



Indian Ocean Territories Research Prospectus

July 2021

Purpose and vision

Purpose statement

The Indian Ocean Territories (IOT) Research Centre will leverage the unique natural environment of the IOT to conduct contemporary world class research. It will strengthen Australia's international reputation in education and research, while diversifying the economy of the IOT to create a sustainable driver of economic growth. Through research and training programs tailored to the needs of the communities of the IOT, the Research Centre will promote the IOT as a world leader in research and education on small, remote islands, act as an agent of positive change, and empower the people of the IOT through educational opportunities.

Vision for the Research Centre

The IOT Research Centre will aim to be a best practice model for remote research that emphasises the importance of sustainability. It will support the IOT to realise the true potential as environmentally and economically sustainable remote islands that leverage the unique environments, cultural diversity and opportunities for research to benefit the communities.

The IOT Research Centre will focus on aligning with community aspirations, offer community benefits and contribute to diversifying and growing the economies of the IOT. It should strive to provide the IOT with:

- Increased economic activity and local jobs, both direct (e.g. performing research and operational roles) and indirect (e.g. catering, accommodation, and equipment and facilities maintenance).
- Training and education programs, both for locals, and to attract (and possibly retain) visitors.
- Diversification of the economies of the IOT by establishing and promoting new and emerging industries such as eco and edu-tourism (e.g. citizen science projects/talks by visiting scientists to the local community and tourists).
- Improved access to technology (e.g. potential use of Research Centre information technology by the community, including opportunities in citizen science).

Research areas of focus

The IOT present unique opportunities for research and education that could contribute to identifying and reducing gaps in global knowledge. Opportunities are presented not only through endemic species, biodiversity and unique ecosystems, but also the challenges that face isolated and culturally diverse island communities. To fit with the broader aims of economic growth through conducting world class research, the scope of research encouraged at the Research Centre should not be limited. Consideration should be

given to all research areas where there is an appetite for research, potential interest from research organisations, and a demonstrated benefit to the Islands.¹

There are opportunities to leverage research into direct outcomes for the community, including knowledge gain and discovery, job opportunities, diversification of public life and improved infrastructure. There would also be indirect outcomes through economic improvement (e.g. development of ecotourism). Additionally, it will assist with the protection, management and appreciation of the IOT's natural resources.

The natural environment

The unique natural environment of the IOT is an integral aspect of life and an important point of pride for the communities. The unique biodiversity of the Islands of high research interest. The success of the Research Centre will, in part, rely on research that leverages this unique natural environment.

Some of the features of Christmas Island's (CI) terrestrial environment include: 85km² of national park, rainforests, endemic species, wetlands of international importance and a unique annual red crab migration. The Cocos (Keeling) Islands (CKI) consists of 27 islands (total approximate area 14 km²), including Pulu Keeling National Park. Wildlife consists primarily of seabirds, such as frigatebirds, boobies, land crabs and mutton birds. Many of the animals are unique to CKI and are protected under the *Environment Protection and Biodiversity Conservation Act 1999*.

Natural terrestrial and marine sciences

CI has more than 250 endemic species, complex ecological systems and largely unperturbed marine systems extending from the shore to very deep water within the CI and CKI Exclusive Economic Zones. It presents unique research opportunities in island ecology, taxonomy, plant and animal genetics, marine parks, and biodiversity conservation.

There will also be opportunities to address the incomplete inventory and understanding of marine and terrestrial species and related ecosystems. Additionally, there is the opportunity to monitor environmental restoration following mining environments in a closed environment. Novel marine bio-products are also an emerging area of industry and research interest.

Biosecurity

The remoteness and unique flora and fauna of the IOT present opportunities for biosecurity research, including monitoring of the impact of invasive species on threatened species and ecosystem restoration, and methods for protecting the unique biodiversity of the Islands. There are a number of specific topics that could be investigated, including:

- Impacts of yellow crazy ants on the red crab population and the entire ecosystem of CI.
- Eradication of invasive species (e.g. wolf snake, giant centipede, cats, rats, fruit flies and various weeds).
- Study of animal diseases (e.g. lizard disease).

