Quaternary Landscapes of Minjerribah (North Stradbroke Island)
AQUA 2024 Field Guide

Patrick Moss, David Neil, Lynda Petherick & Philip Stewart
School of Earth & Environmental Sciences
The University of Queensland
June 2024

Minjerribah (North Stradbroke Island) Physiography

Except for a few rocky outcrops in the vicinity of Point Lookout and Dunwich, the island is comprised of aeolian landforms of siliceous sand. The terrain consists of elongate parabolic dunes (and their eroded remnants) aligned by the prevailing south-easterly wind. Closer examination of these alignments indicates some variation in wind direction during past periods of dune building. The parabolic dune form results from destabilisation (i.e. loss of vegetation cover) of an area of the dune field which is otherwise vegetated and stable.The trailing arm of the dune are fixed by vegetation as the mobile sand is blown downwind, burying vegetation in its path and often cannibalising sands of older land surfaces as it blows across them. Because the wind velocity threshold below which the wind is not sufficiently strong to move sand (~18km/hr for 200-250 micron sand grains) and the rate of sand transport are non-linearly related to wind speed above the entrainment threshold, the alignment of the parabolic dunes are not necessarily with the prevailing wind, but with the wind resultant. Note that a higher wind velocity is needed to initiate sand movement than to maintain it, and other factors such as temperature, sand moisture content, slope and aspect affect the relationship between wind speed and rates of sand transport.

The maximum elevation (239 m) is at Mt Hardgrave, east of Dunwich (Fig 1.). Most of the northern part of the island is at elevations greater than 50m, and most of the high dune sites in this area are in the 50 to 100 m elevation range. Along the northern and western margins of the island lies a low coastal strand plain with little relief. The Flinders Beach site is on the strand-plain of the north coast. On the east coast lies Eighteen Mile Swamp, formed by freshwater entrapment behind a system of fore dunes. This may have formed by stranding of an offshore bar during a period of rapid sea level fall during the mid Holocene or by a northward migration of the Southport Spit till it coalesced with the Island. Boyd (1993) examined fossil pollen from sediments from Eighteen Mile Swamp and found evidence through changes in vegetation that the freshwater swamp reached its present extent ~600 years ago with mostly tidal conditions (i.e., dominated by mangroves) for the previous 2000 years. This was further supported by Mettam et al. (2011), who examined a 2.1 m sediment core that provided a record that covered the last ~650 years. They suggest, based on diatom and sediment analysis that Eighteen Mile Swamp changed from an estuarine system to an acidic freshwater swamp around 420 years ago, which was very resistant to climate variability and human disturbance (based on the diatoms) from that time onward. The estuarine system eventually prograded southwards and the remnants of this wetland can be seen at Swan Bay, as a tidal mangrove system. Although more recent research based on core transects across the wetland suggests a more complicated formation process (see Marshall et al. 2024 presentation at the conference).

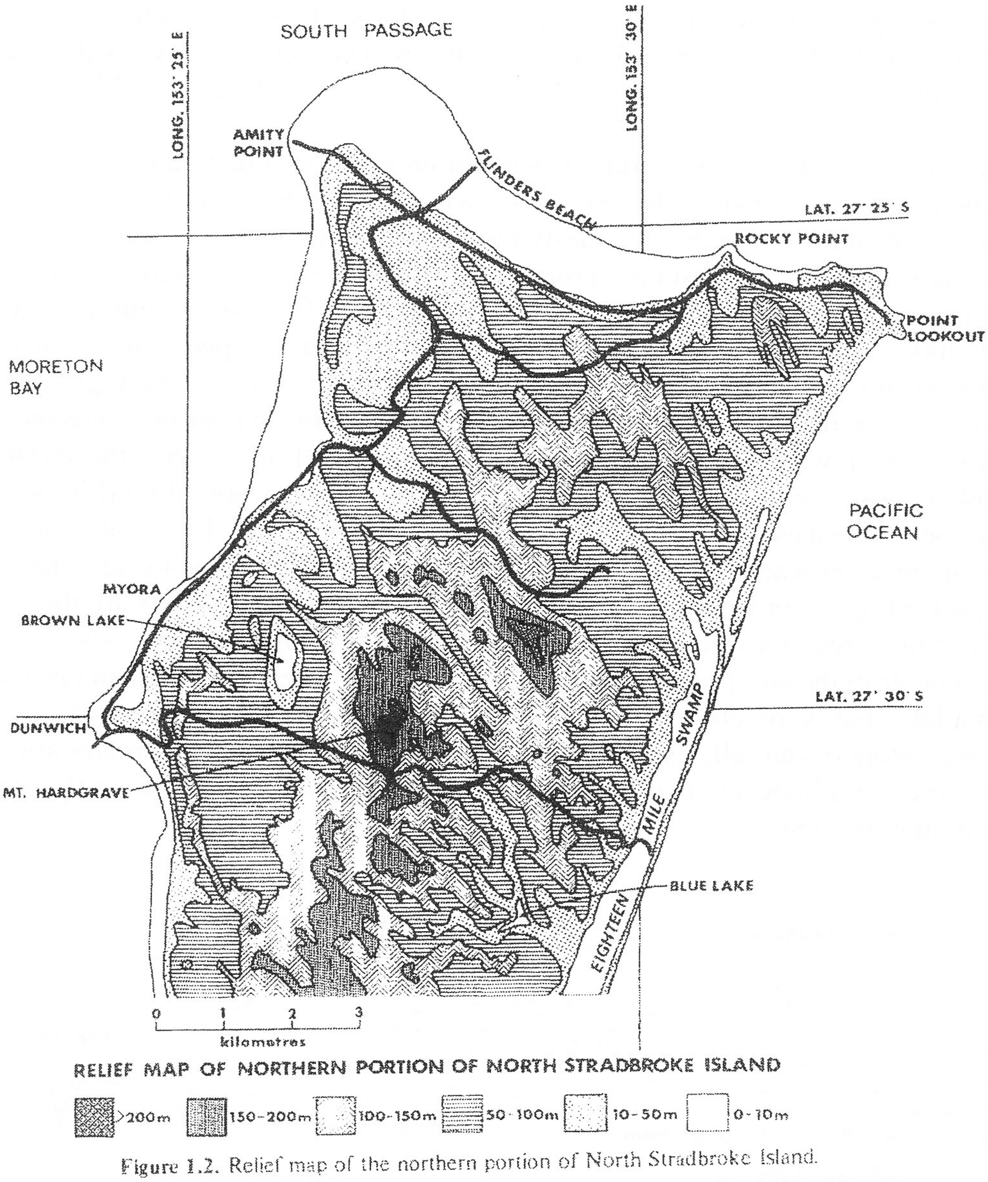

Fig. 1: Relief of Minjerribah (North Stradbroke Island) (Clifford and Specht, 1979, p. 3)

Minjerribah Climate and Hydrology

Minjerribah currently experiences warm, moist summers (~28°C for daily maximum temperatures) with relatively mild winters (~19°C for daily maximum temperatures). Average annual rainfall at Point Lookout is 1670 mm and at Dunwich it is 1570 mm, and the western side of the island is a little drier. Rainfall is seasonal, the wet season occurring in summer and autumn (December to April) and the dry season in winter and spring (May to November). Evaporation exceeds precipitation between August and December. During the winter months winds are predominantly from the southwest and in summer (period of strongest winds), south-easterlies prevail at 9 am observations and north-easterlies at 3 pm observations. The sand-moving resultant is from the southeast.

The Island is an important water resource. This is due to the geomorphology of the island, with the sand allowing easy infiltration of rainwater and the volcanic and sandstone bedrock underlying the island trapping the water in a freshwater lens (Fig. 2). The resultant groundwater mound exerts pressure on the surrounding seawater, keeping the freshwater/seawater interface away from the coast (Bedford, 2006). The large amount of water found on the island supports numerous freshwater springs and window lakes. A freshwater spring (e.g. Myora Springs – with a flow rate of 2.4 million litre/year) forms when the watertable and surface intersect at a low angle (Fig 3), while a window lake (e.g. Karboora (Blue Lake)) will form when the surface dips below the water table forming a lake (i.e. window into the watertable) (Fig. 4). Numerous perched lakes (e.g., Bummeria (Brown Lake) are also found on the Island. These lakes are formed in depression where an impermeable layer has formed in the soils near the surface, preventing water from percolating to the watertable. These layers are the result of chemical reactions between soil and water that precipitate organic and inorganic matter in the soil profile. Thus, the depression will retain rainfall and runoff and form a lake that is 'perched' above the water table. Perched lakes act as very accurate indicators of rainfall, rising and falling with annual changes in precipitation and if a severe drought occurs even drying out (Bedford, 2006). Fig. 5 shows the areas of perched lakes on the island.

