

*Seagrass landscapes along a wave gradient*

By

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*Candidates Declaration*

I declare that this thesis, unless otherwise acknowledged, is entirely my own account of my research and has not been submitted for a degree at any other University.

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## *Abstract*

Seagrasses of southern Western Australia grow in coastal waters exposed to varying degrees of physical exposure from oceanic swell waves and waves created by strong seasonal wind patterns. Seagrass species have preferred niches within these exposures; however knowledge as to how a continuum of exposure effects seagrass distributions and landscape patterns is limited. This thesis examined long term and seasonal variability occurring in a seagrass landscape along a gradient of wave exposure on the North Sands platform, Warnbro Sound, Western Australia.

Long term changes to the seagrass landscape were investigated over a 49 year time period. Seagrass areal extent was mapped from aerial photographs and compared through the years. Over the period, 1953 to 2002, there was a 27 % loss of seagrass; from 273 ha in 1953 to 200 ha in 2002. Loss was separated into two causes anthropogenic (boat mooring/propeller scars) and natural. Boat mooring/propeller scars accounted for only 2 %. The development of a large sand bar, growing from 27 ha to 89 ha, accounted for 66 % of the loss. Historical records show a similar large-scale sediment event occurring in Warnbro Sound 170 years ago. Increased fragmentation of offshore seagrass meadows through time accounted for the remaining 32 %.

To confirm the gradient in exposure, several methods incorporating the effects of time and space were used to characterise water flow. Wind effects were characterised into exposure indices, significant wave heights, bottom flow velocities and surface flows were modelled and *in situ* flow velocity was measured. Modelling

and *in-situ* measurement of flow velocities showed the shape, bathymetry and topography of Warnbro Sound coupled with seasonal wind patterns, contributed to complex flow circulations within the bay. All flow velocities modelled and measured showed a reduction in flow shorewards. Modelled flows were highest during winter storms whereas wind effects were greatest in summer; due to the consistent and strong summer sea breezes. A comparison of two transects along this flow gradient revealed differences between them.

Sediment grain size analyses were used to indicate longer term flow characteristics along the gradient of flow. Sediment profiles were coarser in the offshore exposed sites and finer in the inshore sheltered sites, but there was some modification by the seagrass. A comparison of sediment profiles between two transects along the gradient of flow showed differences. There was also a seasonal influence.

Seagrass landscapes were investigated along the gradient. Aerial photographs showed a progressive increase in fragmentation of seagrass meadows from inshore to offshore. Two transects were used, each with five different seagrass landscapes progressing from solid through to fragmented. The two transects could be separated into three zones each. The middle zones were similar in landscape but differed in seagrass species. The inshore and offshore zones were the same, both in species and landscape. Distribution of seagrass species along the two transects was correlated to the flows measured over the transects. There was a relationship between seagrass distribution for the whole platform and wave exposure.

*Amphibolis* spp. occurred in the offshore region that had high flow velocities.

*Posidonia* spp. occurred in the nearshore region that had low flow velocities.

Distribution of seagrass species and fragmentation patterns were strongly correlated with wave exposure gradients. A strong correlation ( $r^2 = 0.8$ ) existed in winter between seagrass species (density and landscape) and environmental factors associated with exposure. Despite the strong winds in summer these had minimal effect on the seagrasses (low correlation). Winter flow conditions are therefore the driver of patterns in species distribution and fragmentation seen in the seagrass landscape of Warnbro Sound.

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