UTS Climate Change Cluster

Ocean Microbes and Healthy Oceans

Opportunities for Impact

Our Team

We are a diverse group of oceanographers, microbial ecologists, and marine biologists investigating the diversity, function, and interactions of aquatic microorganisms and their influence on oceanographic processes to develop a better perception of the influence of marine microorganisms on marine ecosystems and industries and their impact on human health.

We deeply believe in promoting both ecological and economic sustainability. Our research values align with the values articulated in the UTS 2027 strategy, which supports the establishment of partnerships to drive economic, social and cultural prosperity of our community.

UTS's Sustainability Policy affirms the principles of the United Nations' Sustainable Development Goals (SDG), which constitute 'the blueprint to achieve a better and more sustainable future for all'. Our work aligns with goals 6, 13 and 14 of the SDG.

Our Impact

Australia's coastal ecosystems feature more than 10,000 beaches and 1,000 estuaries, which provide ecosystem services valued at over $895 billion. They host diverse communities of marine plants and animals and act as important nurseries for commercially important fish species.

These environments also deliver considerable cultural and societal value to Australia's population. In Sydney alone, there are more than 40 million beach trips a year, resulting in over $480 million per year in economic activity.

However, large parts of Australia's coastline are highly urbanised, resulting in anthropogenic pressures that are having detrimental impacts on this precious environment. Among these, impaired water quality can have adverse implications for ecosystem function, human coastal activities (e.g. fishing, aquaculture, recreation) and public health. We are dedicated to contributing new knowledge to guide on-ground management and protection of Australia's marine environments.

Team Leaders

Prof. Justin Seymour

ORCID ID: 0000-0002-3745-6541

I am the team leader of the Ocean Microbiology Group in the Climate Change Cluster (C3) at UTS. The over-arching goal of my research is to understand how the seas smallest inhabitants ultimately control the ecology and biogeochemistry of the Ocean.

My research interests incorporate aquatic microbial ecology and biological oceanography, and my research team tackles the important questions of who are the key microbial populations in different ocean ecosystems, and what they are doing?

To answer these questions, I guide my team in examining the ecology of microbes across a range of marine environments (tropical coral reefs to Antarctica). We investigate large-scale oceanographic processes down to a scale of individual drops of seawater, to consider the influence microbial community dynamics and functionality within a diverse and patchy chemical seascape.

Dr. Jean-Baptiste Raina

ORCID ID: 0000-0002-7508-0004

I am an ARC Future Fellow and Deputy Team Leader of the Ocean Microbiology group in the Climate Change Cluster (C3) at UTS.

I work on marine symbiotic interactions (e.g., corals, phytoplankton) and study the processes relevant to microbial cells. I have expertise in utilising a range of molecular and analytical chemistry techniques, high-resolution imaging and custom-made in-situ devices to study ocean microbial interactions and the changes that occur across time and space simultaneously.

My research aims to bridge the gap between the micro scale – where microbial processes occur, and ocean scales – where the effects of these processes are typically reported.

UTS2027

UTS 2027 has set UTS's vision for the next decade: to be a leading public university of technology recognised for delivering global impact.

UTS will establish partnerships in climate mitigation and adaptation to drive the economic, social and cultural prosperity of our communities. C3 will drive with UTS as a world-leading university by advancing knowledge and learning through research-inspired teaching, research with impact and partnerships with industry, the professions and the community.

C3 has a strong track record of forming industry links and using technology to develop innovative climate mitigation strategies, as well as delivering research excellence in the fundamental sciences relevant/linked to human and environmental health.

Facilities

Our team has access to an array of world-class facilities, from a high-end PC2 molecular biology labs to field-ready equipment, including:

Ecogenomics and Molecular Microbial Ecology

Substantial capacity in metagenomics, amplicon sequencing, quantitative PCR, flow cytometry, and microscopic techniques.

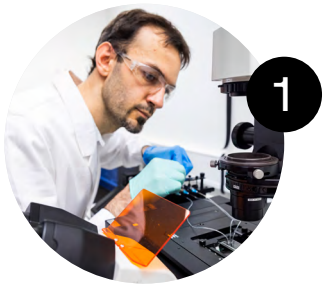
Microbiome Analysis Facilities

Capacity to define the structure and function of the microbiome associated with a wide range of organisms and environments.

Microbial Source-tracking Facilities

The application of quantitative tools to elucidate the causes and sources of contamination within aquatic environments.

Examples of Our Research Impact



GORDON AND BETTY MOORE FOUNDATION

Gordon and Betty Moore Foundation

Marine Microbiological Initiative

This project collaborated with the Gordon and Betty Moore Foundation to pioneer a new way of examining ocean microorganisms. We developed microscale experiments to understand a microscale world.

Microbial behaviours and interactions represent fundamental ecological relationships in the ocean. For example, chemical stimulus can alter microbal behaviour which can play a pivotal role in coral infection processes. Hence, we developed innovative microfluidic technology and bioinformatic approaches which enabled the unprecedented examination of microscale metagenomic and metatranscriptomic's of ocean microbial communities.

Our work has been pivotal in understanding how ocean microbes exploit chemicals, and demonstrating the ecological interactions that affect reef and ocean health.

