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A late Quaternary record of vegetation and climate change from Hazards Lagoon, eastern Tasmania

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ABSTRACT

A late Quaternary pollen and charcoal record from Hazards Lagoon on the east coast of Tasmania provides a continuous record of vegetation and climate change. The pollen record shows an Epacridaceae and Poaceae dominated grassland community replaced dry sclerophyll forest during the Last Glacial Maximum (LGM ~22–18 cal ka BP). *Eucalyptus* and Casuarinaceae increased from the beginning of the deglacial period (~18–12 cal ka BP) indicating early warming on the east coast of Tasmania. Abundant *Myriophyllum* and sedimentary characteristics indicate Hazards Lagoon was a permanent source of water throughout the LGM and until 16 cal ka BP suggesting either increased precipitation and/or decreased evaporation rates. A positive moisture balance throughout the LGM contrasts with records from the west coast of Tasmania and parts of mainland Australia. Fire was suppressed at the site until 14 cal ka BP, corresponding with reduced woody vegetation and a positive moisture balance. Dry sclerophyll forest established during the deglacial period, remaining stable throughout the Holocene. A coastal vegetation community developed in response to sea-level rise, characterised by abundant *Eucalyptus* pollen and increasing values of Casuarinaceae. By the mid-Holocene, the Hazards Lagoon pollen record is typical of a Tasmanian coastal site dominated by Casuarinaceae. This research highlights the need for spatially diverse studies throughout the Southern Hemisphere to identify drivers of environmental change during the late Quaternary.

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1. Introduction

Tasmania plays an important role in understanding late Quaternary environmental change in Australia and the Southern Hemisphere due to its location within the westerly climate system, extensive evidence of past glaciation and a number of suitable palaeoecological sites. However, there is a lack of significant Last Glacial Maximum (LGM) studies from eastern Tasmania, with research focused mainly in central and western Tasmania.

Conflicting drivers of vegetation since the last glaciation are found across the state. Lake St Clair in the central-west experienced reduced precipitation during the deglacial period (Hopf et al., 2000) while Lake Selina in the west points to colder temperatures until 14 cal ka BP limiting vegetation development (Colhoun et al., 1999). Late Quaternary records from Pulbeena, Mowbray and

Broadmeadows Swamp in Tasmania's humid northwest are confounded by overrepresentation of local vegetation types, imprecise dating and variable sediment deposition (Colhoun et al., 1982; van de Geer et al., 1986). Furthermore, limited publications from the east coast of Tasmania – Crown Lagoon (Sigleo and Colhoun, 1981), Lake Tiberias (Macphail and Jackson, 1978), and Waterhouse Marsh (Thomas, 1996) create a geographical bias in our understanding of climate and vegetation development throughout the LGM and Holocene. Recent studies suggest significantly different climatic drivers were influencing temperate Australia's east coast during the late Quaternary (Colhoun and Shimeld, 2012; McIntosh et al., 2012; Moss et al., 2013; Petherick et al., 2013).

A review of temperate Australia by Petherick et al. (2013) identifies a cool LGM (~22–18 cal ka BP) with maximum glaciation at ca. 19 cal BP in the Snowy Mountains and Tasmanian Highlands (Colhoun et al., 1994; Barrows et al., 2001, 2002). In western Tasmania temperatures were 6.5 °C –3.7 °C lower than present, arboreal pollen taxa was greatly reduced and steppe vegetation flourished (Colhoun, 1985; Colhoun et al., 1999; Fletcher

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and Thomas, 2010c). Glacial retreat between 18 and 16 cal ka BP (Barrows et al., 2001; Mackintosh et al., 2006) with warmer and/or wetter conditions allowed Casuarinaceae and *Eucalyptus* to increase across the temperate zone (Macphail, 1979; Markgraf et al., 1986; Harle, 1997; Hopf et al., 2000; Williams et al., 2006; Petherick et al., 2013). A reversal to drier conditions during the late-Deglacial period (15–12 ka cal BP) in the Murray Darling Basin, North Stradbroke Island and eastern Tasmania contrast with wetter conditions across western Tasmania and southwest Victoria, suggesting the Southern Westerly Winds (SWW) had an increasing influence across the temperate zone (Fletcher and Moreno, 2012).

We present the first 22 cal ka BP palaeoecological record from the east coast of Tasmania. Hazards Lagoon on the Freycinet Peninsula provides a unique environmental record as local precipitation is negatively correlated with SWW unlike other Tasmanian studies. Its coastal location is independent from localised glaciation during the LGM and the dry sclerophyll vegetation is adapted to fire; two key factors suppressing vegetation development across much of Tasmania (Macphail, 1979; Thomas and Kirkpatrick, 1996; Fletcher and Thomas, 2007, 2010a,b). This paper addresses geographical bias found in site selection across Tasmania and mainland Australia, contributing to the growing number of Southern Hemisphere records.

