Australian Government

Australian Institute of Marine Science

50 YEARS 1972 - 2022

Science for tomorrow's oceans

AIMS

Australia's tropical marine research agency

In Focus 20/21

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

Care for ourselves and others in all that we do

Together we create impact

Treat everyone with dignity, value diversity, support others

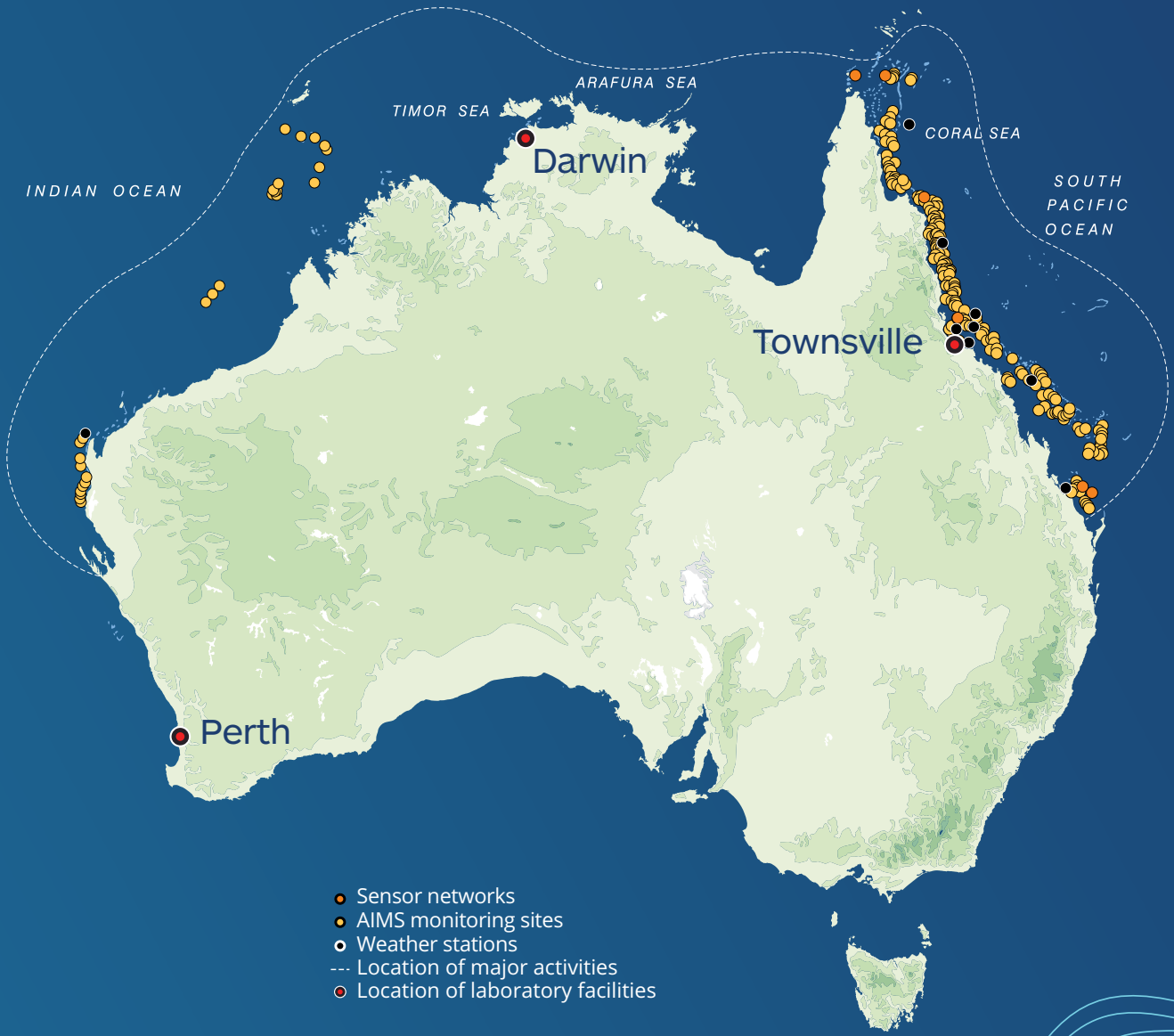
Energy that inspires excellence

Always transparent, ethical and objective

Vision and creativity to solve big challenges

Minimise our footprint

Locations and assets



Australian Institute of Marine Science

20/21 | IN BRIEF

#1 marine science institution in the world.

Benchmarking by Clarivate Analytics InCites research analytical tool

MARINE SCIENCE SOLUTIONS: REEF RESTORATION INITIATIVES

RRAP
Reef Restoration and Adaptation Program

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

ACRRI
Australian Coral Reef Resilience Initiative

ACRRI targets helping reefs suffering under climate change, using sound to rebuild fish populations to support coral seeding technologies.

BLUE TECHNOLOGY: INNOVATION IN MARINE SCIENCE

REEFWORKS

ReefWorks will allow Australia to test new marine technologies, autonomous systems and sensors in a real world environment.

REEFCLOUD

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

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

Long-term Monitoring Program

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

Great Barrier Reef Marine Monitoring Program

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

National Facility

Initiation and conceptual design phases complete for the National Sea Simulator. Construction commences 2021-2022.

$36.3m
OVER 3 YEARS

Environmental Performance

1,315t ↓
ANNUAL REDUCTION IN CARBON FOOTPRINT

95.5t ↓
REDUCTION IN SOLID WASTE TO LANDFILL

Safety Performance

43% ↓
DECREASE IN NUMBER OF RECORDABLE INJURIES

50% ↓
DECREASE IN TOTAL RECORDABLE INJURY FREQUENCY RATES (TRIFR)

Science Output

212
PEER REVIEWED JOURNAL ARTICLES

61% IN INTERNATIONAL COLLABORATION PUBLICATIONS

37% IN NATIONAL COLLABORATION PUBLICATIONS

Science Impact

$222m
ECONOMIC RETURN ESTIMATE

4.9x
RETURN ON GOVERNMENT INVESTMENT

FIELD OPERATIONS

Tropical Northern Australia

42,500
NAUTICAL MILES STEAMED

3,450
NUMBER OF DIVES

1,154
SCIENCE SEA DAYS INCLUDING CHARTERS

103
COLLABORATORS ON FIELD TRIPS

5,790
RESEARCHER FIELD DAYS

Australian Government

Australian Institute of Marine Science

Photo credit: Joe Gioffre

Microdebris field monitoring and laboratory experiments inform national waste reduction strategy

This research contributes to AIMS' strategic target of delivering science that underpins a net improvement in the health of marine ecosystems in northern Australia.

Photo credit: Neill Roberts

The world's marine ecosystems, critical to life on earth, are increasingly stressed and rapidly changing. It's more important than ever that we have the data to make informed decisions about the most effective way to care for, protect and sustain marine ecosystems and the communities that rely on them.

At the Council of Australian Governments meeting in 2019 in Cairns, the leaders of Commonwealth and State governments agreed to develop a strategy to reduce waste, especially plastics.

In a recent study, AIMS and the University of Copenhagen (UCPH) found microdebris (human-made debris less than 5 mm long) is widespread on the Great Barrier Reef.

From 22 surface water tows, 547 items of microdebris were recorded.

The study also examined 60 lemon damselfish (*Pomacentrus moluccensis*) collected at inshore and offshore reefs near Townsville and found 455 items of microdebris, with 57 of the 60 fish containing at least one piece of microdebris. Among the 1,002 items collected, fibres (86%) were much more common than particles (14%).

Spectroscopy was used to determine the polymers in all items of microdebris collected in order to identify potential sources. Plastic polymers, including polyester, nylon and polyethylene, were found in 60% of items found in surface waters and 25% of items recovered from lemon damselfish.

Polyester and nylon likely originate from industrial textiles, while polyethylene probably comes from degraded industrial packaging.

Hydrodynamic modelling determined that the geographic origin of microdebris contamination in surface waters was not distributed equally across sampling locations. Specifically, riverine discharge was a potential source for microdebris collected at inshore reefs, but not offshore reefs.

The Australian Academy of Science produced a video on the AIMS–UCPH joint study. The study team is now examining the potential ecological risks of microdebris contamination on the Great Barrier Reef.

This research contributes to AIMS' strategic target of delivering science that underpins a net improvement in the health of marine ecosystems in northern Australia (AIMS Strategy 2025 Impact Target 2). ■

Photo credit: Marie Roman

Photo credit: Kelley Meehan

World's most advanced research aquarium receives growth investment

In November 2020, the Australian Government provided $36.3 million to expand AIMS' world-class research aquarium facility for tropical marine science, the National Sea Simulator (SeaSim).