Sustainability

There are opportunities in exploring and becoming leaders in how to adopt a circular economy model that ensures economic benefit is driven by sustainable practices. This could include sustainable food production, waste conversion into viable bi-products, bio-waste into soil fertility and renewable energy

¹ The Research Prospectus will not highlight which research areas should be considered critical and those that could be considered non-essential or aspirational. However, it will be important to identify priority research areas for the Research Centre at a later date. Prioritisation could be based on urgency for knowledge to make a difference globally, or the potential for economic development. There are also a number of broader strategic documents, including the National Marine Science Plan and the United Nations Sustainable Development Goals, which could provide insight into Australian and global research priorities, and highlight the broader impact of research and relevance beyond the IOT.

systems for low temperature storage. The Research Centre could also focus on exploring low emissions technology, energy provision, energy security, micro-grids, and high-tech intensive agriculture.

There are also opportunities for tropical architecture, including building and maintaining infrastructure on a tropical marine climate on remote islands, incorporating new technologies, environmentally sustainable buildings, and managing heat load and rust.

Climate change

The natural assets and biogeographic positions of the IOT provide opportunities for long-term monitoring of climate change impacts on marine, terrestrial and built environments. Additionally, there could be a focus on how climate change has impacted ecological processes, and the level of resilience of the Islands' flora and fauna to the impacts of, and adaptation to, climate change.

Agriculture, aquaculture and food

Both CI and CKI currently have limited ability to produce fresh food. Fresh food is expensive and generally imported from mainland Australia. Innovative agricultural production presents an opportunity for local sustainability and export markets (e.g. small scale local food processing). Production of food in the IOT could have a wide range of benefits for the community, including waste reduction, lower costs and dietary improvements. There is also the potential to link intensive agricultural production, renewable energy, organic waste management and water treatment technology development.

Despite the lack of farming land on CI and CKI, there are opportunities for studying innovative and niche agriculture. This could include research into food science, vertical farming, growing tropical niche agricultural products, tropical aquaculture (that is sustainable and does not damage the environment), open water aquaculture, and horticulture. This could also open new export industries for the Islands.

Vertical farming (the practice of growing crops in vertically stacked layers) could provide the Islands with fresh food and mitigate land availability issues. Combined with new or innovative horticulture, this would not only provide fresh food for the Island, but could open export markets.

Aquaculture (the breeding, raising and harvesting of sea-animals and aquatic plants) presents an opportunity for the IOT to capitalise on the unique and extensive marine environments of the Islands. This could also assist the IOT to realise the benefits associated with aquatic foods. Aquatic foods are more environmentally efficient than other animal-based protein sources, and are rich in nutrients and fatty acids essential to healthy childhood development.

The IOT has potential for both onshore and offshore aquaculture, including:

- Onshore aquaculture can explore novel feedstocks such as use of black soldier fly larvae (BSFL) as fish meal replacement. BSFL can be incorporated into organic (e.g. horticultural) waste management with processing systems being high or low tech.
- Offshore aquaculture could focus on open-water aquaculture in a vigorous tidal zone on CKI.

It is important that any implementation of aquaculture or agricultural methods embraces the needs and expectations of the community, and is sustainable (e.g. researching best practice mine-site rehabilitation for agricultural purposes).

Health and medicine

There are a number of areas of health and medicine that could be studied in the IOT. These range from the types of medicines that could be derived from the natural environments of the IOT, to the delivery of health services to remote-island communities. Initial ideas for the Research Centre to focus on include:

- Plant-based medicine: there may be opportunities in tropical health and medicine. The natural environments of the IOT may provide opportunities for pharmaceutical and biochemical discovery.

- Mental and physical health: areas could include mental health in remote communities (e.g. differences between mental health of children and adolescents comparatively to the mainland), and opportunities to improve nutritional outcomes through dietary change towards more locally produced products. Additionally, community nutrition and wellbeing, lifestyle diseases (such as current studies into the prevalence of diabetes on the Islands), strategies to improve mental health in remote islands, and the intersection between health and agriculture (e.g. medicinal cannabis).
- Health services: there may be opportunities to study remote health delivery (e.g. tele-health services) and the impact of isolation, including lack of fresh food, on community health.

Waste

Remote, small-island communities such as the IOT present unique and difficult challenges with waste management. The Research Centre will provide opportunities to explore alternative waste management practices that can overcome these challenges, such as dealing with marine debris plastic waste, local plastic recycling, integrating organic waste management into soil improvement and aquaculture feedstock.

