

Aquaculture and Fisheries at JCU



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"While at JCU I learnt sustainable aquaculture practices, including DNA techniques to more effectively breed animals. The skills I learnt at JCU have been critical in my role supporting development of aquaculture in rural and highland communities of northern Vietnam."

Nga Thanh Vu



Aquaculture & Fisheries at JCU

Tropical regions of the world face unprecedented challenges due to population growth and an associated demand for high-quality seafood. This population expansion will continue to pressure wild fisheries resources and dictate ever higher efficiencies from aquaculture production.

Capitalising on its location, James Cook University (JCU) specialises in the sustainable exploitation of tropical aquatic species and is Australia's leading university in Tropical Fisheries Science. JCU is dedicated to creating a brighter future for life in the tropics world-wide, through graduates and discoveries that make a difference. Our activities in aquaculture and fisheries are ensuring this goal.

The university offers a teaching and industry-outcome R&D portfolio delivered by internationally renowned experts. With a comprehensive undergraduate offering in aquaculture and fisheries sciences, through to graduate coursework and higher degree research options, JCU trains the next global leaders in aquatic food production. Through the Centre for Sustainable Tropical Fisheries and Aquaculture (CSTFA), JCU also partners with industry, NGOs, and government to tackle

grand challenges associated with sustainable production of seafood. Our research is world-class, as evidenced by the Excellence in Research for Australia evaluations, where JCU was the highest ranked Australian university receiving rankings of research "well above" and "above" world average". More information on our teaching and research capabilities can be found at jcu.edu.au/cse and research.jcu.edu.au/cstfa.

Why study at JCU?

JCU's teaching programs in aquaculture and fisheries science have been designed to deliver the knowledge and skills required in the next generation of global leaders in aquatic food production and resource management.

Our programs are taught by global leaders and integrate the latest knowledge and innovations in fisheries science. JCU's major strength is our direct links with industry, ensuring that we produce industry-ready graduates and conduct targeted R&D leading to significant industry outcomes. If you want to become one of these future leaders, come and study at JCU.



Bachelor of Science

This is a three year full time degree in which you can major in fields of:

- Aquaculture Science and Technology
- Marine Biology
- Environmental Management

Subjects available for Aquaculture

Introduction to Aquaculture

Discusses the scope and role of aquaculture for increasing food and profit yields of marine, brackish and freshwater organisms. The biological principles of aquaculture including species selection, hatchery breeding and rearing and grow-out practices, aquaculture technology and systems, overseas experience and Australian potential are addressed.

Aquaculture of Tropical Species

Subject discusses aquaculture in tropical regions of the World and tropical Australia. It provides information about the status and methods of production of the major species cultured in this region and opportunities for new species culture.

Aquaculture: Feeds and Nutrition

Discusses nutritional principles as they relate to aquatic organisms and the types of feeds used in aquaculture. Topics include major nutrients (structure, function and availability), nutritional requirements of fish, crustaceans and molluscs, physical and nutritional characteristics of live feeds, culture of live feeds, manufacture of various artificial diets, characteristics of artificial diets, feeding strategies used in aquaculture.

Aquaculture: Propagation

Discusses husbandry of aquaculture broodstock and larval and juvenile culture techniques of finfish, molluscs, crustaceans and sea cucumbers. Topics include: managed reproduction of broodstock animals using nutritional, environmental, hormonal and chemical manipulation; broodstock nutrition; production of triploids and all-female stocks; factors affecting egg and larval quality; current approaches to larval and juvenile rearing.

Aquaculture: Stock Improvement

For aquaculture to grow and address future food security requirements genetic approaches will need to be implemented into production practices. This subject considers the potential of genetics and how genetic approaches can be applied to improve desirable traits for aquaculture, such as growth rate, feeding efficiency, disease resistance and market acceptability. Topics covered include: genetic selection, hybridisation, effective breeding numbers, sex reversal, chromosomal manipulation and breeding program design.

Aquatic Animal Ecophysiology

The course teaches the principles of aquatic animal physiology and provides insight into the mechanisms involved in the stress, health, growth and reproduction of aquatic animals. A key focus is on how physiological systems respond to important environmental factors and the significance of animal adaptations in their ability to cope with environment stressors, whether it is a managed environment, such as in aquaculture, or in the natural environment.

Aquaculture: Systems Design

This subject discusses the factors which should be considered for the design of a system for culturing aquatic organisms. It addresses fundamental principles and concepts rather than describing how to grow a particular species. Therefore, as a result of studying this subject, students will be able to complete a design for a system for culturing any aquatic species.

Sustainable Aquaculture

Investigates the environmental impacts and determines the sustainability of an aquaculture system. Discusses the implementation and sustainable use of aquaculture practices and describes environmental best practice for developing and operating sustainable aquaculture systems.

Aquaculture: Principles and Practices

Principles and Practices discusses the scope and role of aquaculture for increasing food and profit yields of marine, brackish and freshwater organisms. This subject integrates laboratory and field based learning so that students benefit from varied circumstances, contact and settings.

Aquaculture: Production and Evaluation Report

This subject is a hands-on, teamwork based subject. It covers the design, construction, operation and evaluation of a successful aquatic animal recirculating tank culture system.

Aquaculture: Hatchery Techniques

This subject is a hands-on, teamwork based subject. It covers design, operation and evaluation of the success of hatchery culture systems as well as techniques for production and use of various live feeds and larval culture of aquaculture species.

Aquaculture in Practice

This subject complements the aquaculture learning experience through practical and field exposure to the major aquaculture species cultured in the tropics and will provide students with the opportunity to place their learning into the real-world of large-scale industrial aquaculture practices. The subject entails a two-week field trip to Vietnam where students will be involved in hatchery propagation of tropical aquaculture species and visit commercial farms representative of major tropical species cultured.



Subjects available for Fisheries

Tropical Marine Ecosystems

This subject is an introduction to marine biology and ecology, with descriptions of tropical marine ecosystems, with a focus on mangrove and coastal ecosystems, coral reefs and seagrasses.