NSW GOVERNMENT Planning & Environment

Microbial Source Tracking

Rose Bay

This project is an exciting collaboration that brought together university-based researchers, the NSW Department of Planning and Environment, and Central Coast Council to develop innovative techniques to pinpoint sources of water contamination in Rose Bay.

Microbial source-tracking is a unique approach using molecular biological and DNA sequencing techniques to distinguish the origins of contamination sources, improving the capacity to identify and resolve the causes of coastal pollution. This new technique allowed us to pinpoint the regions of significant sewage contamination in Rose Bay. The knowledge generated directly informed the key water quality strategy "Towards Safer Swimming – Rosebay: Stormwater Catchment Audit". The research resulted in significant improvements in the practical management and protection of Australia's natural environment.

Central Coast Council

Microbial Source Tracking

Terrigal Beach

The Ocean Microbes and Healthy Oceans team, in collaboration with the NSW Department of Planning and Environment and Central Coast Council, set out to address ongoing water remediation issues at Terrigal beach.

By using innovative microbial source tracking techniques, we determined water contamination was primarily influenced by sewage rather than animal faeces and the key drain networks significantly contributing to poor water quality.

These findings were used to directly advise government action, resulting in the "Towards Safer Swimming – Terrigal Beach" document produced by the NSW Department of Planning and Environment. This project has had a significant positive impact on the community, improving transparency and accessibility to information regarding remediation occurring in the sewer network.

Impaired water quality can have adverse implications for ecosystem function, human coastal activities and public health.

Responding to Change

The Australia coastal ecosystem is comprised of 10,000 beaches and 1,000 estuaries, which are home to diverse communities of marine plants and animals.

However, with a large proportion of Australia's population living in coastal locations, our coastlines are highly urbanised, resulting in anthropogenic pressures that are having detrimental impacts on these precious environments. Amongst these, impaired water quality can have adverse implications for ecosystem function, human coastal activities (e.g. fishing, aquaculture, recreation) and public health.

In Sydney alone, it is estimated poor water quality contributes to 180,000 illnesses a year. Additionally, variations in climate events is further exacerbating the problem. For instance, heavy rain events have been shown to significantly reduce water quality, resulting from increased sewage runoff from drainage networks.

We have identified these emerging issues require innovative solutions to transform the capacity of environmental monitoring and management, in efforts to safeguard Australian aquatic ecosystems and human health.

Our Approach

We focus on designing and developing innovative tools, methodologies, and techniques to study the influence of shifting environmental conditions such as pollution and climate change processes on aquatic microorganisms in the marine environment.

Our mission is to provide knowledge and tools that will help enhance and sustain marine ecosystems and maximise the benefits of the world's oceans, whilst mitigating environmental impacts and conserving marine biodiversity.

We have assembled an outstanding team, which incorporates an excellent balance of expertise spanning from academia and government/industry stakeholders, guaranteeing translation of our research into highly relevant broader benefits.

Opportunities for Impact

Microbial Indicators

Defining causes of aquatic contamination

In Sydney alone, it is estimated poor water quality contributes to 180,000 illnesses a year. However, current standard water quality indicators lack the precision to unambiguously identify sources of contamination, hindering efforts to mitigate pollution and protect the community. In response our team is developing novel DNA sequencing technologies to develop a suite of new quantitative water quality indicators that will be applied to precisely determine the causes of poor water quality in key aquatic ecosystems.

This research will deliver a transformative capacity for environmental managers to actively monitor and manage water quality, and thereby safeguard Australian aquatic ecosystems and human health.

$1,000,000
over 3 years

Coastal Water Quality Monitoring

Safeguarding our coasts

Key to community safety in coastal areas is the fast detection of water quality. Currently, there are a lack of rapid detection tools available resulting in significant lag time of results. However, our research has displayed the influence weather events such as heavy rain, have on contamination. So how do we keep up with detecting levels of water contamination as rapidly as the weather changes?

To answer this, we are developing fast detection tools to improve the capacity of councils, communities and their members e.g. our local lifesavers, to regularly monitor water quality, to safeguard coastal community's health.

$800,000
over 3 years

Oyster Health and Disease Monitoring

Preserving the value of Australian aquaculture

The Australian oyster aquaculture industry is valued at over $100 million/year, however this industry and its value is threatened by oyster disease that causes mass oyster mortality events. We have witnessed the crippling effects of oyster disease in Australia, however there is still a way to go in understanding the culprit (Oyster pathogens).

Our work to date has been pivotal, revealing new clues regarding the potential pathogens and environmental triggers causing oyster mortality events. Our work brings together the NSW Department of Primary Industries, NSW Department of Planning and Environment, NSW EPA and the Australian oyster aquaculture industry.

Therefore this project has the potential to guide monitoring and management efforts to safeguard this valuable Australian aquaculture industry.

$800,000
over 3 years

UTS Climate Change Cluster

Further information

If your passion aligns with the Ocean Microbes and Healthy Oceans Team there is opportunity to be involved via partial, full or similar themed funding.

For more detail about the content of this proposal, please contact: Dr Alex Thomson, C3 Industry Engagement Manager, **Alexandra.Thomson@uts.edu.au**

c3.uts.edu. au