UNIVERSITY of TASMANIA

IMAS

Institute for Marine and Antarctic Studies

SUSTAINABLE MARINE RESEARCH COLLABORATION AGREEMENT ACTIVITY REPORT

2019—2020

UNIVERSITY of TASMANIA

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Institute for Marine and Antarctic Studies

IN THIS REPORT

INTRODUCTION FROM THE CHAIR

Surrounded by ocean, people living in Tasmania have always had a strong connection with the marine resources and coastal waters of our island state. Commercial and recreational fisheries, wild harvest and aquaculture all play a part in responsibly managing Tasmania's marine resources. Important for ensuring the sustainability of our marine environments is the work of the Sustainable Marine Research Collaboration Agreement (SMRCA).

The SMRCA is a partnership between the University of Tasmania and the Tasmanian Government, first established as the Tasmanian Aquaculture and Fisheries Institute (TAFI) in 1998 and renewed in 2010. Since then, the SMRCA has provided advice on the status of marine resources and its management, based on thorough, collaborative research with government, industry, and the community. This work informs Government decisions that impact on our local fisheries and aquaculture industries.

Tasmanian bark canoe, with hearth, by Rex Greeno.
National Museum of Australia.

The joint SMRCA partnership benefits the University of Tasmania and the Tasmanian Government. The Government benefits from the intellectual contributions of University staff and the student contributions to research. This high-quality research has put the University at the top of Excellence in Research for Australia (ERA) for fisheries science and within the top 10 globally* for fisheries, marine and freshwater biology, and oceanography.

I would like to acknowledge the SMRCA for its excellent work in the last 10 years and I look forward to seeing its continued success during the next decade.

DEIDRE WILSON

SMRCA Chair
Deputy Secretary, Department of Primary Industries, Parks, Water and Environment

*The Centre for World University Rankings (CWUR) 2017

As a reflection of our recognition of the deep history and culture of this island, the University of Tasmania acknowledges the *muwinina* and *palawa* peoples, the traditional owners and custodians of the lands and waters on which we work and live, and upon which this campus was built. We pay our respects to Elders past, present and emerging.

OUR PURPOSE

OUR PURPOSE

The Sustainable Marine Research Collaboration Agreement (SMRCA) is a partnership between the Tasmanian State Government and the University of Tasmania through the Institute for Marine and Antarctic Studies (IMAS).

The SMRCA supports the effective and sustainable management of Tasmanian marine resources, to ensure the maximum benefit to Tasmania's environment, economy, and industries. Established in 1998, it was integral to the formation of the Tasmanian Aquaculture and Fisheries Institute (TAFI) joint venture between the State Government and the University of Tasmania.

IMAS has continued to provide research that supports sustainable growth of Tasmanian marine resources including through tracking the status of fish stocks, analyses on how to improve management, plus strategic projects to improve production.

Today, our research recognises the different uses of marine resources, including customary use by Tasmanian Aboriginal communities, and recreational and commercial use. Our activities focus on improving performance and yield, understanding population biology, and improving production methods and increasing efficiency. We also provide science-based advice on efficient management, regulation and governance.

Our researchers have wide-ranging expertise and work in multi-disciplinary teams across biology, ecology, sociology and economics, as we aim to maximise the long term benefits from marine resources to the Tasmanian community.

More information is available in the *Sustainable Marine Research Collaboration Strategic Plan 2017-2021* – download at tinyurl.com/SMRC-Strategic-Plan.

Through the SMRCA partnership, IMAS is:

- **undertaking leading, world-class research into temperate marine and coastal environments**
- **providing fisheries, aquaculture, estuarine and coastal environmental research and development services to the Crown, the University, and the fishing and aquaculture sectors**
- **building the capacity of people working in temperate marine research, including postgraduate students**
- **engaging with industry, encouraging partnerships, connections and integrated arrangements that will assist in achieving the aims of the Agreement**
- **supporting the Crown's legislative and administrative obligations through research, data and advice**
- **promoting Tasmania's natural marine resources by encouraging and contributing to the development of new industries that are sustainable, now and into the future.**

YEAR IN REVIEW

Under the SMRCA program, we bring together a diverse and dedicated team to deliver our vision for excellence in fisheries and aquaculture research and education.

In this report, we showcase some of our SMRCA teams' achievements in 2019 and 2020.

It is this dedication and commitment to conducting outstanding science that has seen the SMRCA maintain its research excellence ERA 5 ranking, well above the world standard for fisheries science.

Our focus has always been on delivering research that makes a difference. We work to be relevant and reliable so that our research outcomes are extended into management decisions, helping promote sustainable industry and community interactions with our marine and coastal environments.

This includes developing innovative aquaculture production, investigating the environmental interactions of salmon aquaculture, and delivering wild fisheries assessments, major national surveys, fisheries modelling and mapping, and fish health and seafood safety research. We also investigate the human dimensions of the recreational and commercial fishing sectors.

The SMRCA is committed to providing the community with credible and balanced information about our marine resources. We communicate our science through mainstream, electronic and social media, and through stakeholder and public engagement such as exhibitions, events, student outreach programs, presentations, panel discussions and more.

During 2020, we have all lived and worked through challenging times, as we faced the COVID-19 pandemic together. At IMAS, we made important changes to the way we operate and conduct our research, to keep our research progressing, and our people and the communities we work in safe and healthy.

PROFESSOR CALEB GARDNER

Director, SMRCA

ERA 5 SMRCA's research excellence ranking (ERA) is well above the world standard for fisheries science

$10 million average yearly total investment in SMRCA activities for one of Australia's largest and most successful fisheries and aquaculture programs

79 IMAS PhD candidates contributed research outputs to SMRCA projects during 2019 and 2020, while also building valuable skills in marine resource research

13 fisheries & aquaculture students graduated in 2019–2020

397 days with research teams on the water over 12 months from 1 Dec 2019, across our IMAS fleet and non-IMAS vessels

87 papers and reports published 2019–2020

OUR PROGRAMS

OUR PROGRAM

Our fisheries and aquaculture research is conducted under five programs:

- Aquaculture Environment
- Aquaculture Production
- Wild Fisheries
- Fish Health, Biosecurity and Seafood Safety
- Human Dimensions and Modelling.

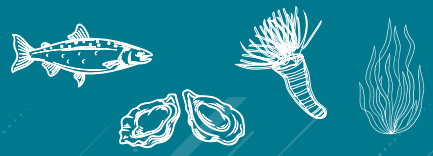
Our research is supported by our state-of-the-art laboratory, aquaculture, and boat and dive facilities.

AQUACULTURE PRODUCTION

Bringing together biology and technology for increasing the production of aquaculture species, including Atlantic salmon, rock lobster, oysters and seaweed

Program leader:
- **Greg Smith**

Teams:
- **Molluscan Aquaculture**
- **Lobster Aquaculture**
- **Salmon Aquaculture**



AQUACULTURE ENVIRONMENT

Research to understand and manage the ecosystem interactions of aquaculture

Program leader:
- **Jeff Ross**

Team:
- **Aquaculture Environmental Interactions**

WILD FISHERIES

Sustainably increasing production and value to the community from recreational, traditional and commercial fisheries

Program leader:
- **Sean Tracey**

Teams:
- **Recreational Fisheries**
- **Scalefish and Cephalapod Fisheries**
- **Dive Fisheries**
- **Crustacean Fisheries**
- **Bivalve Fisheries**

FISH HEALTH, BIOSECURITY AND SEAFOOD SAFETY

Research to protect the health of seafood consumers and aquatic organisms, including issues of toxic marine algae, biosecurity of farmed seafood, and disease

Program leader:
- **Alison Turnbull**

Team:
- **Fish Health, Biosecurity and Seafood Safety**

HUMAN DIMENSIONS AND MODELLING

Modelling, economic and sociological approaches to optimise benefits to the community from fisheries and aquaculture

Program leader:
- **Klaas Hartmann**

Teams:
- **Human Dimensions**
- **Modelling and Mapping**

AQUACULTURE PRODUCTION

Bringing together biology and technology for increasing the production of aquaculture species including Atlantic salmon, rock lobster, oysters and seaweed.

PROGRAM LEADER:

- Greg Smith

RESEARCH TEAM LEADERS:

MOLLUSCAN AQUACULTURE:

- Andrew Trotter

LOBSTER AQUACULTURE:

- Greg Smith

SALMON AQUACULTURE:

- Louise Adams

AQUACULTURE PRODUCTION

OVERVIEW

Our aquaculture production research brings together biology and innovative technology to increase the sustainable production of aquaculture species including Atlantic salmon, rock lobster, oysters and seaweed.

Our key collaborative partnerships and our ability to develop leading technology has enhanced our international research capacity in aquaculture. We seek to apply this scientific knowledge to advance global aquaculture to ensure food security for the future.

At our Experimental Aquaculture Facility (EAF), environmental characteristics like temperature can be controlled, and nutrition and other research can be done on large Atlantic salmon up to market size.

RESEARCH HIGHLIGHTS

Molluscan Aquaculture

Supporting Tasmanian oyster industry's rapid recovery from crippling POMS outbreak

The SMRCA has supported two Future Oysters CRC-P research projects that were critical for the recovery of the Tasmanian oyster industry, following the economically crippling 2016 Pacific Oyster Mortality Syndrome (POMS) outbreak.

Before the outbreak, the industry generated $26 million per annum and employed around 300 people. When POMS struck in 2016, the Tasmanian oyster industry lost more than $12 million and 80 jobs.

Oyster breeding was focused to select for family lines with high levels of POMS resistance. The result was disease resistance in adults approaching maximal values, with top Pacific oyster families for the last three-year classes all having greater than 90% POMS survival.

While disease resistance in juvenile oysters is less established, the success with adult oysters led to the SMRCA supporting the Australian Seafood Industries, CSIRO and IMAS in sourcing Federal funding to address lower survival in juvenile oysters.

Another area of research focused on advancing the understanding of POMS to guide farm management decisions in Tasmania, in collaboration with southern Tasmania oyster farmers. The project investigated the timing of disease in relation to elevated summer water temperature, along with oyster husbandry, including stocking density, oyster age and grading timing.

Based on these two projects, new industry practices were developed, with the new husbandry practices and selective breeding of disease-resistant oysters putting Tasmania's oyster industry on a pathway to complete recovery.

Within three years of the disease outbreak, farms were approaching full stocking densities and employment capacity. The outlook for the future is positive – an unprecedented outcome considering the disease has become endemic in countries across the world.

Photo: Australian Seafood Industry.

IMAS researcher Sarah Ugalde retrieves baskets holding oysters for POMS monitoring research.

Lobster Aquaculture

Towards a world-first sustainable onshore lobster aquaculture industry

Twenty years of dedicated and innovative lobster larval research has now made an Australian lobster aquaculture sector possible.

The research behind this achievement included developing a manufactured lobster larval feed, designing and manufacturing bespoke larval culture systems, and developing the ability to manipulate water quality to modulate adverse larval health.

Finding viable solutions to these long-standing problems has resulted in significant numbers of hatchery-produced lobster juveniles. Over the past two decades, lobster propagation program research has evolved from laboratory experiments focusing on lobster physiological, nutritional and health requirements, to pilot commercial production systems.

Lobster propagation research investigated four commercial species – Southern Rock Lobster *Jasus edwardsii*, Eastern Rock Lobster *Sagmariasus verreauxi*, Tropical Rock Lobster *Panulirus ornatus* and the Slipper Lobster *Thenus australiensis*.

Our research team is extremely proud that the technology will now be commercialised, with Tasmanian company Ornatas securing exclusive Australian rights to the hatchery production technology for Tropical Rock Lobster and the Slipper Lobster.

Overcoming the hurdle of larval rearing has also enabled the research focus to shift to commercial lobster grow-out in Australia, examining onshore lobster culture. We are now leading a major ARC-funded research project to establish the world's first closed-lifecycle rock lobster aquaculture industry focused on commercial, sustainable and socially acceptable lobster production – from hatchery to market.

The aim is to position Australia at the forefront of onshore lobster aquaculture, with the opportunity for technology transfer to other aquaculture sectors.

Tropical rock lobster *Panulirus ornatus*.

Salmon Aquaculture

Innovative science for a sustainable salmon aquaculture industry

Australian aquaculture continues to be dominated by salmonid production, so this industry remains a focus for our aquaculture research at IMAS – both directly with industry through traditional funding agencies, and through the new Blue Economy CRC.

Our salmon research has a strong focus on health and nutrition, and links to physiology and molecular research. We have helped develop feeds that are tailored to specific parts of the production process, such as for maturing broodstock fish or improving the quality of the final product.

While salmon is produced globally, our research has particular benefits for aquaculture in Tasmanian conditions, which tend to be warmer. This warmer water affects how fish metabolise food, so specialist local diets are needed for the best growth with minimal waste. Our research is also used by industry for managing fish health, biosecurity, fish welfare, and more.

Collaborating locally and around the world

Our research capacity in salmon aquaculture is enhanced through collaborative partnerships including with salmon growers Huon Aquaculture, Van Diemen Aquaculture and Petuna, and the feed producers Skretting Australia, Ridley Aquafeeds and Biomar.

Cross-sector collaboration is also vital to our research success. We work locally with the Tasmanian Institute for Agriculture and the Australian Maritime College through the Blue Economy CRC and with CSIRO, while our international collaborations include Skretting Norway, Biomar UK, DSM Nutritional Products and AQUI-S New Zealand, the Cawthron Institute New Zealand, the University of Stirling UK, the University of California in San Diego, the University of Copenhagen in Denmark, the Norwegian Veterinary Institute, and many other local and international organisations.

Better nutrition for reproduction performance and product quality

Recent research into the effect of temperature on product quality and salmon physiology have presented significant opportunities for modifying nutrition to improve reproductive and product quality and performance.

Our nutrition studies encompass all freshwater stages, through smolt and to marine grow-out, and provide a unique opportunity to track performance across all life stages. Similarly, gill health studies are now conducted across all life stages, focusing on the long-term effect of gill health on fish performance (see Fish Health program, p42).

Informing feed design for specific conditions

We've had great success in the design of summer salmon feeds, following the development of the first experimental model to study Atlantic salmon's dietary carotenoid utilisation at high temperature in post-smolt and harvest salmon.

Ongoing research into the interactions between temperature, brood stock nutrition and condition, and larval success are informing improved management and maturation practices. Meanwhile, studies into optimising dietary phosphorus inclusion in early hatchery stages has redefined the use of dietary phosphorus for production efficiency and reducing skeletal deformity in triploid salmon, and has enabled improved the design of feeds for these salmon under Tasmanian conditions. Better feeds are not only good for improving growth rate of fish, they reduce fish excretion and waste which contributes to reducing the environmental impact of fish farming.

Experimental Aquaculture: building a future-ready industry together

Located at IMAS Taroona, the Experimental Aquaculture Facility (EAF) is the first of its kind in the Southern Hemisphere.

The EAF delivers targeted and commercially-relevant research that is essential for ensuring the economic and environmental sustainability of these important industries – for Tasmania, Australia and the world.

Opened in October 2015, the EAF is a partnership between Huon Aquaculture, Skretting, IMAS, and the Tasmanian and Australian Governments.

This dedicated facility has significant tank capacity, where environmental characteristics like temperature can be controlled, and nutrition and other research can be done on large Atlantic salmon up to market size.

For salmonids, this capability accelerates economic and environmental benefits by:

- enhancing research into Amoebic Gill Disease management
- enhancing research into nutrition and aquafeeds
- reducing the environmental impact of salmonid farming
- reducing the fish losses due to high sea water temperatures, and
- maintaining the size of fish during extreme high temperatures.

Waldo Nuez Ortin – salmon PhD candidate, IMAS Taroona. Photo: Peter Mathew, July 2014.

Seaweed Aquaculture

First harvest for innovative seaweed aquaculture project

The Australian seaweed aquaculture industry is believed to have massive potential for use in numerous products. These include for human food and novel applications, such as incorporating a small amount of seaweed into cattle feed to eliminate methane emissions.

The development of an Australian seaweed aquaculture industry is currently the focus of a major research effort that has brought IMAS and Deakin University scientists together with industry, supported by the Australian Government, through the new Seaweed Solutions CRC-P.

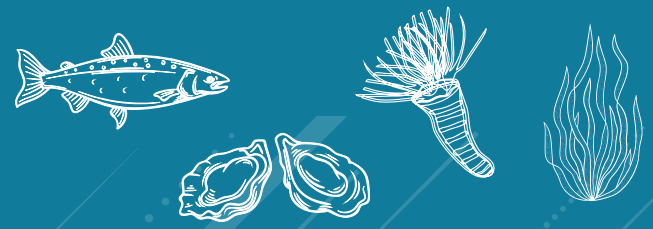
In early-September 2020, Australia's future seaweed industry came a step closer, with the first crop harvested from Spring Bay on Tasmania's East Coast.

Researchers are exploring the potential to farm three native species, with the giant kelp *Macrocystis pyrifera* proving to be the best performer in the harvest. While relatively modest in scale, the harvest is a significant milestone in taking seaweed aquaculture from a concept into a commercial operation.

The harvest was achieved despite many challenges posed by the COVID-19 pandemic, and is a credit to the successful collaboration between research and industry.

The research team is now analysing the composition and quality of the three species harvested, to determine the potential of these seaweeds for food and agriproducts, and how the Australian species grown in the clean cool waters off Tasmania differ from those grown elsewhere.

Harvested kelp (Photo Craig Sanderson).



AQUACULTURE ENVIRONMENT

Research to understand and manage the ecosystem interactions of aquaculture.

PROGRAM LEADER:

- Jeff Ross

RESEARCH TEAM LEADER:

AQUACULTURE ENVIRONMENTAL INTERACTIONS:

- Camille White

AQUACULTURE ENVIRONMENT

OVERVIEW

The SMRCA has a strong focus on research to monitor and minimise the environmental impacts of salmon farming, which the government relies on to manage this important but debated growth industry.

Our research delivers the scientific knowledge to support a sustainable and productive future for Tasmania's salmon aquaculture industry. Through the SMRCA, we are delivering against three ongoing projects:

- Exploring emerging environmental issues, social science and communication on salmon aquaculture
- Delivering the science to support planning new and emerging aquaculture operations in Tasmania
- Supporting the monitoring and ongoing management of current salmon farming operations in Tasmania, to ensure adequate monitoring practices and to recommend improvements.

We continue to lead and collaborate on other important research projects on the environmental interactions of salmon farming through key funding partners, including the Australian Government's FRDC and CRC programs. These projects include:

- Assessing the environmental performance of aquaculture development through our Storm Bay Observing System
- Managing ecosystem interactions across differing environments, to build flexibility and risk assurance into environmental management strategies
- Understanding oxygen dynamics and the importance for benthic recovery in Macquarie Harbour
- Addressing the challenges of offshore food and energy production, as part of the Blue Economy CRC
- Developing a sustainable, integrated multi-trophic aquaculture model to support commercial seaweed production and deliver economic, environmental and community benefits, as part of the Seaweed Solutions for Sustainable Aquaculture CRC.

This research supports the sustainable management and development of the industry in Tasmania and around the world.

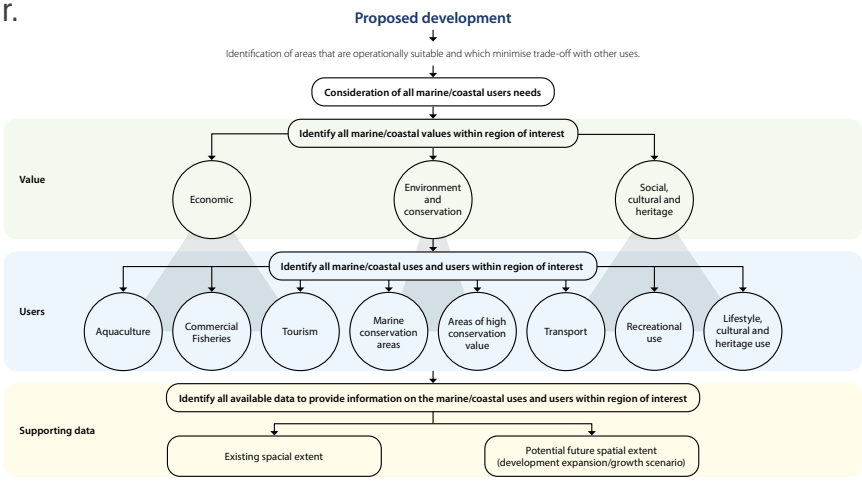
RESEARCH HIGHLIGHTS

Our Aquaculture Environmental Interactions team had an incredibly successful and rewarding period over the last two years. Some of our highlights include developing and conducting a successful trial of a spatial assessment decision support tool, playing a lead role in delivering the science to support the sustainable expansion of the industry in Storm Bay, and ongoing monitoring and public reporting of environmental conditions in Macquarie Harbour.