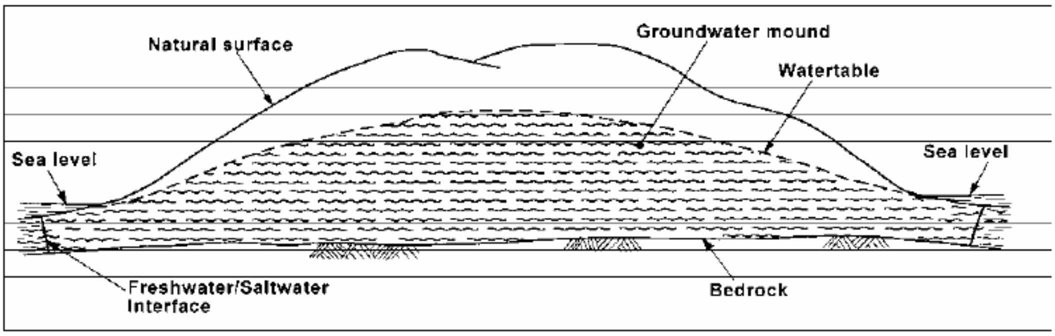

Fig. 2: Generalized cross-section of groundwater on Minjerribah (Bedford, 2006 p.1)

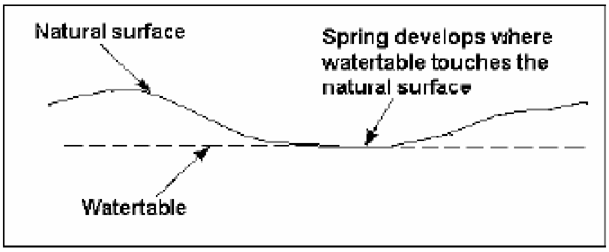

Fig. 3: Diagram of a freshwater spring (Bedford, 2006 p. 2).

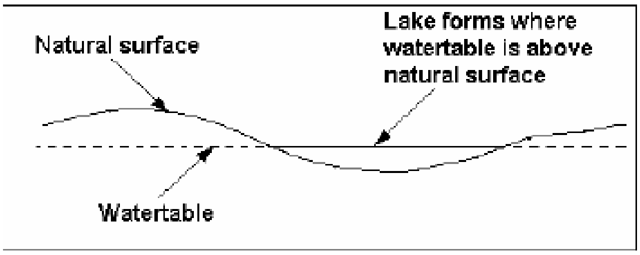

Fig. 4: Diagram of a window lake (Bedford, 2006 p. 1).

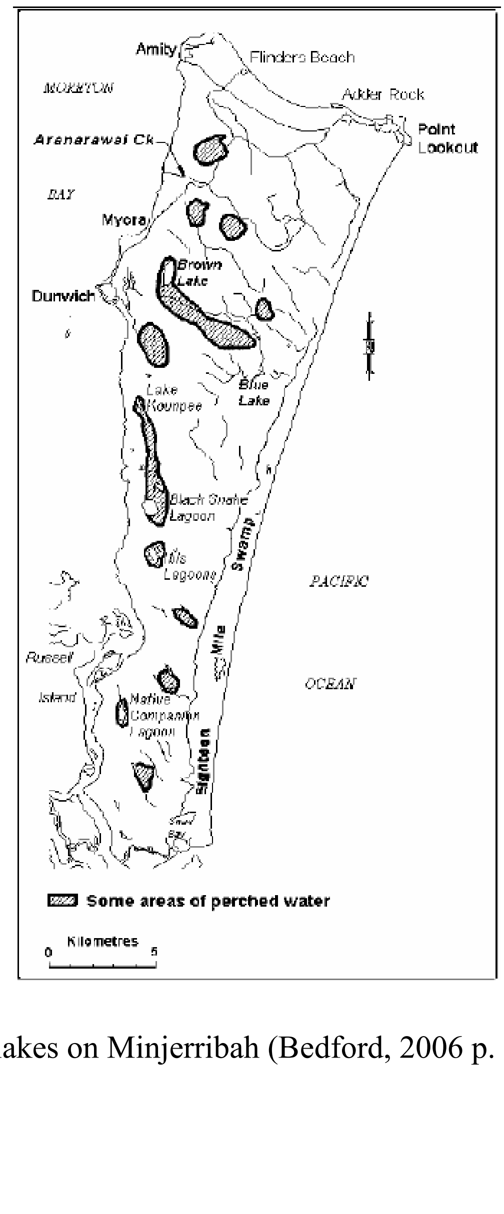

Fig. 5: Areas of perched lakes on Minjerribah (Bedford, 2006 p. 2).

Minjerribah Island Vegetation

Vegetation of the Island is described in some detail by Clifford and Specht (1979) (Fig. 6). The vegetation at Myora Spring is dominated by mangrove forest (mainly *Avicennia marina* and *Rhizophora stylosa*) in the intertidal area, by rainforest taxa (figs, *Syzygium sp.* and palms) in the area between the road and coastal area and *Melaleuca* swamp across the road. Brown Lake is surrounded by open eucalypt forest and immediately around the edge of the lake is dominated by a freshwater marsh community (sedges, rushes and *Melaleuca* trees). Blue Lake is surrounded by open eucalypt forest and Wallum Heath, Eighteen Mile Swamp is surrounded by closed scrub (*Tristania-Banksia* shrubs) and open eucalypt forest on its inland side and Coastal dune vegetation (*Banksia, Casuarina* and *Pandanus*) and coastal closed forest on the seaward side. The vegetation community of Eighteen Mile Swamp itself is freshwater marsh. The Flinders Beach site is dominated by coastal dune vegetation and coastal closed forest, while the high dunes are dominated by open eucalypt forest and Wallum Heath. The vegetation communities have been classified by the Specht classification system (Fig. 7) and dominant vegetation reflect dune age with coastal closed forest/scrub found on the youngest dunes, eucalypt open forest on the intermediate aged dunes and Wallum Heath on the oldest dunes (forms a retrogressive succession).

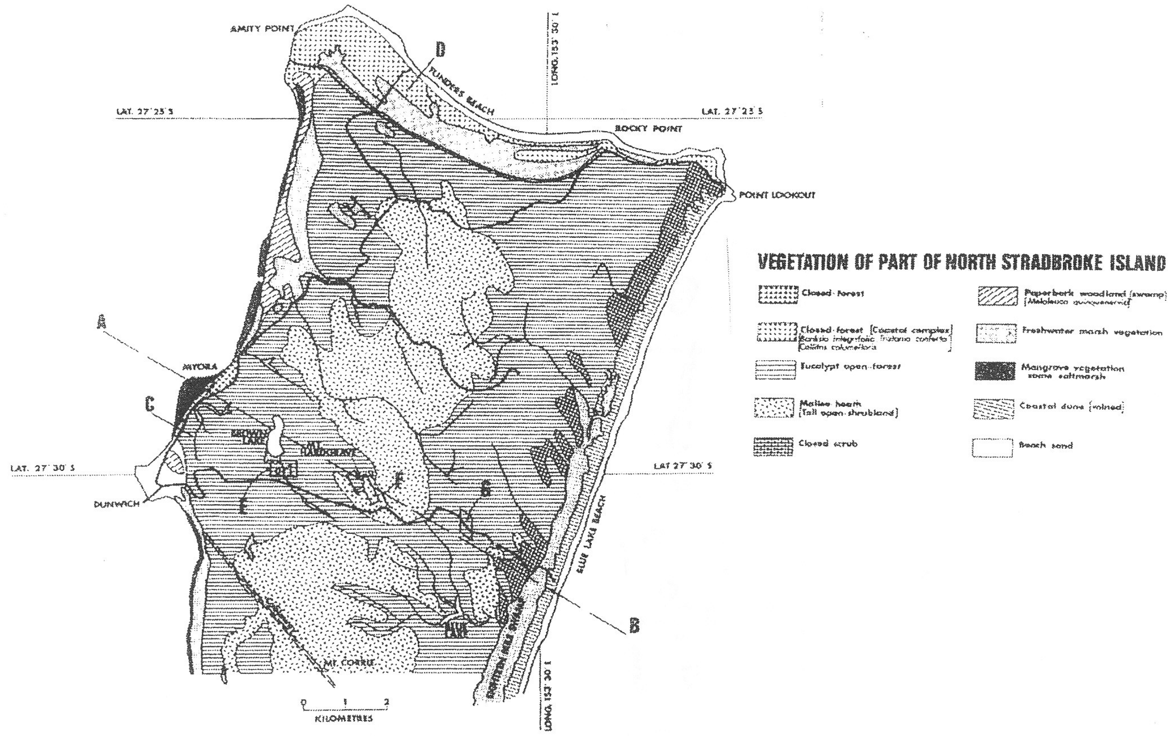

Fig. 6: Vegetation of Minjerribah (Clifford and Specht, 1979 p 20).

