AIMS

Australia's tropical marine research agency

In Focus

2022 – 2023

Australian Government

Australian Institute of Marine Science

Mission

To provide the research and knowledge of Australia's tropical marine estate required to support growth in its sustainable use, effective environmental management and protection of its unique ecosystems.

Values

SAFETY
Care for ourselves and others in all that we do

COLLABORATION
Together we create impact

RESPECT
Treat everyone with dignity, value diversity, support others

PASSION
Energy that inspires excellence

INTEGRITY
Always transparent, ethical and objective

INNOVATION
Vision and creativity to solve big challenges

ENVIRONMENT
Minimise our footprint

Cover Photo: Violeta Jahnel Brosig

Locations and assets

#1 marine science institution in the world*

2022/2023 IN BRIEF

Australian Government

Australian Institute of Marine Science

Field Operations

TROPICAL NORTHERN AUSTRALIA

42,400 NAUTICAL MILES STEAMED

1,675 SCIENCE FIELD DAYS INCLUDING CHARTERS

4,891 NUMBER OF DIVES

293 COLLABORATORS ON FIELD TRIPS

11,358 RESEARCHER FIELD DAYS

Environmental Performance

25% ↓ REDUCTION IN CARBON EMISSIONS ACROSS OUR OPERATIONS*

26% ↓ REDUCTION IN SOLID WASTE TO LANDFILL*

*FROM BASELINE YEAR

National Facility

Initiation & conceptual design phases complete for SeaSim. Construction commenced.

$36.3m OVER 3 YEARS

Science Output

200 PEER REVIEWED JOURNAL ARTICLES

57% IN INTERNATIONAL COLLABORATION PUBLICATIONS

40% IN NATIONAL COLLABORATION PUBLICATIONS

Safety Performance

TOTAL RECORDABLE INJURY FREQUENCY RATE (TRIFR)

10% BETTER THAN TARGET

INJURY SEVERITY RATE

14% BETTER THAN TARGET

Finances

$62.9m APPROPRIATIONS

$52.8m EXTERNAL REVENUE

$108m TOTAL EXPENSES

Science Impact

> $200m ECONOMIC RETURN ESTIMATE

≥ 5x RETURN ON GOVERNMENT INVESTMENT

*Benchmarking by Clarivate Analytics InCites research analytical tool, as at 21 July 2022. Organisations with >200 Web of Science documents in the field of marine and freshwater biology for the period 2017-2021

AN EYE ON OUR TROPICAL OCEANS: LONG-TERM BIODIVERSITY AND WATER QUALITY MONITORING

Long-term Monitoring Program

Our Long-term Monitoring Program for the Great Barrier Reef (GBR) is the world's longest record of change in coral reefs tracking coral and fish populations, crown-of-thorns starfish outbreaks, and the effects of cyclones and coral bleaching.

Great Barrier Reef Marine Monitoring Program

AIMS continues to implement the Marine Monitoring Program led by the GBR Marine Park Authority. Our team records water quality, hard and soft coral cover, macroalgae and coral recruitment on over 30 inshore reefs.

MARINE SCIENCE SOLUTIONS: REEF RESTORATION INITIATIVES

RRAP

Reef Restoration and Adaptation Program

RRAP brings together the best in marine STEM to develop large scale reef interventions for the Great Barrier Reef that are cost-effective, practical, safe and acceptable.

ACRRI

Australian Coral Reef Resilience Initiative

ACRRI uses an ecosystems approach to simultaneously research underwater acoustics to help rebuild fish populations, and develop coral seeding technologies for more resilient reefs.

BLUE TECHNOLOGY: INNOVATION IN MARINE SCIENCE

ReefWorks

ReefWorks is Australia's tropical marine technology test range, enabling Australian innovators to study new marine technologies, autonomous systems and sensors in a real-world environment. Twenty-one events were conducted in 2022/23 supported by about $640k external investment.

ReefScan

A suite of technology-based solutions for coral researchers to conduct in-field marine observations.

ReefCloud

ReefCloud is a cutting-edge data platform that incorporates machine learning to inform decisions by reef managers.

Photo: Roslyn Budd

Fast-tracking algae evolution to increase reef resilience

Breeding heat-tolerant algae may help protect corals from the effects of marine heatwaves

Marine heatwaves put coral reefs under stress by disrupting the symbiotic relationship between corals and the microalgae that live within the coral tissue. These algal symbionts produce sugars that are a vital food source for coral polyps and give coral some of its colour. Heat stress causes algae to become toxic to their coral hosts, which expel them, leading to coral bleaching.

AIMS researchers are breeding algal symbionts for greater heat tolerance, to help coral polyps become more resilient to heatwaves. To achieve this, researchers isolate the algae from the coral tissue, cultivate them at higher temperatures and use laboratory selection to speed up their evolutionary tolerance to increased temperatures. They do this by exposing multiple generations of the algae to elevated temperatures over a period of several years. This process has increased heat tolerance in the resulting algal cultures. When the algae are reintroduced into corals, they may increase coral bleaching tolerance under heat stress.

Heat-evolved symbionts were introduced into adult fragments of the coral species *Galaxea fascicularis* that had first been chemically bleached, showing

Photos: Wing Chan

their ability to form a symbiotic relationship with the adult corals. The new coral-symbiont pairs were more tolerant to bleaching when exposed to heat, and recovered faster from bleaching compared to corals with symbionts that were not evolved in the lab. This research and other experiments have also shown that inoculating coral with heat-evolved symbionts does not compromise its growth, as is often seen with naturally heat-tolerant symbionts.

The research is a collaboration between AIMS, the University of Melbourne, Monash Institute of Pharmaceutical Sciences and the Melbourne Centre for Nanofabrication. It is funded by the Australian Research Council, the Paul G. Allen Family Foundation and the Reef Restoration and Adaptation Program, which is funded by the partnership between the Australian Government's Reef Trust and the Great Barrier Reef Foundation.

Researchers hope that heat-evolved algal symbionts could be a method for use in reef restoration, providing an effective and sustainable strategy to help coral reefs withstand increasingly frequent marine heatwaves.

Field trials are underway to test this outside of the laboratory.

The research aligns with the AIMS Strategy 2030 to regenerate or repair marine ecosystems in northern Australia and deliver social and economic net benefits for tropical Australia.

Photos: Wing Chan

Coral spawning research shared on sea Country

Traditional custodians help fast-track reef recovery coral aquaculture techniques

Traditional custodians are playing an increasingly important role in helping to manage coral reef ecosystems against the impacts of climate change. Since 2019 AIMS researchers have been working with members of the Woppaburra community to understand reef processes, including training in coral aquaculture and reef restoration techniques. The community's sea Country includes the Keppel Islands located in the inshore Southern Great Barrier Reef.

In the past year, the project has been on Country investigating the pros and cons of rearing coral babies using two methods: in large, enclosed tanks in a laboratory or in floating nurseries in the ocean. Using a floating laboratory (a converted car ferry) researchers have learnt more about the technical challenges of coral spawning and coral seeding processes while at sea. The second method keeps baby corals in the ocean while they develop, before being released onto reefs that need a population boost. This research complements work done in previous years of the project in the AIMS National Sea Simulator.

The Woppaburra Coral Project is a seven-year, $27 million research partnership between AIMS, BHP, and the Woppaburra Traditional Custodians. The Woppaburra community have been gaining hands-on experience in marine science and coral seeding techniques. The aim is to build capability and equip community members to manage sea Country in the future – from witnessing and participating in coral

Photo: Jo Huford

spawning activities, assisting with the collection of egg bundles, as well as collecting and culturing wild coral spawn.

