

# Aquaculture and Food Safety at James Cook University in Singapore



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

Capitalising on its location right in the middle of Asia, James Cook University in Singapore has research expertise that specialises in the sustainable production of tropical aquaculture species. With world-class experts in aquaculture genetics, nutrition, hatchery production, husbandry and aquatic animal health and food safety, researchers are ready to partner with commercial industry, government institutions, universities, polytechnics and other stakeholders, to conduct high-quality scientific R&D.

The university offers a teaching and industry-outcome R&D portfolio delivered by internationally renowned experts. With a comprehensive undergraduate offering in aquaculture, through to diverse higher degree research options, JCU in Singapore trains the next global leaders in safe food production. Through the Tropical Futures Institute, Centre for Sustainable Tropical Fisheries and Aquaculture (CSTFA) and the Molecular Allergy Research Laboratory (MARL), JCU also partners with industry, NGOs, and government to tackle grand challenges associated with sustainable production of safer and more sustainable seafood. Our research is world-class, as evidenced by the Excellence in Research for Australia evaluations, where JCU was ranked “well above” world average in Fisheries Sciences.

For further information on how to work with James Cook University in Singapore please send an email to [researchsupport-singapore@jcu.edu.au](mailto:researchsupport-singapore@jcu.edu.au)





# Food Science and Safety in the Tropics



## Research Capacity

James Cook University in Singapore through its Tropical Futures Institute has internationally recognized expertise in industry relevant, outcome driven research and development in the health, biomedical and food sciences sectors. Food safety, nutrition and food security are intricately linked. Annually, 1 in 10 people are affected by contaminated food, resulting in loss of productivity and medical expenses of over \$140 billion globally.

Harmful substances in raw and processed food products can cause adverse health effects in consumers and include bacteria, viruses, parasites, toxins, heavy metals, microplastic and allergens. We assist with thorough risk assessments and mitigation strategies.

Our specific area of research excellence is the identification and characterization of allergy-triggering proteins (allergens) in seafood, which comprises thousands of fish, crustacean and mollusk species wild-caught, farmed and consumed globally. With food safety research teams in both Singapore and Australia, James Cook University continues to significantly contribute towards sustainable development and production of safe and healthy food products in the tropical regions of the world. Our research is world-class as evidenced by the #1 ranking in 'seafood allergy' research in South-East Asia and Oceania. Healthy and safe diets are promoted through next-generation allergy and food diagnosis and management tools, co-developed with medical practitioners, biotechnology and food scientists.

## Research and Development

Researchers from James Cook University in Singapore have experience and expertise in all aspects of food research, collaborating with leading research institutes and industries in the region. Our translational health and food science research bridges many different research disciplines including molecular biology, toxicology, biochemistry, biomedicine, clinical studies, biotechnology, immunology, protein and multi-omics technologies.

Recent examples of innovative and impactful research include:

- Understanding the influence of origin and environmental changes (e.g., climate change) on contaminants and allergenicity of fish, crustaceans and mollusks
- Supporting the development of Alternative Proteins in Singapore through evaluating the complete proteome and allergens of cell-based meat, edible insects and marine algae using advanced omics technologies
- Detailed omics and allergen analysis of cell-based seafood
- Determining the allergen recognition profiles of seafood-allergic patients to locally relevant shellfish and fish species
- Verifying the impact of food processing on the proteome, allergen abundance and safety risks
- Developing novel biotechnological tests to detect seafood adulteration and fraud
- Detection and quantification of eProteins in the environment for better fish health and safety
- Development of immunotherapeutics and vaccines for fish and shellfish in aquaculture

## Profile



### Background

Professor Jerry is a recognised leader in the application of genetic and genomic solutions for the aquaculture industry and leads one of the largest research teams globally devoted specifically to the application of genetic technologies to improve the productivity of aquaculture species. He has worked in the field of aquaculture genetics for 20 years and managed as Chief Investigator 30+ projects (valued at ~\$41M). He has published 165+ peer reviewed scientific articles and served on the editorial boards of Aquaculture Environment Interactions, Agri-Gene and Gene. He has also supervised nearly 50 research students.

Prof Jerry possesses strong skill sets in quantitative genetics, along with molecular and genomic analyses. These skill sets have resulted in numerous translations of his research and direct industry consultancies from conducting genetic audits of foundation stocks, establishment of commercial genotyping and pathogen testing laboratories, through to the design and conduct of industrial-scale advanced genomic-informed selection programs. He has worked with the genetics of most of the major tropical aquaculture industries, including marine shrimp (*Litopenaeus vannamei*, *Penaeus monodon*, *Penaeus japonicus*), pearl oysters (*Pinctada maxima*, *Pinctada margaritifera*), barramundi (*Lates calcarifer*), Nile tilapia (*Oreochromis niloticus*), marine and freshwater crayfish (*Panulirus ornatus*, *P. homarus*, *Cherax quadricarintus*, *C. destructor*), and several other species.

### Areas of expertise

- Design and implementation of advanced aquaculture selective breeding programs
- Development of genetic and genomic tools to assist selective breeding
- Genomic selection of aquaculture species
- Genetic audit of aquaculture breeding populations
- Epigenetics and microbiomes
- Sustainable aquaculture
- Professional development of researcher and industry capabilities

### Impact of research

- Development of DNA parentage microsatellite and SNP marker suites for seven tropical aquaculture species. These marker suites are routinely applied to conduct genetic audits for industry, determine performance of families under commercial evaluation, and as a tool in advanced selective breeding programs
- Provided an understanding of the genetic basis of commercial traits for important aquaculture species. With this information

## Distinguished Professor Dean Jerry

Director ARC Research Hub for Supercharging Tropical Aquaculture through Genetic Solutions  
Director of Tropical Futures Institute  
Tropical Futures Institute, James Cook University in Singapore

PhD (Animal Genetics) Southern Cross University, Australia  
BSc (Hons) University of New England, Australia

selective breeding programs can be designed based on solid genetic parameters resulting in maximisation of genetic gains

- Enabled the capability of numerous companies to instigate selective breeding programs based on a sound understanding of the genetic basis of traits and the ability to incorporate genomic information to improve accuracy of selection
- Increased understanding of the role epigenetics and microbiomes have in the expression of phenotypic traits in aquaculture species
- Assembly of the first comprehensive genomes and transcriptomes for barramundi, the black tiger shrimp, and pearl oyster
- Commercialisation of an Illumina Infinium SNP array for the Pacific White tailed shrimp

