


Research Institute for the
Environment and Livelihoods

ANNUAL REPORT 2024







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: RIEL alum Ellen Ryan-Colton is pictured in the Anangu Pitjantjatjara Yankunytjatjara Lands where she conducted research on the ecological impacts of buffel grass. Photo: Luke Ireland.

Inner front cover: Underwater at an outer Darwin seasonal wetland. The Top End of the NT contains some of the world's most intact wetland ecosystems, making it an important place for wetland conservation, management and research. Photo: Jenny Davis.

Images on the inner front cover, page 13, page 24, and the inner back cover were shortlisted in the *Photo Synthesis: CDU's Research through the Lens 2024* initiative coordinated by the CDU media team.

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Message from the Director

RIEL's research partnerships are building the capability needed to shape natural resource management, sustainable development, biodiversity conservation, and resilient food systems across northern Australia and our near neighbours. Looking ahead, our work will continue to expand the knowledge and tools that drive these outcomes, and this report highlights just a few examples of the breadth and impact of our collaborations.

In 2024, our research was supported by \$37 million in funding, of which \$11.6 million was for new projects awarded in 2024. Of particular note was the ongoing development of a major partnership in Timor-Leste, led at CDU in 2024 by Dr Leigh Vial, Dr Penny Wurm, Assoc Prof Beth Penrose and Prof Stephen Xu, focusing on farm labour productivity for nutrition and livelihoods benefits, funded by the Australian Centre for International Agricultural Research and conducted in partnership with To'os Servisu Kma'an (TOSKA) and Universidade Nacional Timor Lorosa'e (UNTL) in Timor-Leste.

We were also excited to receive new Australian Research Council funding to build on existing strong partnerships with community-based ranger groups and Land Councils around the Northern Territory, including a collaborative project on northern Australian island biodiversity and a project with the Tiwi Land Council on feral cat management. It is a huge privilege for RIEL to be able to partner with ranger groups across northern Australia. The time and expertise that rangers contribute to collaboration with CDU enables us to participate in research in a context that has local relevance and a clear pathway to impact.

We were proud to partner with the Philippine Eagle Foundation on an exchange funded through the Australia Awards Fellowships program. RIEL hosted a delegation led by CDU alum Dr Jayson Ibañez that included 11 fellows from different Ancestral Domains in the Philippines and developed strong connections with the Dhimurru Rangers

from northeast Arnhem Land, who played an important role in Dr Ibañez's PhD at CDU.

Furthermore, we were delighted to see recognition for excellence in research partnerships. Prof Natasha Stacey and colleagues received the award for Research, Development, and Extension at the 2024 National Seafood Industry Awards for their project "Professional fishers' knowledge to inform research and management of sawfish and river sharks", an initiative that demonstrates the power of co-producing knowledge with industry and Indigenous partners to address pressing conservation challenges. Other individuals in RIEL were recognised for their contributions to science, with Prof Alan Andersen awarded the Ecological Society of Australia Gold Medal and Dr Dylan Irvine and Dr Sonu Yadav winning NT Young Tall Poppy awards.

These are just some of the achievements that reflect the dedication of RIEL's researchers, students, adjuncts, and professional staff. Together with our partners, we are contributing to healthier ecosystems, more sustainable livelihoods, and stronger communities across northern Australia and the Asia-Pacific.

I thank all of our members, collaborators, and funders for their continued commitment to RIEL. Your support enables us to pursue rigorous, high-quality research and research training for the north. This work has global significance and is of benefit to us all.



Professor Sam Banks

**Director, Research Institute for the
Environment and Livelihoods**
Charles Darwin University

Who are we?

RIEL is part of the Faculty of Science and Technology (FST) at Charles Darwin University (CDU), based in the Northern Territory (NT) of Australia.

RIEL's work spans tropical, semi-arid and arid regions, and the livelihoods of communities which rely on these environments. The institute is recognised as a leader in tropical environmental research both nationally and globally.

RIEL's members include 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.

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



95 students

RIEL supported 95 students in 2024. This included 88 HDR candidates working on Doctor of Philosophy (PhD) or Master by Research (MRes) projects, and 7 honours students. RIEL's student members are enrolled at CDU through FST. They are supported in their research by RIEL and are supervised by at least one RIEL academic staff member.



86 staff

RIEL had 86 fixed or ongoing staff members in 2024. This includes research-focused academics working at CDU on externally funded programs, and teaching-focused academics from CDU's Environment discipline. These academic staff contribute to significant research projects, offer consultancy services, supervise HDR and honours students, and teach into undergraduate courses. This also includes a small number of professional staff who provide support to RIEL members and projects.



80 adjuncts

RIEL had 80 adjunct and honorary members in 2024. Adjunct and honorary members are affiliated with RIEL and contribute to RIEL research. These members come from a wide range of sectors, from around Australia and internationally, including government, non-government organisations, and other research organisations.

56 casuals*

In addition to fixed and ongoing staff roles, RIEL also had 56 casual staff roles, both academic and professional, over the course of 2024. Many casual staff hold other roles within the university; they may, for example, be coursework students or HDR candidates who work on other research projects on a casual basis. Some casual roles are for short one-off projects, whereas others may span many months.

**These members were not counted in the total staff numbers in the RIEL Annual Report 2022 or RIEL Annual Report 2023.*

Within RIEL, members participated in several important committees and groups in 2024.

- ➔ RIEL's Gender Equity and Inclusion Committee works to improve equity and inclusion among all RIEL members. In 2024 the committee rolled out a new series of equity, diversity and inclusion (EDI) workshops to help promote EDI awareness, create a more inclusive environment, and foster proactive inclusion. The sessions were well received by participants, and have inspired other CDU departments to adopt similar initiatives. The committee also began hosting Parents and Carers Gatherings; marked key dates such as International Women's Day, Pride Month, and NAIDOC Week; and advocated for improved equity and inclusion initiatives for students and staff across the institute. Researchers are regularly invited to join these EDI efforts and can raise issues with the committee at any time.
- ➔ RIEL's Assets Committee coordinates the maintenance, repair and replacement of assets such as vessels, vehicles and equipment. The safe and strategic management of these assets is critical for RIEL members in carrying out field work and laboratory work.
- ➔ RIEL's Boat Committee manages the compliance and usage of RIEL's research vessels. These are essential resources for marine and freshwater researchers. In a special initiative in 2024, the vessels benefited from new wraps that not only provide protection to the hulls and fulfil special signage requirements for research vessels, but were also designed with original artworks of local wildlife.
- ➔ The RIEL & Co Postgraduate Society is led by a team of HDR students from RIEL. It helps to enhance the postgraduate experience by facilitating regular social events and providing support to students over the course of their studies. Its initiatives not only support RIEL's PhD, master and honours students, but also bring together students and researchers from across the faculty.



RIEL's vessels, which are essential resources for aquatic research, now feature artworks of local wildlife.

Where do we work?

RIEL researchers carry out projects across northern and central Australia, the near Asia-Pacific region, and beyond. The institute's researchers are primarily based at CDU's Casuarina campus on Larrakia Country in Darwin and at CDU's campus on Arrernte Country in Alice Springs.