	Type of Vegetation	Foliage Cover %	Broad Description	Fully grown height of highest level of vegetation		
				Over 30 meters	*10 to 30 meters*	*5 – 10 meters*
Woody Plants	Trees	70 - 100	Closed forest	Tall, closed forest	Closed forest	Low closed forest
		30 - 70	Open forest	Tall open forest	Open forest	Low open forest
		10 - 30	Woodland	Tall woodland	Woodland	Low woodland
		<10	Open woodland	Tall open woodland	Open woodland	Low open woodland
	Shrubs			***2 to 8 meters***	***<2 meters***	
		70 – 100	Closed shrubs	Closed scrub	Closed Heath	
		30 - 70	Open shrubs	Open scrub	Open heath	
		10 - 30	Shrublands	Tall shrubland	Low shrubland	
		<10	Open shrublands	Tall open shrubland	Low open shrubland	
Non-Woody Plants	Herbs			***Description based on dominant herb type***		
		70 – 100	Closed herblands	Closed herbfields, closed grassland, closed sedgeland, closed tussock grassland, closed fernlands		
		30 – 70	herblands	Herblands, grasslands, tussock grasslands, sedgelands, fernlands		
		10 – 30	Open herblands	Open herblands, open grasslands, open sedgelands, open tussock grasslands, open hummock grasslands		
		varies	Non-vascular formations	Moss types, algal types & other types		
Various Types				***Description based on habitat***		
		varies	Extreme, varied & altered habitats	Ephemeral formations – mangroves, saltmarsh, wetland, coastal dunes, coastal cliffs; alpine, desert complexes; altered formations		

Fig. 7: Specht Classification System (for Australian Vegetation)

Human History and Palaeoecology on North Stradbroke Island

There is direct archaeological evidence from the Wallen-Wallen Creek and Middle Canalpin Creek sites that people have been present continuously on the island for at least 40,000 years (Adams et al., 2024; Neal and Stock, 1986). Wallen-Wallen Creek suggests occupation from between 30 to 49 ka and Middle Canalpin Creek from between 39 to 41 ka, which are among the oldest evidence of occupation in coastal eastern Australia (Adams et al. 2024). There is also indication from these sites of changes in artefacts related to sea-level rise, with Pleistocene remains reflecting occupation in a forest/woodland setting changing to primarily marine resources during the Holocene (development of a midden). In addition, Wallen-Wallen Creek has been used as evidence for intensification of occupation from the late Holocene period. The Traditional Custodians of Minjerrabah (Indigenous name for the Island) are the Quandamooka and they were granted native title on non-titled land (including national parks and the former mining lease) in 2011. Quandmooka fire management potentially played an important role in shaping the island landscape (Clifford and Specht, 1979), particularly with the formation of Cypress Camps, which is associated with the Canalpin Creek archaeological site, although further research is needed to investigate this. British colonization of the island dates to 1827 when Dunwich was established as a convict settlement. Farming was attempted on the island (cotton farming was reported at Myora in 1828) but was then abandoned and a plantation of slash pine (*Pinus elliotii*) was established near Bummeria (Brown Lake) in the 1960s (Clifford and Specht, 1979). Major activity on the island is now related to tourism, and sand mining (which began in the 1950s) for rutile, zircon and ilmenite was a major resource industry until 2019, with 43% of the island held in a mining lease (which has become a National Park co-managed by the Quandamooka and Queensland Parks and Wildlife Service).

With native title the Quandamooka play an active role in management on the island (through QYAC - Quandamooka Yoolooburrabee Aboriginal Corporation), particularly in terms of fire management and are also promoting ecotourism.

Several palaeoecological studies have been undertaken on the island since the early 2000s. As discussed previously, Boyd (1993) and Mettam et al. (2011) produced late Holocene records from Eighteen Mile Swamp sediments. Pickett et al. (1985) examined fossil corals buried beneath a high dune near Amity, which were dated to 105,000 years ago and suggest a sea level close to present levels for this time (Fig. 8). More recent palaeoecological research by The University of Queensland, The University of Adelaide, Queensland Department of Environment and Science has focussed on reconstructing past environments from sediments in perched lakes, swamps and springs for the late Quaternary period across the Island. A short pollen diagram (Moss et al., 2011) is shown for Myora Springs (Fig 9.) and suggests that prior (up to 1000 years ago) to European settlement the area was dominated by *Melaleuca* swamp and that it wasn't until road construction and the addition of a drainage pipe that rainforest dominated the site. This site has also experienced a high amount of erosion since 2004 and eroding the peat deposit from which the pollen record was derived from. More recently, Barr et al. (2013) discussed the Holocene Karboora (Blue Lake) record and found that for the last 7,500 years Karboora's water depth and quality have remained highly stable (a situation unique in Australia), although there has been significant vegetation change occurring in its vicinity (related to increased aridity over the last 5,000). Moss et al. (2013) have examined late Quaternary variability (up to the last 48,000 years) across the island from pollen and charcoal records from Native Companion Lagoon, Tortoise Lagoon and Welsby Lagoon. Key findings include a positive moisture balance for the Island across the last +40,000 years that allowed the almost continuous occurrence of extensive forests and woodlands (unique in temperate Australia), high degree of inter-site variability and the suggestion that both human and natural climate factors are responsible for altering fire regimes on the island. Tibby et al. (2017) has examined the age of wetland systems on the island, with six wetlands extending back to the Last Glacial Maximum (or older), with the oldest forming 200,000 years ago (Figure 10). Figure 11 shows the pollen and charcoal record from Native Companion Lagoon.

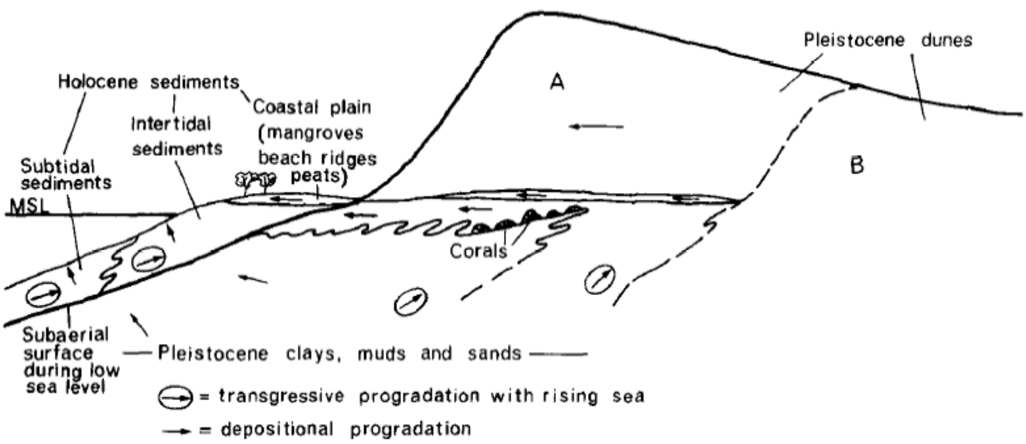

Fig. 8: Geological cross-section of eastern Moreton Bay and western Minjerribah (Pickett et al. 1985, p 106).