### Top five publications

- Jerry, D.R., Jones, D.B., Lillehammer, M., Massault, C., Loughnan, S., Cate, H.S., Harrison, P.J., et al. (2022). Predicted strong genetic gains from the application of genomic selection to improve growth related traits in barramundi (*Lates calcarifer*). *Aquaculture* 549, 737761
- Zenger, K.R., Khatkar, M.S., Jones, D.B., Khalilisamani, N., Jerry, D.R., Raadsma, H.W. (2019). Genomic selection in aquaculture: Application, limitations and opportunities with special reference to marine shrimp and pearl oysters. *Frontiers in Genetics, Livestock Genomics* 23;9:693. doi: 10.3389/fgene.2018.00693
- Huerlimann, R., Wade, N., Gordon, L., Montenegro, J., Goodall, J., McWilliam, S., Tinning, M., Siemering, K., Giardina, E., Donovan, D., Sellars, M., Cowley, J., Condon, K., Coman, G., Khatkar, M.S., Raadsma, H., Maes, G., Zenger, K.R. and Jerry, D.R. (2018). De novo assembly, characterization, functional annotation and expression patterns of the black tiger shrimp (*Penaeus monodon*) transcriptome. *Scientific Reports* 8:13553 | doi.org/10.1038/s41598-018-31148-4
- Jones D.B., Jerry D.R., Khatkar M.S., Raadsma H.W., van der Steen H., Prochaska J., Forêt S., and Zenger K.R. (2017). A comparative integrated gene-based linkage and locus ordering by linkage disequilibrium map for the Pacific white shrimp, *Litopenaeus vannamei*. *Nature Scientific Reports* 7, 10630. doi:10.1038/s41598-017-10515-7
- Budd, A.M., Banh, Q., Domingos, J., and Jerry, D.R. (2015). Sex control in fish: approaches, challenges and opportunities for aquaculture. *Journal of Marine Science and Engineering* 3(2), 329-355.

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## Professor Andreas Lopata

Tropical Futures Institute (TFI) Pillar-Lead:  
Health Sciences & Well-being  
James Cook University in Singapore

PhD (Medical Sciences), University of Cape Town, South Africa  
Master of Sciences (Biology), University of Duesseldorf, Germany  
Bachelor of Science/Hons. (Biochemistry), University of Duesseldorf, Germany

### Background

**Professor Lopata is a recognized expert in the identification and characterization of immunogenic proteins from aquatic organisms, bringing over 25 years of experience in molecular immunology. He leads one of the largest research teams in the Asia-Pacific region, focusing on the characterization of food proteins with medical significance.**

His multidisciplinary research encompasses the identification of proteins/peptides for medical application, the development of sensitive detection assays for contaminants in novel and alternative food products, and the creation of vaccines and immunotherapeutics. He is a strong advocate for developing safe alternative food proteins from cell-based seafood, insects, and marine algae to address the needs of our rapidly growing global population. Furthermore, he has strong skill sets in the analysis of environmental proteins (eProteins) in the aquaculture setting and development of innovative vaccines for sustainable production of safe seafood.

Prof Lopata has published over 280 peer-reviewed articles and serves on the editorial boards of prestigious scientific journals including the World Allergy Organization (WAO) Journal, Clinical and Experimental Allergy, Foods, and Proteome. He has successfully supervised over 60 postgraduate students, contributing to the development of the next generation of researchers.

### Areas of expertise

- Enhancing food safety through improved detection and quantification of food contaminants applying advanced omics technologies
- Identifying uncharacterized allergens in food products using immunological and bioinformatics techniques
- Development of sensitive and specific assays to quantify contaminants and proteins (allergens) in food sources and final products
- Characterisation of immunoreactive proteins in aquatic organisms to promote better health outcomes in humans and aquaculture
- Supporting sustainable food security through alternative protein production, including cell-based seafood, edible insects, and marine algae
- Monitoring the presence and abundance of contaminants (e.g., allergens) during food processing
- Implementing advanced omics technologies for seafood authentication
- Facilitating the professional development of researchers and enhancing industry capabilities

### Impact of research

- Provided the first evidence of immune responses to fish parasite proteins in contaminated fish products, advancing the One Health paradigm and enabling diagnostics for allergic sensitization to fish parasites.
- Developed platforms that identified and registered 20+ novel immunogenic fish and shellfish proteins with the World Allergy Organization, improving diagnostics in partnership with biotech companies.
- Developed antibody-based test systems using eProteins to detect and quantify seafood-derived proteins in the environment.
- Created innovative strategies for vaccine development aimed at enhancing the health of fish and shellfish
- Established omics platforms to identify and quantify proteins in cell-based fish and shellfish products
- Enabled companies in the alternative protein sector to create comprehensive food safety dossiers for product registration
- Empowered the food industry and policymakers to implement accurate food labelling, improving food safety

### Top five publications

- Nugraha R, Kurniawan F, Abdullah A, Lopata AL, Ruethers T. Antihypertensive and Antidiabetic Drug Candidates from Milkfish (*Chanos chanos*)-Identification and Characterization through an Integrated Bioinformatic Approach. *Foods*. 2024 Aug 19;13(16):2594.
- Karnaneedi S, Johnston EB, Bose U, Juhász A, Broadbent JA, Ruethers T, Jerry EM, Kamath SD, Limviphuvadh V, Stockwell S, Byrne K, Clarke D, Colgrave ML, Maurer-Stroh S, Lopata AL. The Allergen Profile of Two Edible Insect Species-*Acheta domesticus* and *Hermetia illucens*. *Mol Nutr Food Res*. 2024 Aug;68(16):e2300811.
- Nguyen MN, Krutz NL, Limviphuvadh V, Lopata AL, Gerberick GF, Maurer-Stroh S. AllerCatPro 2.0: a web server for predicting protein allergenicity potential. *Nucleic Acids Res*. 2022 Jul 5;50(W1):W36-W43.
- Mendoza-Porras O, Kamath S, Harris JO, Colgrave ML, Huerlimann R, Lopata AL, Wade NM. Resolving hemocyanin isoform complexity in haemolymph of black tiger shrimp *Penaeus monodon* - implications in aquaculture, medicine and food safety. *J Proteomics*. 2020 Apr 30;218:103689.
- Pratap K, Taki AC, Johnston EB, Lopata AL, Kamath SD. A Comprehensive Review on Natural Bioactive Compounds and Probiotics as Potential Therapeutics in Food Allergy Treatment. *Front Immunol*. 2020 May 22;11:996.

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## Dr Jose Domingos

Associate Professor, Aquaculture

Tropical Futures Institute, James Cook University in Singapore

PhD (Aquaculture Genetics) James Cook University, Australia

MSc (Aquaculture) Federal University of Santa Catarina, Brazil

BSc (Oceanography) Federal University of Rio Grande, Brazil

### Background

**Dr Jose Domingos' research focuses on the development of efficient breeding programs for tropical aquaculture species. This involves the understanding and manipulation of endogenous and environmental factors affecting gonadal development and broodstock conditioning within appropriate maturation systems for reliable spawnings.** Jose is passionate about marine finfish propagation (reproduction, genomics, selective breeding) and its integration with nutrition and fish health for the development of fast growing and disease resistant strains. Fingerlings of high quality and better genetics will improve farm productivity and allow aquaculture business in the tropics to achieve profitability and sustainability to feed our growing population.