Many RIEL projects are closely connected with First Nations partners and are undertaken in collaboration with Traditional Owners and First Nations community members. RIEL's projects and research collaborations also have long and enduring connections with Timor-Leste and Indonesia, among other countries.

In 2024, projects were concentrated in northern and central Australia, along with sites elsewhere in Australia, with research occurring in and around locations such as:

- | | | |
|----------------------|------------------------------------|------------------------|
| ➤ Adelaide River, NT | ➤ Daly River, NT | ➤ Kimberley region, WA |
| ➤ Ali Curung, NT | ➤ Darwin, NT | ➤ Nhulunbuy, NT |
| ➤ Alice Springs, NT | ➤ Far North Queensland region, QLD | ➤ Pilbara region, WA |
| ➤ Arnhem Land, NT | ➤ Kakadu, NT | ➤ Tiwi Islands, NT |
| ➤ Coffin Bay, SA | ➤ Katherine, NT | |

There were also researchers and project sites in tropical and arid zones around the world in 2024, including:

- | | | |
|-------------|---------------|------------------|
| ➤ China | ➤ Madagascar | ➤ Timor-Leste |
| ➤ India | ➤ Philippines | ➤ United Kingdom |
| ➤ Indonesia | ➤ Switzerland | ➤ Vanuatu |

Research performance

Research income in 2024



\$37 million in active research projects

Of the total, **\$11.6 million** was external research income for new projects in 2024, including \$8.6 million of new Higher Education Research Data Collection (HERDC) income. Some of the major new projects funded in 2024 included:

- ➔ **\$2.95 million** for the project 'Increasing on-farm labour productivity for sustainable production, nutrition and inclusive livelihood gains in Timor-Leste', funded by the Australian Centre for International Agricultural Research and led at CDU by Dr Leigh Vial, Dr Penny Wurm, Assoc Prof Beth Penrose and Prof Stephen Xu. Partners include Dom Bosco; Timor-Leste's Ministry of Agriculture, Fisheries, Livestock and Forestry; TOSKA; and UNTL.
- ➔ **\$1.57 million** from the Australian Research Council for the 'How safe are island havens for biodiversity?' project led by Prof Sam Banks, Dr Teigan Cremona, Prof Brett Murphy, Prof Sarah Legge and Prof John Woinarski with colleagues from the NT Government, Northern Land Council, Tiwi Resources and Larrakia Nation Aboriginal Corporation.
- ➔ **\$743,000** for the Australian Research Council Linkage project 'Cat Management Guided by Country', led by Prof Brett Murphy, Dr Hugh Davies and Prof Sarah Legge at CDU, together with the University of New England and the Tiwi Land Council.

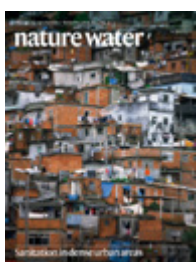
Publications in 2024



167 publications involving RIEL authors

- ➔ **152** peer-reviewed journal articles, of which 108 were in Q1 journals
- ➔ **2** books
- ➔ **5** book chapters
- ➔ **1** report
- ➔ **7** articles on *The Conversation* academic journalism website

Publication highlights included:



McLellan, S.L., Chariton, A., Codello, A., McClary-Gutierrez, J.S., Schussman, M.K., Marzinelli, E.M., O'Neil, J.M., Schott, E.J., Bowen, J.L., Vineis, J.H., Maignien, L., Lemonnier, C., Perennou, M., **Gibb, K.S.**, Zhou, G.-J., Leung, K.M.Y., Kirs, M., Griffith, J.F., Steele, J.A., Swearer, S.E., O'Brien, A.L., Song, D., Liang, S., Li, J., Airolidi, L., Mancuso, F.P., Salomon, P.S., Silva-Lima, A.W., Pereira, R.C., Boehm, A.B., Lim, E.W.X., Wuertz, S., Fernández, E., Teira, E., Liao, M.-L., Dong, Y.-W., Steinberg, P.D., 2024. Universal microbial indicators provide surveillance of sewage contamination in harbours worldwide. *Nature Water* 2, 1061–1070. doi.org/10.1038/s44221-024-00315-5



Seebens, H., Niamir, A., Essl, F., **Garnett, S.T.**, Kumagai, J.A., Molnár, Z., Saeedi, H., Meyerson, L.A., 2024. Biological invasions on Indigenous peoples' lands. *Nature Sustainability* 7, 737–746. doi.org/10.1038/s41893-024-01361-3



Tiegs, S.D., Capps, K.A., Costello, D.M., Schmidt, J.P., Patrick, C.J., Follstad Shah, J.J., LeRoy, C.J., the CELLDEx Consortium (including **Garcia, E.A.**), 2024. Human activities shape global patterns of decomposition rates in rivers. *Science* 384, 1191–1195. doi.org/10.1126/science.adn1262

Students in 2024



95 enrolled students

This included 88 enrolled HDR candidates

- 63 were domestic students
- 25 were international students
- 9 completed their PhD or MRes during the year

The total also included 7 enrolled honours students

- All 7 were domestic students
- As scheduled, 2 completed their honours degrees

HDR completions comprised:

- **Lisa Chandler** – *Responses of groundwater communities to mine-water contamination in the Australian wet-dry tropics*
- **Amy Kirke** – *Life History of Two Bycatch Shark Species in Northern Territory Commercial Trawl Fisheries*
- **Linda Luck** – *From tree structure to carbon cycling: cost-effective terrestrial LiDAR scanning to track the impact and recovery from fire disturbance in a tropical savanna*
- **Gehan Abdelghany** – *Agronomic investigations of Australian native rice species to support Indigenous enterprise development in tropical northern Australia*
- **Juma Joseph Kegamba** – *Assessment of conservation institutional frameworks and benefit-sharing mechanisms for local peoples in the Greater Serengeti Ecosystem, Tanzania*
- **David McKenzie** – *Strengthening the adaptive responses of Australian farmers for reducing the effects of climatic risks*
- **Devika Nair** – *Simulating Long-term Erosion Equilibrium of a Rehabilitated Mine Landform*
- **François Brassard** – *Using a long-term fire experiment to understand how pyrodiversity affects biodiversity in Australian savanna ants*
- **Jennifer House** – *Gendered Perspectives of Community-based Fisheries Management and Participatory Monitoring in Timor-Leste*

Honours completions were:

- **James Pike** – *Using remote sensing to map groundwater-dependent vegetation in the Western Davenport region, Northern Territory*
- **Robert McGregor** – *Modelling above-ground biomass across the tropical savannas of the Northern Territory – A machine learning approach*



Several members of the Ecosystem Services Research Group take a team photo outside RIEL offices at CDU's Casuarina campus.

Research impact

RIEL's research projects lead to new and ongoing impacts every year. In 2024, of the many instances of research impact, two examples were the groundbreaking trans-disciplinary work of the Ecosystem Services Research Group, and a project that considered First Nations cultural values in mine planning.

Ecosystem services research informs sustainable development pathways

Ecological economics is an area of research involving an integrated understanding of environmental, social and economic issues, mainly from Indigenous perspectives. This includes the use, valuation, and management of natural resources; linking ecosystem services and the wellbeing of Indigenous peoples; and integrating science with policy decision-making.