Photo credits: Roslyn Budd

Based at AIMS headquarters near Townsville, the SeaSim is the world's most advanced research aquarium facility. Its industrial-scale process automation provides unprecedented control over environmental variables such as light, temperature, acidity/pCO2, salinity, sedimentation and contaminants, which can be varied at the same rate as occurs in nature. It facilitates long-term holding and propagation of corals as model organisms, allowing multi-generational studies critical to understanding how marine organisms acclimatise and adapt to a changing environment.

The SeaSim is used by national and international researchers, providing data to industry, government, policymakers and regulatory authorities to inform the sustainable use and protection of Australia's northern tropical marine estate. The SeaSim supports critical research underpinning the Reef 2050 Plan, the Australian and Queensland Governments' framework for protecting and managing the Great Barrier Reef to 2050. It facilitates research that cannot be performed anywhere else in the world into areas such as water quality, climate change, emerging contaminants and coral reef adaption and resilience. Access to the facility is in high demand.

The SeaSim expansion and its establishment as a National Facility will be funded through the National Collaborative Research Infrastructure Strategy (NCRIS) as part of the 2020 Research Infrastructure Investment Plan, providing national and international researchers with merit-based access. This funding brought forward the scheduled 2023 to 2025 SeaSim expansion and will support much of the research and development phase of the Australian Government's Reef Restoration and Adaptation Program (RRAP). The RRAP is creating an innovative toolkit of safe, acceptable interventions to help the reefs resist, adapt to, and recover from the impacts of climate change.

The SeaSim expansion will contribute to the delivery of two AIMS Strategy 2025 impact targets: to generate at least $100M per annum in environmental, social and economic net benefits for tropical Australia; and a net improvement in the health of marine ecosystems in northern Australia. ■

Applying gene technology to coral reefs

By making targeted changes to the coral genome, researchers identified a particular gene critical to heat tolerance, increasing our understanding of fundamental coral biology.

Photo credits: Marie Roman

Climate change is the most significant threat to coral reefs worldwide, with mass coral bleaching occurring more frequently in Australia and globally.

While stabilisation of ocean temperatures is required for the long-term survival of coral reefs, AIMS scientists are using genomic technology to identify corals less likely to bleach in order to boost reef resilience in a warming future.

The emergence of gene technology CRISPR-Cas9 in the past decade has provided a powerful tool to study the genes that influence heat and bleaching tolerance in corals.

Knowing which corals are more likely to be resilient to bleaching will inform reef protection strategies and provide stock for selective breeding programs. CRISPR-Cas9 allows scientists to turn off or modify, a target gene in organisms.

In 2020, scientists from AIMS, Stanford University and Queensland University of Technology used a new CRISPR-Cas9 method to test the function of genes believed to have a heat tolerance role in corals. By making precise, targeted changes to the coral genome, they identified a particular gene critical to heat tolerance in the stony coral *Acropora millepora*. This study, increases our understanding of fundamental coral biology.

In another study, AIMS scientists worked with Columbia University and the University of Texas to lay the groundwork for developing a genomic predictor of coral bleaching. They sequenced the genomes of 237 *Acropora millepora* colonies collected from 12 reefs during the 2017 mass bleaching event in the Great Barrier Reef. Researchers found the influence on corals' bleaching response came from the combined effects of many genetic differences rather than the influence of a single gene on its own.

These two studies are improving fundamental knowledge of the genetic potential of corals to strengthen the resilience of reefs in the future. ■

Photo credits: Marie Roman

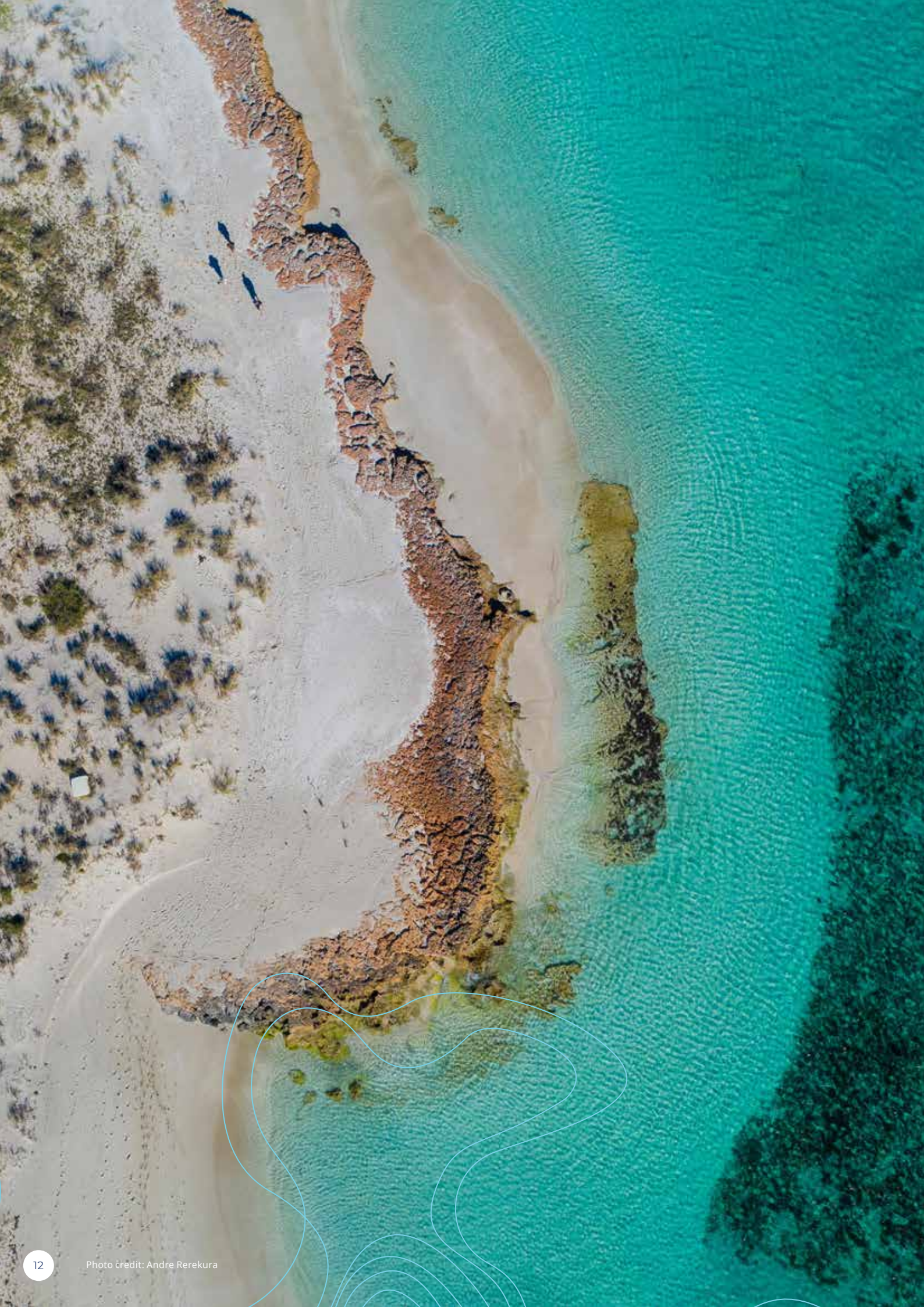
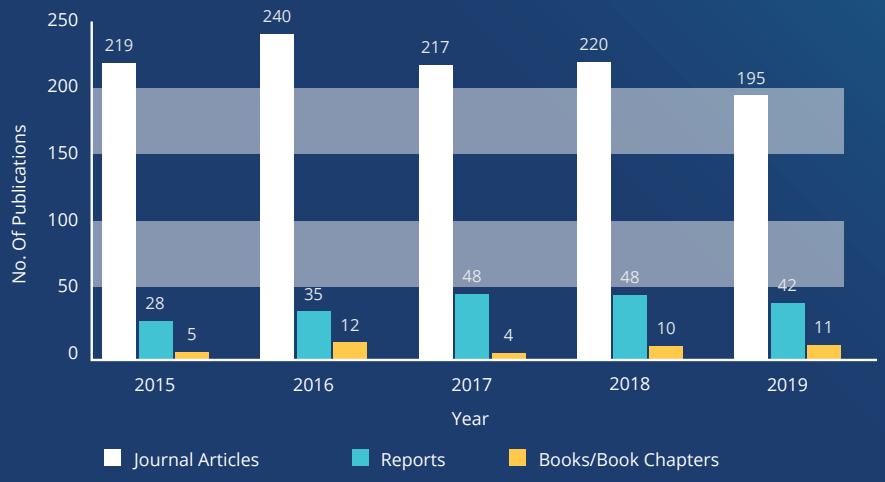


