

# Summary

**6th Biennial Fraser Island Conference  
Organized by the Fraser Island Defenders  
Organisation**



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## **Sand, Sea and Sun**

**Wednesday 12th August, 2015  
Innovations Centre  
University of the Sunshine Coast  
Sippy Downs**

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**University of the  
Sunshine Coast**  
Queensland, Australia



# Sand Sun and Sea — Fraser Island (K’Gari) Conference

On 12 August more than 100 delegates attended the 6th Biennial Fraser Island Conference at the University of the Sunshine Coast at Sippy Downs. It was the best attended Fraser Island (K’Gari) conference yet. It provided a wealth of information about the world’s greatest sand island and what is being discovered to help it be better appreciated and better understood. The island is much more than sand as the speakers made clear and is affected by and affects the marine environment surrounding it. The weather was most pleasant as was the venue and the catering. It was judged to be the best yet Fraser Island conference.



For the Conference FIDO commissioned three banners that helped set the stage quite literally.

**Butchulla Welcome:** Delegates were welcomed by Butchulla elder **Glen Miller** a member of the Fraser Island Indigenous Advisory Committee who gave a commentary on how the granting of Native Title had been needlessly protracted and frustrating to the Butchulla but had delivered so little by way of benefits beyond exemptions from vehicle and camping fees.



There were quite a few Butchulla who took up FIDO’s offer of free registration and we expect this number to grow even more for subsequent conferences. It was appropriate that

instead of the usual welcome to country that since Sippy Downs isn’t Butchulla land and but that it

was dealing with K’Gari the Butchulla traditional land that a Butchulla welcome delegates.

FIDO though has noted that the George Haddock Track can’t be completed without Native Title approval and that the proposed Butchulla approval and support for the proposed Light Rail between Kingfisher and Eurong Resorts can’t become a reality without Butchulla approval. While the Native Title over K’Gari may initially seem tokenistic it becomes increasingly relevant to Fraser Island as we move forward. This was also a message explicit and implicit in many of the subsequent presentations particularly by Prof. Greg Hill who opened the Conference.

**Opening: Prof Greg Hill** has a long association with Fraser Island dating back to his post-graduate work. He is now Vice Chancellor of the University of the Sunshine Coast, He described how his research studies whilst at University of Queensland had introduced him to the incredible satellite imagery of Fraser Island’s “top end”.

This GIS technology impressed both him and subsequently his students. However, it gave him a familiarity with the island that endured during the many years when he was based in Darwin. He did note that having observed the island as a geographer he had concern for the fire regime being implemented. Concern about fire became a recurring topic during the day.

Prof Hill outlined the University of the Sunshine Coast’s commitment to make increasingly better use of Fraser Island as a research and educational facility. He expressed some frustration that it had taken a decade for the USC to get permission to replace the bridge across Govi Creek that the QPWS had removed just as the USC took over this facility,

## Keynote Address

**Prof Ian Lowe** is also an adjunct Professor of USC and a most eloquent speaker whose depth and breadth of knowledge on his topic as well as his humour, analogies, and imagery made it a delight to listen to him. His presentation was titled “**More sun, more sea, more sand? Climate change and K’Gari**” and focused on the impacts of climate change globally as well as bringing them home to Fraser Island. Coincidentally his presentation was made more topical by the release on the eve of the Conference of the Australian Government’s lamentably low carbon emissions reductions target proposed to be taken to the United Nations Climate Change in Paris. This added more relevance to his Keynote address. He spoke of the impacts that can be anticipated for Fraser Island (K’Gari) that will be more severe the further behind global governments fall in reducing their carbon emissions. Climate change was a topic that received a mention in every single presentation at the conference.

Ian began by pointing out that Australia’s State of the Environment Report had been sounding warning bells for decades with statements including, “Australia has some very serious environmental problems. If we are to achieve our goal of ecological sustainability, these problems need to be

dealt with immediately. The problems are the cumulative consequences of population growth and distribution, lifestyles, technologies and demands on natural resources.” The 2011 report noted, “Other parts of the Australian environment are in poor condition or deteriorating... Our

changing climate, and growing population and economy, are now confronting us with new challenges.”