Dr Domingos has a long involvement with commercial shrimp and marine finfish operations. Prior to joining the James Cook University (Australia) Aquaculture Genetics research team in 2008, Jose worked as a production manager for several shrimp farms in the South and Northeast of Brazil, where he supervised over 700 hectares of shrimp farming. Trained in Brazil (Oceanography, FURG; MSc. Aquaculture, UFSC) and Australia (PhD Aquaculture Genetics, JCU), Jose has 20 years of combined industry, government and academic background. As a new member of the James Cook University in Singapore Aquaculture Research team, Jose is excited about collaborating with industry partners in the development and use of genetically superior broodstock within reliable breeding and hatchery facilities, and in the training of students through hands-on experiences and discoveries that make a difference for life in the tropics.

### Areas of expertise

- Aquaculture applied breeding and genomics for selective breeding programs
- Marine finfish broodstock systems and management
- Integrated shrimp farm management

### Impact of research

- Estimation of heritability and discovery of SNPs associated with Scale Drop Disease Virus resistance in farmed barramundi
- Identification of molecular mechanisms downregulating immunity of barramundi when coinfecting with Scale Drop Disease Virus and Lates calcarifer Herpes Virus
- Identification of molecular and cellular larval traits which are highly correlated with fish weight at harvest. This allows for the estimation of broodstock breeding values (EBV) based on their offspring performance at 18 days post hatch, and enables the by avoiding costs associated with rearing of slow-growing families.

- Identification of sex-specific epigenetic differences and alternatively spliced isoforms of *dmrt1* and *cyp19a1* genes in the protandrous hermaphrodite barramundi. This contribution to our understanding of the sex-determination mechanisms is the first step for improved sex-control strategies in Asian seabass broodstock populations.
- Demonstration, through the use of robust animal models traditionally used in animal breeding, of a high potential for adaptation in fitness-related traits of a coral reef fish acclimated to higher temperatures, which could enable reef fish populations to maintain their performance as ocean temperatures rise.

### Top five publications

- Domingos J, Goldsbury J, Bastos Gomes G, Smith B, Tomlinson C, Bade T, Sander C, Forrester J and Jerry D (2021) Genotype by environment interactions of harvest growth traits for barramundi (*Lates calcarifer*) commercially farmed in marine vs. freshwater conditions. *Aquaculture*, 532.
- Domingos J, Shen X, Terence C, Senapin S, Dong H, Tan M, Gibson-Kueh S and Jerry D (2021) Scale Drop Disease Virus (SDDV) and Lates calcarifer Herpes Virus (LCHV) coinfection downregulate immune-relevant pathways and cause splenic and kidney necrosis in barramundi under commercial farming conditions. *Frontiers in Genetics*, 12, 666897.
- Nghia N, Van P, Giang P, Hanh N, St-Hilaire S and Domingos J (2021) Control of *Vibrio parahaemolyticus* (AHPND strain) and improvement of water quality using nanobubble technology. *Aquaculture Research*, 52 (6). pp. 2727-2739
- Domingos JA, Smith-Keune C, Harrison P, Jerry DR (2014) Early prediction of long-term family growth performance based on cellular processes – a tool to expedite the establishment of superior foundation broodstock in breeding programs. *Aquaculture* 428- 429, 88-96.
- Budd A, Banh Q, Domingos JA, Jerry DR (2015) Sex control in fish: approaches, challenges and opportunities for aquaculture. *Journal of Marine Science and Engineering* 3, 329-355.

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## Dr Susan Gibson-Kueh

Associate Professor & Principal Research Fellow,  
Aquatic Animal Health, Tropical Futures Institute,  
James Cook University in Singapore

Member, Australian and New Zealand College of Veterinary  
Scientists (Medicine and Management of Aquaculture Species)  
PhD (Fish Pathology), Murdoch University, Australia  
MSc (Aquatic Veterinary Studies), Institute of Aquaculture,  
University of Stirling, UK  
BVSc, University of Sydney, Australia

### Background

Dr Susan Gibson-Kueh has extensive experience in aquatic animal health from roles in government and academia. Her research is based on an in-depth understanding of the Asian aquaculture industry. Dr Gibson-Kueh's expertise in diagnostic fish pathology encompasses both marine and freshwater finfish and shellfish (shrimps, oysters, mussels, abalone), and the study of complex diseases in valuable food fish species. She has special interests in the development of sustainable livelihoods based on aquaculture and higher education in remote communities in the tropics.

Dr Gibson-Kueh was the first researcher to suggest the viral causative agent of scale-drop disease (SDD) in barramundi during her PhD in 2012. Her current research continues to add to our understanding of SDD, along with other diseases like big belly disease and Lates calcarifer herpesvirus, so that sustainable approaches can be developed for barramundi aquaculture. She is a champion for advancement in the use of haematology and blood biochemistry to support health management of tropical aquaculture species.

### Areas of expertise

- Diagnostic pathology, parasitology, bacteriology, virology, molecular biology and epidemiology
- Extensive knowledge of diseases of warm water aquaculture species; particularly Asian seabass or barramundi, red snapper, and groupers

### Impact of research

- First report of novel chronic bacterial enteritis or Big Belly in Asian seabass fry in 2004, with significant impact on production of Asian seabass in seawater culture
- First report of Scale drop disease in barramundi in 2012 paved the way for further work by De Groof et al. 2015, with the isolation of a novel virus with 60% homology to other known iridoviruses. SDD was originally thought to be caused by *Tenacibaculum maritimum*
- Correlated high incidences of an *Eimeria* infection in juvenile Asian seabass (barramundi) *Lates calcarifer* in small scale nurseries in Vietnam with low water exchange rates. This parasite was later named *Goussia kuehae* by Szekely et al., 2013.

- Suggested affinity of fish systemic iridovirus for cells of mesothelial origin in naturally infected fish via electron microscopy during her MSc at the Institute of Aquaculture, University of Stirling. This information correlated with better success when fibroblastic cell lines are used for viral isolation.