Woppaburra descendants have actively maintained cultural connections and responsibilities to land and sea Country in the Keppel Islands. Reefs in this area have endured many disturbances over the years, including marine heatwaves causing mass coral bleaching, floods, and cyclones. Many reefs are in excellent health, but others are degraded and dominated by macroalgae. This makes the area an ideal place to investigate the barriers to reef recovery and to trial reef restoration techniques.

Coral reef restoration science is driven by the need to reverse declines in reef health due to the impacts of climate change.

This science and traditional knowledge-driven restoration approach aims to enhance coral resilience, accelerate natural adaptative processes and replenish coral communities on degraded reefs using coral aquaculture and coral seeding techniques.

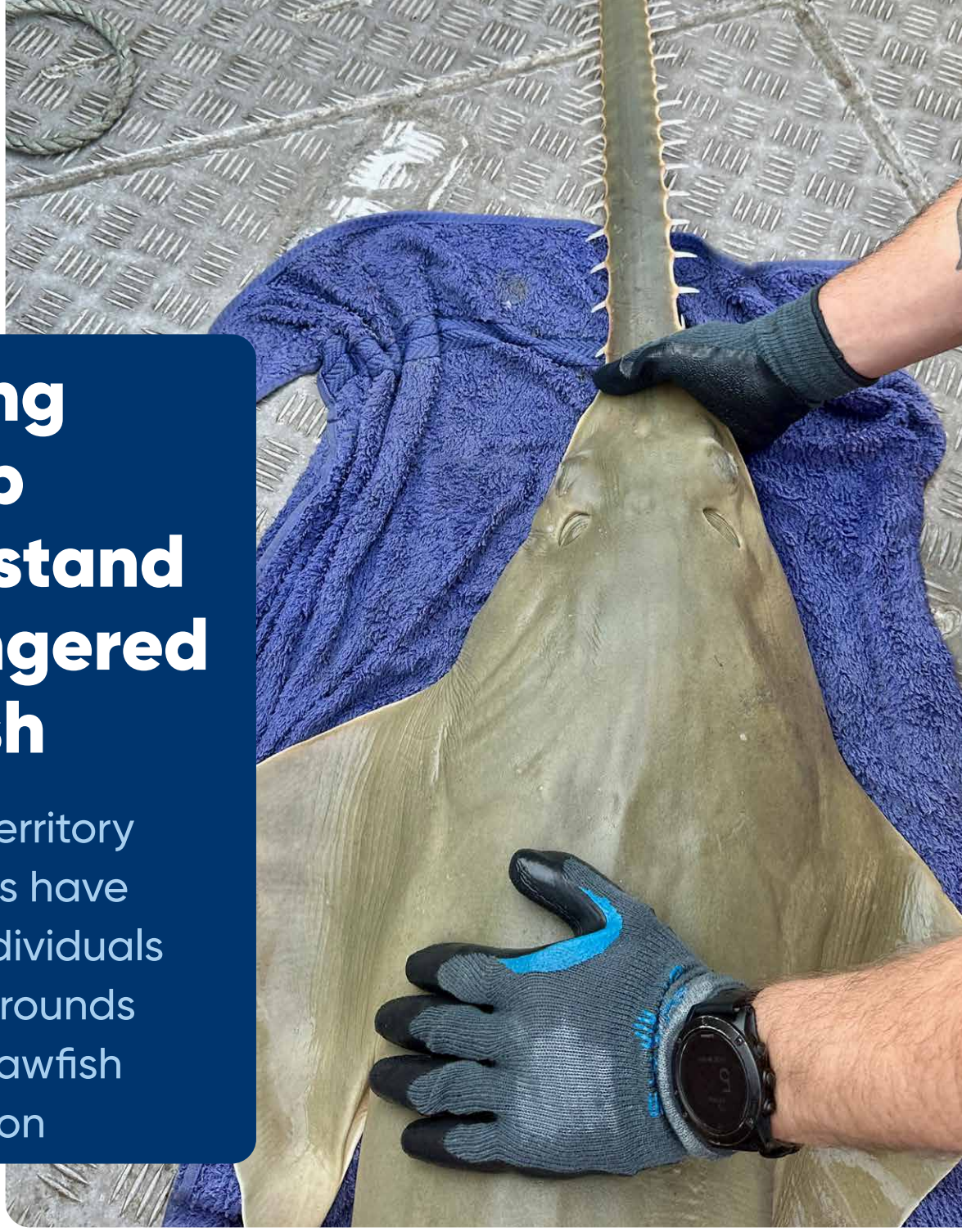
The Woppaburra Coral Project team researches and refines coral seeding – a restoration approach designed to seed or re-introduce corals to accelerate the return of coral cover to disturbed or damaged reefs. They are developing methods which use engineered devices to deliver young corals onto the reef, and investigating how this approach can be scaled to cover large areas. The team examines factors that influence the survival and growth of young corals, to reduce high mortality during their first year of life and boost reef resilience.

This project supports AIMS' Strategy 2030 target to regenerate or repair marine ecosystems in Northern Australia, with 90% of projects on sea Country as Indigenous Partnerships.

Photos: Gus Burrows (top), Kate Green (inset)

Tagging to help understand endangered sawfish

Northern Territory expeditions have tracked individuals in fishing grounds to inform sawfish conservation



Sawfish are a threatened species, but a greater understanding of the population and their movements off Australia's top-end is now possible following field trips that successfully tagged individuals and sourced genetic material. The goal is to understand how this species categorised by the International Union for Conservation of Nature (IUCN) as 'critically endangered', use the habitats in and adjacent to important fishing grounds.

The data collected from the satellite tags will provide AIMS scientists with information about the offshore movement patterns of the sawfish and inform conservation management decisions. It is hoped that genetic samples may provide deeper understanding of how populations in the three bays that were sampled are connected to each other and to other populations in the Northern Territory.

The study benefited from insights provided by professional fishers in 2021 on the lifecycle patterns they noticed while in the field, with regards to juvenile sawfish sightings at different times of the year. The combination of fishers' knowledge, satellite tags and eDNA information provided AIMS researchers with the necessary data to inform managers about the species' lifecycle and behaviour in the three bays surveyed.

During the first trip in 2022 AIMS scientists and a fishing crew from Wild Barra Fisheries' *North Islander* fishing vessel collected data in Buckingham and Arnhem Bays, off the northern coast of Arnhem Land,

Photo: Vinay Udyawer

an area that has not been previously surveyed for sawfish. The team collected genetic samples from 34 juvenile narrow sawfish (*Anoxypristis cuspidata*) over eight days of fishing, and safely captured, tagged and released two adult female narrow sawfishes with satellite tags, as well as collecting genetic samples from them.

The second trip in 2023 resulted in the safe capture, tag, and release of two adult green sawfish (*Pristis zijsron*) and two adult dwarf sawfish (*Pristis clavata*) in Anson Bay and the Daly River region. Genetic samples were also collected.

During both trips water samples were also collected to be tested for the presence of sawfish DNA to identify if any other sawfish species occur in the area.

All three of these species are considered threatened, with the IUCN listing the narrow sawfish as 'endangered' and the green sawfish and dwarf sawfish as 'critically endangered', with the dwarf sawfish now only found in Australian waters.