### **Prof Ian Lowe A delivering the keynote address**

GEO 5 more recently summarised the global situation noting that “current observed changes to the Earth systems are unprecedented in human history” and “several critical global, regional or local thresholds are close or have been exceeded ... abrupt and possibly irreversible changes to the life support functions of the planet are likely to occur”.

The most sobering aspects of his presentation were that the 1980s was the warmest decade ever but that the 1990s were

even warmer with every year being above the 1980s average and worse that the 2000s are warmer still with every year being warmer than 1990s average. The implications for K’Gari are:

- Rising sea level
- Increasing average temperature
- More extremely hot days
- Increased fire risk?
- More severe cyclones?
- Habitat changes

Ian’s Keynote cited the alarming loss of species pointing out Earth’s 6th great mass of species extinctions was already underway. His integrated approach to climate change is to manage what we can’t avoid and to avoid what we can’t manage. He suggested monitoring rising sea level, preparing contingency plans, observing habitat changes, having an effective fire plan and preparing for cyclones

He called for an energy revolution that would reduce use of fossil fuels, develop clean energy supplies and convert efficiently to services He suggested that the impacts of climate change could be mitigated on K’Gari by: moving toward a low – carbon energy on K’Gari through establishing a light rail line or network. He also suggested the need to reduce the use of private vehicles and to limit visitor numbers?

## **Other Speakers**

**In the last three sessions there were a dozen different speakers on a broad range of topics all of which had relevance to Fraser Island (K’Gari).**

### **Fire Patterns of South East Queensland Great Sandy Region in a Global Context**

**Philip Le C. F. Stewart, University Queensland’s School of Geography, Planning and Environmental Management**

**Patrick T. Moss, University of Queensland’s School of Geography, Planning and Environmental Management**

**Abstract:** *Fire is an important driver in ecosystem evolution, composition, structure and distribution, and is vital for maintaining ecosystems of the Great Sandy Region (GSR).*

*Charcoal records for the area dating back over 40, 000 years provide evidence of the great changes in vegetation composition, distribution and abundance in the region over time as a result of fire. Fires have shaped landscapes and ecosystems, creating fire-dependencies and fire disturbance-adapted flora and fauna with traits to survive fire, such as resprouting post-fire and serotiny of cones and fruit for example. Paleo-records and modern observations show a definitive link between fire and climate (temperature and precipitation), with an increase in fire with increasing temperatures. Strong evidence exists of a warming of the atmosphere which is seeing an increase in warm El Nino Southern Oscillation (ENSO) years with a weakening of the Walker circulation over the past decades. Present data saw that there has been an increase in width of the tropical belt of between 2o to 4.8o latitude north/south over the past 30 years. This has serious implications as in a warmer world there will be an increase of wildfire risk. Of importance is the*

*understanding of the interactions between multiple drivers of fire regimes from the past and present remembering that no single driver can explain past fire patterns and many events may be the result of multiple drivers interacting on differing temporal and spatial scales. This understanding is critical for developing fire regime management protocols for the Great Sandy Region and other similar fire-prone regions into the future.*

**Phillip Stewart** presented fascinating information about past and present fire regimes.

The first charcoal evidence extends back 440 million years with extensive charcoal deposits appearing around 345 to 2.5mya in the pre-human era and linked to fluctuations in atmospheric oxygen levels.

Aboriginal burning began as early as 45,000 years ago in NE Qld. Persistent warm ENSO ~800 to 500 years ago and drought – flammable vegetation and burning but the most significant change in fire regime occurred with European settlement

Our present fire regimes are related to latitudinal gradient in summer monsoon activity

- Frequent low intensity fires in monsoonal north
- Fire frequency has increased in recent decades as have wildfires due to natural and anthropogenic change
- Our fire seasons are becoming longer and there is a definitive link between fire and climate

The future fire regimes are uncertain due to the uncertainty of interactions between fire and anthropogenic induced climate change. However increased drought, higher

temperatures and reduced precipitation lead to the probability of

- More frequent fires
- More intense fires; and
- An increased in length of fire season

Phillip's graph showing the frequency of fires on Fraser Island (K'Gari) based on charcoal evidence showed a significant increase in fire frequency about 6,000 years ago. It is not yet known whether this was due to Aboriginal activity, sea-level rising or ENSO. The fens though are proving to hold some important data.