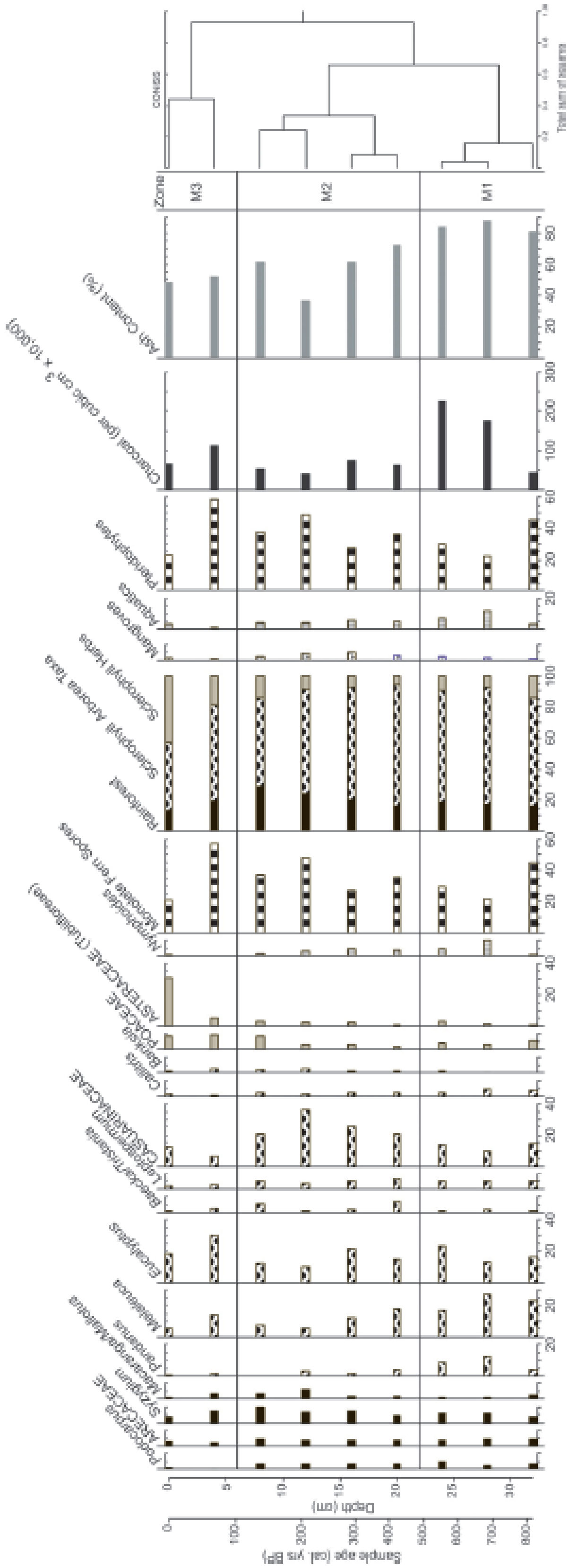

Fig. 9: Myora Springs Pollen Diagram

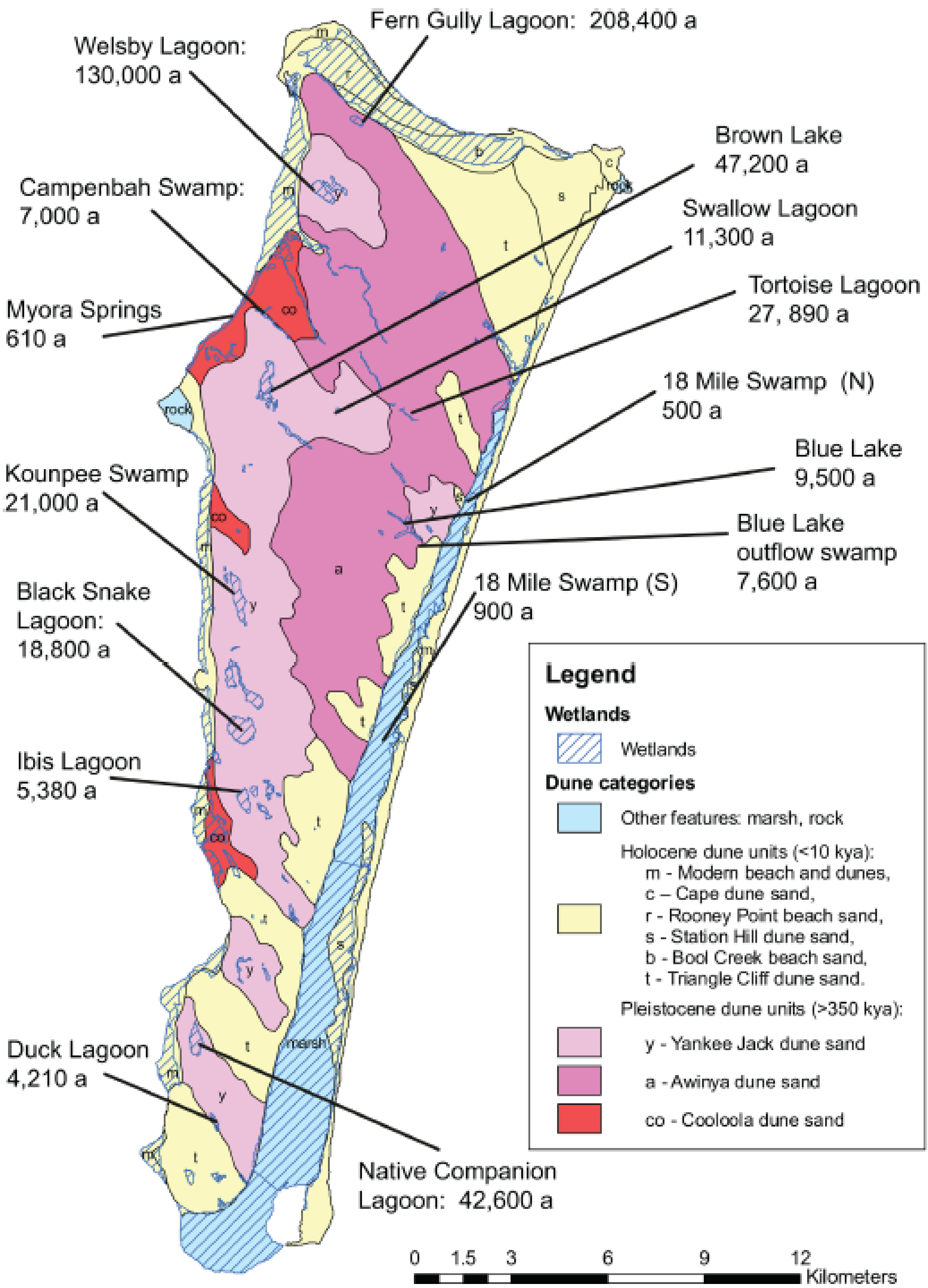

Fig. 10. Ages of the North Stradbroke Isl

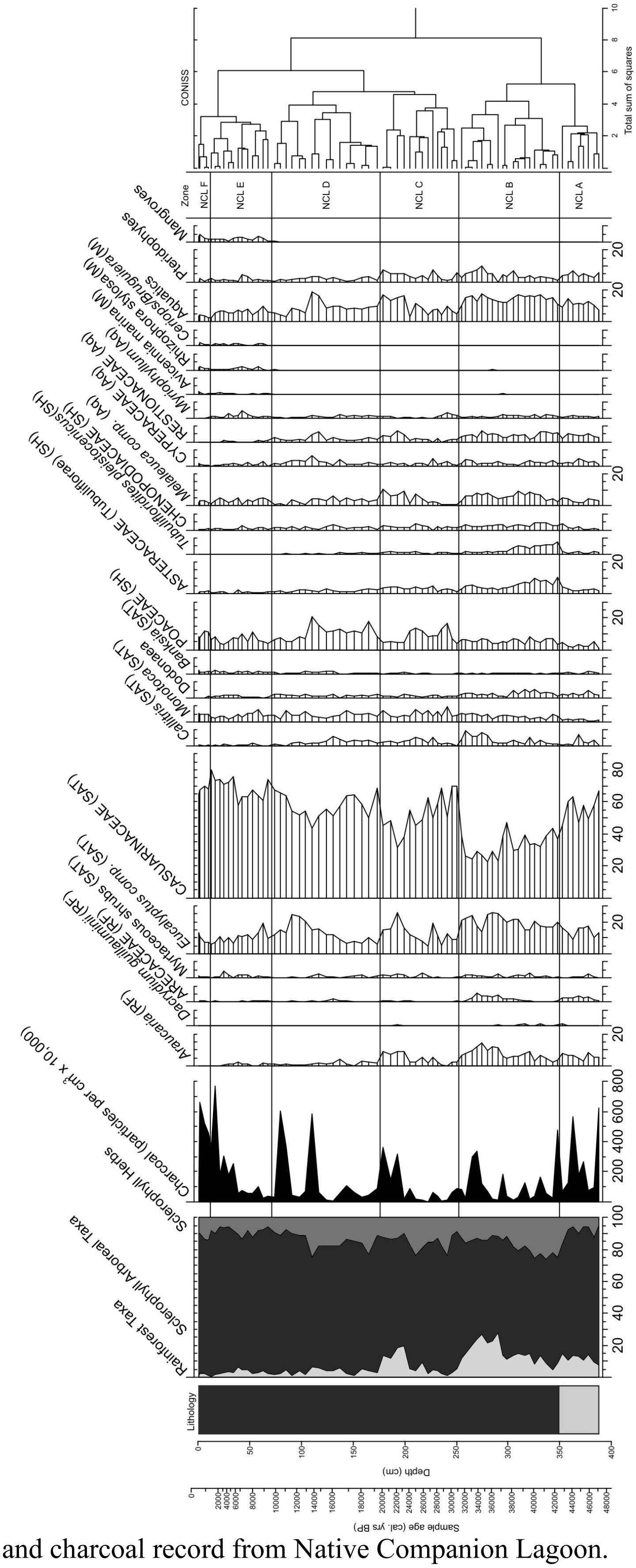

Figure 10. Pollen and charcoal record from Native Companion Lagoon.

The Chronosequence

Many studies of geomorphology, soils and vegetation on aeolian dunes are based on the concept of the chronosequence. A chronosequence is defined by Stevens and Walker (1970) as “A sequence of soils developed on similar parent materials and relief under the influence of constant or ineffectively varying climate and biotic factors, whose differences can thus be ascribed to the lapse of differing increments of time since the initiation of soil development.” Consider this definition in the context of what you know of sand dune systems and Quaternary environments, and what you observe in the field.

Flinders Beach Strand Plain

The Holocene beach ridges at Flinders Beach on the north coast of NSI have formed since sea level reached its Holocene maximum (+1.0 to 1.5 m) at about 6,000 to 6,500 years ago (Flood, 1984). At this time sea levels had truncated the vegetated, Pleistocene high dunes to form the steep scarp still evident at the landward margin of the beach ridge sequence.

Progradation (deposition, seaward accumulation) of the beach ridge sequence took place as the sea level fell slightly to the present level during the mid to late Holocene. Evidence from radiocarbon dated beach ridge sequences elsewhere in eastern Australia suggests that maximum progradation rates occurred during the mid-Holocene and have declined since that time, possibly as a result of diminished sand supply. Ward (1978) identified three morphostratigraphic units in the Flinders Beach strand-plain (other workers have identified more than 3 units). A morphostratigraphic unit is a geomorphic unit defined by both its form and its position in the landscape. At Flinders Beach these units are progressively younger to seaward.

In examining soils and vegetation in a chronosequence on this strand-plain we cannot assume a simple linear relationship between distance and time due to three reasons:

1. As already stated, the progradation rate was not constant.
2. The planform geometry is not simple and the shore parallel.
3. The fact that three distinct morphostratigraphic units could be identified suggests that progradation is episodic.
4.

We can see this relationship from Ground Penetrating Radar data that was collected in 2012 by Prof Allen Gontz (a US geomorphologist) and presented in Figure 11 (see Gontz et al., 2014).

The distribution of vegetation shows clearly a transition from a suite of herbaceous plants ubiquitous on fore dunes, to trees and shrubs (some of which are often found in high dune communities). A question that can be asked is how does this distribution relate to the characteristics of the physical environment?

