Research Institute for the Environment and Livelihoods

ANNUAL REPORT 2025



CHARLES DARWIN UNIVERSITY AUSTRALIA

RIEL
Research Institute for the Environment and Livelihoods

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Charles Darwin University and the Research Institute for the Environment and Livelihoods acknowledge the Traditional Custodians across the lands and waters on which we live and work. We acknowledge First Nations peoples' long tradition of sustaining communities and the environment over tens of thousands of years. First Nations peoples are the first educators and first innovators and the holders of knowledge that contributes to the improvement of local, national, and global communities. We extend our respects to Elders past and present, and to all First Nations peoples.



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Cover: Bartalumba Bay on Groote Eylandt in the Northern Territory is seen from above. Groote Aqua Aboriginal Corporation manages 50,000 blacklip oysters on long-lines in Bartalumba Bay. Most days are spent tending oysters and keeping an eye out for crocodiles, but other days involve sending up a drone to uncover the hidden scenery around the 'office'. This image was the winner of the RIEL Photo Competition 2025. Photo: Valentin Thépot.

Inner front cover: A flock of galahs gathers on a dead gidgee tree at Pilungah Reserve on the Queensland–Northern Territory border. This image was shortlisted in the RIEL Photo Competition 2025. Photo: Maddison Stuart.

CRICOS Provider No. 00300K | RTO Provider No. 0373 | TEQSA Provider ID PRV12069

Message from the Director

RIEL's research partnerships continued to grow in 2025, supporting environmental management, biodiversity conservation and sustainable livelihoods across northern Australia and our region.

Several major new projects got underway during the year. These included an environmental monitoring program for the Beetaloo region with the Northern Territory Government, and the Australian Research Council-funded 'How safe are island havens for biodiversity?' project, working with the Northern Land Council, NT Government, Tiwi Resources, Larrakia Nation Aboriginal Corporation, ranger groups and Traditional Owners to map and help manage the biodiversity values of NT islands. We also launched the Macroderma Initiative, bringing together government agencies, mining companies, non-government organisations and researchers to improve the knowledge needed for conservation of the ghost bat.

Our partnerships continued to extend internationally, including through exchanges with Dhimurru Aboriginal Corporation and partners in the Philippines, and the International Savanna Fire Management Initiative which brought delegates from Botswana, Mozambique, Zambia, Indonesia and Papua New Guinea to CDU. A project supported under the National Foundation for Australia-China Relations project facilitated exchanges with Hainan University and Shantou University and has fostered ongoing research and research training partnerships between the institutions.

A particular highlight was the completion of 20 MRes and PhDs during the year, reflecting RIEL's major commitment to research training. Honours students Emma-Louise Daly and James Pike were awarded Chancellor's Medals for their research, and overall there were 6 honours completions in 2025.

Our researchers continued to produce research with national and international impact, including Dr Keller Kopf and colleagues' work in *Science* highlighting the importance of conserving old and wise animals and the ecological functions they provide, which you can read more about in the research impact section of this report, alongside case studies on using drones and AI to detect ghost nets, and a new application that is improving gamba grass management.

In the research performance section we showcase some of the many publications released over the year, including on greenhouse gas emissions from tropical freshwater ecosystems, guidance to help science-based decisions about groundwater resources, and a paper on women's experiences of recreational fishing that is part of an upcoming special collection of *Maritime Studies* highlighting marine and coastal livelihoods in northern Australia.

RIEL researchers, students and partners received recognition through numerous awards during the year, including the Ecological Society of Australia, NT Natural Resource Management, and Radicle Science awards, along with the Vice Chancellor's long service awards where Prof Karen Gibb was recognised for 35 years at CDU, Prof Stephen Garnett for 20 years, Matt Northwood and Dr Peter Kyne for 15 years, and Jay Evans, Assoc Prof Kamal Sangha and Dr Teigan Cremona for 10 years.

Finally, toward the end of the year we prepared for RIEL's five-yearly review and re-accreditation in early 2026. I thank all our staff, students, adjuncts and partners for their contributions to that process, and for the research, training and partnerships it reflected.



Photo: Kane Chenoweth

Professor Sam Banks

Director, Research Institute for the Environment and Livelihoods

Charles Darwin University

Who are we?

RIEL sits within Charles Darwin University's (CDU) Faculty of Science and Technology (FST), based in the Northern Territory (NT) of Australia.

RIEL conducts research across tropical, semi-arid and arid regions, and with the communities that rely on these environments. The institute is recognised both nationally and globally as a leader in tropical environmental research.

RIEL comprises academic staff, professional staff, higher degree by research (HDR) candidates, honours students, and adjunct and honorary members. Together, RIEL researchers are working to preserve environments and biodiversity across northern Australia and the near Asia-Pacific.

RIEL's work contributes to environmental policy, planning, and sustainable management, in collaboration with partners and based on robust scientific evidence.

319 members

137 staff

- RIEL had 137 staff members in 2025.
- RIEL hosts research-focused academics who work on externally funded programs, as well as teaching-focused academics from CDU's Environment discipline. Academic staff contribute to significant research projects, offer consultancy services, supervise HDR and honours students, and teach into undergraduate courses. RIEL has a small number of professional staff who provide operational and technical supports to researchers and projects. RIEL also offers casual staff roles for short one-off projects or longer-term work; many casual staff also hold other roles within the university, such as students completing coursework or research degrees.
- This number includes 80 fixed and continuing staff, of whom 68 were academic staff and 12 were professional staff, down from 86 the previous year.
- This also includes 57 casual staff, of whom 35 were academics and 22 were professionals, up from 56 in the previous year.

96 student researchers

- RIEL supported 96 students in 2025, the same total as the previous year.
- RIEL's student members are enrolled at CDU through FST. They are supported by RIEL in their research and are supervised by at least one RIEL academic staff member.
- This figure included 85 HDR candidates working on Doctor of Philosophy (PhD) or Master by Research (MRes) projects, and 11 honours students.

86 adjunct members

- RIEL had a total of 86 adjunct and honorary members in 2025, up from 80 the previous year.
- Adjunct and honorary members are affiliated with RIEL and contribute to RIEL research, while also often holding positions in sectors such as government, non-government organisations, and other research organisations.
- This includes 82 adjunct members from external organisations, and 4 honorary members from other faculties of CDU.

Alongside their work and study, RIEL members held roles on important committees and groups within the institute in 2025:

- RIEL's Gender Equity and Inclusion Committee, which works to improve equity and inclusion among all RIEL members and offers workshops and gatherings, marks key inclusion dates, and advocates for students and staff across the institute.
- RIEL's Assets Committee, which coordinates the maintenance, repair and replacement of assets such as vessels, vehicles and equipment that are critical for field work and laboratory work.
- RIEL's Boat Committee, which manages the compliance and usage of RIEL's research vessels that are essential resources for marine and freshwater researchers. This committee did not sit in 2025 but remains an important group and will be reinvigorated in the future.
- The RIEL & Co Postgraduate Society, which is led by a team of HDR students and enhances the postgraduate experience by running regular social events and providing a network for students.

Where do we work?

RIEL researchers work across northern and central Australia, the near Asia-Pacific region — with long-standing relationships in Timor-Leste and Indonesia, and growing partnerships in India and China — and beyond.

A majority of researchers are based at CDU's Casuarina campus on Larrakia Country in Garramilla/Darwin and at CDU's campus on Arrernte Country in Mparntwe/Alice Springs, while other researchers are based remotely.

Many RIEL projects are closely connected with First Nations partners and are undertaken in collaboration with Traditional Owners and First Nations community members.

While RIEL's research is concentrated in northern and central Australia, projects occurred all around the Northern Territory, Queensland, Australian Capital Territory, South Australia, and Western Australia in 2025, including in:

- Adelaide River, NT
- Ali Curung, NT
- Alice Springs, NT
- Arnhem Land, NT
- Beetaloo Basin, NT
- Brisbane, QLD
- Cairns, QLD
- Canberra, ACT
- Central Australia region, NT
- Coffin Bay, SA
- Daly River, NT
- Darwin, NT
- Dry River, NT
- Far North Queensland region, QLD
- Gove region, NT
- Groote Eylandt, NT
- Gulf of Carpentaria, NT and QLD
- Kakadu, NT
- Katherine, NT
- Kimberley region, WA
- Kununurra, WA
- Lower Burdekin Delta, QLD
- Mary River, QLD
- Mutitjulu, NT
- Pilbara region, WA
- Pine Creek, NT
- Pudakul, NT
- Sturt Plains, NT
- Tiwi Islands, NT
- Townsville, NT
- Western Top End region, NT

RIEL has a presence around the world, with a strong focus on China, India, Indonesia, and Timor-Leste, with researchers and projects located in:

- Argentina
- Austria
- Belgium
- Brazil
- China
- Colombia
- Costa Rica
- Germany
- Hong Kong
- India
- Indonesia
- Ireland
- Kenya
- Netherlands
- New Zealand
- Norway
- Philippines
- Sweden
- Timor-Leste
- United States
- United Kingdom
- Vanuatu
- Viet Nam

Research performance

Research income in 2025



$40.7 million

in active projects in 2025, up from $37 million the previous year.