RIEL is home to the Ecosystem Services Research Group which is carrying out groundbreaking trans-disciplinary work in this area, highlighting the importance of Ecosystem Services for Indigenous well-being and informing policy. Ecosystem services are the benefits people obtain from natural systems. The team's global collaborations, including the development of Payments for Ecosystem Services and contributions to major international platforms, are transforming both academic research and policy. The team's work on linking Indigenous natural resource management and peoples' wellbeing

has been and continues to be transformative for the science-policy interface.

The group has demonstrated leadership in research to support the development of economic opportunities for Indigenous peoples that are aligned with environmental management. The team offers a scientific and economic perspective of the holistic living that many Indigenous peoples practice across northern Australia and globally. The main focus of the work is on understanding and assessing the role of Indigenous land management for enhancing peoples' wellbeing, informing relevant public policies – such as 'Closing the Gap', 'Developing the North', or bushfire management in northern Australia – and transitioning toward sustainable economies at a global scale.

Group leaders Assoc Prof Kamaljit Sangha and Prof Jeremy Russell-Smith, who have decades of research experience in

this field, are involved in high-level international initiatives, including those led by the United Nations Environment Program and the International Union for Conservation of Nature. They have also supported the development of international research partnerships with benefits for communities and researchers in Australia and overseas.

From 2020 to 2024, the group secured significant national and international research grants for this work, and also attracted and mentored at least 12 HDR students who will continue ecosystem services research into the future. The team works collaboratively with Indigenous peoples and local communities across northern Australia, India, Tanzania, and the Asia-Pacific region. Alongside Assoc Prof Sangha and Prof Russell-Smith, in 2024 the team included Dr Andrew Edwards, Jay Evans, Dr Ronju Ahammad,

Dr Veronica Toral-Granda, Dr Juma Kegamba, Dr Hari Paramjyothi, Samy Leyton-Flor, Oscar Metcalfe, Srishti Badola, Getahun Kassa Mengesha and Othusitse Lekoko, each working on diverse topics.

The group was awarded a Vice Chancellor's Award for research impact in late 2024, recognising how this work is advancing Indigenous-led land and sea management practices and the wellbeing of landscapes and livelihoods. The team's work is highly cited in policy documents from 10 different countries. Demonstrating the strength of its academic leadership and global networks, the team was also entrusted with hosting the 11th Ecosystem Services Partnership World Conference in Darwin, slated for June 2025.

Consideration of First Nations cultural values in mining rehabilitation in the NT

Most mine sites in the NT either are on, or impact, the lands of Traditional Owners (TOs). TOs have a fundamental spiritual connection with the land, which includes responsibility for the care of the land and relates to physical, health, cultural, and environmental dimensions. RIEL has had a sustained focus on assessing the ability of mining companies to consider First Nations cultural impacts when carrying out mining rehabilitation.

From 2019 to 2023, Master by Research student Will Kemp investigated the consideration of First Nations cultural values in mine planning, under the supervision of RIEL's Dr Sean Bellairs and Edith Cowan University's (ECU) Prof Janine Joyce. One aspect of this research used thematic analysis to investigate how, when, and in what context First Nations cultural values are considered by environmental professionals when planning and undertaking mine rehabilitation activities, which involved interviews with environment professionals. A second component of the research used content analysis software to analyse NT Environment Protection Authority (EPA) reports on proposals for mining projects that were submitted between 1991 and 2020.

The eight professionals who were interviewed all had experience managing the rehabilitation of mine sites on First Nations land in the NT and had a combined total of more than 150 years of experience in mine site environmental management. After analysing the interviews, six themes were identified: cultural and other values, rehabilitation planning, impediments or barriers to achieving restoration of cultural values, solutions, consideration of principles, and TOs. A key principle that emerged was that ecological and cultural

traditional knowledge are interwoven but both need to be communicated effectively and respectfully.

The professionals felt that often there could be the ability to plan for and achieve TO cultural values, but that there was rarely a detailed agreement prior to mine approval about outcomes to achieve cultural values. After a project had been approved TOs often had to compromise rather than achieve the ecological and cultural outcomes that they would like.

Analysis of EPA reports found that when the reports were grouped by decade, the attention given to First Nations peoples in mine proposals fell by more than half over the 30 years that were analysed, from 18% relevance to 7%.

General outcomes were that the regulation of mining approval needs to achieve clearer agreed goals that companies commit to, with respect to First Nations cultural values, as part of the initial approval process. Costs to TOs in loss of traditional resources, loss of cultural values that are not economic to restore, and of ongoing additional land management need to be considered. Communication needs to be effective, which requires time and cultural appropriateness. TOs need to be involved at all stages – from planning, to defining restoration criteria, development of solutions, implementation of rehabilitation, and approval of rehabilitation success.

In 2024, project participants Mr Kemp, Dr Bellairs, Prof Joyce and ECU's Jane Henderson were invited to present at Mines and Environment's Mine Closure Conference in Perth. The team also made a submission to the Western Australian Mine Closure Plan Guidelines review, and has published the research.



NACAS Chief Remote Pilot Rebecca Ludgate and PhD candidate Aliesha Hvala prepare for a drone operation. The NACAS team provides expertise in safely operating drones in some of Australia's most challenging and remote environments.
Photo: NACAS.

Research strengths

RIEL's research is grouped into key strengths, 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 new area of research strength, defined in 2024, encompasses work on agriculture, aquaculture, and food systems from researchers across RIEL.



Centres and services

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

Biodiversity and conservation



As one of RIEL's research strengths, biodiversity and conservation covers the conservation and management of tropical and arid biodiversity, along with specialist environmental monitoring services and advice.

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

- Ecological monitoring and management
- Terrestrial ecology
- Animal movement and behaviour
- Threatened species conservation and management
- Genetic analysis in conservation science
- Invasive plant and animal impacts and management
- Native vegetation restoration
- Post-mining environmental service restoration
- Spatial planning and area-based management
- Invertebrate 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 threat and extinction, for improved management
- Improving conservation and management of threatened marine species
- Identifying and delineating important habitat for marine 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
- Collaborating with First Nations ranger groups, development corporations and Traditional Owners on environmental and primary production research



Members of the Nyangumarta survey team are pictured with Environs Kimberley and RIEL staff. Photo: Nyangumarta Rangers.



RESEARCH HIGHLIGHT

Fire and biodiversity conservation in Great Sandy Desert

An ongoing project aims to understand how desert fire patterns have changed since colonisation, and how that affects the species which reside in the desert.

The 'Improving desert fire management with culturally directed science' project, which runs from 2023 to 2027 in Western Australia's Great Sandy Desert, is using culturally directed science to improve understanding of how fire patterns in the desert have changed since European colonisation compared to the tens of thousands of years of Indigenous fire practice before that.

The work looks at how changes in fire patterns are affecting vegetation structure and native fauna, including culturally important species, from desert mice and marsupial moles to snakes and goannas.

The team includes RIEL's Prof Sarah Legge, Prof Sam Banks, Prof Brett Murphy and Dr Kristina Macdonald, alongside members of the Karajarri, Ngurrara, Nyangumarta, and Ngururpa rangers, and staff of Environs Kimberley and the Indigenous Desert Alliance. In 2024 the team also gained PhD candidate Stephanie Lee.