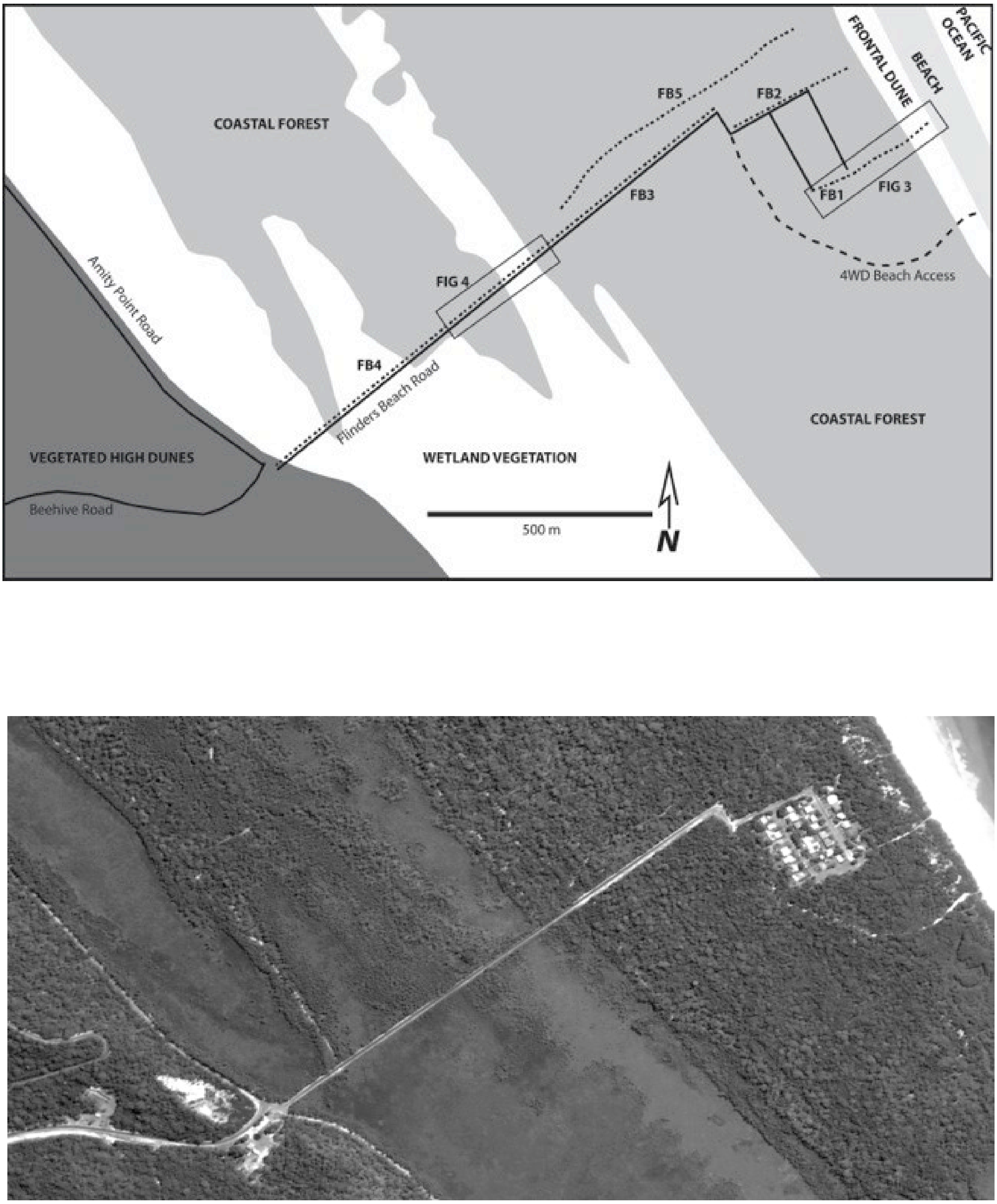

Figure 12. The Flinders Beach strandplain and wetland.

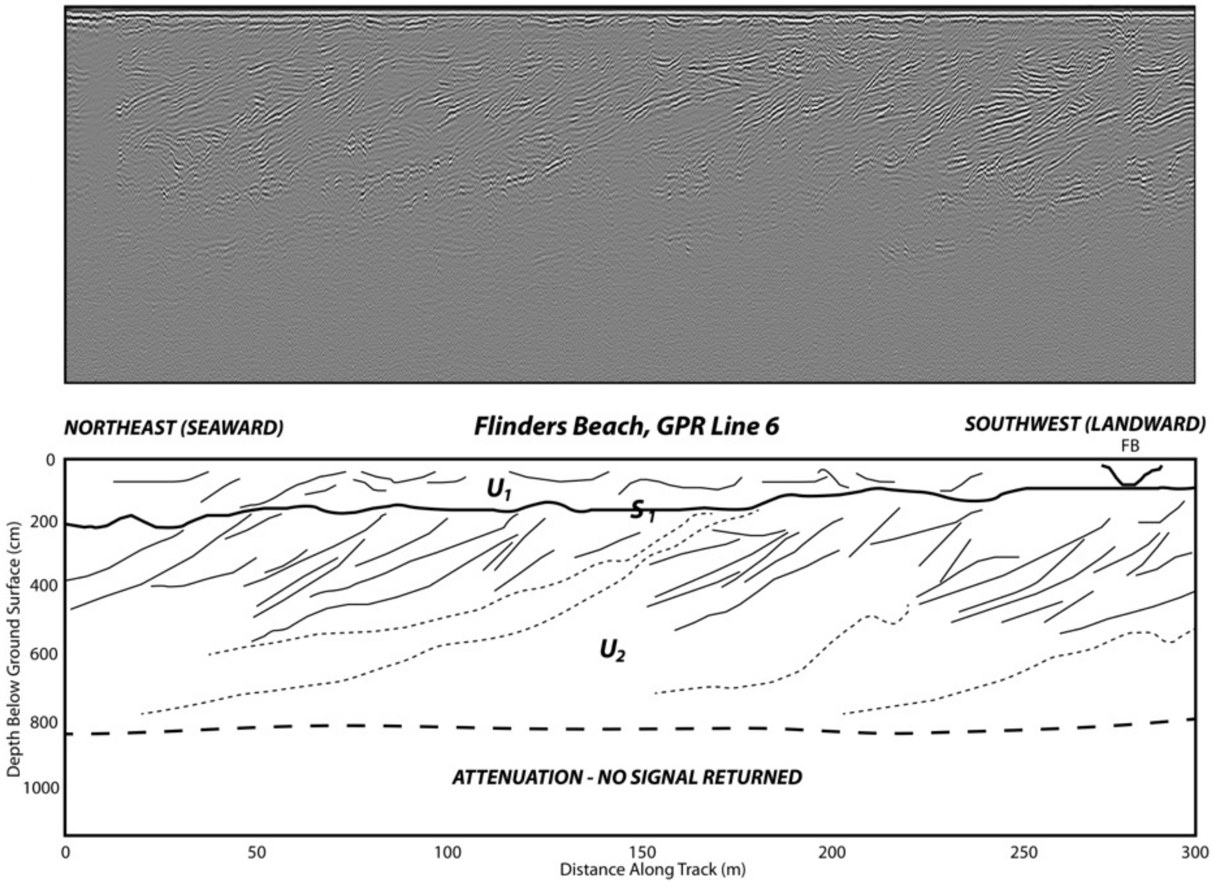

Figure 13. Ground Penetrating Radar results for Flinders Beach coastal dunes. Note the lines show that the dunes formed in a non-linear fashion related to changes in storm and wind strength.

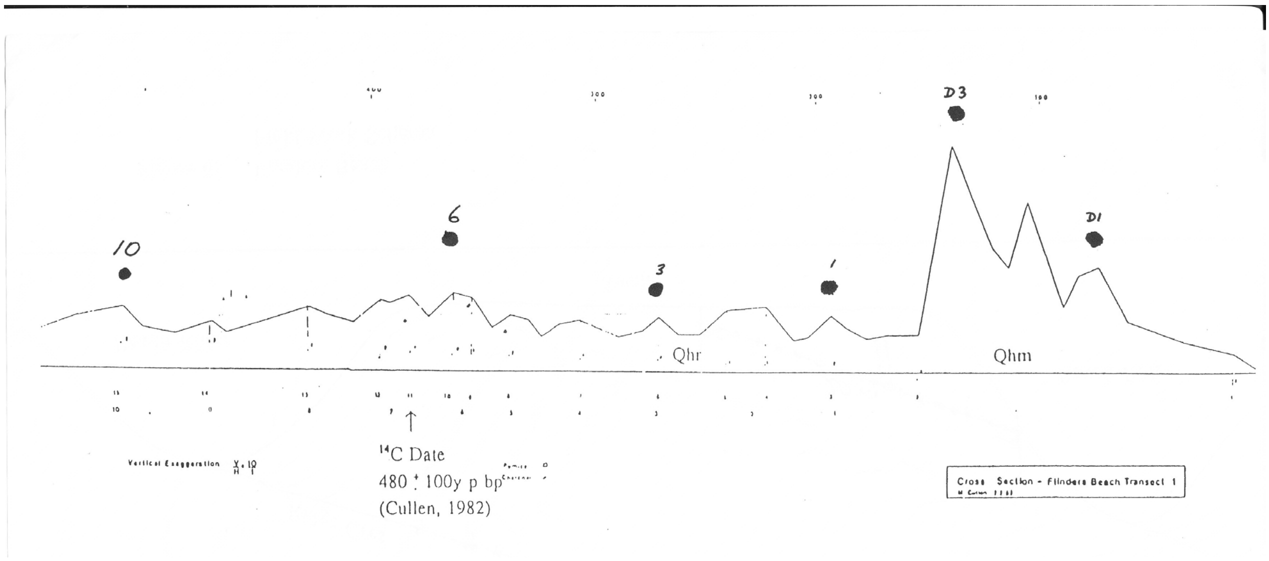

Figure 14. Cross-section of the Flinders Beach transect. D1 and D3 refer to Beach ridges and numbers 1 to 10 refer to the dune ridges located inland from the Beach ridges. A radiocarbon date suggests that ridge 6 formed (as a beach ridge) around 500 years ago. You should use this image to help decide the intervals for measuring soil and vegetation characteristics.

