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Agriculture Science & Technology

RESEARCH CAPABILITY

Updated November 2020

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UQ **RESEARCH** PARTNERSHIPS

Inside ...

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UQ'S UNIQUE RECORD AND CAPABILITY IN **AGRICULTURE** SCIENCE & **TECHNOLOGY**

World-class expertise and facilities

UQ enjoys an established international reputation for research excellence, and ranks consistently among the world's top universities within the broad fields of agriculture and life sciences.

In fact UQ — which was ranked as the top agricultural research institution in Australia (NTU rankings 2017) — leads the world in **tropical agriculture** research. We're also consistently in the top-five agriculture research institutions globally, and Australia's most diversified agriculture research group.

Our ready access to cutting-edge investigative resources across UQ's wider research community offers partner organisations many unique benefits.

UQ has world-leading researchers in fields such as **crop** and **pasture production**, food science, soil sciences, plant biology and **genetics**, horticultural production, environmental science, as well as animal, equine and wildlife sciences. During the period 2017–2019, UQ attracted more than $111 million in competitive research funding for Agriculture science related projects.

By collaborating with our UQ colleagues and beyond, and by interfacing with industry and government, we rapidly translate research into improvements in the field. Our recent rankings milestones reflect the diversity, commitment and collaborative nature of our staff.

Our researchers come from all over the world, and are engaged in international interactions in countries as diverse as Indonesia, the USA, China, Brazil, India and Germany.

We maintain strong links with rural communities, industry and government, both locally and abroad. Together with our partners we work to find sustainable solutions for feeding the world, and to identify commercialisation opportunities.

Photo: QAAFI

UQ **AGRICULTURE** SCIENCE & TECHNOLOGY

- Agriculture & Food Sciences
- Animal, equine and wildlife sciences
- Bioengineering & Nanotechnology
- Chemical Engineering

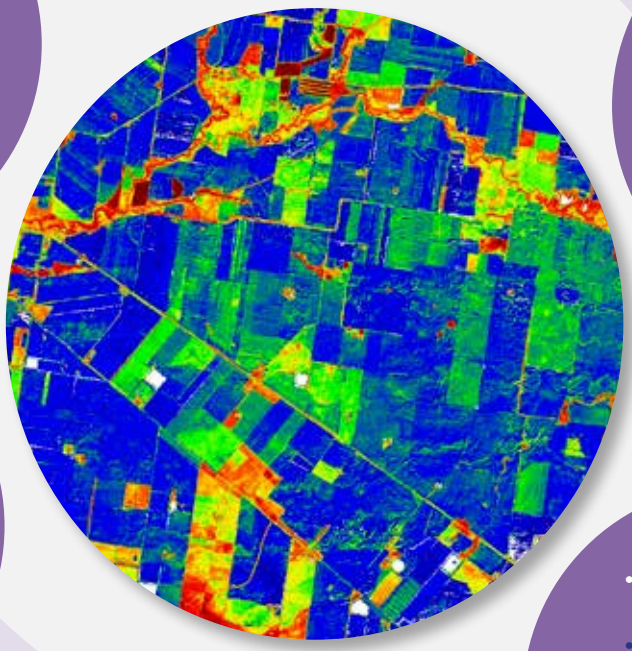
- Agribusiness
- Agriculture science regulation
- Rural development
- Agriculture trade policy
- Supply chains & markets
- Product commercialisation
- Food waste

- Genomics and genetics
- Food science and technology
- Next-Gen Fertilisers
- Sensors and automation

- China Agricultural Economics Group
- Integrative legume research group
- Extensive network of existing national & international research partners

- Environmental science
- Statistical modelling
- Environmental management
- Mapping
- Remote sensing
- Data management systems

- Crop Science
- Horticultural Science
- Crop modelling and forecasting
- Protected cropping and controlled environments
- Plant and soil sciences research



Below: Queensland Animal Science Precinct at UQ's Gatton Campus

WORLD-CLASS RESOURCES

GATTON CAMPUS

The University of Queensland Gatton Farms is located on its Gatton Campus, 80 km west of Brisbane. The farms cover **1068 hectares** and include a dairy, piggery, sheep and goat herd, horticultural fields, post-harvest facilities and greenhouses, and an extensive range of plant and farm machinery.

Gatton Farms is spread across two locations. The main area of activities is on the Gatton Campus with another farm, *Darbalara*, located 10 km from the main campus.

Darbalara's 184 hectares is home to the School of Veterinary Science **Droughtmaster herd** and beef cattle teaching facility, along with other grazing and crop production.

The Gatton campus is located in the Lockyer Valley which is a highly fertile horticulture area with a subtropical climate that features relatively long hot summers, and short, mild winters with occasional frosts.

Rainfall is summer dominant with 65-70% of the total rainfall occurring in October–March. The average annual rainfall to the area is about 780 mm, making this the driest part of south-east Queensland.

Queensland Animal Science Precinct

The Queensland Animal Science Precinct (QASP) provides a biosecure research environment with experienced and qualified staff to deliver high-quality support for all phases of research projects.

QASP is a world-class research facility that accommodates training, teaching, validation and commercialisation of animal research focusing on the research and development requirements of state, national and international animal industries.

QASP can undertake a diverse range of animal research including nutrition, health and disease management, vaccine development, behavioural and welfare studies, biosecurity investigational work, reproduction and food safety.

Animal industries contribute more than of $4 billion to the Queensland economy annually in gross production value and are underpinned by an investment in people, infrastructure and resources of some $25 billion. Animal industries provide major employment in rural and regional Queensland.

Specialised veterinary services

Services include small animal, production animal and equine services at Gatton Campus and the Dayboro Clinic, genetic and laboratory testing, and an adoption program for cats and dogs.

Other Gatton Campus resources also include:

- Native Wildlife Teaching and Research Facility
- Centre for Animal Welfare and Ethics
- Centre for Spray Technology Application Research and Training
- Poultry Science Unit
- Research Nursery

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Photo: QAAFI

Right: QAAFI Centre for Nutrition and Food Sciences Principal Research Fellow A/Prof. Yasmina Sultanbawa

UQ SCHOOL OF AGRICULTURE & FOOD SCIENCES

UQ'S world-leading research addresses complex international concerns about food security and sustainable agricultural production.

Our primary focus lies in balancing how to feed a growing world population against rising affluence in developing countries, diminishing natural resources, and the need to improve productivity – while minimising environmental insult.

Our unique geographical location, multidisciplinary and collaborative nature, and stellar track record of innovation and research translation make us global leaders in tropical and sub-tropical agricultural systems research.

Research clusters

Our research is focused within four broad areas, although our individual researchers' expertise and methodologies cross these boundaries.

- Agribusiness and rural development
- Animal, equine and wildlife sciences
- Food science and technology
- Plant and soil sciences

QUEENSLAND ALLIANCE FOR AGRICULTURE & FOOD INNOVATION

A UQ research institute, the Queensland Alliance for Agriculture and Food Innovation (QAAFI) is one of the world's leading providers of research in tropical and sub-tropical agriculture and food production. QAAFI works across areas such as crops, horticulture, animals, and nutrition and food sciences, supported by its established links with industry and the **Queensland Government**.

QAAFI is comprised of four inter-related research centres, with a focus on the challenges facing tropical and sub-tropical food and agribusiness sectors in the tropical and subtropical systems.

Our vision is sustainable agriculture and food achieved through science and innovation.

- Centre for Crop Science
- Centre for Animal Science
- Centre for Nutrition and Food Sciences
- Centre for Horticultural Science


Photo: QAAFI

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Left: Viridiana Silva-Pere and Alex Wu

Digital Agriculture

THE digital revolution continues to transform agriculture, in the way it has transformed other key industries, such as telecommunications, banking and mining.

Our digital agriculture capabilities include:

- Crop modelling and forecasting
- Crop forecasting
- Genomics and genetics
- Sensors and automation
- Supply chains and markets
- Protected cropping and controlled environments

Digital agriculture makes use of integrated and connected computerised tools and information, to improve decision-making and productivity across all stages of food production — from genetics to farm management, transport and to the consumer.

Agriculture is yet to experience the full effect of digital technology but leads the way in some of the frontier digital sciences, such as linking remote sensing and predictive systems with genetics and genomics.

UQ'S Queensland Alliance for Agriculture and Food Innovation (QAAFI) offers world-leading capabilities in digital agriculture. At QAAFI, our integrated research teams across cereal and legume crops, horticulture, animal, and food and nutrition sciences, are world-leaders in cutting edge digital technologies.

Crop modelling and decision support

QAAFI conducts world-leading research, targeting enhanced profitability and sustainability of cereal and legume cropping systems in tropical and sub-tropical environments. Digital agriculture technologies allow us to integrate our research capabilities across molecular, whole plant, and production-level systems with our frontier research in climate modelling, prediction agriculture, genetics and farming systems to provide informed decision-support tools.

Sorghum research heats up

In a changing climate, farmers are already finding that extreme heat events are having a negative impact on the productivity of sorghum crops. Combining genomics, phenomics and modelling, QAAFI researchers are developing more temperature-tolerant varieties of this staple crop.

Computer 'brain' trawls vast datasets for crop advances

New breeding systems predict the likely paddock performance of breeding material based on a marriage of biological data, climate records and machine-based crop improvement.

Professor Mark Cooper is leading the way as the Chair in Prediction Based Crop Improvement – a role which aims to find innovative solutions to the world's food-gap issue.

Artificial intelligence helps make the world more food secure

A new QAAFI-developed crop simulation software can be fed early-stage photosynthesis discoveries that are being made at the molecular (or subcellular) scale — and extrapolate how this altered photosynthesis biochemistry might impact on crop performance in the form of virtual plants grown under realistic farming conditions affected by real-world weather, soil and rainfall data.

