine Roper, a postdoctoral researcher, then shared insights into how the use of innovative technology, combined with collective community action, contributed to the successful restoration of high-value reef sites like the Great Barrier Reef.

11th
October

Green Light Pitch Showcase 2024

The Green Light accelerator program is dedicated to supporting the development of algae based biotech solutions across a range of industries in NSW. Green light followed the progress of four start-ups, providing entrepreneurial support, mentorship from leading algae experts at C3 and seed funding.

The pitch showcase was an opportunity for the teams to share their progress with a like-minded, innovative audience.

16th
October

SXSW Sydney Industry Breakfast: Spotlight on Algae

Distinguished Professor Peter Ralph discussed how C3's Algae Biosystems and Biotechnology (ABB) group's work extended beyond the lab to build greener industries. Dr. Sana Malik spoke about UTS's new commercial microalgae biobank, a development poised to revolutionize algae biotechnology.



C3 Seminar Series

Tanai Cardona Londono

Reader/UK Research and Innovation Future Leaders Fellow, Queen Mary University of London, "The evolution and evolvability of photosynthesis"

Dr. Angela Falciatore

Director, Department of Chloroplast Biology and Light sensing in Microalgae, Institut de Biologie Physico-Chimique (IBPC) Paris, France, "Light-driven processes: key players of the functional biodiversity of marine diatoms"

Prof. Florence Elias

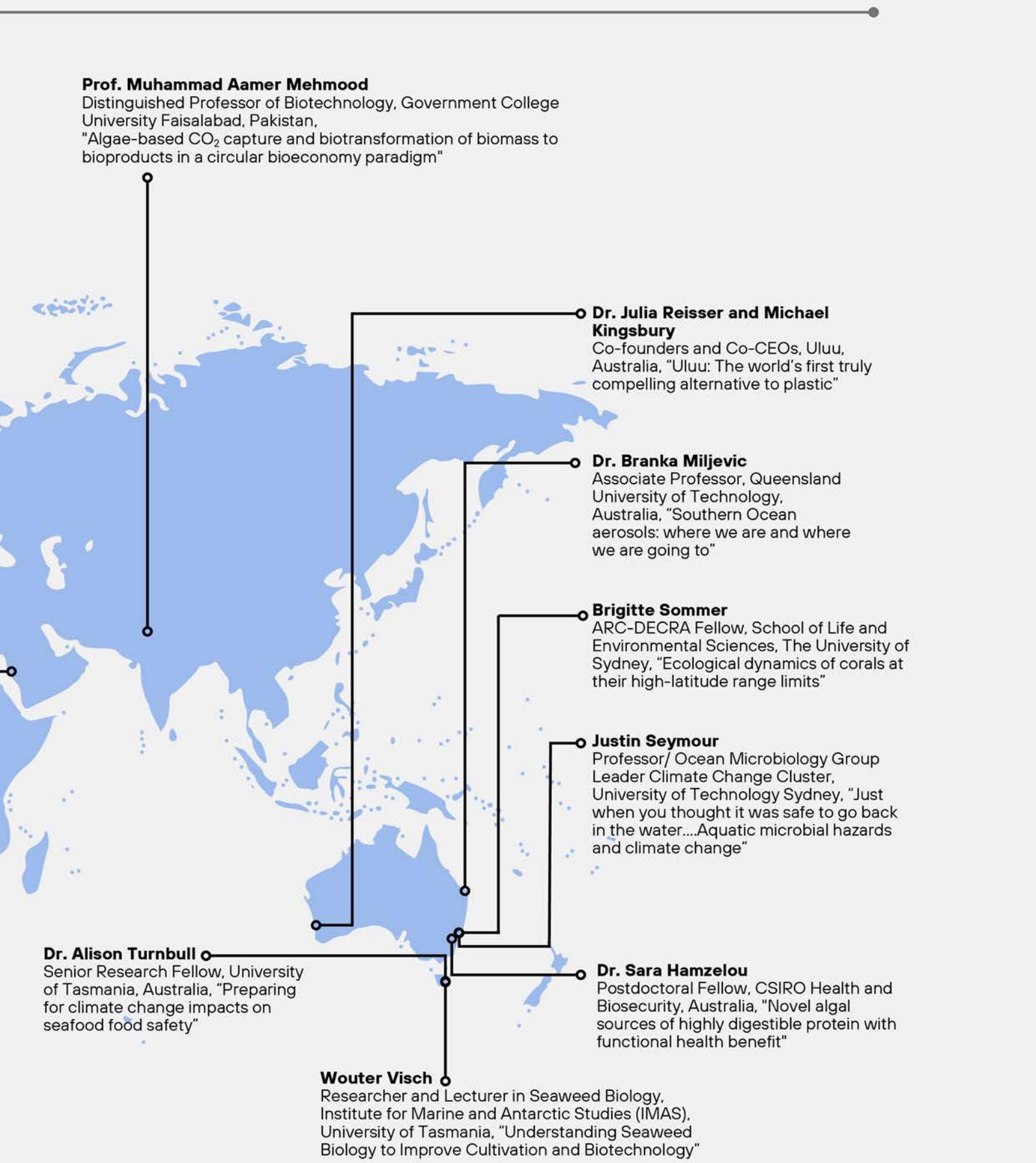
Professor, Université Paris Cité, France, "Marine foam: capture of phytoplankton in foam"