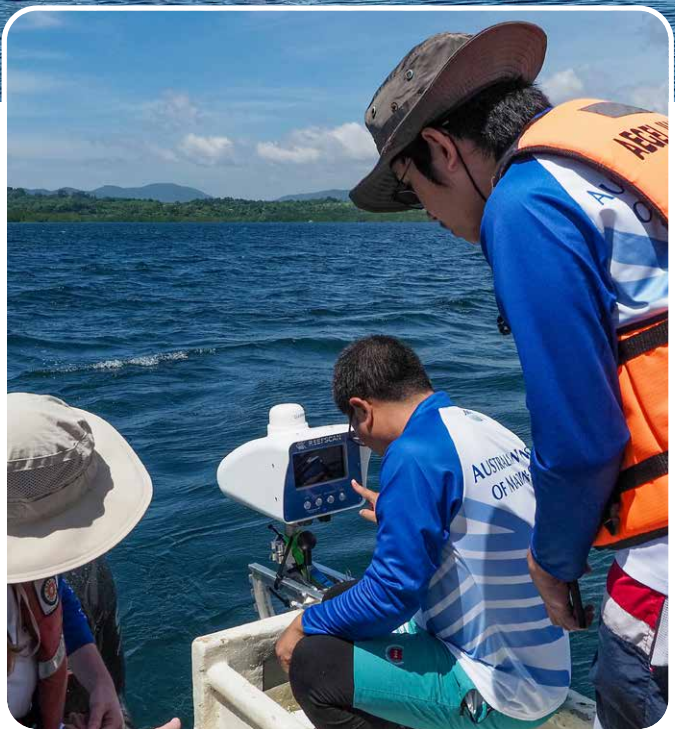
These trips were made possible by a partnership between AIMS, the Northern Territory Seafood Council, the Research Institute for the Environment and Livelihoods, Charles Darwin University and Parks Australia.

The project is supported by Our Marine Parks Grant funding from the Australian Government.

Photos: Donna English

Philippine researchers adopt AIMS reef monitoring technology

Research collaboration is helping to better manage coral reefs



Coral reefs support marine life, provide coastal protection, sustenance and underpin economic and social wellbeing for many communities in the Asia Pacific.

Climate change is accelerating its impacts on coral reefs worldwide, with increasingly frequent and severe coral bleaching events outpacing corals' ability to regenerate and adapt to warmer temperatures.

Protecting coral reefs is a globally shared challenge, especially important in locations where people rely on healthy reefs for their sustenance and livelihoods, and where reefs are of cultural and spiritual significance.

Adaptive management solutions benefitting coral reefs, people and industries that rely on them, need to be based on up-to-date data and knowledge about coral reefs' condition and trends.

Australian expertise and technology for monitoring coral reef habitats is now providing Philippine researchers with the latest information about the condition of their reefs.

In 2023, AIMS scientists introduced coral reef monitoring practitioners from the island province of Palawan, Philippines, to innovative new

Photo: Scott Bainbridge

technologies developed by AIMS, that provide real time information about coral reef condition cost-effectively.

ReefScan Transom is an autonomous device that can be attached to a vessel to take underwater images as the vessel travels. These images are later transferred to ReefCloud for analysis.

ReefCloud is a web-based digital platform that uses artificial intelligence (AI) to analyse underwater images of coral reefs and rapidly extract data about their condition to provide comprehensive, standardised and easily understood reports.

Our Philippine partners were trained to use the technology, and a Reefscan Transom system was provided to the Palawan Council for Sustainable Development (PCSD).

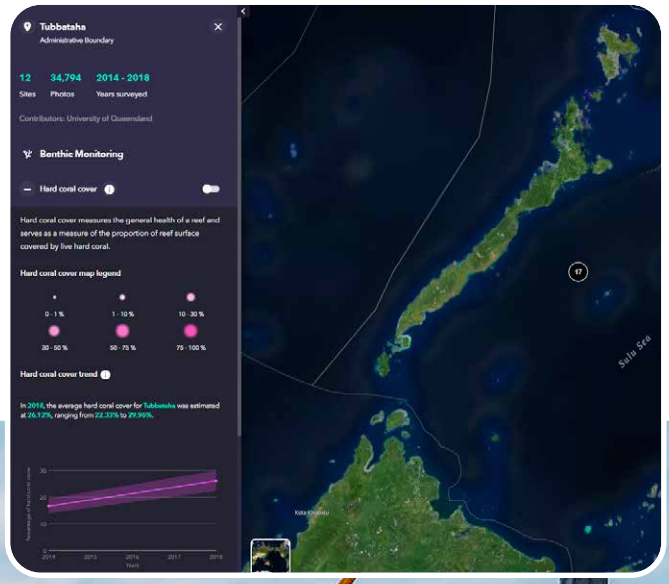
ReefScan and ReefCloud will improve the Palawan Council for Sustainable Development's reef monitoring activities by providing more rapid information.

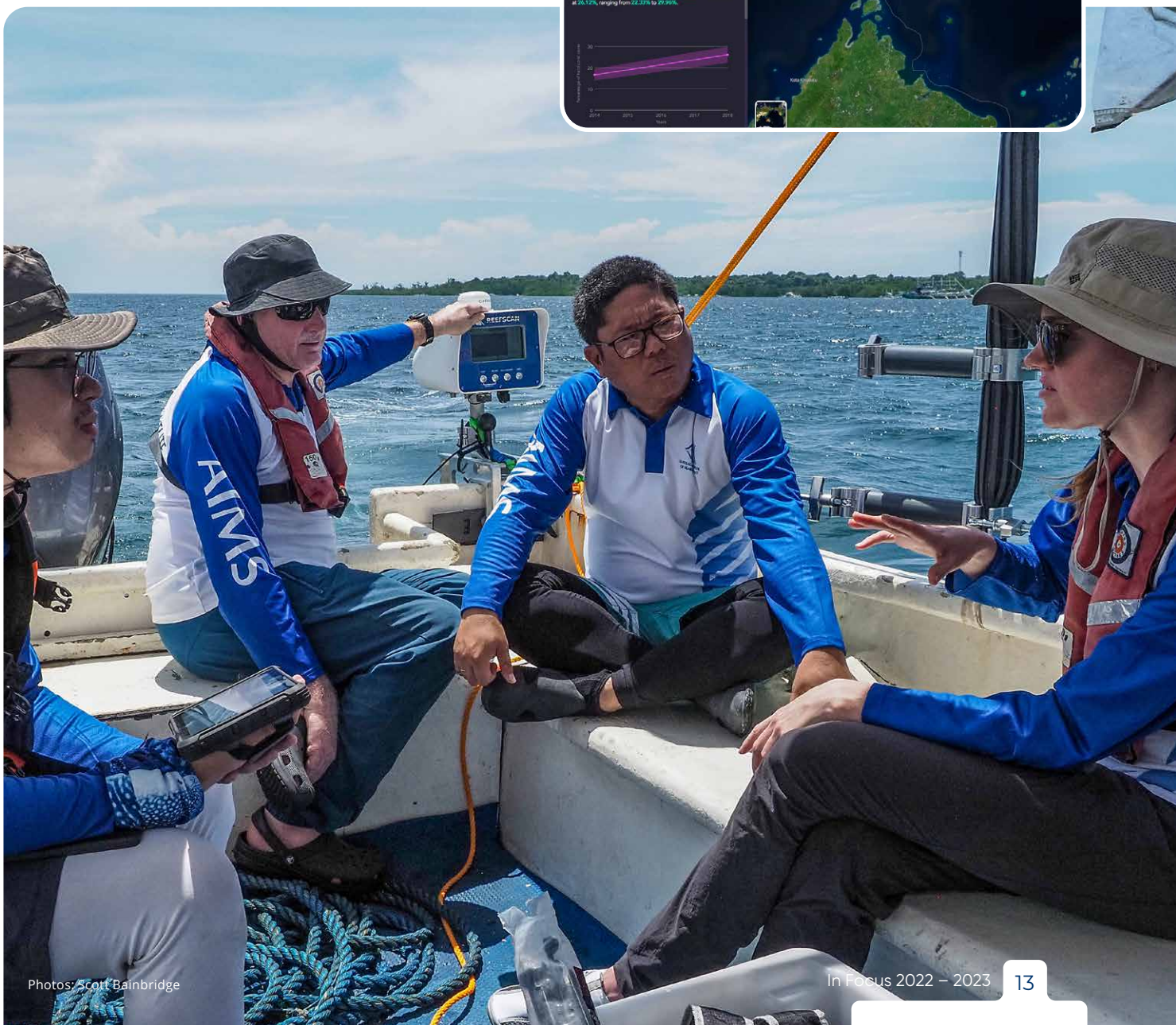
ReefCloud provides the platform to enable the Philippines to bring together its disparate coral reef datasets for a more comprehensive view of the state of the nation's reefs.