Small trees horticultural initiative: modelling biology

The Small-Trees High-Productivity project seeks to improve mango, avocado and macadamia harvests through a better understanding of tree vigour, developmental architecture, crop load, and canopy light relations. Outcomes of experiments in these areas are integrated through functional-structural plant modelling, enabling insights into design of the new orchard systems, which are the ultimate target of the project.

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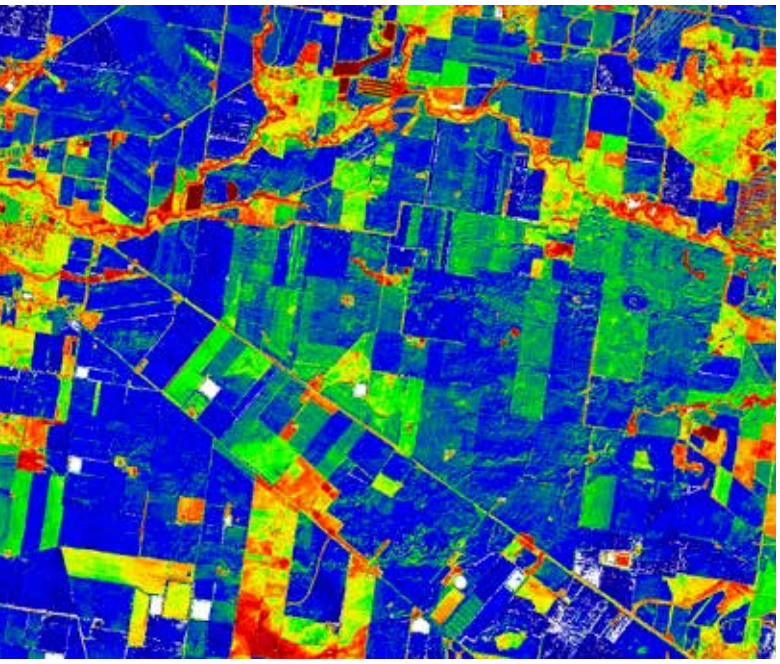

Satellite imagery of Darling Downs and around Dalby captured on 31 May 2017 from the Sentinel II satellite. © QAAFI

QAAFI is working with the Beijing-based **Institute of Remote Sensing and Digital Earth** (RADI) to develop crop yield prediction systems using satellite data and biophysical crop modelling.

Crop forecasting

QAAFI integrates satellite data, field experimentation, modelling tools, and socioeconomic data, to generate new science that supports decision-making for economic, environmental, and social outcomes to design farming systems better able to deal with production, climate and market risks.

QAAFI is working with the Beijing-based Institute of Remote Sensing and Digital Earth (RADI) to develop crop yield prediction systems using satellite data and biophysical crop modelling systems. The project will help producers and industry cope with weather extremes and climate change.

Predicting optimum crop designs using crop models and seasonal climate forecasts

Bridging productivity gaps by identifying optimum combination genetics and agronomic managements (i.e. crop designs) for the prevailing and expected growing environment — testing skilful seasonal climate forecasting systems.

Seasonal sorghum and wheat forecasts

QAAFI produces regular seasonal outlooks for sorghum and wheat producers in Queensland. OZ-Wheat regional wheat yield forecasts are developed from climate data and modelling, remote sensing and historical data showing likely yield outcomes. They cover Queensland and northern New South Wales. sorghum crop outlooks cover Queensland and northern New South Wales and are based on cropping after winter fallow, sorghum modelling, actual climate data, up to the forecasting date and projected climate data.

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High folate strawberry in the lab © QAAFI

Wild Australian rice genes could make commercial rice production better suited to northern Australian conditions.

Genomics and genetics

QAAFI is home to several of the world's most highly recognised scientists working in genetics, genomics and genomic prediction across plant and animal agriculture.

In crops, our integrated pre-breeding research programs deliver improved lines to industry based on advanced genetics, phenotyping, bioinformatics, trait physiology and modelling. In animals, we have major programs and capability in genetics and genomics; and the breeding and reproductive capability of northern Australian cattle breeds.

Developing a DNA test to predict the value of an animal's genetics for fertility

The dream of running a heifer up a crush somewhere in the Gulf country, pulling out some tail hair and within minutes, getting an accurate prediction on her fertility, is one that could soon be realised.

Sugarcane genomics — a game-changer

Sugarcane is world leading industrial crop, important to Queensland and Australia. It is a highly efficient biomass crop and produces higher value products. QAAFI researchers, working with Sugar Research Australia, to sequence the sugarcane genome.

Sugarcane is the last of the global crops to have its genome sequenced, and it is the most complex genome of crop plants.

High folate strawberry in the lab

Scientists have discovered an 'alpha strawberry' that is very sweet in flavour and has folate levels that may be up to three times higher than standard strawberries.

Ancient rice genetics a boon for modern production

Wild Australian rice genes could make commercial rice production better suited to northern Australian conditions. The wild rices could contribute resistance to diseases such as rice blast, brown spot and bacterial leaf spots.

Could AI deliver the next wheat breakthrough?

Recent advances in 'evolutionary computing' — a branch of artificial intelligence (AI) — are being tapped into in an effort to speed up genetic gain in wheat breeding programs. AI platform FastStack is being designed to track the flow of valuable genes in breeding programs and detect those combinations most likely to improve crop performance.

Breeding Program Analysis Tool

QAAFI and UQ are working with the Bill & Melinda Gates Foundation to evaluate and improve breeding programs in developing countries. The project aims to identify ways of improving breeding programs, leading to greater genetic gains and on-farm profitability.

Sustainable intensification of Australia's horticultural industry

The Horticultural Tree Genomics project will provide the genetic knowledge required for advanced breeding programs and future intensification of five important Australian horticultural tree crops — avocado, mango, macadamia, citrus and almond.

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Gekko phenotyping tractor at Hermitage Field Station, Warwick.

Across the plant, livestock and horticulture sectors, **digital technologies** are helping to tailor decisions and improve productivity across the supply chain.

Sensors and automation

Digital technologies such as the use of satellite linked geo-positioning systems and sensors mounted on UAVs and fit-for-purpose ground rigs enable remote estimation of plant vigour and growth traits. This accelerates selection of adapted lines in large breeding trials and helps in making agronomic decisions on field management tailored to in-field variation. Across the plant, livestock and horticulture sectors, digital technologies are helping to tailor decisions and improve productivity across the supply chain.

An all-seeing mobile platform bristling with lenses and sensors can drive over trial plots during different growth stages and compile a composite 'picture' from the visible to the infrared light spectrums, from thermal and chemical imaging, and laser reflectance (or Lidar as it is known) for high-definition 3D profiles of the plant canopy.

Drought adaptation: automated lysimeter platforms

Each lysimeter is located on a load cell and lysimeter weights are recorded every 10 minutes. The re-watering of each lysimeter is fully automated and linked to breeding and phenotyping programs.

This Internet of Things digital technology has been trialled on maize, sorghum and wheat to develop fully automated watering systems and to identify water usage and transpiration rates.

Below: QAAFI researcher Alemu Tirfessa inspecting the lysimeter platforms © QAAFI

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New digital technologies such as **blockchain** and distributed ledger enable coordination and transparency across supply chains, supporting provenance and value adding.

Supply chain and markets

AUSTRALIA enjoys an enviable and deserved reputation as the producer of safe, clean, green foods and agricultural products.

Protecting this supply chain is of paramount importance to the value of our agricultural produce and food supply.

New digital technologies such as blockchain and distributed ledger enable coordination and transparency across supply chains, supporting provenance and value adding.

It should also be noted that blockchain is also being used by major players in value chains to maintain and increase their bargaining power over the chain.

Associate Professor Damian Hine is leading a project on building farm financial models, supported by the rapid uptake of accounting systems such as Xero and MYOB.

The project is designed to enhance the evidence base for better decision making at several levels.

Opportunities for horticultural industries in northern Australia

Working with the CRC for Northern Australia, Associate Professor Damian Hine, QAAFI's Professor Robert Henry and Professor Neena Mitter head a project to evaluate the potential to expand horticultural industries such as mangoes, lychees and avocados in northern Australia.

Blockchain, genomics and cryptocurrency

Could cryptocurrencies let you control & sell access to your DNA data? Blockchain is the technology that underpins digital currencies. It works as a digital ledger and provides accountability and transparency.

Australian native food

With a developing global interest from consumers wanting to know where their food comes from and a growing, newly-affluent population in many Asian and other export markets, there is an opportunity for Australia to build on its reputation as a producer of quality foods to develop added-value products. QAAFI has major research themes and projects in this space.

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Protected cropping and controlled environments

Automation and robotics are revolutionising the growth of crops in protected and controlled environments. Such environments range from netting and plastic coverings of crops, to climate-controlled structures with computerised ventilation systems, advanced computer-controlled heating and cooling systems and nutrition enrichment technologies which are now driving the growth of urban and vertical farms. Controlled environments provide optimal growing conditions while reducing and, in some conditions, almost eliminating the need for chemical inputs to manage pests and diseases.

Digital horticulture

QAAFI's Professor Neena Mitter, Director of the Centre for Horticultural Sciences says protected cropping promises big things for both western and developing nations in terms of production and nutrition. Read more

By using speed breeding techniques in specially modified glasshouses we can grow **six generations** of wheat, chickpea and barley plants, and four generations of canola plants in a single year.

Space age plant breeding lights the way for future crops

By using speed breeding techniques in specially modified glasshouses we can grow six generations of wheat, chickpea and barley plants, and four generations of canola plants in a single year – as opposed to two or three generations in a regular glasshouse, or a single generation in the field.

Speed breeding wheat under lights: Dr Lee Hickey inspecting wheat in a UQ glasshouse.

Space age **plant breeding** lights the way for future crops

NASA experiments to grow wheat in space were the inspiration for UQ scientists to develop the world's first 'speed breeding' procedures here on planet Earth.

UQ Queensland Alliance for Agriculture and Food Innovation (QAAFI) Senior Research Fellow Dr Lee Hickey said the NASA experiments involved using continuous light on wheat which triggered early reproduction in the plants.