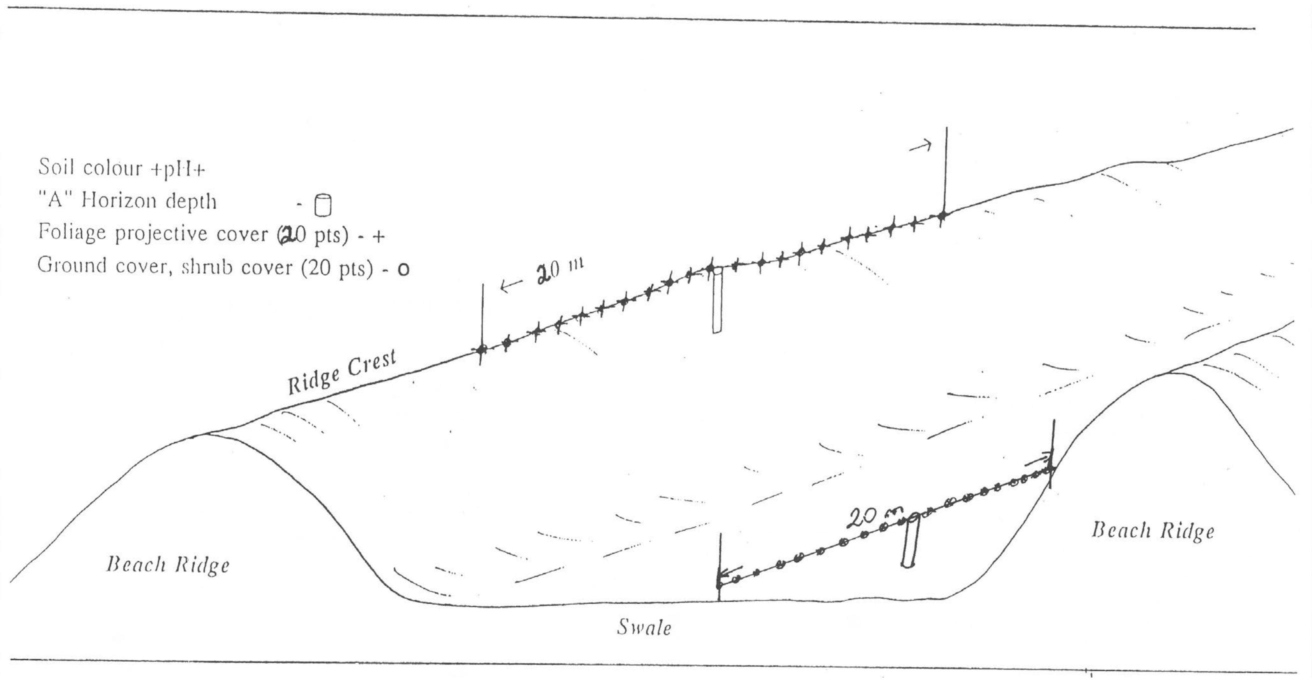

Figure 15. Station design for measurements of soil and vegetation characteristics at Flinders Beach.

The High Dunes

During period of marine transgression onshore sand mobilisation has occurred, with episodes of dune building the results (although a case can be made for periods of dune building at times of rising, stable and falling sea level). More recent research by Ellerton et al. (2022) suggests that the giant sand masses of Southeast Queensland formed between 1.2 to 0.7 Ma and may have played a role in the development of the Great Barrier Reef (trapping sand and resulting in clearer water north of K'gari). This may have been related to the Mid-Bruhnes Event with the shift from 41 ka glacial-interglacial cyclicity to 100 ka cyclicity.

The general pattern is one of dunes becoming younger and smaller from west to east. There is only one reliable set of dates for the Pleistocene dune sequence. This comes from Pickett et al.'s (1984 & 1985) study on a coral reef buried beneath a transgressive dune at Amity Point (Fig. 8). The average age of three U-series dates is 105,000 years BP, therefore the overlying dune must be younger than this age. It also appears that since sea level reached its present level, dune instability and sand supply may have diminished. Evidence for this pattern comes from many east coast sites and from northern Tasmania.

The dominant soil forming process is podsolisation, in which nutrients, humic material, minerals and fine clays are leached downward through the soil profile to be precipitated at greater depth. The presence of vegetation is an essential part of this process, firstly to stabilise dune sand and secondly, in providing the organic acids which allow podsolisation chemistry to occur. In addition, water infiltration is fundamental to soil development, but water repellence due to organic matter can reduce infiltration by >80%. Precipitation of leached material may be due to insufficient water, mechanical sieving or destruction of complex organic compounds by bacteria.

The usual profile is:

O horizon – leaf litter
A **A1** – accumulated organic matter; generally dark grey
E **A2** – (elluvial) leached of mineral and organic matter; white
B **B** – (illuvial) region of precipitation of organic acids, sesquioxides and fin clay; grey – black (humic), red, yellow, orange (Al & Fe oxides)
C **C** – undifferentiated sands; light brownish yellow

The A horizon becomes thicker, with an increased plant nutrient content, with age. In the oldest dune soils, as the B horizon gets too deep for plants to access, the A diminishes in thickness and nutrient content.

The E increases in thickness with age to a maximum in excess of 12 m. The difference between the E and the A is the higher quantity of organic matter in the A, continuously replenished by litter fall from the vegetation.

From a thickness of 5 – 10 cm at the rudimentary stage, the B horizon thickens with age to in excess of 5 m in a strongly developed soil.

In the northern hemisphere, podsols are generally <1 m thick. In the dune fields of eastern Australia, they may exceed 20 m in depth, due to the free drainage, great age and great depth of the sands and to the high rainfall. Walker et al. (1981) developed a 'retrogressive succession' model to explain vegetation dynamics at the Cooloola sand mass. The model:

- Emphasises the importance of endomycorrhizal fungi, nitrogen fixation and nutrient cycling in the nutrient deficient dune sands.
- Documents an increase in biomass and species diversity related to the degree of soil development.
- Reveals a decrease in diversity and biomass on the oldest dunes with the deepest soils (a retrogressive succession). This is attributed to leaching of the B horizon nutrient store beyond the sinker and tap roots of eucalypt forest (~10 m). There is also a pattern of vegetation stratification which parallels the soil development. What is it and why?

Walker et al. (1981) summarises their findings regarding the relationship between soils and vegetation in the Cooloola sand mass as follows:

- Loss of nutrients from the system occurs through leaching and drainage.
- Atmospheric nutrient accession is less than leaching and drainage losses.
- As podsolisation proceeds the quantity of nutrients stored in and released from sand grains declines.
- Although nutrients can be stored in organic matter, losses occur during nutrient cycling.
- Some plants have adaptations to low nutrient levels.
- Nutrient availability is not the only limiting factor in these systems.

In the islands high dune landscape, we will examine sites of widely differing presumed ages and describe the topography, soils and vegetation found at each. These sites are located on the basis of mapping of morphostratigraphic units by Ward (1978). In order that sites be comparable, it is necessary to undertake fieldwork at topographically similar locations. Soil depth, soil moisture, vegetation type can all vary with aspect and position on dune slope (from the crest to the base of a dune ridge). Erosion occurs on the upper slopes and deposition on the lower slopes. Walker et al. (1981) argues that, although the slopes of the trailing arms of parabolic dunes are steep, unstable and susceptible to erosion, the crests of the trailing arms are relatively stable and therefore suitable for soil profile comparison. Each of our high dune observations will therefore be made on the dune crest. But – observations of vegetated trailing arms of dunes which have been episodically mobile over long periods (e.g., First Ridge near Blue Lagoon on Moreton Island) show a great deal of erosion has taken place in the oldest (upwind) part of the dune crest.

Flinders Beach Development

At Flinders Beach there is a complex relationship between the mid Holocene beach ridge and strandplain system, wetlands immediately behind them and the Pleistocene (high dunes) dunes. Ground Penetrating Radar (GPR) has been used to examine this relationship and suggests that there is a link between the three that can be related to changes in sea-level, vegetation and groundwater flow. An evolutionary model has been proposed that suggests that the Pleistocene dunes are the oldest, the wetland established sometime during the late Pleistocene and the beach ridges formed as a result of the regression of sea-levels after the mid-Holocene highstand event (sea-levels ~1 to 1.5 m higher at ~6,500 to 6,000 years ago). Figures 15 to 17 shows a proposed sedimentary model and the results of the GPR across the wetland and to Flinders Beach.