This will facilitate more effective decision-making for achieving sustainable reef management.

Australia and the Philippines have a longstanding connection in reef management, with both nations being founding members of the International Coral Reef Initiative (ICRI).

This initiative is supported by the Australian Department of Foreign Affairs and Trade.





Photos: Scott Bainbridge

Developing the next generation of world-leading marine scientists

The challenge

To maintain and strengthen its position as a world-leader in marine science, Australia needs to build a pipeline of highly skilled marine scientists with expertise in relevant areas.

More broadly, it is widely recognised that to maintain Australia's competitive edge and reach our potential for innovation, we need to increase our numbers of science, technology, engineering, and maths (STEM)-trained professionals. Also, women are underrepresented in STEM in Australia, currently making up only 13% of those employed in STEM jobs.

The approach

With the highly regarded marine science programs of James Cook University (JCU) on its doorstep in Townsville, AIMS and JCU have been close collaborators facilitating the transfer of inter-generational experience since both institutions were established around 50 years ago.

In 2004, this partnership was formalised with the AIMS@JCU program, funded by a special Commonwealth allocation for PhD scholarships, joint post-doctoral fellowships, project costs and infrastructure.

The partnership was renewed at the conclusion of funding in 2013, with the joint sponsoring of higher degree research students.

The impact

Since 2004, AIMS@JCU has supported more than 120 PhD graduates, of which approximately half are women, and many other students through work-integrated learning and internships.

It has delivered substantial value to Australian marine science, particularly in establishing a world-class core capability in understanding the impact of global and local stressors on tropical marine systems; coastal processes; and quantitative marine science.

Many AIMS@JCU alumni have gone on to become global marine science leaders, collectively addressing national and international priorities with leading edge science outcomes.

The program has helped cement Townsville's reputation as a centre of marine science excellence in Australia. From January 2022, the scope of this long-standing partnership was strengthened and broadened with a new 10-year, $22 million agreement.

For more information: aims.jcu.edu.au

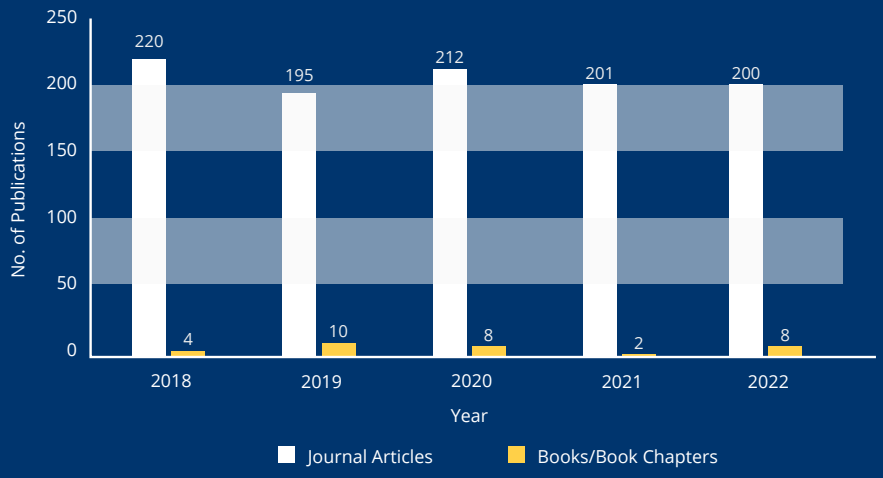
120
PHD GRADUATES
(50% FEMALE)

HELPED ESTABLISH
MARINE SCIENCE
EXCELLENCE
FOR AUSTRALIA

BUILDING
GLOBAL
MARINE SCIENCE LEADERS

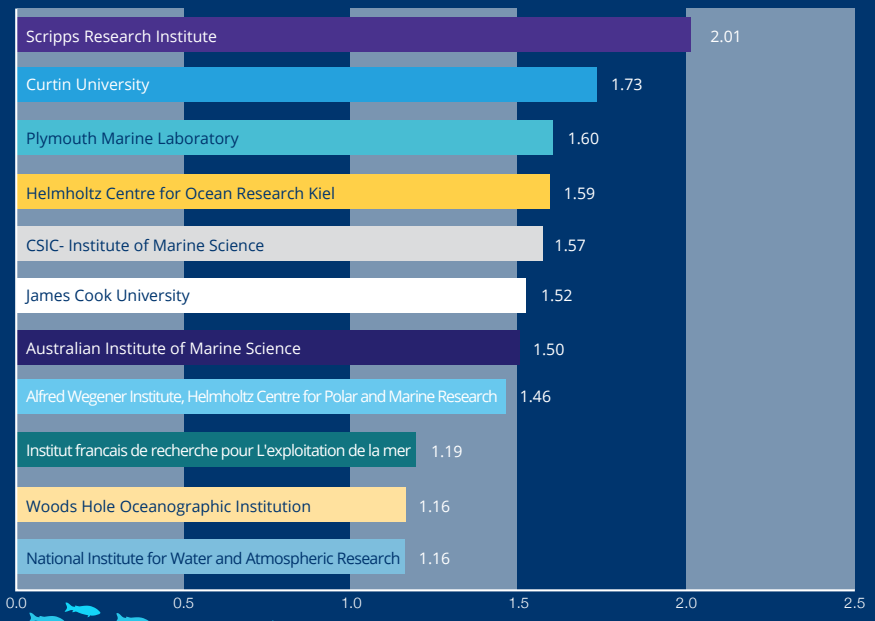
EXPANDED
$22M
10 YEAR PARTNERSHIP

Research performance



Number of AIMS publications by type, 2018 to 2022

The main types of publications produced by our research staff are peer-reviewed journal articles and reviews, books and book chapters, followed by client reports.