By the end of 2024, team members had published an initial pilot study in the journal *Wildlife Research*, along with an article on *The Conversation* website to share the work with a wider audience.

Rangers, researchers, and research partners carried out three field trips for data collection in the Great Sandy Desert over the same year. Nyangumarta rangers Vernon Bellou and Denzel Hunter said they enjoyed getting out to the desert, being on Country, and figuring out if fire management efforts are helping small animals.

"It's really important for rangers to get out on Country and stay connected, and this work helps them do that," said senior Nyangumartu woman Janey Wright.

Over time, the project expects to document fire patterns, undertake further fieldwork to understand the effects on native fauna, and help inform future fire management plans and conservation management.

This project is funded by an Australian Research Council Linkage grant.



SPECIES SPOTLIGHT

Supporting conservation efforts for pygmy blue whales

Blue whales are a global icon of ocean conservation. The waters of Timor-Leste, particularly the Ombai-Wetar Strait, are a hotspot for whales and dolphins, including blue whales. In particular, these waters are home to the smallest and only tropical subspecies of blue whale – *Balaenoptera musculus brevicauda* (pygmy blue whale).

While blue whales are listed as endangered, and commercial whaling has been banned since 1966, recovery of the species has been extremely slow. They remain highly susceptible to climate impacts, particularly ocean warming, and to the impacts of shipping, seismic activities related to oil and gas development, and ocean pollution. They are also highly elusive, with limited information available on their migratory routes and their feeding, calving and breeding areas – particularly in tropical waters.

In addition to this, Timor-Leste has become a major whale tourism destination over the past 10 years, particularly for 'swim with whales' tourism. While this industry provides major opportunities for Timor-Leste to help address critical poverty and economic development challenges, the industry is growing very rapidly and remains unregulated.

Dr Karen Edyvane, Adjunct Senior Research Fellow at RIEL, is leading a decade-long research and 'citizen science' monitoring program that is providing baseline information on the status, movements, behaviour and ecology of blue whales in Timor-Leste. This information is vital for conservation efforts, including threat mitigation and environmental impact and risk assessments for ongoing

human activities. This work will also provide critical information to support Timor-Leste's important whale tourism industry and sustainable tourism.

The program is run in partnership with local universities, fishing communities, government and whale tour operators in Timor-Leste, as well as blue whale researchers and conservation managers in Australia and globally.



A migrating pygmy blue whale glides through deep waters off the coast of Timor-Leste. Photo: Karen Edyvane/Zacarias da Cunha.

Communities and livelihoods



This research strength 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, environment 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
- Restoration, rehabilitation and collaborative management of mangroves
- Involvement in United Nations-led 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 practice to improve production in smallholder farming systems in Timor-Leste
- Working with First Nations communities to develop nature-based economic opportunities
- Understanding the impacts of mining on First Nations communities
- 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
- Indigenous knowledges and traditional foods
- Engaging with First Nations peoples and local communities to contribute to biodiversity conservation
- Understanding how First Nations communities will be affected by climate change
- Researching the benefits that threatened species conservation can deliver to people globally
- Rehabilitation of blue carbon habitats for sustainable livelihoods
- Implementing a world-first program for a savanna burning carbon industry in northern Australia, and other savanna landscapes around the world
- Developing digital technologies to improve livelihoods of local communities in the Asia-Pacific



Paula Torres from Agora Food Studio speaks at the Wild Food event at CDU's Casuarina campus in October 2024. Photo: Bevlyne Sithole.



PARTNERSHIP STORY

Big, cheeky yams a focus of knowledge exchange

The Wild Foods Project is a collaboration between RIEL's Aboriginal Research Practitioners Network (ARPNNet) in northern Australia and the Agora Food Studio in Timor-Leste.

Funded by ACIAR and led by CDU, the project runs from 2023 to early 2025 and aims to support knowledge sharing and capacity building on wild foods between northern Australia and Timor-Leste. The two countries share many complexities and overlapping challenges relating to the commercialisation of wild foods – a subject that requires careful balance between economic development and environmental conservation.

The project recognises that platforms for transferring Indigenous knowledge need to be created and managed by communities on their own terms. In May 2024, in collaboration with the University of New South Wales, the team organised two Indigenous cultural and intellectual property workshops hosted by ARPNNet founder and RIEL Adjunct Assoc Prof Bevyne Sithole, together with ethnobotanist Dr Lorraine Williams.

From June to July the team undertook field work and interviews in several communities across the Top End of the NT and in six municipalities in Timor-Leste. Three species were a particular focus of the work – *Dioscorea transversa*, the 'long yam'; *Dioscorea bulbifera*, the 'cheeky yam'; and *Amorphophallus* sp. or the 'big cheeky yam'. Timor-Leste communities also use the term yam to include other root plants.

Towards the end of the project, in October 2024, the team hosted public events in Darwin and Dili. This included the 'Wild foods are us' event held at CDU's Casuarina campus, which focused on sharing and yarning about yams, and the Wild Food Fair hosted by Agora Food Studio in Dili.

It is hoped that by facilitating genuine knowledge sharing on the value of wild foods, the project will help to address challenges and to foster more resilient food systems based on the immense knowledge held by these communities.



RESEARCH HIGHLIGHT

Supporting sustainable fisheries management in the Torres Strait

A proposed mobile application for collecting data about traditional fishing could help to ensure sustainable fisheries management in the Torres Strait region of North Queensland.

Traditional fishing in the Torres Strait region is vital to livelihoods and nutrition. The long-term sustainability of fisheries requires reliable catch data from all sectors. While commercial fisheries have management plans in place, non-commercial catches are not always counted or recorded. Torres Strait Islands residents have expressed concern around this and for the need to protect and monitor traditional fisheries to ensure sustainable resource management and food security.

The project 'Measuring non-commercial fishing catches (traditional fishing) in the Torres Strait in order to improve fisheries management and promote sustainable livelihoods' (FRDC Project Number 2022-045) collated and shared information about the development of a traditional fishing catch recording system to help address these data gaps. The project ran from 2022 to 2024 and was co-led by RIEL's Prof Natasha Stacey and Torres Strait fisheries consultant and Traditional Owner Kenny Bedford, with team members Tim Skewes and David Brewer.

Through a co-design process led by Mr Bedford, representatives of 15 communities from across the Northern Peninsula Area in North Queensland and the Torres Strait Islands identified and discussed traditional fishing behaviours, priorities, and needs for a proposed app. The team also completed a review of other fishing apps, costs and options, and collated information for app design and development.

The project came up with recommendations for monitoring including principles for an app program and governance arrangements. The research highlighted the need for a future monitoring program to be implemented within an Indigenous-led governance structure working in partnership with a coalition of trusted organisations. These results are important for other national and international Indigenous fisheries monitoring programs led by First Nations peoples to support Sea Country protection, fisheries management and protection of traditional seafoods and livelihoods.

The project was supported by funding from the Fisheries Research Development Corporation and the Australian Fisheries Management Authority on behalf of the Australian Government, and would not have been possible without the support, time and knowledge of Torres Strait communities, regional stakeholders, and app developers and custodians.