Pilot decision support tool for marine waters

Our researchers have developed and trialled a spatial assessment decision support tool that could assist decision-makers in assessing and balancing marine use change within Tasmanian coastal waters.

The pilot study was conducted in Tasmania's southeast coastal waters using existing data, GIS mapping and the software program MARXAN to capture a process for developing the tool.



Structural model illustrating the relationships between values, users and information sources when developing a decision support tool.

The Pilot Marine Spatial Assessment Tool identifies potential marine users who may have conflicting values for locating new development sites or relocating existing sites.

The tool is used to identify locations, under different development scenarios, that minimise the potential for competing resource use within the marine environment. The study demonstrated the potential use and constraints of such a tool in areas where sufficient data exists.

The project was completed in just over six months, with the team commended by DPIPWE and the project steering committee on their work in delivering a tool with the potential to be an important starting point within the broader planning process.

The success of this project has led to the development of the FRDC Marine Atlas project, which will help deliver access to the necessary data and GIS information for Tasmania's coastal waters.

Supporting sustainable expansion of aquaculture in Storm Bay

Our researchers continue to play a lead role in delivering the science that will support sustainable expansion of the salmon aquaculture industry in Storm Bay. Our nutrient dispersion modelling has enabled us to advise government on the environmental risks of different biomass scenarios during the planning phase.

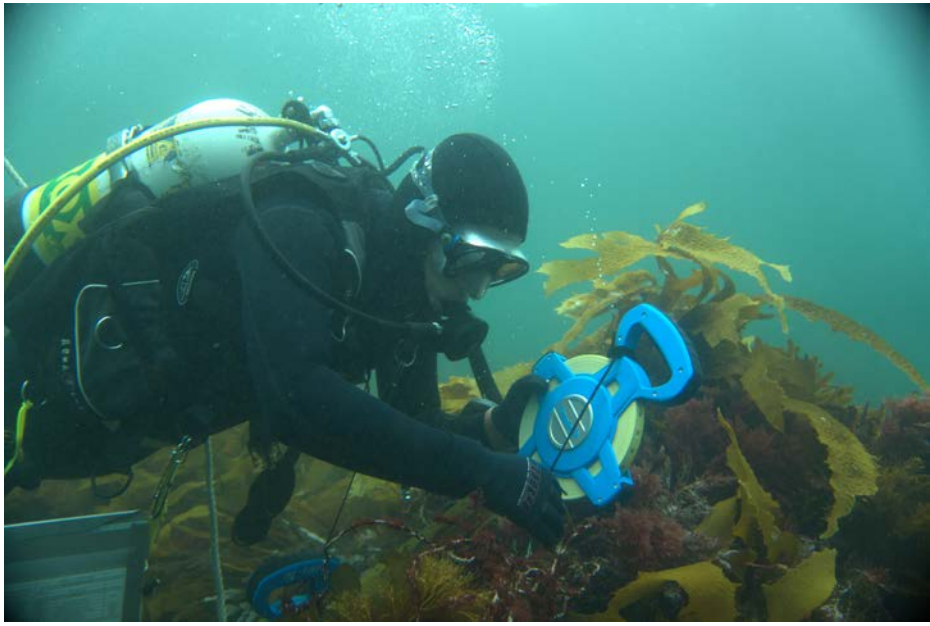
Meanwhile, the IMAS Storm Bay FRDC project has been pivotal in designing and implementing a monitoring program to assess the environmental performance of the industry. The data will also assist in calibrating and validating the biogeochemical model CSIRO are developing for the whole system.

This program will allow industry and government regulators to predict the effect of different farming inputs on the surrounding environment, under varying conditions and with different management scenarios.

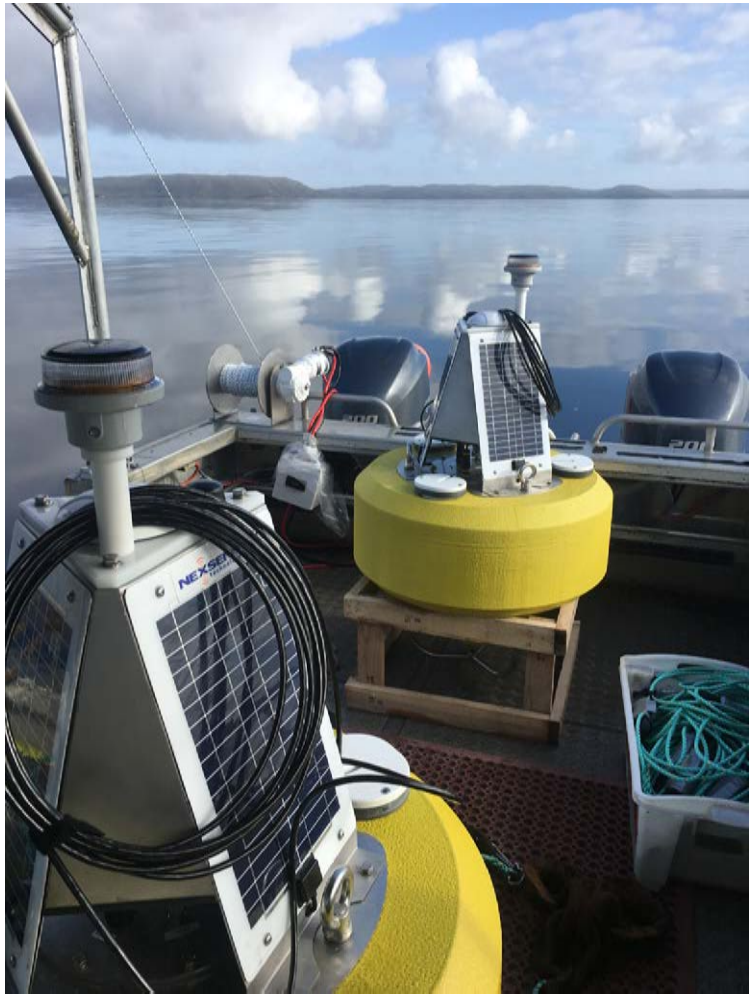
Over the past 18 months, we have engaged with community groups, industry, government and other research organisations and groups, to communicate the science supporting sustainable farming in Storm Bay.

This includes presentations to Members of the Legislative Council, as well as presentations to the Tasmanian Alliance for Marine Protection (TAMP), The D'Entrecasteaux Channel and Huon Collaboration (Our Waterway conference), the FRDC Board, DPIPWE Marine Resources, the EPA, salmonid companies and other organisations. We also presented at Blue Economy and Seaweed Solution CRC workshops, and presented a King Salmon MBIE Feed Conversion Efficiency Project workshop.

Meanwhile, our extension work in the Derwent Estuary led to a project with the Derwent Estuary Program, which will apply our Rapid Visual Assessment technique for inshore rocky reef habitats to Derwent Estuary sites.



Scuba surveys of inshore reefs are used to monitor the abundances and species richness of fish, invertebrates and algae.



Surface buoys house the strings of environmental sensors that provide realtime data (above) on the conditions and health of the harbour.

Monitoring environmental conditions in Macquarie Harbour

IMAS continues to play a lead role in providing scientific advice to government on environmental conditions in Macquarie Harbour, based on ongoing monitoring of oxygen dynamics and benthic conditions on the bottom of the harbour.

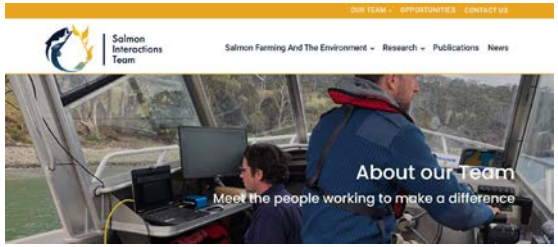
The project is funded by the Australian Government's FRDC, the Tasmanian Government, and Tasmanian Atlantic salmon aquaculture companies.

Our work includes engaging with the community on the health of Macquarie Harbour, through both mainstream media and community events, such as presenting the latest science on the health of the harbour and the status of the Maugean Skate to the Strahan community.

New website for salmon interactions team

Our Salmon Interactions Team has a new website for anyone to access up-to-date information about our research and projects. At salmoninteractionsteam.org, we highlight new knowledge and updates about the interactions between salmon aquaculture, the environment and society.

Website visitors can see our full team of experts and 'put faces to names', making our people and our work especially visible to project collaborators and stakeholders.



Our Team section of the Salmon Interactions Team website.

WILD FISHERIES

Sustainably increasing production and value to the community from recreational, traditional and commercial fisheries.

PROGRAM LEADER:

- Sean Tracey

RESEARCH TEAM LEADERS:

DIVE FISHERIES:

- Craig Mundy

CRUSTACEAN FISHERIES:

- Rafael Leon

BIVALVE FISHERIES:

- Jayson Semmens

RECREATIONAL FISHERIES:

- Sean Tracey

SCALEFISH & CEPHALOPOD FISHERIES:

- Jeremy Lyle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WILD FISHERIES PROGRAM (2019–2020)

OVERVIEW

For thousands of years, fishing has played an important role in human survival and cultural tradition. Today, recreational fishing is a popular pastime and provides economic and social benefits for our community, with our research showing that 24% of Tasmanians fish at least once a year.

For the 76% of Tasmanians who do not fish but may want to access to the bounty of the sea, seafood caught by commercial fishers is available. Some of Tasmania's seafood resources are also major export commodities, with the gross value of production from the commercial Southern Rock Lobster and abalone fisheries approaching $200 million per annum in most years (ABARES, 2020). These industries had much lower values in the second half of 2020 due to market disruption.

Our teams develop technology to study and monitor fish stocks and identify important trends in commercial and recreational fisheries. We also study the changing dynamics of fish populations, post-release survival, fish biology and resilience to environmental changes, and a range of other work.

Our research is allocated across teams in Dive Fisheries, Crustacean Fisheries, Scalefish and Cephalopod Fisheries, Bivalve Fisheries, and Recreational Fisheries.

Fisheries research outputs from IMAS have been independently assessed as world leading by the Australian Research Council through their Excellence in Research Australia (ERA) program. It is important to us that this research is not only excellent but also applied and useful. We're fortunate that the close relationship between IMAS research and management of marine resources at DPIPWE means that our activities make a difference in the performance of wild fisheries.

RESEARCH HIGHLIGHTS

Dive Fisheries

Our IMAS Dive Fisheries team has a focus on abalone and urchins, among other species. Our team tags and collects specimens, and conducts dive surveys. We also trial innovative software and equipment, such as NextGen GPS loggers for urchin and abalone fishers, and electronic abalone measuring boards with integrated weight recording and remote data transfer.

Investigating invasive sea urchin population changes

IMAS surveys of invasive Long-spined Sea Urchins *Centrostephanus rodgersii* along Tasmania's East Coast reefs have measured the increase in the urchin population, and the barren areas they create by overgrazing kelp beds.

In late 2018, our researchers conducted SCUBA and towed-underwater-video surveys spanning 156 sites across 13 East Coast locations between Eddystone Point and Recherche Bay, repeating a baseline survey carried out in 2001–02. We found that since a single Long-spined Sea Urchin was found in St Helens in 1978, the Tasmanian population has grown to an estimated 20 million.

Urchin biomass increased by an average of 170 tonnes each year through to 2018, before the urchin fishery expanded. Along the open coastline from Eddystone Point to Tasman Island, urchin barrens now cover an estimated 15% of reefs at depths of four to 40 metres, up from 3% in 2001–02.

The initial range-extension of the Long-spined Sea Urchin from New South Wales to Tasmania is the result of warming coastal waters, primarily driven by a strengthening East Australian Current. In the absence of abundant large predators such as rock lobsters, urchins have established in large numbers and are destructively overgrazing kelp beds.

On the East Coast, the urchins have largely transformed some reefs to barren grounds that are essentially underwater deserts, devoid of other marine life including important commercial species such as lobsters and abalone.

IMAS research is informing a range of measures fisheries managers are implementing to address the urchin problem. This currently includes increasing the abundance of rock lobster on the East Coast, by reducing the commercial and recreational catch, and translocating lobsters from the south west to the East Coast to accelerate population rebuilding.

Invasive sea urchins overgraze kelp beds, creating 'urchin barrens'. Photo: John Keane.

Harvesting urchins for their roe is a cost-effective control measure. This golden, creamy delicacy is called uni (*oo-nee*) in Japan.

Another management response has been facilitating an urchin fishing and processing industry for urchin roe. This has already resulted in catches increasing to over 560 tonnes in 2019, far larger than the average annual biomass increase seen in years before the fishery commenced. Culling operations have also occurred in locations less suitable for harvest, with each of these strategies attempting to restore areas where barrens have formed, and protect reefs from turning into barrens.

We track progress with these initiatives through our annual assessment of the urchin fishery, and also by fishery-independent surveys of urchin stocks and barren coverage along the east coast.

Monitoring Long-spined Sea Urchin complete harvest trial

Invasive Long-spined Sea Urchins were the target of a 'complete harvest trial' conducted in mid-2020 – and our IMAS researchers were on hand to monitor the trial and conduct sampling.

Conducted between Marion and Fortescue Bays on Tasmania's East Coast, the harvest aimed to prevent large scale urchin barren formation in productive abalone and rock lobster habitat.

Divers from the Tasmanian Commercial Dive Association (TCDA) removed 35 tonne of urchins across all size classes. During the harvest, our IMAS monitoring team sampled almost 10,000 urchins, while two thirds of the 35-tonne harvest was available for the RTS PauaCo facility to process.

Divers used new GPS and depth loggers to transmit data back to the researchers after each fishing activity. This enabled daily fine-scale mapping of diver activities and facilitated adaptive fishing practices.

We found that the 5% urchin barren observed in the harvest area between Marion Bay and Fortescue Bay in 2017 had not increased at the rate observed along other sections of coastline. We revisited towed video sites in late-2020 to monitor kelp recovery.

Funding from the Abalone Industry Reinvestment Fund (AIRF) enabled divers from the Tasmanian Commercial Dive Association (TCDA) to conduct the harvest.

Dive team collects abalone data in record time

Our IMAS researchers made up for time lost during the COVID-19 lockdown, working with commercial abalone divers to complete Blacklip Abalone dive survey research at 300 locations, despite Tasmania's chilly late-winter conditions.

We teamed up with four commercial abalone divers, and together we surveyed sites along the Eastern Zone of the abalone fishery, with most activity completed during August.

The rapid assessment dive surveys are conducted to determine the extent of depletion in the East Coast abalone blocks, with the data informing Tasmanian Government decisions on how to best manage recovery of depleted sections of the Eastern Zone abalone fishery.

Commercial abalone diver Bryan Denny (L) and IMAS researcher Lachlan Tainsh (R) prepare for their dive. Photo: Sean Larby.

From the data gathered, we can determine what proportion of the once-productive fishery could recover without intervention, which could include costly reseeding.

In 2020, six Eastern Zone reporting 'blocks' were closed to commercial abalone fishing due to overall declines in both catch and catch rates (catch per unit effort), and historically low catch rates since the 1990s. The recreational bag limit was also halved from 10 abalone to five.

To determine if sufficient remnant biomass remains over a high proportion of the known fishing grounds, we surveyed about 300 sites, at around 60 sites per block. These were selected based on identifying areas supporting medium-to-high catch rates up to 2017, from spatial GPS logger and corresponding catch data collected over the past seven years.

We used rapid assessment methods such as 'timed swims' to effectively measure widespread recovery and abundance, rather than the belt transect method which is better suited to estimating absolute biomass. The result was a snapshot of abundance and size-structure data, collected at a large number of sites, within a short period of time.

The dive survey was achieved despite the challenges posed by the COVID-19 pandemic, and is another example of the successful collaboration between research and industry.

To establish abalone growth rates, researchers measure and tag the abalone, then locate as many as they can 12-months later to see how much they have grown.

Crustacean Fisheries

Crustacean Fisheries research helps keep fishers engaged and data collection streamlined for resource management. Our work improves data collection, the efficient allocation of sampling efforts, and catch sampling programs. We also develop prototypes, such as the electronic calliper for fishers to measure lobsters on board.

Developing fast, efficient tools for data collection

IMAS researchers have developed an electronic calliper prototype designed to make lobster data collection more efficient for fishers and observers.

The electronic callipers have customised software and a built-in GPS, which streamlines and speeds up length measurement, and recording data including lobster sex, maturity, catch location and more.

We have also implemented an automated system to generate custom-made feedback reports for fishers involved in our research pot program. This keeps fishers informed on data they are collecting.

Two pots estimate lobster recruitment into the fishery

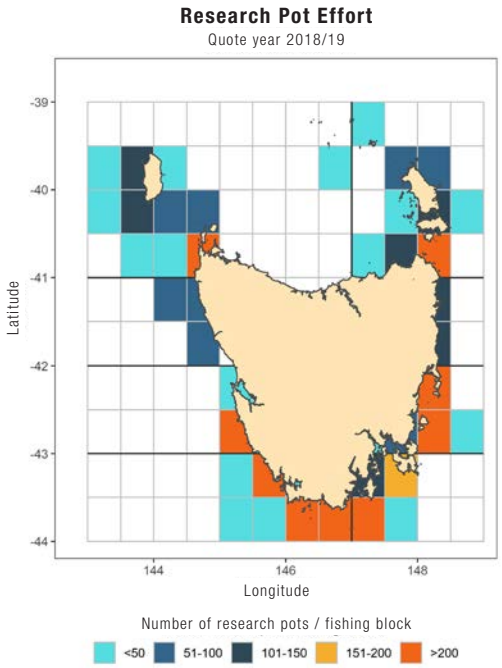
Fishers participating in our IMAS two-pots (2POTS) research program are contributing important data for estimating the biomass of recruits into the Tasmanian Rock Lobster Fishery for the next season, and are playing a vital role in the sustainable management of the fishery.

To carry out stock assessments and ultimately provide recommendations on the annual total allowable catch, researchers need data on the size structure of the lobster stock. We collect some data from commercial pots, but this is not ideal because these pots are designed with escape gaps to allow undersize individuals to escape, so the size structure data is biased.

Commercial fishers who volunteer for the 2POTS program are issued with permits to carry two extra pots with the standard escape gaps closed. They record and measure all lobsters captured by these two pots and can keep all legal-size lobsters caught. Their catch is still limited by the quota they hold.

Along with annual IMAS research trips at fixed sites around Tasmania, the 2POT program is designed to collect additional data on the whole stock size structure.

An added benefit is that the data fishers collect comes from all around Tasmania and over the entire quota year. This enables us to better understand and describe the spatial and temporal variations of lobster size and the biomass of pre-recruits.



2POTS research program – distribution of set research pots per fishing block in the last fishing season showing wide coverage around all areas with significant production.

Lobster organs and reflexes damaged by marine seismic surveys

Researchers have found that seismic air guns, used in geological surveys of the seafloor, damage the sensory organs and righting reflexes of rock lobster – and this is likely to affect their ability to function in the wild.

Our IMAS researchers collaborated with scientists from the Centre for Marine Science and Technology at Curtin University, in a series of studies into the effects of seismic air guns on marine animals.

During field tests in Tasmania's Storm Bay, rock lobster were exposed to seismic air gun noise. Researchers then examined the effects on a key sensory organ, the statocyst, and on lobster reflexes.

While the impact of air guns on whales and fishes has been relatively well-studied, the effects on marine invertebrates such as lobsters, crabs and squid remain poorly understood. The study focused on the impact on rock lobster, as they are a high value fishery and an important part of many reef ecosystems.

Previous studies have shown the statocyst, a sensory organ on a lobster's head, is critical in controlling their righting reflex, enabling them to remain coordinated and evade predators.