Citation Impact Ranking

Top 10 organisations in the field of marine and freshwater biology globally

(Comparison of Field-Weighted Citation Impact (FWCI) of similar organisations with publications in marine sciences, 2022, SciVal)

Seismic surveys unlikely to affect pearl production

Pearl oysters subjected to sonic shocks show no consistent change in commercial productivity

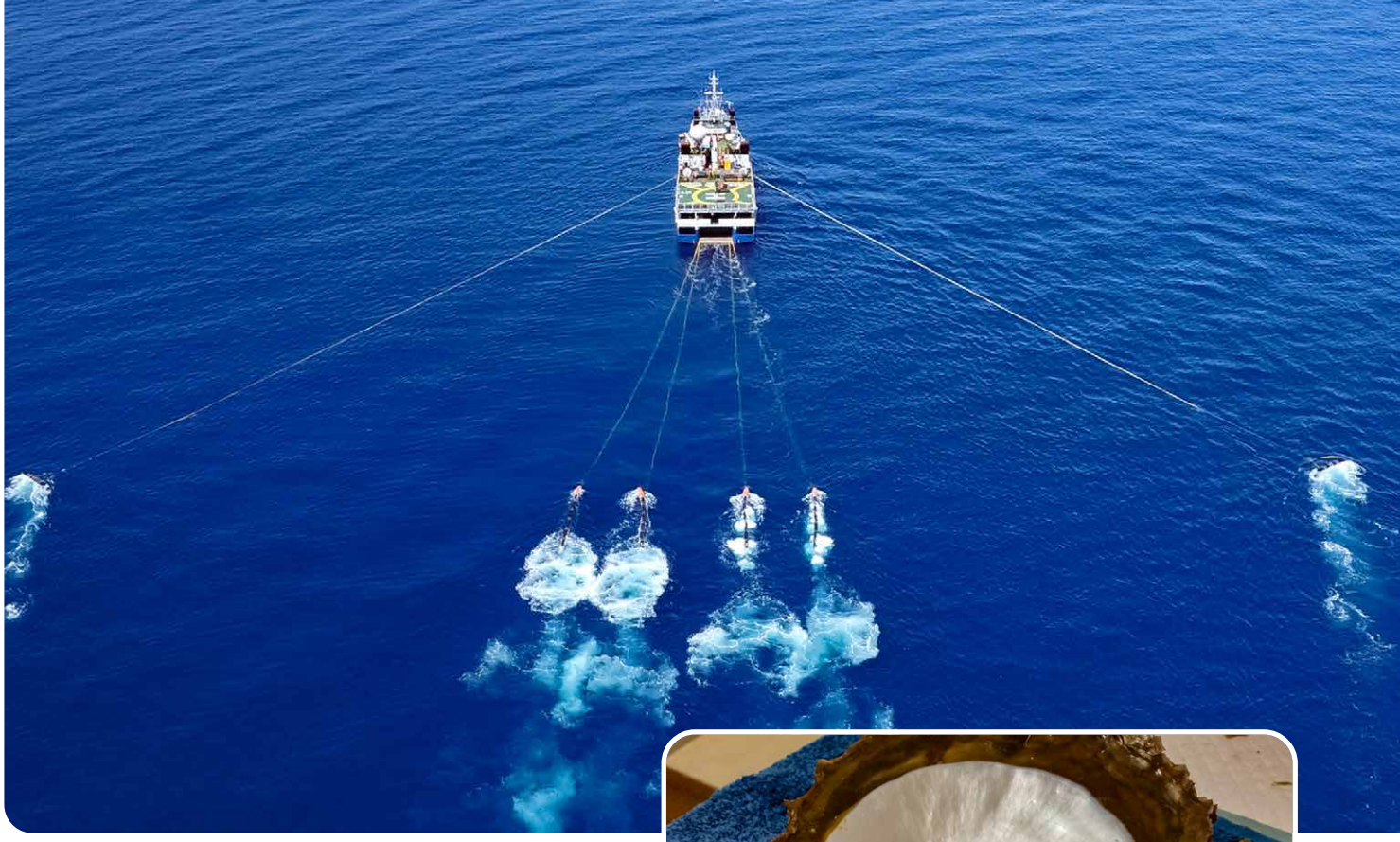
Recently published research suggests that exposure to a single seismic survey is unlikely to increase mortality or affect pearl production in adults of an oyster species farmed in Australian waters.

Seismic surveys are a key activity for offshore oil and gas exploration. The technique uses an airgun to punch loud, repetitive sounds underwater to penetrate the sea floor. The rebounding sounds create detailed imaging of the rock layers below the seabed.

Commercial fishers are concerned seismic survey noise could change the abundance and behaviour of key fisheries species, negatively impacting their industry.

During the study, AIMS researchers exposed around 11,000 silverlip pearl oysters (*Pintada maxima*) to

Photo: Nick Thake



a four-day seismic source survey. Survival rates were then monitored throughout a full two-year production cycle, and the number and quality of pearls produced at harvest were assessed.

The silverlip pearl oyster is a dinner-plate sized, commercially valuable species found in the Indo-Pacific region. Western Australia's pearling industry grows these oysters in waters off the Pilbara and the Kimberley coasts for use in jewellery. This area overlaps with offshore oil and gas exploration and development.

This was the first time oysters have been tested in such a dedicated experimental design using an actual seismic vessel and a commercial-sized airgun array to investigate the effects of seismic energy on this species where they are commercially farmed.

The study found no conclusive evidence of a single seismic survey affecting the survival rates of adult silverlip oysters or their ability to produce pearls.

The study also looked at the quality of pearls produced by the oysters exposed to the seismic survey, finding no consistent differences in the weight, roundness, colour, lustre or complexion of the pearls produced by exposed oysters compared to unexposed oysters.

This research reduces uncertainty for the species and gives managers, marine industries and policymakers additional information based on actual industry practises, to guide the sustainable use of seismic surveys.

The findings contribute to the AIMS Strategy 2030 to create economic, social, and environmental net benefits for marine industries and coastal communities.

The study was part of the North West Shoals to Shore Research Program, funded by Santos Ltd to better understand Australia's marine environment, in collaboration with AIMS, The University of Western Australia, Curtin University, the Department of Primary Industries and Regional Development, University of Tasmania and the WA pearling industry.

Photos: Nick Thake

ReefWorks: Australia's permit-free autonomous vessel test range

AIMS testing range speeds up autonomous marine technology developers projects

In an Australian first, autonomous marine technology developers can now safely test their vessels at our ReefWorks tropical marine technology test range without needing to apply for a permit.

In 2023, ReefWorks was granted regulatory sandbox approval for uncrewed vessels from the Australian Maritime Safety Authority (AMSA). The five-year agreement allows for permit-free testing and evaluation of vessels up to 12m in length, travelling up to 20 knots within the test range.

It was the first approval issued under a proposed Australian Maritime Regulatory Sandbox.

This sandbox status removes uncertainty and a time-consuming hurdle for technology developers and helps to clear the development pathway for Australia's fledgling autonomous marine technology sector.

In 2023, ReefWorks facilitated the successful trial of Geoscience Australia and FrontierSI's Ginan positioning toolkit. At ReefWorks, Ginan precisely positioned an AIMS autonomous surface vessel within centimetre-accuracy in real time. Standard GPS positioning is 5-10m in Australia.

Many other organisations have tested their technology at AIMS. Artificial intelligence, robotics and navigation company Advanced Navigation tasked its Hydrus Micro-AUV (Autonomous Underwater Vehicle) with mapping and searching the seabed of the AIMS Inshore Test Range to locate an object that had been planted.

North Queensland company EdgeROV tested its tethered autonomous aerial drone, Raptor sUAV

Photo: Vic Grosjean

(Unmanned Aerial Vehicle), to search for a 'missing person'. It found the 'person' and, as an unexpected bonus, a whale and her calf frolicking 2km off the coast.