### Top five publications

- Gibson-Kueh, S., Chee, D., Chen, J., Wang, Y. H., Tay, S., Leong, L. N., Ng, M. L., Jones, J. B., Nicholls, P. K., & Ferguson, H. W. (2012). The pathology of 'scale drop syndrome' in Asian seabass, *Lates calcarifer* Bloch, a first description. *Journal of Fish Diseases*, 35(1), 19–27. <https://doi.org/10.1111/j.1365-2761.2011.01319.x>
- Gibson-Kueh, S., Awate, S., & Schrittwieser, M. (2023). The pathology of *Lates calcarifer* herpesviral disease—Disseminated intravascular coagulation explains mortality spikes. *Journal of Fish Diseases*, 46(8), 861–871. <https://doi.org/10.1111/jfd.13796>
- Gibson-Kueh, S., Netto, P., Ngoh-Lim, G. H., Chang, S. F., Ho, L. L., Qin, Q. W., Chua, F. H. C., Ng, M. L., & Ferguson, H. W. (2003). The Pathology of Systemic Iridoviral Disease in Fish. *Journal of Comparative Pathology*, 129(2), 111–119. [https://doi.org/10.1016/S0021-9975\(03\)00010-0](https://doi.org/10.1016/S0021-9975(03)00010-0)
- Chew, X. Z., & Gibson-Kueh, S. (2023). The haematology of clinically healthy, farmed juvenile Asian seabass (*Lates calcarifer* Bloch)—reference intervals, and indicators of subclinical disease. *Journal of Fish Diseases*, 46(10), 1109–1124. <https://doi.org/10.1111/jfd.13831>
- Gibson-Kueh, S., Crumlish, M., & Ferguson, H. W. (2004). A novel "skinny pot-belly" disease in Asian seabass fry, *Lates calcarifer* (Bloch). *Journal of Fish Diseases*, 27(12), 731–735. <https://doi.org/10.1111/j.1365-2761.2004.00594.x>

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## Dr Xueyan Shen

Senior Lecturer, Aquaculture  
James Cook University in Singapore

PhD (Biochemistry & Molecular Biology), Ocean University of China, China  
MSc (Aquaculture), Ocean University of China, China  
BSc (Aquaculture), Hebei Normal University of Science & Technology, China

### Background

Dr Xueyan Shen completed her postdoctoral work on the maintenance of genomic resources for the National BioResource Project Medaka at the National Institute for Basic Biology in Okazaki, Japan. From 2010-2018, she worked in the Temasek Life Sciences Laboratory (TLL), Singapore, where, as a Research Fellow, she led several research teams towards increasing Singapore's food fish supply through application of aquaculture genomics research and development. Now at James Cook University in Singapore, Dr Shen continues to apply her state-of-the-art teaching and genetic research approaches to help Singapore and other Asian countries achieve their aquaculture-related food security strategies.

Dr Shen's research focus is on the development of "robust" aquaculture strains to boost seafood production. She has conducted genomics-assisted selection on two economically important fish, namely Asian seabass/barramundi and Mozambique tilapia, and also the ornamental fish Asian arowana. Specific areas of her research interest include: 1) development and application of new genomic resources and genetic tools for selective breeding; 2) elucidation of the genetic basis underlying commercially important traits such as disease resistance, fast growth, and adaption to various environmental stressors through deep RNA sequencing, QTL mapping, and whole genome association studies (GWAS) as well as genomic selection (GS). As a Senior Lecturer at JCU in Singapore, Dr Shen is keen to continue to collaborate with partners from commercial industry, and government universities/institutes to create 'state of the art' genomic platforms to further improve the productivity and quality of food fish species.

### Areas of expertise

- Aquaculture new genomic tools development and application
- Aquaculture genetics
- Aquaculture disease
- Selective breeding

### Impact of research

- Dr Shen's research into the genetic improvement of Asian seabass and tilapia have allowed for a 'quantum leap' in generation of more superior broodstock leading to more efficient and greater productivity of foodfish products.

- In addition, tools Dr Shen has developed will be easily applicable and adaptable to the aquaculture systems of other tropical marine fish species, advancing their production systems from the current, mostly traditional methods into modern, science-assisted aquaculture.

### Top five publications

- Shen, X., Hu, J., Yáñez, J. M., Bastos Gomes, G., Poon, Z. W. J., Foster, D., ... & Domingos, J. A. (2024). Exploring the cobia (*Rachycentron canadum*) genome: unveiling putative male heterogametic regions and identification of sex-specific markers. *GigaScience*, 13, giae034.
- Shen, X., Niu, Y. C., Uichanco, J. A. V., Phua, N., Bhandare, P., Thevasagayam, N. M., ... & Orbán, L. (2023). Mapping of a major QTL for increased robustness and detection of genome assembly errors in Asian seabass (*Lates calcarifer*). *BMC genomics*, 24(1), 449.
- Chew, X. Z., Gibson-Kueh, S., Jerry, D. R., & Shen, X\*. (2023). Comparison of intestinal bacterial communities in asymptomatic and diseased Asian seabass (*Lates calcarifer*) with chronic enteritis and mixed bacterial infections. *Aquaculture*, 572, 739516.
- Domingos J, Shen X, Terence C, Senapin S, Dong H, Tan M, Gibson-Kueh S and Jerry D (2021) Scale Drop Disease Virus (SDDV) and Lates calcarifer Herpes Virus (LCHV) coinfection downregulate immune-relevant pathways and cause splenic and kidney necrosis in barramundi under commercial farming conditions. *Frontiers in Genetics*, 12. doi: 10.3389/fgene.2021.666897
- Orbán L, Shen X, Phua N and Varga L (2021) Toward genome-based selection in Asian seabass: what can we learn from other food fishes and farm animals? *Frontiers in Genetics*, 12. doi: 10.3389/fgene.2021.506754

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## Dr Fanny Yasumaru

Senior Lecturer, Aquaculture & Environmental Science  
James Cook University in Singapore

PhD (Biological Oceanography – Aquaculture Nutrition),  
Universidade de Sao Paulo, Brazil  
MSc. Aquaculture (Nutrition), Universidade Federal de Santa  
Catarina, Brazil  
BSc. Aquaculture Engineering, Universidade Federal de Santa  
Catarina, Brazil

### Background

Dr Yasumaru has experience in aquaculture nutrition of tropical species, such as whiteleg shrimp, tilapia, cobia, Asian sea bass, grouper, and mud crab. Her expertise includes *in vitro* protein hydrolysis for quality measurement in feedstuffs and finished feeds, with focus on industrial application for marine shrimp (larval to juvenile stages), and freshwater and marine fish species, feed formulation, feed making, *in vivo* nutrient digestibility and growth trials with fish and shrimp species, proximate composition analysis of ingredients and finished feeds. Additionally, she has conducted training courses on the Singapore Standard - Good Aquaculture Practice (SS670:2021).