Circular economy

Small-island communities, with finite resources that are heavily reliant on freight, can provide an opportunity for research in the ‘circular economy’. A circular economy is a system which seeks to eliminate waste production and pollution while promoting sustainable development. These goals are achieved through reducing waste, reusing materials and recycling. As much as possible, instead of being discarded, materials and products are repurposed and recirculated within the system. A circular economy is underpinned by a transition to renewable energy and can ultimately provide economic, social and environmental benefits for the community.

Given sustainability will be key to the Research Centre, the concept of circular economy could be of major benefit to the IOT more broadly. It may also help in developing a more self-sustaining economies on the Islands.

Social sciences

The IOT are multi-faith and multi-cultural communities, with CI and CKI’s existing social research projects showing an ongoing research interest in the region. Further research opportunities could include how to support CKI’s goal to establishing ‘Muslim friendly tourism’.

Achieving the Research Centre’s vision

The living laboratory

The Research Centre can integrate the various research areas of focus through the concept of the ‘living laboratory’. A living laboratory, in contrast to a traditional laboratory, operates in a real-life context with a user-centric approach, where research and outcomes are actively integrated into the community. Living laboratories are user-centred, iterative and open-innovation ecosystems, operating within a region. With direct engagement and collaboration between locals, researchers, and other Research Centre visitors, a living lab can produce and test research outcomes across a wide range of issues directly relevant to the people of the IOT. In practice, the IOT could become a living lab for sustainable production of high quality food, or provide research and educational opportunities for the local population, research community and industry. Ultimately, this could also lead to expanded economic opportunities for the communities.

A living lab can also be a model for other remote communities, in the areas of food security, employment, and increased self-determination and maintenance of culture. In time, with a solid foundation and development of the living lab concept, the Research Centre could become an Indo-Pacific node for developing cutting-edge solutions for the region. This could translate into an international training centre in this area and other circular bioeconomy innovations.

Non-research opportunities

There are opportunities to engage the community and implement new technologies and methods at the Research Centre, such as prioritising green technology and investing in telecommunications/internet infrastructure that could be used by the community. There are also opportunities to engage with local and non-local partners to bring visitors to the island, such as workshops, special events, and unique corporate retreats and team building.

Educational opportunities

Education will be a core pillar of the non-research opportunities of the Research Centre. The Research Centre should focus on providing educational opportunities to all residents of the IOT. It could be linked with the local community through scholarships and involvement for local students and activities that align with the curriculum. With better communications infrastructure, it could be a hybrid approach of on-island and virtual learning, allowing Australian and international educators to connect with students both virtually and in person.

Tourism and visitor offerings

The Research Centre presents an opportunity to expand and diversify the tourism and visitor offerings in the IOT. Tourism and visitor offerings linked to the Research Centre could include:

- Bike tours, including virtual mountain biking offerings.
- Eco-tourism.
- Edu-tourism (e.g. unique intensive short or boutique courses that target specific student audiences, including undergrads, advanced graduates, naturalists and adventure tourists).
- Interactive Visitors Centre (e.g. displays, lectures, videos and games).
- Themed visitor encounters (e.g. 'science week' or 'be a marine biologist for a day').

Environmental sustainability

An overarching aspiration of the Research Centre should be to strive for best practice environmental sustainability. A strategic plan to outline how the Research Centre will achieve best practice in design, implementation and maintenance would assist in achieving best practice, but also act as a best practice guide for other remote-island research stations.

Financial sustainability

The Research Centre should focus on areas where it will have a strong competitive advantage to ensure it has a strong and sustainable foundation to build upon. In particular, attracting self-funded student research trips may help build a strong foundation, as the students act as economic multipliers. The Research Centre should have a strategic plan to attract international and domestic partners, researchers, students and eco-tourists. The Research Centre should identify drivers to attract partners that will invest in CI over the long term. Research priorities could also align with national and global research priorities to ensure broader impact of research and relevance beyond just the IOT.

It should also look to manage community expectations around the transition from research to tangible outcomes, to ensure expectations are realistic.