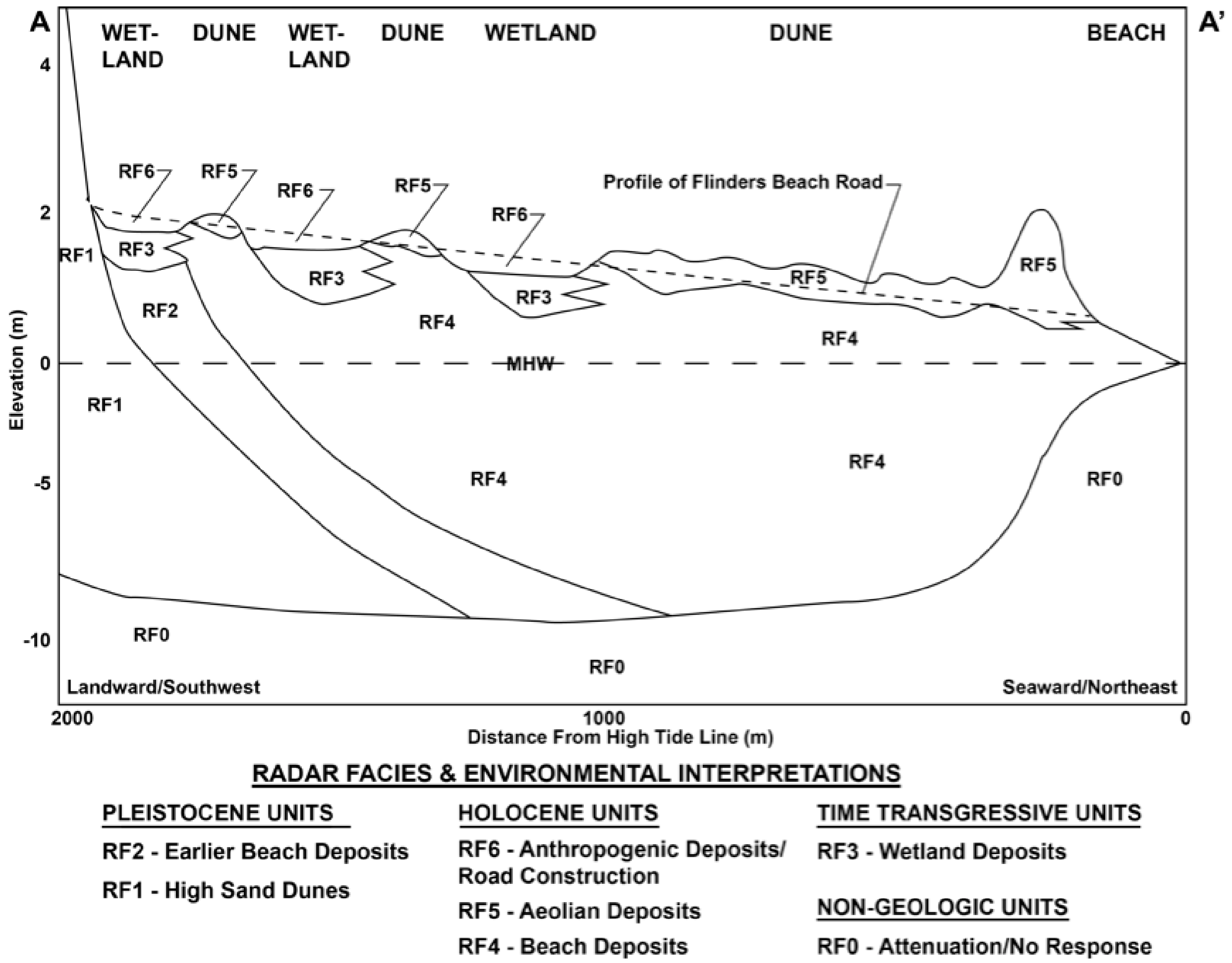

Figure 16. Proposed evolutionary model of the Flinders Beach strandplain and wetlands.

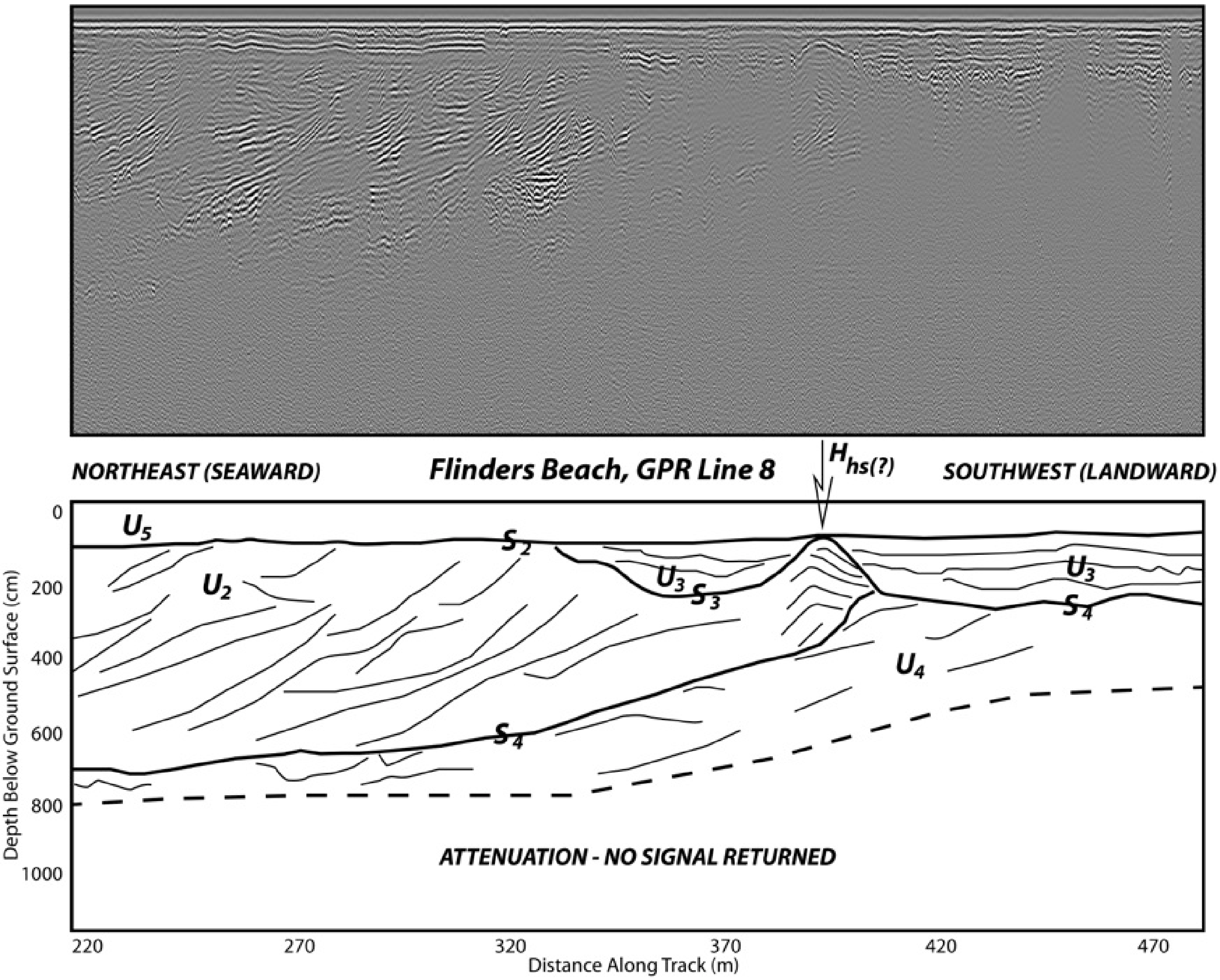

Figure 17. Ground Penetrating Radar Results for the Flinders Beach Wetland. U3 reflects the wetland deposits and H may represent the dunes deposited during the mid-Holocene highstand event.

Useful References (some have been cited in the text):

Adams, S., Norman, K., Kemp, J., Jacobs, Z., Costelloe, M., Fairbairn, A., Robins, R., Stock, E., Moss, P., Smith, T. and Love, S., (2024) Early human occupation of Australia's eastern seaboard. *Scientific Reports* 14, 2579.

Barr, C., Tibby, J., Marshall, J, McGregor, G., Moss, P., Halverson, G. and Fluin, J. (2013) Combining monitoring, models and palaeolimnology to assess ecosystem response to environmental change at monthly to millennial time scales: The stability of Blue Lake, North Stradbroke Island, Australia. *Freshwater Biology* 58, 1614-1630.

Barr, C., Tibby, J., Moss, P.T., Halverson, G.P., Marshall, J.C., McGregor, G.B. and Stirling, E., (2017) A 25,000-year record of environmental change from Welsby Lagoon, North Stradbroke Island, in the Australian subtropics. *Quaternary International* 449, 106-118.

Barr, C., Tibby, J., Leng, M.J., Tyler, J.J., Henderson, A.C.G., Overpeck, J.T., Simpson, G.L., Cole, J.E., Phipps, S.J., Marshall, J.C. and McGregor, G.B. (2019) Holocene el Niño–southern Oscillation variability reflected in subtropical Australian precipitation. *Scientific Reports 9,* 627.

Bedford, K. (2006) *Hydrology of North Stradbroke Island,* NRM Fact sheet, Department of Natural Resources and Mines, Queensland.

Boyd, W.E. (1993) Proto-Swan Bay: A palaeogeographical model of the late Holocene Eighteen Mile Swamp, North Stradbroke Island, S.E. Queensland. *Proceedings of the Royal Society of Queensland,* 103, 75-83.

Cadd, H.R., Tibby, J., Barr, C., Tyler, J., Unger, L., Leng, M.J., Marshall, J.C., McGregor, G., Lewis, R., Arnold, L.J. and Lewis, T. (2018) Development of a southern hemisphere subtropical wetland (Welsby Lagoon, south-east Queensland, Australia) through the last glacial cycle. *Quaternary Science Reviews* 202,.53-65.