Fisheries Science

The subject provides an introduction to fisheries science and identifies the important features of tropical fisheries. Core elements include methods used in assessing fish populations, the methods of fisheries science and their application in tropical environments and the importance of the biology of tropical marine species in regard to management strategies.

Marine Conservation Biology

In this subject ecological effects of overfishing, nutrient enrichment, habitat loss, pollution and marine introductions are described. A central focus is the ecological principles and practice of designing marine reserves, enhancing populations of rare species and restoring damaged biological communities.

Wetland and Estuarine Ecosystems

This subject describes the components and functioning of wetland and estuarine ecosystems, with particular emphasis on tropical systems.

Marine Reserves as Fisheries Management Tools

Here students participate in an 8-day intensive subject learning about recent advances in the use of no-take marine reserves as fisheries management tools. Emphasis is on tropical marine fisheries and reserves. Major themes are the status of world marine fisheries and the need for new approaches to management like no-take marine reserves, the long-term impacts of fishing on marine ecosystems, the need for appropriate ecosystem baselines, and thus the need for no-take marine reserves protected effectively in the long-term, and the advantages and disadvantages of no-take marine reserves as fisheries management and conservation tools.

Managing Tropical Fisheries

This subject examines the process of managing fisheries in tropical regions to ensure positive outcomes for fish stocks, ecosystems and human communities. The paradigm of fisheries as linked social-ecological systems is used to develop an understanding about how biology, economics, human communities and legislative factors all contribute to outcomes in fisheries management. Case studies from tropical regions are examined, including industrial, artisanal and recreational fisheries. Practical skills in achieving positive outcomes are also developed.



"Throughout my studies, high quality interaction with staff and fellow students at JCU provided me with an excellent knowledge base for a career in applied research. This has been invaluable in my job at WorldFish, an international research organization targeting poverty reduction and improved food security through aquaculture."

Curtis Lind, WorldFish



Bachelor of Science (Honours) – Aquaculture or Fisheries

These are a 1 year, fulltime course involving the undertaking of an extensive research project. Students are expected to design and conduct independent, original research in Aquaculture or Fisheries, and to contextualize, report, and interpret research results effectively in speech and in writing.

Study Aquaculture@JCU Online

NOW AVAILABLE – you can now study at JCU online. Studying aquaculture through JCU offers students a unique opportunity to play a role in the world's fastest growing primary production industry as it expands through Asia and the world. For more information visit jcu.edu.au/cse/courses

JCU has five aquaculture online subjects leading to an online Graduate Certificate in Science:

- Aquaculture: Introductory Principles and Practices (AQ5806)
- Aquaculture in the Tropics (AQ5809)
- Aquaculture in Practice (AQ5016)
- Aquaculture: Nutrition and Feeding Practices (AQ5802)
- Sustainable Aquaculture Principles and Practices (AQ5815)

Postgraduate study at JCU

Master of Science

JCU offers 18 month (full time) Master of Science by coursework in: Aquaculture Science and Technology

- Fisheries Biology and Management

The course offers students a wide range of courses and can include a short independent research project for high achieving students.

Doctor of Philosophy (PhD) and Master of Philosophy (MPhil)

Higher degree research only degrees are available in a wide range of disciplines at JCU, including Aquaculture or Fisheries. Students undertake independent research programs of 2 years (MPhil) or 3 years (PhD) that investigate applied issues. Research is normally published in peer-reviewed journals and presented at national or international conferences.

*For details on how to apply please go to the page 17 of this brochure.

"Attending JCU gave me an advantage. I learned about global issues in aquaculture and food safety. This international edge opened doors for me when I returned to the US. Now I work in food quality control – keeping families safe."

Scott Zimmerman

Research Capacity

Barramundi

James Cook University is internationally renowned for its barramundi industry-relevant training programs and outcome driven Research and Development. Barramundi has been the model species for education, training and research at James Cook University for 15 years, with the institution responsible for development of the core knowledge base leading to the productive and profitable aquaculture of barramundi. Teaching programs at all levels that focus on the biology and science of the species, with hands-on training in hatchery production techniques and nursery/juvenile grow-out are offered at JCU.

Facilities

Aquaculture@JCU comprises the largest aquaculture tertiary teaching and research group in Australia which is centred around world-class infrastructure on-campus specifically designed for finfish training and industry research and development, including a commercial-scale barramundi hatchery.

Teaching and Training

Capitalising on its place in the tropics and long-standing industry engagement James Cook University offers Aquaculture training as a specialised Bachelor of Science (Aquaculture), through to postgraduate coursework and research degrees. Within these degrees hands-on training and direct engagement in industry relevant practices are provided, including subjects dedicated to breeding and rearing barramundi larvae (including hormone induction and spawning techniques, live food production, weaning to artificial pellets, grading and larval fish husbandry, culture system design, nursery/commercial grow-out practices). Importantly, industry-tailored training courses can be developed to meet client needs using the state-of-the-art teaching material, infrastructure and expertise at James Cook University. JCU has also led industry personnel training, providing not only the leaders in the field of barramundi nutrition, reproduction, production, health and management, but the bulk of key hatchery and production managers within the barramundi industry globally.

Research and Development

Aquaculture@JCU has been a world-leader in barramundi research and development for more than 15 years and over this period has been the primary international source of high-quality research for the species. The institution is a recognised leader in biology and production research, including hatchery production, genetic stock improvement, fish health, adaptation to climate change, post-harvest quality, organoleptic properties, nutrition and feed development, reproductive control, and the bioremediation of barramundi farm waste water.

Industry Engagement

Aquaculture@JCU is engaged with the barramundi industry in Australia and internationally through direct partnerships and research and training based on-campus and on-farms. As an example of an industry partnership, James Cook University and a commercial company Mainstream Aquaculture (Pty Ltd) have collaborated to build and operate a barramundi hatchery on-campus that is used for teaching and research purposes.

Staff

Eleven profile academic staff and 12 senior research staff (PhD) combine to provide the highest level of professional excellence and expertise in aquaculture and contribute to an industry focused teaching and research platform that delivers training to undergraduate and postgraduate students from all over the world.



