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SALTMARSH DISTRIBUTION AND RESILIENCE IN RESPONSE TO ALTERED TIDAL DYNAMICS AND SEA LEVEL RISE

INTRODUCTION:

As an endangered ecological community located in the tidal zone, coastal saltmarsh is exceedingly vulnerable to climate change, in particular rising sea level (Department of Climate Change and Energy Efficiency, 2009). Other challenges, including mangrove migration into saltmarsh areas and changes in estuary catchments due to urban and rural development, further exacerbates the effects of sea level rise on saltmarsh distribution (Harty, 2010; Spencer and Howe, 2008). Unfortunately, the effectiveness of large scale remediation works underway in estuaries across Australia are restricted due to limited information available on how saltmarsh responds to floodplain hydrologic pressures in relation to these issues.

This honours thesis investigates the relationship between coastal saltmarsh and hydrology in Tomago Wetland, a large tidally restored wetland located in the lower Hunter Region of NSW. Three main technologies were used in this investigation – digital camera images capturing a 13400m^2 section of wetland, a hydrodynamic model of the site, and a Tomago Wetland vegetation map commissioned by the Parks and Wildlife Division (PWD) of the NSW Office of Environment and Heritage.

MAJOR FINDINGS AND OUTCOMES:

Digital camera image analysis was undertaken to assess the distribution of saltmarsh extent over time. Over the time period analysed (August 2010 – August 2012), it was found that wetland vegetation extent has greatly changed. A decrease in grass extent was observed, with grass originally occupying approximately 40% of the area analysed to being almost completely eradicated by August 2012. Conversely, the extent of open water has increased from 10% to 50% occupancy of the area. The extent of area covered by reeds has experienced a slow growth after approximately a year, however not by a substantial amount. Camera images from 2009 indicate a complete absence of saltmarsh, after which saltmarsh extent fluctuates around approximately 30% coverage of the area during the 2010 -2012 period. This analysis of the digital camera images indicates that tidal restoration works have been highly effective at Tomago Wetland, with diminished exotic grass and a stable community of saltmarsh having been established.

A hydrodynamic model was used in conjunction with a vegetation map of the site to investigate current depth and inundation extent in Tomago Wetland. From these results, the hydrological requirements of saltmarsh were de[illegible] Phragmites australis/ Bolboschoenus (sp.), Sporobolus virginicus/ Triglochin striata, open water and exotic grassland), have different associated hydrological conditions. In particular, this study has highlighted that at the Tomago Wetland site, water depth is the most important hydrological condition in determining vegetation distribution.

The hydrological conditions associated with the saltmarsh group *Sporobolus virginicus*/ *Triglochin striata* do not appear to be affected by proximity to tidal flows. However, the hydrological conditions associated with the fresh water reed *Phragmites australis* differ from location to location. This suggests that *Sporobolus virginicus*/ *Triglochin striata* can only grow in a strict range of hydrological conditions at Tomago Wetland, while *Phragmites australis* is a highly competitive species. These differing hydrological conditions, the level of on-site salinity, in addition to plant susceptibility to these factors contribute in determining the distribution of vegetation at Tomago Wetland.

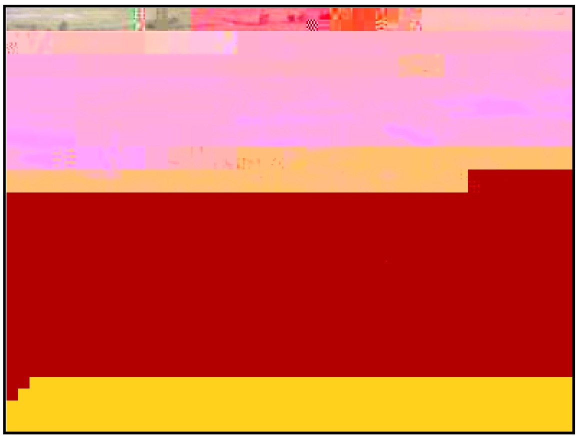
The site's hydrodynamic model was expanded to incorporate potential sea level rise scenarios and used to predict the future extent of saltmarsh under these sea level rise scenarios. It was found that potential vegetation responses under sea level rise scenarios differ depending on the relative rate of accretion and sea level rise. To ensure that saltmarsh continues to prosper at Tomago Wetland under sea level rise, wetland maximum depths should be restricted to under 0.25m through management of onsite SmartGates which allow the site to become more wet or dry as required through tidal exchange.