After exposing lobsters to the equivalent of a commercial air gun signal at a range of 100-150 metres, the study found that the animals suffered significant and lasting damage to these reflexes.

While the damage was incurred at the time of exposure, researchers discovered it persisted for at least one year, even after the exposed lobsters had moulted.

The findings add to a growing body of research showing that marine invertebrates can suffer physiological impacts and changes to their reflexes in response to anthropogenic noise, such as seismic surveys.

The research will enable government, industry and the community to make informed decisions about how these activities can best be conducted, while minimising negative outcomes for fisheries and ecosystems globally.

The study was funded by the Australian Government's Fisheries Research and Development Corporation, Origin Energy, and the Victorian Government's CarbonNet Project.

Seismic testing has been shown to damage the sensory organs and righting reflexes of rock lobsters, which can affect their ability to function in the wild.

Seismic air gun test in Storm Bay, Tasmania. Photo: Rob McCauley.

Rock lobster bycatch monitoring

Demand for sustainably and responsibly-sourced products and a shift in government monitoring and reporting requirements have put the spotlight on fisheries bycatch in recent years, including those with minimal bycatch.

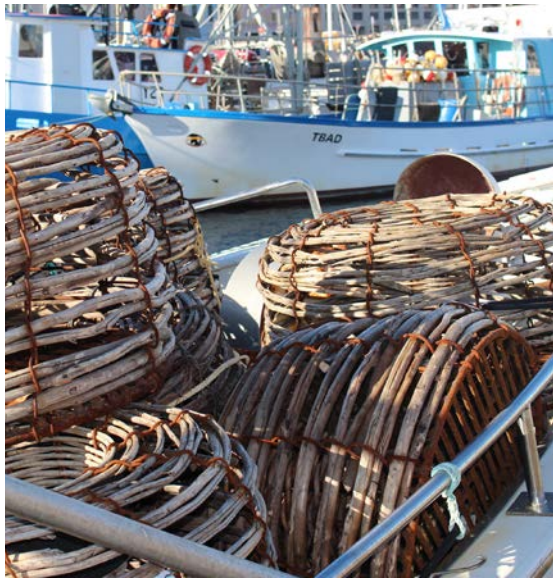
A recent Fisheries Research and Development Corporation funded project has helped raise the bar on bycatch data collection and monitoring in the Southern Rock Lobster Fishery (SRLF).

While bycatch is perceived as low impact for pot fisheries such as the SRLF, we needed to verify this assumption. Researchers from the South Australia Research and Development Institute, Victorian Fisheries Authority and IMAS worked together to assess bycatch data collection practices, perform a risk assessment for bycatch species, and recommend management strategies for South Australia, Victoria and Tasmania.

In Tasmania, hermit crabs were the top bycatch in number, and draughtboard sharks were the heaviest. Other obvious bycatch were octopus, velvet crab, leatherjackets, blue-throat wrasse, giant crab and conger eel.

In the SRLF risk assessments, no species were high-risk, however some species were labelled mid-risk. The mid-risk label was given because the species are kept as a by-product, and generally occurred due to a lack of information about their biological traits.

The mid-risk species included wrasse, leatherjackets and conger eel. We were able to estimate the total catches of each and set reference points for ongoing monitoring. A study is underway to fill knowledge gaps on the life-history of these species and then review the risk.



Scalefish and Cephalopod Fisheries

Our research supports the sustainable management of Tasmania's diverse scalefish and cephalopod fisheries. We work to better understand the biology and ecology of species sought by commercial and recreational fishers and how fishing and other human activities impact on non-target species.

Over the last 18 months, we carried out scientific surveys to assess banded morwong and sand flathead stocks, and researched the spawning dynamics of southern calamari, fishery opportunities offered by range-extending species, and the environmental ecology of the endangered Maugean Skate. We also collaborated with the Australian Antarctic Division to study the distribution of toothfish and the potential impacts of the toothfish fishery in East Antarctica.

Maugean skate vulnerable to Macquarie Harbour environmental conditions

Environmental conditions in Macquarie Harbour have declined over the past decade, and new IMAS research has highlighted the endangered Maugean skate's vulnerability to the changed conditions in what may be its only remaining habitat.

The Maugean skate is a rare and fascinating species, with one of the most restricted distributions of any member of the shark, ray and skate group. But the current environmental state of the harbour, coupled with the effects of climate change, appear to be challenging the skate's capacity to cope with its changing habitat.

Our research examined egg development and survival, physiological tolerances to varying oxygen and salinity conditions and, using sensors attached to adult skate, the links between dissolved oxygen conditions and the skate's behaviour in the wild.

A range of behavioural and physiological adaptations have enabled Maugean skate to survive in such a challenging environment, including the capacity to tolerate the range of salinities and oxygen levels they normally experience.

However, the study revealed signs of population stress. The data suggests there may have been a recent decline in juvenile recruitment, and there were also several unexpected mortalities among the tracked individuals during the study, many coinciding with periods of marked environmental variability

This study contributes to the growing body of knowledge about the Maugean skate, shedding light on some of the unique adaptations that have allowed this remarkable creature to survive in such a challenging habitat.

It also highlights uncertainties about the future conservation status of a species that is already listed as endangered. The success of any conservation strategy will ultimately depend on being able to effectively manage the environmental impacts of human activities in Macquarie Harbour.

The study was funded by the Australian Government through the Fisheries Research and Development Corporation, with additional support from the Tasmanian Government, the salmonid industry, and World Wildlife Fund for Nature.

Photo: Jeremy Lyle.

Photo: Neville Barrett.

Calamari spawning habits on Tasmania's north coast

Over the past decade, the Southern Calamari fishery in northern Tasmania has experienced a rapid increase in effort, as well as volatility in catches since 2015. This has raised concerns for both fishers and fisheries managers.

Since 2016, our IMAS researchers have been investigating the distribution and intensity of Southern Calamari spawning activity along the north coast of Tasmania, to provide a scientific basis to improve the management of this fishery and inform spawning season closures.

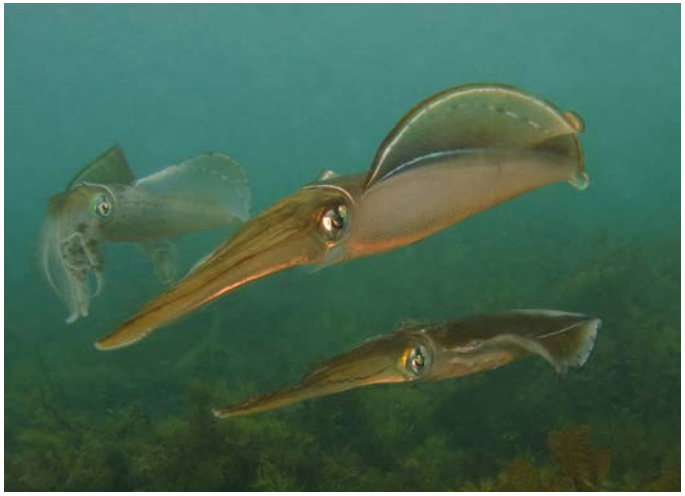
The focus of the study was to confirm the peak Southern Calamari spawning season and identify potential spawning 'hotspots' along the coast.

Since calamari only live for a year and die naturally soon after spawning, pinpointing the optimum and sustainable fishery opening times is a challenge. The aim of fishery closures is to enable mature calamari to lay their eggs, but re-open the fishery before they die after spawning.

Researchers conducted egg mass surveys across four consecutive spawning seasons from 2016 to 2020. Consistent with the advice of fishers, they found the eastern and western extremities of Bass Strait were hotspots for spawning aggregations.

Rainfall and sea surface temperatures were also found to impact spawning. High winter rainfall before the spawning season commenced was strongly connected to high catches and spawning intensity, while low catches were linked to low pre-season sea surface temperatures followed by a steep increase in temperature.

Funded by the Fisheries Research and Development Corporation, the study has provided an evidence base for applying spawning season closures, to improve management responses to the challenges facing the fishery.



Southern Calamari *Sepioteuthis australis*. Photo: Antonia Cooper, Reef Life Survey.

Pecten fumatus. Photo: Hugh Pederson.

Bivalve Fisheries

Our Bivalve Fisheries team studies scallops and minor fisheries species such as native oysters, clams and cockles. Through our research on life-history relationships, we determine growth rates, spawning periods and fecundity, which contributes to sustainable management practices.

The data from our stock assessments inform Tasmania's total allowable catch. We also research anthropogenic impacts on bivalve stocks, such as the impact of seismic testing on scallops.

Establishing when and where to fish for scallops in Tasmania

The commercial scallop fishery targets *Pecten fumatus*, one of three naturally-occurring species in Tasmania.

These fisheries were overfished in southeast Australia from their inception in the 1920s, up until the late 1980s when there were no productive scallop grounds left in the region.

This historic overfishing led to a significant stock and recruitment rebuilding challenge for fisheries managers.

The fishery has now been regulated under a spatial management approach since 2003, with fishing only permitted in areas designated as commercially viable.

The open and closed areas are defined based on the results of an annual pre-season survey, which is also used to set a total allowable catch for areas opened for fishing.

For this study, we examined the spatial harvest strategies used in the southeast Australian commercial scallop fisheries, which are designed as a buffer against recruitment variation to increase both production and continuity between seasons.

Our research aimed to better define the timing of scallop spawning and to identify any differences in spawning potential among scallop bed locations.

We also assessed the spawning potential between scallops ranging from 80 to 90 mm shell length, and assessed the size limits used to define a bed as commercially viable across the three southeast Australian jurisdictions.

Understanding growth rate in several fishing locations across these jurisdictions may allow better management of individual beds. When combined with scallop condition, growth rates can also inform current season openings and closings.

Our research provides valuable information that will give the jurisdictions greater capacity to work together to effectively manage the fishery as a whole.

Photo credit: Tania Mendo.

The study was funded by the Australian Government's the Fisheries Research and Development Corporation, Origin Energy, and the Victorian Government's CarbonNet Project.

Scallops respond to seismic airgun signals on the seabed

Research has revealed that the sound signals from seismic air guns used in geological surveys of the seafloor can cause harm to scallops. The intense, low-frequency noise penetrates kilometres into the Earth's crust.

Our IMAS researchers and scientists from the Centre for Marine Science and Technology at Curtin University collaborated on a series of studies, to understand the effect of seismic signal exposure on invertebrates, including economically and ecologically-important bivalves, such as scallops.

The team found that exposure to seismic signals significantly increases the mortality of scallops, particularly in the months following exposure. Scallops also showed significant changes in behavioural patterns, notably a 'flinch' response to air gun signals.

With repeated exposure, scallops buried themselves in sediment at a faster rate. Their physiology was also compromised, such as the reduced density of circulating blood cells. While the size of the air gun had no effect, repeated exposure intensified responses.

The research will inform government and industry decisions about seabed mapping, and will help to minimise negative outcomes for fisheries and ecosystems globally.

Recreational Fisheries

At IMAS, we work with the recreational fishing community to assist with our scientific research and the sustainable management of a range of species. Fishing surveys are regularly used to determine the catch across many recreational fisheries and are designed to provide data for sustainable management.

Our expertise has enabled us to broaden our research activities to include national and international recreational fishing surveys, and representation on the International Council for the Exploration of the Sea (ICES) Working Group on Recreational Fisheries Surveys (WGRFS).

In addition to undertaking regular surveys of key Tasmanian fisheries, we led the National Recreational Fishing Survey of Southern Bluefin Tuna, collaborated on the recent National Survey of Recreational Fishing in Norway, and are currently leading a survey of recreational fishing in South Australia.

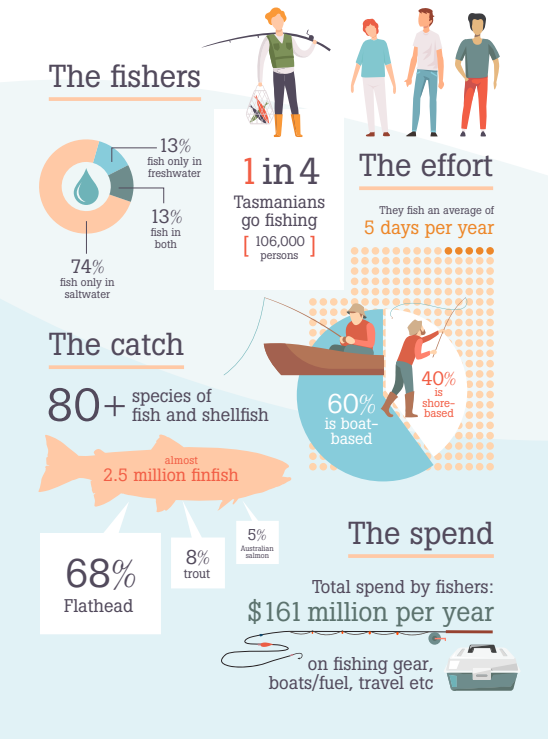
Angling for information: survey of recreational fishing in Tasmania

Every five years, we conduct a recreational fishing survey across Tasmania to estimate the number of fishers, their catch and trends in the type of recreational fishing that occurs.

The latest state-wide survey is the fourth general recreational fishing survey conducted since 2000 and provides a timely update of recent developments in the fishery. It involved many recreational fishers operating in marine and freshwater waterways.

It builds on previous research which found that one in four Tasmanians fish at least once a year and highlighted the social and economic benefits for Tasmania.

These major studies are commissioned by DPIPWE to assist with sustainable management of Tasmania's recreational fisheries. The studies are funded through a Fishwise Resource Management Grant, with additional support from the Inland Fisheries Service.



Effort and catch of offshore and recreational fishing in Tasmania

IMAS investigated game and offshore recreational fishing effort and catch in Tasmania from December 2018 to the end of November 2019.

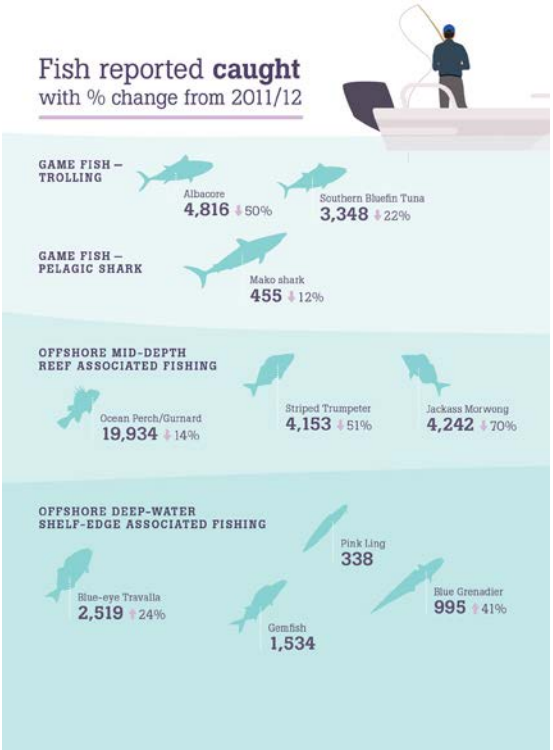
Comparing results with the 2011-12 survey enabled us to produce a snapshot of information, which helps people understand fish numbers and the changing marine environment.

Compared to the last survey, the number of fishing days (effort) and catch declined for tuna fishing, with the catch of the highly-prized Southern Bluefin Tuna down by 22% and the popular Albacore down by 50%.

The migratory nature of tuna means that their availability to recreational fishers in Tasmania can change greatly from year to year.

Interestingly since the last survey, there was a shift to fishing in deep water shelf-edge zones for fish such as Blue Grenadier and Blue-eye Trevalla.

The survey complements our general five-yearly recreational fishing surveys, since only a small proportion of Tasmania's 100,000 recreational anglers fish offshore.



The sample was randomly selected from the private vessel registration database maintained by Marine and Safety Tasmania (MAST). Over 2,000 fishers, who own powered vessels over 4.5 metres long, participated in the survey.

The study was supported by the University of Tasmania, the Tasmanian Government and the Fishwise Fund.

Photo: Scott Ling.

Photo: Antonia Cooper RLS.

Estimating recreational catch in Tasmania's rock lobster and abalone fisheries

Each year, our researchers collect information on how many people fish or dive for rock lobster and abalone, how often, in what regions, and their catch and success rates.

We have conducted the annual state-wide surveys since 2014, to assist in the sustainable management of Tasmania's rock lobster and abalone fisheries.

In 2013, the East Coast Stock Rebuilding Strategy was implemented to address declining rock lobster stocks off the East Coast of Tasmania. The Strategy aims to rebuild east coast rock lobster stocks to at least 20% of the unfished biomass by 2023.

The surveys are funded from recreational fishing licence fees and involve a large number of Tasmanian recreational licence-holders.

The 2019-20 fishing season survey found that the reduced recreational fishing opportunities from COVID-19 travel restrictions had influenced the number of rock lobster and abalone caught in 2020.

Photo: Jonah Yick.

National survey of recreational bluefin tuna catch

In 2020, our IMAS researchers completed the first comprehensive assessment of the recreational harvest of Southern Bluefin Tuna (SBT) in Australia, on behalf of the Australian Government.

SBT are an iconic pelagic fish found in the open seas of the southern hemisphere. Managed internationally as a single stock, they are currently recovering from low levels with the increase in stock apparent to recreational fishers in Tasmania.

The survey was carried out to understand the recreational fishing harvest of SBT. This information assists Australia in meeting its reporting obligations to the intergovernmental organisation, Commission for the Conservation of Southern Bluefin Tuna. Australia must report all sources of SBT mortality to the Commission.

The survey, which ran for 12-months from December 2018, describes the fishing effort, harvest and released catch from South Australia, Victoria, Tasmania and New South Wales. It includes Western Australia's most recent recreational SBT catch estimates from Department of Primary Industries and Regional Development boat-based surveys.

The results inform stock assessments and resource sharing arrangements between recreational and commercial fishing sectors.

Extension and engagement

From Tasmania to the world...

Our Wild Fisheries team is working with communities to make a real impact with our research. Collecting samples is essential to our research, so the contribution of recreational fishers as citizen scientists is vital to bolster sample sizes.

Tasmanian fishers are helping us take samples through our Tassie Fish Frame Collection Program. The biological data collected underpins basic fisheries management, such as defining appropriate size limits. We are able to model the distribution of the species and how it might affect existing marine ecosystems, while the program also enhances engagement with major stakeholders in these fisheries.

We are also communicating our science and influencing behavioural change through engagement and education programs like the Tuna Champions. Meanwhile, after first making waves in Tasmania as an IMAS project, the Range Extension Database & Mapping (Redmap) project has now reached a national scale.

Our high-quality research has also led to broader national and international projects, including surveys such as the recent National Survey of Recreational Fishing for Southern Bluefin Tuna in Australia.

Tuna Champions onboard as stewards of recovering SBT fishery

Recreational fishers are passionate about their sport, especially those who invest a lot of money, time and effort in the pursuit of game fish like the athletic Southern Bluefin Tuna (SBT).

After being overfished in the 1980s, SBT was not seen in local waters off south-east Australia for decades. Today, this iconic species is on a pathway to recovery, and is a highly-prized catch in the recreational game fishing sector.

The idea of the Tuna Champions program was born during a post-release survival study on SBT, where IMAS researchers worked with recreational fishers. Funded by the Australian Government through the Fisheries Research and Development Corporation, Tuna Champions is an initiative of the Australian Recreational Fishing Foundation in collaboration with IMAS.

Community engagement and evidence-based education are at the heart of this innovative and ambitious national program, which aims to reduce unnecessary mortality and wastage of SBT.

The program encourages fishers to become stewards of the SBT fishery, to understand more about this endothermic species and how to catch, handle, release, keep and prepare it so no fish is wasted. The clear focus is to nudge fishers through education, to create a snowball effect of positive change from within the fishery itself.

We have seen this vision becoming a reality, where using best-practice fishing methods is becoming 'just the way we do it now', and across the sector this change of behaviour is referred to as 'the Tuna Champion movement'.

The Tuna Champions program is a win for the University of Tasmania's IMAS fisheries research extension, the recreational fishing community, and for bluefin and other tuna species.

Southern Bluefin Tuna. Photo: Al McGlashan.

Citizen scientists log out-of-range species through REDMAP

Redmap invites the Australian community to spot, log and map marine species that are uncommon in Australia, or along particular parts of our coast.