### Areas of expertise

- Fish nutrition
- Shrimp nutrition
- Alternative ingredients
- *in vivo* and *in vitro* nutrient digestibility

### Impact of research

Dr Yasumaru has developed species specific *in vitro* protein digestion method for tilapia, cobia, and rainbow trout. She has also conducted *in vivo* studies to assess alternative feed ingredients, such as insect meals and single-cell proteins to produce more sustainable feeds for fish and shrimp. She serves on the editorial board of the journal *Critical Insights in Aquaculture* and as ad hoc reviewer for other journals such as *Aquaculture*, *Aquaculture Research*, and *Reviews in Fisheries Science & Aquaculture*. In 2022 she was elected Student Director for WAS APC (World Aquaculture Society, Asia-Pacific Chapter).

### Top five publications

- Santillan, E., Yasumaru, F., Vethathirri, R.S., Thi, S.W., Hui, Y.H., Chan, D. P.S., & Wuertz, S.. (2024). Microbial community-based protein from soybean-processing wastewater as a sustainable alternative fish feed ingredient. *Scientific Reports*, 14, 2620. <https://doi.org/10.1038/s41598-024-51737-w>
- Coelho, R. T. I., Yasumaru, F. A., Passos, M. J. A. C. R., Gomes, V., & Lemos, D.. (2019). Energy budgets for juvenile Pacific whiteleg shrimp *Litopenaeus vannamei* fed different diets. *Brazilian Journal of Oceanography*, 67, e19243. <https://doi.org/10.1590/S1679-87592019024306701>
- Yasumaru, F.A., C. De Maesschalck, R. Wouters, & Lemos, D.. (2018). *In vitro* degree of protein hydrolysis using enzyme extracts from larval and postlarval *Litopenaeus vannamei* (Boone). *Aquaculture Research*, 49:3933-3937. <https://doi.org/10.1111/are.13864>
- Botelho, M. T., Passos, M. J. de A. C. R., Hasue, F. M., Lemos, D., Rodrigues, E., Yasumaru, F., Phan, N. van., & Gomes, V.. (2018). Citogenotoxic response of juvenile cobia *Rachycentron canadum* (Linnaeus, 1766) reared in two different systems. *Brazilian Journal of Oceanography*, 66(2), 189-198. <https://doi.org/10.1590/S1679-87592018005406602>
- Tibbetts, S.M., F. Yasumaru, F., & Lemos, D.. (2017). *In vitro* prediction of digestible protein content of marine microalgae (*Nannochloropsis granulata*) meals for Pacific white shrimp (*Litopenaeus vannamei*) and rainbow trout (*Oncorhynchus mykiss*). *Algal Research*, 21:76-80. <https://doi.org/10.1016/j.algal.2016.11.010>

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## Ts. Dr Jiun-Yan Loh (James)

Associate Professor  
Principal Research Fellow Aquaculture  
James Cook University in Singapore

PhD, Monash University  
PGDTT, UCSI University  
MSc, University Tunku Abdul Rahman  
B.Appl.Sc & Diploma, University Malaysia Terengganu  
Professional Technologist (Malaysia Board of Technologist –  
Marine Technology)

### Background

Associate Professor Dr. Jiun-Yan Loh (James) is specialized in fish nutrition. He obtained his PhD from Monash University, where his research focused on prebiotics, probiotics, and alternative protein sources, including insect meals. Currently, he is the Principal Research Fellow at the Tropical Futures Institute, James Cook University in Singapore.

He serves as a Visiting Professor in China and an Adjunct Professor in Indonesia, while also acting as an Advisor to two Malaysian aquaculture associations. Dr. Loh's research has received international acclaim, resulting in the acquisition of grants, patents, and recognition from industry stakeholders. His innovative aquafeeds have been successfully commercialized, effectively bridging the gap between academic research and practical applications in aquaculture. Prior to his academic career, Dr. Loh worked as a Territory Manager with responsible for overseeing the marketing of aquafeed within the region. His industry experience encompasses a diverse range of species, including sea bass, grouper, shrimp, and mud crab.

### Areas of expertise

- Fish nutrition
- Prebiotics
- Probiotics
- Postbiotics;
- Immunostimulants;
- Alternative protein sources

### Impact of research

- Development of insect-based diets for marine fishes, shrimps, bivalves, and ornamental fishes. Commercialization of novel aquafeeds containing specialized bioactive compounds that enhance specific biological performance metrics of cultured species.
- Bioprospecting beneficial microbial strains and extracellular polymeric substances, including prebiotics, which confer health benefits to cultured species.

- Development of functional feeds and immunostimulants designed to enhance the immune systems of fish through a series of experimental approaches aimed at elucidating the immunomodulatory effects of bioactive compounds.

### Top five publications

- Chen, Y., Ma, J., Yong, Y.-S., Chen, Y., Chen, B., Cao, J., Peng, K., Wang, G., Huang, H. & Loh, J.Y. (2024). Impacts of black soldier fly (*Hermetia illucens*) larval meal on intestinal histopathology and microbiome responses in hybrid grouper (*Epinephelus fuscoguttatus* ♀ × *E. lanceolatus* ♂): A comprehensive analysis. *Animals* 2024, 14, 3596.
- Liu, Y., Andin, V. C., Chor, W.-K., Gunasekaran, B., Chong, C.-M., Lee, P.-T., & Loh, J.Y. (2024). A preliminary study on the effects of substituting fishmeal with defatted black soldier fly (*Hermetia illucens*) larval meal on Asian seabass (*Lates calcarifer*) juveniles: Growth performance, feed efficiency, nutrient composition, disease resistance, and economic returns. *Journal of Fish Biology*, 1–13.
- Wong, K.Y., Khair, M.H.M.M., Song, A.A.L., Masarudin, M.J., Loh, J.Y., Chong, C.M., Beardall, J., Teo, M.Y.M. and In L.L.A. (2024). Recombinant lactococcal -based oral vaccine for protection against *Streptococcus agalactiae* infections in tilapia (*Oreochromis niloticus*). *Fish and Shellfish Immunology*, 149, 109572.
- Qiu, J.Q., Chen, B., Zhao, H.X., Huang, W., Cao, J.M., Wang, G.X., Loh, J.Y., and Peng, K. (2024). The protective role of condensed tannins on growth inhibition and enterohepatic injury induced by histamine in Chinese seabass (*Lateolabrax maculatus*). *Animal Feed Science and Technology*, 310, 115921.
- Vakaloloma, U. Ho, T.H., Loh, J.Y., Chong, C.M., Wangkahart, E., Lee, M.C., Nan, F.H., Lai, H.C. and Lee, P.T. (2023). Modulation of immune genes in the mucosal-associated lymphoid tissues of cobia by *Sarcodia suae* extract. *Veterinary Research Communications*, 47, 1973–1990.