### **Is the answer blowing in the wind? Towards an environmental history of the Fraser Island/K'Gari dune fields**

**Prof Jamie Shulmeister, University of Queensland's School of Geography, Planning and Environmental Management**

**Abstract:** *Fraser Island is the world's largest sand island (c. 800 km<sup>2</sup>) and in association with the adjacent and contiguous Cooloola sand mass, is the terminus of the longest downdrift sand system on the planet. The dune fields contain one of the best archives of environmental change in the Australian sub-tropics but are remarkably little investigated. Here we propose to decipher the climate and sea-level relationships of the dune sequences at a variety of scales from decadal to multi-millennial. We will test hypotheses of dune activation and stabilisation due to storms, sea-level change and climate (rainfall and winds) and determine the long term variability of climate and environment in this globally significant region. The work will test rival hypotheses about the formation of parabolic and transgressive dune fields and the impacts of sea-level rise. It will contribute critical information to debates on inter-hemispheric climate connectivity and the climate impacts of cyclones and oscillatory climate systems. It will also provide fundamental knowledge to underpin the Outstanding Universal Value of Fraser Island, which has been declared a World Heritage Area based on its dune fields and the unique hydrology and biota of its dune field.*

**Prof James Shulmeister's** presentation discussed an Australian Research Council Discovery Project with collaboration from USC, UMass-Boston, Utah State and University of Nebraska.

He summarized the special qualities of Fraser Island (K'Gari).

1. It is the largest downdrift sand island and has world's best developed soils
2. Declared a world heritage area substantively because of the dunes and the dune soils (giant podzols)
3. What we know about the dunefields has been drawn mostly from Cooloola and not Fraser/K'Gari

He explained how the sand is moved over 1000kms from the south by littoral currents but it then either ends up on K'Gari or is lost to the ocean

From the sand deposited multiple phases of dune formation can be detected

The ARC Team aims to date the dunefields using **luminescence dating** again. It is an intensive campaign with preliminary work carried out at Cooloola. It will also investigate the soil forming processes to determine the

environmental conditions at the time the dune soils are constructed. It will also investigate the causes of dunefield activation from aerial photographs and core sections

Some early insights so far gained from this study to continue for the next three years include:

- That while in some places the simple stacked model of Thompson works, in many locations the top 1-2m's has little to do with the rest of the dune.
- All the dune types on Fraser/K'Gari are associated with development of dunes in vegetated areas -- it was never very arid
- The dunes are unlikely to be the result of stronger winds but may still be glacial age
- There is 'cool stuff' happening in the soils
- Surprisingly the Cooloola and Fraser/K'Gari are separate systems.

### **Rare earth element fractionation as a marker of weathering history in giant podzols**

**Dr Talitha Santini, University of Queensland**

**Abstract:** *Fraser Island and the Cooloola Coast form the terminus of the longest downdrift sand system on the planet. Giant podzols (extending to >20 m depth) have formed over the long weathering history of the sand dunes in this system, containing buried and truncated soil profiles as a result of periods of dune erosion and building in response to climate change and sea level fluctuations. These dunefields therefore contain one of the best archives on environmental change in the Australian sub-tropics. Our project combines geomorphology, geology, geochemistry, sedimentology, and paleoclimatology to test exactly how these large sand islands form over millennial timescales and determine the long term variability of climate and environment in this globally significant region. It will also contribute critical information to debates on inter-hemispheric climate connectivity and the climate impacts of cyclones and oscillatory climate systems.*

**Dr Talitha Santini**, explained the work that she and a team from University of Queensland are doing to establish if rare earth elements (REE) can be used as markers of weathering intensity and climatic history in giant podzols. It was a complex and fascinating study to complement the work other members of the UQ team are doing to establish the age of the dunes.

### **Moon Point Mires – A 40,000-year Window into the Fraser Island Environment**

**Patrick Moss, School of Geography, Planning and Environmental Management, University of Queensland**

**Abstract:** *Moon Point contains numerous wetlands that provide an environmental record of at least 40,000 years for the iconic Fraser Island. This study, based on sedimentological and palynological analysis of six cores, has primarily focussed on the wire rush (*Empodisma minus*) dominated communities (both patterned and non-patterned) along the Moon Point and Bullock Roads, but there are a variety of other wetlands (mangroves and *Melaleuca* swamps) that can provide additional records located across the Moon Point region. Key findings suggest that there has been a significant alteration from lacustrine to wire rush dominated swamps at the start of the Holocene epoch (~12,000 years ago), which may be associated with the formation of the unique patterned fen*

systems; evidence of significant environmental change, possibly associated with human arrival, between 40,000 to 35,000 years ago, with a transition from a rainforest dominated community to a sclerophyll one and associated increase in burning; and once established, patterned fen ecosystems appear to be highly stable, although there is evidence that vegetation thickening may be occurring at the edge of the wetland and other hydrological changes (increase in mangroves and grass), possibly associated with alterations in fire regimes and road construction linked to European settlement of the island.