"We thought we could use the NASA idea to grow plants quickly back on Earth, and in turn, accelerate the genetic gain in our plant breeding programs," Dr Hickey said.

He was part of the team from the UQ School of Agriculture that began trialling speed-breeding techniques to cut the length of plant breeding cycles more than 10 years ago.

"By using speed-breeding techniques in specially modified glasshouses we can grow six generations of wheat, chickpea and barley plants, and four generations of canola plants in a single year — as opposed to two or three generations in a regular glasshouse, or a single generation in the field," Dr Hickey said.

"Our experiments showed that the quality and yield of the plants grown under controlled climate and extended daylight conditions was as good, or sometimes better, than those grown in regular glasshouses."

He said information on how to use speed breeding was increasingly in demand from other researchers and industry.

"There has been a lot of interest globally in this technique due to the fact that the world has to produce 60–80 per cent more food by 2050 to feed its nine billion people."

The speed-breeding technique has largely been used for research purposes but is now being adopted by industry.

UQ scientists, in partnership with Dow AgroSciences, have used the technique to develop the new 'DS Faraday' wheat variety.

"DS Faraday is a high protein, milling wheat with tolerance to pre-harvest sprouting," Dr Hickey said.

"We introduced genes for grain dormancy so it can better handle wet weather at harvest time — which has been a problem wheat scientists in Australia have been trying to solve for 40 years," he said.

"We've finally had a breakthrough in grain dormancy, and speed breeding really helped us to do it."

Dr Hickey said the level of interest in speed breeding led to his collaborators at the John Innes Centre and the University of Sydney to write a *Nature Plants* paper, which outlines all the protocols involved in establishing speed breeding systems and adaptation of regular glasshouse facilities.

UQ PhD student Amy Watson was a co-first author of the paper and conducted some of the key experiments that documented the rapid plant growth and flexibility of the system for multiple crop species.

Dr Hickey believes the sky is the limit for the new technology and he is now investigating the integration of speed breeding with other modern crop breeding technologies.

"It could also have some great applications in future vertical farming systems, and some horticultural crops," Dr Hickey said.

Speed breeding is a powerful tool to accelerate crop research and breeding is available at Nature Plants. (doi: 10.1038/s41477-017-0083-8)

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Sugar set for '**energycane**' reinvention

GENE-editing sugarcane for use in renewable energy and bio-plastics could help secure the industry's future.

The University of Queensland's Professor Robert Henry said sugarcane's reinvention as an "energycane" crop could sustain the industry in the face of falling global demand for sugar.

"The industry must think beyond just producing sugar, to also producing electricity, biofuels for transportation and oils to replace traditional plastics," he said

Professor Henry, Director of the Queensland Alliance for Agriculture and Food Innovation (QAAFI) at UQ, is conducting the first gene-editing experiments to tailor sugarcane production to effectively produce biofuels and bioplastics.

"It's about reinventing sugarcane as a crop with a wider range of end uses, and sugarcane is ideal for renewables because it is fast-growing with abundant biomass," he said.

He is working with a global team to sequence the sugarcane genome as part of a US Joint Genome Institute project.

"Sugar is the last major cultivated plant to have its genome sequenced, and we expect to see it fully decoded by 2020," Professor Henry said.

"Having sugar's genetic template will allow us to look at growing sugarcane as a biofuel and a source of 100 per cent recyclable bioplastic, making it a substitute for petroleum in the production of countless items from cosmetics to car parts," he said.

Professor Henry's call to rethink sugarcane is supported by Cooperative Research Centre for Developing Northern Australia Chair Ms Sheriden Morris.

Sugarcane at Meringa research station"Gene-editing of the sugarcane genome will allow the sugar industry to explore adaptations that will reduce environmental impacts, especially on the Great Barrier Reef," Ms Morris said.

"It will help the industry to broaden the potential of a sugar crop to a wider range of uses. Biofuels and bioplastics will be important to the long-term future of the industry," she said.

Professor Henry, who has helped lead genomic breakthroughs in decoding the sugarcane genome, said the science was quickly developing to allow growers to tap into the commercial opportunities in renewables.

Above: Professor Robert Henry is conducting the first gene-editing experiments to effectively produce biofuels and bioplastics.

"Australia's sugarcane growers are facing a falling sugar price — driven by declining world demand and increased competition in India and Brazil.

"The industry must look to the future," she said.

QAAFI researchers supported by the US Joint BioEnergy Institute and Sugar Research Australia through an Australian Research Council Linkage grant are testing a range of sugarcane varieties to identify which types produce ethanol most effectively and efficiently.

Researchers are also collaborating with the Indian Institute of Technology in Delhi to investigate processes that break down sugarcane fibre to make bioplastics.

"Drink bottles made from sugarcane bioplastics are just one product on the agenda from this collaboration," Professor Henry said.

"Economics is the key. Now that we understand more about the genetics of sugarcane, these sorts of products are becoming commercially realistic."

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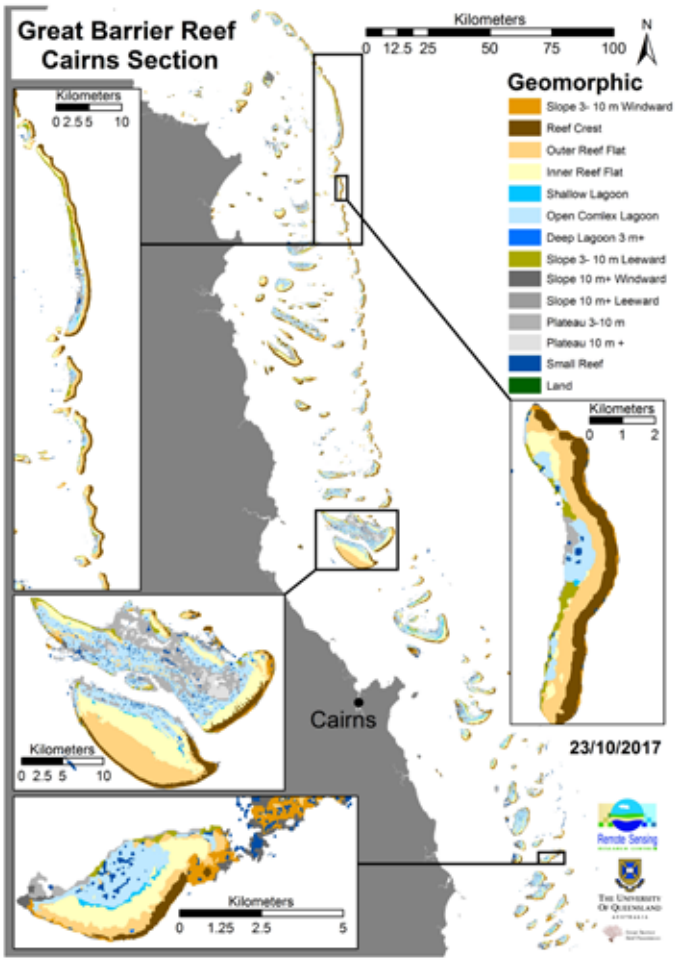
Remote sensing – key to modern environmental management

The remote sensing teams' skills are in high demand across state and federal agencies, helping them to measure the effectiveness of environmental management policy decisions.



Great Barrier Reef geomorphic — one of the many observational data tools used to measure and monitor environmental changes.

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REMOTE sensing has evolved to become the tool-of-choice for environmental organisations around the world. UQ researchers **Professor Stuart Phinn**, **Dr Chris Roelfsema** and **Dr Peter Scarth** lead a cross-disciplinary team of scientists who specialise in measuring and monitoring environmental changes using earth observation data.

Their teams' skills are in high demand across local, state and federal agencies, private industry and NGOs helping them to measure the effectiveness of environmental management decisions.

By being at the forefront of the scientific methods used to measure and monitor environmental changes, the **Joint Remote Sensing Research Program** assists Australian government agencies in keeping pace with rapid changes in remote sensing technology.

Their methods and research to operational program underpins the use of satellite data in legislated mapping and monitoring programs in multiple states and territories, as well as leading national development and coordination of earth observation through Earth Observation Australia.

As professor of Geography at UQ, Stuart Phinn teaches remote sensing and directs the **Remote Sensing Research Centre**, which includes programs to support government agencies across Australia (Joint Remote Sensing Research Program) and enabling coordination across all government, industry and research groups collecting and using EO data (Earth Observation Australia).

The majority of Dr Scarth's work uses images collected from satellite and aircraft, in combination with field measurements, to map and monitor the Earth's environments and how they are changing over time. This work is done in collaboration with other environmental scientists, government environmental management agencies, NGO's and private companies.

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Drought fodder crop takes centre stage

A FAST-GROWING legume could become a viable feed option for drought-affected cattle farmers in Australia's north.

Associate Professor Max Shelton, from UQ's School of Agriculture and Food Sciences, said leucaena legume (*Leucaena leucocephala*) offers a profitable and environmentally-sustainable option for cattle producers in dry, tropical regions.

"*Leucaena* addresses the main problem with achieving high quality range-fed beef in the tropics — it supplies high-quality protein when cattle need it most, in the dry season, or during a drought such as we're having now," he said.

"There are substantial establishment costs, but it's a profitable long-term investment with few risks, so in trying times like this, it's an amazing fodder crop."

Leucaena has been widely adopted in northern Australia and other tropical countries in the past 20 years, and has been the subject of considerable research.

This long-term data has helped address environmental concerns about the widespread use of the legume in farming.

"Many environmentalists view the legume as a potential weed threat, as there's already a lot of weed *leucaena* along coastal Queensland," Dr Shelton said.

"The evidence shows that it didn't come from graziers' paddocks."

"In fact, there are environmental benefits, as *leucaena* is very effective at reducing methane emissions and sequestering carbon."

"That's just another reason why planting *leucaena* is the most productive, profitable and sustainable long-term strategy for pasture improvement for the northern Australian beef industry."