PROJECT SIGNIFICANCE TO ADAPTING AND PROTECTING AUSTRALIA'S SETTLEMENTS AND INFRASTRUCTURE

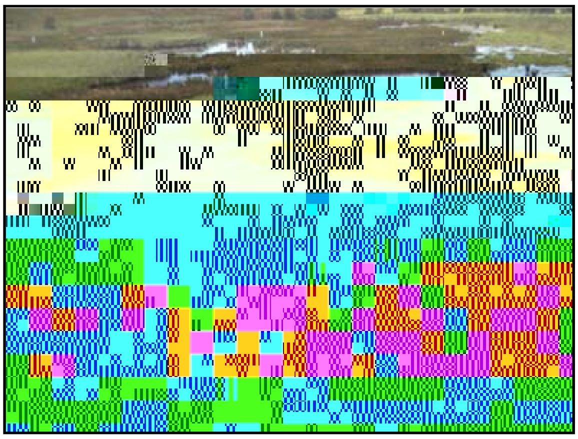
This study provides information that PWD can use to manage onsite hydrology to promote the growth of saltmarsh species and discourage the growth of exotic and freshwater species. By determining the hydrology requirements of onsite vegetation, the site can be manipulated through changing the configuration of installed SmartGates. It has been determined that at Tomago Wetland depth is more important than hydroperiod in determining distribution of different vegetation types. This has significant implications for the management of the SmartGates under sea level rise. Under potentially rapid sea level rise scenarios, upstream depths need to be carefully restricted through the management of the SmartGate system. SmartGates restrict wetland water depths by cutting off the peak of all tides, which has the consequence of increasing the proportion of time that the wetland is wet (i.e. hydroperiod). As vegetation distribution has been determined to be primarily controlled by water depth, it is considered that vegetation at Tomago should not be effected detrimentally due to this management strategy. Wetland maximum depths should be restricted to remain under 0.25m to promote the growth of saltmarsh.

The rate of sea level rise will also need to be carefully monitored, as the SmartGate levee is at a fixed height of approximately 1.3m. If sea level rise is likely to exceed the levee heights, raising the height of the levee should be considered to prevent overtopping and tidal flooding in the wetland.

There are currently light-industrial developments being designed along the Tomago Wetland property boundary, which will reduce the site's overall ability to adapt with future climatic change. Determining the current distribution of saltmarsh, and potential distribution as a result of sea level rise, may have implications towards the development of strategies to manage the wetland and improve future restoration design.



November 2010 Camera Image



February 2012 Camera Image

FURTHER RESEARCH SUGGESTIONS:

Similar studies in other tidal wetlands would aid in increasing the understanding of the relationship between vegetation and hydrology. Further research is required to assess water depth as a major hydrological factor in determining vegetation extent at other wetland sites. Additionally, further research into this area should endeavour to examine the relationship between vegetation, hydrology and salinity, which has been neglected in this study.

Long term monitoring should also continue at Tomago Wetland using the elevated digital camera installed on site. Further, quantitative analysis of geo-rectified camera images should be undertaken to obtain accurate vegetation trajectories and observe changes in open water coverage over time.

Onsite vegetation may attempt to migrate to higher ground in response to sea level rise, as tidal forcing generally promotes landward migration of wetland vegetation species. However, at Tomago Wetland, private ownership of upstream land applies constraints to vegetation retreat from sea level rise. As such, further investigation should be undertaken into the suitability of upland areas for saltmarsh migration, to determine if land buy-back for conservation purposes could be a vi