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JCU Research Profile





## Dr Thimo Ruethers

Research Fellow in Health Sciences (Tropical Futures Institute, James Cook University in Singapore; Bioinformatics Institute, Agency for Science, Technology and Research)

Adjunct Senior Lecturer in Molecular Biology (JCU Australia)

PhD (Medical and Molecular Sciences), James Cook University, Australia  
MSc (Biochemistry), Heinrich Heine University Düsseldorf, Germany  
BSc (Biochemistry), Heinrich Heine University Düsseldorf, Germany

### Background

Dr Ruethers is an early career researcher and science communicator with extensive expertise in medical sciences, protein chemistry, clinical research, and advanced laboratory techniques. He has over a decade of international interdisciplinary research experience, having worked in Australia, Austria, Germany, Philippines, Thailand and Vietnam before moving to Singapore.

His research focuses on molecular interactions between food and humans, with an emphasis on the immune system and food allergies. Dr Ruethers is particularly interested in advancing health benefits and mitigating safety risks arising from aquaculture products and novel foods, aligning with Singapore's ambitious Food Story goals. He aims to help overcome challenges in securing sustainable food protein sources while carefully considering food innovations and safety, allergic diseases, risk management strategies and planetary health.

### Areas of expertise

- Food safety and adverse reactions to (novel) food
- Proteomics, allergology, immunology, and molecular medicine
- Seafood and food allergies - diagnostics and management
- Sustainable food security and planetary health
- Boosting food production through advanced productions and processing innovations
- Advanced biochemistry, proteomics, and bioinformatics
- Translated molecular diagnostics
- Enabling healthier and safer diets for all consumers

### Impact of research

- Advanced our understanding of seafood allergies at the molecular and global level by evaluating the allergenicity of over 100 fish species and related vertebrates.
- Provided the foundation for improved food safety measures and advanced tools for diagnosing, managing and treating food allergies.
- Assessed food safety risks associated with aquaculture innovations and explored the impact of food processing on allergenicity

- Continuously creating a brighter future for life in the tropics through impactful research and research education that promotes access to healthy, safe, nutritious and sustainable food for everyone.

### Top five publications

- Chin, T. G., Ruethers, T., Chan, B. A., Lopata, A. L., & Du, J. (2024). Techno-functional properties and allergenicity of mung bean (*Vigna radiata*) protein isolates from Imara and KPS2 varieties. *Food Chemistry*, 457, 140069.
- Ruethers, T., Johnston, E. B., Karnaneedi, S., Nie, S., Nugraha, R., Taki, A. C., Kamath, S. D., Williamson, N. A., Mehr, S. S., Campbell, D. E., & Lopata, A. L. (2023). Commercial shellfish skin prick test extracts show critical variability in allergen repertoire. *Allergy*, 78(12), 3261-3265.
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- Ruethers, T., Taki, A. C., Karnaneedi, S. V., Nie, S., Kalic, T., Dai, D., Williamson, N. A., Breiteneder, H., Mehr, S. S., Kamath, S. D., Campbell, D. E., & Lopata, A. L. (2021). Expanding the allergen repertoire of salmon and catfish. *Allergy*, 76(5), 1443-1453.
- Ruethers, T., Taki, A. C., Johnston, E. B., Nugraha, R., Le, T. T., Kalic, T., McLean, T. R., Kamath, S. D., & Lopata, A. L. (2018). Seafood allergy: A comprehensive review of fish and shellfish allergens. *Molecular Immunology*, 100, 28-57.

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## Dr Maura Carrai

Senior Research Fellow-Aquaculture Molecular Health  
Tropical Futures Institute, James Cook University in Singapore

PhD in Microbiology and Genetics, Pisa University, Italy, Master of Science (MS in Molecular Biology), Pisa University, Italy, Bachelor of Science, Pisa University, Italy  
Diploma of Management, Australian Pacific College, Sydney, Australia.  
Dr. Carrai is an ISO/IEC 17025:2017 Lead Auditor (LABQMS)

### Background

Dr Carrai's research focuses on commercially significant viral diseases in aquaculture, particularly the Scale Drop Disease Virus (SDDV) in Asian seabass/barramundi (*Lates calcarifer*). Her work aims to enhance the understanding of the genetic basis of resistance to SDDV and to facilitate the selection of disease-resistant strains.

Dr Carrai is an experienced molecular biologist. Her research has been extensive and varied, spanning human and animal fields. Over the past six years, she has concentrated on virological studies across several specimens, including cats, dogs, pigs, and fish. During a metagenomic analysis, Dr Maura Carrai discovered a new papillomavirus in a cat, named *Felis catus papillomavirus 6* (FcaPV6). Furthermore, she was employed as a Research Associate at The Centre for Applied One Health Research and Policy Advice (OHRP) at the City University of Hong Kong, where she contributed to the development of advanced health management tools for improved pig production, product safety, and quality in Hong Kong.

### Areas of expertise

- Molecular biology
- Virology
- Genetics
- Genomic
- Metagenomics

### Impact of research

- Dr. Maura Carrai published 30 papers in internationally peer-reviewed journals in the fields of genetics, genomics, and aquaculture. These papers have been cited 549 times since 2019, reflecting an h-index/h10-index impact of 14/18.
- Dr. Carrai is currently engaged in several research projects, serving as the Principal Investigator for the project titled "A Pilot Study to Analyse Whether Changes in Bacterial Microbial Community Using Flow Cytometry and Pathogen eDNA Can Be Employed to Monitor and Predict Disease Outbreaks in Commercial Fish Farms in Singapore," which is funded by the Internal Collaboration Grant Scheme.

### Top five publications

- Xian Zhe Chew, Maura Carrai, Xueyan Shen, Susan Gibson-Kueh. "Impact of transport conditions and underlying disease on post-stocking survival of juvenile *Lates calcarifer*". May 2024. *Journal of Fish Disease*. e13963
- Yun Young Go, Maura Carrai, Yan Ru Choi, Christopher J. Brackman, Karina W. S. Tam, Y. T. Law, Pierra, Fiona Woodhouse, Jane Gray, Ji Hun Kim, Joohyung Park, Chae Won Jeon, Hyomi Jang, Ioannis Magouras, Nicola Decaro, Samuel M. S. Cheng, Malik Peiris, Julia A. Beatty, Vanessa R. Barrs. "Low Prevalence of SARS-CoV-2 Antibodies in Canine and Feline Serum Samples Collected during the Covid-19 Pandemic in Hong Kong and Korea". February 2023. *Viruses*. 15(2), 582
- Paolo Capozza, Maura Carrai, Yan Ru Choi, Thomas Tu, Omid Nekouei, Gianvito Lanave, Vito Martella, Julia A Beatty, Vanessa R Barrs. Domestic cat hepadnavirus: Molecular epidemiology and phylogeny in cats in Hong Kong". January 2023. *Viruses*. 15(1), 150
- Kate Van Brussel, Jackie E. Mahara, Ayda Susana Ortiz-Baeza, Maura Carrai, Derek Spielman, Wayne S.J. Boardmand, Michelle L. Bakere, Julia A. Beatty, Jemma L. Geogheganfg, Vanessa R. Barrs, Edward C. Holmes. "Faecal virome of the Australian grey-headed flying fox from urban/suburban environments contains novel coronaviruses, retroviruses and sapoviruses". September 2022. *Virology*. Pages 42-51
- M. Carrai, K. V. Brussel, M. Shi, CX Li, WS Chang, J. S. Munday, K. Voss, A. McLuckie, D. Taylor, A. Laws, E. C. Holmes, V. R. Barrs, Julia A. Beatty. "Identification of A Novel Papillomavirus Associated with Squamous Cell Carcinoma in A Domestic Cat". Jan 2020. *Viruses*.12(1), 124