A young steer grazing 'Redlands', a new leucaena crop resistant to both drought and the psyllid pest

Super clones to conquer coconut crisis

AGEING coconut palm trees could be replaced quickly and cheaply by superior cloned coconuts being developed by University of Queensland researchers.

PhD student Eveline Kong, from the Cocobio Laboratory at UQ's School Of Agriculture and Food Sciences, said the project would help avoid a coconut shortage caused by old coconut palms becoming less productive each year.

"Hype for coconut products used as dairy alternatives, for coconut oil or snacks is driving exponential growth in the market," Ms Kong said.

"However, the industry faces a looming shortage as most trees were planted 70 or more years ago and every year these older plants produce fewer and fewer coconuts."

She said rough estimates suggested that nearly a billion new trees need to be planted to meet rising demand.

"The problem is that conventional breeding – from seed – takes a long time and it's hard to breed palms with specific characteristics.

"So to keep up with market demands we're developing coconut cloning, propagation and conservation techniques that are fast, economical and let us select desired traits.

"It should only take three years to turn a baby palm — a plantlet — into a fruit bearing tree, a dramatic improvement on traditional breeding methods that can take many years."

The team plans to clone coconut plantlets from 'mother' plants that are high yield, disease resistant and drought tolerant.

"We're not only aiding productivity, but also creating a more resilient, more nutritious coconut," Ms Kong said.

"We do this by taking a small piece of tissue from the mother plant and then growing it in culture, helping achieve high rates of coconut cell multiplication.

"Once the cells form into embryos, they're transferred to a platform containing nutrients and growth hormones this stimulates roots, stem and leaf production.

"From there it's a matter of planting, and then, voilà.

"These advances will bring great benefits to Australian farmers, as well as farmers from Pacific nations like Fiji, Samoa, Papua New Guinea, Vanuatu and Kiribati — so our research is truly protecting livelihoods around the globe."

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Research to improve management of agricultural pests and diseases in the Pacific

UNIVERSITY of Queensland researchers will develop a program to help improve the livelihoods of farmers in the Pacific islands by tackling problems caused by pests and crop diseases.

The program is the keystone of a five year project funded by a $4.4 million grant from The Australian Centre for International Agricultural Research.

Dr Michael Furlong, an applied entomologist from UQ's School of Biological Sciences, said developing sustainable solutions for farmers was vital.

"The project will work with Pacific island governments to promote biological control of insect pests as part of an overall approach to sustainable agriculture," he said.

"The production of high-value fruit and vegetable crops free from unsafe agrochemicals is a priority in many Pacific island countries.

"These chemicals can be expensive and often have adverse effects on the environment and human health.

"This grant gives us a real opportunity to help improve the livelihoods of farming families and their communities by significantly improving the ways in which crop pests and diseases are managed over the longer term."

The researchers will develop a regional 'Plant Health Clinic' program, which will train ministry and NGO extension staff to run clinics where farmers can have crop problems diagnosed and get advice on how to manage pests and diseases.

"This will increase the capacity of national ministries and help poor farmers deal with difficult production issues at a time when food security presents a serious problem," Dr Furlong said.

UQ will partner on the project with regional organisation, Pacific Community, the agriculture ministries of Fiji, Samoa, Solomon Islands and Tonga and the National Agricultural Research Institute in Papua New Guinea.

Above: Dr Michael Furlong. Talking with a farmer in Fiji about the problems associated with using pesticides.

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> "The project will work with Pacific island governments to promote biological control of insect pests as part of an overall approach to sustainable agriculture."
> **— Dr Michael Furlong**

A spider eats a pest insect in a crop that has not been sprayed with synthetic pesticide. These predators are also important biological control agents of pests.

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Against the grain: **soil constraints** holding back Australian wheat

A model developed by researchers at The University of Queensland could address soil problems that cost Australia's wheat producers almost $2 billion a year.

Dr Yash Dang, from UQ's School of Agriculture and Food Sciences, said the model measured the economic impact of soil problems and could help guide investment decisions on remediation and minimise productivity losses.

"Soil sodicity (too much sodium in the soil), salinity, acidity and alkalinity and compaction significantly affect grain production in Australia," he said.

"Each soil constraint has a different cause – with different treatment options – meaning that the management of each issue has different economic costs and opportunities."

The project used data from sources, including yield data based on previous work by CSIRO, ABS and analysis of remote sensing imagery, soil data from the National Soil Site Collation and climate data from the Scientific Information for Land Owners database.

Dr Thilak Mallawaarachchi, from UQ's School of Economics, said the team managed to isolate the real costs of some of the country's worst soil issues for wheat production.

"The results underlined the large impact of soil sodicity, affecting 68 per cent of Australia's wheat-cropping land and costing farmers $1.15 billion annually," he said.

"On top of that, we estimate that $380 million of our wheat crops are lost per year from soil acidity.

"We know how to address these issues – through traditional treatments like the application of gypsum and lime respectively – so we can use this data to find the best way to make re-mediation investments."

In a follow-up project, the team is looking to provide fine-scale information for landholders.

"We're building a software tool that can collate and summarise the relevant remote-sensing and soil data in a form that would be useful for individual farmers," Dr Dang said.

"The software tool, along with a soil kit, will help them identify consistently high or low-yielding areas of paddocks, and diagnose potential soil constraints that might be causing any production losses in their paddocks.

"We're hoping this work not only contributes towards ensuring greater profits for farmers, but also to better global food security."

The research was published in *Land Degradation and Development* (DOI: 10.1002/ldr.3130).

Funding for this project was provided by the Grains Research and Development Corporation.

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Research groups and centres

Integrative Legume Research Group

The Integrative Legume Research Group is an internationally renowned research network of plant scientists conducting cutting-edge research into legumes and other plant species.

Head-quartered at UQ, it has research affiliates in leading Australian and overseas laboratories.

We selected legumes (17,000 species are known – ranging from herbaceous, weeds, grain crops to large forest trees) as a focus because of their wide role in human and environmental well-being, their special ability to enter a nitrogen-fixing symbiosis with soil bacteria, and their broad scientific database in phytochemistry, genetics, genomics and physiology.

Our scientists aim to understand how plant cells communicate, grow and differentiate to attain specific physiological functions. Cutting-edge research into plant physiology, genetics, molecular and cell biology is providing fundamental insights into developing enhanced food production, agricultural sustainability, environmental quality and products for human health.

The original centre was established in 2003 with a grant from the Australian Research Council (ARC), combining researchers at the Australian National University, the University of Melbourne and the University of Newcastle. Substantial advances were attained. By the end of 2010, ARC central funding ceased, but ARC permitted the continuation of the centre within the Queensland node. Current funding is from competitive grants, UQ support and industrial partnerships as well as donations.

Population genomics of migration dynamics in brown planthopper

Brown planthopper is the most serious insect pest of rice – a key staple crop. Despite decades of research tracking this insect with traditional techniques the migration dynamics of this pest across China and southeast Asia have not been resolved. With his collaborators (insect ecologists) in China, Dr Hereward has been using whole-genome resequencing of natural populations of this pest to determine their migration dynamics. They have shown that southeast Asia is the main source of the annual migration into the temperate regions of China. Counter to previous studies – their genomics approach shows that the Philippines population is quite separate from the mainland populations and doesn't contribute to the migration. This explains why the Philippines population has high levels of insecticide resistance but the mainland population doesn't.

Herbicide resistance in agricultural weeds

Postdoctoral Research Fellow Dr James Hereward has sequenced the genomes (and gene expression) of two important agricultural weeds in Australia to understand how they have evolved resistance to the herbicide glyphosate, and then used population genetics to track how many times herbicide resistance has evolved and how it might spread through the agricultural landscape.

Using genetics to understand cryptic species of agricultural pests

Many of our serious agricultural pests look like one species, but when scientists investigate them using genetics they turn out to be more than one "cryptic species". This has important implications for the way we manage these pests and also how we set biosecurity priorities. Recently, one thrips' pest that Dr Hereward investigated turned out to have as many as seven cryptic species within it – three of which are present in Australia. This means that in Australia we have to approach this insect as three different pests – and that we also need to try to exclude the other four with biosecurity measures.

China Agricultural Economics Group

We've been involved in agricultural economics research in China since the mid-1980s. Our work focuses strongly on research into China's ruminant livestock industries and its western and pastoral regions, and covers:

- Grassland management
- Integrated crop livestock systems in Tibet and Gansu
- Industry policy and marketing in the cattle and beef, wool and wool textile, sheepmeat, cashmere and dairy industries.

In recent years, we've extended our research into neighbouring Asian countries, including Mongolia.

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Left: QAAFI Principal Research Fellow A/Professor RCN Rachaputi

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QAAFI

The **Centre for Crop Science** within UQ's Queensland Alliance for Agriculture and Food Innovation (QAAFI) conducts world-leading research targeting enhanced profitability and sustainability of cereal and legume cropping systems in tropical and sub-tropical environments. The centre pursues excellence in crop science at molecular, whole plant, and production system levels. QAAFI's integrated research capabilities include crop genetics, physiology, and modelling, along with soil science and weed biology.

Crop improvement

Integrated pre-breeding research programs delivering advanced lines to industry based on advanced genetics, phenotyping, bioinformatics, trait physiology and modelling.

- Germplasm development with structured populations, advanced phenotyping, and speed breeding in sorghum, barley, and wheat
- Traits delivering adaptation to water limited environments and resistance to pests and diseases
- Strong industry and international links

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Weed biology and management

Weed seed biology and weed ecology research targeting management of weed species

- Non-chemical and chemical control options to manage weeds in grain and cotton cropping systems
- Managing herbicide resistant – weeds
- Weed and seed physiology and biology

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Centre for Crop Science

Soil nutrition and health

Field and controlled environment research to support the development of agronomic practices and crop rotations that maintain healthy soils and sustainable farming systems.