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Macroalgae

James Cook University is internationally renowned for its innovative industry and outcome driven Research and Development in macroalgae. The integrated production and application of macroalgae has been a focus of research at James Cook University for 14 years, with the institution responsible for development of the core knowledge base leading to the productive and profitable aquaculture of freshwater and marine macroalgae (seaweed).

Facilities

Research on macroalgae is centred around a purpose-built modern, world-class research and development facility on-campus. The facility is specifically designed for industry research and development and includes pilot-scale commercial production for marine and freshwater macroalgae.

Teaching and Training

Specific training in the production of freshwater and marine macroalgae is delivered at the postgraduate level, including the integrated production of biomass at industry partner facilities at a municipal wastewater treatment plant and intensive land-based aquaculture systems. Importantly, industry-tailored training courses can be developed to meet client needs using the state-of-the-art teaching material, infrastructure and expertise at James Cook University.

Research and Development

James Cook University has been a world leader in the research and development of macroalgae for more than 14 years and over this period has been a leading international source of high-quality research for the integrated production of macroalgae for the bioremediation of wastewaters. The institution is a recognised leader in biology, chemistry and production research, including the use of biomass in products ranging from human food and food ingredients (phycocolloids) through to nutraceuticals, animal feeds, fertilisers, biochar and bioenergy.

Industry Engagement

James Cook University is heavily engaged with the aquaculture and wastewater treatment industries in Australia and internationally through direct partnerships and research and training based on-campus and on-farms. The exemplar of this industry engagement is MBD Energy, a long-term partnership with substantial and ongoing collaboration in the development and implementation of the bioremediation of wastewaters, and the profitable use of the end-product biomass.

Staff

A senior academic, 7 research staff (PhD), 7 technical staff and postgraduate students provide the highest level of professional excellence and expertise in production and end-use of macroalgae and contribute to an industry focused teaching and research platform.



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Aquatic Animal Health

James Cook University has expertise in aquatic animal health and diagnosis that integrates parasite species discovery and biology (taxonomy, life cycles, ecology and behaviour), with practical, applied research (risk-assessment, disease diagnosis, management and treatment). R&D expertise ranges from viral and bacterial pathogens of crustaceans, through to metazoan parasites of fish. Research conducted by JCU researchers enables fisheries, aquaculture and Australian quarantine, to make informed decisions in regards to stock structure, disease management and import regulations. This marriage of pure and applied research has led to the development of unique and strong partnerships between industry, academia and government agencies.

Facilities

The *Marine Parasitology Laboratory* includes a 5,000L recirculating seawater system, a monogenean parasite (*Neobenedia* sp.) monoculture, and state-of-the-art microscopy. The facilities within the laboratory have the capacity to conduct replicate experiments on live aquatic parasites on fish. The laboratory also has access to Australia's largest tertiary aquarium research infrastructure at JCU if required to undertake larger-scale industry-relevant R&D. The *Aquatic Pathobiology Group* houses PC2 aquaria facilities enabling them to undertake research involving viral and bacterial pathogenic aquatic organisms.

Teaching and Training

JCU delivers specialist subjects in aquatic animal health, including MI3021 – Aquatic Microbial Pathobiology, MI5003 Advanced Marine Microbiology and MI5061 – Advanced Aquatic Pathobiology, as well as offering short Master Classes such as Disease in Tropical Aquatic Animals. These subjects focus on disease and how to diagnosis them, particularly as they are relevant to tropical aquaculture systems.

Research and Development

Aquatic health specialists undertake sponsored and contract R&D and partner closely with industry to develop solutions that lower disease risk. Projects recently conducted involving industry include understanding the effects of climate change on parasite risk to barramundi, development of integrated management solutions for tropical marine aquaculture, and health status and biosecurity assessment for barramundi imports from Australia to Saudi Arabia. They also focus on diseases and immune reactions of crustaceans and fish in tropical waters, particularly as they relate to species in aquaculture. JCU has developed a disease testing capability for shrimp and finfish viral and bacterial pathogens, and offers R&D and commercial testing services to industry. Another major R&D capability is in the *Vibrio harveyi* clade of bacteria and their virulence determinants including the role of bacteriophages.

Staff

Dr Kate Hutson, A/Prof Leigh Owens, Dr Ariel Ellen



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Nutrition, Physiology and Post-Harvest Technology

James Cook University is internationally renowned for their work in aquaculture nutrition, physiology and post-harvest technology. The Nutrition, Physiology and Post-Harvest Technology Group has been influential in developing and implementing applied solutions across these fields for several important tropical species, including barramundi, grouper, tilapia, freshwater crayfish, tiger prawn and sea cucumbers. The university also boasts a world-leading comprehensive teaching program in aquaculture physiology, nutrition, and propagation, with specific applications to commercial aquaculture and hands-on training in up-to-date relevant production techniques.

Teaching and Training

Capitalising on its place in the tropics and long-standing industry engagement James Cook University offers Aquaculture training as a specialised Bachelor of Science (Aquaculture), through to postgraduate coursework and research degrees (Graduate Certificate, Graduate Diploma, MSc, MPhil, PhD). Within these degrees hands-on training and direct engagement in industry relevant practices are provided. Importantly, industry-tailored training courses can be developed on request to meet client needs using the state-of-the-art teaching material, infrastructure and expertise at James Cook University. James Cook University teaches a comprehensive nutrition, physiology and propagation offering at 3rd year. These include specialist subjects devoted to nutrition (AQ3002/5002 Aquaculture Feeds and Nutrition), physiology (AQ3007/5007 Aquatic Physiology) and propagation (AQ3003/5003 Aquaculture Propagation). These offerings focus on enhancing productivity via nutrition and husbandry practices, understanding new species requirements and refinement of techniques for existing species.