The total included **$7.2 million** in funding for new projects in 2025, and **$8.3 million** in Higher Education Research Data Collection (HERDC) income.

Some of the major projects funded in 2025 included:

- **$1.4 million** from the NT Department of Lands, Planning and Environment for the first phase of the project 'Development and implementation of a regional monitoring program for the Beetaloo region', led by Prof Alan Andersen, Prof Sam Banks, Assoc Prof Dylan Irvine, Prof Maxine Piggott, Dr Erica Garcia, Dr Richard Crabbe, and Cameron Yates.
- **$1.27 million** for the Terrestrial Ecosystem Research Network (TERN) 'Litchfield Savanna Supersite, NT (2024–2028)' facility, led by Prof Lindsay Hutley, Dr Stefan Maier, and Matthew Northwood, in partnership with James Cook University.
- **$255,497** from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) for the project 'Welfare and behaviour implications of virtual fencing in Northern beef cow-calf systems', led by Assoc Prof Beth Penrose and Prof Sunil Kadri.
- **$246,000** from the NT Department of Lands, Planning and Environment for the project 'Evaluating the use of eDNA methods to detect saltwater crocodiles in high-risk locations', led by Prof Maxine Piggott.

Publications in 2025

236 publications

involving RIEL authors in 2025, up from 167 in the previous year.

- **223** peer-reviewed articles, of which 159 were published in high-impact Q1 journals
- **6** books or book chapters
- **3** reports
- **4** articles on *The Conversation* academic journalism website

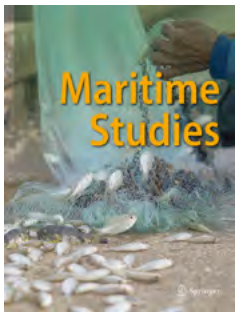
Some of the highlight publications included:



Duvert, C., Borges, A.V., Calamita, E., Rocher-Ros, G., Linkhorst, A., Rosentreter, J.A., Liu, S., Taillardat, P., Attermeyer, K., DelSontro, T., Deirmendjian, L., Dixon, A.A., Grasset, C., Herreid, A.M., Jeffrey, L.C., Marcon, L., Mwanake, R.M., Paranaíba, J.R., Ran, L., **Rexroade, A.T., Solano, V., Ulloa-Cedamanos, F.**, Wang, J., Whitmore, K.M., Zhang, L., López-Lloreda, C., Macedo, M.N., Oviedo-Vargas, D., Riveros-Iregui, D.A., Marzolf, N.S., 2025. Hydroclimate and landscape diversity drive highly variable greenhouse gas emissions from tropical and subtropical inland waters. *Nature Water* 3, 1303–1317. https://doi.org/10.1038/s44221-025-00522-8

Find out more

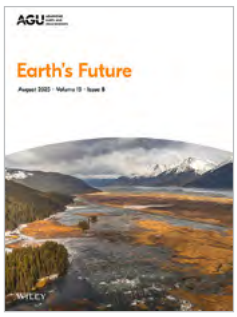
Freshwater ecosystems such as streams, rivers, lakes and reservoirs play an important but often overlooked role in the global carbon cycle. Much of the carbon stored in soils and vegetation does not stay on land, but is washed into freshwater systems, where it can be transformed and released to the atmosphere as greenhouse gases. This study, led by RIEL's Dr Clément Duvert, compiled a new global dataset of greenhouse gas emissions from tropical freshwater ecosystems. The results show that emissions vary widely across regions and are influenced by climate, landscape features, ecosystem productivity and human activities. Understanding these drivers is critical for managing freshwater systems and improving global carbon budgets.



House, J., 2025. "Reel Women" and "Secret Women's Business": women's recreational fishing in the Top End of the Northern Territory, Australia. *Maritime Studies* 24, 58. https://doi.org/10.1007/s40152-025-00448-7

Find out more

Australia's recreational fishing industry can provide significant health and wellbeing benefits for people of all genders. This study by RIEL researcher Dr Jenny House is the first to explore women's experiences of recreational fishing in the NT, which is the only Australian jurisdiction with gender parity in the recreational fishing participation rate (according to a national survey). While the NT's fishing culture is considered by many to be more inclusive, gendered barriers remain, such as limited visibility of female fishers in media and industry, and inequitable gender norms. The findings of the study may have implications beyond the NT, and could promote equitable access to the benefits of fishing and the outdoors for everyone.



Mourot, F.M., **Irvine, D.J.**, Remenyi, T.A., **Hutley, L.B.**, Crosbie, R.S., Moore, C.R., 2025. Producing Hydrological Projections Under Climate Change: A Groundwater-Inclusive Practical Guide. *Earth's Future* 13, e2025EF006316. https://doi.org/10.1029/2025EF006316

Find out more

With climate change projected to produce longer droughts, more intense floods and more erratic rainfall, it is necessary to prepare for a future where water resources will be less reliable. Led by RIEL PhD candidate and groundwater scientist Frédérique Mourot, this practical guide draws upon extensive scientific expertise and information to provide end-user focused recommendations. The guidance is helping to break down knowledge barriers and empower better-informed, science-based decisions about groundwater resources.

Students in 2025

96 enrolled students

- This included **85 HDR candidates**
  - **64** were domestic students
  - **21** were international students
  - **20** completed their MRes or PhD during the year
- The total also included **11 honours students**
  - **10** were domestic students
  - **1** was an international student
  - As scheduled, **6** completed their honours degrees during the year

MRes and PhD completions comprised:

- **Acacio Da Costa Guterres, PhD** — Fortified Biochar in a Cropping Sequence in Timor-Leste: Crop Responses, Economic Benefits, and Farmer Perceptions
- **Adrian Gurra, MRes** — Habitat preference and thermal ecology of geckos in Girraween National Park, south-east Queensland, Australia
- **Alexander Carey, PhD** — Spatial population dynamics of declining mammals in fire-prone landscapes
- **Andrew Caven, PhD** — Whooping Crane Ecology & Conservation in Remnant & Reintroduced Populations
- **Angga Rachmansah, PhD** — Responses of lizard assemblages to fire in an Australian savanna
- **Ellen Ryan-Colton, PhD** — Impacts of buffel grass (*Cenchrus ciliaris*) on plant and animal communities in an arid system
- **Ellen Rochelmeyer, PhD** — Hollows, Termites and Long-term Fire Regimes in Top End Tropical Savannas
- **Gavin Trewella, PhD** — Conservation ecology of the northern quoll (*Dasyurus hallucatus*) at Weipa
- **Hansi Alwis, PhD** — Green synthesis of metal nanoparticles using *Terminalia ferdinandiana* fruit and leaf extracts: characterization, molecular modelling and evaluation of their biological activities
- **Hayley Geyle, PhD** — Conservation ecology of the greater bilby
- **Julia Constance, PhD** — Movement Ecology and Natural Mortality of Threatened River Sharks: Informing Conservation Planning
- **Kade Skelton, PhD** — How Hydric & Thermal Physiological Traits of North Australian Dtellas Compare Across Species & Environments
- **Lucinda Middleton, PhD** — Have Mangroves Been Overlooked for their Potential to Support Gendered Food and Nutrition Security in Indonesia?
- **Mara Müller, PhD** — Integrating Individual-based Movement Information with Genetics to Better Understand the Drivers of Population Structure in Birds
- **Natalie Robson, PhD** — Foraging ecology, genetic connectivity and threat exposure of green turtles (*Chelonia mydas*) in the Northern Territory
- **Penelope Godwin, PhD** — Catchment Hydrology and Landcover in Karst Savannas: A Case Study in East Sumba, Indonesia
- **Rachel Murphy, MRes** — To what extent does prescribed burning leverage unburnt habitat in subsequent years in central Australian ecosystems?
- **Simon Votto, PhD** — Investigating factors that drive avian occurrence and assemblage structure at central Australian waterholes
- **Tegan Dedman, PhD** — Ecological Effects of Sea Level Rise on Freshwater Wetland Communities of the Wet-Dry Tropics of Australia
- **Vanessa Solano, PhD** — Carbon dynamics in a lowland headwater stream in the Australian wet-dry tropics