Cadd, H.R., Tyler, J., Tibby, J., Baldock, J., Hawke, B., Barr, C. and Leng, M.J. (2020) The potential for rapid determination of charcoal from wetland sediments using infrared spectroscopy. *Palaeogeography, Palaeoclimatology, Palaeoecology* 542, 109562.

Chang, J.C., Shulmeister, J., Woodward, C., Steinberger, L., Tibby, J. and Barr, C. (2015) A chironomid-inferred summer temperature reconstruction from subtropical Australia during the last glacial maximum (LGM) and the last deglaciation. *Quaternary Science Reviews*, *122*, 282-292.

Chappell, J. (1983) A revised sea-level record for the last 300,000 years from Papua New Guinea. *Search* 14 99-101.

Clifford, H.T. and Specht, R.L. (1979) *The Vegetation of North Stradbroke Island*, University of Queensland Press, St Lucia, Australia.

Cullen, M. (1982) *The Establishment of a Chronosequence on Beach Ridges, Flinders Beach, North Stradbroke Island.* Unpublished B.Sc. (Honours) thesis, Griffith University.

Ellerton, D., Rittenour, T.M., Shulmeister, J., Roberts, A.P., Miot da Silva, G., Gontz, A., Hesp, P.A., Moss, P., Patton, N., Santini, T. and Welsh, K. (2022) Fraser Island (K'gari) and initiation of the Great Barrier Reef linked by Middle Pleistocene sea-level change. *Nature Geoscience* 15, 1017-1026.

Flood, P.G. (1984) A review of Holocene Sea level data, southeastern Queensland. In Coleman, R.J., Covacevich, J. and Davie, P. (eds.) *Focus on Stradbroke Island.* Boolarong Publications.

Gontz, A.M., Moss, P.T. & Wagenknecht, E.K. (2013) Stratigraphic architecture of a regressive strand plain, Flinders Beach, North Stradbroke Island, Queensland, Australia. *Journal of Coastal Research* 30, 575-585.

Hadwen, W.L. and Arthington, A.H. (2011) Visitor impacts and climatic variability will shape the future ecology of Fraser Island's perched dune lakes. *Proceedings of the Royal Society of Queensland* 117, 485-493.

Kelley, R.A. and Baker, J. (1984) Geological development of North and South Stradbroke Islands and surround. In Coleman, R.J., Covacevich, J. and Davie, P. (eds.) *Focus on Stradbroke Island.* Boolarong Publications.

Kemp, C.W., Tibby, J., Arnold, L.J., Barr, C., Gadd, P.S., Marshall, J.C., Mcgregor, G.B. and Jacobsen, G.E. (2020) Climates of the last three interglacials in subtropical eastern Australia inferred from wetland sediment geochemistry. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 538, 109463.

Kemp, C., Tibby, J., Barr, C. and Arnold, L. (2021) Climate, fire and vegetation history from subtropical North Stradbroke Island (Minjerribah), eastern Australia, during the last three interglacials. *Journal of Quaternary Science* 36, 1201-1213.

Lang, S., McClure, S., Grosser, M., Lawless, M. and Herdy, T. (1998) Sedimentation and coastal evolution, northern Moreton Bay. In Tibbetts, I., Hall, N. and Dennison, W. (eds.) *Moreton Bay and Catchment.* 81-92.

Leach, L.M. (2011) Hydrology and Physical Setting of North Stradbroke Island. *Proceedings of the Royal Society of Queensland* 117, 21-46.

Lewis, R.J., Tibby, J., Arnold, L.J., Barr, C., Marshall, J., McGregor, G., Gadd, P. and Yokoyama, Y., (2020) Insights into subtropical Australian aridity from Welsby Lagoon, north Stradbroke Island, over the past 80,000 years. *Quaternary Science Reviews* 234, 106262.

Lewis, R.J., Tibby, J., Arnold, L.J., Gadd, P., Jacobsen, G., Barr, C., Negus, P.M., Mariani, M., Penny, D., Chittleborough, D. and Moss, E. (2021) Patterns of aeolian deposition in subtropical Australia through the last glacial and deglacial periods. *Quaternary Research* 102, 68-90.

McGowan, H.A., Petherick, L.M. and Kamber, B.S. (2008) Aeolian sedimentation and climate variability during the late Quaternary in southeast Queensland, Australia. *Palaeogeography, Palaeoclimatology, Palaeoecology* 265, 171-181.

Mariani, M., Tibby, J., Barr, C., Moss, P., Marshall, J.C. and McGregor, G.B. (2019) Reduced rainfall drives biomass limitation of long-term fire activity in Australia's subtropical sclerophyll forests. *Journal of Biogeography* 46, 1974-1987.

Maxson, C., Tibby, J., Barr, C., Tyler, J., Leng, M., Lomax, B., Marshall, J., McGregor, G., Schulz, C., Cadd, H. and Jacobsen, G. (2021) Ecology and climate sensitivity of a groundwater-fed lake on subtropical North Stradbroke Island (Minjerribah), Queensland, Australia over the last 7500 years. *Journal of Paleolimnology*, 67, 75-93.

Mettam, P., Tibby, J., Barr, C. and Marshall, J.C. (2011) Development of Eighteen Mile Swamp, North Stradbroke Island: A Palaeolimnological Study. *Proceedings of the Royal Society of Queensland* 117,119-131.

Moss, P.T., Tibby, J., *Petherick, L*., McGowan, H. and Barr, C. (2013) Late Quaternary vegetation history of North Stradbroke Island, Queensland, eastern Australia. *Quaternary Science Reviews*, 74, pp. 257-272.

Moss, P., Petherick, L. and Neil, D. (2011) Environmental Change at Myora Springs, North Stradbroke Island over the last Millennium. *Proceedings of the Royal Society of Queensland* 117,133-140.

Neal, R. and Stock, E. (1986) Pleistocene occupation in the south-east Queensland coastal region. *Nature,* 323, 618-621.

Petherick, L.M., McGowan, H.A. and Moss, P.T. (2008) Climate variability during the Last Glacial Maximum in eastern Australia: Evidence of two stadials? *Journal of Quaternary Science 23*, pp. 787-802.

Petherick, L.M., McGowan, H.A., Moss, P.T. and Kamber, B. (2008) Late Quaternary aridity and dust transport pathways in eastern Australia. *Quaternary Australasia* 25, 2-11.

Petherick, L.M., McGowan, H.A. and Kamber, B.S. (2009) Reconstructing transport pathways for late Quaternary dust from eastern Australia using the composition of trace elements of long traveled dusts. *Geomorphology* 105, 67-79.

Petherick, L.M., Moss, P.T. and McGowan, H.A., 2017. An extended last glacial maximum in Subtropical Australia. *Quaternary International* 432, 1-12.

Pickett, J.W. Thompson, C.H., Martin, H.A. and Kelley, R.A. (1984) Late Pleistocene fossils from beneath a high dune near Amity, North Stradbroke Island, Queensland. In Coleman, R.J., Covacevich, J. and Davie, P. (eds.) *Focus on Stradbroke Island.* Boolarong Publications.

Pickett, J.W., Thompson, C.H., Kelley, R.A. and Roman, D. (1985) Evidence of high sea level during isotope stage 5c in Queensland, Australia. *Quaternary Research,* 24 103-114.

Smith, P. and Nichols, O. (2011) Development and assessment of rehabilitation criteria for high dune mineral sands mining on North Stradbroke Island. *Proceedings of the Royal Society of Queensland* 117, 347-363.
Specht, A. (2011) Plant Communities of North Stradbroke Island: Development of structure and species richness. *Proceedings of the Royal Society of Queensland* 117, 181-191.
Stevens, P.R. and Walker, T.W. (1970) The chronosequence concept and soil formations. *Q. Rev. Biol.* 45 330-350.
Stubbs, B.J. and Specht, A. (2011) Water for a droughted metropolis: The early twentieth century scheme to supply water to Brisbane from Stradbroke Island. *Proceedings of the Royal Society of Queensland* 117, 11-20.
Tibby, J., Barr, C., Marshall, J.C., McGregor, G.B., Moss, P.T., Arnold, L.J., Page, T.J., Questiaux, D., Olley, J., Kemp, J. & Spooner, N. (2017) Persistence of wetlands on North Stradbroke Island (south-east Queensland, Australia) during the last glacial cycle: implications for Quaternary science and biogeography. *Journal of Quaternary Science* 32, pp.770-781.
Thompson, C.H. (1981) Podzol chronosequences on coastal dunes of eastern Australia, *Nature* 291 59-61.
Tyler, J.J., Marshall, J.C., Schulz, C., Barr, C., Hofmann, H., Blessing, J.J., McCoy, K., McGregor, G.B. and Tibby, J. (2022) Hydrological and Isotopic Variability of Perched Wetlands on North Stradbroke Island (Minjerribah), Australia: Implications for Understanding the Effects of Past and Future Climate Change. *Frontiers in Environmental Science* 10, 868114.
Walker, J., Thompson, C.H., Fergus, I.H. and Tunstall, B.R. (1981) Plant succession and soil development in coastal dunes of subtropical eastern Australia. In West, D.C., Shugart, H.H. and Botkin, D.B. *Forest Succession: Concepts and Applications* Springer-Verlag.
Ward, W.T. (1978) *Notes on the Origin of Stradbroke Island.* University of Queensland Department of Geology Publication 8, 97-104.
Ward, W.T. (2006) Coastal dunes and strandplains in southeast Queensland: sequence and chronology. *Australian Journal of Earth Sciences* 53, 363-373.