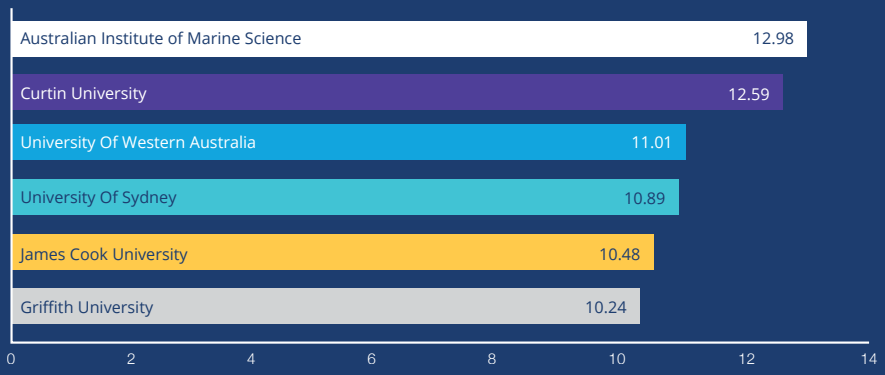
Photo credit: Andre Rerekura

Research performance



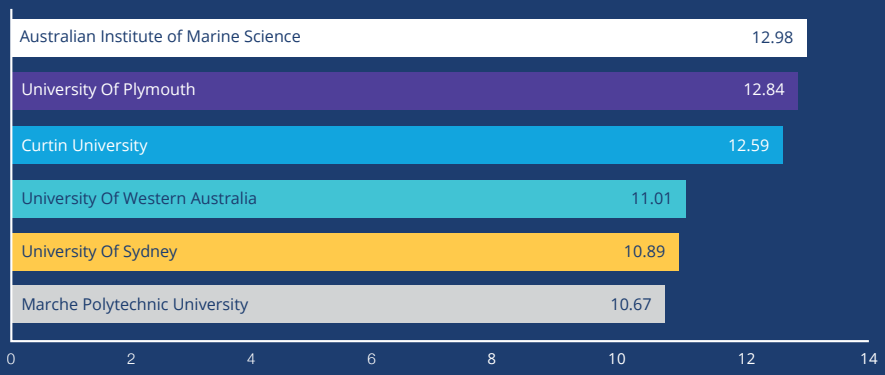
Number of AIMS publications by type, 2015 to 2019

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



Top 6 organisations in the field of marine and freshwater biology in Australia ranked by citation impact

(InCites June 2020)



Top 6 organisations globally in the field of marine and freshwater biology ranked by citation impact

(InCites June 2020)

Water monitoring expands to Fitzroy region

AIMS researchers monitor water quality at several sites between the Fitzroy River mouth and North Keppel Island.

Photo credits: Marie Roman

At 150,000 square kilometres, the Fitzroy River basin in Queensland is the second largest catchment that drains to the east coast in Australia. It is also a major source of excess sediment and nutrients to local inshore waters, contributing to pressures on the Great Barrier Reef.

While AIMS has monitored water quality on the inshore reef for 15 years, a new program of field sampling has begun in the Fitzroy basin.

In partnership with the Great Barrier Reef Foundation, the program will help us to understand the whole story of water quality on the reef. It is expected to provide valuable information on the condition and trend of water quality in this high-priority catchment.

Graziers and land managers in the Fitzroy region are already helping keep 50,000 tonnes of sediment from running into the reef's waters every year, through a $19.6 million water quality improvement program.

The monitoring program will re-establish a baseline to allow governments and industry to see how their investment into gully control and streambank rehabilitation improves the quality of water, and meets targets set out in the Reef 2050 Water Quality Improvement Plan.

In recent years, environmental conditions have accelerated decline of the reef, and the iconic ecosystem's value to humanity requires us to monitor and manage it more closely.

Over the years, new technology has seen fresh observations added to the program, such as measuring carbon dioxide dissolved in seawater which then makes the seawater pH more acidic. This has allowed AIMS to tease out the effects of acidification on coral reefs.

AIMS researchers collect water samples at several sites between the Fitzroy River mouth and North Keppel Island, using a network of underwater loggers to measure sediment and nutrients in coastal waters. They will measure other important factors such as water clarity to understand the conditions experienced by seagrasses and corals in the area.

The Fitzroy basin program will also deliver information to (the complementary) Great Barrier Reef Marine Monitoring Program (MMP) – Inshore Water Quality.

The Fitzroy Basin Marine Monitoring Program is funded through the Australian Government's Reef Trust Partnership with the Great Barrier Reef Foundation. ■

Thamarrurr Sea Rangers monitor marine biodiversity

AIMS is working with the Thamarrurr Sea Rangers, Parks Australia and energy company ENI to deliver impactful research within the Joseph Bonaparte Gulf Marine Park.

Photo credits: Claire Streten

The Joseph Bonaparte Gulf Marine Park in Australia's Top End has huge tides and an abundance of biodiversity. It also overlaps areas of potential disturbance from oil and gas development.

Thamarrurr Sea Rangers are key partners in a collaborative project to monitor the health of sea Country in this environmentally sensitive marine park.

The project brings together western and traditional knowledge systems as the rangers monitor marine biodiversity and benthic habitats around Emu Reef. Using baited underwater video stations (BRUVS) and dropping cameras at 27 sites, they collect key ecological baseline information about the region.

Emu Reef is within a fishing exclusion zone, implemented to protect reef fish biodiversity within the region.

AIMS scientists are delivering ongoing marine monitoring training to the rangers. Early data shows a highly biodiverse reef system with healthy coral habitats and an abundance of fish and shark species.

The partnership strengthens two-way learning, exemplifying AIMS' strategic focus on weaving traditional ecological knowledge with western marine science to create new insights into our coastal ecosystems. The rangers use the local Aboriginal Murrinhpatha language terms to name some of the species such as 'ku yenge' (shark), 'ku parram' (trevally) and 'ku yulurn' (snapper). This helps the Thamurrur rangers to stay connected to their culture and Country.

This project is important because it recognises the aspirations of Traditional Owners for greater empowerment in sea Country monitoring, research, decision making and science. As the rangers learn how to use and deploy scientific equipment, the project furthers AIMS' strong track record of building meaningful partnerships with Traditional Owners. ■