Honours completions were:

- **Amy Cook** — Hunting Enterococci: A Microbial Source Tracking Approach in Lake Alexander
- **Ella-Monique Mason** — Nest Temperature Effects in the Northern Territory Flatback (*Natator depressus*) and Olive Ridley (*Lepidochelys olivacea*) Turtles Populations
- **Joel Smith** — Adaptive management of groundwater resources: A review of recent adaptive strategies from Australia, North America and the Pacific
- **Noor Ul Ain Rashid** — Understanding Microbial Communities and Antimicrobial Resistant Genes in Environmental Samples from the Darwin region using Environmental DNA
- **Sam Amini** — O' brother where art thou: Stranded Critically Endangered Largetooth Sawfish (*Pristis pristis*) provide insights into habitat, ecology, and kinship
- **Samantha Connor** — How wind influences sheep behaviours in arid Australia

Research impact

RIEL's research continues to make impact every year. In 2025, of the many examples, this included shaping global policy to protect Earth's elder animals, detecting ghost nets using drones and artificial intelligence, and strategic management of gamba and other invasive grasses.

Longevity conservation: shaping global policy to protect Earth's elders

Across the world's oceans, forests and grasslands, the oldest and largest animals are disappearing fast, and with them the knowledge and ecological values that individuals have accumulated over decades.

In freshwater and ocean environments, the oldest age classes of fish have been depleted in many populations, and extremely old corals are being harvested and are irreplaceable within human lifespans. On land, poaching, trophy hunting, predator control and recreational harvests have contributed to the loss of older animals, compounded by habitat loss, disease, and extreme climate events.

These old individual animals often play critical ecological roles, contributing to population stability, ecosystem resilience, and knowledge transfer within species. There's a common assumption that once an animal has passed its reproductive peak, it contributes little to the future of its population. But for many long-lived species, the opposite is true.

Old individuals of long-lived species such as elephants and whales accumulate knowledge over long periods, which allows them to provide better care for offspring and 'grandoffspring'. In fish and other cold-blooded animals, older individuals generally continue to grow throughout their lives, increasing the number and individual survival of offspring they produce. Despite this, conservation policy has largely overlooked age structure, leaving a significant gap in biodiversity management.

RIEL's Dr Keller Kopf led a review published in the journal *Science* examining the ecological and socioeconomic consequences of losing older animals. The paper introduced the concept of 'longevity conservation', advocating for the protection of older individuals and the ecological processes that allow animals to survive to old age. The research proposed new frameworks for conservation policy and management that prioritise age diversity. The research was conducted with an interdisciplinary team from CDU including Prof Sam Banks, Dr Chris Jolly and Dr Osmar Luiz, alongside colleagues from the University of Exeter, Charles Sturt University, Macquarie University, the Amboseli Trust for Elephants in Kenya, the University of Stirling, and Texas A&M University.

The research directly informed International Union for Conservation of Nature (IUCN) Motion 113, submitted by five global IUCN members to formally recognise longevity conservation as a conservation principle. The motion was



A Rhesus macaque grooms a youngster. Research has found that older animals can play critical ecological roles, contributing to population stability and knowledge transfer within species. Photo: Lauren Brent.

debated at the IUCN World Conservation Congress 2025 in Abu Dhabi, involving more than 1,400 government, civil society and Indigenous member organisations, and was adopted with majority support across all voting categories.

Longevity conservation is now formally recognised within IUCN policy frameworks. The motion directs member states, agencies, and governments to develop research and monitoring frameworks and, where appropriate, implement strategies to protect old and large individuals across species, rather than species as a whole.

Government and conservation agencies now have a new evidence-based framework to guide wildlife and fisheries management, with anticipated benefits for fisheries and wildlife-dependent communities and, contingent on implementation, greater protection and resilience for wild animal populations. Motion 113's adoption aligns with international commitments, including the United Nations Sustainable Development Goals, the Kunming-Montreal Global Biodiversity Framework, and Australia's Threatened Species Strategy.

Implementation will require ongoing collaboration between scientists, governments, and conservation practitioners to translate the principle into effective conservation action globally.

Read the publication ▶



Louise Bruce launches a drone as part of training which is empowering teams to actively detect and respond to ghost nets across the Anindilyakwa Indigenous Protected Area in the NT. This work is strengthening on-Country capacity and building long-term monitoring skills. This image was shortlisted in the RIEL Photo Competition 2025. Photo: Aliesha Hvala.

A partnership to protect Sea Country: detecting ghost nets using drones and artificial intelligence

Northern Australia's coastlines are among the most remote and ecologically significant in the world. Yet, far from public view, they face a growing threat from tonnes of ghost nets and marine plastics washing ashore every year, entangling wildlife and damaging once-pristine coastal habitats. Responsibility for managing this pollution rests with Indigenous ranger groups, whose efforts are constrained by the vast distances, remoteness, and limited resources available for routine monitoring and retrieval.

To help address this challenge, researchers at the North Australia Centre for Autonomous Systems (NACAS), led by Prof Hamish Campbell and PhD candidate Aliesha Hvala, partnered with the Anindilyakwa Rangers to trial the use of drones and artificial intelligence (AI) to detect and map ghost nets, supporting the rangers' existing monitoring and retrieval efforts within the Anindilyakwa Indigenous Protected Area. The project was funded by the Australian Government's Ghost Nets Innovative Solutions Grants program, administered by Parks Australia.

The team developed a program that combined beyond visual line of sight (BVLOS) drone surveys with AI algorithms to identify ghost nets in the resulting high-resolution imagery. To date, 210 kilometres of coastline along Groote Eylandt have been surveyed, with 291 ghost nets detected, ranging from small fragments to nets more than five metres long. The geolocation data extracted from the images was then used to visualise net locations on Google Earth and in a global positioning system (GPS) navigation application, allowing the rangers to plan retrieval activities and travel directly to the targeted nets.

Alongside ghost net mapping, strengthening on-Country technical skills was a focus of the project. Two training programs were delivered using both fixed-wing and multi-rotor drones, including the Healthy Country Digital Training Program site survey using drones, and the nationally accredited Certificate III in Aviation (Remote Pilot) course. In total, 19 participants from the ranger team and the Anindilyakwa Land Council attended training. This hands-on approach was intended to support rangers in using drones to independently monitor Sea Country beyond the life of the ghost net project.

The drone survey program is set to expand in 2026 to include three additional Indigenous ranger groups, with new funding from the Australian Institute of Marine Science and the National Integrated Marine Observing System. As it transitions into a long-term monitoring program, the project's data will contribute to the National State of the Environment Report, extending its impact from local to national scale.

Reducing the threat: Supporting improved gamba grass management across northern Australia

Invasive grasses are one of the most significant threats to biodiversity across northern Australia, changing fire regimes, altering habitat structure, and threatening the cultural and tourism values of the landscapes they invade. Gamba grass is the most significant of these threats. It's now widespread across the NT and is spreading throughout Cape York.

The Australian Government's Threatened Species Action Plan 2022–2032 sets a target to reduce gamba grass to an area smaller than its 2022 range by 2027. Achieving this target depends on land managers being able to map the extent of the problem, and monitor management progress, at a landscape scale.

That mapping challenge is the focus of 'Supporting the strategic management of invasive grasses', a National Environmental Science Program (NESP) Resilient Landscapes Hub project co-led by RIEL's Dr Natalie Rossiter-Rachor and the University of Western Australia's Prof Samantha Setterfield. The project targets gamba grass, para grass, and olive hymenachne, and runs from 2023 to 2027. Working with the Terrestrial Ecosystem Research Network (TERN), the team has spent the past few years developing and testing a mobile data-capture application to be used for helicopter surveys of weed distribution, replacing an ageing, unreliable Access database system decommissioned in 2022.

The new mapping tool has moved well past the prototype stage. NT Parks now carry out annual gamba grass surveys in Litchfield National Park with support of the NESP researchers — a marked shift from the previous approach, where comprehensive surveys only happened when funding allowed, roughly every seven years, with gamba grass expanding by around 10,000 hectares during each period. The NT Weed Management Branch has also used the tool to map olive hymenachne across the Arafura Swamp in Arnhem Land. In total, testing and active use of the mapping tool has now covered an estimated 145,000 hectares.