Research and Development

Aquaculture@JCU is a leader in aquaculture research and development in nutrition, physiology and post-harvest technology. We combine whole animal studies with relevance to commercial culture conditions; this includes work on both new and well-established aquaculture species, particularly marine and freshwater finfish. The group is recognised as being at the forefront of R&D in these respective areas and provides a full complement of expertise, including methods for determining nutritional requirements of species, evaluating the use of sustainable plant based ingredients to replace marine ingredients as well as of novel and functional dietary ingredients to improve intestinal health, molecular characterisation of the physiological response to dietary and environmental changes, resolving the drivers of egg and larval quality, and measurement of metabolism and energetics in aquaculture species.

Industry Engagement

Aquaculture@JCU is heavily engaged with aquaculture industries in Australia and internationally through research partnerships and training based on-campus and on-farms. As examples of some of these partnerships we currently, or have recently worked with barramundi (Australian Barramundi Farmers Association, Ridley Aquafeeds, Skretting, Coral Coast Fisheries), redclaw crayfish (Australian Redclaw Farmers Association, Rural Industries Research and Development Corporation), tilapia (Australian Centre for International Agricultural Research; Secretariat of the Pacific Community), grouper (US Soybean Export Council), and sea cucumbers (Australian Institute of Marine Science, Australian Centre for International Agricultural Research). Although the group works with a wide variety of species and countries, it has a particular focus on important, or developing aquaculture species in tropical Australia and Asia.

Staff

Three academic and 11 research staff and postgraduate students provide the highest level of professional excellence and expertise across the group and contribute to an industry focused teaching and research platform. Key senior personnel include Dr Igor Pirozzi, Dr Waldo Nuez and A/Prof Jan Strugnell.



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Aquaculture Genetics

James Cook University is internationally renowned for their work in aquaculture genetics and hosts the largest research team in the southern hemisphere. This team is focused on developing the knowledge and tools required by the aquaculture industry to understand genetic processes affecting culture success and in the conduct of efficient selective breeding programs. With over 15 years' expertise delivering services to the global aquaculture industry, James Cook University has been instrumental in the design and conduct of breeding programs for many important tropical species, including barramundi, marine shrimps, pearl oysters and freshwater crayfish. The university also has a comprehensive teaching program in genetics and biotechnology as applied to aquaculture.

Facilities

James Cook University has a fully-equipped, modern genetics laboratory, including an Illumina Mi-Seq sequencer, flow cytometers, robotics, quantitative PCR and high throughput PCR capabilities. Given its strengths in quantitative statistics and genomics, it also has the high-performance computing capability necessary to link phenotypes with the genome and develop genomic selection algorithms. JCU also has the largest tertiary aquaculture aquaria research infrastructure in Australia for the conduct of genetic related experiments and training.

Teaching and Training

James Cook University teaches a full genetics offering at 2nd and 3rd year, including a specialist subject devoted to the use of genetics in aquaculture as a means to boost productivity (AQ3004/5004 – Stock Improvement). This specialised subject is taught by world leading geneticists in their particular niche of aquaculture genetics. Capitalising on its place in the tropics and long-standing industry engagement James Cook University offers Aquaculture training as a specialised Bachelor of Science (Aquaculture), through to postgraduate coursework and research degrees (Graduate Certificate, Graduate Diploma, MSc, MPhil, PhD) where genetics is a core focus. Within these degrees hands-on training and direct engagement in industry relevant practices are provided.

Research and Development

James Cook University is a global leader in the area of aquaculture genetics and provides a full complement of expertise relevant to genetic improvement of aquatic organisms, including development of molecular markers for new species, DNA pedigreeing, genetic audits of broodstock, estimation of genetic parameters for commercial traits, molecular early prediction of growth performance, transcriptomic, nutrigenomic, advanced genomic applications, breeding program design and genomic selection approaches. The team has the capability to start fresh with new species, or to integrate current knowledge to aid industry in their aspirations to breed faster growing and disease tolerance strains.

Industry Engagement

The aquaculture genetics team works directly with the aquaculture industry to develop the tools and knowledge required for them to commence selective breeding programs. As examples of some of these partnerships we currently work with global companies involved in breeding programs for marine shrimp (Global Gen Inc, Seafarms Ltd), barramundi (Mainstream Aquaculture), tilapia (Worldfish), redclaw crayfish (NQFA), pearl oyster (Atlas South Sea Pearl) and abalone. There is a particular focus on improvement of important aquaculture species in Australia and Asia.

Staff

The aquaculture genetics team comprises eight senior researchers and 13 graduate students with skills in quantitative genetics, DNA pedigreeing, gene expression, genomics and project management.



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Marine Ornamental Breeding Overview



The aquarium trade is a multi-billion dollar industry, and it is growing at a rapid pace. However, unlike freshwater ornamentals, of which 98% are captive bred, it is estimated that over 95% of all marine specimens are still collected directly from the wild, mainly from coral reefs.

In order to be sustainable highly sought-after aquarium species must be bred locally to allow them to be traded and to further expand the industry. The Marine Ornamentals Captive Breeding Group are developing captive breeding techniques for dozens of popular marine ornamentals, including crustaceans and fish. The Group have so far successfully bred more than 20 species, several of which are world firsts, and work on multiple species is ongoing.

Facilities

The Marine Ornamentals Captive Breeding Group uses a purpose-built modern research and development facility on-campus consisting of several large dedicated temperature and environmental controlled freshwater and saltwater recirculation systems. These systems are specifically designed to conduct experiments to improve culture techniques for marine ornamentals focusing primarily on key aspects such as reproductive biology, optimisation of larval feeding regime and designing species-specific culture systems to reduce mortality.

Teaching and Training

Capitalising on its place in the tropics and long-standing industry engagement James Cook University offers Aquaculture training as a specialised Bachelor of Science (Aquaculture), through to postgraduate coursework and research degrees (Graduate Certificate, Graduate Diploma, MSc, MPhil, PhD). Within these degrees hands-on training and direct engagement in industry relevant practices are provided, including subjects dedicated to Aquaculture of Tropical Species (AQ2002), Feeds and Nutrition (AQ5002), and Hatchery Techniques (AQ5012).