- Developing fertility management strategies to maintain productive capacity of cropping soils.
- Exploring impacts of root systems on acquisition of water and nutrients
- Developing strategies for effective use of grain legumes in farming systems

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Grain crop physiology and modelling

Integrating crop science from the molecular to whole plant levels by linking experimentation with mathematical models of crop growth and development

- Exploring the physiology and genetics of complex adaptive traits in field crops with a focus on water productivity
- Aiding crop management and design for enhanced production in water-limited environments• Evaluating the efficiency with which resources (radiation, water and nitrogen) are utilized by crop plants

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Farming systems

Integrating field experimentation, modelling tools, and socioeconomic data, to generate new science that supports decision-making for economic, environmental, and social outcomes

- Designing farming systems better able to deal with production, climate and market risks
- Working with farmers to reduce yield gaps, manage risks, and enhance resilience and sustainability of production systems

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Centre for Horticultural Science

QAAFI

The **Centre for Horticultural Science** within UQ's Queensland Alliance for Agriculture and Food Innovation (QAAFI) delivers improvements to productivity, profitability and sustainability of horticulture industries.
Our world-class researchers drive innovation and industry adoption to increase the competitiveness of Australia's horticultural industries globally. We work in close collaboration with government, industry and growers to boost innovation, productivity and economic growth.

Plant protection

Detection and identification of diseases in tropical horticulture and develop integrated disease management practices to reduce crop losses, improve productivity and ensure product quality.

- Detection and identification of emerging and exotic pests and pathogens
- Diagnostic capability for tropical plant diseases
- Disease management in avocado, banana, citrus, macadamia.
- Phenotyping germplasm for disease resistance
- Fruit quality

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Emerging technologies

Innovative, cross–disciplinary platform technologies to impact productivity, environmental sustainability and economic growth of the horticulture sector.

- Nanotechnology for crop protection — BioClay platform
- Novel plant propagation technologies
- Germplasm conservation
- Genomics, gene editing and modelling for crop improvement

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Horticulture crop breeding and agronomy

Improving the productivity and quality of horticultural crops through application of genetics and genomics in selection and breeding, integrated with orchard agronomy.

- Conservation and genetic improvement of horticultural crops
- Sub-tropical and tropical fruit tree crop breeding and improvement
- Rootstock evaluation and selection to improve productivity
- Improving orchard production systems

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Maximising the **economic benefits** of agriculture

UQ is well endowed with researchers who work to boost the economic benefits of agriculture. The complexities of trade policy, commercialisation and financial modelling are but some of the many high-level challenges behind shifting agricultural products from farm to fork.

The pace, scale and complexity of global trade and finance have rapidly evolved over the past 60 years, placing enormous pressure on governments, policy-makers and industry. Similarly, the threats faced by countries and societies have changed dramatically in recent years with cyber attacks and threats to climate, energy and water security now a feature of contemporary policy debate.

- **Professor Brad Sherman** works across many aspects of intellectual property law, with a particular emphasis on its historical, doctrinal and conceptual development. He is also interested in the role of intellectual property in relation to food security.
- **Associate Professor Damian Hine** works on business model innovation for community businesses to make them more attractive to impact investors. His research interests are built on the impact of innovation and innovations for businesses, communities and industries. He has worked with fisheries, the pearl industry, horticulture and tourism across the Asia-Pacific region.
- **Dr Kiah Smith** is an early career sociologist in the fields of environment and development, with a focus on agrifood political and cultural economy. Her research focuses on understanding the transformation of local and global food systems in light of shifting social relations and global environmental change, and emphasises the social and political-economic factors underpinning the ways that food production, trade and consumption are understood and contested by multiple actors (farmers, women, supermarkets, policy makers, activists) at local, national and global levels.
- **Professor Karen Hussey** and her colleagues are assessing the major challenges that Australian and European negotiators face in tackling the agricultural trade barriers between the two trading partners. The work is informed by statistical analysis of the current trading relationship; interviews with key industry peak bodies and government departments; analysis of previous FTAs involving Australia and the EU; submissions to government enquiries; and the peer-reviewed academic literature.

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Using population genetics and **genomics** to better understand insect pests and **weeds**

UQ researchers are using population genetics and genomics to improve our understanding of insect pests and weeds (both agricultural and environmental).

One group is using population genetics to see how different populations are connected by movement, and to determine how many species might be present in an agricultural pest (many agricultural pests look like one species, but using genetics we often find that they are actually several species that look the same — this is important for control and biosecurity).

Genomics helps us to understand how insects and plants evolve resistance to chemical control measures.

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The brown planthopper, a serious threat to rice crops in south-east Asia

Herbicide resistance in agricultural weeds

Postdoctoral Research Fellow Dr James Hereward has sequenced the genomes (and gene expression) of two important agricultural weeds in Australia to understand how they have evolved resistance to the herbicide glyphosate, and then used population genetics to track how many times herbicide resistance has evolved and how it might spread through the agricultural landscape.

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Outstanding record of publication

Consistently ranked among Australia's leading agriculture research institutions, UQ makes a strong and lasting contribution to published scientific literature in areas such as agriculture, land and farm management, animal production, crop and pasture production, fisheries sciences, forestry sciences, horticultural production, and veterinary sciences.

During the period 2017–2019, UQ researchers published more than 816 first-quartile papers in these disciplines (field of research code 07).
Below we showcase 118 publications, all in the global top 5% of their subject area.*

AUTHORS	YEAR	TITLE	PUBLICATION
Giakoumi, S., Pey, A.	2017	Assessing the effects of marine protected areas on biological invasions: A global review	Frontiers in Marine Science
Cowie, A.L., Orr, B.J., Castillo Sanchez, V.M., Chasek, P., Crossman, N.D., Erlewein, A., Louwagie, G., Maron, M., Metternicht, G.I., Minelli, S., Tengberg, A.E., Walter, S., Welton, S.	2018	Land in balance: The scientific conceptual framework for Land Degradation Neutrality	Environmental Science and Policy
Reeves, R.D., Baker, A.J.M., Jaffré, T., Erskine, P.D., Echevarria, G., van der Ent, A.	2018	Taxonomy of the order Mononegavirales: update 2018	Archives of Virology
Reeves, R.D., Baker, A.J.M., Jaffré, T., Erskine, P.D., Echevarria, G., van der Ent, A.	2018	A global database for plants that hyperaccumulate metal and metalloid trace elements	New Phytologist
Yang, F., Zhang, M., Bhandari, B., Liu, Y.	2018	Investigation on lemon juice gel as food material for 3D printing and optimization of printing parameters	LWT - Food Science and Technology
Venter, O., Magrach, A., Outram, N., Klein, C.J., Possingham, H.P., Di Marco, M., Watson, J.E.M.	2018	Bias in protected-area location and its effects on long-term aspirations of biodiversity conventions	Conservation Biology

(*Categorised under FoR code 07 published in journals ranked according to CiteScore)

AUTHORS	YEAR	TITLE	PUBLICATION
Amarasinghe, G.K., Bào, Y., Basler, C.F., Bavari, S., Beer, M., Bejerman, N., Blasdell, K.R., Bochnowski, A., Briese, T., Bukreyev, A., Calisher, C.H., Chandran, K., Collins, P.L., Dietzgen, R.G., et al.	2017	Taxonomy of the order Mononegavirales: update 2017	Archives of Virology
Maes, P., Alkhovsky, S.V., Bào, Y., Beer, M., Birkhead, M., Briese, T., Buchmeier, M.J., Calisher, C.H., Charrel, R.N., Choi, I.R., Clegg, C.S., de la Torre, J.C., Delwart, E., DeRisi, J.L., Di Bello, P.L., et al.	2018	Taxonomy of the family Arenaviridae and the order Bunyavirales: update 2018	Archives of Virology
Krupovic, M., Blomberg, J., Coffin, J.M., Dasgupta, I., Fan, H., Geering, A.D., Gifford, R., Harrach, B., Hull, R., Johnson, W., Kreuze, J.F., Lindemann, D., Llorens, C., Lockhart, et al.	2018	Ortervirales: New virus order unifying five families of reverse-transcribing viruses	Journal of Virology
van Eeuwijk, F.A., Bustos-Korts, D., Millet, E.J., Boer, M.P., Kruijer, W., Thompson, A., Malosetti, M., Iwata, H., Quiroz, R., Kuppe, C., Muller, O., Blazakis, K.N., Yu, K., Tardieu, F., Chapman, S.C.	2018	Modelling strategies for assessing and increasing the effectiveness of new phenotyping techniques in plant breeding	Plant Science
Alamery, S., Tirnaz, S., Bayer, P., Tollenaere, R., Chaloub, B., Edwards, D., Batley, J.	2018	Genome-wide identification and comparative analysis of NBS-LRR resistance genes in Brassica napus	Crop and Pasture Science
Salazar, G., Mills, M., Veríssimo, D.	2018	Qualitative impact evaluation of a social marketing campaign for conservation	Conservation Biology
Dhital, S., Warren, F.J., Butterworth, P.J., Ellis, P.R., Gidley, M.J.	2017	Mechanisms of starch digestion by α-amylase—Structural basis for kinetic properties	Critical Reviews in Food Science and Nutrition