Mixed Rabbitfish are seen as part of a traditional fishing catch in the Torres Strait. Photo: Lala Gutchen.

Savanna and arid ecology



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

Within this research strength, 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

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
- > Developing innovative methodologies to evaluate climate change impacts on turtle breeding in the Amazon
- > 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 diversity and using ants as indicators of restoration success
- > Improving methods for detecting, mapping and monitoring groundwater-dependent ecosystems in semi-arid regions



Maryanne McKaige talks with Tiwi College students about aquatic macroinvertebrates caught in the local creek. Photo: Alan Andersen.



RESEARCH HIGHLIGHT

Scientists contribute to Tiwi Junior Rangers Program

The Tiwi Junior Rangers Program is an important initiative helping Tiwi College students to engage with the Tiwi Islands' unique environment and cultural heritage. In 2024, members of RIEL's invertebrate biodiversity group contributed to the program by sharing environmental science skills with the junior rangers.

Over a series of four visits to Pickertaramoor on Melville Island in the Tiwi Islands, RIEL's Prof Alan Andersen and PhD students Allyson Malpartida and François Brassard taught modules on botany, terrestrial insects, and aquatic biodiversity. They were supported by aquatic macroinvertebrate specialist Maryanne McKaige.

In the botany module, students learnt how to recognise features of different plants and how to classify them. The module also covered traditional names and uses of common Tiwi plants. The insect module focused on the

roles of insects in ecosystems, and on insect classification and identification. Students sampled insects using sweep nets and pitfall traps, before sorting and identifying specimens in the lab. The aquatic biodiversity work involved testing water quality and sampling aquatic macro-invertebrates in a local creek, then looking at invertebrate samples and drawing food webs in the classroom.

"The students were fascinated by seeing so many different sorts of insects and other invertebrates, and for many it was their first experience with a microscope. A whole new world was opened up for them!" said Prof Andersen.

Tiwi senior Elders and rangers were involved in all the activities, as were Tiwi College teachers. The RIEL team delivered the modules in partnership with Tiwi College, Tiwi Resources, and Calytrix Communication. This impactful program is set to continue in 2025.



SPECIES SPOTLIGHT

Strategic management of gamba and other invasive grasses

Invasive grasses have significant impacts on fire regimes and biodiversity across northern Australia. Some invasive grasses are now widespread, representing a significant risk and major management challenge.

The 'Supporting the strategic management of invasive grasses' project provides information to managers of protected areas and Indigenous ranger groups to support strategic management and reduce biodiversity impacts of invasive grasses. This includes the co-development of user-friendly mapping, monitoring and decision-support tools. The project, which focuses on gamba grass, para grass and olive hymenachne, runs from 2023 to 2027. It is a National Environmental Science Program (NESP) Resilient Landscapes Hub project and is co-led by RIEL's Dr Natalie Rossiter-Rachor and The University of Western Australia's Prof Samantha Setterfield.

During 2024, the team worked with the Terrestrial Ecosystem Research Network (TERN) on a prototype mobile application that enables aerial mapping of gamba grass and other weeds at a landscape scale. The app can help weed managers to visualise gamba grass distribution, examine landscape-scale patterns of gamba spread, identify priority areas for control, and monitor and report progress. The researchers conducted on-ground and helicopter testing in Litchfield National Park, before presenting the app to weed managers from a range of NT and Queensland land management organisations. The app will be released as a national Ecological Monitoring System Australia (EMSA) protocol.

In 2024 Dr Rossiter-Rachor and Prof Setterfield also contributed to the National best practice management manual for gamba grass by authoring three sections of this important publication, which also discusses the aerial mapping app.

The development of the app has already made a significant impact. The team briefed the NT Parks and Wildlife Commission's Executive Committee and park rangers on the survey results from Litchfield National Park, which led to the issue being raised at the NT Legislative Assembly and set the scene for funding commitments for gamba grass control.

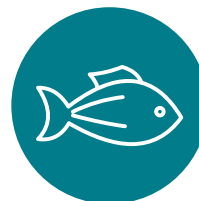
These efforts are supporting Litchfield National Park to adapt its approach for managing gamba grass.

This project is supported by funding from the Australian Government under NESP.



Dr Natalie Rossiter-Rachor conducts helicopter testing of a mobile application in Litchfield National Park. The app enables aerial mapping of gamba grass and other weeds at a landscape scale. Photo: NESP Resilient Landscapes Hub.

Water and catchments



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

Using the latest technological advances, this research strength explores:

- > Aquatic ecology
- > Animal movement and behaviour
- > Animal–microbe interactions
- > Population dynamics
- > Microbiological and molecular analyses in aquatic environments
- > Microbial source tracking to identify sources of impact
- > Water quality
- > Effect of human disturbance on aquatic ecosystems
- > Catchment and groundwater processes
- > Carbon dynamics in riverine settings
- > Wetland condition and health of groundwater dependent ecosystems
- > Estimating groundwater recharge
- > Impacts of climate change on water resources
- > Projections of future water availability

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 terrestrial and aquatic species for strategic baseline assessment
- > Assessing environmental water requirements for aquatic ecosystems and sustainable fisheries management
- > Using new technologies and methodologies for monitoring fish movement
- > Predicting impacts of climate change on aquatic food webs, ecosystems, carbon dynamics and nutrient cycling
- > 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 analysis including iron cycling bacteria
- > 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
- > Seasonal and migration-driven dynamics of shorebird gut microbiomes (*Vibrios*) within water ecosystems
- > 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
- > Investigating water resources use and management in the Lower Burdekin Delta, Queensland, with a focus on sustaining intensive agriculture through droughts and floods
- > Determining the source waters of the Doongmabulla Springs Complex in the vicinity of the Carmichael coal mine
- > The development of scientific capability in freshwater ecology and the use of new technologies in natural resource management in northern Australia
- > Assessing trends in concentrations of agricultural runoff in tropical rivers
- > Numerical simulations of groundwater flow and transport, and groundwater–surface water interactions



PARTNERSHIP STORY

Developing scientific capability in freshwater ecology

A multi-year cooperative agreement is helping to develop the NT's scientific capability in freshwater ecology research. The initiative, which is a collaboration between the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and CDU, supports natural resource management in northern Australia through establishing and funding a number of 3-year postdoctoral fellowships.

RIEL hosts several of these postdoctoral positions, with projects covering three broad ecological domains: predicting the resilience of riverine biodiversity, wetland condition and biodiversity, and floodplain and riparian vegetation. All of the projects aim to improve understanding of impacts to freshwater systems due to changes in water availability associated with water resource development and climate change.

The first of the postdoctoral research fellows, Dr Osmar Luiz, began work on riverine biodiversity resilience in January 2022. Dr Luiz developed models to understand the impacts of dams and river flow alteration on aquatic communities and helped identify river catchments of northern Australia that should be a conservation priority for future water resource development.

A second fellow, Dr Kaline de Mello, commenced in April 2023 with a focus on forecasting wetland condition and biodiversity. Since then, Dr de Mello has improved methods for wetland mapping, provided flood maps for the Adelaide River catchment, and supervised students.