Alongside the mapping app, Dr Rossiter-Rachor and Prof Setterfield have continued contributing to national best-practice guidance, authoring sections of the national gamba grass management manual and helping develop an aerial weed survey protocol so mangers can easily use the mapping tool. These protocols will be included in the Ecological Monitoring System Australia (EMSA), a national monitoring system developed by TERN with the Australian Government's Department of Climate Change, Energy, the Environment and Water. Because the mapping tool is built around Weeds of National Significance mapping categories, it isn't limited to gamba grass: it can be used for any weed identifiable from a helicopter, including mimosa and siam weed, extending its relevance well beyond the project's three focus invasive grass species.

The mapping app is expected to launch as part of the national EMSA suite in 2026. In 2027, training is planned to extend into Cape York, so land managers can carry out their own weed surveys using the same system. Together, these steps are shifting invasive grass management in northern Australia from sporadic, funding-dependent surveys toward the kind of continuous, manager-led monitoring needed to meet the national Threatened Species Action Plan target for gamba grass by 2027.

Prof Samantha Setterfield and Dr Natalie Rossiter-Rachor display aerial weed survey tablets at the Northern Land Council's ExtravaGAMBA training day in 2025. Photo: Emily Davis/NESP Resilient Landscapes Hub.





Cattle wear GPS collars at CDU's Katherine Rural Campus in Cossack, NT, as part of innovative research on virtual fencing. This image was shortlisted in the RIEL Photo Competition 2025. Photo: Beth Penrose.

Research themes and groups

At a broad level, RIEL's research is grouped into five key themes, each of which encompasses a diverse collection of research groups and projects.



Biodiversity and conservation

This strength covers the conservation and management of tropical and arid biodiversity, along with specialist environmental monitoring services and advice.



Communities and livelihoods

This area provides impact-orientated environmental and livelihoods research, and specialist advice on the development of rural agricultural and natural resource based enterprises.



Savanna and arid ecology

This work is focused on savanna burning and carbon, greenhouse gas emissions and land-use change, modelling carbon cycles, plant and animal adaptation, invasive species management and restoration ecology.



Water and catchments

This strength looks at surface and groundwater interactions, water quality assessments, aquatic ecology, threatened species conservation, pollution and source tracking.



Food production

This area of research encompasses work on agriculture, aquaculture, and food systems.



Centres and services

RIEL also hosts several key centres and services working in specific areas of environmental research.

RIEL members worked across 19 research groups in 2025, representing a practical structure below the broader research themes.

- Animal physiological ecology
- Applied plant ecology
- Arid-zone wildlife ecology and conservation
- Communities, livelihoods and natural resources
- Conservation and sustainable livelihoods
- Conservation genomics
- Cropping systems
- Ecosystem services
- Environmental chemistry
- Tropical plant and invasion ecology
- Freshwater, estuarine and marine ecology
- Landscape, water and carbon dynamics
- Northern shark and ray research group
- Remote sensing and Earth observation
- Sustainable pastoral systems
- Terrestrial invertebrates
- Top End hydrology
- Tropical aquaculture
- Tropical savanna ecology

Biodiversity and conservation

As one of RIEL's research themes, this area covers the conservation and management of tropical and arid biodiversity, along with specialist ecological monitoring services and advice.

Within this theme, RIEL researchers offer knowledge and advice on:

- Ecological monitoring and management
- Terrestrial ecology
- Fire ecology and management
- Animal movement and behaviour
- Threatened species conservation and management
- Conservation genetics
- Invasive plant and animal impacts and management
- Native vegetation restoration
- Post-mining restoration of ecosystem services
- Spatial planning and area-based management
- Invertebrate biodiversity and bio-indicators

RIEL's projects and opportunities in this area include:

- Aligning Australia's threatened species assessments with global standards
- Identifying major drivers of species threats and extinction risk, for improved management
- Improving conservation and management of threatened aquatic species
- Identifying and delineating important habitat for aquatic species
- Developing climate change adaptation strategies for threatened species
- Predicting ecological impacts of climate change on aquatic and terrestrial ecosystems in northern Australia and globally
- Understanding growth performance and physiological range of weed species for targeted management
- Rehabilitating mine sites
- Developing innovative technologies and analysis techniques to understand land use and climate change impacts on native flora and fauna
- Assessing biodiversity responses to fire management regimes
- Using ants as indicators of environmental change
- Understanding genetic diversity of threatened species and integrating genetics into conservation planning
- Metabarcoding of aquatic and terrestrial fauna
- Collaborating with First Nations ranger groups, development corporations, and Traditional Owners on a range of research projects



Dr Nicola Hanrahan measures the forearm length of a captured ghost bat, a routine measurement collected in bat research. Photo: Hannah Maddison-Harris.

Research highlight

The Macroderma Lab: uncovering the secret life of ghost bats

In northern Australia lives one of the country's most mysterious predators: the ghost bat, *Macroderma gigas*.

Since 2023, researchers Dr Nicola Hanrahan and Prof Sam Banks have been building a detailed picture of these carnivorous bats and their roosting and foraging habits to gain critical knowledge on how to protect the species as development pressures grow. The project was officially launched in July 2025 and is funded until 2028 through an Australian Research Council Linkage grant, in close collaboration with industry, government, and conservation groups.

Tagging work began in the Pine Creek region, and the team installed an automated antenna system in 2025 at the world's largest known ghost bat colony. This allows continuous tracking of individual bats without the stress of repeated handling. Genetic samples from every tagged bat are feeding into a growing library for future population studies, while partnerships with the Australian Government's Department of Climate Change, Energy, the Environment and Water in the Kimberley region and the South Endeavour Trust in North Queensland are extending this work into new, understudied regions.

Community engagement has been a key part of the project too, with events like the Casuarina Coastal Reserve Bioblitz bringing locals into the conservation effort. Dr Hanrahan also chairs the National Ghost Bat Recovery Team and led coordination of the 20th International Bat Research Conference in Cairns in August 2025, which drew more than 500 delegates from 58 countries.

Looking ahead, the Ghost Bat National Recovery Plan has now been finalised by the Western Australian Government's Department of Biodiversity, Conservation and Attractions, shaped closely by the recovery team's input. The project is also growing, with two PhD students, Bryony Hitchcock and Fernanda Gual-Suarez, set to join the team in 2026 to dig deeper into questions about ghost bat populations and habitats. Meanwhile, a full year of antenna-tag data is starting to reveal fascinating patterns when the bats emerge from and return to their roosts each season.

"This colony is one of the most significant strongholds we have for the species, so understanding exactly how the bats are using it is critical to their long-term persistence," Dr Hanrahan says.

"The antenna system lets us build a detailed picture of roosting behaviour there, and that picture becomes a reference point we can use to interpret what we're seeing at other, less-studied roost sites."

Communities and livelihoods

This research theme provides impact-orientated environmental and livelihoods research, and specialist advice for rural agricultural and natural resource-based enterprises. It aims to generate knowledge and applied solutions to key challenges in the tropics such as poverty, equity, wellbeing, food security, resource management, and improved livelihoods.

Within this area, researchers' specialist knowledge and advice covers:

- Natural resource-based enterprise development and sustainable livelihoods
- Gender, food security and marine-based livelihoods
- Ecosystem services and their role in human wellbeing, including ecosystem services concepts and valuation approaches, particularly from Indigenous perspectives
- Nature-based solutions including payments for ecosystem services, nature-based economies or nature repair opportunities
- Livelihood strategies in smallholder agricultural systems
- Participatory land and sea management and Indigenous and local knowledges
- Capacity building for natural resource management in terrestrial and marine environments
- Social impact assessment, qualitative and quantitative methodologies, socioeconomic surveys and participatory action research
- Program and policy review and evaluation
- Assessing alternative economic pathways, and related trade-offs
- Developing sustainable, economically feasible solutions for farming systems across northern Australia
- Involvement in United Nations-led and other global initiatives to highlight Indigenous peoples and local communities' perspectives and values of natural resource management

RIEL's work in this area includes:

- Supporting enterprises in aquaculture, fisheries, and plant production in the Arafura and Timor seas region of northern Australia, Indonesia, and Timor-Leste
- Farmer perspectives and practices to improve production of broadacre farming systems in the NT, and smallholder farming systems in Timor-Leste
- Working with First Nations communities to develop nature-based economic opportunities
- Working with First Nations communities to strengthen land and sea management outcomes
- Contributing to the sustainability of ecosystem services for the benefit of Indigenous communities and livelihoods in Australia and the Asia-Pacific
- Engaging with First Nations peoples and local communities to contribute to biodiversity conservation
- Encountering maritime northern Australia: perspectives on fisheries, Sea Country, and governance
- Towards improved livelihoods for Indonesian fishers in East Nusa Tenggara province, Indonesia
- Baselines for population assessment of long-lived marine animals and stakeholder trust and participation in sustainable fisheries of northern Australia
- Women in the seafood industry of the Northern Territory: participation, contribution and workforce attraction and retention
- Gendered livelihoods, vulnerability, and coping strategies of Sama-Bajo fishing communities in Southeast Sulawesi, Indonesia



A *perahu lambo* (sailing boat) and various hull types in Kampung Tanjung Pasir, Rote Island, East Nusa Tenggara, Indonesia. Photo: Dedi Supriadi Adhuri.