Scientific aging of Fraser Island lakes ranges from Lake Allom (Longmore 1997; Donders et al. 2006) – 56 kya record with a hiatus from 28 to 10 kya to Old Lake Coomboo (Longmore & Heijnis 1999) – 600 kya with a hiatus from 22 to 12 kya. More recent work revealed Lake Mackenzie (Atahan et al. 2014; Hembrow et al.

2014) – 35 kya with a hiatus from 18 to 14 kya Previous Palaeoenvironmental Research

Patrick noted that Wire Rush (*E. minus*), the main peat forming plant across the Giant Sand Masses of South East Queensland forms extensive swamps (can be rain and groundwater fed)

Patterned Fens consist of flarks (pools) & ridges or strings & ridges (Aapa) that have developed over thousands of years through a complex interaction between hydrology, wetland vegetation & sand substrate. He noted that Northern Hemisphere patterned fens formation are related to biological processes but that the formation process for Great Sandy Region fens are different.

Patrick's research from taking cores shows that the Puthoo fens are about 35,000 years old, with possible fen development occurring over last 12,000 years whereas the Wathumba & Rainbow Beach research suggests that the fens developed over last 5,000 years, with swamp development at Rainbow Beach occurring from 9 kya

He believes that because wetland environments from the region provide an incredible record of past environments, his team has only scratched the surface.

Fraser Island Research and Learning Centre: Dilli Village Workshop

After lunch Dr Kim Walker provided some background and history of Dilli Village to introduce the workshop.

Dilli Village was originally built by an American mining company, Dillingham, to support sand mining operations on Fraser Island. It was acquired by USC from the Queensland government 10 years ago in a leasehold arrangement and now provides a mixture of camping and basic cabin accommodation. While education has the highest proportion of use, tourism and camping is the fastest growing use. The facility is well managed by a newly appointed husband and wife team.

The site consists of 6 self-contained cabins (accommodating up to 24 staff or students), 5 bunk houses (accommodating 40) and camp sites. There are gas barbecues and a function centre with extensive catering facilities but Dilli Village does not have any specialist teaching or research facilities

While education has the highest proportion of use, tourism and camping is the fastest growing use.

There is tension between the competing and sometimes conflicting uses of Dilli Village: the tourist recreation park

versus the Research and Learning Centre. USC needs a policy and strategy for the development and promotion of teaching and research on Fraser Island.

## The Marine Environment of the Fraser Island Region

A/Professor Dr Joachim Ribbe Associate Professor in Climatology, University of Southern Queensland

**Abstract:** *The sea surrounding Fraser Island is one of the most biodiverse and unique Australian marine environments. It embraces the waters of Hervey Bay, the Great Sandy Strait and the continental shelf to the south of Fraser Island and is home to rare endangered marine species including humpback whales, marine turtles, and dugongs. However, it is also characterised by unique ocean and climate processes that are the physical drivers of environmental conditions and high marine primary productivity.*

This presentation, discussed and reviewed the forces that shape marine environmental conditions and reviewed some of our recently made discoveries. These include the identification and characterisation of the "Southeast Fraser Island Upwelling System" using satellite remote sensing data and the classification of Hervey Bay as a hypersaline system using field data collected during several research cruises.

The high level of marine biodiversity of the Great Sandy indicates that it is a marine ecological hotspot

- Climate variations & change impact
- Commercially important species and aquaculture
- Tourism and recreational fishing
- Population growth
- Science

He described three characteristics that he has identified in the waters surrounding Fraser Island. This has been based on events he has monitored associated with flooding events in the Mary River.