Positively impacting the community

Research should feed back into the community and environment, and the Research Centre should focus on employing locals where possible. Co-design is essential, taking into account community sentiments and aspirations, including employment, economic stability, and cultural and socioeconomic goals.

Background

The Research Centre

The development of a Research Centre is part of a broader economic diversification process for the IOT. In 2019, the Australian Government announced a \$4.2 million economic diversification package for CI to create jobs and ensure long-term economic sustainability. As part of this package, the Hon Nola Marino MP, Assistant Minister for Regional Development and Territories, hosted a Research Roundtable on 28 February 2020. The Roundtable discussed opportunities to capitalise on the Island's unique ecosystems, endemic species and conservation value, and explored the potential for a Research Centre on CI. The IOT Research Prospectus was developed by the IOT Research Working Group, which emerged from the Research Roundtable.

The development of a Research Centre in the IOT also supports the objectives outlined in the CI Strategic Plan. *Our Christmas Island 2030 Strategic Plan* considers research and education to be one of the three future pillars of CI's economy, alongside tourism and agriculture. The Strategic Plan recommends investigating opportunities for universities and other research institutions to be involved in the development of a Research Centre focusing on the environment.

Our Cocos (Keeling) Islands 2030 Strategic Plan similarly emphasises the importance of international partnerships and educational opportunities, including determining 'the appetite from universities on the mainland to establish a marine research facility in the IOTs, and ensure joint benefits for CKI and CI'.

The Indian Ocean Territories

Collectively known as the IOT, CI and CKI are located 2,600km and 2,900km north-west of Perth respectively. They are home to an abundance of unique species of birds, crabs and marine life.

CI is 63% national park, containing rainforest, beaches, caves, freshwater streams and waterfalls. There are a number of unique flora and fauna, including Golden Bosun birds, the endangered Abbott's Booby, Frigate birds, and the famous red crabs. The summit of a submarine mountain, the central plateau of CI rises to 361 metres above sea level. There is 80km of coastline with sea cliffs ranging up to 20 metres high. The Island is dominated by rainforest and is surrounded by a coral reef, with virtually no coastal shelf.

CKI consists of 27 coral islands, with a total land area of approximately 14km². The islands form a horseshoe shaped atoll surrounding a lagoon, with the exception of North Keeling Island, which is approximately 30km from the main cluster. North Keeling Island was declared as Pulu Keeling National Park in 1995 and is administered by Parks Australia. Wildlife consists primarily of seabirds, such as frigatebirds, boobies, land crabs and mutton birds. Many species are unique to CKI and are protected under the *Environment Protection and Biodiversity Conservation Act 1999*.

Challenges in the IOT

There are a number of barriers to economic sustainability and growth in the IOT. A Research Centre will not only need to overcome these challenges if it is to be successful and sustainable, but it also has the potential to play a role in addressing them.

Economic barriers and challenges

- Transport: access to the islands is limited, as flights and cargo shipments are expensive and infrequent. There is a lack of available transport for hire and infrastructure is limited on both CI and CKI.
- Business: telecommunications and mobile internet infrastructure available in the IOTs are lacking, and there are limited options for affordable insurance. The small and transient population base of the islands limits the supply of skilled labour.

- Tourism: there is limited tourism and visitor infrastructure throughout the IOT. This was particularly evident during the COVID-19 travel bubble with Western Australia, which has attracted tourists and visitors to the IOT.
- Agriculture: there are limited options for traditional agriculture due to many factors, including topography, climate and pests.
- Education: school leavers do not have many educational or career opportunities, and many choose to leave for the mainland to continue studying or start their careers. There is little economic incentive for them to return to the IOT as there is a shortage of professional jobs.

Research barriers and challenges

- Logistics and connectivity: researchers will need to address limitations with the type and quality of accommodation, sporadic access to the internet, vehicle and taxi hire, logistical issues with large amounts of equipment required for research and the possibility flights are cancelled or delayed on short notice due to inclement weather.
- Community and stakeholder engagement: lessons learned from previous research projects have highlighted that gaining priority access to some facilities can be dependent on local contacts. It is important for researchers to understand that using existing resources and leveraging local knowledge can be imperative for the success of their projects.
- Weather and seasonal challenges and opportunities: fieldwork can be dependent on seasons, and there can be significant issues with water access.