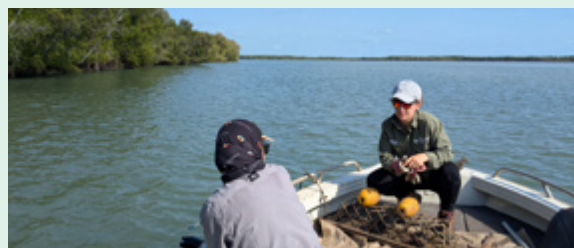
The third fellow, Dr Rafael Bohn Reckziegel, arrived at RIEL in June 2023 to work on floodplain and riparian vegetation.

Dr Bohn Reckziegel has supported field work, been a guest lecturer, convened the 2024 RIEL Seminar Series, and participated in outreach activities such as CDU Open Day.

Another fellow, Holly Lourie, began her role in November 2022 before joining the RIEL team in 2024. Her work focuses on impacts of feral animals on wetland biodiversity and cultural assets. Ms Lourie has delivered trainings and has completed large feral animal surveys and waterhole assessments during this time.

Between them, the fellows have also submitted and published numerous papers and have presented their work at a wide range of conferences. While most of the research is expected to conclude in 2025, related work will continue into the future.

This initiative highlights not only the importance of freshwater ecology research for northern Australia, but also the enduring research partnership between CSIRO and CDU.



Dr Erica Garcia (left) and Dr Kaline de Mello work with water quality equipment on the Adelaide River, NT. Photo: Colton Perna.



RESEARCH HIGHLIGHT

Study finds groundwater is warming due to climate change

Groundwater is considered critical for life on Earth. However, relatively little is known about how groundwater responds to rising temperatures on the surface. A new assessment has shed light on this vast underground resource.

Around the globe, groundwater plays important roles in catchments by providing baseflow to rivers and sustaining groundwater-dependent vegetation, among other things. Like surface waters, groundwater is projected to be impacted by climate change-driven modifications to the hydrological cycle.

RIEL's Dr Dylan Irvine was part of a team that produced the first projections of groundwater temperature change due to atmospheric warming in the paper 'Global groundwater warming due to climate change', published in Nature Geoscience in 2024. The paper first develops a model of current groundwater temperatures, then produces projections, driven by global climate models.

Groundwater temperature can influence water quality

through enhanced leaching or microbial activity.

Groundwater discharge also maintains thermal refugia in rivers and streams. Increased groundwater discharge temperature can impact temperature sensitive groundwater-dependent ecosystems. Understanding potential changes in future groundwater temperature can help to inform investigations to assist water resources and ecosystem management.

The study shows that relative to the year 2000, the 2100 average water table temperature is projected to warm by between 2.1 °C and 3.5 °C, depending on the climate scenario.

The projected groundwater temperatures from the study are transferrable to future research via a Google Earth Engine App that can extract projected groundwater temperatures. This makes the findings immensely useful for the research community.



View the Google Earth Engine App

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.

RIEL is home to ongoing research on the commercial production and the ecology of native plant species, the management of plants in agricultural systems, and *Vibrio* ecology and shellfish safety. This research includes:

- > 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

RIEL also hosts the Research Institute for Northern Agriculture (RINA), which was established in 2022 to develop a critical mass of research excellence aimed at meeting the research, technical and innovation requirements of the agricultural and aquaculture sectors in northern Australia, including First Nations enterprises. This research covers a wide range of areas, including:

- > 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
- > New species development
- > Aggression, growth, heat resilience and other key variables among cultured aquaculture stock
- > 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
- > Pasture systems, pasture agronomy, and plant nutrition
- > Improving animal health and welfare
- > Linking of soil and plant nutrition to human, animal and environmental health



The edible snail *Telescopium telescopium* sits in mangrove mud.
Photo: Anna Padovan.



RESEARCH HIGHLIGHT

Team examines *Vibrio* ecology in Darwin Harbour

Research has found that wet season and monsoon rain events are connected to an increase of potentially pathogenic *Vibrio* bacteria in tropical waters, which could affect human health through food sources.

David Simma, Dr Anna Padovan, Dr Mirjam Kaestli and Prof Karen Gibb, who are members of RIEL's Bioscience North Australia (BNA) group, measured the spatio-temporal patterns of two marine opportunistic pathogens in a tropical estuary — in seawater, sediment, and an edible snail. The goal was to use the information to identify high-risk periods for human health in Darwin Harbour.

The work, which formed Mr Simma's master by research in 2021–2023, was published and finalised in 2024. The results suggest that the wet season, and particularly times of extreme weather events when environmental conditions change rapidly, could be periods of high risk for vibriosis in tropical Australia, an area which is predicted to experience more frequent severe weather events into the future.

Vibriosis is an infection caused by *Vibrio* bacteria.

"Pathogenic species of *Vibrio* have been called the 'barometer of climate change' and our work supported this claim," said Prof Gibb. "More severe weather events are predicted in the monsoonal north and in our study a monsoon event coincided with an increase in two known *Vibrio* pathogens in artisanal harvest."

By including an edible snail — the *Telescopium telescopium*, or long bum snail, which is collected in the shallows by Indigenous peoples and lightly cooked or occasionally eaten raw — researchers could demonstrate accumulation in food rather than just water and sediment, which helped to show good eating times.

The research, which was funded by BNA and CDU's Faculty of Science and Technology, also expands the current understanding of the factors driving the abundance of potentially pathogenic *Vibrio* species in tropical estuaries.



SPECIES SPOTLIGHT

Detecting parasitic worms to safeguard crops in northern Australia

Northern Australia is home to key agricultural growing regions, including in Darwin, Katherine, Kununurra, Carnarvon, and Cairns. However, it is also recognised as a high-risk zone for plant pests due to its vastness, remoteness and high vulnerability to exotic incursions.

Plant-parasitic nematodes are tiny worms that feed on plant parts. They are one of the pests that are a major challenge in the production of grains, cotton, or horticultural crops.

The 'Understanding current and future impacts of plant-parasitic nematodes in northern Australia' project focuses on assessing the presence, distribution, and abundance of plant-parasitic nematodes in four key northern Australian crop-growing districts and enhancing plant-parasitic nematode diagnostic capacity. The project, which is led by Prof Maxine Piggott, Prof Chengyuan (Stephen) Xu and Dr Yujuan (Jady) Li of RINA, runs from 2023-2025.

"The impact of plant-parasitic nematodes on crops is often underestimated due to the below-ground nature of their damage and the complexity of accurate diagnosis," said Dr Li. "However, it is crucial to improve awareness and diagnostic capacity, because early detection and management of these pests are key to safeguarding crop productivity and supporting the long-term sustainability of agriculture in northern Australia."

Throughout 2024, the team collected soil and root samples across 72 sites, including farms, community gardens, and bushland. They were able to identify 16 kinds of plant-parasitic nematode, including two that were newly recorded in northern Australia. The project also delivered training sessions, stakeholder presentations, factsheets and a regional nematode distribution map, which helped

to engage stakeholders in the importance of nematode management and surveillance.

The next phase of the project will build on this foundational work. It will provide current data on plant-parasitic nematode presence and distribution in northern Australia, which will be presented in GIS-based nematode distribution maps for northern Australia to enable accessibility. Training and capacity building in diagnostics and surveillance will also be a key part of enhancing northern Australian biosecurity. The team will develop an industry-focused booklet to translate scientific findings into practical and accessible information.