Research and Development

Aquaculture@JCU is a world-leader for the development of successful intensive aquaculture methods for tropical copepods, as well as captive breeding techniques for various marine ornamental fish and crustaceans. These data are being used to improve the economic and environmental sustainability capacity of the multi-billion dollar marine ornamental trade industry.



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Fisheries Science



James Cook University is globally recognised for its research strength in Fisheries Science. This research strength translates into excellent teaching opportunities by providing students with access to leaders in the field, and opportunities to learn applied skills through interactions with the fishing industry and fisheries management agencies. JCU staff and students work closely with the fishing industry and management agencies to provide relevant science-based advice on improving the management of fisheries in the tropical world.

Facilities

High calibre facilities including field (Orpheus Island Research Station, research vessels), laboratory and computing infrastructure support research and teaching efforts.

Teaching and Training

JCU has an excellent reputation for teaching in fisheries science, enhanced by access to world-leading researchers. Students interested in a career Fisheries Science can access courses at the undergraduate (Bachelor of Science majoring in Marine Biology or Environmental Science and Geography), postgraduate coursework (Graduate Certificate, Graduate Diploma, MSc) and research higher degree (MPhil, PhD) level. Key subjects for students interested in Fisheries Science include Marine Ecology and Environmental Assessment (MB2060), Quantitative Methods in Science (BZ2001), Fisheries Science (MB3510), Managing Tropical Fisheries (EV3014), Marine Conservation Biology (MB3200), and Ecological Dynamics: An Introduction to Modelling (MB3260).

Research and Development

JCU is a global leader in fisheries research, especially in relation to tropical systems such as coral reefs. Research is conducted not only in Australia, but through much of Southeast Asia and globally; and is designed to inform improved management. Research includes biology of fished species, ecosystem effects of fishing, fisheries assessment, stock assessment, ecological risk assessment and socio-economic assessment and monitoring. JCU's research strength is recognised by its ranking as Well Above World Standard or Above World Standard in recent Excellence in Research for Australia exercises.

Industry Engagement

JCU researchers work closely with commercial, recreational, charter and indigenous fishers, and provide advice on management of fished resources to relevant management agencies locally, nationally and internationally. JCU staff hold key positions on national and international advisory panels and management bodies actively advising policy and management. JCU's location provides for close links with world leading marine and fisheries research and management agencies, and with fishing industry centres.

Staff

Five profile staff, numerous research staff and several active adjunct staff have active Fisheries Science research programs.



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North Queensland Algae Identification Facility (NQAIF)

As a fundamental component of aquatic food webs, microalgae form the backbone of the Aquaculture industry. In recognition, the Australian Research Council funded the establishment of the World's first tropical microalgae research facility, the North Queensland Algal Identification/Culturing Facility (NQAIF) at James Cook University in 2004. More than 300 endemic tropical microalgae strains have been established since, forming the basis for research in aquaculture nutrition, renewable bioproduct development (fuel and energy, high value nutraceuticals and nutritional supplements (antioxidant pigments, essential long chain polyunsaturated fatty acids) and animal feed, biodegradable plastics) and bioremediation of waste water and greenhouse gases.

Facilities

NQAIF has specialist research infrastructure for high resolution microscopy imaging for strain identification, isolation, domestication and specialist cultivation infrastructure for culture establishment at laboratory to large outdoor scale, fermenters for greenhouse gas emission abatement research and equipment for dewatering and harvesting. Biochemical profiling of the biomass for bioproduct development, biomass and bioproduct productivities and fertilisation requirements are core activities of the facility.



Teaching and Training

Honours and higher degree research (HDR) courses at the level of Master of Science, Master of Philosophy, and PhD are undertaken at NQAIF. The global importance of the research undertaken and track record of NQAIF attracts international PhD students providing a vibrant multi-cultural experience. NQAIF co-teaches into core Aquaculture subjects (AQ2001/5006 Introduction to Aquaculture, AQ 3002/5002 Animal Feed and Nutrition) at the undergraduate and postgraduate level. In line with the ecological importance of microalgae, NQAIF also co-teaches into Biological Oceanography (MB3050/5055).

Research and Development

Development of a microalgae industry is being pursued globally and is an intrinsic part of Aquaculture@JCU. NQAIF is involved in research and development projects aiming at producing renewable products from waste waters and gases. NQAIF contributes to these R&D projects by providing expertise in strain selection, biochemical profiling for product development, biomass and bioproduct productivity estimation, waste water remediation and greenhouse gas emission abatement potential and development of novel industrial-scale cultivation and biomass dewatering approaches. These data are used in techno-economic analyses to assess economic and environmental sustainability capacity for existing and new industries.



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Human dimensions of aquatic resources and production

James Cook University is internationally recognised for its strength in interdisciplinary research that improves the lives of people living in the tropics through the effective management and conservation of coastal and marine environments. The sustainable use and production of aquatic resources can only occur if emerging biophysical and technological knowledge is effectively translated into management action. Resilient, adaptive, and receptive societies are essential for achieving this goal. Understanding the broader social context, including how people perceive, value, and use aquatic resources is therefore key to ensuring sustainability through the effective uptake of new science and technology.

Teaching and Training

JCU's teaching in the field of human dimensions of the environment is integral to multiple degrees at the undergraduate (Bachelor of Science, Bachelor of Arts), postgraduate coursework (Graduate Certificate, Graduate Diploma, Master of Science) and research higher degree (MPhil, PhD) levels. Key subjects for students interested in environmental social science include Human Dimensions of Nature, Environment, and Conservation (EV3020/5020), Principles and Practices of Protected Area Management (EV5209), Indigenous Environmental Management (EV5252), Social Impact Assessment (EV3601), and Human Geography (EV1008). JCU staff teaching in this subject area are active, internationally recognised researchers and work continually to engage students at the teaching- research nexus.