Research highlight

Beyond the border: why Indonesian fishers keep coming to Australian waters

Since the COVID-19 pandemic, Australian authorities have reported a sharp rise in Indonesian fishing boats entering Australian waters illegally, from only a handful of interceptions before 2020 to hundreds per year at the peak. For Prof Natasha Stacey and a team of Australian and Indonesian researchers, the key question was not only how many boats were crossing the border, but why.

Over two years, the Australian Centre for International Agricultural Research (ACIAR)-funded project 'Towards improved livelihoods for Indonesian fishers in East Nusa Tenggara Province' examined why Indonesian fishers enter Australian waters and what could change that. Led by Prof Stacey and Dr Kylie McKenna from RIEL, in partnership with researchers from Indonesia's National Research and Innovation Agency (BRIN) — co-led by Dr Dedi Adhuri and his team, including Dr Achmad Zamroni — and Nusa Cendana University, the team interviewed 211 people, including boat owners, captains, crew, traders and family members, across four fishing communities in Rote Ndao and Kupang in East Nusa Tenggara.

The research found that many factors contributed to illegal fishing, including: economic hardship, family and cultural traditions, pandemic-era shifts in enforcement, and a decades-old maritime agreement that has not delivered the promised alternative livelihoods. Although fishing in Australian waters is high risk, it remains one of the few reliable sources of income for many households in eastern Indonesia. The impacts also extend to families left behind, increasing debt and hardship for the women who sustain households during a fisher's absence.

The team's findings support a shift from one-off interventions to longer-term, community-designed livelihood programs that address these drivers directly, revisit outdated maritime agreements and involve women and young people alongside male fishing crews. The research, published in a final report by ACIAR and in the journal Maritime Studies, was presented earlier this year to the Australian Embassy and Indonesia's Ministry of Marine Affairs and Fisheries in Jakarta, where it helped inform discussions on future policy and livelihood support in the region.

The study was funded by the Australian Government through the ACIAR Social Systems Program project SSS/2022/117 'Towards improved livelihoods for Indonesian fishers in East Nusa Tenggara Province, Indonesia'. The views expressed in this story are the authors' alone and are not necessarily the views of the Australian Government.

Savanna and arid ecology

This work is focused on savanna and desert burning, plant and animal diversity and functional ecology, landscape ecology, carbon dynamics, water resources, genomics, invasive species management, and restoration ecology.

Within this research theme, RIEL focuses on:

- Amphibian and reptile ecology and physiology
- Arid zone ecology
- Animal movement and behaviour
- The use and impact of fire as a land management tool
- Invasive plant and animal impacts and management
- Native vegetation restoration
- Threatened species management
- Refugia and biodiversity
- Ant biodiversity and bioindicators
- Geospatial and Earth observation data analytics
- Monitoring groundwater dependant vegetation
- Carbon and water balance of tropical savanna

Research projects and opportunities in this area cover:

- Assessing ecosystem responses to changes in fire frequency, climate, and land use change
- Quantifying and modelling carbon and water cycles in north Australian ecosystems
- Researching environmental impacts and behavioural adaptations of invasive and feral animal and plant species
- Examining the impacts of deforestation on greenhouse gas emissions and water resources in northern Australia
- Investigating the restoration of ecosystems and ecosystem services following mining
- Physiological and behavioural adaptations of amphibians and reptiles to savanna and arid environments
- Implementing a world-first program for a savanna burning carbon industry in northern Australia
- Understanding the role of biodiversity hotspots and refuge ‘islands’ in a ‘sea’ of savanna
- Leveraging space technology and big data analytics for mapping and monitoring essential biodiversity variables
- Documenting undescribed ant megadiversity and using ants as indicators of restoration success
- Improving methods for detecting, mapping and monitoring groundwater-dependent ecosystems in semi-arid regions
- Long-term fire experiment at the Territory Wildlife Park
- Developing frameworks for culturally directed fire management in the spinifex deserts
- Understanding the response of mammals and reptiles to fire in the desert
- Reconstructing the outcomes of traditional fire practice on fire patterns using historical aerial photos
- Using remote sensing to map vegetation structure and understand its response to fire regimes in the pindan savanna
- Using remote sensing to map vegetation recovery after fire in the spinifex deserts
- Using remote sensing to monitor and assess impacts of climate change, fire, and groundwater use on groundwater-dependant ecosystems



RIEL's Dr Julia Constance (*left*) and Dr Erica Garcia undertake preliminary sampling of aquatic macro-invertebrates as part of the Beetaloo regional monitoring project. Photo: Francesco Ulloa-Cedamanos.

Research highlight

Monitoring the Beetaloo: tracking the environmental impacts of shale-gas development

The Beetaloo Sub-basin in the NT holds some of Australia's most prospective shale-gas reserves and, alongside that promise, there is widespread public concern over the potential environmental impacts of extraction.

Following the Pepper Inquiry into fracking in the NT, CDU was contracted by the NT Government to establish a long-term, regional-scale environmental monitoring program for the Beetaloo, complementing the site-level monitoring already required of gas companies around individual drill sites.

Led by Prof Alan Andersen, the five-year project, which began in April 2025, is developing cost-effective monitoring protocols using new technologies, including environmental DNA (eDNA) for aquatic biodiversity, acoustic recorders and drone-based surveillance for bird surveys, and satellite remote sensing of methane emissions, fire regimes and vegetation clearing.

"There is widespread public concern over potential environmental impacts of fracking, especially relating to water. This makes long-term environmental monitoring a critical component of shale-gas development," says Prof Andersen.

In its first year, the project established a Steering Committee and Management Team to guide governance.

Project operations are shaped by a Stakeholder Engagement Plan and an Indigenous Participation Strategy, which allow for the exchange of knowledge and for stakeholder input into which indicators are monitored and how. This reflects CDU's commitment to full consultation with all involved.

Preliminary investigations have already begun across the project's key environmental values. This has included pilot eDNA sampling, water-quality testing at four bores and a spring, and mapping 25 years of fire history using satellite data.

The work is being undertaken in collaboration with representatives of RIEL research groups focused on eDNA, hydrology, aquatic ecology, bushfires, and remote sensing.

Over the project's five-year life, this work will build a long-term monitoring program covering groundwater and surface water quality, aquatic biodiversity, water-dependent vegetation and bird communities, landscape fire regimes, vegetation clearing, and methane emissions across the broader Beetaloo region.

The project is funded by the NT Government.

Water and catchments

This theme looks at surface and groundwater interactions, water quality assessments, aquatic ecology, threatened species conservation, pollution and source tracking.

Using the latest technological advances, this research theme explores:

- Food web dynamics
- Water quality
- Microbiological and molecular analyses in aquatic environments
- Effect of human disturbance on aquatic ecosystems
- Catchment and groundwater processes
- Carbon and nutrient flux in riverine settings
- Wetland condition and health of groundwater dependent ecosystems
- Impacts of climate change on water resources
- Aquatic ecology and biodiversity
- Aquatic animal movement and behaviour
- Aquatic animal–microbe interactions

Some of the key projects and opportunities in this area include:

- Analysing atmospheric moisture sources, rainfall patterns, groundwater origin, and plant water usage
- Using environmental DNA to monitor aquatic species for strategic baseline assessment
- Assessing environmental water requirements for aquatic ecosystems and sustainable fisheries management
- Wetland condition assessment and biodiversity monitoring
- Advances in wetland monitoring using remote sensing and geospatial technologies
- Conservation and management of threatened aquatic fauna
- Using new technologies and methodologies for monitoring fish movement
- Predicting impacts of climate change on aquatic food webs, ecosystems, carbon dynamics, and nutrient cycling
- Defining the links between climate change and marine disease
- Conducting research on mangrove ecosystems, including restoration and carbon sequestration
- Informing conservation and management of threatened marine species, including sharks and rays
- Improving groundwater security through a citizen science project that enables people who depend on groundwater in northern Australia to record and share groundwater information
- Determining safety of aquatic foods in relation to effluent discharge
- Detection of cyanotoxins in wastewater targeting genes in synthesis pathways
- Detection of soil-transmitted parasitic worms in wastewater from remote communities
- The occurrence of opportunistic pathogens in drinking water
- Microbial source tracking in marine and freshwater systems
- Molecular detection/enumeration of faecal indicators
- Drinking water, bore water, and water tank microbiome
- Biofilm formation in drinking water distribution systems
- Spatial and temporal dynamics of frog–toad and reptile skin microbiomes in freshwater environments
- Spatial and temporal dynamics of fish microbiomes and parasite load in rivers
- Assessing the potential impact of climate change on groundwater recharge in northern Australia
- ‘Big data’ assessments of groundwater recharge across the Australian continent
- Investigating catchment residence time in tropical catchments
- Investigating groundwater recharge and informing conceptual models of arid zone hydrogeology
- Determining the amount of terrestrial carbon that leaks into rivers across Australia
- Refining the net carbon sequestration potential for Australia
- Assessing trends in concentrations of agricultural runoff in tropical rivers
- Numerical simulations of groundwater flow and transport, and groundwater–surface water interactions



Malak Malak rangers Aaron Green (*left to right*) and Bikihita (Vicky) Dora and PhD candidate Porni Mollick undertake a river bathymetry survey — measuring depth and mapping the riverbed — in the downstream reaches of the Daly River. Photo: Kaline de Mello.

Research highlight

Mapping how climate change is reshaping northern Australia's wetlands

Wetlands are shaped not only by how much water they receive, but by when, where and for how long that water connects across the landscape. Understanding how climate change and water extraction alter wetland–river connections is essential for protecting northern Australia's wetlands and informing sustainable water management.

PhD candidate Porni Mollick, supervised by Dr Kaline de Mello, Assoc Prof Dylan Irvine, and Dr Erica Garcia, is addressing this knowledge gap in the Daly River catchment region. Her research combines remote sensing, climate data, and hydrological modelling to track how wetlands have changed over nearly a decade. Using machine learning algorithms in Google Earth Engine, Porni has mapped wetland extent and type across the Daly River catchment from 2017 to 2025, integrating high-resolution Sentinel-2, Sentinel-1 (radar) imagery, LiDAR remote sensing technology, and Traditional Ecological Knowledges.

"Understanding when, where and how water connects our wetlands is essential if we want to protect them in a changing climate and with ongoing pressure for water extraction," says Ms Mollick.

Looking ahead, the project will forecast how future water extraction could alter hydrological connectivity in ecologically significant wetlands across the Daly River floodplain. These insights are expected to help inform water management policy for the region.

The project's significance has already been recognised, with RIEL in collaboration with Malak Malak Rangers winning the 'Research for NRM' category for this body of work at the 2025 NT Natural Resource Management Awards. This work has also been presented at three international conferences and two domestic seminars. Two co-authored papers have been published in high-impact Q1 journals, alongside a conference paper published as a book chapter. Five further research chapters or publications are anticipated as the project progresses toward completion in late 2026.

The research is supported by the Malak Malak Rangers through the Northern Land Council, the NT Government, the Cooperative Research Centre for Northern Australia (CRCNA), the Australian Government Research Training Program, and Espace-Dev, IRD Montpellier in France.

Food production

Through research projects and partnerships, RIEL leads and contributes to academic, industry, and government efforts to support growth and sustainable development in the food and agriculture sector.

This research covers broad areas of:

- Tropical aquaculture
- Tropical biosecurity
- Cropping systems
- Sustainable pastoral systems
- Native plant species

This research covers a wide range of projects, including:

- Commercial production from native plant species, including producing high-value culturally identified grain from native rice, fruits from Kakadu plum, and products from other species
- Efficient and effective management of native plant communities, including of native food species, such as rehabilitation of land disturbances ranging from large-scale mining rehabilitation to restoration of rainforest on small urban reserves
- Biology of native plant species, related to commercial species, or wild food species, with the aim to understand their ecology to manage their environment and promote their conservation
- Management of plants in agricultural systems in northern Australia and in Southeast Asia
- Knowledge sharing on bush foods, supporting communities in the NT and Timor-Leste to work together on Indigenous knowledge
- *Vibrio* ecology and shellfish safety
- Examination of individual differences within farmed populations and their implications for animal welfare, production and sustainability
- Deployment of specialist technologies for monitoring within farming systems
- Support of First Nations peoples' ambitions surrounding food security, employment and income generation in remote communities
- Using genomic approaches to investigate population structure and gene flow of disease vectors to understand disease entry and spread in northern Australia
- Improving environmental and biosecurity surveillance and monitoring using environmental DNA
- Understanding the risk of endemic species in tropical Australia as potential vectors and hosts for diseases
- Improved diagnostics and taxonomy for agricultural and environmental biosecurity
- Investigating how crops respond to climatic factors and variations in resource availability
- Exploring innovative approaches to enhance soil fertility and crop yields through carbon farming
- Pioneering the adoption of precision agriculture techniques and technologies to enhance the sustainability of horticultural farming systems
- Promoting the use of agricultural waste in the creation of new products
- Improving food system sustainability
- Understanding and optimising pasture systems, pasture agronomy, and plant nutrition
- Using on-animal technology to understand and control livestock grazing
- Improving animal health and welfare
- Understanding on-farm labour productivity in small-holder mixed farming systems in Timor-Leste
- Linking of soil and plant nutrition to human, animal, and environmental health



Waseem Ahmed shows oyster mushrooms freshly harvested from cotton trash substrate. Photo: Toga Napitupulu.

Research highlight

Turning cotton waste into new food

What if an agricultural by-product could become the foundation of a new local food industry?

As cotton production expands across the NT, thousands of tonnes of cotton gin trash are generated each year. Research Institute for Northern Agriculture (RINA) PhD researcher Waseem Ahmed is exploring how this locally available resource can be transformed from an underutilised agricultural residue into nutritious food through mushroom cultivation.

The research addresses two challenges simultaneously. Cotton trash — which can be made up of fragments of leaves, sticks, soil, and seeds — remains a largely untapped resource in Australia, while mushrooms sold in the NT are mainly transported thousands of kilometres from interstate before reaching local consumers.

"Instead of viewing cotton trash as a waste, I see it as a resource," says Mr Ahmed. "By converting it into nutritious mushrooms, we can connect agricultural waste management with local food production and create new opportunities for the NT."

By connecting waste, science, and food production, the project investigates a circular-economy pathway that could bring mushroom production closer to where the fungi are consumed.

Controlled cultivation trials have shown that cotton trash, alone or blended with other agricultural residues and nutritional supplements, can successfully support oyster mushroom production. In some trials, biological efficiency — a measure of mushroom yield relative to substrate weight — exceeded 100%, demonstrating strong potential.

This research points to an opportunity that goes beyond waste utilisation. It opens the door to local food production, reduced reliance on long-distance supply chains, and new regional enterprise opportunities, with broader economic, social, and environmental benefits for the NT. Two publications from the project have already been completed, with several more anticipated by 2027.

Centres and services

RIEL hosts a number of centres and services. While each of these groups stands alone, their research and impacts are also woven together with RIEL's work, and the institute is stronger for it.

Bioscience North Australia

Bioscience North Australia (BNA) conducts high-impact research and customised research consultancies that focus on detecting and interpreting microbiological threats in a complex world.

The team specialises in microbiological and molecular analyses in aquatic and terrestrial environments, including animal–microbe interactions, and analyses of sediment, water, and biota. This research supports shellfish food safety, safe drinking water and animal health, and uses microbial signatures to monitor the footprint of pollution in the environment.

The group, which is part of RIEL, is solution oriented, positive and supportive both within the team and in interactions with partners. In its research and research consultancy interactions, BNA provides customised research solutions and aims to be flexible, responsive, versatile, and adaptable in all interactions.

BNA's research topics include microbial DNA detection and diagnosis, emerging and opportunistic pathogens in water, sediment and shellfish, and monitoring impact.

www.cdu.edu.au/riel/consultancy-services/bioscience-north-australia

Darwin Centre for Bushfire Research

The Darwin Centre for Bushfire Research (DCBR), hosted by RIEL at CDU, delivers applied fire management research and training opportunities to land managers in northern Australia, Southeast Asia, Papua New Guinea, Africa, and South America.

The team combines field sampling, spatial analysis, and Indigenous knowledge to understand the ecological processes for improved fire management in tropical savannas and rangelands, whilst supporting a team of PhD, master, and honours researchers.