The SE Fraser Island Upwelling system was compared with the discharge and impacts of the Amazon River:

0.2.106 m<sup>3</sup>/s, one fifth of global river discharge, largest drainage basin, all rivers combined about ~1.106 m<sup>3</sup>/s,

Evaporation minus precipitation is negative

Cross-shelf exchange process that is density driven

This was established by field surveys since 2004. Using observations, developed an ocean circulation model and quantified the process that noted the following influences:

- Population growth
- overlaps with documented bio hot spots
- overlaps EAC bottom shear stress at maximum
- 87% occur with upwelling favourable bottom stress

Cyclonic Eddies are a cross-shelf exchange process that drives near-coastal water in a clockwise fashion across the shelf and toward the open ocean.

What we did? Analysed 20 years of remote SSH-Anomaly data, the eddies are small scale 40-50 km, short lift, characterized by upwelling, like low pressure systems in the atmosphere; usually upwelling of nutrient and cold water into water that is already preconditioned due to the interaction with the coast.

## Great Sandy Strait Ramsar Site

**Mike Ronan, Manager, Queensland Wetlands Program.**

**Department of Environment and Heritage Protection**

**Abstract:** *The Great Sandy Strait Ramsar site is one of Queensland's most important coastal wetlands. The Strait is a sand passage estuary between the mainland and the World Heritage-listed Fraser Island, encompassing portions of the eastern fringe of the Island. It is the least modified of three such passages in Queensland. The Great Sandy Strait is the largest area of tidal swamps within the South East Queensland bioregion, consisting of intertidal sand and mud flats, making up roughly one-third of its area, extended seagrass beds, mangrove forests, salt flats and saltmarshes, and often contiguous with freshwater Melaleuca wetlands and coastal wallum swamps. The Strait is an exceptionally important feeding ground for migratory shorebirds and important for a wide range of other shorebirds, waterfowl and seabirds, marine fish, crustaceans, oysters, dugong, sea turtles and dolphins.*

**Mike Ronan** is the Manager of the Wetlands unit in the Department of Environment and Heritage Protection, based in Brisbane. For the last ten years he has managed the Queensland Wetlands Program which coordinates wetland related projects in Queensland through various government departments. The program also provides a wealth of wetland resources and guidance for land managers such as Natural Resource Management groups via the WetlandInfo website.

Mike Ronan introduced the Great Sandy Strait and described some the values that make the Ramsar site so special.

## What's happening with Australia's Shorebirds: Locally, Nationally and throughout the flyway?

**Dr Jon Coleman, Chairperson, Queensland Wader Study Group**

**Abstract:** *Great Sandy Strait is an internationally important wetland recognised under the Ramsar convention and one of the most significant migratory shorebird sites in Australia.*

*Up to 40,000 shorebirds have been recorded using this location during the Australian summer. This talk will describe the basic lifecycle of migratory shorebirds that use the Great Sandy Strait, and their migration patterns as well as highlighting the important roost sites used by shorebirds in the region. National population trends for a number of species will be presented and then compared to local changes in shorebird numbers in the Great Sandy Strait Ramsar site, using data gathered by the Queensland Wader Study Group over a 20-year period. Those trends will be discussed in relation to local, national and international factors"*

**Dr. Coleman** described what is happening with Australia's shorebirds generally and what is happening to the 23 species of migratory shorebirds in Great Sandy Strait where there are at least 60 high tide roosts. Great Sandy Strait has been a Ramsar site with populations of 7 species of international significance and where the Wader Study Group QWSG has undertaken biannual surveys.



- Ramsar site (7 spp international significance in 1999)
- Only 4 spp int signif in Dec 2013 survey
- 13 sites monitored monthly Species declining in Great Sandy Strait

Curlew Sandpiper is down to 46% while the Greater Great Knot has increased its numbers by 79%

Summary:

- 22 years of surveys in Great Sandy Strait
- 4 species increasing (15 – 85%)
- 3 species declining (30 – 46%)
- Pattern differs to national trend
- Pattern also differs from nearby Moreton Bay