This research is funded by the Northern Australia Biosecurity Strategy (NABS), Biosecurity Plant and Science Services Division, Department of Agriculture, Fisheries and Forestry, Australian Government.



Dr Jady Li conducts field sampling in an NT community garden, as part of a regional survey to detect and map plant-parasitic nematodes across northern Australia. Photo: Tisha Tejaya.

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 pathogens, opportunistic pathogens in water, microbial source tracking, and monitoring impact.



Darwin Centre for Bushfire Research

The Darwin Centre for Bushfire Research (DCBR) 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 is being applied through collaborations with international partners.

The centre's major ongoing projects include advising the North Australia and Rangelands Fire Information (NAFI) service, and 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.

Find out more at bushfireresearch.org.au.



North Australia and Rangelands Fire Information

RIEL's North Australia and Rangelands Fire Information (NAFI) service provides regularly updated satellite-based maps of fire activity across most of Australia.



Image: NAFI.

These maps allow land managers to better manage bushfires in rural and remote areas. The team also provides a range of fire histories and reporting tools that help land managers across these landscapes. NAFI services around 80% of Australia.

The NAFI service has been widely adopted by thousands of people across this large area, such as pastoralists, Indigenous rangers and NT Parks and Wildlife Commission rangers, and is now embedded in their practice. Building on the popularity of the website, the team also provides tailored products such as fine scale burnt area mapping to industry and government agencies.

The NAFI service underpins savanna burning greenhouse gas reduction projects across northern Australia and has played a key role in helping people reduce the frequency of wildfires across the north.

The NAFI team had a busy year in 2024. There was a large increase in the number of computers/servers accessing NAFI website maps in 2023 and, despite 2024 being a milder fire season, this usage rate was maintained.

Interestingly, around 80% of these map requests came from areas south of the far north where wildfires are more prevalent.

Access the NAFI service at 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, including testing and prototyping, remote sensing, surveillance, and guidance on airspace integration. Additionally, NACAS provides a range of pilot education, upskilling, and training programs.

In the past year, NACAS has successfully trained over 60 remote pilots in the NT, equipping them to operate drones safely and effectively. These trained pilots come from various sectors, including government, industry, schools, and private individuals. NACAS has also launched an On Country Indigenous Ranger Remote Pilot Training program aimed at enhancing capacity among ranger groups. This program enables participants to utilise drone technologies for environmental management and land care activities, promoting safe and effective practices.

NACAS's recent research initiatives have been focused on expanding the use of UAS across northern Australia including for remote community healthcare, coastal surveillance, weed and pest control, and large-scale environmental monitoring.

Looking ahead, NACAS will continue to advance policy and regulation around UAS, develop a drone innovation ecosystem for northern Australia, foster an educated and skilled workforce, collaborate with NT communities, and provide assistance to other researchers, government, and industry.

Read more at 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 CDU 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.

Read more at cdu.edu.au/rina.



An Australian humpback dolphin (*Sousa sahulensis*) plays in Bynoe Harbour, NT. This species is only found in the coastal waters of northern Australia and Papua New Guinea. Photo: Natalie Robson.

Collaborations

Partner organisations

RIEL collaborates and engages with a wide range of partners. The institute's valued partners come from across government, First Nations, industry, non-profit, community and research organisations.

In 2024, some of the many examples of RIEL's partners and collaborators included:

- > Arnhem Land Fire Abatement Northern Territory
- > Australian Centre for International Agricultural Research (ACIAR)
- > Australian Institute of Marine Science
- > Commonwealth Scientific and Industrial Research Organisation (CSIRO)
- > Department of Climate Change, Energy, the Environment and Water
- > Department of Agriculture, Fisheries and Forestry
- > First Nations land councils including current projects with the Tiwi Land Council, Northern Land Council and Central Land Council
- > Fisheries Research and Development Corporation
- > Indigenous Carbon Industry Network
- > Northern Territory Government
- > Terrestrial Ecosystem Research Network
- > Territory Natural Resource Management
- > Thamarrurr Development Corporation
- > Yagbani 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 not only support strong outcomes for commissioning organisations, but also contribute to building local capacity in research and to increasing understanding of local ecosystems.

Consultancy services available from RIEL's centres and teams include:

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

Students and alumni

RIEL is home to a large cohort of students every year who are striving toward honours, MRes, or PhD qualifications. The institute also remains closely connected with many of its alumni. The journeys of three student members are showcased below.

Producing practical recommendations for bilby conservation

Over a multi-year journey, Dr Hayley Geyle completed a valuable PhD project focused on the ecology of the greater bilby. The work centred on improving understanding of the ecology, distribution, and abundance of the bilby in arid and semi-arid Australia, particularly in the NT which is one of the species' last remaining strongholds.

Dr Geyle investigated how fire and predation by introduced species affect bilby populations, using a combination of field surveys, genetic sampling, ecological modelling, and Indigenous knowledge. The research produced practical recommendations for bilby conservation and highlighted the value of collaborative approaches that integrate Indigenous knowledge with ecological science.

She submitted her PhD — titled 'Conservation ecology of the greater bilby (*Macrotis lagotis*)' and supervised by RIEL's Prof Sam Banks with Assoc Prof Christine Schlesinger, Prof Brett Murphy, the University of Sydney's Prof Chris Dickman, and TNRM's Dr Kelly Dixon — in late 2024. Prior to commencing her PhD in 2021, Dr Geyle also worked as an assistant researcher at RIEL for several years.

"One of the best parts of being at RIEL was the support and camaraderie from other students," said Dr Geyle. "Being based in the NT also meant I could work on practical

conservation issues in collaboration with Indigenous rangers, which really shaped my research."

During her candidature, Dr Geyle presented at several conferences, both in Australia and overseas. She notes that a particular highlight was co-presenting with North Tanami Ranger Helen Wilson at the 2024 Ecological Society of Australia Conference, where they received the Bush Heritage Award for Best Spoken Presentation Demonstrating Right-Way Science. Alongside such achievements, the project also had its share of challenging moments.

"If I'd known in advance how challenging my PhD would be, I might have thought twice about starting it — but I'm glad I didn't. The skills, relationships, and perspectives I gained throughout the project and my time at RIEL made every challenge worth it," she said.

Dr Geyle is now continuing work that she began during the PhD in a hybrid role that combines applied conservation and research with TNRM and the Northern Institute. This allows her to stay involved in on-ground projects while also contributing to research that supports cross-cultural approaches to ecological conservation.



Photo: Sarah Maclagan.

Preserving genetic diversity of endangered rabbit-rats



Bryn Pickering focused closely on brush-tailed rabbit-rats (*Conilurus penicillatus*) during his honours year. In particular, he aimed to evaluate the viability of a population of rabbit-rats that were translocated from mainland Cobourg Peninsula onto Greenhill Island, within Garig Gunak Barlu National Park in the NT.

Rabbit-rats are a rodent that have faced significant population declines in recent decades due to threats such as feral cats and intense fires, and are listed as endangered in the NT. Mr Pickering's work contributed to important efforts to support rabbit-rats' population growth and to preserve genetic diversity of the species.