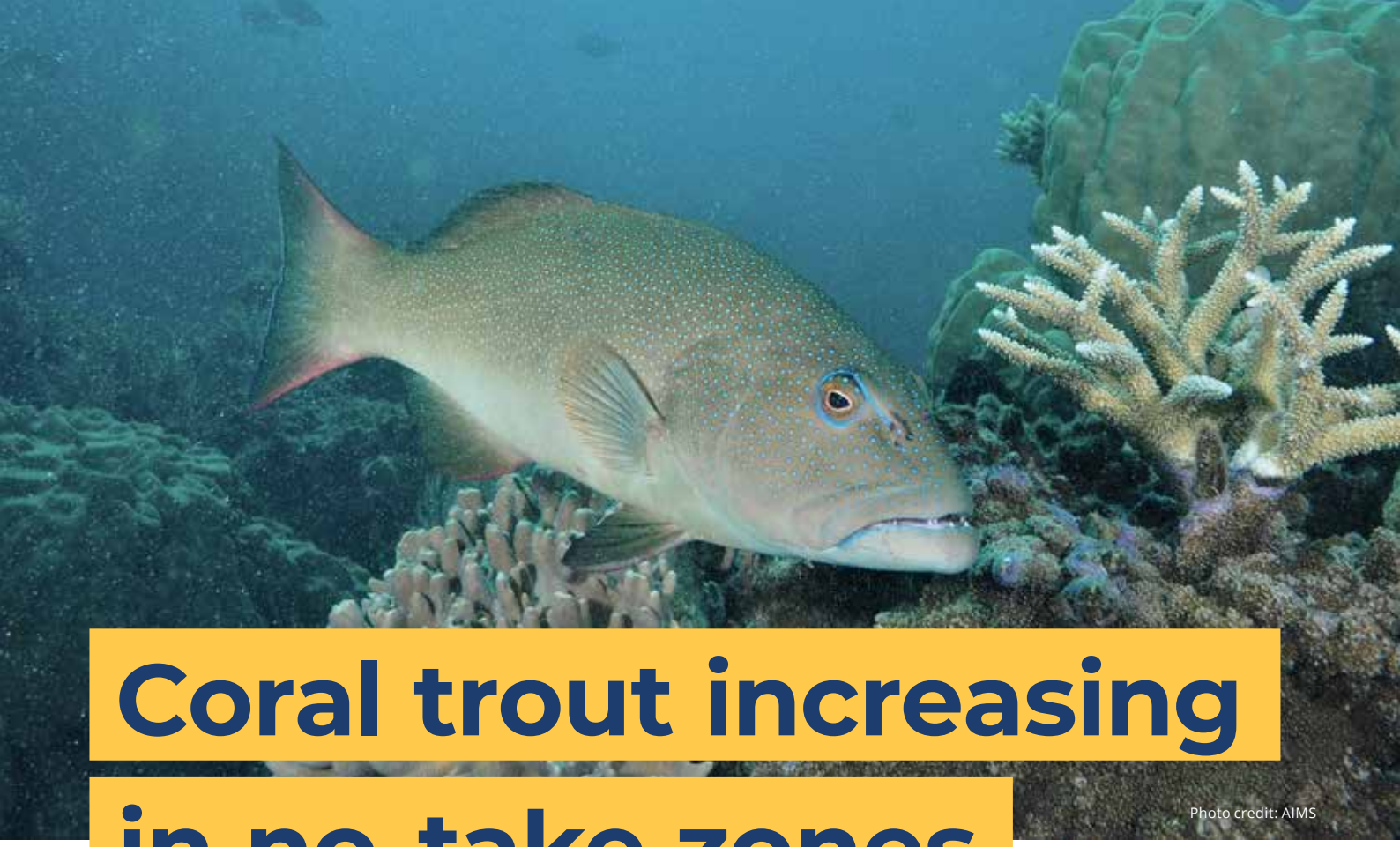


Photo credit: AIMS

Coral trout increasing in no-take zones

There were nearly twice as many coral trout in green zones than in areas open to fishing, and the biomass was 122% higher on reefs inside protected areas.

AIMS' Long-Term Monitoring Program found no-take marine reserves (NTMR), or 'green zones', continue to boost coral trout populations on the Great Barrier Reef.

Monitoring conducted in 2020 found numbers of the highly-prized fish are increasing in marine reserves, and they are getting larger.

There were nearly twice as many coral trout (*Plectropomus* spp., *Variola* spp.) in green zones than in areas open to fishing, and the biomass – the total weight of all fish – was 122% higher on reefs inside protected areas.

Previous research has found coral trout in NTMR re-seed populations for anglers by providing larval subsidies to areas open to fishing (under this process larvae are freely exchanged among reefs resulting in increased catches outside of areas closed to fishing).

Coral trout are one of the most popular species of fish targeted by recreational anglers in the Great Barrier Reef. The fish is also a valuable export market which grew so rapidly that by the early 2000s there were concerns for the fishery.

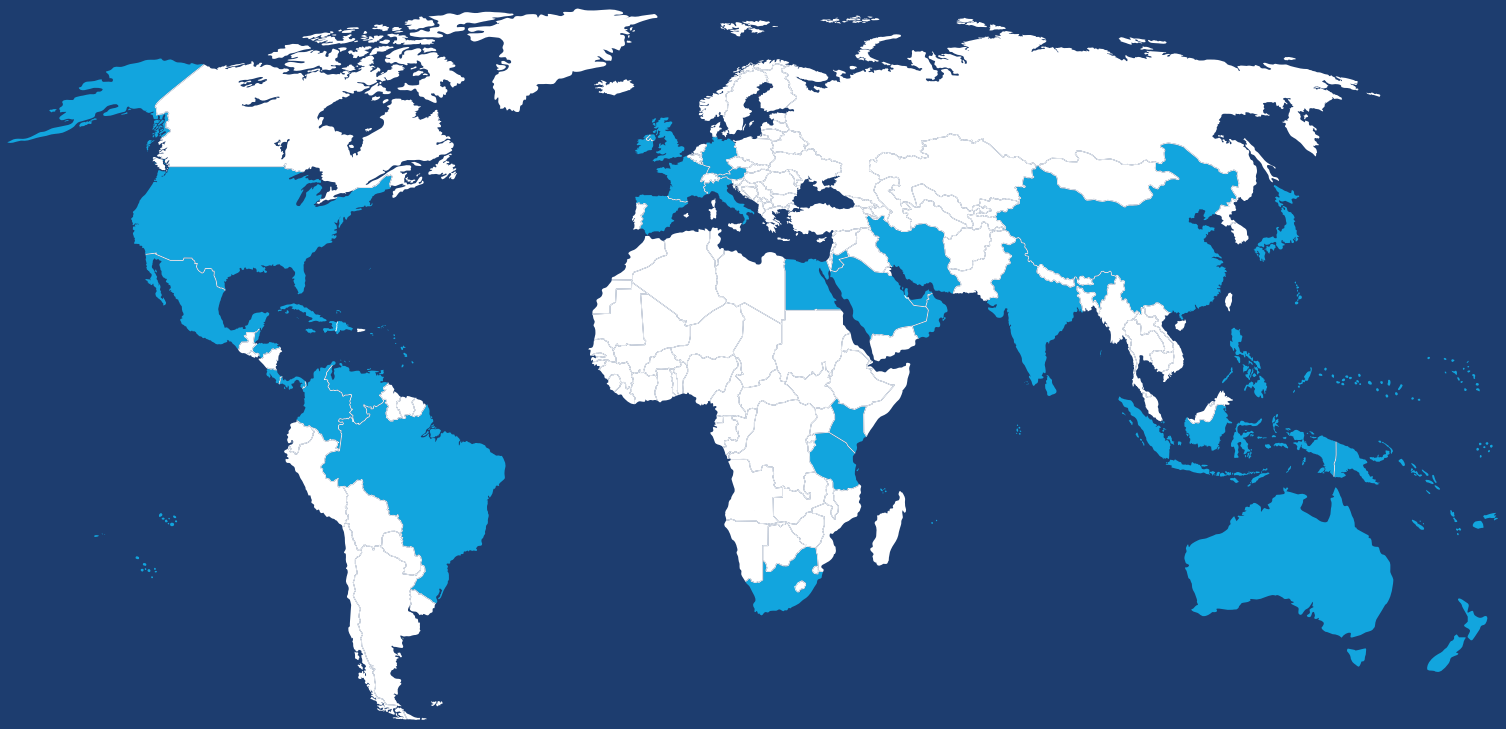
At that time, AIMS contributed to the Great Barrier Reef Marine Park Authority's development of new green zones with data, expertise and research effort to inform the design of NTMRs. The zones came into effect in 2004, increasing the area of protected reef from less than 5% to more than 30%.

More than 15 years later, the 2020 monitoring confirms the success of the re-zoning. Today, approximately 1,000 tonnes of coral trout are caught annually along the Great Barrier Reef, with no evidence this is putting the stock at risk.

The rezoning supports up to $311 million injected into the Queensland economy by fishing activity in the region each year. It also has a social benefit for the state's one million recreational fishers.

AIMS continues to monitor the impact of the protected areas to confirm they are having the intended effect. ■

Research collaboration



Countries hosting collaborative projects

Collaboration is a core value of AIMS. Collaboration with domestic and international partners enables AIMS to draw on complementary skills to deliver practical research results and to share knowledge more broadly. During 2019–20, AIMS was involved in 148 collaborative projects conducted in 81 countries.

Collaborative research accounts for a high proportion of AIMS' scientific publications. Of the 192 journal articles published by AIMS scientists, 71 (37%) had co-authors from other Australian research organisations and 109 (57%) involved international colleagues. Only 12 articles (6%) were authored solely by AIMS staff.

Collaborative projects involved:

268 Australian scientists from

48 Australian organisations and

293 international colleagues from

160 overseas organisations

First ever global survey of reef sharks reveals widespread decline

Reef sharks are a key part of the reef ecosystem. They play an important role in maintaining healthy coral reefs, particularly at a time when reefs are already threatened by climate change.

Photo credits: AIMS

A landmark global survey found sharks are functionally extinct on many of the world's coral reefs, meaning shark populations had declined to the point where they can no longer play a significant role in their reef ecosystem.

The world-first Global FinPrint study, published in *Nature*, saw hundreds of researchers survey 371 reefs in 58 countries over 4 years. Sharks were not observed on almost 20% of reefs surveyed around the world, indicating a widespread decline that had previously gone largely undocumented.

