

Aquaculture at James Cook University in Singapore



Aquaculture at James Cook University in Singapore

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 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, 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 higher degree research options, JCU in Singapore trains the next global leaders in aquatic food production. Through the Tropical Futures Institute and 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 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



Tropical Aquaculture

Research Capacity

James Cook University in Singapore through its Tropical Futures Institute has internationally recognized expertise in industry relevant, outcome driven research and development for a multitude of globally important farmed tropical species, including well-established aquaculture species such as barramundi, marine shrimp, pearl oysters, tilapia, sea cucumbers, cobia, tropical lobsters, and freshwater prawn.

With aquaculture research teams in both Singapore and Australia, James Cook University is perfectly positioned to continue to significantly contribute towards sustainable and productive aquaculture development in tropical zones of the world.

Research and Development

Researchers from James Cook University in Singapore have experience and expertise in all biological and industry aspects of tropical aquaculture, including hatchery and nursery techniques, aquatic animal health, nutrition and feed

development, bioremediation, sustainable livelihoods and tourism, reproductive control and domestication, and the application of advanced selective breeding techniques. Recent examples of leading and industry-impactful research includes:

- Development and implementation of genomic-based breeding programs for barramundi, pearl oysters and marine shrimp (Pacific white shrimp, black tiger shrimp)
- Biosecurity audits for Australian shrimp farms
- Trialling new and sustainable aquaculture feeds
- Influence of microbial communities for health and productivity of marine shrimp
- Understanding the genetic basis of scale drop disease in barramundi





Prof Dean Jerry

Director ARC Research Hub for Advanced Prawn Breeding
Deputy Director Centre for Sustainable Tropical Fisheries and Aquaculture
Director of Tropical Futures Institute
Tropical Futures Institute
James Cook University (Singapore)

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

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 ~\$24M). He has published 130 peer reviewed scientific articles and served on the editorial boards of *Aquaculture Environment Interactions*, *Agri-Gene* and *Gene*. He has also supervised nearly 100 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

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

- 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.
- Domingos, J.A., Smith-Keune, C. and Jerry, D.R. (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.

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JCU Research Profile



Assoc Prof Katheline Hua

Associate Professor, Aquaculture
Principal Research Fellow
Tropical Futures Institute
James Cook University (Singapore)

PhD University of Guelph, Canada
MSc University of Guelph, Canada

Background

Associate Professor Katheline Hua specializes in the field of aquaculture nutrition. She has more than 16 years of experience in working with both tropical and coldwater fish species.

A/Prof Hua holds a PhD in Fish Nutrition from the University of Guelph, Canada. She worked at the University of Guelph as a Post-doctoral fellow and Adjunct Professor where she conducted research on coldwater fish. Afterwards she worked as a Junior Professor at the Humboldt University of Berlin, Germany where she led the aquaculture nutrition research group. She joined James Cook University in Singapore in 2018.

A/Prof Hua's primary research interest is to develop cost-effective aquaculture feeds to promote growth and nutrient utilization of fish and crustaceans. Her research program encompasses basic and applied research topics in aquaculture nutrition. One of her expertise areas is nutritional modelling, exploring the synergy of empirical and modelling approaches to integrate and synthesize information related to optimum aquaculture diets.

Areas of expertise

- Feed formulations
- Ingredient evaluation
- Macronutrients and feed additives
- Nutrient requirement and utilization of fish
- Nutritional modeling

Impact of research

- Developed a series of nutrient digestibility models that represent significant progress from the conventional experimental approach to estimate digestibility values of lipid, starch and phosphorus. The models are being used as feed formulation tools by academic researchers and feed producers.
- Developed a model simulation-based approach that achieves broader and more flexible evaluations of nutritive values of feed ingredients than conducting individual feeding trials. This approach allows not only proper quantifications of the effect of alternative ingredients, but also simulations of growth and nutrient utilization.
- Elucidated the appropriate mode of expressing essential amino acids requirement, a fundamental issue in fish nutrition research, which contributes to a better understanding of underlying dietary factors that affect amino acid requirements of fish.