His honours project, 'Evaluating the short-term success of a translocation of Brush-tailed Rabbit-Rats at Cobourg Peninsula', ran from early 2023 to early 2024 and was supervised by RIEL's Prof Sam Banks and Prof Brett Murphy with Territory Natural Resources Management's (TNRM) Dr Kelly Dixon.

The translocation itself was managed by TNRM, with the first translocation event taking place in August 2023. In total, 46 rabbit-rats were moved onto Greenhill Island, 29 of which were fitted with radio-transmitting collars and tracked over a 3-month period. The team was able to confirm that 18 of the collared animals survived beyond

the 3-month tracking period, with ongoing monitoring also indicating several breeding events on Greenhill Island.

Using the survivorship results from radio-tracking and demographic parameters from previous studies on the species, Mr Pickering simulated the population trajectory and genetic drift in different scenarios in order to bolster genetic diversity. Whilst he found in most cases that population growth would be high, the best scenario for preserving genetic diversity was to perform supplementary translocations of 10 to 20 animals every 2 years.

"The opportunity to be involved in this project came about because alumni are so eager to collaborate and get new students involved, which I am very grateful for," Mr Pickering said. "Studying at RIEL provided an excellent opportunity for personal growth and development."

Following his honours year, Mr Pickering began working as an ecologist for TNRM projects on the Cobourg Peninsula and more broadly in western Arnhem Land. In 2024, he was involved in a supplementary translocation in which a further 20 rabbit-rats were moved to Greenhill Island, indicating that translocation efforts have been effective so far.

Project examines fisheries and aquaculture work through gender lens



Photo: Nur Isiyana Wianti.

Nilanjana Biswas's PhD project explores the under-researched role of women in the NT's commercial seafood sector. Using a gender lens and mixed methods, it examines historical contributions, structural barriers, and policy impacts, making it one of Australia's first studies in this field.

Initial findings have revealed that, despite institutional and domestic constraints, women actively contributed to the seafood industry, particularly before the 1980s, in diverse harvest, postharvest, and support roles. However, increasing commercialisation and efficiency optimisation in later years constrained women's participation, highlighting the need for inclusive policies that support regional employment, equity, and local value retention to enhance women's economic participation and sector sustainability.

The project, 'Changing times, changing tides: Women's engagement in the Northern Territory seafood sector', began in mid 2023 and is supervised by RIEL's Prof Natasha Stacey and the Northern Institute's Dr Kate Golebiowska.

Ms Biswas notes that RIEL's interdisciplinary

and applied research environment has provided valuable access to national networks, industry partnerships, and sector-wide engagement. She highlights that the NT offers a distinctive context for her work, with its remote, regional and tropical fisheries presenting diverse challenges and opportunities, including the under-examined role of gender in seafood production processes. She also emphasises that the strong support and sense of community among RIEL staff and students have greatly enhanced her PhD journey.

"RIEL offers scope for multidisciplinary research to understand real-world change in fisheries, with a focus on gender inclusion and strong industry and sectoral engagement," Ms Biswas said.

Over the course of her studies so far, Ms Biswas has been recognised through various awards, including a National Industry PhD Program Award in 2023 and a Women in Seafood Australasia bursary to attend the Seafood Directions Conference in Hobart in 2024.

Ms Biswas anticipates submitting her thesis in late 2026 and hopes to extend her interactive, multidisciplinary engagement with the seafood sector into the future.

Outreach and engagement

RIEL carries out a range of communications and outreach activities every year. Some highlights from 2024 are outlined below.

Research seminars

The 2024 RIEL Seminar Series comprised 20 seminars between February and November. As many as 26 different speakers presented their work, with topics ranging from artificial intelligence to fire management and fisheries resources. Most seminars were available both in person and online, and all were open to students, staff, and the public. There were 13 speakers from RIEL, alongside 13 speakers from external partners such as the CSIRO, Northern Institute, Philippine Eagle Foundation, Terrestrial Ecosystem Research Network, University of Tasmania, and Wageningen University. The quality of the series was further improved on the previous year. Each seminar reached around 50 people on average.

Strategic events

Together with CDU, NAFI and DCBR, RIEL was a gold sponsor of the Indigenous Carbon Industry Network's North Australia Savanna Fire Forum in February. RIEL was also a gold sponsor of the Territory Natural Resource Management Conference in November. This provided exposure and engagement opportunities for RIEL researchers, as well as continued partnerships and support for these important sectors. RIEL also provided assistance to other internal and external events over the year, such as the Inland Water Carbon Workshop; Encountering Maritime Northern Australia Symposium; IUCN SSC Crocodile Specialist Group Working Meeting; Northern Territory Aquaculture Research, Development and Extension Workshop; and First Nations Clean Energy Solutions Forum.

Media coverage

RIEL saw a total of 258 direct mentions in media coverage during 2024, with a potential audience reach of 546 million, as reported by the CDU media team. This was an increase from 142 direct mentions the previous year. Individual RIEL researchers received significant amounts of coverage on top of this. For example, Prof Stephen Garnett saw 214 direct mentions over the year on subjects like invasive species, endangered birds, and taxonomy, while Prof Karen Edyvane achieved at least 192 mentions primarily focused on blue whales and Dr Cameron Baker saw 182 mentions mostly relating to crocodile safety.



Through displays, workshops and information sharing, researchers from NAFI, DCBR and RIEL played a major role in the 2024 North Australia Savanna Fire Forum, an important conference held annually in Darwin.

Other achievements

- The RIEL Conference, a daylong hybrid event, was held in December with around 90 people in attendance. The theme was “Showcasing the work of early career researchers”. A total of 14 researchers presented their work to fellow RIEL members and invited partner representatives.
- RIEL, RINA and NACAS had a strong presence at CDU's Casuarina Open Day in August, where the team shared information about environmental science and research opportunities with prospective students. This included interactive displays on groundwater sampling, water resources, LiDAR technology, and drones.
- In collaboration with CDU's media and marketing teams, 36 stories showcasing researchers' work were published on the website or in newsletters throughout the year. These covered a wide range of RIEL projects, including work from RINA, NACAS and NAFI.
- Working together with UniPrint, the RIEL team created a set of postcards to accompany other existing printed materials such as flyers and posters. These provide a lightweight option to share information during events, partner visits and meetings.
- RINA saw a strong push in terms of its profile and branding in 2024. RIEL supported RINA to create a new logo and identity, and to launch a new website. This provided immediate benefits ahead of an official RINA launch event in April.
- RIEL installed new signage across four buildings used by RIEL members in 2024. This contributed to greater awareness of RIEL's teams and presence at Casuarina campus, and also improved building access and accuracy of information.
- RIEL installed new wraps on its vessels Sea Jay, Tyeyu and Manbiri in 2024. This helped to meet vessel regulations and branding requirements, and also provided an opportunity to highlight important species that are a focus of aquatic research.



A bird's eye view of estuarine crocodiles (*Crocodylus porosus*) basking amid green vegetation at Corroboree Billabong. Research is continuing to unravel the ecological importance of crocodiles across the NT. Photo: Cameron Baker.

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