Dr. Dana Hunt, Associate

Professor of Microbial Ecology, Duke University, USA
"Microbes as sentinels of changing oceans"

Prof. David J Suggett

Professor of Marine Biology, King Abdullah University of Science and Technology, KSA
"Transforming at scale restoration via industry 4.0 to aid ecological recovery of coral reefs"



Prof. Muhammad Aamer Mehmood

Distinguished Professor of Biotechnology, Government College University Faisalabad, Pakistan, "Algae-based CO₂ capture and biotransformation of biomass to bioproducts in a circular bioeconomy paradigm"

Dr. Julia Reisser and Michael Kingsbury

Co-founders and Co-CEOs, Uluu, Australia, "Uluu: The world's first truly compelling alternative to plastic"

Dr. Branka Miljevic

Associate Professor, Queensland University of Technology, Australia, "Southern Ocean aerosols: where we are and where we are going to"

Brigitte Sommer

ARC-DECRA Fellow, School of Life and Environmental Sciences, The University of Sydney, "Ecological dynamics of corals at their high-latitude range limits"

Justin Seymour

Professor/ Ocean Microbiology Group Leader Climate Change Cluster, University of Technology Sydney, "Just when you thought it was safe to go back in the water...Aquatic microbial hazards and climate change"

Dr. Alison Turnbull

Senior Research Fellow, University of Tasmania, Australia, "Preparing for climate change impacts on seafood food safety"

Dr. Sara Hamzelou

Postdoctoral Fellow, CSIRO Health and Biosecurity, Australia, "Novel algal sources of highly digestible protein with functional health benefit"

Wouter Visch

Researcher and Lecturer in Seaweed Biology, Institute for Marine and Antarctic Studies (IMAS), University of Tasmania, "Understanding Seaweed Biology to Improve Cultivation and Biotechnology"

C3 Staff and Students

Team Leaders



Director
Peter Ralph



Deputy Director
Mathieu Pernice



**Team Leader
Future Reefs**
Emma Camp



**Team Leader
Productive Coasts**
Martina Doblin



**Team Leader
Ocean Microbiology**
Justin Seymour

Academic Staff + Students

Senior Research Fellow

Andrei Herdean
Jean-Baptiste Raina
Unnikrishnan Kuzhiumparambil

DECRA Research Fellow

Elliot Scanes

Chancellor's Postdoctoral Research Fellow

Ariel Pezner
Jennifer Matthews
Phong Vo

Postdoctoral Research Fellow

Nahshon Siboni
Nature Poddar
Rose Nyugen
Vishal Gupta
Chris Songsomboon

Postdoctoral Research Associate

Amaranta Focardi
Maeva Brunet
Paige Strudwick
Sana Malik
Stalin Kondaveeti
Wyatt Million