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AUTHORS	YEAR	TITLE	PUBLICATION
Meier, A.D., de Laat, M.A., Reiche, D.B., Pollitt, C.C., Walsh, D.M., McGree, J.M., Sillence, M.N.	2018	The oral glucose test predicts laminitis risk in ponies fed a diet high in nonstructural carbohydrates	Domestic Animal Endocrinology
Ledo, A., Paul, K.I., Burslem, D.F.R.P., Ewel, J.J., Barton, C., Battaglia, M., Brooksbank, K., Carter, J., Eid, T.H., England, J.R., Fitzgerald, A., Jonson, et al.	2018	Tree size and climatic water deficit control root to shoot ratio in individual trees globally	New Phytologist
Gaydon, D.S., Balwinder-Singh, , Wang, E., Poulton, P.L., Ahmad, B., Ahmed, F., Akhter, S., Ali, I., Amarasingha, R., Chaki, A.K., Chen, C., Choudhury, B.U., Darai, R., Das, A., Hochman, Z., Horan, et al.	2017	Evaluation of the APSIM model in cropping systems of Asia	Field Crops Research
Septevani, A.A., Evans, D.A.C., Annamalai, P.K., Martin, D.J.	2017	The use of cellulose nanocrystals to enhance the thermal insulation properties and sustainability of rigid polyurethane foam	Industrial Crops and Products
Padayachee, A., Day, L., Howell, K., Gidley, M.J.	2017	Complexity and health functionality of plant cell wall fibers from fruits and vegetables	Critical Reviews in Food Science and Nutrition
Ching, S.H., Bansal, N., Bhandari, B.	2017	Alginate gel particles–A review of production techniques and physical properties	Critical Reviews in Food Science and Nutrition
Schläppy, M.-L., Loder, J., Salmond, J., Lea, A., Dean, A.J., Roelfsema, C.M.	2017	Making waves: Marine citizen science for impact	Frontiers in Marine Science
Shefferson, R.P., Jones, O.R., Salguero-Gómez, R.	2017	Introduction: Wilting leaves and rotting branches: Reconciling evolutionary perspectives on senescence	The Evolution of Senescence in the Tree of Life
Downes, S., Kriticos, D., Parry, H., Paull, C., Schellhorn, N., Zalucki, M.P.	2017	A perspective on management of Helicoverpa armigera: transgenic Bt cotton, IPM, and landscapes	Pest Management Science
Hoegh-Guldberg, O., Poloczanska, E.S.	2017	Editorial: The effect of climate change across ocean regions	Frontiers in Marine Science

AUTHORS	YEAR	TITLE	PUBLICATION
Dyer, E.E., Cassey, P., Redding, D.W., Collen, B., Franks, V., Gaston, K.J., Jones, K.E., Kark, S., Orme, C.D.L., Blackburn, T.M. et al.	2017	The Global Distribution and Drivers of Alien Bird Species Richness	PLoS Biology
	2018	ICTV virus taxonomy profile: Rhabdoviridae	Journal of General Virology
Martin, S.B., Cutmore, S.C., Cribb, T.H.	2018	Revision of Podocotyloides Yamaguti, 1934 (Digenea: Opecoelidae), resurrection of Pedunculacetabulum Yamaguti, 1934 and the naming of a cryptic opecoelid species	Systematic Parasitology
Adamescu, G.S., Plumptre, A.J., Abernethy, K.A., Polansky, L., Bush, E.R., Chapman, C.A., Shoo, L.P., Fayolle, A., Janmaat, K.R.L., Robbins, M.M., Ndangalasi, H.J., Cordeiro, N.J., Gilby, I.C., Wittig, R.M., Breuer, T., et al.	2018	Annual cycles are the most common reproductive strategy in African tropical tree communities	Biotropica
Law, E.A., Bennett, N.J., Ives, C.D., Friedman, R., Davis, K.J., Archibald, C., Wilson, K.A.	2018	Equity trade-offs in conservation decision making	Conservation Biology
Camp, E.F., Schoepf, V., Mumby, P.J., Suggett, D.J.	2018	Editorial: The future of coral reefs subject to rapid climate change: Lessons from natural extreme environments	Frontiers in Marine Science
Rehman, S., Shahzad, B., Bajwa, A.A., Hussain, S., Rehman, A., Cheema, S.A., Abbas, T., Ali, A., Shah, L., Adkins, S., Li, P.	2018	Utilizing the Allelopathic Potential of Brassica Species for Sustainable Crop Production: A Review	Journal of Plant Growth Regulation
Sarker, J.R., Singh, B.P., Dougherty, W.J., Fang, Y., Badgery, W., Hoyle, F.C., Dalal, R.C., Cowie, A.L.	2018	Impact of agricultural management practices on the nutrient supply potential of soil organic matter under long-term farming systems	Soil and Tillage Research

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Nouvian, M., Mandal, S., Jamme, C., Claudianos, C., D'Ettorre, P., Reinhard, J., Barron, A.B., Giurfa, M.	2018	Cooperative defence operates by social modulation of biogenic amine levels in the honey bee brain	Proceedings of the Royal Society B: Biological Sciences
Radanielson, A.M., Angeles, O., Li, T., Ismail, A.M., Gaydon, D.S.	2017	Corrigendum to "Describing the physiological responses of different rice genotypes to salt stress using sigmoid and piecewise linear functions" (Field Crops Research (2017) (S0378429017307578)(10.1016/j.fcr.2017.05.001)	Field Crops Research
Bertin, F.R., de Laat, M.A.	2017	The diagnosis of equine insulin dysregulation	Equine Veterinary Journal
Dern, K., van Eps, A., Wittum, T., Watts, M., Pollitt, C., Belknap, J.	2018	Effect of Continuous Digital Hypothermia on Lamellar Inflammatory Signaling When Applied at a Clinically-Relevant Timepoint in the Oligofructose Laminitis Model	Journal of Veterinary Internal Medicine
Blackall, P.J., Soriano-Vargas, E.	2017	Infectious Coryza and Related Bacterial Infections	Diseases of Poultry: Thirteenth Edition
Duan, T., Chapman, S.C., Guo, Y., Zheng, B.	2017	Dynamic monitoring of NDVI in wheat agronomy and breeding trials using an unmanned aerial vehicle	Field Crops Research
Hannapel, D.J., Sharma, P., Lin, T., Banerjee, A.K.	2017	The multiple signals that control tuber formation	Plant Physiology
Sejian, V., Kumar, D., Gaughan, J.B., Naqvi, S.M.K.	2017	Effect of multiple environmental stressors on the adaptive capability of Malpura rams based on physiological responses in a semi-arid tropical environment	Journal of Veterinary Behavior
Vaughan, D.B., Grutter, A.S., Costello, M.J., Hutson, K.S.	2017	Cleaner fishes and shrimp diversity and a re-evaluation of cleaning symbioses	Fish and Fisheries
Hoegh-Guldberg, O., Poloczanska, E.S., Skirving, W., Dove, S.	2017	Coral reef ecosystems under climate change and ocean acidification	Frontiers in Marine Science
Biggs, D., Cooney, R., Roe, D., Dublin, H.T., Allan, J.R., Challender, D.W.S., Skinner, D.	2017	Developing a theory of change for a community-based response to illegal wildlife trade	Conservation Biology

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AUTHORS	YEAR	TITLE	PUBLICATION
Davies, T.G., Rahman, I.A., Lautenschlager, S., Cunningham, J.A., Asher, R.J., Barrett, P.M., Bates, K.T., Bengtson, S., Benson, R.B.J., Boyer, D.M., Braga, J., Bright, J.A., Claessens, L.P.A.M., Cox, P.G., Dong, X.-P., et al.	2017	Open data and digital morphology	Proceedings of the Royal Society B: Biological Sciences
Allan, J.R., Venter, O., Maxwell, S., Bertzky, B., Jones, K., Shi, Y., Watson, J.E.M.	2017	Recent increases in human pressure and forest loss threaten many Natural World Heritage Sites	Biological Conservation
McMeekin, C.H., Hill, K.E., Gibson, I.R., Bridges, J.P., Benschop, J.	2017	Antimicrobial resistance patterns of bacteria isolated from canine urinary samples submitted to a New Zealand veterinary diagnostic laboratory between 2005–2012	New Zealand Veterinary Journal
Łebkowska-Wieruszewska, B., Barsotti, G., Lisowski, A., Gazzano, A., Owen, H., Giorgi, M.	2017	Pharmacokinetics and estimated bioavailability of grapiprant, a novel selective prostaglandin E2receptor antagonist, after oral administration in fasted and fed dogs	New Zealand Veterinary Journal
Gilliham, M., Chapman, S., Martin, L., Jose, S., Bastow, R.	2017	The case for evidence-based policy to support stress-resilient cropping systems	Food and Energy Security
Montes De Oca-Jimenez, R., Vega-Sanchez, V., Morales-Erasto, V., Salgado-Miranda, C., Blackall, P.J., Soriano-Vargas, E.	2018	Phylogenetic relationship of Ornithobacterium rhinotracheale strains	Journal of Veterinary Medical Science
Schmid, J., Lange, D., Sjöström, J., Brandon, D., Klippel, M., Frangi, A.	2018	The use of furnace tests to describe real fires of timber structures	WCTE 2018 - World Conference on Timber Engineering
Solarte, A., Hidalgo, J.P., Torero, J.L.	2018	Flammability studies for the design of fire-safe bamboo structures	WCTE 2018 - World Conference on Timber Engineering
Li, H., Rasheed, A., Hickey, L.T., He, Z.	2018	Fast-Forwarding Genetic Gain	Trends in Plant Science