In past years, much of the applied research focused on the development of the science behind savanna burning and the development of methods for calculating greenhouse gas emissions reduction and carbon sequestration. More recently this work has been applied through collaborations with international partners.

The DCBR's major ongoing projects include advising the North Australia and Rangelands Fire Information (NAFI) service and maintaining the Savanna Monitoring and Evaluation Reporting Framework (SMERF) tool which provides detailed reports based on a large variety of significant fire metrics.

DCBR researchers also provide support to fire ecology-based programs, moderate and high-resolution fire mapping, vegetation and fire community mapping, thresholds analysis of fire modelling, alternative nature-based methods development, more general payment for ecosystem services economic/ecological analyses, and bushfire management planning.

The DCBR aims to extend fire management research and training opportunities to land managers across north Australia and to regional neighbours. While doing so, the team aims to maintain core commitments to current partners, especially on Indigenous and conservation lands.

www.bushfireresearch.org.au

North Australia and Rangelands Fire Information

The North Australia and Rangelands Fire Information (NAFI) service is a nationally significant fire information platform that supports land managers, government agencies, industry and researchers across Australia's savanna and rangeland regions.

Through free access to satellite-derived fire mapping, historical fire data spanning more than 25 years, and a suite of monitoring, reporting and analytical tools, NAFI enables users to monitor current fire activity, assess long-term fire patterns, and make informed land management decisions.

The service delivers accurate, timely and accessible fire data, along with fine-scale burnt area mapping and tailored training resources to meet the needs of individual properties, projects and regions. Covering approximately 80% of Australia and capturing around 97% of the nation's mapped fire extent, the service is a critical source of fire information and contributes to improved environmental outcomes, enhanced protection of people and assets, more sustainable land management practices, and economic benefits.

In 2025, the region recorded the second-largest fire season of the past decade, surpassed only by 2023. At the same time, the team modernised its software systems and launched a new version of the service, known as NAFI 4. The team expects the site to be fully operational in 2026. The current site will remain active until all tools have been successfully migrated to the new platform and users have had sufficient time to transition.

Building the capacity of land managers, researchers, and fire practitioners remains a core focus of NAFI's work. Throughout the year, support was delivered through in-person workshops, fine-scale mapping products, automated burnt area imagery services, and engagement at industry forums and conferences through displays and presentations.

www.firenorth.org.au

North Australia Centre for Autonomous Systems

The North Australia Centre for Autonomous Systems (NACAS), embedded within RIEL, unites internationally recognised research capabilities with cutting-edge technologies, comprehensive infrastructure, and technical and operational expertise.

As an uncrewed aerial system (UAS) hub for northern Australia, NACAS offers a wide range of services, with specialisation in long-range and remote operations, including repeated aerial survey and artificial intelligence (AI)-based automated object detection, to support environmental monitoring, land management, and surveillance. These are typically undertaken in collaboration with Traditional Owners and remote Indigenous communities. Additionally, NACAS partners with CDU TAFE to offer a range of pilot training programs.

In an Australian first, the NACAS team used drones to deliver medical supplies to Aboriginal communities in West Arnhem after road access was cut off by floodwater in 2025. NACAS's recent research initiatives have been focused on expanding the use of UAS across northern Australia. This includes broad-area monitoring and surveying of northern Australia's wetlands, coastline, and offshore marine environment.

Looking ahead, NACAS will continue to build partnerships and training that grow sovereign capability, local expertise, and a skilled workforce. NACAS will accelerate the safe adoption and end-to-end deployment of UAS and other autonomous technologies, translating research into scalable impact across multiple sectors, driving regional growth and resilience in northern Australia.

www.nacas.net

Research Institute for Northern Agriculture

The Research Institute for Northern Agriculture (RINA) is addressing the opportunities and challenges of sustaining and developing primary industry in northern Australia with a focus on agriculture, aquaculture and biosecurity research.

RINA's work covers specialist research and training in horticulture, broadacre cropping systems, invasive species and biosecurity, commercial aquaculture, and pastoral production systems and sustainability.

RINA works closely with researchers in RIEL, and builds on RIEL's strengths in environment and livelihoods research to specifically support agriculture and aquaculture in northern Australia.

RINA is a partnership with industry, the NT Government and university partners, supported by the Australian Government Department of Education. It supports the growth agenda of the broader industry, including First Nations enterprises, and sustainable development.

www.cdu.edu.au/rina



A thorny devil basks on the hot sand of Ethabuka Reserve on the Queensland–Northern Territory border. This image was runner-up in the RIEL Photo Competition 2025. Photo: Maddison Stuart.

Collaborations

Partner organisations

RIEL collaborates and engages with a wide range of partners from across government, First Nations, industry, non-profit, community and research organisations around Australia and internationally. These valued partnerships can expand the scale of research activity and strengthen the institute's work.

A distinctive feature of RIEL's research is the extent of partnerships with First Nations communities and ranger groups. RIEL's strong working relationships are typically with community-based rangers, businesses or Traditional Owners, while formal research agreements tend to be facilitated through partnerships with relevant land councils, development corporations or other organisations.

RIEL also has decades of research partnerships with a range of Indonesian universities, NGOs and government agencies, particularly in marine and fisheries research, and equally long-term partnerships in Timor-Leste, particularly in agriculture, marine science, community-based fisheries and traditional foods. These partnerships have supported multi-institutional programs, strong HDR outcomes, and a network of influential alumni in government and universities.

RIEL's national and international research partners and networks include:

- Aak Puul Ngantam Ltd
- Australian Centre for International Agricultural Research (ACIAR)
- Australian Department of Agriculture, Fisheries and Forestry
- Australian Department of Climate Change, Energy, the Environment and Water (Marine Parks)
- Australian Department of Foreign Affairs and Trade
- Australian Institute of Marine Science
- Anindiliyakwa Land Council
- Arafura Swamp Rangers Aboriginal Corporation
- Arnhem Land Fire Abatement Ltd
- Bawinanga Aboriginal Corporation
- Blue Forests
- Parks Australia (Kakadu Bininj Mungguy Research Committee)
- Central Land Council
- CDU's Energy and Resources Institute
- CDU's Northern Institute
- CDU TAFE
- Commonwealth Scientific and Industrial Research Organisation (CSIRO)
- Desert Support Services Pty Ltd
- Dom Bosco Technical Institute
- Fisheries Research and Development Corporation
- Halu Oleo University
- Hasanuddin University
- Indigenous Carbon Industry Network
- Indigenous Desert Alliance Limited
- Indigenous Land and Sea Corporation
- Indonesian National Research and Innovation Agency
- Karajarri Traditional Lands Association
- Kimberley Land Council
- Larrakia Nation Aboriginal Corporation
- Laynhapuy Homelands Aboriginal Corporation
- Menzies School of Tropical Health Research
- North Australian Indigenous Land and Sea Management Alliance Ltd
- Northern Land Council
- Northern Territory Government
- Nusa Cendana University
- Nyangatjatjara Aboriginal Corporation
- Nyangumarta Warrarn Aboriginal Corporation
- Polyteknik Pertanian Negeri Kupang
- Tanjung Pura University
- Terrestrial Ecosystem Research Network
- Territory Natural Resource Management
- Thamarrurr Development Corporation
- Timor-Leste Ministry of Agriculture, Livestock, Forestry and Fisheries
- Tiwi Land Council
- Tiwi Resources
- To'os Servisu Kma'an (TOSKA)
- Universidade Nacional Timor Lorosa'e (UNTL)
- WorldFish
- Yagbani Aboriginal Corporation
- Yanunijarra Aboriginal Corporation

Consultancy services

RIEL is known for offering high-quality consultancy services and expert advice in relation to the environment and livelihoods.

Organisations can commission research, training or reviews from RIEL. These services support strong outcomes for commissioning organisations, and also contribute to building local capacity in research and increasing understanding of local ecosystems.

Consultancy services available at RIEL include:

- Applied fire management research and training
- Biodiversity assessment
- Blue carbon
- Calculating greenhouse gas emissions reduction and carbon sequestration
- Cultural training for researchers on Country
- Diversified farming systems
- Feral animal management
- Fine-scale burnt area mapping for industry and government agencies
- Fire histories and reporting tools for land managers
- Genetics and environmental DNA
- Microbiological and molecular analyses
- Remote environmental monitoring
- Remote sensing, surveillance, and guidance on airspace integration
- Satellite-based maps of fire activity
- Testing and prototyping of uncrewed aerial systems (UAS)
- Training in participatory action research
- Vegetation mapping and analysis

Students and alumni

RIEL is home to many students each year who are working toward honours, MRes, or PhD qualifications. Many alumni also remain closely connected with the institute. Three student stories are showcased below.