Research Projects:

- Refinement of methodologies in evaluating nutritive values of

fish feed ingredients and development of mechanistic models to estimate nutrient digestibility

- Investigation of nutritive values of alternative raw materials for aquaculture species
- Investigation of strain effects on nutrient requirement and utilization in Nile tilapia
- Nutrient requirement of Striped snakehead *Channa striatus* and development of low fish meal feed formulation for aquaculture of Striped snakehead *Channa striatus*
- Comparison of bioavailability of different sources of Lysine nutrition in Nile tilapia
- Comparison of Lysine utilization efficiency by Nile tilapia at different fish sizes
- Nutritional modelling of amino acids nutrition in fish: estimating amino acids requirements through nonlinear mixed models and multilevel models
- Quantification of the effects of plant protein ingredients in fish feeds using meta-analysis and nutritional model simulation-based approaches
- Development of lipid and starch digestibility models for fish

Top five publications

- Hua, Katheline, and Bureau, Dominique (2019) "<https://researchonline.jcu.edu.au/60490/>" Estimating changes in essential amino acid requirements of rainbow trout and Atlantic salmon as a function of body weight or diet composition using a novel factorial requirement model. *Aquaculture*, 513. 733440.
- Hua, Katheline, Suwendi, Erwin, and Bureau, Dominique P. (2019) "<https://researchonline.jcu.edu.au/57146/>" Effect of body weight on lysine utilization efficiency in Nile Tilapia (*Oreochromis niloticus*). *Aquaculture*, 505. pp. 47-53.
- Hua, Katheline, Koppe, Wolfgang, and Fontanillas, Ramon (2019) "<https://researchonline.jcu.edu.au/56468/>" Effects of dietary protein and lipid levels on growth, body composition and nutrient utilization of *Channa striata*. *Aquaculture*, 501. pp. 368-373.
- Hua, Katheline, Cobcroft, Jennifer M., Cole, Andrew, Condon, Kelly, Jerry, Dean R., Mangott, Arnold, Praeger, Christina, Vucko, Matthew J., Zeng, Chaoshu, Zenger, Kyall, and Strugnell, Jan M. (2019) "<https://researchonline.jcu.edu.au/61160/>" The future of aquatic protein: implications for protein sources in aquaculture diets. *One Earth*, 1 (3). pp. 316-329.
- Hua, K. 2013. Investigating the appropriate mode of expressing lysine requirement of fish through non-linear mixed model analysis and multilevel analysis. *British Journal of Nutrition* 109, 1013-102.

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JCU Research Profile





Assoc Prof Clive Jones

Associate Professor, Aquaculture
Principal Research Fellow
Tropical Futures Institute
James Cook University (Singapore)

PhD University of Queensland, Australia
BSc (Hons) University of Queensland, Australia

Background

Associate Professor Clive Jones is internationally recognised for his aquaculture research and technology development, with a primary focus on marine rock lobster and freshwater crayfish aquaculture. Thirty-seven years of professional experience have equipped A/Prof Jones with an exceptional skillset through research project leadership, building research teams to address industry development objectives across all necessary biological disciplines, bio-economics, social science, marketing and policy development. His work engages him with small-holder practitioners, medium and large scale commercial operators, government and University research organisations and senior government officials, to deliver practical solutions that enable industry development and growth. A/Prof Jones has secured more than \$10 million in external funding for the projects he has led and participated in, delivered in Australia, Vietnam, Indonesia, the Philippines and Sri Lanka. He has published more than 230 scientific communications.

His current research focus is on development of rock lobster farming in Indonesia and the Philippines, improvement of nursery technology for redclaw freshwater crayfish in Australia and development of culture-based fisheries for giant freshwater prawns in Sri Lanka.

A/Prof Jones has a special interest in developing aquaculture opportunities for Australian Indigenous communities using rock lobsters and freshwater crayfish as target species.

He works closely with industry with a strong, successful track record in technology transfer from research to commercial production, bolstered in particular by an ability to communicate effectively at scientist, farmer, government and corporate levels. A/Prof Jones draws his greatest motivation from working with village-based, small-holder farmers in Asia to improve their lives and livelihoods.