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AUTHORS	YEAR	TITLE	PUBLICATION
Risely, A., Waite, D.W., Ujvari, B., Hoye, B.J., Klaassen, M.	2018	Active migration is associated with specific and consistent changes to gut microbiota in Calidris shorebirds	Journal of Animal Ecology
Gao, W., Xu, F.-C., Guo, D.-D., Zhao, J.-R., Liu, J., Guo, Y.-W., Singh, P.K., Ma, X.-N., Long, L., Botella, J.R., Song, C.-P.	2018	Calcium-dependent protein kinases in cotton: Insights into early plant responses to salt stress	BMC Plant Biology
Chittarath, K., Mostert, D., Crew, K.S., Viljoen, A., Kong, G., Molina, A.B., Thomas, J.E.	2018	First report of Fusarium oxysporum f. Sp. Cubense tropical race 4 (VCG 01213/16) associated with cavendish bananas in laos	Plant Disease
Czislowski, E., Fraser-Smith, S., Zander, M., O'Neill, W.T., Meldrum, R.A., Tran-Nguyen, L.T.T., Batley, J., Aitken, E.A.B.	2018	Investigation of the diversity of effector genes in the banana pathogen, Fusarium oxysporum f. sp. cubense, reveals evidence of horizontal gene transfer	Molecular Plant Pathology
Stewart, J.E., Ross-Davis, A.L., Graça, R.N., Alfenas, A.C., Peever, T.L., Hanna, J.W., Uchida, J.Y., Hauff, R.D., Kadooka, C.Y., Kim, M.-S., Cannon, P.G., Namba, S., Simeto, S., Pérez, C.A., Rayamajhi, M.B., Lodge, D.J., Arguedas, M., Medel-Ortiz, R., López-Ramirez, M.A., Tennant, P., Glen, M., Machado, P.S., McTaggart, A.R., Carnegie, A.J., Klopfenstein, N.B.	2018	Genetic diversity of the myrtle rust pathogen (Austropuccinia psidii) in the Americas and Hawaii: Global implications for invasive threat assessments	Forest Pathology
Stanisic, D.I., McCarthy, J.S., Good, M.F.	2018	Controlled human malaria infection: Applications, advances, and challenges	Infection and Immunity
Hu, P., Chapman, S.C., Wang, X., Potgieter, A., Duan, T., Jordan, D., Guo, Y., Zheng, B.	2018	Estimation of plant height using a high throughput phenotyping platform based on unmanned aerial vehicle and self-calibration: Example for sorghum breeding	European Journal of Agronomy
Hayes, M.H.B., Swift, R.S.	2018	An appreciation of the contribution of Frank Stevenson to the advancement of studies of soil organic matter and humic substances	Journal of Soils and Sediments

AUTHORS	YEAR	TITLE	PUBLICATION
Stouffer, D.B., Wainwright, C.E., Flanagan, T., Mayfield, M.M.	2018	Cyclic population dynamics and density-dependent intransitivity as pathways to coexistence between co-occurring annual plants	Journal of Ecology
Syed Ab Rahman, S.F., Singh, E., Pieterse, C.M.J., Schenk, P.M.	2018	Emerging microbial biocontrol strategies for plant pathogens	Plant Science
Di Franco, A., Plass-Johnson, J.G., Di Lorenzo, M., Meola, B., Claudet, J., Gaines, S.D., García-Charton, J.A., Giakoumi, S., Grorud-Colvert, K., Hackradt, C.W., Micheli, F., Guidetti, P.	2018	Linking home ranges to protected area size: The case study of the Mediterranean Sea	Biological Conservation
Bajwa, A.A., Chauhan, B.S., Adkins, S.W.	2018	Germination Ecology of Two Australian Biotypes of Ragweed Parthenium (Parthenium hysterophorus) Relates to Their Invasiveness	Weed Science
Akçakaya, H.R., Bennett, E.L., Brooks, T.M., Grace, M.K., Heath, A., Hedges, S., Hilton-Taylor, C., Hoffmann, M., Keith, D.A., Long, B., Mallon, D.P., Meijaard, E., Milner-Gulland, E.J., Rodrigues, A.S.L., Rodriguez, J.P., Stephenson, P.J., Stuart, S.N., Young, R.P.	2018	Quantifying species recovery and conservation success to develop an IUCN Green List of Species	Conservation Biology
Gissi, E., McGowan, J., Venier, C., Carlo, D.D., Musco, F., Menegon, S., Mackelworth, P., Agardy, T., Possingham, H.	2018	Addressing transboundary conservation challenges through marine spatial prioritization	Conservation Biology
Boakes, E.H., Isaac, N.J.B., Fuller, R.A., Mace, G.M., McGowan, P.J.K.	2018	Examining the relationship between local extinction risk and position in range	Conservation Biology

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AUTHORS	YEAR	TITLE	PUBLICATION
Geyle, H.M., Woinarski, J.C.Z., Baker, G.B., Dickman, C.R., Dutson, G., Fisher, D.O., Ford, H., Holdsworth, M., Jones, M.E., Kutt, A., Legge, S., Leiper, I., Loyn, R., Murphy, B.P., Menkhorst, P., Reside, A.E., Ritchie, E.G., Roberts, F.E., Tingley, R., Garnett, S.T.	2018	Quantifying extinction risk and forecasting the number of impending Australian bird and mammal extinctions	Pacific Conservation Biology
Lindenmayer, D.B., Crane, M., Evans, M.C., Maron, M., Gibbons, P., Bekessy, S., Blanchard, W.	2017	The anatomy of a failed offset	Biological Conservation
Fanson, K.V., Best, E.C., Bunce, A., Fanson, B.G., Hogan, L.A., Keeley, T., Narayan, E.J., Palme, R., Parrott, M.L., Sharp, T.M., Skogvold, K., Tuthill, L., Webster, K.N., Bashaw, M.	2017	One size does not fit all: Monitoring faecal glucocorticoid metabolites in marsupials	General and Comparative Endocrinology
Hardefeldt, L.Y., Holloway, S., Trott, D.J., Shipstone, M., Barrs, V.R., Malik, R., Burrows, M., Armstrong, S., Browning, G.F., Stevenson, M.	2017	Antimicrobial Prescribing in Dogs and Cats in Australia: Results of the Australasian Infectious Disease Advisory Panel Survey	Journal of Veterinary Internal Medicine
Powell, J.J., Carere, J., Fitzgerald, T.L., Stiller, J., Covarelli, L., Xu, Q., Gubler, F., Colgrave, M.L., Gardiner, D.M., Manners, J.M., Henry, R.J., Kazan, K.	2017	The Fusarium crown rot pathogen Fusarium pseudograminearum triggers a suite of transcriptional and metabolic changes in bread wheat (Triticum aestivum L.)	Annals of Botany
Sow, L.C., Peh, Y.R., Pekerti, B.N., Fu, C., Bansal, N., Yang, H.	2017	Nanostructural analysis and textural modification of tilapia fish gelatin affected by gellan and calcium chloride addition	LWT - Food Science and Technology
Yang, F., Zhang, M., Bhandari, B.	2017	Recent development in 3D food printing	Critical Reviews in Food Science and Nutrition

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Rigolot, C., de Voil, P., Douxchamps, S., Prestwidge, D., Van Wijk, M., Thornton, P.K., Rodriguez, D., Henderson, B., Medina, D., Herrero, M.	2017	Interactions between intervention packages, climatic risk, climate change and food security in mixed crop–livestock systems in Burkina Faso	Agricultural Systems
Dietzgen, R.G., Kondo, H., Goodin, M.M., Kurath, G., Vasilakis, N.	2017	The family Rhabdoviridae: mono- and bipartite negative-sense RNA viruses with diverse genome organization and common evolutionary origins	Virus Research
Comeau, S., Tambutté, E., Carpenter, R.C., Edmunds, P.J., Evensen, N.R., Allemand, D., Ferrier-Pagès, C., Tambutté, S., Venn, A.A.	2017	Coral calcifying fluid pH is modulated by seawater carbonate chemistry not solely seawater pH	Proceedings of the Royal Society B: Biological Sciences
Rodriguez-Valle, M., Moolhuijzen, P., Barrero, R.A., Ong, C.T., Busch, G., Karbanowicz, T., Booth, M., Clark, R., Koehbach, J., Ijaz, H., Broady, K., Agnew, K., Knowles, A.G., Bellgard, M.I., Tabor, A.E.	2018	Transcriptome and toxin family analysis of the paralysis tick, Ixodes holocyclus	International Journal for Parasitology
Radanielson, A.M., Gaydon, D.S., Li, T., Angeles, O., Roth, C.H.	2018	Modeling salinity effect on rice growth and grain yield with ORYZA v3 and APSIM-Oryza	European Journal of Agronomy
Cameron, N.L., Carnegie, A.J., Wardlaw, T., Lawson, S., Venn, T.	2018	Economic appraisal of Sirex Wood Wasp (Sirex noctilio) control in Australian pine plantations	Australian Forestry
Lawson, S.A., Carnegie, A.J., Cameron, N., Wardlaw, T., Venn, T.J.	2018	Risk of exotic pests to the Australian forest industry	Australian Forestry
Sultan, S., Huma, N., Butt, M.S., Aleem, M., Abbas, M.	2018	Therapeutic potential of dairy bioactive peptides: A contemporary perspective	Critical Reviews in Food Science and Nutrition

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Mortensen, B., Danielson, B., Harpole, W.S., Alberti, J., Arnillas, C.A., Biederman, L., Borer, E.T., Cadotte, M.W., Dwyer, J.M., Hagenah, N., Hautier, Y., Peri, P.L., Seabloom, E.W.	2018	Herbivores safeguard plant diversity by reducing variability in dominance	Journal of Ecology
Giorgi, M., Łebkowska-Wieruszewska, B., Lisowski, A., Owen, H., Poapolathep, A., Kim, T.W., De Vito, V.	2018	Pharmacokinetic profiles of the active metamizole metabolites after four different routes of administration in healthy dogs	Journal of Veterinary Pharmacology and Therapeutics
Hearn, A.J., Cushman, S.A., Goossens, B., Macdonald, E., Ross, J., Hunter, L.T.B., Abram, N.K., Macdonald, D.W.	2018	Evaluating scenarios of landscape change for Sunda clouded leopard connectivity in a human dominated landscape	Biological Conservation
Hulse, L.S., Hickey, D., Mitchell, J.M., Beagley, K.W., Ellis, W., Johnston, S.D.	2018	Development and application of two multiplex real-time PCR assays for detection and speciation of bacterial pathogens in the koala	Journal of Veterinary Diagnostic Investigation
Karbanowicz, T.P., Nouwens, A., Tabor, A.E., Rodriguez-Valle, M.	2018	Comparison of protein gut samples from Rhipicephalus spp. Using a crude and an innovative preparation method for proteome analysis	Veterinary Sciences
Schibrowski, M.L., Barnes, T.S., Wawegama, N.K., Vance, M.E., Markham, P.F., Mansell, P.D., Marenda, M.S., Kanci, A., Perez-Casal, J., Browning, G.F., Gibson, J.S., Mahony, T.J.	2018	The performance of three immune assays to assess the serological status of cattle experimentally exposed to Mycoplasma bovis	Veterinary Sciences
Meler, E., Berent, A.C., Weisse, C., Dunn, M.	2018	Treatment of congenital distal ureteral orifice stenosis by endoscopic laser ablation in dogs: 16 cases (2010–2014)	Journal of the American Veterinary Medical Association
Turni, C., Singh, R., Blackall, P.J.	2018	Genotypic diversity of Pasteurella multocida isolates from pigs and poultry in Australia	Australian Veterinary Journal
Herne, M.C., Tait, A.M., Weisbecker, V., Hall, M., Nair, J.P., Cleeland, M., Salisbury, S.W.	2018	A new small-bodied ornithopod (Dinosauria, Ornithischia) from a deep, high-energy Early Cretaceous river of the Australian-Antarctic rift system	PeerJ