James Cook University put its latest WAM-V autonomous surface vessel through its paces in a simulated marked channel.

ReefWorks Project Director Melanie Olsen was recognised for her industry leadership by the Australian Association for Uncrewed Systems which presented her with the 2023 Industry Champion Leadership Award.

She was recognised for establishing ReefWorks, Australia's first tropical marine technology test range, bridging an important gap for certifying and commissioning autonomous marine systems into operational service. She was also recognised for driving engagement between innovators and regulatory bodies to help create a strong future for uncrewed systems in Australia.

AIMS is developing a suite of autonomous marine monitoring technology to provide more comprehensive knowledge, faster, to inform sustainable management of Australia's changing tropical marine environment.

ReefWorks opened its doors to industry innovators in 2022, with support from the Queensland Government.

Photos: Jo Hurford (main), Marie Roman (inset)

Could seaweed reduce climate change severity?

Natural processes under the waves may be harnessed to help protect marine ecosystems

The oceans hold significant potential for sequestering atmospheric carbon. Much of this happens by gases that dissolve in our oceans at the poles, which then sinks into the deep ocean and is effectively locked away from the atmosphere for thousands of years.

However, there is also a biological pathway for carbon sequestration through photosynthesis by coastal and marine plants, such as mangroves, seagrass, and seaweeds. One particular seaweed, *Sargassum*, is being studied as a potential agent to bolster this process and help reduce the severity of climate change impacts.

The five-year, $20 million Blue Carbon Seascapes research project, jointly funded by AIMS and BHP, is investigating if *Sargassum* could be part of the world's portfolio of nature-based solutions to mitigating climate change.

Sargassum grows naturally in vast meadows along tropical coasts around the world, including Australia. During summer the plants grow rapidly, soaking up carbon from the surrounding seawater. Once *Sargassum* has completed its breeding cycle in

Photo: Violeta Jahnel Brosig

autumn, it breaks away, and disperses across the seascape. Some of this seaweed becomes buried in the mud under mangroves, seagrass beds, or in the deep sea, where it can be stored for decades to centuries.

A primary goal of the Blue Carbon Seascapes project is to measure how much, and for how long this *Sargassum* carbon is buried in tropical marine soils.

Once we understand this, we can develop management strategies to protect and even enhance this natural blue carbon sequestration along our tropical coasts. Blue carbon refers to the carbon stored in the oceans via marine plants that use photosynthesis to absorb carbon dioxide from the air and water around them as part of their growth cycle.

The Blue Carbon Seascapes project has already begun collecting the hard data needed to verify blue carbon storage along the Western Australian tropical coast. Soil core collections are underway , and will continue along the Ningaloo and Pilbara coasts in early 2024. The outcomes of this research will be examined in an independent peer review so the results can be used world-wide to help advance national and international blue carbon policies, standards and methods. Validating the research will also provide transparency, accountability and confidence to industry, businesses, and governments to adopt blue carbon solutions for emissions reduction targets.

The Blue Carbon Seascapes project is part of AIMS' 'public good research' and long-term strategy to protect Australia's marine ecosystems from the effects of climate change.

Photos: Violeta Jahnel Brosig

Using statistics to protect marine environments from unsafe levels of pollution

The challenge

Contaminants released into marine environments from human activities like wastewater outflow and discharges from industry, need to be kept within safe levels to protect the health of marine animals, habitats and the people who depend on the ocean.

The Australian and New Zealand water quality default guideline values (DGVs) set the water quality benchmark industry must achieve to ensure protection of our marine ecosystems. They are applied to contaminants like pesticides, anti-foulants, pharmaceuticals and metals, and underpin environmental management.

The current DGVs for Australia and New Zealand were derived using statistical methods that are 20 years old and do not incorporate new developments in the field. As these guidelines are one of the key tools used by regulators, the methods which underpin their derivation should evolve with the increased scientific knowledge to ensure they are as robust as possible.

The approach

The Australian Institute of Marine Science (AIMS) collaborated with key Australian and Canadian experts to further develop and improve a statistical software tool to calculate water quality DGVs for Australia, New Zealand and Canada. The tool harnesses recent innovative statistical methods that provide better, more robust estimates of safe contaminant concentrations for any industry which discharges into marine and freshwater environments, for example oil and gas extraction, or mining and aquaculture.

To test their new tool, the scientists examined how the new method compared to the existing method in Australia, finding that the new tool always found a solution (i.e., a safe concentration), reduced bias in estimates of the safe concentration and was statistically more likely to be correct.

The impact

Improved reliability of the guidelines will reduce the need for unnecessarily conservative approaches that can frequently have a high cost to industry.

The public and environmental regulators can be assured that the best available practices, techniques and statistical methods are being used to derive water quality guidelines to manage discharges and best protect the health of local marine ecosystems.

Industries which discharge into marine environments can be assured that the guidelines that are derived are scientifically credible and legally defensible.

AIMS further developed and improved the software tool in collaboration with water quality consultants working across industry.

PROTECTS
THE MARINE ENVIRONMENT FOR ALL USERS

COST
SAVINGS
FOR INDUSTRY

TRUST
IN GUIDELINES LEADS TO BETTER MANAGEMENT

MEET
COMMUNITY
EXPECTATIONS ON WATER QUALITY

Photo: Christian Miller

Water Usage

Our water usage at Cape Ferguson was 56 megalitres (ML) for 2022-23. This is a decrease of 3.1 ML from the previous year.

Recycling

Our co-mingling recycling programme continues to reduce the amount of solid waste sent to landfill. We achieved an average reduction of 26% over the last three years, compared to our 2017-18 baseline.

In 2022-23 we recycled approximately 21.3 Tonnes of paper, cardboard and plastic products. This is an increase of 11% from the previous year.

We continue to recycle batteries, printer cartridges, metal and lubricants.

Energy Usage

Our Total Energy Usage across the sites that we operate was 7200 MW for 2022-23. This includes reductions in usage of 3% at our Cape Ferguson Facilities and 2% at our facility in Darwin.

Electricity production from our PV Solar systems produced 1300MW, avoiding 1066T of carbon emissions.

Radiation Safety

During the year, AIMS continued to hold a source licence issued by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).

This licence is subject to conditions including quarterly reporting, maintaining a source inventory and complying with relevant regulations, codes and standards.

Gene Technology

No new proposals for dealings involving genetically modified organisms (GMOs) were assessed by the AIMS Biosafety Committee this year.

AIMS has two active dealings with GMOs. Both projects are Notifiable Low-Risk Dealings (NLRDs).

Australian reefs a lifeboat for sharks and rays

World-wide drop in shark numbers has serious implications for marine ecosystems

One-quarter of the world's sharks and rays are threatened with extinction, and the rest are either approaching threatened status or too poorly studied to be assessed. The information needed to protect these species and their ecosystem roles has been gathered in a five-year international study by Global FinPrint, one of the first unified studies to assess global shark and ray populations on tropical coral reefs.

One of the few positive findings indicated sharks and rays on Australian coral reefs are faring better than the same species in other regions where populations are being depleted by excessive fishing.

The study was co-authored by AIMS researchers who found the five main shark species that live on coral

reefs worldwide – grey reef, blacktip reef, whitetip reef, nurse and Caribbean reef sharks – have declined by an average of 63%. The main driver of the population declines was found to be widespread overfishing.