Areas of expertise

- Tropical rock lobster aquaculture, nutrition, husbandry, health management, industry development, sustainable livelihoods, intensive production
- Tropical freshwater crayfish aquaculture, nursery, nutrition, husbandry, intensification
- Culture-based fisheries for inland reservoirs, Macrobrachium and freshwater finfish

Impact of research

- Development of production technologies for aquaculture of tropical rock lobsters and freshwater crayfish that enhance productivity and generate greater incomes and more sustainable livelihoods
- Understanding socio-economic factors for tropical rock lobster and freshwater crayfish aquaculture to maximise benefits to women, men and children
- Capability to engage with private industry enterprises to transfer knowledge and ensure commercial outcomes
- Influencing policy decisions by governments in Southeast Asia to enable sustainable aquaculture development

Top five publications

- Jones, C.M. (2018). Progress and obstacles in establishing rock lobster aquaculture in Indonesia. *Bulletin of Marine Science*, 94, 1223-1233.
- Jones, C.M., Anh, T.L., Priyambodo, B. (2019). Chapter 12. Lobster aquaculture development in Vietnam and Indonesia in: Radhakrishnan, E.V. (Ed.), *Lobsters: Biology, Fisheries and Aquaculture*. Springer Nature, Singapore.
- Jones, C.M. (2015). Spiny lobster aquaculture development in Indonesia, Vietnam and Australia. *Proceedings of the International Lobster Aquaculture Symposium held in Lombok, Indonesia, 22–25 April 2014*. Australian Centre for International Agricultural Research (ACIAR), Canberra, 163 pp.
- Marchese, G., Fitzgibbon, Q.P., Trotter, A.J., Carter, C.G., Jones, C.M., Smith, G.G. (2019). The influence of flesh ingredients format and krill meal on growth and feeding behaviour of juvenile tropical spiny lobster *Panulirus ornatus*. *Aquaculture*, 499, 128-139.
- Diedrich, A., Blythe, J., Euriga, E., Fatchiya, A., Petersen, L., Shimada, T., Jones, C. (2019). Socio-economic drivers of adoption of lobster aquaculture in Indonesia. *Sustainability*, 11, 15.

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JCU Research Profile





Dr Susan Gibson-Kueh

Senior Research Fellow, Aquaculture
Tropical Futures Institute
James Cook University (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 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 Kueh's expertise in diagnostic fish pathology encompasses both finfish (marine and freshwater, food and ornamental species) and shellfish (shrimps, oysters, mussels, abalone), and the study of complex diseases in valuable food fish species. She has special interests in development of sustainable livelihoods based on aquaculture in remote communities in South-East Asia.

Dr Kueh was the first researcher to understand the causative agent of scale-drop in barramundi and has a strong interest to continue to understand this disease, along with other diseases like big belly disease, so that sustainable approaches can be developed for barramundi aquaculture.

Areas of expertise

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

Impact of research

- First report of Big Belly or Pot Belly in Asian seabass fry with high mortality in 2004, resulted in recognition of a novel bacterial gut disease with significant impact on production of Asian seabass
- 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
- 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, 19–27.
- Gibson-Kueh, S., Netto, P., Ngoh, 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*, 129,111-119.
- 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. 731-735.
- Gibson-Kueh, S., Ngoh-Lim, G.H., Netto, P., Kurita, J., Nakajima, K., Ng, M.L. (2004). A systemic iridoviral disease in mullet, *Mugil cephalus* Linnaeus and tiger grouper, *Epinephelus fuscoguttatus* Forsskal – a first report and study. *Journal of Fish Diseases*, 27, 693-699.
- Qin, Q.W., Chang, S.F., Ngoh-Lin, G.H., Gibson-Kueh, S., Shi, C., Lam, T.J. (2003). Characterisation of a novel Ranavirus isolated from Grouper, *Epinephelus tauvina*. *Diseases of Aquatic Organisms*, 53, 1-9.

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JCU Research Profile





Dr Jose Domingos

Senior Research Fellow, Aquaculture
Tropical Futures Institute
James Cook University (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 genetics
- Quantitative genetics and genomics for selective breeding programs
- Development and application of genomic tools to boost seafood production
- Marine finfish broodstock systems and management
- Integrated shrimp farm management

Impact of research

- 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 ranking of existing broodstock based on their genetic merit for growth. Through this technique, fish hatcheries can spawn their superior brooders and immediately improve farm productivity

by avoiding costs associated with rearing of slow-growing families.