AUTHORS	YEAR	TITLE	PUBLICATION
Burivalova, Z., Towsey, M., Boucher, T., Truskinger, A., Apelis, C., Roe, P., Game, E.T.	2018	Using soundscapes to detect variable degrees of human influence on tropical forests in Papua New Guinea	Conservation Biology
Carrera Pacheco, S.E., Hankamer, B., Oey, M.	2018	Optimising light conditions increases recombinant protein production in Chlamydomonas reinhardtii chloroplasts	Algal Research
Sardana, V., Mahajan, G., Jabran, K., Chauhan, B.S.	2017	Role of competition in managing weeds: An introduction to the special issue	Crop Protection
Thierfelder, C., Chivenge, P., Mupangwa, W., Rosenstock, T.S., Lamanna, C., Eyre, J.X.	2017	How climate-smart is conservation agriculture (CA)? – its potential to deliver on adaptation, mitigation and productivity on smallholder farms in southern Africa	Food Security
Bokhorst, S., Kardol, P., Bellingham, P.J., Kooyman, R.M., Richardson, S.J., Schmidt, S., Wardle, D.A.	2017	Responses of communities of soil organisms and plants to soil aging at two contrasting long-term chronosequences	Soil Biology and Biochemistry
Garner, J.B., Douglas, M., Williams, S.R.O., Wales, W.J., Marett, L.C., DIgiacomo, K., Leury, B.J., Hayes, B.J.	2017	Responses of dairy cows to short-term heat stress in controlled-climate chambers	Animal Production Science
Ledezma, P., Jermakka, J., Keller, J., Freguia, S.	2017	Recovering Nitrogen as a Solid without Chemical Dosing: Bio-Electroconcentration for Recovery of Nutrients from Urine	Environmental Science and Technology Letters
Wenger, A.S., Harvey, E., Wilson, S., Rawson, C., Newman, S.J., Clarke, D., Saunders, B.J., Browne, N., Travers, M.J., Mcilwain, J.L., Erftemeijer, P.L.A., Hobbs, J.-P.A., Mclean, D., Depczynski, M., Evans, R.D.	2017	A critical analysis of the direct effects of dredging on fish	Fish and Fisheries
Primack, R.B., Maron, M., Campos-Arceiz, A.	2017	Who are our reviewers and how do they review? The profile and work of Biological Conservation reviewers	Biological Conservation

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Woinarski, J.C.Z., Murphy, B.P., Legge, S.M., Garnett, S.T., Lawes, M.J., Comer, S., Dickman, C.R., Doherty, T.S., Edwards, G., Nankivell, A., Paton, D., Palmer, R., Woolley, L.A.	2017	How many birds are killed by cats in Australia?	Biological Conservation
McHugh, L., Andrews, R.M., Lambert, S.B., Viney, K.A., Wood, N., Perrett, K.P., Marshall, H.S., Richmond, P., O'Grady, K.-A.F.	2017	Birth outcomes for Australian mother-infant pairs who received an influenza vaccine during pregnancy, 2012–2014: The FluMum study	Vaccine
Dwyer, J.M., Laughlin, D.C.	2017	Selection on trait combinations along environmental gradients	Journal of Vegetation Science
Kazan, K., Gardiner, D.M.	2018	Fusarium crown rot caused by Fusarium pseudograminearum in cereal crops: recent progress and future prospects	Molecular Plant Pathology
Almughlliq, F.B., Koh, Y.Q., Peiris, H.N., Vaswani, K., McDougall, S., Graham, E.M., Burke, C.R., Arachchige, B.J., Reed, S., Mitchell, M.D.	2018	Proteomic content of circulating exosomes in dairy cows with or without uterine infection	Theriogenology
Tulloch, V.J.D., Plagányi, É.E., Matear, R., Brown, C.J., Richardson, A.J.	2018	Ecosystem modelling to quantify the impact of historical whaling on Southern Hemisphere baleen whales	Fish and Fisheries
Woinarski, J.C.Z., Garnett, S.T., Legge, S.M., Lindenmayer, D.B.	2017	The contribution of policy, law, management, research, and advocacy failings to the recent extinctions of three Australian vertebrate species	Conservation Biology
Pang, Z., Deeth, H., Yang, H., Prakash, S., Bansal, N.	2017	Evaluation of tilapia skin gelatin as a mammalian gelatin replacer in acid milk gels and low-fat stirred yogurt	Journal of Dairy Science
Doneley, B., Monks, D., Johnson, R., Carmel, B.	2017	Preface	Reptile Medicine and Surgery in Clinical Practice
Marx, W., Ried, K., McCarthy, A.L., Vitetta, L., Sali, A., McKavanagh, D., Isenring, L.	2017	Ginger—Mechanism of action in chemotherapy-induced nausea and vomiting: A review	Critical Reviews in Food Science and Nutrition

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Krueck, N.C., Ahmadia, G.N., Green, A., Jones, G.P., Possingham, H.P., Riginos, C., Treml, E.A., Mumby, P.J.	2017	Incorporating larval dispersal into MPA design for both conservation and fisheries	Ecological Applications
Aaskov, J.G., Doherty, R.L.	2017	Arboviral zoonoses of Australasia	Handbook of Zoonoses, Second Edition, Section B: Viral Zoonoses
Demczuk, W., Sidhu, S., Unemo, M., Whiley, D.M., Allen, V.G., Dillon, J.R., Cole, M., Seah, C., Trembizki, E., Trees, D.L., Kersh, E.N., Abrams, A.J., De Vries, H.J.C., Van Dam, A.P., Medina, I., Bharat, A., Mulvey, M.R., Van Domselaar, G., Martin, I.	2017	Neisseria gonorrhoeae sequence typing for antimicrobial resistance, a novel antimicrobial resistance multilocus typing scheme for tracking global dissemination of N. Gonorrhoeae strains	Journal of Clinical Microbiology
Hock, K., Wolff, N.H., Ortiz, J.C., Condie, S.A., Anthony, K.R.N., Blackwell, P.G., Mumby, P.J.	2017	Connectivity and systemic resilience of the Great Barrier Reef	PLoS Biology
Charlton Hume, H.K., Lua, L.H.L.	2017	Platform technologies for modern vaccine manufacturing	Vaccine
Degeling, C., Fawcett, A., Collins, T., Hazel, S., Johnson, J., Lloyd, J., Phillips, C.J.C., Stafford, K., Tzioumis, V., McGreevy, P.	2017	Students' opinions on welfare and ethics issues for companion animals in Australian and New Zealand veterinary schools	Australian Veterinary Journal
Dudley, N., Attwood, S.J., Goulson, D., Jarvis, D., Bharucha, Z.P., Pretty, J.	2017	How should conservationists respond to pesticides as a driver of biodiversity loss in agroecosystems?	Biological Conservation
Haynes, R.J.	2017	The nature of biogenic Si and its potential role in Si supply in agricultural soils	Agriculture, Ecosystems and Environment
Negret, P.J., Allan, J., Braczkowski, A., Maron, M., Watson, J.E.M.	2017	Need for conservation planning in postconflict Colombia	Conservation Biology

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Approved funding 2017–2019

Entity	Count of RM	2017	2018	2019
Queensland Alliance for Agriculture and Food Innovation	41	$26,513,186	$32,267,527	$27,676,923
Science	21	$5,778,776	$6,743,432	$7,063,536
Engineering, Architecture and Information Technology	4	$220,364	$937,129	$1,598,457
Australian Institute for Bioengineering and Nanotechnology	1	$198,000		$683,000
Institute for Molecular Bioscience	1	$448,561	$461,273	$503,315
Totals	68	$33,158,886	$40,409,361	$37,525,230

(The difference in total projects is the result of querying by 'funding year' rather than by 'active in year')

Parameters:
- (Include Research Grants Only)
- AND (Research Active In Year In List { 2017; 2018; 2019 })
- AND (Total Amount Approved Greater than or Equal to 1000000)
- AND (Success Indicator In List Yes)
- AND (ClassificationType In List FOR-08)
- AND (Classification Code In List)

{070501; 070602; 079901; 070403; 070899; 070701; 070603; 070105; 071200; 070709; 079999; 070100; 070507; 070305; 070302; 070799; 070703; 070711; 070699; 070303; 070400; 070900; 071304; 070901; 070308; 070207; 070299; 070107; 071001; 070600; 070102; 070704; 070706; 070199; 070707; 070300; 070604; 071299; 070712; 070710; 070800; 070307; 070200; 071000; 071005; 070205; 070508; 071399; 071400; 070505; 070402; 070301; 071300; 071403; 070401; 071104; 070203; 070101; 070499; 070404; 070702; 070601; 070700; 070599; 070204; 070708; 070304; 071004; 070503; 079900; 079902; 070405; 070000; 071102; 071099; 070509; 070108; 070206; 070705; 070106; 070399; 070605; 070801; 070903; 071402; 070500; 070502; 070202; 070103; 070504; 070510; 070306; 070201; 070104; 071401; 071101; 070999}

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