2. Regional setting

Hazards Lagoon (42°10'20"S, 148°17'21"E) sits between the wide tombolo-dune barred lagoon system of Wineglass and Hazards beach (Bradbury, 1993) in Freycinet National Park on the east coast of Tasmania (Fig. 1). The oval shaped basin is 1.8 m above current mean sea level, perched on Quaternary sands and alluvial deposits (Everard, 2001), with a surface area of approximately 1 km² collecting precipitation and runoff from Mount Freycinet and Mount Graham. The lagoon is periodically full after high rainfall events with outflow from the southern rim onto Hazards Beach. The sediment core was collected approximately 150 m from the

northwest edge within an isolated mire that was dry during sampling. The late-Pleistocene age of the organic material and the presence of a leached sand lens at the base of the core suggests the site formed during the previous interglacial period as an isolated basin between fossil dunes similar to sites in the Newcastle region, New South Wales (Thom et al., 1981). To the north west of the isthmus lies Mount Mayson (415 m) and The Hazards (Mount Amos, Dove, Baudin and Parsons) and to the south east Mount Freycinet (620 m).

The Freycinet Peninsula is located at the edge of the west-east environmental gradient controlling the climate and vegetation of Tasmania. Precipitation decreases across the State as the dominant westerly airflow is uplifted by the central mountain ranges, providing a mean annual precipitation of 600 mm per year to the east coast and 3500 mm on the West Coast Range. Evaporation during the summer months exceeds regional rainfall values while descending air masses contribute to warmer prevailing temperatures, creating a sub humid maritime climate along the east coast with mean temperatures fluctuating between 10 °C and 20 °C in summer and 4 °C–14 °C in winter.

Tasmania's vegetation is a product of the State's precipitation and temperature gradients with dry sclerophyll communities dominating the eastern coast and wet mixed forest/cool temperate rainforest in the west (Colhoun and Shimeld, 2012). To the north and south of Hazards Lagoon exposed granitic slopes with shallow soils support dry eucalyptus forest and woodlands and a heath understory. Black peppermint (*Eucalyptus amygdalina*) coastal forests and woodlands are established to the north and south of the lagoon with a mixed understory of common heath species including *Thryptomene micrantha*, *Banksia marginata*, *Claytrix tetragona*, *Melaleuca squarrosa* and *Leptospermum scoparium*. To the east of Hazards Lagoon, *E. ovata* and *E. obliqua* dry forest woodlands separate a strip of coastal heath from the lagoon while to the west *Acacia longifolia* dominates the coastal scrub. The westerly Fleurieu Point supports a dense *Allocasuarina verticillata* forest excluding other vegetation.

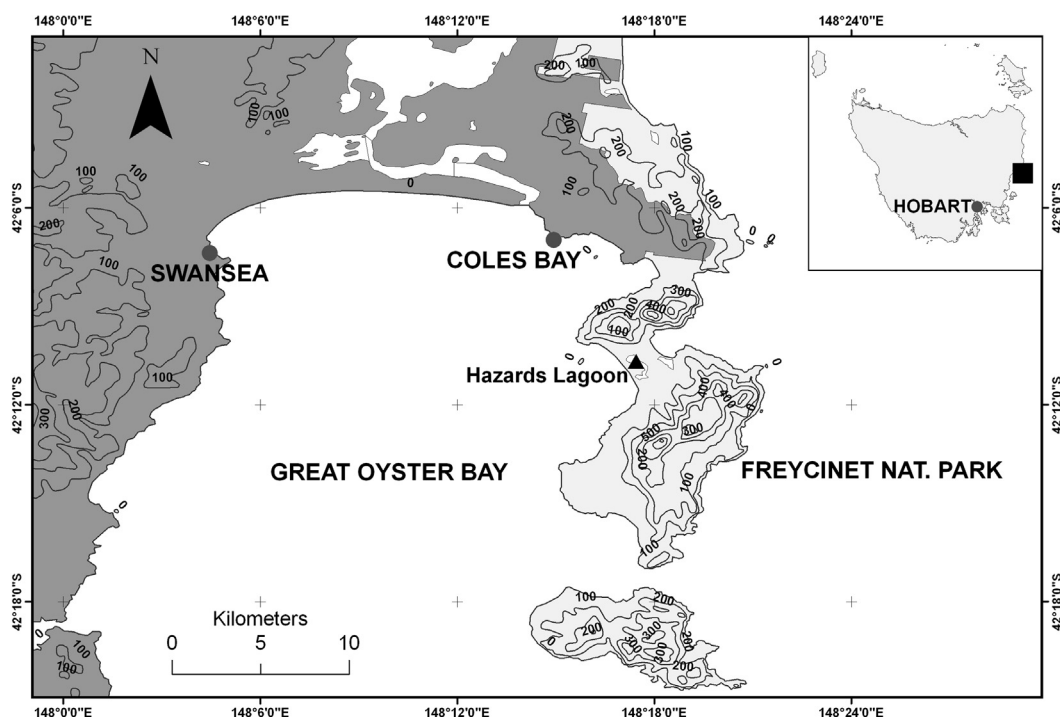


Fig. 1. Topographic map showing the location of Hazards Lagoon and the extent of Freycinet National Park.

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