Photo: William Howcroft.

Detecting groundwater-dependent vegetation from space in the NT drylands

James Pike joined CDU in 2020 to study a Bachelor of Environmental Science, majoring in both Biodiversity and Conservation and Spatial and Quantitative Ecology. After completing honours in 2024 and being awarded a Chancellor's Medal for academic achievement, he progressed into a PhD at RIEL in 2025, supervised by Dr Richard Crabbe, Assoc Prof Dylan Irvine, and Prof Lindsay Hutley.

Mr Pike's research uses remote sensing to detect and monitor groundwater-dependent vegetation (GDV) across the drylands of the NT. Sustained by root contact with underlying aquifers, GDV plays an important ecological and cultural role in dryland systems, often standing out from surrounding vegetation as persistent "green islands" in satellite imagery. Mr Pike's work is refining this picture: native dryland plants can produce a similar persistence signal through their own drought-dormancy adaptations, which makes it easy to mistake GDV for other plants when using traditional methods.

By examining how vegetation responds to climatic and hydrogeological events, Mr Pike is helping identify better ways to detect and monitor GDV communities across remote parts of Australia's drylands. His current research, focused on multi-year drought conditions, points to dormancy as a key confounding factor, and suggests including measures of structural complexity such as spaceborne radar could sharpen detection.

Achieving first class honours was a highlight of James's time at RIEL, opening the door to his current PhD. Of his experience so far, James says the RIEL community stands out: a passionate and supportive team of researchers, students, and teachers who have shaped his research journey.

Using eDNA to track antimicrobial resistance in Darwin's waterways

Noor Ul Ain Rashid's honours research explored microbial communities and antimicrobial resistance (AMR) in the waterways around Darwin, using environmental DNA (eDNA) to reveal what's living in the water, and what findings might mean for public and environmental health.

Supervised by the Research Institute for Northern Agriculture's Prof Maxine Piggott, Ms Rashid collected samples from four tidal creeks, including sites influenced by wastewater and others that weren't. Using eDNA sequencing and qPCR testing, she found clear differences in microbial life between waterways, with Buffalo Creek standing out as particularly distinct. Notably, AMR-associated genes turned up at both effluent and non-effluent sites, showing that these markers aren't confined to areas directly touched by wastewater.

Ms Rashid graduated with first class honours and received an Academic Excellence Award for Real World Statistics and Data Reasoning. During 2025, she also presented her research to a Malaysian government delegation, including the Secretary General of Malaysia's Ministry of Agriculture and Food Security.



Photo: Ali Mubarik.

Ms Rashid completed her research all while navigating the transition into motherhood.

"Honestly, I feel very blessed to have been part of RIEL," she said. "It allowed me to learn from experienced researchers, develop my skills, and become part of such a supportive and welcoming research community."

She is now exploring PhD opportunities in environmental microbiology, biotechnology and One Health, building on the interests sparked by her honours project.

Tracking green turtles across the NT's coastline

Natalie Robson spent three and a half years at RIEL completing a PhD on the foraging ecology, genetic connectivity and threat exposure of green turtles (*Chelonia mydas*) in the NT, supervised by Prof Sam Banks and Dr Carol Palmer.

Her research combined genetics, satellite tracking, habitat mapping, eDNA and spatial risk assessment to build a fuller picture of green turtle ecology and conservation across the NT. Working closely with Indigenous ranger groups, Natalie identified important foraging habitats, uncovered genetic connections between NT turtles and nesting populations elsewhere in northern Australia, and mapped areas where turtles face overlapping threats.

Natalie's work was recognised with two major awards in 2025: the Australian Marine Sciences Association Conference's Sea World Prize for Best Oral Presentation in the Conservation and Science of Marine Megafauna and/or Seabirds category, and the Australian Society for Fish Biology's Gilbert P. Whitley Memorial Student Award (Senior) for an outstanding presentation on fish or fisheries.

Reflecting on her PhD, Natalie says the opportunity to work across incredible locations throughout the Territory was a highlight, but it was the people, especially the Indigenous rangers and Traditional Owners she worked alongside, who had the biggest impact.



Photo: Carol Palmer.

"Although my research has expanded beyond marine turtles, my PhD continues to shape the way I approach research," she says.

After submitting her PhD, Natalie moved to James Cook University to take up a role as Postdoctoral Research Fellow in Land and Sea Management with the Australian Research Council Centre of Excellence for Indigenous and Environmental Histories and Futures.

Outreach and engagement

The RIEL team aims for a variety of communication and outreach activities every year. Some of the highlights from 2025 are outlined below.

Research seminars

The 2025 RIEL Seminar Series comprised 16 seminars featuring 25 speakers between March and November. The lineup included 19 speakers from RIEL and 6 from partner organisations, namely the NT Department of Lands, Planning and Environment; Bard College at Simon's Rock; the University of Tasmania's Fire Centre; the NT Department of Agriculture and Fisheries; the Environmental Research Institute of the Supervising Scientist; and the University of KwaZulu-Natal.

All seminars were offered both in person and online, and were open to students, staff, and the public. Each seminar was attended by around 46 people on average. In most cases, recordings were later made available on the RIEL Outreach YouTube channel, leading to hundreds more views. The 2025 series was convened by Dr Zach Clark and Dr Bill Howcroft, supported by Will Kemp and Hannah Maddison-Harris.

Media coverage

As an institute, RIEL achieved a total of 243 direct mentions in media coverage during 2025. This translated to a potential audience reach of 609 million people, as reported by the CDU media team.

On top of this, many individual RIEL researchers also received significant coverage. For instance, Prof John Woinarski had 625 mentions in the media relating to his work on the Christmas Island shrew, Christmas Island flying fox, feral animal threats, and the impending risk of avian influenza, among other topics. Dr Carol Palmer achieved 200 media mentions covering dolphin strandings, false killer whale sightings, and more. Assoc Prof Kamal Sangha had 142 media mentions, relating to research on nature-based solutions and the Ecosystem Services Partnership Conference.

Conferences and events

RIEL, NAFI, DCBR and CDU were a gold sponsor of the Indigenous Carbon Industry Network's North Australia Savanna Fire Forum in February, building on a long-standing partnership. RIEL was also a gold sponsor of the Territory Natural Resource Management Conference in November, leading to strong engagement and research-sharing opportunities.

RIEL provided support for various other external events involving RIEL researchers over the course of the year, including the Northern Australia Food Futures Conference in April, the Ecosystem Services Partnership World Conference in June, the Science Comedy Program in July, the Australian Society for Fish Biology Conference and the TEDxCDU public speaking event in August, and a wetlands workshop in November.

Internally, RIEL held celebrations recognising HDR submissions and completions in February and November, while RIEL's GEIC hosted a morning tea to mark NAIDOC Week in July, and researchers organised a morning tea highlighting National Threatened Species Day in September. The RINA team organised a postgraduate conference in April in connection with the Northern Australia Food Futures Conference.



Honours student Sam Amini (*left*) and PhD candidate Porni Mollick speak live on air to Territory FM radio station during CDU's Casuarina Open Day 2025. Photo: Hannah Maddison-Harris.

Other activities

- In coordination with the CDU media and marketing teams, 33 stories about RIEL research were developed during the year. This included 23 media releases, 7 digital newsletter stories, and 3 digital student stories, which named either RIEL, RINA, NACAS, or NAFI.
- RIEL published 12 editions of the monthly members-only RIEL Digest, which helps to share information among members on new and ongoing research activities, and includes introductions for all new members of the institute.
- RIEL, RINA, and NACAS shared information about environmental and agricultural research at CDU's annual Casuarina Open Day to promote awareness of environmental research options among prospective students.
- CDU's first ever TEDx public speaking event was held at Danala campus. Three RIEL members — Prof Alan Andersen, Assoc Prof Dylan Irvine, and Prof Hamish Campbell — were among the 10 selected speakers. The event was presented live to an audience of 100 people, while recordings and clippings were later posted online where they garnered thousands more views.
- The biennial RIEL Photo Competition was run in late 2025 to help bring more attention to the landscapes and species depicted in researchers' images.



Reflections are seen in the waters of Bitter Springs in Elsey National Park near Mataranka, NT. This image was shortlisted in the RIEL Photo Competition 2025. Photo: Jenny Davis.

To find out more about RIEL's research, contact us at:

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