It is an online tool and smartphone app that captures important information about potential changes in species ranges, and seeks to listen and learn from recreational fishers and divers to better understand the changes they are seeing.

A citizen science initiative, Redmap allows gaps in data and knowledge to be filled on a scale that is useful for management and research. Working together to combine scientific information with the knowledge and observations of experienced fishers and divers leads to a more complete picture of how our systems are changing.

First making waves in Tasmania in 2009 as an IMAS project, Redmap has now grown to a national scale. Redmap Australia is supported by Inspiring Australia, the Department of Agriculture and the Australian National Data Service, in combination with users and advocates across the country. It has been shortlisted twice for a prestigious Australian Museum Eureka Prize for excellence in science.

FISH HEALTH, BIOSECURITY AND SEAFOOD SAFETY

Research to protect the health of seafood consumers and aquatic organisms, including issues of toxic marine algae, biosecurity of farmed seafood, and disease.

PROGRAM LEADER:

- Alison Turnbull

FISH HEALTH, BIOSECURITY AND SEAFOOD SAFETY

OVERVIEW

Animal disease, food safety incidents and market access failures can cause significant economic loss for fisheries and aquaculture sectors. Achieving the true value from seafood requires ensuring the animals are healthy and comply with market access requirements for biosecurity and food safety.

Our research in fish health is focused on developing a vaccine against amoebic gill disease for Atlantic salmon, and ensuring optimal health and biosecurity for the development of onshore lobster aquaculture.

Amoebic gill disease (AGD) is the most significant health problem affecting Atlantic salmon aquaculture in Tasmania and increases the cost of production by 10–20%. We are currently identifying candidate vaccine antigens with our Australian Research Council (ARC) linkage partner, Ridley AquaFeeds. The aim is to produce an experimental vaccine against AGD that will benefit the Tasmanian and international Atlantic salmon aquaculture industries.

IMAS is leading the world in developing lobster aquaculture, with health and biosecurity a critical element in the successful culture of lobsters. In three ARC Research Hubs, lobster health research is using world-leading third generation long-read nanopore RNA/DNA sequencing to characterise microbial populations, identify potential pathogens, and develop comprehensive disease surveillance and biosecurity practices.

In the seafood safety space, we have been researching paralytic shellfish toxin (PST) accumulation in Southern Rock Lobster and abalone, providing cost effective strategies to manage the risk associated with recurrent highly-toxic blooms of *Alexandrium catenella* on the east coast of Tasmania.

Through a combination of experimental and field studies, we are increasing our knowledge of prey sources, speed of uptake, seasonality of risk, and the variability of risk along the east coast. We are developing and validating new sampling and analysis techniques and have also been researching the impact of PST on lobster health to determine its effects on the productivity of the fishery.

RESEARCH HIGHLIGHTS

Our IMAS staff are part of SafeFish, a successful national food safety and market access research project that has been running for 10 years. Current activities directly relevant to the Tasmanian seafood industry include:

- reviewing the national food standards regulatory limits for marine biotoxins for bivalve shellfish and bacteria in seafood, to ensure these are risk commensurate and aligned with international regulations, and
- upskilling capability in industry, regulators and laboratories in Vibrio analysis and risk management, which is particularly relevant to Tasmania after a succession of Vibriosis outbreaks traced to local oysters.

Investigating disease solutions for improved fish health

Our fish health research team collaborates with more than 17 universities and private and government research institutes. In 2019, the program supported 11 PhD students, and produced 16 peer-reviewed publications, with five directly relevant to Atlantic salmon and flathead.

The focus of our research has been on Amoebic gill disease (AGD) and the bacterial disease yersiniosis, while the effects of environmental factors on wild and farmed fish health were described in eight publications. We also collaborated with Cawthron Institute New Zealand on chinook salmon skin health and gut microbiome.

Our fish health team's major achievements in 2019 include:

- being part of an international group, which developed an in vitro model for studying AGD
- demonstrating that isolates of the protozoan parasite *Neoparamoeba perurans* from Tasmania had more similarities to each other than to the isolates from other countries – the parasite is the causative agent of AGD and an emerging threat to marine finfish aquaculture worldwide
- showing that moderate hypoxia reduces the capacity for activity and locomotion in Atlantic salmon, with smaller salmon most vulnerable to the condition
- in collaboration with the University of California San Diego, showing a link between tank biofilm microbiome and fish microbiome (especially skin) in Atlantic salmon
- conducting in-depth phylogenetic profiling of chinook salmon gut microbiota which showed that fish age and size significantly affected gut microbiome
- identifying hotspots of muscle melanisation in sand flathead in Tasmania
- establishing that muscle melanisation was associated with high levels of zinc.

Investigating extent of melanisation in Tasmanian sand flathead

A survey of Tasmanian recreational fishers conducted by IMAS researchers revealed that dark pigmentation found in usually-white Sand Flathead fillets has been known about for many years and, although typically rare, has been observed in catches taken from a range of locations around the state.

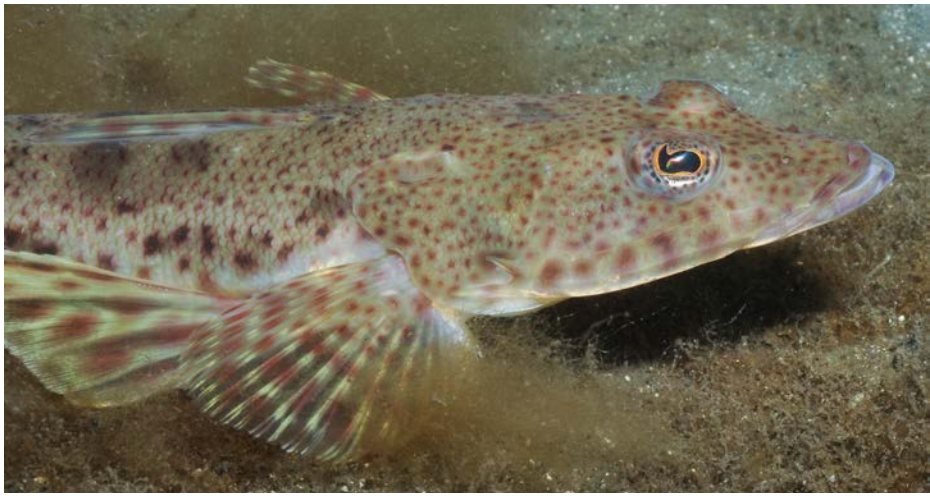
This dark pigmentation, called melanisation, occurs when the natural pigment melanin becomes concentrated in the muscles of fish. While one of the known causes of melanisation in northern hemisphere fish species is parasites, no evidence of this was found in our studies on Sand Flathead conducted at the University of Tasmania.

Over half of all finfish caught by recreational fishers in Tasmania are flathead, and most of those are Sand Flathead, so understanding the extent, causes and consequences of melanisation was of interest to many people in the State.

The online survey was designed to connect the current scientific understanding of muscle melanisation in Sand Flathead with the observations and experiences of recreational fishers.

The survey identified the locations where melanisation was commonly observed, although the proportions of affected fish tended to be low. Key locations included the Tamar River in the north and multiple sites in the south-east, including the Derwent Estuary, D'Entrecasteaux Channel, Norfolk-Frederick Henry Bays and the Tasman Peninsula. Areas where fishers reported little of no evidence of melanisation included the north coast, apart from the Tamar, and the more exposed areas off the East Coast.

The survey has helped set the direction for research into muscle melanisation in fish. Future research will explore the type of melanin present and seek to assess site-specific and environmental factors that may be implicated in the occurrence of melanisation.



Sand Flathead. Credit: Rick Stuart-Smith, Reef Life Survey.

Informing proactive risk management of marine biotoxins

Outcomes from our marine biotoxin research are directly assisting the abalone and lobster industries in the proactive risk management of paralytic shellfish toxin (PST). We have shown that:

- non-destructive sampling using lobster haemolymph cannot be used to indicate toxicity, so the focus remains on measuring PST in the hepatopancreas
- sentinel mussels are appropriate tools to indicate elevated risk of PST accumulation in lobster
- lobsters are highly tolerant of PST, with high levels of the toxin having no major impact on vigour
- lobster do not take up toxins through direct exposure to toxic algal cells, indicating no risk for lobsters in holding tanks in vessels steaming to shore, holding facilities drawing water from bloom areas, or sea-cages in bloom areas as occurs in New Zealand
- uptake of toxins does occur in Blacklip Abalone from direct exposure to algal cells and toxin consumption
- toxin uptake and depuration in abalone operates on considerably different time scales to lobsters, so requires different risk management.

The Seafood Safety team also successfully conducted a laboratory validation of a rapid test kit for PST, for use with lobster hepatopancreas and abalone foot tissues. In current field trials, this rapid test kit shows promise for at least a 50% reduction in the analytical testing budget, and for a fast and accurate indication of the safety of fishing during high risk periods.

Meanwhile, our involvement with industry and regulators in the annual review of the Tasmanian marine biotoxin plan for Southern Rock Lobster has led to continued improvement in the program.

Program Leader Alison Turnbull extracts lobster haemolymph to determine if it can be used to identify paralytic shellfish toxin in lobster hepatopancreas, and allow researchers to move to non-destructive sampling.

Making a global impact...

Our team and students had many successes in 2019.

PhD student Khattapan Jantawongsri (Em) spent two months at the Norwegian Technical University in Trondheim working on metal residues and gene expression in sculpins.

PhD student Petra Quezada won two high profile travel awards and the Fisheries of British Isles Research Award. This will support Petra's travel to Galway, Ireland to study the effects of gill health on grow out in the hatchery.

Professor Barbara Nowak was elected an Honorary Member of European Association of Fish Pathologists in 2019. She is President of Australian Society for Parasitology, Associate Editor for Journal of Fish Diseases and Peer, and invited editor of a special issue on fish parasites for the International Journal for Parasitology.

Professor Nowak is also on the international committee organising the International Symposium for Fish Parasitology, to be held in Cairns in 2021 with the Australian Society for Parasitology Conference.

Fish Health, Biosecurity and Seafood Safety program leader, Alison Turnbull, is currently on the International Advisory Panel for Seafood Safety Research Program, New Zealand.

Alison is also on the 2017–2021 expert roster of the Joint Expert Committee on Food Additives (JECFA) which is administered jointly by the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO). Since 1956, the JECFA has been evaluating the safety of food additives, contaminants, naturally occurring toxicants and residues of veterinary drugs in food.

Fish Health, Biosecurity and Seafood Safety Program Leader Alison Turnbull.

Professior Barbara Nowak.

Khattapan Jantawongsri (Em) inspects sculpin AGD histology in Copenhagen.

Juan Dorantes Aranda with Professor Gustaaf Hallegraeff.

HUMAN DIMENSIONS AND MODELLING

Modelling, economic governance and sociological approaches to optimise benefits to the community from fisheries and aquaculture.

PROGRAM LEADER:

- Klaas Hartmann

RESEARCH TEAM LEADERS:

HUMAN DIMENSIONS:

- Emily Ogier

MODELLING AND MAPPING:

- Katie Cresswell

Photo: Tasmanian Commmercial Dive Association.

HUMAN DIMENSIONS AND MODELLING 2019–2020

Our Human Dimensions team focuses on the people side of fisheries and aquaculture, including communities, businesses, economies, markets and institutions linked to marine systems.

Our research supports the SMRCA goal of sustainability of marine resources by understanding the ways people, markets and institutions interact with marine resources and the ecological system, and how that interaction generates benefits and burdens for different users and communities.

Our team leads research activities in marine social sciences, economics and political studies, and supports other IMAS teams with our expertise and capability in human dimensions.

Our role in national and international projects, such as the FRDC's Human Dimensions Research Subprogram and ICES Working Group on Social and Economic Dimensions of Aquaculture, enhances our ability to holistically support the SMRCA program.

The COVID-19 crisis triggered huge changes, damage and opportunities in Tasmania's fisheries and aquaculture sector.

Urchin processing at RTS PauaCo, Electrona.

HUMAN DIMENSIONS

Our Human Dimensions team focuses on the social and economic indicators for Tasmania's fisheries and aquaculture, community wellbeing, social acceptability, and effective governance.

Social and economic indicators for Tasmania's fisheries and aquaculture

Our Human Dimensions team assesses the economic and social performance of Tasmanian commercial Rock Lobster and Scalefish fisheries against a series of indicators. The survey data helps to understand current conditions and support management of the fishery, to enhance economic and social performance and generate greater benefits.

The surveys are run through the IMAS Economic and Social Assessment project and are supported by the Tasmanian Seafood Industry Council (TSIC), the Tasmanian Rock Lobster Fishermen's Association (TRLFA) and the Department of Primary Industries, Parks, Water and Environment (DPIPWE).

We are also tracking how Tasmania's fishing and aquaculture community responded to the COVID-19 pandemic. Our research will support the recovery efforts from this crisis, which triggered huge changes, damage and opportunity in the sector.

There have been several small market shocks previously, such for SARS or temporary trade barriers and we can expect more of these in the future. An aim of the Covid-19 research is to be better prepared and more able to respond to future events.

IMAS is partnering with the state-wide Tasmania Project which is looking more broadly at the effects of this pandemic, the associated economic crisis, and the coping strategies of Tasmanian people and businesses.

Our research includes surveying people about seafood purchasing and recreational fishing, and tracking responses from operators over time, to feed into the Premier's Economic and Social Recovery Advisory Council and TSIC's recovery planning.

Our team is also tracking the global, national and local events that have changed the operating environment for our fisheries and aquaculture industry, such as government stimulus and cost-easing measures. Matching this with the impacts will help us understand what helped or hindered crisis management and recovery. We are also supporting the research needs of the Seafood Industry Recovery Coordination Group established by the Tasmanian Government with TSIC.

Community wellbeing and social acceptability

Our Human Dimensions team is measuring social support for wild fisheries and aquaculture. Building and maintaining societal support is vital for fisheries industries, but there is uncertainty around what is meant by societal support and what it looks like.

Our team investigated this and came up with determinants and tools. We looked at culture, relationships, participation, and trust – and how these determinants contribute to societal support. Our research entered new territory, beyond well-researched individual values and perceptions associated with 'sustainability'.

Using these factors and a risk-based approach, we developed a process for detecting, assessing and monitoring societal support for wild-catch and aquaculture fisheries. We also developed a self-assessment tool to enable those working in wild-catch fisheries and aquaculture activities to critically reflect on and track their progress against each determinant of societal support.

Using these processes, fishing industry leaders can measure the support from communities and stakeholders and better understand their future sustainability and prosperity.

COVID-19 economic shock and response timeline for the Tasmanian seafood sector

JAN 24 Rock lobster exports halt as Covid-19 shuts down Lunar New Year

JAN 25 First case of Covid-19 detected in Australia

JAN 30 Loss of Abalone export markets in late January

JAN 23 Chinese government implements lockdown in Wuhan and Hubei

JAN 29 Roll-over of uncaught rock lobster quota to 2020-21

FEB 14 Seafood export trade to China recommences at very low volumes

FEB 10 Partial inversion of the United States' yield curve (10-year rate falls below 3-month rate)

FEB 24 Covid-19 spread worsens outside of China

MAR 03 RBA cuts cash rate to 0.50%

MAR 09 *Black Monday* global share market collapse

MAR 10 Australia announces A$2.4 billion pandemic countermeasures

MAR 11 US President Donald Trump announces temporary 30-day travel ban on Europe

MAR 12 *Black Thursday* global share market collapse

MAR 12 Australia announces a A$17.6 billion stimulus package

MAR 15 All travellers arriving in Australia must self-isolate for period of 14 days

MAR 16 *Black Monday II* global sharemarket collapse

MAR 17 Tas Gov waives annual fees and levies for rock lobster, giant crab, scalefish, abalone (A$3.7 million)

MAR 18 RBA cuts cash rate to 0.25%

MAR 19 All non-essential travellers to Tasmania subject to mandatory 14 day quarantine period

MAR 19 US Fed announces over $450 billion in foreign exchange swap lines to stabilise world currencies

MAR 20 Australia closes borders to all non-residents

MAR 20 Australia's banks announce repayment freezes for home and small business loans

MAR 22 Australian government announces A$66 billion fiscal stimulus

MAR 22 Retail turnover rises 0.4% in Feb due hoarding

MAR 23 Australian social distancing measures come into effect

MAR 23 Tas oyster and scalefish impacted by restaurant/hospitality shutdowns

MAR 23 Australian government announces A$66 billion fiscal stimulus

MAR 23 Australian parliament passes A$80 billion fiscal stimulus

MAR 25 National Covid-19 Coordination Commission (NCCC) established

MAR 26 Chinese government announces $344 billion fiscal stimulus

MAR 27 Tasmanian Government A$1.8 million fee-relief package for fishing sector

MAR 28 China implements strict border controls and diverts international flights

MAR 29 Australia limits public gatherings to two people

MAR 29 All travellers arriving in Australia must self-isolate for period of 14 days

MAR 30 Australian government announces A$130billion JobKeeper wage subsidy (fisheries eligible)

APR 01 Australian government A$110m airfreight assistance package for agriculture and seafood exports

APR 01 OECD endorses global economic hibernation plan during the Covid-19 pandemic

APR 01 Seafood exports to China pick up as government air-freight assistance scheme

APR 03 Recreational scallop season closed

APR 07 Chinese officials ease lock-down in Wuhan

APR 21 Virgin Australian enters voluntary administration

APR 21 Beijing imposes new restrictions to prevent a second wave; gyms and swimming pools shutdown in Beijing.

MAY 05 The number of jobs in Australia falls by 7.5% between March 14 and April 18

MAY 07 US Secretary of State renews attacks on China, claiming virus came from Wuhan lab

MAY 08 National Cabinet announces roadmap out of restrictions

TAS gov agrees to gradual reopening of the state

MAY 10 Jilin officials raise the risk level of Shulan city to high after 11 new cases confirmed

MAY 11 Restrictions easing but concerns remain over asymptomatic transmission.

MAY 12 China imposes an import ban on four Australian abattoirs

MAY 18 World Health Assembly to pass a motion by Australia & EU for an inquiry into COVID-19

MAY 18 China imposes an 80% tariff on Australian barley exports

MAY 20 China holds LPR benchmarks constant (3.85%, 4.65%).

MAY 22 Taste of Tasmania cancelled for 2020.

MAY 22 China announces $430 billion stimulus distributed by local government special bonds

Australian JobKeeper numbers revised down by 3 million

MAY 25 China accuses Australia of a 'Washington plot' in relation to COVID-19 inquiry

MAY 26 Australia's borders remain closed

MAY 28 Tasmania's state borders remain closed

MAY 29 Government to refund A$721 million in robodebt claims beginning in July.

MAY 31 VIC extends state of emergency

JUN 03 Australia enters first recession in 29 years.

JUN 05 US officially enters recession ending longest expansion in history.

JUN 05 Recreational scallop season opens in TAS.

JUN 07 Australian Government continues to underwrite domestic flights until 30 September.

JUN 08 Free child care to end in Australia on 12 July.

JUN 09 Reports of fishers shifting to supermarket, aquaculture, oil & gas work to survive.

JUN 12 National Cabinet continues easing of social-distancing.

JUN 12 SA announces borders will reopen on 20 July.

JUN 13 Beijing reimposes lockdowns due to a cluster eminating from Xinfadi market.

JUN 15 Australia gov announces JobMaker plan to fast-track infrastructure projects.

JUN 15 Chinese retail sales fall for 4th straight month; heavy job losses and fears of a second wave.

JUN 16 SA opens borders to WA, TAS & NT.

JUN 16 China suspends European salmon imports, fearing link to Xinfadi outbreak.

JUN 17 Dexamethasone shown to reduce mortality in the most severe cases of COVID-19.

JUN 18 NT announces borders will open from Jul 17.

Qantas cancels overseas flights until late October.

JUN 18 China cancels >60% of flights to Beijing & raises warning level due to COVID-19 outbreak.

JUN 19 Global air freight prices start to decline as demand for PPE drops.

JUN 19 Lobster and abalone exports to China on hold again as Beijing requires COVID-19 testing.

JUN 21 QLD requires quarantine for visitors from 36 hotspots in VIC.

JUN 21 State of emergency extended in VIC.