Research and Development

The CSTFA human dimensions team collaborate closely with staff from other themes to implement interdisciplinary research aimed at improving the lives of people through effective management and conservation of coastal and marine resources. Topics include the sustainability of fishers, producers, industries and communities involved in aquatic food production; how to deal with change in fisheries and aquaculture to ensure aquatic food security; and identification of adaptation strategies in coastal communities. Research projects span Australia, Melanesia, Southeast Asia and South America.

Industry Engagement

Staff on the human dimensions team work directly with individuals, communities, and decision-making bodies to provide targeted advice and research to support use, management and conservation needs. These include commercial, recreational, charter and indigenous fishers both nationally and internationally, and key agencies such as the Great Barrier Reef Marine Park Authority of Australia, the National Fisheries Authority of Papua New Guinea, and the Galapagos National Park Service of Ecuador. JCU human dimensions staff hold key positions on national and international advisory panels such as the World Commission on Protected Areas and the International Council for the Exploration of the Seas' Study Group on the Socio-economic Dimensions of Aquaculture.

Staff

The human dimensions team comprises four profile staff members including Dr Amy Diedrich (Group Leader), Dr Taha Chaiechi, Prof Natalie Stoeckl, and Dr Renae Tobin. A growing cohort of graduate students and adjunct staff also actively contribute to this theme.

Contact



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Sharks and rays

James Cook University is globally recognised for its research strength in sharks and rays, and its teaching in marine biology, fisheries science and management, and environmental science. This provides students of all levels to engage with leaders in the discipline to learn about sharks and rays, and their management and conservation. The adjacent Great Barrier Reef World Heritage Area provides students with ready access to field research sites and exposure to a diverse range of management and conservation issues.

Facilities

JCU has world class facilities that allows the study of sharks and rays in the field, including the Orpheus Island Research Station and a fleet of vessels. Access to field and laboratory infrastructure for telemetry, life history, genetics and stable isotope studies is also available.

Teaching and Training

JCU has an excellent reputation for teaching in fisheries science and management, marine biology, environmental management and conservation science. Students interested in careers related to sharks and rays can access courses at the undergraduate (Bachelor of Science majoring in Marine Biology or Environmental Science and Geography), postgraduate coursework (Graduate Certificate, Graduate Diploma, MSc) and research higher degree (MPhil, PhD) level. Key subjects for students interested in sharks and rays are include Functional Biology of Marine Organisms (MB2050), Fisheries Science (MB3510), Managing Tropical Fisheries (EV3014), Marine Conservation Biology (MB3200), and Behaviour of Marine Animals (MB5430).

Research and Development



JCU is a global leader in shark and ray research, being the top ranked university for publications in the last five years. Research is especially designed to inform the management and conservation of sharks and rays at local, national and international scales. This includes work on the spatial ecology of sharks, stock structure and connectivity, population status, life history, fisheries interactions and post-release effects, and novel survey techniques. JCU staff are listed within the top ten shark and ray researchers worldwide (Google Scholar).

Industry Engagement

JCU researchers work closely with commercial, recreational and indigenous fishers, and provides advice on management and conservation of sharks to relevant management agencies locally, nationally and internationally. JCU staff hold key positions on national and international advisory panels and management bodies such as the IUCN Shark Specialist Group and government reference groups, actively advising policy and management.

Staff

Two profile staff, six research staff and several active adjunct staff have active research programs on sharks and rays in the Great Barrier Reef, across Australia, and in the Indo-Pacific region

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Crustaceans

James Cook University is internationally renowned for their innovative industry relevant work on a wide range of established and newly emerging aquaculture crustacean species, including marine shrimp (Pacific white shrimp, black tiger shrimp), spiny lobsters, freshwater crayfish, mud crab, blue swimmer crab, Australian native freshwater prawn (Cherabin), marine ornamental crustaceans, copepods and the potential of cleaner shrimp as biological controls. Crustacean research conducted by JCU researchers spans both aquaculture, fisheries and ornamental industries and includes genomic-informed breeding programs for shrimp, the investigation of signatures of local adaptation in rock lobsters, hatchery and nursery culture techniques, crustacean disease, aquaculture related crustacean ecophysiology (e.g. osmoregulation, toxicology of effluent water and cannibalism), development of hatchery feeds, copepod production as live prey for larvae and the involvement of cleaner shrimp in wound-healing and ectoparasite removal of fishes. Teaching programs across all levels focussing on crustacean biology are offered at JCU.

Teaching and Training

Crustacean biology and rearing is embedded throughout 2nd and 3rd year Aquaculture subjects including 5 undergraduate and 6 postgraduate subjects. Direct engagement in industry relevant practices are provided. Postgraduate coursework and higher research degrees focussing on crustacean biology, hatchery techniques and genetics are available.

Research and Development

JCU is a world leader in crustacean aquaculture research and is home to the Australian Research Council (ARC) Research Hub for Advanced Prawn Breeding. This research hub brings together world-leading animal geneticists, research and service providers like CSIRO and AGRF and Australia's largest prawn farm. The hub will gather genomic resources, commercial phenotypic data and apply cutting-edge genetic and genomic selection methodologies, leading to the most advanced and industry transformative improvement program for any prawn/shrimp species globally. Another major R & D capability is in the application of population genomic techniques to identify genetic signatures that shape recruitment and fine scale population differentiation in rock lobsters. This research helps form a framework for managing stock diversity and maximising fisheries production. Development of culture techniques, particularly hatchery techniques, for emerging species for aquaculture, such as Australian native freshwater prawn (Cherabin), mud crab, blue swimmer crab and marine ornamental crustaceans, aquaculture related crustacean ecophysiology, and feeds and nutrition compile other important areas of crustacean aquaculture research at JCU.

Industry Engagement

JCU is heavily engaged with crustacean aquaculture and fisheries industries in Australia and internationally through research partnerships and training based on-campus and on-farms. As examples of these partnerships we currently, or have recently worked with redclaw crayfish (Australian Redclaw Farmers Association, Rural Industries Research and Development Corporation), Rock lobster (NSW Department of Primary Industries and South African Department of Agriculture, Forestry and Fisheries).