Higher Degree Research Students

Aaron Wright
Abeeha Khalil
Alexandra Skeer
Amanda Grima
Bhuwan Ghimire
Caitlin Younis
Chantal Philippe
Christine Roper
Colin Lock
Emma Fineran
Farjana Akter
Gemma Gilette
Giselle Firme
Hadley England
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Joan Labara Tirado
Justin Tierney
Kira Picknell
Kathryn Cobleigh
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Raissa Gill
Sanna Eriksson
Sidaswar Krishnan
Shintu Varghese
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Anna Tevaga

Breanna Osborne

Clem Ehret

Fiona Shadwick

Isaac McElhinney

Loc Nguyen

Lucia Bennar

Melyssa van der Splinter

Natalie (Lji) Radojcic

Paris Hanan

Thai Bach (Eric) Luong

Partnerships



Australian Government
Great Barrier Reef
Marine Park Authority



Planning and
Environment

**YOUNG
HENRYS**



UNITED NATIONS DECADE ON
**ECOSYSTEM
RESTORATION**
2021-2030



FOR CLEAN OCEANS

**marine
bioproducts**
cooperative research centre



MEAT & LIVESTOCK AUSTRALIA



National
**Environmental
Science
Programme**





Key Publications

Biomasonry products from macroalgae: A design driven approach to developing biomaterials for carbon storage

Journal of Applied Phycology 36 (2), 935-950

Kate Scardifield, Nahum McLean, Unnikrishnan Kuzhiumparambil, Peter J Ralph, Nicolas Neveux, Geoff Isaac, Tim Schork

Carbonate budgets induced by coral restoration of a Great Barrier Reef site following cyclone damage

Frontiers in Marine Science 10, 1298411

Isabel Nuñez Lendo, David J Suggett, Chloë Boote, Alicia McArdle, Freda Nicholson, Eric E Fisher, David Smith, Emma F Camp

Coral reef protection is fundamental to human rights

Global Change Biology 30 (9), e17512

EF Camp, I Braverman, G Wilkinson, CR Woolstra

Emerging diseases in Australian oysters and the challenges of climate change and uncertain futures

Australian Zoologist 44 (1), 185-193

Elliot Scanes, Wayne A O'Connor, Justin R Seymour, Nachshon Siboni, Laura M Parker, Pauline M Ross

Increased abundance of potentially pathogenic *Vibrio* and a marine heatwave co-occur with a Pacific oyster summer mortality event

Aquaculture 583, 740618

Nachshon Siboni, William L King, Nathan LR Williams, Elliot Scanes, Marco Giardina, Timothy J Green, Martin Ostrowski, Wayne O'Connor, Michael Dove, Maurizio Labbate, Justin R Seymour

Mussel-inspired resilient hydrogels with strong skin adhesion and high-sensitivity for wearable device

Nano Convergence 11 (1), 12

Stalin Kondaveeti, Geonjun Choi, Sarath Chandra Veerla, Somi Kim, Jaell Kim, Hee Jin Lee, Unnikrishnan Kuzhiumparambil, Peter J Ralph, Junyeob Yeo, Hoon Eui Jeong

Restoration as a meaningful aid to ecological recovery of coral reefs

Ocean Sustainability 3 (1), 20

David J Suggett, James Guest, Emma F Camp, Alasdair Edwards, Liz Goergen, Margaux Hein, Adriana Humanes, Jessica S Levy, Phanor H Montoya-Maya, David J Smith, Tali Vardi, R Scott Winters, Tom Moore

Seaweed-based polysaccharides—review of extraction, characterization, and bioplastic application

Green Chemistry 26 (10), 5790-5823

Lakshmi Krishnan, Nandhini Ravi, Anjon Kumar Mondal, Farjana Akter, Manoj Kumar, Peter Ralph, Unnikrishnan Kuzhiumparambil

Swimming towards each other: the role of chemotaxis in bacterial interactions

Trends in Microbiology 32 (7), 640-649

JR Seymour, DR Brumley, R Stocker, JB Raina

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