JUN 23 Shortage of backpackers reported for farm work (oysters &c.) due to restrictions.

JUN 25 IMF issues another downgrade to global growth forecasts.

JUN 26 Virgin Australia enters sale contract allowing continued operation.

JUN 26 NT announces borders to close to COVID-19 hotpots.

JUN 30 VIC imposes local hotspot 'stay at home' orders for 10 postcodes.

JUN 30 TAS borders remain closed, SA & QLD continue closure with VIC.

- Tasmanian seafood industry event
- Australian physical distancing or control measure
- Chinese government event or measure
- World economic event
- Australian economic event
- Australian monetary stimulus
- Australian fiscal stimulus

The IMAS COVID-19 economic shock and response timeline is available at tinyurl.com/IMAS-COVID19-response-timeline

In another community-focused project, we are investigating community futures of North-West Tasmania during 2019-2021. We are asking North-West residents about how they envisage development and wellbeing for their region, and how marine industries could better align with these values.

To gain a breadth of perspectives, we are also interviewing decision-makers in government and industry, and will engage with the Tasmanian Aboriginal community to explore how they would like to be involved in the project.

Economic contribution of Tasmanian fisheries and aquaculture

Our research into the economic value of Tasmania's fisheries and aquaculture industries has revealed they contribute more than $1.5 billion to the Australian economy and create more than 11,600 full-time equivalent (FTE) jobs.

The study found that within Tasmania, fisheries and aquaculture generated $1.15 billion and created almost 3,000 direct FTE jobs and 5,400 indirect jobs. Through the Tasmanian seafood industry's expenditure and indirect effects outside the State, it contributed a further $364 million and supported 2,844 indirect jobs nationally.

Tasmania's contribution to the national economy is the greatest of any jurisdiction, amounting to more than one quarter of the total economic contribution in dollar terms, as well as in jobs created.

This was the first time the economic contribution of Tasmania's seafood industries has been reported at state and national levels.

This kind of data becomes most valuable when tracked through time because trends show the impact of management or policy changes, global influences, or changes in the way fishing or aquaculture businesses operate.

The study was funded by the Australian Government's Fisheries Research and Development Corporation and produced by BDO EconSearch.

Opportunities for growth through governance

Our Human Dimensions team is developing a model to assist in the ecologically-sustainable production of commercial seaweed, as part of the Seaweed Solutions for Sustainable Aquaculture CRC project.

We are developing a model of sustainable Integrated Multi-Trophic Aquaculture (IMTA) to help producers make decisions about how best to use by-products, including waste, to benefit other species and the marine ecosystem.

We are also developing a regionally-relevant IMTA partnership model involving collaboration between different types of aquaculture and other marine product producers, and the Tasmanian Government, focusing on economic, environmental and societal benefits.

In early 2020, we worked with the Central Queensland University on a nationwide oyster value chain project, providing advice on barriers and opportunities in value chain development at both national and state levels.

We conducted interviews with Tasmanian oyster growers and organisations integral to the supply chain, and contributed this data to the project. The value chain analysis compares value chain characteristics between Australian states, and provides information specific to Tasmania.

MODELLING AND MAPPING

Our Modelling and Mapping team conducts a broad range of biological, ecological, economic and habitat mapping and modelling. This work includes creating high-resolution maps of the shape and composition of the seafloor, modelling nutrient flows in inshore environments, and bio-economic modelling to support the management of our marine resources.

We work closely with stakeholders to ensure our work can directly inform the decision making process. Together with the Human Dimensions team, we deliver analyses that integrate the human and economic elements as well as the biological and ecological aspects.

Along with providing substantial advice for the management of our key recreational and commercial fisheries, we have been involved in a broad range of work relating to other marine resource management issues, including spatial planning issues such as fish farms.

We recently developed and released tasfisheries.org, a website that provides access to our detailed stock assessments and related research. The website is structured to be accessible to a diverse audience, while retaining the full level of technical detail.

A core focus of our work has been higher valued fisheries such as the Tasmanian Rock Lobster fishery, but an increasing level of attention is being directed to some of the smaller fisheries that are of substantial interest for ecological or social reasons. One of these emerging issues has been an assessment of the Long-spined Sea Urchin and an evaluation of associated research.

First assessment of invasive Long-spined sea urchin fishery

IMAS researchers have produced the first scientific assessment of Tasmania's growing Long-spined Sea Urchin fishery.

The expansion of the commercial fishery is one of a number of measures addressing growth in the invasive *Centrostephanus rodgersii* population, and the barrens they create by overgrazing reefs along Tasmania's East Coast.

The fishery assessment for the 2018-19 season showed that the annual catch has risen dramatically since harvesting began in 2009, reaching 560 tonnes in 2019. This fishery is now the third largest in Tasmania per wet tonnage harvested.

The catch has been spatially concentrated, with 80–90% of the urchin harvest coming from a small area of the East Coast around the St Helens region.

Our researchers found evidence that this catch is beginning to reduce stocks in some areas, thereby providing an effective reduction in urchin grazing.

This also suggests that as catch rates decline, divers will fish further southward and the fishery will have positive impacts in a broader area.

Commercial harvesting is one of a number of actions taken to reduce the number of these invasive urchins, with most interventions based on IMAS research and supported by the State Government and the Tasmanian Abalone Council under the Abalone Industry Reinvestment Fund.

Evaluating Tasmania's urchin harvest subsidy

Our researchers have evaluated the Long-spined Sea Urchin subsidy, which was introduced to promote expansion of the commercial harvest in 2016.

We looked at the spatial and economic effectiveness of the subsidy, and investigated various alternative subsidy structures including the effect of removing or reducing the subsidy.

Initially a flat rate of $0.75 per kilogram wet-weight of harvest, the subsidy was changed to a spatially explicit structure in early-March 2019. This is where the price per kilogram depends on latitudinal zones along the East Coast of Tasmania.

Our researchers found the subsidy had achieved its primary goal: to re-spark the harvest industry for Long-spined Sea Urchins in Tasmania. Before the subsidy, the total harvest had dropped to less than 50 tonnes but has increased to 560 and 360 tonnes in the last two seasons. This has been far larger than the average linear increase in stock tracked with IMAS dive surveys, which was 153 tonnes per year. Consequently, the harvesting operations appear on track to deplete urchins which is the desired outcome.

We found that while the higher subsidy for more southern areas pushed some catch southward, further refinement may be needed as the State Government's Centrostephanus Response Strategy is developed.

While the cost-effectiveness of urchin culling versus harvesting depends on speed, urchin density and other factors, we found that harvesting was generally more cost-effective than culling for a subsidy of $1 per kilogram or less. However, culling was more cost-effective when higher subsidies were used to incentivise divers in more southern areas.

The project was funded by the Abalone Industry Reinvestment Fund.

What is Australia's wild fishery production potential?

IMAS researchers were part of a group of scientists from Australia who collaborated to estimate the potential production that could come from our wild fisheries. This assumes they were managed with the objective of maximum sustainable yield (MSY) and that we had markets to sell all the fish.

Finding willing buyers is straightforward for high value fish species in Australia but most of our fisheries are limited by low market demand and price. While the estimate of Australia's wild fishery potential is not plausible under present conditions, the research gave insight into what could be achieved if food production became a higher priority and there was higher demand.

MSY estimates were obtained for the 290 species/stocks currently fished and comprised 84% of annual landings. Potential production from these in aggregate is more than double the current national wild fishery catch, an increase over current catches of around 124%.

In Tasmania, the current wild fishery catch averages 3,547 tonnes but could increase to 9,797 tonnes (approximately 180% extra) if fisheries were managed and harvested at MSY.

This potential increase comes from either rebuilding existing high value fisheries like lobster and abalone, or developing markets for low value, under-utilised species like sardines, Australian salmon and leather jackets.

Photo: Shutterstock.

Photo: Scott Ling.

OUR PEOPLE

OUR PEOPLE

The SMRCA brings together a diverse and dedicated team of research scientists, academics, cross-discipline researchers such as economists and sociologists, and highly-skilled professional staff.

We aim to integrate inclusion and diversity into our daily work practices, to create an inclusive culture where everyone can contribute and develop regardless of differences.

Together, our people deliver our vision for excellence in fisheries and aquaculture research and education.

TAKING THE NEXT STEP...

We are dedicated to passing on our knowledge and passion for great research to the next generation of scientists, industry leaders and policy makers.

Our students contribute outstanding research outcomes and work with us on many of our projects.

During 2019 and 2020, almost 80 IMAS PhD candidates contributed research outputs to SMRCA projects, while also building valuable skills in marine resource research. While generally financially supported from other sources, these students add value to, and gain benefits from, the collaboration with SMRCA projects.

In 2019 and 2020, we saw 13 students graduate, with a number continuing to work with us. *Meet all our graduates in Appendix I*

PhD Graduates Tina Oldham (hypoxia in salmon) and Jessica Johnson-Mackinnon (N.perurans comparison of isolates).

Over the past two years we've seen many new faces on our team, and we have also wished several other staff all the best as they embark on the next exciting phase of their lives. We make special mention of some who have made a substantial contribution to the SMRCA over many years.

Aquaculture Facility Manager, Alan Beech

Alan worked at the IMAS Taroona site for over 26 years and contributed to many aquaculture projects. Alan provided critical after hours on-call support for the aquaculture facility and associated pump station.

Before his retirement in 2020, Alan worked as a key member of the ARC Research Hub for Sustainable Onshore Lobster Aquaculture, ensuring that the facilities were maintained for this highly innovative research program.

Senior Research Fellow, Dr Christine Crawford

Christine led the Marine Environment (later Natural Resource Management) section at TAFI, and was involved in many research projects on the interaction between human activities and the estuarine environment.

Christine received the Vice-Chancellor's Award for outstanding community engagement, and served on various state and national committees on marine environmental issues.

Before her retirement in 2019, her research concentrated on environmental management of Tasmanian salmon and oyster aquaculture industries.

Senior Technical Officer, Karl Van Drunen

Karl worked at the IMAS Taroona site for over 17 years and contributed to many aquaculture research projects.

For many years Karl led the care of lobster brood stock, and ensured the hatchery had a supply of larvae to undertake world-leading lobster culture research.

Before his retirement in 2020, Karl worked as a key member of the ARC Research Hub for Sustainable Onshore Lobster Aquaculture, leading the technical team in the experimental juvenile culture room.

Administrative Officer Taroona, Lynne Baily

Lynne was the Administrative Officer at IMAS Taroona for 10 years until her retirement in 2020. Lynne kept the reception operations of Taroona running smoothly, connected our people, and could answer any administrative question that came up.

RECOGNITION FOR RESEARCH EXCELLENCE

Our research excellence is recognised nationally and internationally. Our research is innovative, relevant, and globally distinctive. Our highly trained scientists and researchers, many internationally acclaimed leaders in their field, serve the needs of academic institutions, industry, government and the community.

In the Centre for World University Rankings 2017 by subject, based on our IMAS activities, the University of Tasmania was ranked fourth in the world for Marine and Freshwater Biology, and seventh in the world for both Fisheries and Oceanography.

In the QS World University Rankings by subject for 2017, the University of Tasmania was ranked in the top 50 for Earth and Marine Sciences, which encompasses most of our IMAS research and teaching activities.

IMAS salmon team takes out top University award

Our IMAS Salmon Environmental Interactions Team took out the prestigious University of Tasmania Medal for Research Excellence in 2019, in recognition of their science on the effects of salmon farming in our coastal zone.

The award honours the outstanding contribution Associate Professor Jeff Ross, Associate Professor Catriona Macleod and their dedicated team have made to ensuring the research that underpins our understanding and monitoring of the environmental interactions of salmon farming is of the highest quality, across the spectrum of innovation and impact, mentoring and early-career researcher development, and community engagement.

The team showed an outstanding commitment, both to Tasmania's natural environment and to generating the understanding needed to support the sustainable development of the salmon industry. Their work has contributed to better balancing the protection of natural values of our coastal environment, with the social and economic benefits from the industry. This benefits society and the communities we are a part of, and informs government and industry management.

Members of the Salmon Environmental Interaction Team receiving their award from the University of Tasmania Vice Chancellor Professor Rufus Black.

Alison Turnbull with South Australian Research and Development Institute (SARDI) CEO Peter Appleford and SARDI Aquatics Director Gavin Begg.

Assoc Prof Jeff Ross (left) with some of our Salmon Environmental Interaction Team: (L to R) James Hortle, Andrew Pender, Kylie Cahill, Sam Kruimink, Olivia Johnson, Jason Beard, David Moreno, Adam Davey, Dr Scott Hadley and Ben Quigley. Other members of our award-winning team include Associate Professor Catriona MacLeod, Dr Camille White, Dr Karen Alexander, Flora Bush, Myriam Lacharite and Jessica Kube.

Associate Professor Sean Tracey is presented with the award for research in action by fisheries scientist Dr Julian Pepperell, who is well-known for his work in developing the Australian Gamefish Tagging Program.

Tuna Champions awarded for research in action

Our IMAS Tuna Champions project team was recognised for turning research into action, with the 2019 Recreational Fishing Award for Excellence in Support of Recreational Fishing Research Outcomes.

Announced at the National Recreational Fishing Conference (NRFC), the award recognises the contribution of individuals or organisations to recreational fishing research.

Tuna Champions was also a finalist in the Project of the Year and the Excellence in Recreational Fishing Communication awards. The initiative shows the benefits of going beyond research outcomes to build strong partnerships and deliver evidence-based education.

Filling vital knowledge gaps for improved industry outcomes

In 2019, the Seafood Safety team was part of a collaborative effort that took out the Seafood Industry Award for Research, Development and Extension in South Australia, and was a finalist in the Australian awards.

The award recognises excellence in developing and undertaking a research, development and extension activity that has made a substantial contribution towards a sustainable and profitable seafood industry.

The team was awarded for their biotoxin research to support market access and public health risk management activities.

Based in a marine biotoxin contamination centre in the South Australia, the research investigated paralytic shellfish toxin uptake and depuration in Southern Rock Lobster, Blacklip Abalone and Pacific Oysters.

High volumes of toxic algae were cultured, and the lobster, abalone and oysters were exposed to these algae directly or through contaminated feed.

The research was designed to fill some of the high priority knowledge gaps identified by industry, to improve public health and market access risk management and reduce the associated expenses.

VISITORS FROM AUSTRALIA AND THE WORLD

We welcome many visitors to IMAS Taroona, from Australia and the world. These include international scientists who come to work with us for a period, along with visiting dignitaries, government officials, local and international student groups, and research, university and industry delegations. A list of visitors during 2019 is available in Appendix II.


Bergen, Norway
United Kingdom
Kuwait
South Korea
Qingdao, China
Shanghai, China
Thailand
Kerala, India
Malaysia
Jakarta, Indonesia
Lamongan, East Java, Indonesia
Fiji
Brisbane, Australia
ACT, Australia
Melbourne, Australia

Photo: Tasmanian Commercial Dive Association.

OUR IMPACT

Photo: Tasmanian Commercial Dive Association.

OUR IMPACT

Our fisheries and aquaculture research is always focused on achieving useful outcomes that make a difference to the sustainable use of marine resources. Commercial, recreational and indigenous fishers harvest these important resources, and each group has different needs. The key to our success is working with fishers across all sectors, which enables us to gather data from many different sources and locations.

Along with community collaboration and data collection, we are developing leading technology to assist with monitoring efforts, and working with industry to combat threats such as Pacific Oyster Mortality Syndrome (POMS).

Through our research, rigorous data is driving management, fish stocks such as lobster are increasing, and ecosystems are being monitored. Our aquaculture research is also contributing to building a sustainable source of nutrition and food for populations worldwide, and has the potential to fill gaps in food security into the future.

Virtual diving over urchin barrens.

GUIDING OUR DIRECTION AND PERFORMANCE

The Sustainable Marine Research Advisory Committee (SMRAC) sets the direction for our research, as well as guiding us with strategic investments and in our response to urgent issues such as the COVID-19 pandemic during 2020.

The Committee's role is to develop our strategic and operating plan, and monitor our research performance to ensure it aligns with the Agreement and the annual operating plan.

SMRAC has representatives from the University of Tasmania, the Tasmanian Government, and members from various associations appointed for their expertise in marine resource management. Our SMRAC members in 2019-2020 include:

- Dierdre Wilson (Chair), Deputy Secretary DPIPWE
- Fionna Bourne (Outgoing Chair), General Manager, Water & Marine Resources DPIPWE
- Prof Caleb Gardner, Director SMRCA
- Terry Bailey, Executive Director IMAS
- Assoc Prof Jeremy Lyle, Deputy Director SMRCA
- Julian Harrington, CEO Tasmanian Seafood Industry Council
- Dr Ian Dutton, Director, Marine Resources, DPIPWE
- John Sansom, Executive Officer Tasmanian Rock Lobster Fishermen's Association
- Greg Woodham, Tasmanian Abalone Council
- Andrea Woolnough (Secretary), SMRCA Administration Manager.

SCIENCE IN PROGRESS OUTCOMES IN PRINT

As a research institute of excellence in temperate marine research, IMAS works in collaboration with the Tasmanian Government in the Sustainable Marine Research Collaboration Agreement (SMRCA) to ensure Tasmania's marine resources and industries are sustainably developed and managed. This includes providing fishery assessments, management advice and tactical projects on current fishery issues.

For planning and reporting, our SMRCA activities are divided into Tier 1 and Tier 2 needs and projects. Tier 1 projects are of the highest priority and tend to have a longer funding horizon, with funds committed from the Tasmanian Government and/or the University of Tasmania. Tier 2 projects are externally-funded research projects which receive a contribution of resources from the SMRCA.

The SMRCA receives both cash and in-kind contributions from its partners, the Tasmanian Government and IMAS at the University of Tasmania. When successful, additional funding is also received from external funders as grants and consultancies.

See Appendix III for our projects and funding and Appendix IV for our research grants.

Our scientists and students publish many significant reports and papers, often with international collaborators. Putting our research into the international scientific literature is not merely an academic exercise – it achieves two important outcomes.

Firstly, publication exposes our work to anonymous international critique, which improves the quality and objectivity of our research. Secondly, it enhances our engagement with research around the world, which means Tasmania can benefit from the latest developments, and our researchers can contribute to better global use of marine resources.

See Appendix V for our publications.

Beyond the lab…

At the SMRCA, we have a strong focus on communicating our science in simple and engaging ways, accessible to everyone in the community – from the young to the young at heart.

While all events were cancelled in 2020 due to COVID-19 restrictions, we had a huge year in 2019. Our events had a special focus on the East Coast and invasive Long-spined Sea Urchins, including an urchin display, virtual dives over barrens, a touch tank and urchin activities. We took this to the Agfest annual agricultural field days event, the Taroona Primary School Seaside Festival, the UTAS open day, and more.

Our Wild Fisheries *Tuna Champions* project team also event-managed the highly-successful world premiere and launch of Al McGlashan's Southern Bluefin Tuna documentary, Life on the Line, at the IMAX Melbourne Museum.

Along with hosting 14 work experience students and tours for the TSIC Working on Water event, our popular Science Week school tours saw around 200 primary and secondary students visiting our Taroona site. This included visiting the Experimental Aquaculture Facility and Lobster Aquaculture Hub, short entertaining scientist talks on sharks, oysters and lobsters, and the opportunity to see the diving, boating, underwater video equipment and other gear we use for our research.

We have also produced a series of videos which give an insight into our fisheries and aquaculture research:

- Tasmanian Fisheries and Aquaculture Research – collecting data, community collaboration, developing technology, combating threats

- Tasmanian Salmon – the research story
- Looking out for the little guys – minor species research
- Every dive counts – abalone research
- Data collection by lobster fishers – improving stock monitoring and management
- Hook, line and satellite – recreational fishing research
- Oysters in hot water – managing Pacific Oyster Mortality Syndrome (POMS)
- Aspects of Salmon nutrition
- Experimental Aquaculture Facility – improving systems, nutrition, growth and health
- Reef Protectors – an animation about lobsters being translocated to predate on urchins.

We are all looking forward to taking our science to the streets when COVID-19 restrictions are fully lifted and events return in 2021.

Senior Technical Officer Kylie Cahill introduces "Jeffrey" the hermit crab to young visitors at Agfest in 2019.