The findings demonstrate a potential ecological disaster, alongside significant economic losses from reduced reef tourism.

Reef sharks maintain a functioning reef ecosystem leading to more coral on tropical reefs. They control an overabundance of mid-size predatory fish predators such as snappers and emperors, who eat the smaller herbivorous fish that keep the coral healthy by feeding on turf algae,

The survey, which captured and analysed more than 15,000 hours of underwater video, suggests good management, including the control of shark fishing, plays a key role in determining the status of reef sharks.

Fortunately, the study found Australian reef shark populations are among the healthiest. Shark populations on Australian coral reefs are still largely intact, with the most commonly observed species being grey reef, whitetip reef and blacktip reef sharks. Reef shark conservation is also effective in other nations including the Bahamas, the Federated States of Micronesia, French Polynesia, the Maldives and the United States.

Rebuilding shark numbers is financially important. Reef sharks are particularly crucial to the economies of many small island nations because they are a key attraction for reef tourism. This has led to the establishment of shark sanctuaries in places such as Palau.

This study will assist countries to protect these top-level predators and in turn aid reefs in their recovery from climate-related disturbances such as cyclones and marine heatwaves.

This research was a multinational effort to tackle a global challenge. To achieve this success, AIMS collaborated with Florida International University, Curtin University, Dalhousie University, and James Cook University. ■

Coral seeding of Woppaburra corals on the Keppel Islands

This research underpins reef restoration interventions to seed and grow corals at scale.

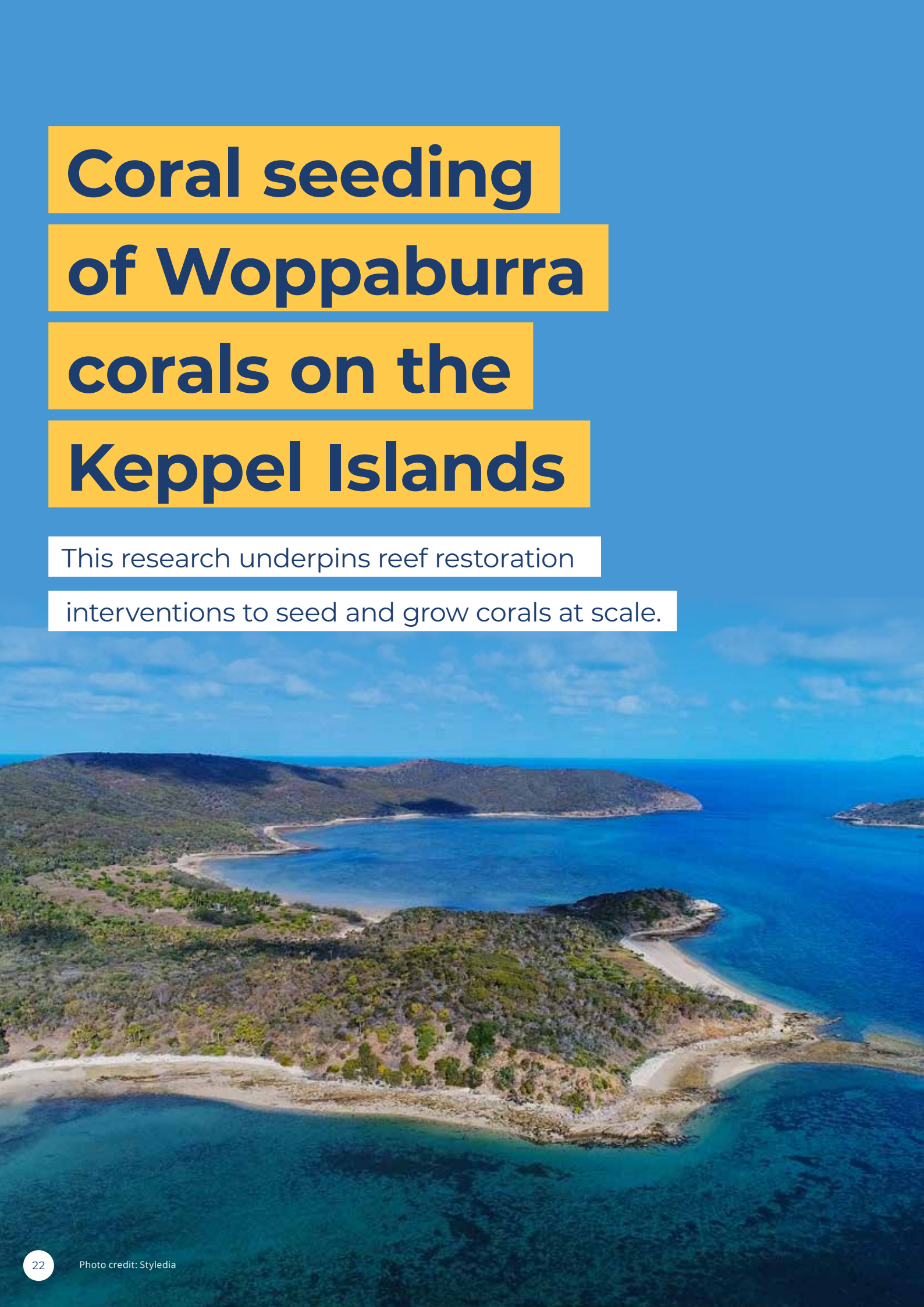


Photo credit: Styledia

Research to support reef resilience, adaptation and restoration is an urgent priority for marine science.

Often, less than 10% of settled coral recruits survive their first year on the reef. To optimise reef restoration efforts, we need to better understand the environmental factors that influence these high rates of mortality.

The Keppel Islands Coral Project investigates the process of 'coral seeding' in a bid to reduce this high mortality during the corals' first year of life. It is one of many innovative tools AIMS is exploring to help coral reefs recover from the effects of climate change.

The research is being carried out on Woppaburra sea Country, on the southern Great Barrier Reef near Rockhampton in Queensland, as part of the Australian Coral Reef Resilience Initiative (ACCRI). This national endeavour takes a unique, whole-of-system approach to developing methods to improve the resilience of coral reefs.

The coral seeding project involves researchers using both laboratory and field-based experiments to identify the most favourable environmental and biological conditions for the growth and survival of re-seeded corals.

Scientists first spawn corals at AIMS National Sea Simulator – the world's most sophisticated research aquarium, based at AIMS in Townsville – and then place or 'sow' the young corals onto degraded reefs using small devices. They seek to determine whether the method could speed the recovery of damaged reefs.

The coral seeding research informs our understanding of reef adaptation and recovery and underpins new interventions to seed and grow corals at scale, which could be applied elsewhere on reefs in Australia and the rest of the world.

This research supports AIMS' strong focus on reef adaptation science. It demonstrates our goal to provide solutions to improve marine ecosystem health along with engaging with Traditional Owners in key science.

This project is in partnership with Woppaburra Traditional Owners, and, as part of ACRRI, is jointly funded by BHP and AIMS. ■

Photo credit: Carly Randall

Photo credit: Gemma Molinaro

New CoTS-detection test as quick as a home pregnancy test

AIMS researchers developed a dipstick test to detect crown-of-thorns starfish (CoTS) on coral reefs using the same technology as home pregnancy tests.

Photo credit: AIMS

Photo credits: Mick Vaughan

A new dipstick test, designed to be used in the field, can support an early warning and intervention system for future CoTS outbreaks. Citizen scientists, tourism operators and Great Barrier Reef managers can also use the test to help with early detection of the coral-eating pest.

AIMS scientists Jason Doyle and Dr Sven Uthicke developed the dipstick test which measures specific DNA that CoTS release into the seawater. The rapid test can detect very low numbers of the starfish, which are difficult to spot with current survey methods.

Younger CoTS can be as small as a couple of millimetres, and larger starfish are also very good at hiding within the many crevices of coral reefs. This makes it harder for traditional diver surveys to find the creatures and identify emerging outbreaks.

The study published in the journal *Environmental DNA* builds on previous laboratory-based DNA-detection techniques to find CoTS more effectively prior to an outbreak.

An average adult CoTS (*Acanthaster cf. solaris*) can eat up to a dinner-plate amount of coral every day, and outbreaks contribute considerably to the loss of corals on the Great Barrier Reef, which is currently experiencing its fourth outbreak since 1962.

Mr Doyle and Dr Uthicke adapted an off-the-shelf dipstick and a technology called Lateral Flow Assay (LFA) to detect DNA in marine environments. LFA has been used for many years in home blood sugar and pregnancy tests, and more recently for coronavirus tests.