This was reflected in some Australian populations, but to a lesser degree. Coral reefs within marine protected areas off both the west and east coasts were found to have the healthiest shark and ray populations.

For example, in the isolated reefs of the Rowley Shoals, 430 kilometres off Broome and part-covered by a Marine Protected Area that has excluded fishing for three decades, the researchers recorded healthy populations of reef sharks, including transient species like tiger sharks, and eagle rays. By comparison, at Scott Reef, 200km north-west of Broome where fishing is allowed, the numbers of sharks and large fish species is lower.

Photos: AIMS | Global FinPrint

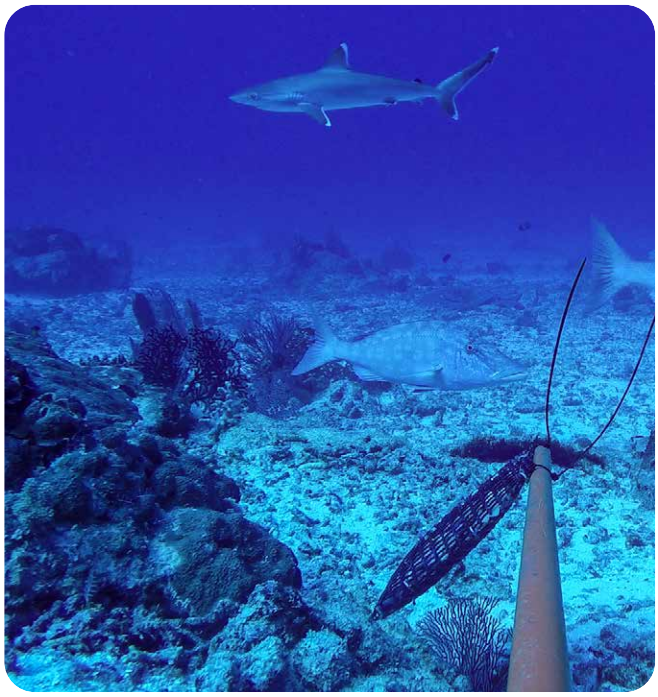
Fewer sharks on reefs have flow-on impacts on coral reef health, especially if a reef has been damaged by other factors. Starting with algae-coral relationships and back up through the food chain, healthy shark populations are crucial to ecosystem health.

Researchers have hypothesised that sharks help control the numbers of other fish species, which in-turn prey on herbivore species like parrotfish.

Parrotfish keep the density of 'turf' algae down, which if not controlled can blanket the reef structure and prevent young corals from settling. Coral settlement is crucial for reef recovery after an impact such as a cyclone, or bleaching following a marine heatwave.

AIMS scientists also led surveys along the Great Barrier Reef. Its northern section was one of the few locations with very high diversity (27 species) of both sharks and rays.

The results of this research were collated from 22,000 hours of video footage captured by underwater cameras across 391 reefs in 67 nations and territories. It supports the AIMS Strategy 2030 to improve the health and resilience of marine and coastal ecosystems across northern Australia



The study was supported by the Paul G. Allen Family Foundation and led by Colin Simpfendorfer, Adjunct Professor of Marine and Aquaculture Science at James Cook University in Australia. More than 150 researchers from more than 120 institutions across the world contributed to the research.

Photos: AIMS | Global FinPrint

AIMS designs self-sufficient coral production facility to aid global coral recovery

A transportable coral propagation system for remote areas

An estimated two-thirds of the world's coral reefs have been lost, directly and indirectly through the impacts of climate change, and 70-90% of remaining reefs could disappear in the next 10-15 years if no remedial action is taken.

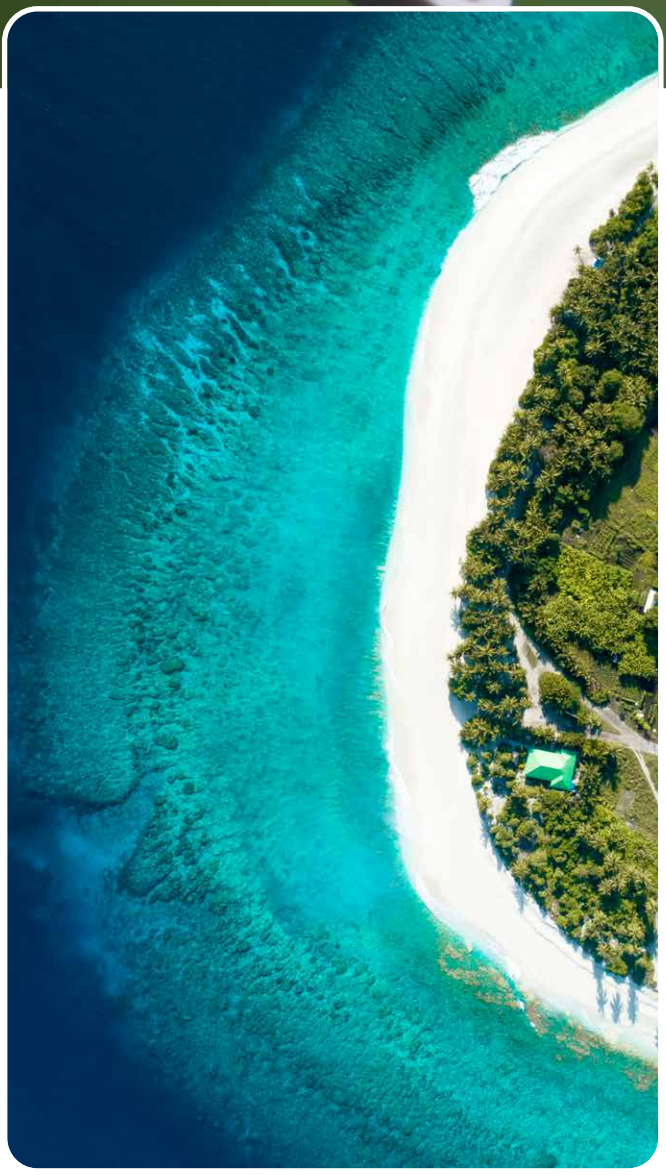
In 2023, a G20 initiative to fast-track solutions to help protect the world's coral reefs, the Coral Research and Development Accelerator Platform (CORDAP), awarded a US$1.5M (AU$2.3M) grant over three years to AIMS, CSIRO and Maldives Marine Research Institute (MMRI) to develop and implement ReefSeed.

ReefSeed is a system of self-sufficient coral production facilities being developed by AIMS, that can be set up in remote areas to propagate young corals for reef restoration.

Each rearing tank can propagate up to 100,000 young corals at a time. The system's portability allows it to be set up next to a beach, draw water from the sea and use an independent power source for filtration, pumps and temperature control.

The first deployment of ReefSeed, in 2025, will be in the Maldives, a coral-based archipelago. Like many countries in the region, the Maldives relies on its coral

Photo: Marie Roman



reefs to sustain local livelihoods from reef fisheries and tourism. However, it has suffered increasingly severe bleaching events over the past 20 years.

CSIRO is investigating natural patterns of coral reproduction in the Maldives while training local people in coral restoration techniques.

In the lead up to the first deployment of ReefSeed, MMRI marine biologists and technicians will be working in Australia at AIMS' National Sea Simulator to study largescale methods to generate coral larvae for reef restoration.