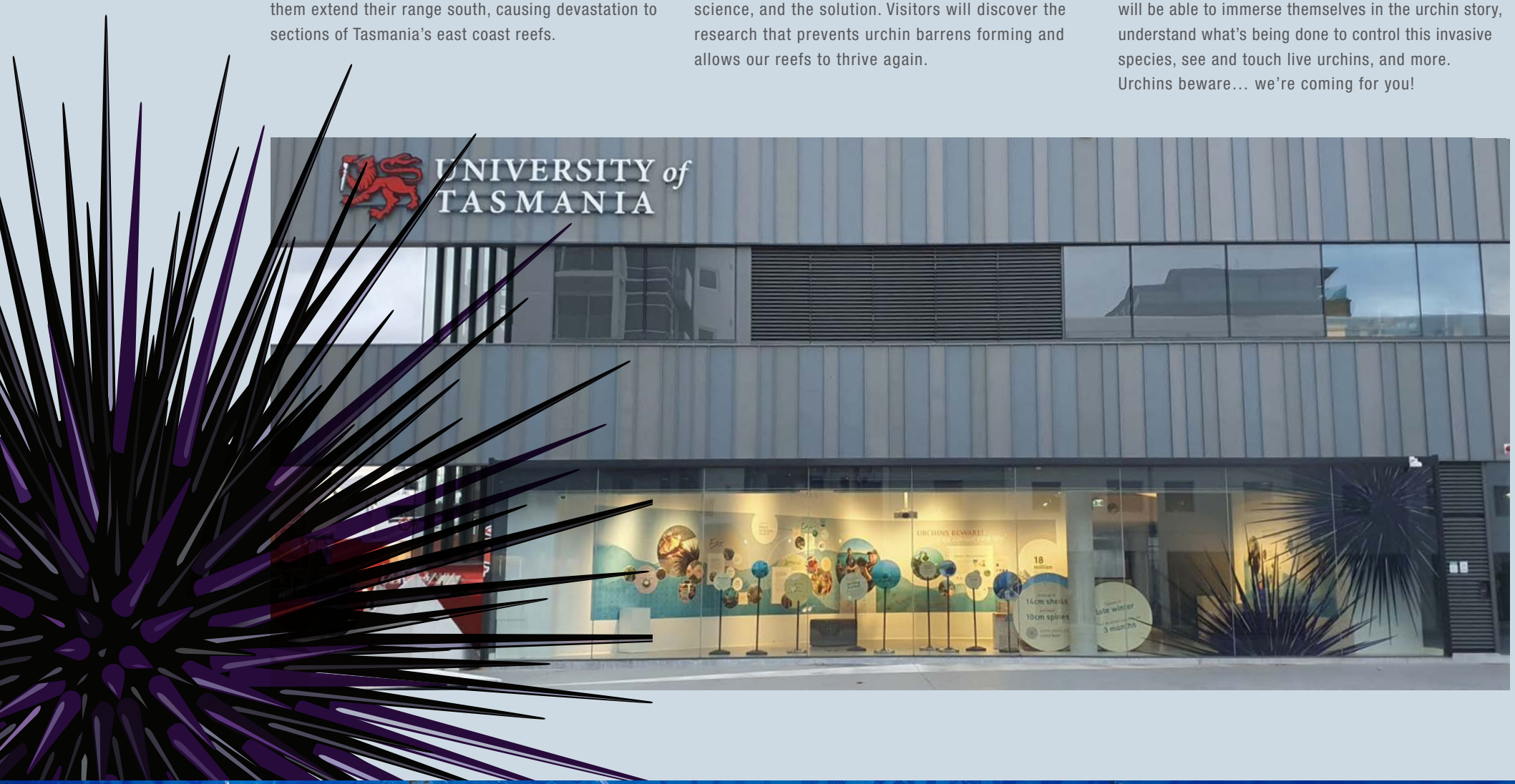
Associate Professor Quinn Fitzgibbon shows primary students our 20 year old lobster, during our Science Week tours in 2019.

URCHINS IN THE SPOTLIGHT

Long-spined Sea Urchins (*Centrostephanus rodgersii*) were once rare outside NSW, but warming waters and a strengthening East Australian Current have seen them extend their range south, causing devastation to sections of Tasmania's east coast reefs.

A new exhibition at IMAS in Salamanca, supported by the Abalone Industry Reinvestment Fund, tells the story of these urchin invaders – the problem, the science, and the solution. Visitors will discover the research that prevents urchin barrens forming and allows our reefs to thrive again.

During the COVID-19 restrictions, the exhibition has been a 'window-shopping' experience, but will be officially launched when restrictions are lifted. Visitors will be able to immerse themselves in the urchin story, understand what's being done to control this invasive species, see and touch live urchins, and more. Urchins beware… we're coming for you!



APPENDICES

APPENDIX I GRADUATES 2019–2020

Jimena Balli Garza	PhD	Identification of Parasitic Diseases Affecting Ranched Southern Bluefin Tuna
Travis Baulch	Masters	Cracking the Code: Defining roe quality of the long-spined sea urchin *Centrostephanus rodgersii* in Tasmania
Maree Fudge	PhD	Participation and Political Representation: A critique of 'participation' in marine governance
Madeline Green	PhD	Testing expectations of connectivity and breeding biology among shark species in a tropical hot spot: the Indo-Pacific
Thibaut Houitte de La Chesnais	PhD	Role of Cephalopods in the Structure and Functioning of Marine Ecosystems
Jessica Johnson-Mackinnon	PhD	Geographic Characterisation and Environmental Detection of *Neoparamoeba perurans* the Causative Agent of Amoebic Gill Disease
Mei Chen Ooi	PhD	Haemolymph and Gut Microbiomes of the Ornate Spiny Lobster *Panulirus ornatus*
Tina Oldman	PhD	Causes and Consequences of Hypoxia in Atlantic Salmon Aquaculture
Javier Porobic Garate	PhD	An Ecosystem Based Management Framework for the Juan Fernandez Ridge Fisheries
Alicia Consuelo Joanna Schmidt-Roach	PhD	Stock Structure and Critical Habitats for a Key Apex Predator: the broadnose sevengill shark *Notorynchus cepedianus*
Trinh Thi Mong Tran	PhD	Considerations for Monitoring River Catchments in relation to Potential Environmental Impacts from Intensive Aquaculture Systems
Samantha Twiname	PhD	Mechanistic Understanding of Climate-Driven Range Shifts: Using thermal tolerances of rock lobster to predict future change
Roxana Vasille	PhD	Modelling the Larval Dispersal of the Southern Rock Lobster, Jasus Edwardsii (Hutton, 1857)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APPENDIX II VISITORS TO TAROONA 2019

- Minister Guy Barnett – tour of IMAS Taroona facility hosted by Prof Caleb Gardner, Dr Quinn Fitzgibbon and Dr Polly Hilder (February 2019)
- Delegation from Nova Scotia – IMAS researchers Drs Sarah Ugalde, Juan Dorantes Aranda, Klaas Hartmann, Craig Mundy, John Keane, Emily Ogier and A/Prof Gretta Pecl gave an overview of IMAS projects (February 2019)
- Visiting Professor – Professor Heather Hunt from the University of New Brunswick worked with A/Prof Gretta Pecl and the Redmap Australia team (January–April 2019)
- Visiting scientist – Dr Alf Ring Kleiven from the Institute for Marine Research, Norway, worked with A/Prof Jeremy Lyle and Dr Sean Tracey on recreational fisheries surveys (February – July 2019)
- Senator Penny Wong and Carol Brown toured the Rock Lobster Hub – hosted by A/Prof Greg Smith (March 2019)
- Governor Her Excellency Professor Kate Warner AC, Governor of Tasmania and Mr Warner toured the Rock Lobster Hub – hosted by A/Prof Greg Smith and Prof Caleb Gardner hosted the tour, with Orna-Tas CEO Mr Scott Parkinson; UTAS (CoSE) Professor of Plant Science, Anthony Koutoulis; UTAS CoSE Executive Dean, Brian Yates; Deputy Vice-Chancellor for Research Professor Brigid Heyward; and PFG Group Chief Executive Michael Sylvestor
- Indonesia Maritime University (April 2019)
- Shandong University (May 2019)
- ANZ Bank representatives, including ANZ Bank Chairman, CEO, Deputy CEO, Non-executive directors, Executive Committee members, and other managers and media team (June 2019)
- DPIPWE Tasmanian Chief Veterinary Officer, Kevin De Witte; and Lloyd Klump, DPIPWE (July 2019)
- Queensland Minister for Agricultural Industry Development and Fisheries, Mark Furner (August 2019)
- Senator Andrew Wilkie, Independent Federal Member for Clark (August 2019)
- Premier of Tasmania, Will Hodgman, and a delegation of 15 members of the Korean National Federation of Fisheries Cooperatives toured our facilities – hosted by Prof Chris Carter and IMAS Executive Director Terry Bailey (August 2019)
- Federal Assistant Minister (Forestry and Fisheries) Jonathan Duniam, and media (August 2019)
- Australian Research Council CEO, Professor Sue Thomas (August 2019)
- Australia's Ambassador to Denmark (September 2019)
- Acting General Manager, Technology and Innovation Branch of the Australian Antarctic Division Philip Boxall, and eight colleagues, hosted by IMAS Executive Director Terry Bailey (August 2020)

Premier of Tasmania, Will Hodgman, visited our Experimental Aquaculture Facility with the Korean National Federation of Fisheries Cooperatives delegation, hosted by Prof Chris Carter and IMAS Executive Director Terry Bailey.

APPENDIX III PROJECTS 2019–2020

Our research investments are prioritised with government and other stakeholder input through Research Advisory Groups (RAGs). These are a formal requirement of the SMRCA Agreement and occur at least once a year to discuss research needs and how to resource these. Current RAGs include:

- Crustacean and Rock Lobster
- Abalone
- Scalefish, Scallops & Minor Species (SSMS)
- Shellfish Aquaculture
- Finfish Aquaculture
- Recreational Fishery.

Projects that have been underway since 2019 are detailed below, including information on funding sources. Projects are nominally placed into categories of marine resource, although in many cases there will be an overlap between categories.

Dive fisheries

Fishery Assessment: Abalone (2020)

Led by Dr Craig Mundy, this project provides an annual assessment for the Tasmanian Abalone Fishery, recommendations for sustainable total allowable catch (TAC), and regular summary updates of the abalone stocks in the various blocks around the state, using logbook and electronic dive logger data. It is used by DPIPWE and the TACL for management decisions for each zone.

- SMRCA investment $117,813; UTAS indirect support $101,319.

Fishery Data: Abalone Processor Sampling (2020)

Led by Dr Jaime McAllister, this project provides size composition data used in the Abalone Fishery Assessment, gathered from the sampling at commercial abalone catches at processing factories. Factory staff measure 100 randomly-selected abalone from a fishers' catch, from all abalone quota zones and across seasons. In addition, several commercial abalone divers also collect length frequency data while actively fishing at sea. Length frequency catch data provide the size structure information needed to determine the relative contribution of different size classes in supporting the fishery, and in assessing the resilience of the fishery to sustain different levels of fishing pressure. More recently the project has focused on sampling catches from the Eastern Zone in response to declining catches and environmental stresses, and indicates this zone is becoming increasingly reliant on new recruits entering the fishery. This project has also commenced a sampling program for the long-spined sea urchin, to provide catch size structure information for research, modelling and assessment of the long-spined sea-urchin fishery. More recently, there has also been some sampling of short-spined sea urchin.

- SMRCA investment $54,011; UTAS indirect support $46,449.

Fishery Data: Fisheries Dependent e-Data Collection (2020)

Led by Dr Craig Mundy, this project uses state of the art technology data loggers, fitted with 4G modems, to collect fine-scale data on fishing activity. This is critical for assessing fishery performance, understanding changes in utilisation of productive reefs, and tracking shifts in the way the fleet operates in response to management action. The data are used as spatial indicators of fishery performance to capture changes in fishing strategy as indicators of change in stock levels. The data are also used to quantify the reef area supporting the commercial abalone fishery, the proportion of the known fishable reef used annually, and any changes in the way the fleet operates across or within years.

- SMRCA investment $87,214; UTAS indirect support $75,004.

Fishery Data: Inshore Water Temperature Monitoring (2020)

Led by Dr Craig Mundy, this project has collected in situ water temperature data from up to 20 sites around Tasmania annually. The data are used to establish a water temperature time series, to support validation of SST modelling for climate change research, and is freely available to students and researchers if required.

- SMRCA investment $8,621; UTAS indirect support $7,414.

Population Biology: Abalone (2020)

Led by Dr Craig Mundy, this project aims to obtain broad biological information required to provide sustainable advice, and underpins the abalone diving-based research program. This includes annual surveys of abundance, measurements of growth rates, patterns in size at reproductive maturity and reproductive biology and, more recently, sampling to examine the effects of warming and climate change on abalone physiology.

- SMRCA investment $435,881; UTAS indirect support $374,858.

Evaluation of the subsidy for the Centrostephanus fishery

Led by Dr Katie Cresswell, this project tracks the performance of the recently developed fishery for long-spined sea urchins, which now involves a harvest of several hundred tonnes per annum. This assessment is especially useful for managing the government harvest subsidy program.

- External leverage (DPIPWE) $40,000; SMRCA investment $11,692; UTAS indirect support $44,455.

Fisheries biology of short-spined sea urchins in Tasmania

Led by Dr John Keane, this project aims to provide sound scientific knowledge of short-spined sea urchin growth and reproduction, to allow for sustainable management of the fishery. Additional research on roe quality will optimise harvesting strategies and the profitability the fishery, while scientific support of farming trials will assist in the management and development of a new industry.

- External leverage (FRDC) $262,870; SMRCA investment $195,800; UTAS indirect support $394.456.

Can spatial fishery-dependent data be used to determine stock status in a spatially structured fishery?

Led by Dr Craig Mundy, this project will investigate key abalone fishery performance indicators, developing metrics for detecting hyper-stability, conducting Management Strategy Evaluation of four alternate Abalone Fishery Harvest Strategies, and developing a defensible strategy of assigning stock status to abalone fisheries for the Status of Australian Fish Stocks (SAFS) framework.

- External leverage (FRDC) $562,128; SMRCA investment $25,568; UTAS indirect support $529.973.

Commercial upscaling of urchin fertiliser

Led by Dr John Keane, this project is conducting trials to test the effectiveness of dried sea urchin waste as a soil conditioner/fertiliser for commercial crops, and liquid sea urchin waste as a spray to enhance frost resistance in commercial crops. If successful, it will eliminate waste management costs, generate revenue and increase the viability and profitability of small-scale urchin processors.

- External leverage (AIRF) $538,580; SMRCA investment $9,999; UTAS indirect support $471,778.

Resetting urchin barrens: Liming as a rapid widespread urchin removal tool

Led by Dr John Keane, this project will identify the liming application rates required to kill long-spined sea urchins and the impact of this approach on other invertebrates. The project will determine whether localised field trials are warranted and if the method is cost effective.

- External leverage (AIRF) $58,778; SMRCA investment $22,527; UTAS indirect support $69,922.

Effects of urchin fishing on urchin populations and recovery

Led by Dr John Keane, this project will determine the effects of high fishing pressure on urchin populations and quantify kelp recovery in heavily fished areas in North East Tasmania. Field data collection will be a combination of dive surveys, video surveys and urchin processing.

- External leverage (AIRF) $132,203; SMRCA investment $61,840; UTAS indirect support $69,922

Waste to profit in urchin fisheries: developing business opportunities to ensure fishery sustainability and safeguard reef dependent fisheries from destructive urchin grazing

Led by Dr John Keane, this project commenced in 2017 to investigate the exploitation of waste products from urchins, to increase the commercial viability of the fishery. Developing business opportunities from the vast quantities of urchin waste is seen as an effective way to increase the viability of urchin fisheries, while reducing costs associated with urchin waste management and decreasing urchin numbers in valuable abalone and rock lobster fishing grounds.

- External leverage (FRDC) $52,102; SMRCA investment $42,032; UTAS indirect support $166,877.

Monitoring abalone juvenile abundance following removal of Centrostephanus and translocation

Led by Dr Craig Mundy, this project will install abalone juvenile collectors at urchin cull control and treatment sites in Eastern Victoria, and a single re-survey will be conducted.

- External leverage (FRDC) $67,916; SMRCA investment $17,117; UTAS indirect support $73,128.

Postdoctoral Research Fellow: Quantitative Fisheries

Led by Professor Caleb Gardner, the Postdoctoral Research Fellow will conduct quantitative fisheries research, aimed to both develop their postdoctoral skills and contribute to the management of Tasmania's marine resources.

- External leverage (CSIRO) $214,372; SMRCA investment $214,372; UTAS indirect support $368,720.

Drawing strength from each other – Simulation testing of Australia's abalone harvest strategies

Led by Dr Craig Mundy, this project will address the need to write Management Strategy Evaluation code that will be usable for the future and in other jurisdictions. This code will be tested on two abalone stocks (one blacklip, one greenlip) to assist with code generality. The final product will be freely available on a version control site such as GitHub with detailed guides on how it is best used.

- External leverage (FRDC) $366,701; SMRCA investment $32,499; UTAS indirect support $343,312.

Scalefish and Cephalopods

Fishery Assessment: Scalefish (2020)

Led by Dr Nils Krueck, this project combines data on catch and fishing effort with information from fishery-independent biological surveys, to assess the status of Tasmanian Scalefish Fishery species. This is a complex fishery, comprising multiple data-poor species in coastal waters, that are harvested by both commercial and recreational fishers using various gear types.

- SMRCA investment $102,303; UTAS indirect support $97,981.

Population Biology: Scalefish (2020)

Led by Associate Professor Sean Tracey, this project aims to generate biological information required for managing the Tasmanian Scalefish Fishery. An important component of this program is to collect fish frames from both commercial and recreational fishers, which can be used to provide important biological information. In particular, otoliths (fish ear bones) are extracted and analysed to assess the age of the fish. This provides insights into the resilience of a stock, as it is used to assess the contribution of different age classes of fish to a population. The project also involves targeted fishery independent sampling, where information on aspects such as the reproductive biology of a particular species can be assessed. This can assist in determining the best timing for spawning season closures, and for ensuring that minimum legal size limits are appropriate so a good proportion of fish can spawn before they are potentially harvested.

- SMRCA investment $210,767; UTAS indirect support $181,260.

Where do Calamari spawn in Northern Tasmania

Led by Associate Professor Sean Tracey, this three-year project commenced in 2016 to research the spawning of calamari in Northern Tasmania. Completed in 2020, the project identified the spatial and temporal variation in calamari spawning, connectivity between heavily fished regions, development of the fishery, and potential options to ensure the sustainable development of this emerging fishery.

- External leverage (FRDC) $169,493; SMRCA investment $230,056; UTAS indirect support $343,612.

Investigate oceanographic and environmental factors impacting the Eastern Tuna and Billfish Fishery target species

Associate Professor Sean Tracey is part of the CSIRO-led research team developing spatial distribution models relative to the Eastern Tuna and Billfish Fishery target species.

- External leverage (FRDC) $11,310; SMRCA investment $10,475; UTAS indirect support $18,735.

Science to support Australia's Southern Ocean Fisheries 2018–2020

Led by Philippe Ziegler, this project will:

1. Support and improve data collection programs in the Australian fisheries at Heard and MacDonald Islands
2. Reduce sources of uncertainty in icefish and toothfish assessments
3. Provide avenues for adaptation of the fishery to climate change
4. Monitor, evaluate and mitigate fish and skate/ray bycatch, seabird bycatch and cetacean depredation
5. Support Australian research activities in the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) exploratory fisheries.

- External leverage (FRDC) $1,473,400; SMRCA investment $300,000; UTAS indirect support $1,525,124.

Socio-economic characterisation of a small-scale commercial fishery: opportunities to improve viability and profitability in the Tasmanian Scalefish Fishery

Led by Associate Professor Jeremy Lyle, this in-depth social and economic assessment of the Tasmanian Scalefish Fishery includes improved understanding of fisher dynamics, supply chains and opportunities to improve industry performance, with a focus on social, economic, and environmental outcomes.

- External leverage (FRDC) $249,855; SMRCA investment $352,358; UTAS indirect support $517,903.