Staff

7 academic staff, 4 research staff (PhD) and 7 postgraduate students provide the highest level of professional excellence and expertise across the group and contribute to an industry focused teaching and research platform. Key senior personnel include Dr Chaoshu Zeng, Prof Dean Jerry, A/Prof Kyall Zenger, A/Prof Jan Strugnell, A/Prof Leigh Owens, Dr Igor Pirozzi, Dr Kate Hutson, and Dr Roger Huerlimann, Dr Agnes le Port, Dr Andrew Foote, Dr Catarina Silva.



Contact

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Molluscs

James Cook University has globally recognised expertise in industry relevant, outcome driven research on a diverse range of molluscan species including for example pearl oysters, abalone, and octopus. Molluscan research conducted by JCU researchers includes all biological and industry aspects ranging from animal propagation to the development and integration of advanced genomic techniques for animal improvement in the silver-lipped pearl oyster and abalone aquaculture industries. Teaching programs across all levels focussing on molluscan biology are offered at JCU including mollusc culture systems, pearl oyster propagation / grow out, animal health and animal improvement. All of these aspects are directly linked to industry objectives incorporating the most up-to-date techniques and information.

Teaching and Training

Molluscan biology, culture and rearing is embedded throughout all levels of Aquaculture subjects including five undergraduate and six postgraduate coursework subjects. Postgraduate research degrees encompass a diverse array of industry relevant topics from molluscan culture to animal improvement.

Research and Development

JCU is a global leader in molluscan aquaculture research with particular strength in pearl oyster and abalone genetics. JCU researchers are developing innovative genomic techniques to overcome current limitations associated with traditional animal production methods. For example, long-term pearl oyster industry linked programs have provided critical information relating to understanding the genetic components of pearl oyster traits, environmental influences on production systems, and integrating genomic information into industrial scale selective breeding programs. JCU researchers also employ transcriptomic methods to investigate the genetic basis for resilience and susceptibility to summer mortality in abalone.

Industry Engagement

JCU is engaged with several molluscan aquaculture industries in Australia and internationally. For example, JCU has research partnerships with the Australian Abalone Growers Association (AAGA) and Atlas South Sea Pearls Ltd.

Staff

Four academic staff, two research staff (PhD) and seven postgraduate students provide the highest level of professional excellence and expertise across the group and contribute to an industry focused teaching and research platform. Key senior personnel include Prof Dean Jerry, A/Prof Kyall Zenger, A/Prof Jan Strugnell and Dr David Jones.



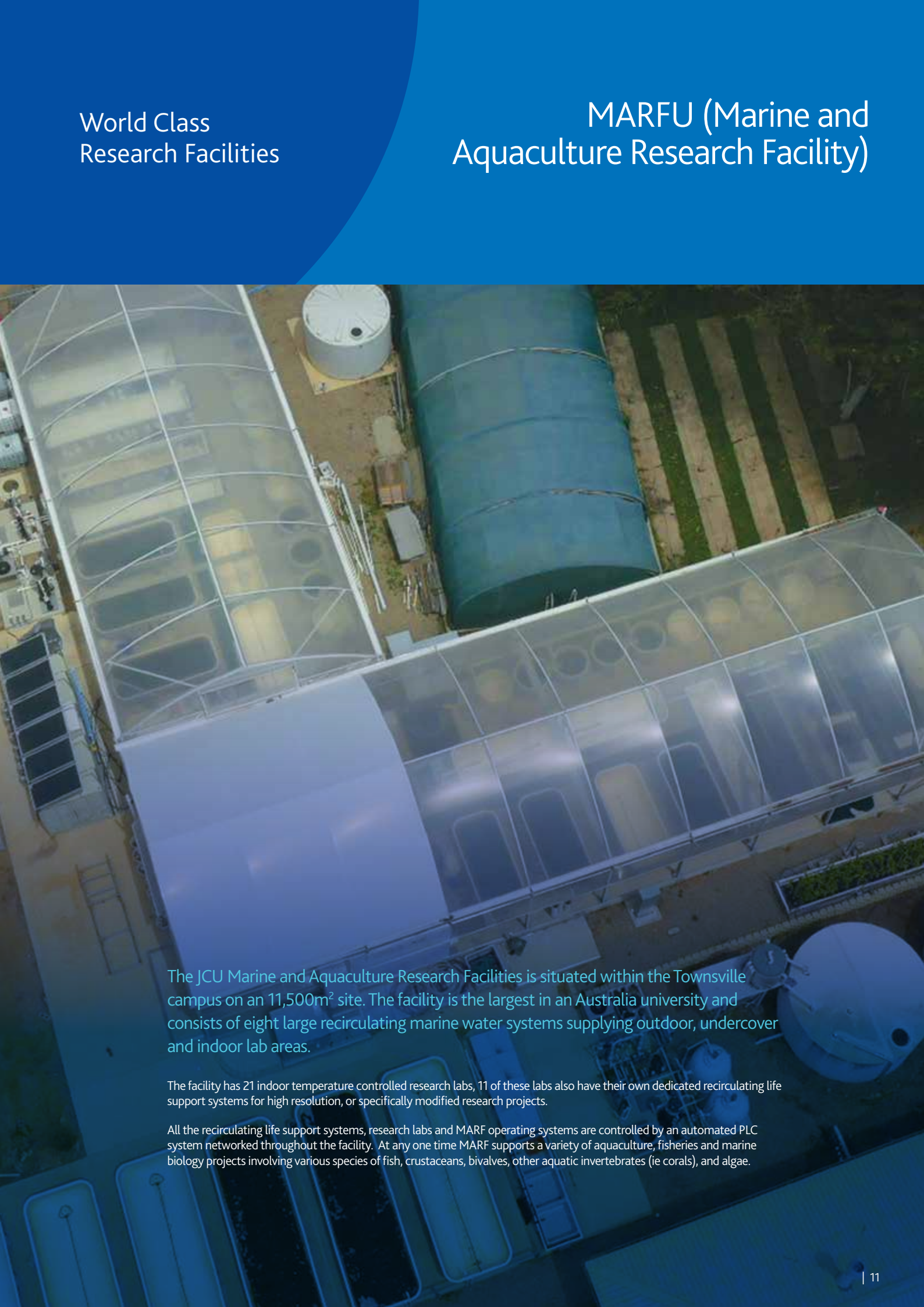
Contact

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World Class
Research Facilities

MARFU (Marine and Aquaculture Research Facility)



The JCU Marine and Aquaculture Research Facilities is situated within the Townsville campus on an 11,500m² site. The facility is the largest in an Australia university and consists of eight large recirculating marine water systems supplying outdoor, undercover and indoor lab areas.