The new test can measure very small amounts of CoTS DNA, down to 0.1 picogram, making it potentially sensitive to very low densities of the animal.

The study was supported by a National Geographic Society grant and the Ian Potter Foundation. ■

Environmental performance

Water Usage

Our operations at Cape Ferguson used 50.4 megalitres (ML) of water in 2020–21, a reduction of 4 ML.

Recycling

Our co-mingle recycling program reduced the amount of solid waste we sent to landfill by 27 tonnes in 2020–21 (a 22% reduction on the previous year).

In 2020–21 we recycled 17,700 kg of paper, cardboard and plastic products. We continue to recycle batteries, printer cartridges, lubricants and metals.

Energy Usage

Cape Ferguson electricity consumption for 2020–21 was 6,309 megawatts (MW), a small increase on the previous year, due mainly to increased cooling demands from a longer summer. This consumption was offset by increased PV solar production of 1,624 MW compared to 1,396 MW the previous year.

Radiation Safety

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

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 with genetically modified organisms (GMOs) were submitted to the AIMS Biosafety Committee this year.

None of the existing GMO projects finished during this time. AIMS now has 4 active GMO projects: 2 Notifiable Low Risk Dealings (NLRDs) and 2 exempt dealings.

AIMS Index of Marine Industry

The ‘blue economy’ is a vital part of the Australian economy.

More than 85% of Australia’s population is concentrated near the coast and more than 70% of Australia’s territory lies beneath the ocean.

Our national marine industry – or blue economy – is an important, vital and growing part of the Australian economy, recording a four-fold increase in value over the past 2 decades.

Marine-based industries build economic value, create employment, and improve livelihoods. The sustainable productivity of many marine industries is underpinned by AIMS’ scientific research.

The AIMS Index of Marine Industry is a biennial economic update of the value the marine sector contributes to Australia’s wealth. The 2020 edition, undertaken by Deloitte Access Economics under AIMS leadership, examined data released since the previous index and available only to 2017–18.

The Index found the value of Australia’s marine industry increased by almost 28% in 2 years, contributing more than $80 billion a year and employing almost 340,000 full-time workers. In 2017–18, our $81.2 billion blue economy produced more than the agricultural sector ($58.9 billion), coal mining ($69.7 billion) and heavy and civil engineering construction ($68.5 billion).

The 2020 AIMS Index of Marine Industry found growth in the total income of the marine industry over the 2 years

was driven by offshore natural gas production (up 79%), shipbuilding and repairs (up 57%), and marine tourism (up 11%).

Now in its 8th edition, the AIMS Index of Marine Industry, for the first time, includes breakdowns of key marine industry sub-sectors by state or territory. It also uses an illustration of the values provided by the Great Barrier Reef as an example of the broader economic, social and environmental significance of marine assets, and the susceptibility of these values to the effects of climate change.

It acknowledges the COVID-19 pandemic brought unprecedented disruption to the Australian economy which will be measured by the next index due to be published in 2022. ■

Study rewrites the book on whale shark growth

A decade-long study shows that females grow slower and larger than males.

AIMS researchers found female whale sharks grow slower than males but end up being larger by a considerable margin, reaching an average length of about 14 metres.

According to a decade-long study of the iconic fish at Ningaloo Reef, male whale sharks grow quickly, before plateauing at an average adult length of about 8 or 9 metres. While growing more slowly, female whale sharks eventually overtake the males. This is in complete contrast to our previous understanding which indicated no difference between the sexes.

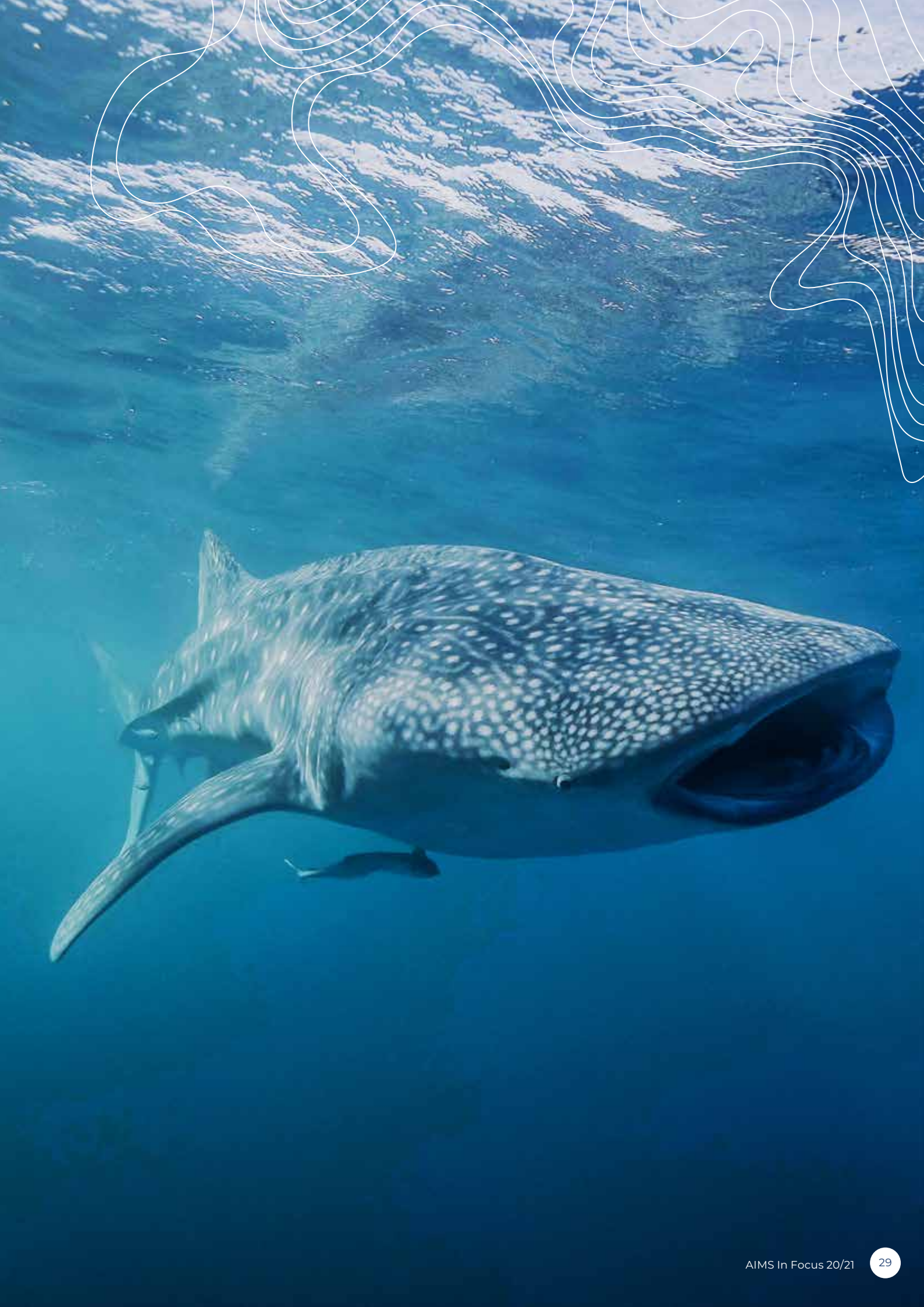
The Ningaloo growth study has important implications for the global conservation of the species. Protected in the coastal waters of Australia and many other countries, the species was still listed as Endangered by the International Union for the Conservation of Nature in 2016.

Whale sharks are threatened by targeted fishing and ships strikes, which is a major concern for a very slow-growing animal that can take 30 years or more to reach maturity, and could be killed before it has the chance to breed.

In conducting the research, marine scientists visited Western Australia's Ningaloo Reef for 11 seasons between 2009 and 2019. They tracked 54 individual whale sharks as they grew – a feat made possible by a unique 'fingerprint' of spots on each animal. The team recorded more than 1,000 whale shark measurements using stereo-video cameras, and also used overseas data from whale sharks in aquaria. The study was published in the journal *Frontiers in Marine Science*.

Whale sharks are Western Australia's marine emblem, and swimming with the iconic fish at Ningaloo Reef boosts the local economy to the tune of $24 million a year. ■

Photo credits: Andre Rerekura



ReefWorks: the world's first tropical marine test range

ReefWorks will streamline commercialisation of next-generation marine technologies in robotics, autonomous systems and artificial intelligence.