## Diet and health of dingoes on Fraser Island (K'gari)

**Including incidence of human-provided food**

**Linda Behrendorff**

**Ranger in charge- Natural Resource Management (Fraser Island & Cooloola North)**

**PhD Student - University of Queensland**

**Abstract:** *As top-predators, dingoes (*Canis lupus dingo*) play an integral role in the food web on Fraser Island.*

*Subsidising such predators with human-sourced food (HSF) can disrupt this balance. The occurrence of HSF in dingo diets is poorly understood. A greater understanding of dingo diets is imperative given the potential effects of HSF on dingo health, dingo impacts on other prey fauna, the nature of interactions between humans and dingoes, and on the way dingoes and humans are managed on Fraser Island. In this study through the collation of a variety of data from dingo scats, stomach contents, remote-camera monitoring and necropsy records collected between 2001 and 2015, a description of the diet and health of dingoes on Fraser Island has been produced. We also focus on the role of management practices in altering the occurrence of HSF in dingo diet records, identify fauna species of significance to Fraser Island dingoes, and describe their overall health and body condition.*

Linda data showed the percentage of dingo scats containing human sourced food had declined from 46.9% in 1995 to 7.5% in 2014.

<b>% Scats containing prey item</b>	<b>Moussalli 1994</b>	<b>Twyford (1995)</b>	<b>Baker 2002</b>	<b>Angel 2006</b>	<b>Current study (2011-2014)</b>
Sample size (# Scats)	<b>28</b>	<b>1073</b>	<b>86</b>	<b>126</b>	<b>2196</b>
Mammal	39	53.8	-	79.4	<b>85.1</b>
Bandicoot (all species)	29	23.9	25.5	51.6	<b>49.9</b>
Rodent (all species)	11	39	8.9	32.5	<b>10</b>
Reptile	0	1.6	8.5	11.1	<b>14.9</b>
Bird	25	4.2	2.4	5.6	<b>7.4</b>
Fish	61	25.6	53	19	<b>26.8</b>
<b>Human source</b>	<b>39</b>	<b>46.9</b>	<b>10.3</b>	<b>26.2</b>	<b>7.5</b>
Invertebrate	3	6.6	26	56.3	<b>9.8</b>
Vegetation	7	36.5	17	98.4	<b>6</b>

## **Balancing Dingo Conservation with Human Safety On Fraser Island: The Numerical and Demographic Effects of Humane Destruction of Dingoes**

**Ben Allen**

**Dingo ecologist University of Queensland**

**Abstract:** Australian dingoes are threatened by interbreeding with domestic dogs. As a refuge from further interbreeding, the conservation significance of dingoes on Fraser Island is unquestioned. However, some dingoes presenting genuine human safety risks are humanely destroyed. We explore the potential effects of this on the sustainability of the Island's dingo population. Dingo abundance was 76–171 adult individuals during the mating (pre-whelping) season of 2012. A total of 110 dingoes were destroyed between 2001 and 2013. Approximately 66% of known-age dingoes destroyed were < 18 months old and 65% of known-gender dingoes destroyed were male. In any given year, no more than four female dingoes of any age were destroyed during dingoes' annual mating and whelping seasons. On only one occasion was an adult (and subordinate) female dingo destroyed during this period.

Available data therefore indicate that the spatially and temporally variable removal of so few female and/or adult animals from a population of this size is highly unlikely to have adverse effects on dingo population growth rates or breeding success. Adverse effects of humane destructions might be expected to increase if a substantially greater proportion of adult and/or female dingoes are targeted for destruction in the future.

He advised that there are 76 Australian islands with wild-living Canis spp. Only purebred dingoes are in decline It is mostly young male dingoes that are destroyed on K'Gari. This isn't endangering the population. The issue of humane destructions is, he says, *An ecological question, not a moral one.*

## **DNA Barcoding of South East Queensland Rainforest Plants.**

**Marion Howard.**

**University of the Sunshine Coast**

**Abstract:** Biodiversity conservation is important for species and ecosystem adaptive capacity to change. Australian rainforests contain a high proportion of the continents terrestrial biodiversity. Traditionally studies have focused on the Wet Tropical rainforests of Northern Queensland. The biodiversity and community assemblages of the subtropical rainforests of South East Queensland are less well known, but recent studies have indicated that these rainforests contain areas of high endemism which may indicate refugial areas. Refugia are vital for the recolonization of the surrounding areas following disturbance, especially in relation to climate change. One area that has been found to contain significant levels of endemism is The Great Sandy Region. My study will utilise the DNA barcoded library of South East Queensland Rainforest plants to analyse the phylogenetic patterns and relatedness within and between the Great Sandy Region and surrounding subregions, and attempt to determine if the phylogenetic relationships indicate refugial areas that are important for species survival.