The facility has 21 indoor temperature controlled research labs, 11 of these labs also have their own dedicated recirculating life support systems for high resolution, or specifically modified research projects.

All the recirculating life support systems, research labs and MARF operating systems are controlled by an automated PLC system networked throughout the facility. At any one time MARF supports a variety of aquaculture, fisheries and marine biology projects involving various species of fish, crustaceans, bivalves, other aquatic invertebrates (ie corals), and algae.

World Class
Research Facilities

Orpheus Island Research Station



Orpheus Island Research Station facility provides researchers and students with outstanding access to a variety of marine environments.

This research station has accommodation, boats, dive facilities, a lecture theatre, extensive laboratory facilities, wet labs and a versatile saltwater aquarium system. The Island is located on the Great Barrier Reef and is situated 120 km North of Townsville and 220 km south of Cairns.

World Class Research Facilities



Centre for
Sustainable
Tropical Fisheries
& Aquaculture

The Centre for Sustainable Tropical Fisheries and Aquaculture aims to provide knowledge to underpin aquatic food security for Australia, the tropics and globally.

With aquatic food resources already under pressure and declining it is essential to gather data related to wild fisheries to ensure their long-term sustainability, as well as to develop sustainable aquaculture products to supplement that coming from wild fisheries. Both sources of seafood have to be produced in a sustainable, socially and economically viable fashion to improve aquatic food security. This will come about not only by improved biological understanding, but also through examination of the human systems that produce and consume aquatic food resources, and by restoring already degraded systems to re-establish their production potential.

The Centre brings together a multidisciplinary team organised into three main Research Themes: Aquatic food security and safety, novel aquatic products and applications, and human dimensions of aquatic resources and production.

To find out more visit: research.jcu.edu.au/cstfa



The Australian Research Council Industrial Transformation Research Hub (ARC ITRH) for Advanced Prawn Breeding is a consortium involving researchers and industry from James Cook University, CSIRO, Australian Genome Research Facility, University of Sydney, and Seafarms Group.

The goal of the Hub for Advanced Prawn Breeding is to develop and transfer to the farmed black tiger prawn industry the capacity to benefit from advanced genomic-informed breeding programs. It will achieve this through:

- developing comprehensive genomic resources for the black tiger prawn including a draft genome,
- acquiring necessary quantitative genetic information for traits along with the development of industrial-scale disease testing and phenotypic data collection processes,
- developing genetic algorithms to allow a multi-trait genomic selection approach to be practised in breeding programs.

To find out more visit: research.jcu.edu.au/itrh-apb


World Class
Research Facilities



Macroalgae are an exceptional resource for the supply of biomass feedstock for a diversity of bio-products.

Both marine and freshwater macroalgae are bio-resources that can be produced through an integrated process with the treatment of waste waters from aquaculture, agriculture, municipal water treatment, and industrial, mining and mineral processing. Our research and development focuses on the integrated production of macroalgae with existing industries for bioremediation (treating waste streams), utilising carefully selected marine and freshwater species. Subsequently, we focus on the development and delivery of valuable bio-products and biotechnologies, based on the unique biochemistry and properties of macroalgae. Our ultimate goal is to develop and commercialise marine and freshwater macroalgae for products ranging from human food and food ingredients (phycocolloids) through to nutraceuticals, animal feeds, fertilisers, biochar and bioenergy.

To find out more visit: research.jcu.edu.au/macro



The Centre for Tropical Water and Aquatic Ecosystem Research (TropWATER) is an amalgamation of aquatic expertise from across James Cook University.

It brings together over 150 research and supporting staff and over 100 post-graduate students into one cohesive research group. TropWATER provides a unique opportunity for multidisciplinary research activities by integrating JCU's aquatic expertise into one unit, which covers the full spectrum of freshwater, estuarine and marine waters, with expertise from ecology, water quality, hydrology, engineering, physics, oceanography, modelling and resource economics.

TropWATER aims to conduct highly-recognised and influential research in fields related to water science, resource management and the ecology of water ecosystems, with a special focus on achieving sustainable use of water resource systems and water ecosystems. Our overall goal is to secure the future of water ecosystems and maintain their critical functional processes. The Centre has a strong, but not exclusive, focus on tropical water systems, both in Australia and internationally. It is concerned with major issues in water science, including water resources, water quality and aquatic biodiversity, in relation to economic, social and environmental needs, constraints and change.

To find out more visit: research.jcu.edu.au/tropwater

How to apply to JCU

Undergraduate studies

Your first degree is known as an undergraduate degree. A bachelor degree, a Bachelor with honours degree and a Diploma are all undergraduate degrees.

All applications for undergraduate degrees at JCU are made through Queensland Tertiary Admissions Centre (QTAC – qtac.edu.au). Exceptions are for international students and current or recent students of JCU.

If you need help to apply or have enquires please contact the JCU student Centre on 1800 246446 (in Australia) or email isadmissions@jcu.edu.au (International students)

Call us toll free **1800 246 446**

Enrolment:

You can enrol by visiting: jcu.edu.au/international-students and follow the steps provided on the website.

Postgraduate studies

Postgraduate studies include degree of Masters (by coursework or research) and Doctor of Philosophy.

To make an enquiry about undertaking a Higher Degree by Research please go to: jcu.edu.au/grs/prospective

Find a JCU representative

If you are an International student and would like to engage the services of one of JCU's authorised overseas representatives please go to jcu.edu.au/international/apply/jcurepresentatives