Photo credit: Geoff Page

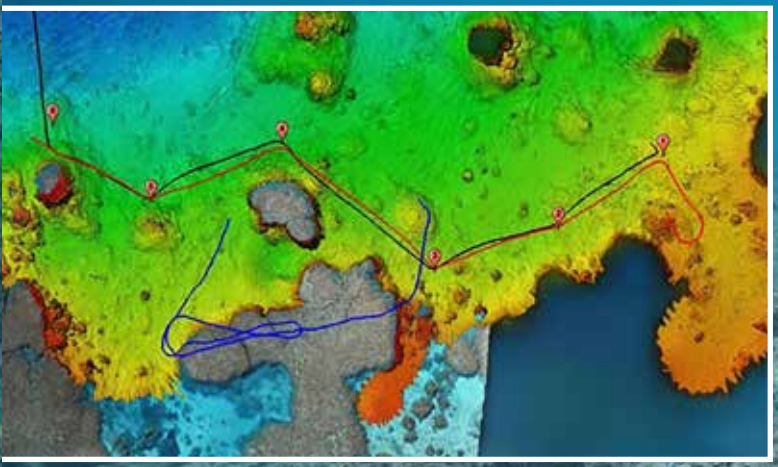
Australia has, until now, lacked the capability to routinely test marine technologies, uncrewed systems and new sensors.

AIMS is extending its marine technology testing infrastructure and capability to a new national facility available to industry, government, and academic innovators.

ReefWorks will allow for the safe testing of autonomous – or self-driving – systems in a real-world environment.

Self-driving systems have stringent compliance requirements for managing risks to personnel, equipment, vessels and the environment.

AIMS has leveraged its existing facilities and expertise to establish ReefWorks, the world's first tropical marine technology test and evaluation facility.



Based at our headquarters in Townsville, ReefWorks will streamline commercialisation of current and next-generation marine technologies in robotics, autonomous systems and artificial intelligence for the tropical marine environment.

It will propel Australian marine technology innovation into a sustainable, national sector servicing Australia's marine activities in northern Australia and the Indo-Pacific.

ReefWorks entered its Foundation Stage in 2021 in partnership with the Queensland Government.

Services and facilities at ReefWorks include:

- marine platform and sensor test tanks
- tropical marine test ranges offering different representative environments, with drone corridors to routinely verify the performance of uncrewed underwater, surface and aerial platforms
- digital simulation to enable selected development, testing and certification activities. This will vastly increase development rates while reducing costs.

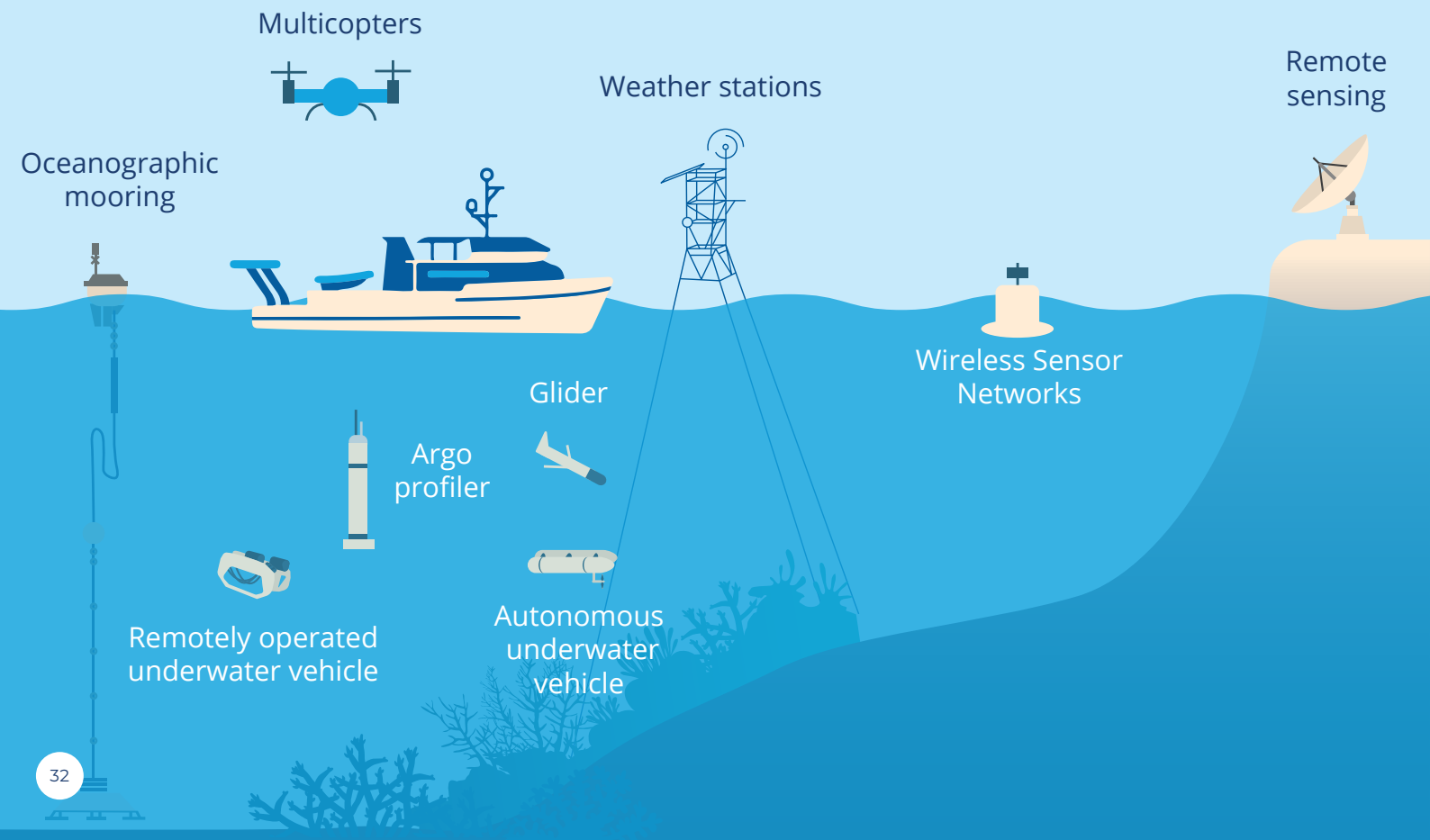
ReefWorks expands Australia's capability to tackle such challenges as coral bleaching and other impacts of climate change. Sectors that will potentially benefit include environmental monitoring, reef restoration, defence, education, filmmaking, search and rescue, transportation, storm-tracking, forecasting, and ocean mapping.

The facility is an important new capability for AIMS in supporting broader marine engineering solutions. ■