These conservation aquaculture methods were developed under the Australian Government's Reef Restoration and Adaptation Program (RRAP). Coral larvae are settled onto sheets, which are economical for storage and transportation, before being assembled into specially engineered devices to resettle coral onto damaged reefs. The devices protect the young corals while they establish and begin reef ecosystem recovery.

CORDAP was set up by the intergovernmental forum, G20, to bring together the best minds worldwide, in a multidisciplinary approach, to accelerate and scale up the development of new technologies that support global coral conservation efforts.

ReefSeed contributes to AIMS' Strategy to build on its national science excellence to be in the top five international marine science providers by 2030.

Photos: Marie Roman (main)

The National Sea Simulator celebrates a decade of achievement

The world's most advanced research aquarium at the heart of coral reefs knowledge

In the face of escalating environmental pressures on coral reefs, research into tropical marine environments has become increasingly crucial and challenging. The complex nature of marine environments makes it difficult to set up controlled environments for research.

The National Sea Simulator was developed at the AIMS headquarters near Townsville to enable marine scientists to run sophisticated experiments simulating marine conditions with advanced control of environmental factors.

Also known as SeaSim, the facility is celebrating a decade of achievements this year. Comprising sophisticated systems of seawater tanks that simulate natural environmental variables, it allows researchers to manipulate, and tightly control, multiple factors such as light, temperature, acidity, carbon dioxide, salinity, sediments and contaminants.

SeaSim's controlled aquaria conditions, round-the-clock monitoring and world-leading technologies enables researchers to gain a better understanding of these environments. The advanced controls systems allow the SeaSim to replicated future climate scenarios, enabling the research and development of solutions for climate adaptation.

SeaSim has facilities for the long-term holding and propagation of corals as model organisms for research, which allows multi-generational studies that inform how they may adapt to changing environmental conditions over time. Three generations of corals have now been reared in the SeaSim.

Over the past decade the SeaSim team has expanded from 12 to 37 and includes aquarists, biologists, tradespeople, engineers, technicians and support services who help design, build, operate and

Photo: Roslyn Budd

maintain the facility. The facility is still growing and eventually there will be over 50 staff supporting this critical research.

Over the last 10 years, SeaSim has been used by more than 1320 researchers working on over 330 experiments – the longest running for more than 2500 days.

SeaSim has hosted more than 70 collaborating and funding organisations and supported more than 230 published scientific papers.

Over a 100 million coral larvae have been produced in SeaSim since 2017, with some 56 coral species from the Great Barrier Reef successfully spawned and reared.

SeaSim's controlled environments have also enabled the development of out-of-season coral spawning methods, with the ability to manipulate light and temperature to replicate the seasonal cues of six coral species outside of their natural cycle.

SeaSim also supports studies into the coral-eating crown-of-thorns starfish. With more than five million starfish larvae raised in SeaSim each year, researchers are gaining a better understanding of the lifecycle of the starfish, to help protect the corals of the Great Barrier Reef against destructive outbreaks.

The unique experimental capabilities of the SeaSim have also enabled groundbreaking work and critical research supporting sustainable marine industries. The studies helped improve the management of dredging in tropical marine areas and investigated potential impacts of contaminants on tropical marine organisms, under current and future climate scenarios.

SeaSim opened with support from the Education Investment Fund and AIMS. Its latest expansion, more than doubling the experimental space, is supported by the Department of Education through the National Collaborative Research Infrastructure Strategy, due to open in 2024.

SeaSim meets the AIMS Strategy 2030 to improve the health and resilience of marine and coastal ecosystems across northern Australia, and to enhance research capabilities and outcomes by facilitating collaboration among stakeholders and partners.

Photos: Roslyn Budd (main), Chris Brunner (inset)

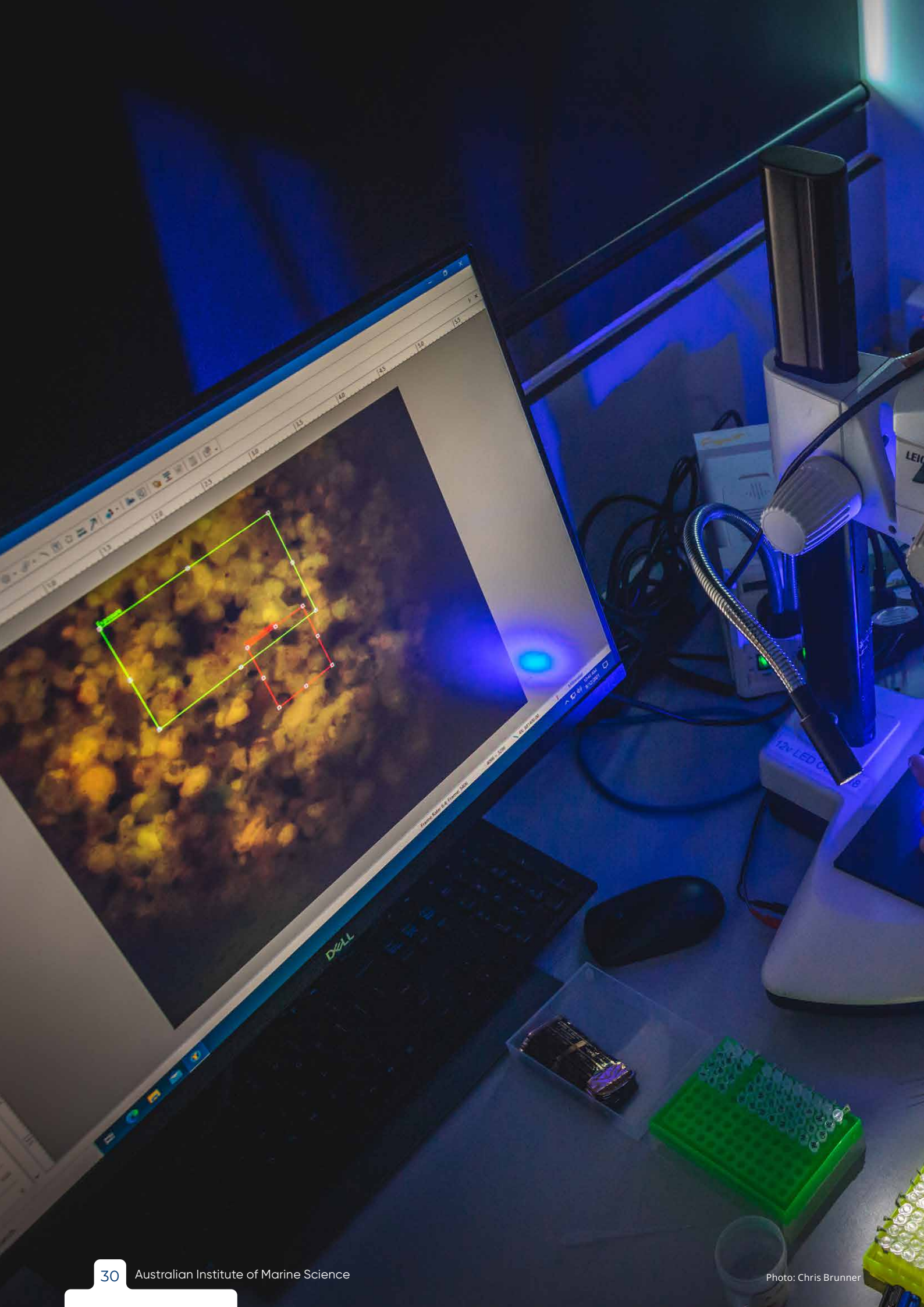


Photo: Chris Brunner

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