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## Dr Nguyen Thanh Vu

Senior Research Fellow, Aquaculture  
Tropical Futures Institute, James Cook University in Singapore

PhD (Aquaculture Genetics) University of the Sunshine Coast, Australia  
MSc (Aquaculture Sciences) Norwegian University of Life Sciences, Norway  
BSc (Biotechnology) Nong Lam University, Vietnam

### Background

Dr Nguyen Thanh Vu is currently working as a Research Fellow at James Cook University in the application of practical genetic and genomic approaches for improving fish productivity. His background involved multidiscipline aquaculture sciences with an emphasis on genetic research for aquaculture species, especially on enhancing fish productivity and quality through selective breeding. From over ten years working in aquaculture research and industry, especially in Vietnam, he has gained invaluable experiences regarding propagation, breeding, nursing, diseases, and selection methodologies in diverse aquaculture species, including fish, freshwater prawn and shrimp. Graduating from the University of the Sunshine Coast, Australia, his PhD thesis aimed at understanding the genetic and genomic basis in mitigating the disease severity caused by a bacterial infection in striped catfish farming. Now, he is focused on genomics application for improving traits of commercial importance for Red Snapper and Asian Seabass in Singapore.

### Areas of expertise

- Population genetics and genomics
- Aquaculture selective breeding: genetics and genomics of complex traits
- Aquatic science, and applied statistics
- Design and conduct of genetic improvement programs for aquatic species
- Statistics and bioinformatics methods applied to genetic improvement

### Impact of research

- Routine genetic evaluations and management of practical genetic improvement programs for aquaculture species (striped catfish, tilapia, giant freshwater prawn, tiger shrimp).
- Assessment of genetic diversity among geographical populations of striped catfish within Vietnam and recommended the restructure or re-introduction of the most diverse stock into the current population to secure long-term breeding.
- Evaluation of different algorithms for genomic prediction on striped catfish breeding, especially for traits that are difficult to measure such as disease resistance. The breeding program will benefit from the power of modern prediction methods, i.e., machine and deep learning in the context of genomic selection.

### Top five publications

- Nguyen, N.H., Vu, N.T., Patil, S.S. and Sandhu, K.S., 2022. Multivariate genomic prediction for commercial traits of economic importance in Banana shrimp *Fenneropenaeus merguensis*. *Aquaculture*, 555, p.738229.
- Nguyen, N.H. and Vu, N.T., 2022. Threshold models using Gibbs sampling and machine learning genomic predictions for skin fluke disease recorded under field environment in yellowtail kingfish *Seriola lalandi*. *Aquaculture*, 547, p.737513.
- Vu, N.T., Phuc, T.H., Oanh, K.T.P., Sang, N.V., Trang, T.T. and Nguyen, N.H., 2022. Accuracies of genomic predictions for disease resistance of striped catfish to *Edwardsiella ictaluri* using artificial intelligence algorithms. *G3*, 12(1), p.jkab361.
- Vu, N.T., Sang, N.V., Trong, T.Q., Duy, N.H., Dang, N.T. and Nguyen, N.H., 2019. Breeding for improved resistance to *Edwardsiella ictaluri* in striped catfish (*Pangasianodon hypophthalmus*): Quantitative genetic parameters. *Journal of fish diseases*, 42(10), pp.1409-1417.
- Vu, N.T., Van Sang, N., Phuc, T.H., Vuong, N.T. and Nguyen, N.H., 2019. Genetic evaluation of a 15-year selection program for high growth in striped catfish *Pangasianodon hypophthalmus*. *Aquaculture*, 509, pp.221-226.



## Dr Neil Hutchinson

Senior Lecturer, Environmental Science  
James Cook University in Singapore

PhD (Marine Biology) The University of Hong Kong, Hong Kong SAR  
BSc (Hons) (Environmental Biology) Sunderland University, UK

### Background

Dr Neil Hutchinson has worked as a marine ecologist for over 20 years, predominantly in the Asia-Pacific region. He has experience in a diverse range of fisheries related projects examining environmental impacts such as climate change and habitat destruction, and developing understanding of how they affect fisheries and aquaculture species. His research has traversed a variety of taxonomic groups including sharks, invertebrates and algae, examining the processes governing their natural distribution patterns and abundance.

Neil has a PhD in marine ecology from The University of Hong Kong and prior to joining James Cook University in Singapore in 2012, was a fisheries research scientist at Fisheries Victoria, Australia. While there he worked on government and industry funded projects examining the impacts of coastal development on key fisheries habitat and the development of tools to assess the sensitivity of commercially important fisheries and aquaculture species to climate change. His current research on coastal fisheries encompasses at risk species, such as elasmobranchs, and the provision of ecosystem services by urban habitats. This builds on past projects on the ecology and behaviour of predatory fish at the Marine Biological Association of the UK, Kyushu University in Japan and in The Federated States of Micronesia. Additionally, through his research and consultancy on intertidal ecosystems in Hong Kong and Japan, Neil has developed an extensive suite of skills relevant to assessing human impacts on marine ecosystems. He leads the Environmental Science teaching program at James Cook University in Singapore.

### Areas of expertise

- Movement and behavioural ecology of marine fish and invertebrates utilizing underwater video systems and acoustic telemetry
- Environmental impact assessment
- Climate change mitigation
- Ecosystem services
- Intertidal community ecology
- Predator-prey interactions

### Impact of research

- Identification of key fishery habitat for at risk elasmobranchs and coastal fisheries. This research had implications in relation to management of coastal development.
- Developed assessment tools to aid the understanding of climate change sensitivity of fisheries and aquaculture species.
- Identified non-breeding habitat and home ranges of grouper in Micronesia, providing information relevant to management of a locally important fisheries species.