Photo credit: Scott Bainbridge

Field technology

Photo credit: Eric Lawrey



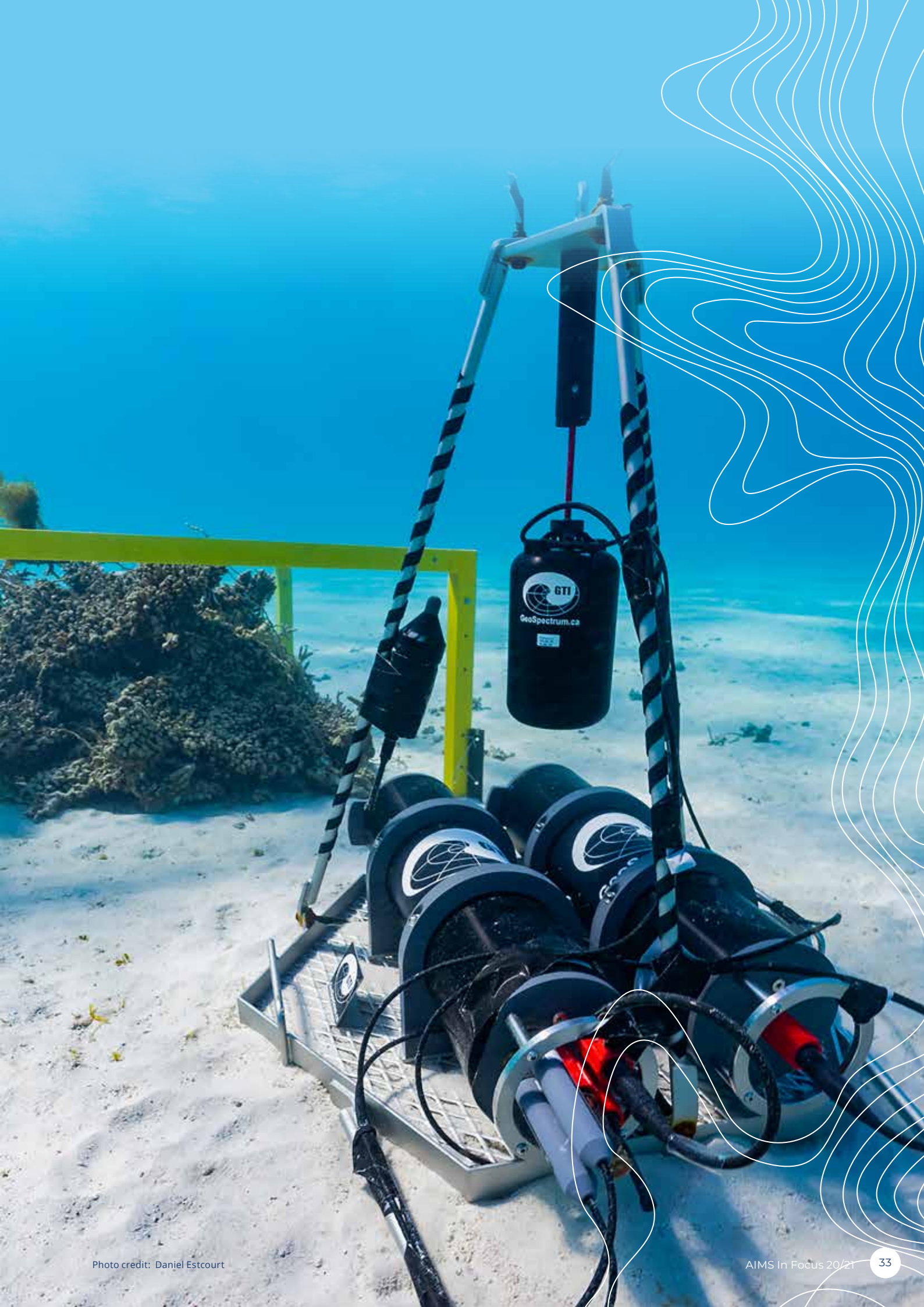


Photo credit: Daniel Estcourt

Seismic surveys and commercially valuable fish

AIMS-led research is the first of its kind to use a dedicated seismic vessel to measure the effects of survey noise in the ocean.

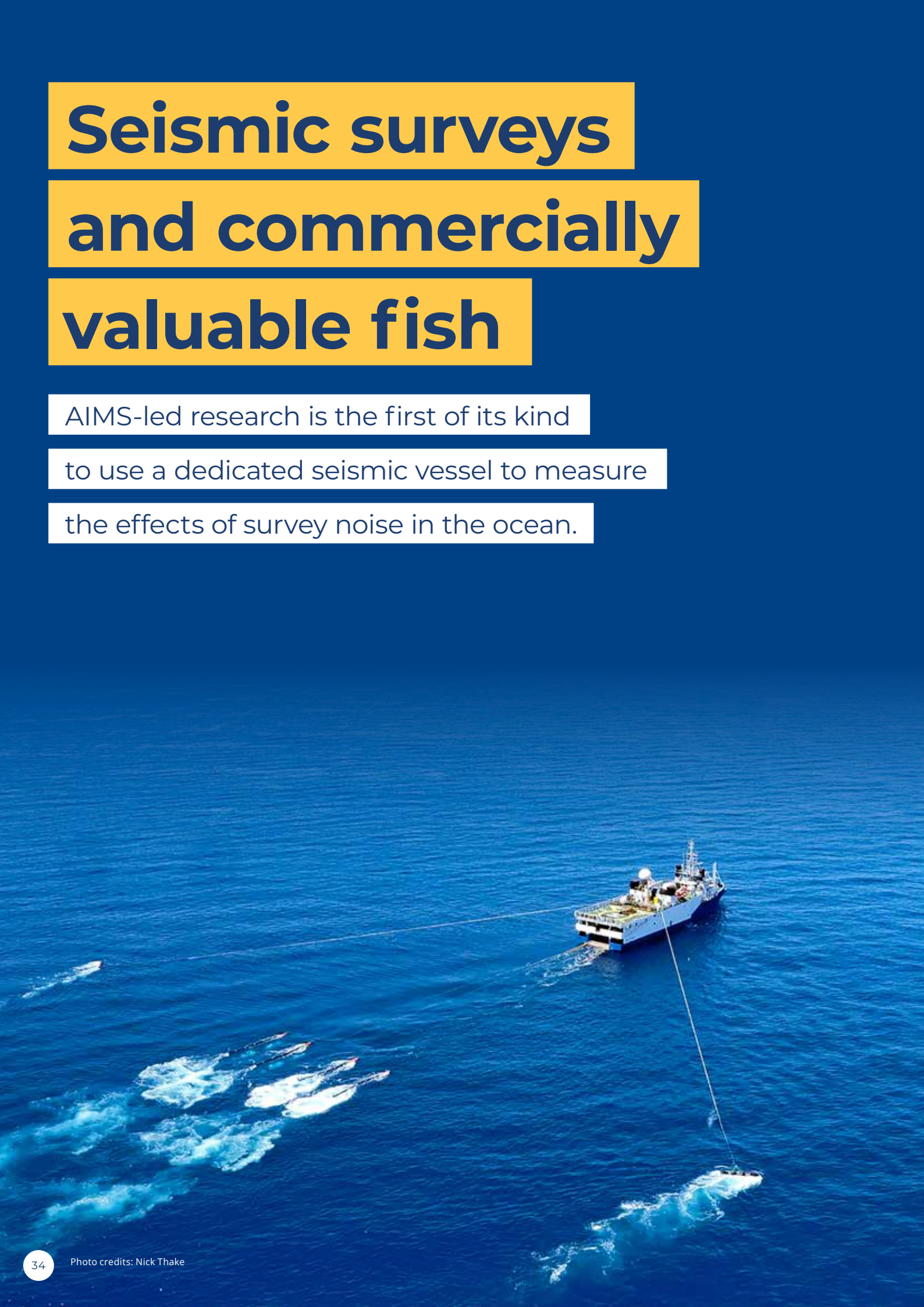


Photo credits: Nick Thake

A major study found no evidence that marine seismic surveys used in oil and gas exploration impacted the abundance or behaviour of bottom-feeding fish off the north-west coast of Western Australia.

The 8-month study measured the effects of seismic airgun blasts on commercially valuable species, such as the red emperor (*Lutjanus sebae*).

Conducted in a 2,500 square kilometre fishery management zone off the North West Shelf, the research was unique in using a seismic vessel, along with advanced technologies, to track and measure possible impacts.

To understand the impacts, AIMS scientists used underwater cameras 600 times to track and measure the behaviour of benthic fish before and after firing seismic airguns into the ocean. They tagged and tracked 387 red emperors via an array of acoustic sensors.

The study was designed in part to address commercial fishers' concerns that seismic noise could change the abundance and behaviour of key fish species and to determine whether commercially valuable fish leave the area or hide when exposed to seismic surveys.

Oil and gas companies use seismic airguns to search for lucrative oil and gas deposits that could be buried in the sea floor.

The researchers found no evidence of effects on the abundance, behaviour and movement of bottom-living fishes, suggesting seismic surveys have little impact on commercially valuable fish species in this environment.

The research filled a key knowledge gap necessary for managers, marine industries and policymakers to make informed decisions about sustainable use of shared resources on the North West Shelf. The magnitude of the study means the results also provide valuable knowledge on potential impacts in similar environments, both within Australia and internationally.

The research was a collaboration between AIMS, The University of Western Australia, Curtin University, the University of Tasmania and the WA Department of Primary Industries and Regional Development. It is part of the North West Shoals to Shore Research Program, which is supported by Santos as part of the company's commitment to better understanding Western Australia's marine environment. The program continues to investigate the impacts of seismic surveys on *Pinctada maxima* (pearl oysters). ■

Townsville

PMB No. 3, Townsville MC QLD 4810

Telephone: 07 4753 4444 | Facsimile: 07 4772 5852

Darwin

PO Box 41775, Casuarina NT 0811

Telephone: 08 8920 9240 | Facsimile: 08 8920 9222

Perth

Indian Ocean Marine Research Centre

University of Western Australia (M096)

35 Stirling Highway, Crawley WA 6009

Telephone: 08 6369 4000 | Facsimile 08 6369 4050

Canberra

AIMS Liaison Office

Level 6, Industry House, Canberra ACT 2601

Telephone: 02 6243 7182