Understanding population structure and dynamics of Victoria's developing Octopus fishery

Led by Professor Jayson Semmens, this project aims to provide information for the assessment and sustainable management of octopus populations in Victoria and across the southeast of Australia.

- External leverage (FRDC) $372,411; SMRCA investment $57,704; UTAS indirect support $369,899.

The impacts of climate change on behaviour and physiology of key elasmobranch species in Southeast Tasmania

Led by Professor Jayson Semmens, this project will be the first study to measure the rates of protein synthesis in elasmobranchs, and to undertake behavioural and physiology research on fluctuating temperatures, especially compounded with changing salinities.

- External leverage (Holsworth) $6,750; SMRCA investment $1,566; UTAS indirect support $7,151.

Finescale behaviour of elasmobranchs

Led by Professor Jayson Semmens, this project will investigate the fine-scale behaviour of elasmobranchs, using a multi-sensor biologging package to examine their movements (diving behaviour) and investigate their locomotion using biomechanical principles.

- External leverage (Holsworth) $6,750; SMRCA investment $1,253; UTAS indirect support $6,882.

Rock Lobster and Giant Crab

Fishery Assessment: Rock Lobster (2020)

Led by Dr Klaas Hartmann, this project assesses egg production and recruitment to measure the biological sustainability of Tasmania's rock lobster fishery. Both fishing effort and biological parameters vary dramatically from region to region, presenting major challenges for fishery assessment and management. We use a spatially-explicit stock assessment model that considers different assessment areas separately and informs harvest strategies that incorporate regional differences.

- SMRCA investment $148,482; UTAS indirect support $127,695.

Fishery Data: Commercial Catch Sampling (2020)

Led by Dr Rafael León, this project is the primary source of length-frequency data for stock assessment and involves fishery dependent and independent data collection. Information recorded includes location, specimen data (e.g. sex, size, maturity stage), and bycatch species. An updating process for electronic data collection is also being investigated.

- SMRCA investment $472,050; UTAS indirect support $405,963.

Population Biology: Rock Lobster (2020)

Led by Dr Rafael León, this project aims to generate biological information required for management, such as reproductive research for some fish species to review their relative risk status as bycatch species in the Tasmanian rock lobster fishery. The research also aims to answer questions from the industry or Fishery Authority, such as evaluating the viability of rock lobster larvae when berried females are exposed to cold-temperature shock in winter catch.

- SMRCA investment $288,061; UTAS indirect support $247,733.

Fishery Assessment: Giant Crab (2020)

Led by Dr Rafael León, this project aims to carry out an annual assessment to estimate a total allowable catch (TAC), review the stock status, and assess fishery performance against indicators (limit reference or trigger points). This will assist the Fisheries Authority to allocate the individual quotas to fishers and to take action if any limit reference point or trigger point has been exceeded. This project also involves a series of other projects, such as improving length-frequency data collection and assessing the potential interaction with other fishing sectors (bottom trawling) which can result in conflict due to competition for access to shared fishing grounds.

- SMRCA investment $36,784; UTAS indirect support $31,634.

Rebuilding Southern Rock Lobster stocks on the east coast of Tasmania: informing options for management

Led by Associate Professor Jeremy Lyle, this project seeks to describe and model the relationships between fisher behaviour, stock status and management intervention in the east coast rock lobster fishery. This will be used to develop a management framework to support the rebuilding of east coast rock lobster stocks, recognising that traditional management approaches are expected to become less effective at controlling the catch as the east coast stocks recover.

- External leverage (FRDC) $103,800; SMRCA investment $227,551; UTAS indirect support $284,962.

Improved risk management of paralytic shellfish toxins in Southern Rock Lobster

Led by Professor Gustaff Hallegraeff and managed by Alison Turnbull, this project will refine monitoring tools to reduce the costs associated with paralytic shellfish toxin (PST) risk management of southern rock lobster, including the application of cheaper and faster PST testing. It will also explore whether tests can be conducted in a non- destructive manner. The $84M lobster industry has been impacted by seasonal Tasmanian closures of up to 5+ months, due to PST contamination of hepatopancreas (HP). This has particularly occurred in the St Helens and Maria Island regions, and up to Flinders Island, with an estimated $780,000 in lost revenue.

- External leverage (FRDC) $895,500; SMRCA investment $662,000; UTAS indirect support $1,339,450.

Ensuring monitoring and management of bycatch in Southern Rock Lobster fisheries is best practice

Led by Dr Rafael León, this project is addressing the identified shortcomings in performance relative to bycatch reporting, assessment and management in the southern rock lobster fisheries of South Australia, Victoria and Tasmania. The aim is to raise the standard to best practice.

- External leverage (FRDC) $225,282; SMRCA investment $82,880; UTAS indirect support $265,019.

Victorian Rock Lobster and Giant Crab Assessments 2019-2021

Led by Dr Klaas Hartmann, this project will conduct the giant crab and southern rock lobster stock assessments for the Victorian Fisheries Authority (VFA), review a new stock assessment model, run sensitivity analyses across the range of input parameters, and conduct ongoing work on developing a harvest strategy.

- External leverage (VFA) $317,010; SMRCA investment $82,450; UTAS indirect support $343,536.

Examining the potential impacts of seismic surveys on octopus and larval stages of Southern Rock Lobster

Led by Professor Jayson Semmens, this project will use a field and laboratory experimental approach to provide a thorough assessment of the potential impacts of seismic surveys on the pale octopus Octopus pallidus (the primary species captured in the fishery) in the natural environment, as a model species for octopus fisheries. The project will also examine the potential impact of the seismic survey on octopus catches and catch rates.

- External leverage (FRDC) $547,070; SMRCA investment $58,970; UTAS indirect support $521,194.

Lobster predation re-survey

Led by Dr Scott Ling, this project will re-survey baseline sites established during a previous FRDC project, which investigated the effectiveness of rebuilding large lobsters to mitigate risk of urchin overgrazing.

- External leverage (AIRF) $30,000; SMRCA investment $54,996; UTAS indirect support $73,097.

Improving the southern rock lobster on-vessel handling practices, data collection and industry tools for lobster quality

Led by Associate Professor Quinn Fitzgibbon, this project will:

1. Investigate the impacts of on-vessel and maintenance practices on live southern rock lobster (SRL) post-harvest performance
2. Develop practical tools for the improved management of SRL industry live lobster operations, i.e. handheld lactate meter and refractive index including thresholds for poor lobster performance
3. Extend findings to the SRL industry (best practice guides and workshops) and incorporate results into the SRL Clean Green program.

- External leverage (FRDC) $538,604; SMRCA investment $383,861; UTAS indirect support $793,320.

Improving post-harvest survivability of southern rock lobster in a changing environment

Led by Associate Professor Quinn Fitzgibbon, this two-year study commenced in 2017. It examined epidemiology, physiology and pathology of southern rock lobster, to understand the recent mortalities observed in holding facilities in both Tasmania and South Australia.

- External leverage (FRDC) $663,817; SMRCA investment $184,247; UTAS indirect support $729,335.

Larval dispersal for southern rock lobster and long-spined sea urchin to support management decisions

Led by Dr Katie Cresswell, this project will provide the first attempt to capture the dispersal of long-spined sea urchin and southern rock lobster larvae using contemporary oceanographic models, and will be the first to incorporate vertical movement of larvae. It will allow a calculation of which reefs are the most likely sources for large recruitment events and link this to egg production estimates for reefs. The model can also be used to predict whether Tasmanian populations are now likely to be self-recruiting.

- External leverage (FRDC) $242,861; SMRCA investment $22,586; UTAS indirect support $228,284.

Recreational southern rock lobster tagging program: Assessing current data and modelling assumptions and approaches to establish a robust estimate

Led by Karlie McDonald, this project will be an in-depth survey of the Victorian recreational rock lobster fishery and catch in the 2020–21 season. In consultation with VFA and stakeholders, this project will improve and direct the development of the Victorian rock lobster tagging program.

- External leverage (FRDC) $147,805; SMRCA investment $148,024; UTAS indirect support $254,413.

Bivalve fisheries

Fishery Assessment: Commercial Scallop (2020)

Led by Professor Jayson Semmens, this project supports the Tasmanian Scallop Fishery's harvest strategy, by undertaking surveys to estimate abundance and size frequency distributions. This will allow decision rules to be used to open or close areas to fishing, with total allowable catches based on the estimated abundance.

- SMRCA investment $131,211; UTAS indirect support $112,842.

Fishery Assessment: Small Bivalve (2020)

Led by Dr John Keane, this project will estimate the population size of Venus clams *Venerupis largillierti* and flat oysters *Ostrea angasi* in St Helens to facilitate setting of the total allowable catch.

- SMRCA investment $17,945; UTAS indirect support $15,433.

Fishery Assessment: Sheltered Coastal Waters Scallop (2020)

Led by Associate Professor Sean Tracey, this project aims to survey the D'Entrecasteaux Channel to assess the abundance of scallops, to determine whether there is sufficient biomass to open the recreational fishery in the area.

- SMRCA investment $37,923; UTAS indirect support $32,614.

Recreational fisheries

Provision of annual catch estimates for the recreational rock lobster and abalone fisheries

Led by Associate Professor Jeremy Lyle, this project has been conducted annually since the late 1990s. The information collected includes how many people go fishing or diving for rock lobster and abalone, how often and in what regions, and their catch and success rates. The research assists in the sustainable management of Tasmania's rock lobster and abalone fisheries.

- External leverage (DPIPWE) $152,022; SMRCA investment $113,369; UTAS indirect support: $228,236.

Fishery Data: Sand Flathead Independent Surveys (2020)

Led by Associate Professor Jeremy Lyle, this project continues a series of fishery-independent surveys, undertaken annually since 2012, to identify trends in the sand flathead populations off south-eastern Tasmania.

- SMRCA investment $48,003; UTAS indirect support $41,282.

Understanding the movement, behaviour and post-release survival rate of recreationally caught swordfish in Australia

Led by Associate Professor Sean Tracey, this project investigates the post-release survival, movement and migration behaviour and factors effecting ethical capture of swordfish by recreational fishers. It is an extension of the pilot study funded by FRDC, TARFish, the Tasmanian Government and the Gamefishing Association of Australia

- External leverage (VFA) $80,549; SMRCA investment $10,291; UTAS indirect support $78,122.

Mechanisms and consequences of a climate-driven range extension of snapper (Chrysophrys auratus) in southeast Australia

Led by PhD student Barrett Wolfe, this project is investigating the ecological consequences of climate-driven marine species range shifts.

- External leverage (Sea World Research and Rescue Foundation) $33,666; SMRCA investment $23,003; UTAS indirect support $48,735.

Opportunities and impacts of range extending scalefish species

Led by Associate Professor Sean Tracey, this project investigates scalefish species-level responses to ocean warming. This is a priority research area, as these species underpin the structure and function of marine ecosystems and the productivity of the fisheries that operate within them. Understanding population attributes such as growth, mortality and reproductive dynamics, and relationships such as competition with species at similar trophic levels, will have benefits for the assessment and management of the Tasmanian recreational fishery more generally.

- External leverage (funder) $249,587; SMRCA investment $280,967; UTAS indirect support $456,276.

The role of recreational fisher in stewardship of the SBT fishery

Led by Associate Professor Sean Tracey, the Tuna Champions project is delivering an education program to improve stewardship, fish handling and responsible fishing practices in the recreational fishery for southern bluefin tuna, via a multi-faceted communication strategy. A research assessment of the communications mediums and strategies used will also be delivered, to provide new insight into the most effective strategies to ensure uptake of key messages within the recreational fishing sector.

- External leverage (FRDC) $597,955; UTAS indirect support $514,241.

Determining the design, output specifications and sample size for a national social and economic survey of recreational fishers in Australia

Led by Associate Professor Sean Tracey, this project defined a survey methodology and appropriate sample size to accommodate the data needs and output specifications for a national socio-economic survey of recreational fishing in Australia.

- External leverage (FRDC) $12,755; SMRCA investment $12,755; UTAS indirect support $21,939.

National Survey of the Recreational Catch of Southern Bluefin Tuna

Led by Associate Professor Sean Tracey, this national survey used a multi-faceted survey approach and delivered the analysis for a national estimate of the recreational catch of southern bluefin tuna (SBT). The survey is designed to understand the recreational fishing harvest of SBT, so Australia can meet its obligation to report all sources of SBT mortality to the Commission for the Conservation of Southern Bluefin Tuna (CCSBT).

- Survey – External leverage (DAWE) $2,024,190; UTAS indirect support $1,740,803.
- Analysis – External leverage (DAWE) $108,000; UTAS indirect support $92,880.

Characterisation and Catch Estimates for Offshore Recreational Fishing in Tasmania 2018-19

Led by Associate Professor Sean Tracey, this project delivered a state-wide estimate of the recreational catch of offshore species in Tasmania, using a multi-faceted survey approach. This snapshot complements the general recreational fishing surveys we conduct every five years.

- External leverage (DPIPWE) $50,000; UTAS indirect support $43,000.

Survey of General Recreational Fishing in Tasmania – reporting of fisheries information and catch estimates for all Tasmanian recreational fisheries

Led by Associate Professor Jeremy Lyle, this project is conducted every five years across Tasmania to collect information about how many people go recreational fishing, how often they fish, where they fish and what they catch. This major study assists the Tasmanian Government in sustainably managing our recreational fisheries. It is funded through a Fishwise Resource Management Grant, with additional support from the Inland Fisheries Service.

- External leverage (DPIPWE): $226,289; SMRCA investment $136,594; UTAS indirect support $312,079.

Exploring recreational fishing data for use in Harvest Strategies: NSW DPI research collaboration

Led by Associate Professor Sean Tracey, this project is working with NSW DPI to mine and analyse a plethora of recreational fishing data to find aspects that will be useful in fisheries Harvest Strategy Management plans. These aspects may extend beyond traditional catch and effort metrics into social and economic indices.

- External leverage (DPINSW): $78,437; SMRCA investment $60,560; UTAS indirect support $119,537.

Integrating recreational fishing information into harvest strategies for multi-sector fisheries

Led by Associate Professor Jeremy Lyle, this project will use a combination of desktop research, stakeholder workshops, quantitative survey techniques, along with a modelling framework (FishPath) to develop guidelines to formally integrate recreational fishing into harvest strategies for multi-sector fisheries, using a range of NSW fisheries as case studies.

- External leverage (DPINSW): $19,999; SMRCA investment $8,490; UTAS indirect support $24,500

Management and governance

Fishery Data: Economic and Social Data Collection and Management (2020)

Led by Dr Emily Ogier, this project aims to fill gaps in assessments of Tasmanian fisheries relating to social and economic performance. Tasmanian fisheries are managed to ensure ecological sustainability, and to take account of the community's needs and interest in living marine resources (LMRMA 1995).

Assessment of social and economic performance has started with identifying relevant indicators, and using available data, to produce preliminary assessments of Tasmania's major fisheries and aquaculture sectors. Relevant indicators include those that measure fleet-wide and public benefits arising from the use of these fisheries resources. They include trends in how much economic yield these fisheries generate, what level of benefits are private (industry) and public, who participates, and who derives livelihoods from these activities.

The project also aims to establish regular collection and ongoing management of social and economic data, in partnership with industry associations and the Tasmanian Government.

- SMRCA investment $35,003; UTAS indirect support $30,103.

An economic and social assessment of the outcomes of individual transferable quota (ITQ) fisheries and how to improve benefits to Tasmania

Led by Dr Steven Rust, this project focuses on the Rock Lobster and Abalone (RLA) fisheries and will:

1. Understand changes in the economic resilience of the harvesting sector, quota market (e.g. accumulation of market power) and fishing community (e.g. fleet size, employment) dynamics, and any other unintended consequences
2. Identify indicators for ongoing monitoring of extent and effects of individual transferable quota systems
3. Develop capability for scenario analysis for comparing business-as-usual with alternate management strategies for the Crustacean and Abalone Fisheries Advisory Committee.

- SMRCA investment $37,470; UTAS indirect support $32,224.

Tactical social and economic analyses

Led by Dr Emily Ogier, this project addresses critical social and economic assessment needs arising from changing conditions for Tasmania's marine resources. This project will:

1. Collect primary data to support assessment through economic and social surveys
2. Develop human and model capacity for ongoing analysis of Tasmanian fisheries and aquaculture economic contribution, and
3. Analyse Tasmanian seafood workforce trends, oyster supply chains and opportunities for improved market outcomes, centrality and substitutability of rock lobster and the east coast for recreational fishers, seafood tourism levels, and COVID-19 economic shocks to the seafood industry and recreational fishing opportunity, and explanatory factors for economic performance post-crisis.

- SMRCA investment $212,915; UTAS indirect support $183,107.

Lever opportunities under the Aquatic Resources Management Act WA: benefit sharing, re-allocation, and co-management in practice

Led by Dr Emily Ogier, this project will explore and test potential policy 'pathways' for managing aquatic resources, including fisheries, in Western Australia. The project will generate cost-effective decision-support tools and recommendations for measuring and managing social and economic performance. These outputs are being developed for both managers and direct stakeholders engaged in drafting management objectives and instruments under the new legislation governing Western Australia's management of aquatic resources.

- External leverage (FRDC) $273,240; SMRCA investment $121,672; UTAS indirect support $339,624.

National Fisheries and Aquaculture Industry Contributions Study 18

Led by Dr Emily Ogier, this project aims to:

1. Provide an estimate of the economic contribution of wildcatch fisheries and aquaculture to the Australian (national) economy, and of jurisdiction-based fisheries and aquaculture to their State or Territory economies
2. Provide measures of social and economic contributions made by selected fisheries and aquaculture sectors at the regional and product scale
3. Develop a robust and nationally consistent framework to support data collection and estimation of contributions in the future.

- External leverage (FRDC) $393,218; SMRCA investment $7,890; UTAS indirect support $344,953.

Building economics into Fisheries Management decision making, to utilise a suite of SA case studies

Led by Professor Caleb Gardner, this project will identify and explore more cost-effective and efficient ways to incorporate economic information in harvest strategies and decision-making processes that aim to achieve maximum economic yield.

- External leverage (EconSearch/FRDC) $18,000; SMRCA investment $15,625; UTAS indirect support $28,918.

Salmonid farming

Aquaculture Environment Interactions: Planning (2020)

Led by Dr Myriam Lacharite and Associate Professor Jeff Ross, this project provides science and research support for planning of new and developing salmon aquaculture operations in Tasmania. We synthesize marine data and provide seafloor mapping products to assist spatial planning, and conduct and further develop marine zone assessments of aquaculture sites.

- SMRCA investment $461,701; UTAS indirect support $397,063.

Aquaculture Environment Interactions: Emerging Issues, Social Science and Communication (2020)

Led by Dr Camille White and Associate Professor Jeff Ross, this project explores a range of emerging issues in salmon aquaculture, such as environmental monitoring of salmon farming in both a regulatory and operational management context, and approaches for informing the community about aquaculture planning and development. We are currently developing a series of reviews on the ecological effects of aquaculture, and have launched a new website salmoninteractionsteam.org which provides updates and learnings about the interactions between salmon aquaculture, the environment, and society.

- SMRCA investment $271,623; UTAS indirect support $233,596.

Aquaculture Environment Interactions: Monitoring and Management (2020)

Led by Associate Professor Jeff Ross, this project supports the monitoring and ongoing management of current salmon farming operations in Tasmania. It ensures current monitoring practices are adequate and makes recommendations for improvement where necessary.

- SMRCA investment $326,600; UTAS indirect support $280,876.

Managing ecosystem interactions across differing environments

Led by Associate Professor Jeff Ross, this project commenced in late-2015 and covers two geographic regions – Macquarie Harbour and the southeast of Tasmania. The project will provide an understanding of the ecological significance of any differences in observed effects across regions, and how that information may be used to inform and improve site-specific and regional monitoring, modelling and management approaches.

- External leverage (FRDC) $1,078,729; SMRCA investment $790,352; UTAS indirect support $1,607,564.

Understanding oxygen dynamics and the importance for benthic recovery in Macquarie Harbour

Led by Associate Professor Jeff Ross, this ongoing project contributes to improved advice on appropriate fallowing and remediation strategies for the conditions currently occurring in Macquarie Harbour.