### Top five publications

- Clark-Shen, N., Chin, A., Arunrugstichai, S., Labaja, J., Mizrahi, M., Simeon, B., & Hutchinson, N. (2022). Status of Southeast Asia's marine sharks and rays. *Conservation Biology*, e13962. <https://doi.org/10.1111/cobi.13962>
- Ng T, Lau S, Davies M, Stafford R, Seuront L, Hutchinson N, Hui T and Williams G (2021) Behavioural repertoire of highshore littorinid snails reveals novel adaptations to an extreme environment. *Ecology and Evolution*, 11 (12) ,7114-7124
- Benzeev R, Hutchinson N and Friess D (2017) Quantifying fisheries ecosystem services of mangroves and tropical artificial urban shorelines. *Hydrobiologia*, 803 (1), 225-237
- Doubleday Z, Clarke S, Li X, Pecl G, Ward T, Battaglione S, Frusher S, Gibbs P, Hobday A, Hutchinson N, Jennings S and Stoklosa R (2013) Assessing the risk of climate change to aquaculture: a case study from south-east Australia. *Aquaculture Environment Interactions*, 3 (2), 163-175
- Hutchinson N and Rhodes K (2010) Home range estimates for squaretail coral grouper, *Plectropomus areolatus* (Rüppell 1830). *Coral Reefs*, 29 (2), 511-519

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## Programs

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# Aquaculture teaching programs at James Cook University

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

The Singapore campus of James Cook University offers undergraduate and higher degree by research programs in aquaculture as follows:

### **Bachelor of Business and Environmental Science (Majoring in Aquaculture)**

With aquatic food resources already under pressure and declining, it is essential to develop aquaculture products in a sustainable fashion to improve aquatic food security. With JCU's Bachelor of Business and Environmental Science (Majoring in Aquaculture), students will learn how to manage the delicate balance between profit, policy, conservation and aquaculture. This multi-disciplinary program provides students with core knowledge and training in the application of business and environmental principles, with particular attention to aquaculture.

### **Bachelor of Science (Majoring in Aquaculture Science and Technology)**

Breeding, rearing, and harvesting of fish, shellfish, and aquatic plants is the main objective of aquaculture. This is an increasingly important area for developing a sustainable, food secure, future. Ensuring a consistent supply of food and associated products for human consumption, while also helping in the preservation of species in the wild, is key to solving real world problems. Throughout this major, students will explore the scientific and practical applications of breeding, rearing and harvesting of plants and animals in all types of water environments. You will understand the biodiversity of species and how they are farmed, the design of aquaculture systems, and the basics of nutrition.

### **Graduate Certificate of Research Methods (Tropical Environments and Societies) and Graduate Diploma of Research Methods (Tropical Environments and Societies)**

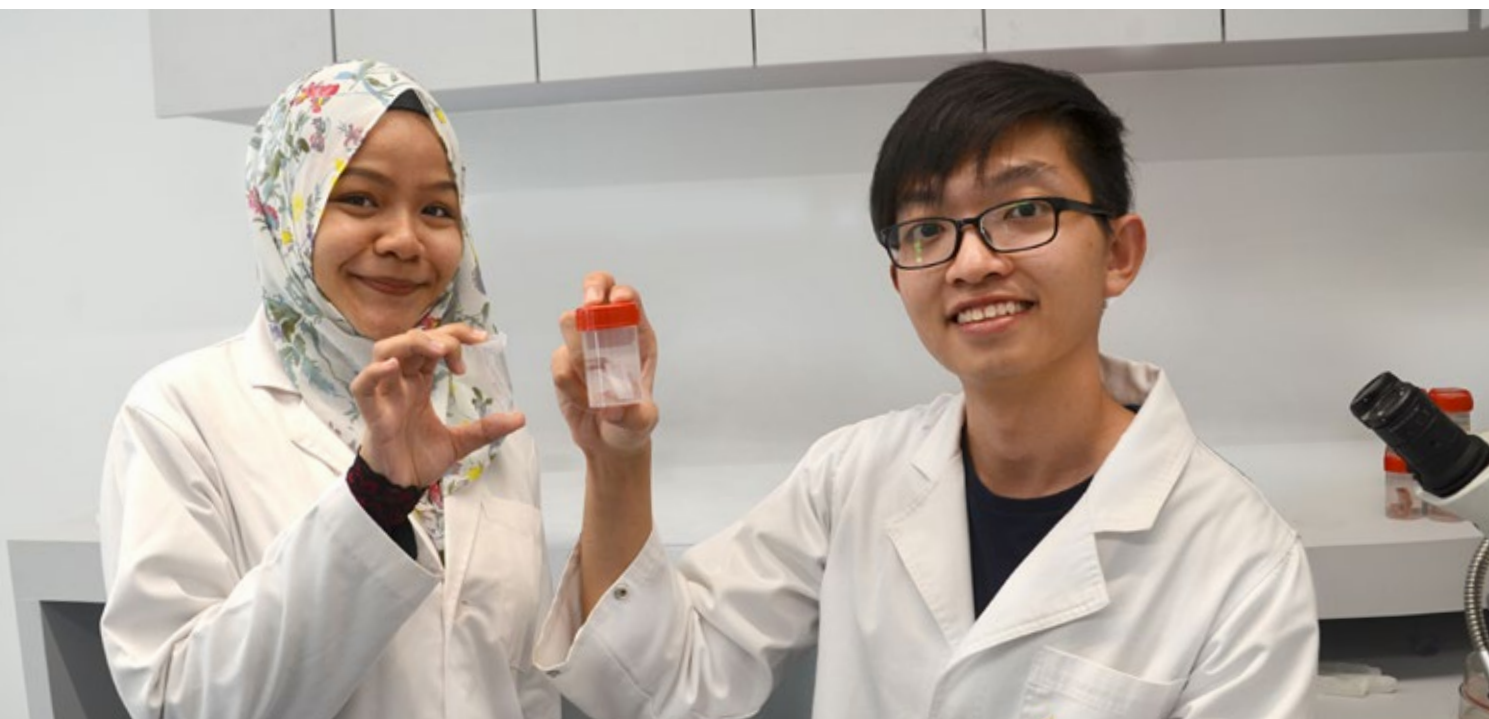
These courses are designed for those who want to gain the formal research training experience needed to begin an exciting higher research degree.

### **Doctor of Philosophy (PhD) and Master of Philosophy**

The Doctor of Philosophy (PhD) is a program of supervised original research. It culminates in the submission of a thesis that demonstrates the ability for critical analysis and research that makes a significant and original contribution to the knowledge and understanding of the field of study.

The Master of Philosophy offers postgraduate research supervision on a smaller scale than the PhD, towards which it can provide a pathway.

For further information on our courses, email [admissions-singapore@jcu.edu.au](mailto:admissions-singapore@jcu.edu.au) or visit [www.jcu.edu.sg](http://www.jcu.edu.sg)









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