- Estimation of heritability and genotype by environment interactions of harvest growth traits, and the fate of genetic diversity within and between generations in Asian seabass, essential information for the implementation of effective selective breeding programs for the species.
- Identification of sex-specific epigenetic differences and alternatively spliced isoforms of *dmrt1* and *cyp19a1* genes in the protandrous hermaphrodite Asian seabass. 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 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.
- Domingos JA, Smith-Keune C, Robinson N, Loughnan S, Harrison P, Jerry DR (2013) Heritability of harvest growth traits and genotype-environment interactions in barramundi, *Lates calcarifer* (Block). *Aquaculture*, 402-403: 66-75.
- Domingos JA, Zenger, KR, Jerry DR (2015) Whole-genome shotgun sequence assembly enables rapid gene characterization in the tropical fish barramundi, *Lates calcarifer*. *Animal Genetics*, 46, 468-469.
- Munday PL, Donelson JM, Domingos JA (2017) Potential for adaptation to climate change in a coral reef fish. *Global Change Biology*, 23 (1), 307-317.
- 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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JCU Research Profile





Dr Xueyan Shen

Senior Lecturer, Aquaculture
James Cook University (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., Ngho, S.Y., Thevasagayam N.M & Orbán, L. (2016). BAC-pool sequencing and analysis confirms growth-associated QTLs in the Asian seabass genome. *Scientific Reports*, 6, 36647. doi:10.1038/srep36647
- Li J, Bian C., Hu Y., Mu X., Shen X* & Shi Q. (2016). A chromosome-level genome assembly of the Asian arowana, *Scleropages formosus*. *Scientific Data*, 3, 160105. <http://dx.doi.org/10.1038/sdata.2016.105>
- Bian C., Hu Y. C., Ravi V., Kuznetsova, I. S., Shen, X*, et al. (2016). The Asian arowana (*Scleropages formosus*) genome provides new insights into the evolution of an early lineage of teleosts. *Scientific Reports*, 6, 24501. doi:10.1038/srep24501
- Ngho, S., Tan, D., Shen, X., Orbán, L. (2015). Nutrigenomic and nutritional analyses reveal the effects of pelleted feeds on Asian seabass (*Lates calcarifer*). *PloS one*, 10(12), e0145456. doi: 10.1371/journal.pone.0145456
- Shen, X., Kwan, H., Thevasagayam, N., Prakki, S. R. S., Kuznetsova, I. S., Ngho, S., & Orbán, L. (2013). The first transcriptome and genetic linkage map for Asian arowana. *Molecular Ecology Resources*, 14(3), 622-635. doi:10.1111/1755-0998.12212

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JCU Research Profile





Dr Neil Hutchinson

Senior Lecturer, Environmental Science
James Cook University (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 18 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 fish, 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.

Impact of research

- Advanced understanding of the relative importance of seagrass beds as key fishery habitat in temperate Australia. 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.

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

Top five publications

- Benzeev R, Hutchinson N and Friess D (2017) Quantifying fisheries ecosystem services of mangroves and tropical artificial urban shorelines. *Hydrobiologia*, 803 (1), 225-237
- Hutchinson N, Jenkins G, Brown A and Smith T (2014) Variation with depth in temperate seagrass-associated fish assemblages in Southern Victoria, Australia. *Estuaries and Coasts*, 37 (4), 801-814
- Pecl G, Ward T, Doubleday Z, Clarke S, Day J, Dixon C, Frusher S, Gibbs P, Hobday A, Hutchinson N, Jennings S, Jones K, Li X, Spooner D and Stoklosa R (2014) Rapid assessment of fisheries species sensitivity to climate change. *Climatic Change*, 127 (3), 505-520
- Doubleday Z, Clarke S, Li X, Pecl G, Ward T, Battaglene 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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JCU Research Profile



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.

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

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For further information on our courses, email admissions-singapore@jcu.edu.au or visit www.jcu.edu.sg



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