- External leverage (FRDC) $2,274,802; SMRCA investment $816,688; UTAS indirect support $2,658,681.

Vulnerability of the endangered Maugean Skate population to degraded environmental conditions in Macquarie Harbour

Led by Associate Professor Jeremy Lyle, this project is assessing the impacts and implications of environmental conditions in Macquarie Harbour on the physiology and survival of an endangered species, the Maugean skate. The aim is to formulate threat abatement and recovery plans for the species.

- External leverage (FRDC) $421,129; SMRCA investment $346,778; UTAS indirect support $660,400.

Aquaculture-Community Futures: North West Tasmania

Led by Dr Karen Alexander, this project aims to understand the regional development and wellbeing futures envisaged by residents of North West Tasmania, and how salmonid farming can contribute to meeting these shared values.

- External leverage (FRDC) $172,996; SMRCA investment $28,057; UTAS indirect support $172,906.

Storm Bay Observing System: Assessing the Performance of Aquaculture Development

Led by Associate Professor Jeff Ross, this project measures a suite of environmental information for Storm Bay and sets up systems for tracking change in the future. It will support the design and implementation of an effective, efficient and reliable monitoring program, providing expert advice on sampling locations, timelines and strategies, and testing this data over 3–4 years to refine and improve the program. Sustainable management of salmon farming in Storm Bay under conditions set by the EPA would not be possible without this project.

- External leverage (FRDC) $3,683,628; SMRCA investment $1,149,326; UTAS indirect support $4,156,340.

Life history and reproductive behaviour of the vulnerable Melbourne skate to inform fisheries management and conservation

Led by Professor Jayson Semmens, this project will address the lack of vital biological and ecological information available on the Melbourne skate, to guide conservation efforts for this vulnerable species.

- External leverage (Sea World Research & Rescue Foundation) $25,048; SMRCA investment $175,229; UTAS indirect support $172,238.

Experimental Aquaculture Facility (EAF)

Launched in 2015 and led by Professor Chris Carter, the EAF has enabled IMAS to expand its salmon research into production and husbandry. Large-scale replicated experiments are now underway in Tasmanian conditions to fine-tune feeding and other aspects of husbandry.

- External leverage (Department of Industry, Science, Energy and Resources; Department of Primary Industries, Parks, Water & Environment; Huon Aquaculture; Skretting Australia) $467,000; SMRCA investment $90,000; UTAS indirect support $479,020.

Macquarie Harbour String Maintenance – Rolling Agreement

This project is led by Associate Professor Jeff Ross. Currently there are three real-time environmental monitoring strings deployed in Macquarie Harbour, as part of the FRDC project: Understanding oxygen dynamics and the importance for benthic recovery in Macquarie Harbour. This project will continue the maintenance of these strings and will provide dashboard data to the FRDC.

Oyster farming

Risk of OsHV-1 uvar transmission to spat when breeding from exposed broodstock

Led by Dr Andrew Trotter, this project will investigate vertical transmission of OsHV-1 in Pacific oyster hatcheries, with the aim to provide findings to allow biosecurity policy decisions to be made.

- External leverage (Australian Seafood Industries) $89,713; SMRCA investment $117,367; UTAS indirect support $178,089.

Shellfish Farming (2020)

Led by Dr Andrew Trotter, this project will support continuation of the national Pacific oyster breeding program, which aims to complete the breeding for POMS resistance in young spat, and recommence breeding for traditional commercial traits (i.e. growth rate, meat condition, shell shape and non-specific survival).

- SMRCA investment $66,220; UTAS indirect support $56,949.

Future Oysters CRC-P: Advanced understanding of POMS to guide farm management decisions in Tasmania

Led by Dr Christine Crawford, this project commenced in late 2016 as a part of the $11M Future Oysters CRC Project. The CRC-P has the overall objective of conducting research that will accelerate the breeding of disease resistant oysters, improving disease management, increasing productivity and profitability, and diversifying risks to allow the Australian oyster aquaculture industry to grow both domestically and globally.

- External leverage (Department of Industry, Innovation and Science) $694,773; SMRCA investment $190,562; UTAS indirect support $761,388.

Future Oysters CRC-P: Reliable hatchery production of POMS resistant oysters

Led by Professor Greg Smith, this project determined the best practices for breeding from previously exposed POMS (OsHV-1) stocks.

- External leverage (Department of Industry, Innovation and Science) $601,218; SMRCA investment $782,742; UTAS indirect support $1,190,206.

Future Oysters CRC-P: Species diversification to provide alternatives for commercial production

Led by Dr Christine Crawford, and working with oyster farmers, this project developed new methods to grow and market native oysters in Tasmania.

- External leverage (Department of Industry, Innovation and Science) $89,468; SMRCA investment $109,831; UTAS indirect support $171,397.

Assessing the risk of pathogenic vibrio species in Tasmanian oysters

Led by Alison Turnbull, this project will survey oysters in Tasmanian growing areas for pathogenic vibrio species, to assess risk to human health. The project seeks to identify relationships between environmental parameters such as salinity and temperature, to inform potential risk management strategies.

- External leverage (Oysters Tasmania) $7,600; SMRCA investment $6,694; UTAS indirect support $12,293.

Values and expectations of a sensor network for oysters

Led by Alison Turnbull, this study will determine stakeholder expectations and the potential value of a sensor network in Tasmanian oyster growing areas.

- External leverage (Oysters Tasmania) $10,000; UTAS indirect support $8,600.

Seaweed farming

Kelp aquaculture scoping study

Led by Associate Professor Jeffrey Wright, this project will gain the information needed to bring bull kelp Durvillaea spp into integrated offshore aquaculture.

- External leverage (Blue Economy CRC) $35,479; SMRCA investment $4,775; UTAS indirect support $34,618.

Seaweed Solutions for Sustainable Aquaculture CRC – AUD 2.385M over the next three years

Led by Associate Professor Catriona MacLeod, this three-year project will develop a sustainable Integrated Multi-Trophic Aquaculture (IMTA) model that supports commercial seaweed production. To do this, the research will:

1. Define the seaweed culture proposition – identify species, growing techniques and products
2. Develop a regionally relevant IMTA partnership model that brings together salmon, shellfish and seaweed producers to ensure economic, environmental and societal benefits.

The project is funded by the Department of Industry, Innovation and Science at $2.385M ($1.437M to UTAS) over the next three years, and is conducted in collaboration with Deakin University, Spring Bay Seafoods, and Tassal.

- External leverage (Department of Industry, Innovation and Science) $1,437,429; SMRCA investment $352,845; UTAS Investment $167,415; UTAS indirect support $1,683,613.

Assessing the role of restored and natural kelp forests in protecting against coastal erosion and acidification

Led by Dr Beth Strain, this project will test the role of the dominant kelp species from south-eastern Australia, Ecklonia radiata, in providing vital ecosystems services of reducing the threat of coastal erosion by dampening storm waves and alleviating the pressure of ocean acidification by buffering pH2.

- External leverage (Australian Academy of Science) $25,000; SMRCA investment $379; UTAS indirect support $21,826.

Economic Assessment of Blue Economy

Led by Associate Professor Owen Nguyen, this study reviews and develops the economic assessment frameworks for Sustainable Blue Economy Developments (RP5). A systematic review will be conducted to draw on the knowledge and experience across countries and regions.

- External leverage (Blue Economy CRC) $39,380; SMRCA investment $3,125; UTAS investment $15,625.33; UTAS indirect support $49,992.

Industrywide projects

Derwent Estuary Program Reef Monitoring

Led by Dr Camille White, this project aims to:

1. Use the rocky reef algal communities as a biological indicator of nutrient availability
2. Undertake Rapid Visual Assessment (RVA) surveys at six locations twice per year to assess the functionality of algae communities
3. Report on how the function of algal communities may change over time.

- External leverage (Derwent Estuary Program) $31,495; SMRCA investment $4,285; UTAS indirect support $30,771.

SafeFish Project

Led by Alison Turnbull, this three-year project aims to deliver robust food safety research and advice to industry and regulators; resolve barriers to trade; support industry to address food safety risks in a cost effective, efficient and timely manner; and enhance research and technical food safety capabilities in the Australian seafood industry.

- External leverage (SARDI) $59,865; SMRCA investment $50,264; UTAS indirect support $94,711.

Climate-driven range shifts in fishes and the impacts on temperate marine ecosystems

Led by Associate Professor Sean Tracey, this three-year project will develop species-level understanding of climate change impacts on fishes and temperate marine ecosystems, significantly improving our ability to provide advice relevant to the strategic management of these valuable natural resources.

- External leverage (Holsworth Wildlife Research Endowment) $18,330; SMRCA investment $24,738; UTAS indirect support $37,038.

Status of Australian Fish Stocks (SAFS) reports

Led by Dr Klaas Hartmann, this project brings together available biological, catch and effort information to determine the status of Tasmania's key wildcatch fish stocks against a nationally-agreed reporting framework, and to provide a resource to inform the general public, policy makers and industry on the sustainability of these stocks.

- External leverage (FRDC) $84,400; SMRCA investment $129,056; UTAS indirect support $183,572.

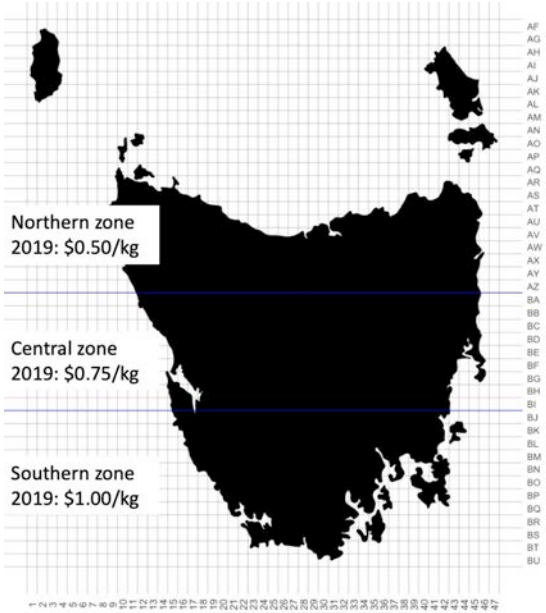
APPENDIX IV RESEARCH GRANTS 2020

CHIEF INVESTIGATOR	PROJECT NAME	TOTAL SMRCA INVESTMENT	2020 INCOME	FUNDING BODY
MacLeod	Managing ecosystem interactions across differing environs: building flexibility and risk assurance into environmental management strategies.	1,000	133,729	FRDC
Tracey	Where do Calamari spawn in Northern Tasmania how will this information aid the management of the Calamari fishery in Northern Tasmania?	1,500	20,468	FRDC
Ross	Understanding oxygen dynamics and the importance for benthic recovery in Macquarie Harbour	11,119	720,768	FRDC
Lyle	Vulnerability of the endangered Maugean Skate population to degraded environmental conditions in Macquarie Harbour	25,474	111,771	FRDC
Tracey	Understanding the movement, behaviour and post-release survival rate of recreationally caught Swordfish in Australia	0	8,055	VFA
Keane	Fisheries biology of short-spined sea urchins (*Heliocidaris erythrogramma*) in Tasmania	1,500	108,348	FRDC
Ogier	Lever opportunities under the Aquatic Resources Management Act WA: benefit sharing, re-allocation, and co-management in practise	24,817	129,976	FRDC
Lyle	Rebuilding Southern Rock Lobster stocks on the east coast of Tasmania: informing options for management	0	56,695	FRDC
Tracey	Investigate oceanographic and environmental factors impacting on the Eastern Tuna and Billfish Fishery target species	3,596	3,930	FRDC
Hallegraeff	Improved risk management of paralytic shellfish toxins in Southern Rock Lobster	106,003	171,000	FRDC
Leon	Ensuring monitoring and management of bycatch in Southern Rock Lobster fisheries is best practice	0	19,440	FRDC

CHIEF INVESTIGATOR	PROJECT NAME	TOTAL SMRCA INVESTMENT	2020 INCOME	FUNDING BODY
Ogier	National Fisheries and Aquaculture Industry Contributions Study 2018	5,018	93,218	FRDC
Pecl	Mechanisms and consequences of a climate-driven range extension of snapper (*Chrysophrys auratus*) in southeast Australia	9,278	11,562	Sea World Research & Rescue Foundation
Mundy	Can spatial fishery-dependent data be used to determine stock status in a spatially structured fishery?	0	162,041	FRDC
Alexander	Aquaculture-Community Futures: North West Tasmania	14,236	142,645	FRDC
MacLeod	CRC Project: Seaweed solutions for sustainable aquaculture	139,808	543,126	DoIIS
Tracey	Opportunities and impacts of range extending scalefish species	29,467	169,587	FRDC
Gardner	Science to support Australia's Southern Ocean Fisheries 2018-2020	11,744	873,400	FRDC (AAD Toothfish)
White	Derwent Estuary Program Reef Monitoring	2,696	16,500	Derwent Estuary Program
Hartmann	Victorian Rock Lobster and Giant Crab Assessments 2019-2021	30,425	208,712	VFA
Ross	Storm Bay Observing System: Assessing the Performance of Aquaculture Development	374,023	904,050	FRDC
Trotter	Risk of OsHV-1 uvar transmission to spat when breeding from exposed broodstock	30,031	44,857	ASI
Semmens	Examining the potential impacts of seismic surveys on octopus and larval stages of Southern Rock Lobster	32,078	100,000	FRDC
Keane	Commercial upscaling of urchin fertiliser	6,627	242,361	AIRF
Lyle	Socio-economic characterisation of a small scale commercial fishery: opportunities to improve viability and profitability in the Tasmanian Scalefish Fishery	167,546	57,932	FRDC

CHIEF INVESTIGATOR	PROJECT NAME	TOTAL SMRCA INVESTMENT	2020 INCOME	FUNDING BODY
Keane	Resetting urchin barrens: Liming as a rapid widespread urchin removal tool	22,527	58,778	AIRF
Ling	Lobster predation re-survey	54,996	18,000	AIRF
Semmens	Life-history and reproductive behaviour of the vulnerable Melbourne skate to inform fisheries management and conservation	122,308	25,048	Sea World Research & Rescue Foundation
Semmens	Understanding population structure and dynamics of Victoria's developing Octopus fishery	19,031	145,257	FRDC
Strain	Assessing the role of restored and natural kelp forests in protecting against coastal erosion and ocean acidification	187	12,440	Australian Academy of Science
Fitzgibbon	Improving the Southern Rock Lobster on-vessel handling practices, data collection and industry tools for lobster quality assessment	30,655	174,174	FRDC
Semmens	Improving knowledge of hammerhead shark aggregations to assist conservation of an iconic predator	20,643	32,500	Winifred Violet Scott Charitable Trust
Semmens	The impacts of climate change on behaviour and physiology of key elasmobranch species in Southeast Tasmania	1,566	6,750	Holsworth
Semmens	Fine-scale behaviour of elasmobranchs	1,253	6,750	Holsworth
Nguyen (Ogier)	Economic Assessment of Blue Economy	1,929	49,396	Blue Economy CRC
Wright (MacLeod, Strain)	Kelp aquaculture scoping study	4,775	48,459	Blue Economy CRC
Turnbull	SafeFish Project	23,140	50,264	SARDI
Giuhen (Ross)	Autonomous marine systems at offshore aquaculture and energy sites	3,579	48,304	Blue Economy CRC
Wright	ARC: Seagrass Restoration	15,000	0	ARC
White	BE Biofouling Challenges and Possible Solutions	0	50,224	Blue Economy CRC
	TOTAL SMRCA INVESTMENT	**1,349,574**	**5,780,515**	

APPENDIX V PUBLICATIONS & PRESENTATIONS 2019–2020



Centrostephanus subsidy zones in 2019. Based on the IMAS evaluation, this was updated from 1 January 2020 to northern $0, central $0.75 and southern zone $1.50.

Reports

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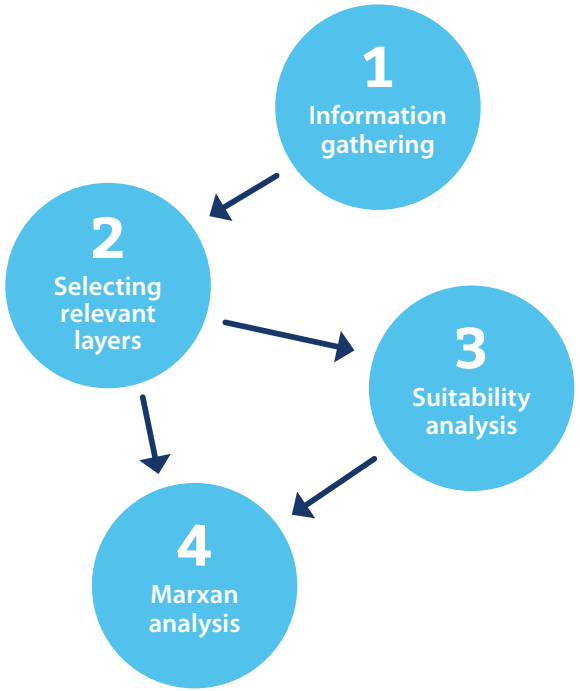

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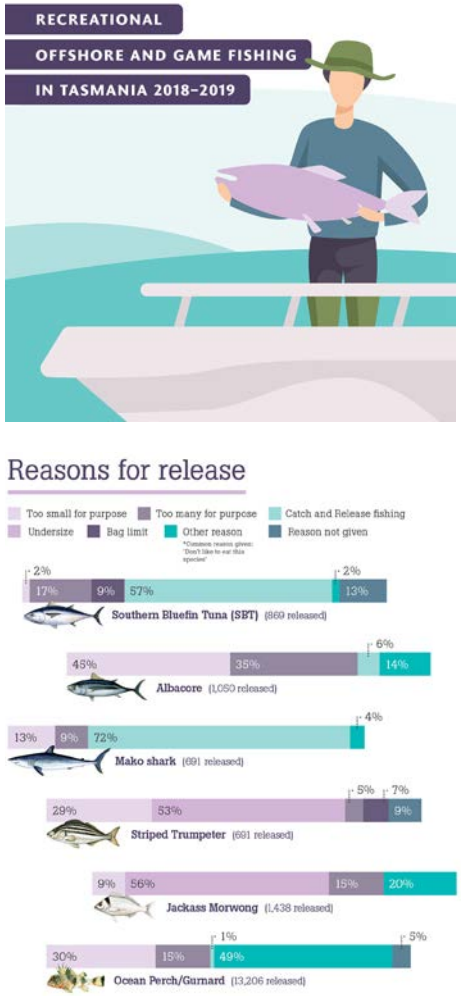

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Access all our reports here:
tinyurl.com/IMAS-FA-Reports

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GLOSSARY

AAD	Australian Antarctic Division
AIRF	Abalone Industry Reinvestment Fund
ARC	Australian Research Council
ARFF	Australian Recreational Fishing Foundation
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CoSE	UTAS College of Sciences and Engineering
CRC	Cooperative Research Centre
CRC-P	Cooperative Research Centre Project
CSIRO	Commonwealth Scientific & Industrial Research Organisation
CWUR	Centre for World University Rankings
DAWE	Department of Agriculture, Water and the Environment – Australian Government
DPIPWE	Department of Primary Industries, Parks, Water and Environment – Tasmanian Government
DPIRD	Department of Primary Industries and Regional Development – Australian Government
EAF	Experimental Aquaculture Facility
FRDC	Fisheries Research and Development Corporation – Australian Government
Holsworth	Holsworth Wildlife Research Endowment
ICES	International Council for the Exploration of the Sea
IMAS	Institute for Marine and Antarctic Studies – University of Tasmania
NRFC	National Recreational Fishing Conference
POMS	Pacific Oyster Mortality Syndrome
RAG	Research Advisory Group
SAFS	Status of Australian Fish Stocks
SMRCA	Sustainable Marine Research Collaboration Agreement
TAC	Total Allowable Catch
TAFI	Tasmanian Aquaculture and Fisheries Institute
TAMP	Tasmanian Alliance for Marine Protection
TRLFA	Tasmanian Rock Lobster Fishermen's Association
TSIC	Tasmanian Seafood Industry Council
UTAS	University of Tasmania
WGRFS	Working Group on Recreational Fisheries Surveys

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