Saltmarshes
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Description and distribution
Saltmarshes are usually areas of muddy or sometimes sandy sediments along sheltered coastlines which are often described as ‘Coastal Wetlands’ on many maps or coastal descriptions. In Australia, saltmarshes do not conform to ‘traditional’ models of saltmarshes from overseas (which are often dominated by the grass genus *Spartina*). There are saltmarshes distributed around all of the coast of Australia (Saintilan 2009a,b) and they vary geographically in terms of both speciosity (more species in the south than north) and area (more in the north).

In South Australia saltmarshes are composed of several different plant associations including species from the grasses, shrubs, herbs and sedges. As for mangroves we use the term “saltmarsh” to describe both the overall habitat and also the plants that grow there. Unlike the east coast versions, saltmarshes in SA are not mainly confined to estuaries; instead they occupy large areas behind the open coastlines of our sheltered waters such as in the Gulf. They are also only sometimes found in SA in association with the grey mangrove, *Avicennia marina*, and most of the largest marshes extend well beyond where mangroves can grow.

*Avicennia marina*, RS Saltfields,
(Photograph: Ron Sandercock)

South Australia is in many ways the centre for saltmarshes in Australia. For example, of the 36 Interim Biogeographic Regionalisation of Australia (IBRA) bioregions, five in SA are ranked 1 to 4 and 13 for the proportion of the national saltmarsh flora (from 37 to 68% of all plant species; see Saintilan 2009b) contained therein. The same author goes on to say that “[t]hree quarters of the 93 listed saltmarsh species grow within 200 km of Adelaide”! Only WA has more species within its State borders but that includes a large tropical component that SA lacks.

The northern parts of the two gulf in South Australia are the location for vast saltmarshes covering about 15000 ha in the Northern & Yorke NRM region and 6500 ha in the Eyre NRM region (Rumbelow & Speziali 2010). As mentioned previously, our saltmarshes are not confined to estuaries, which is the common perception from the eastern states’ experience.
Typically, saltmarsh habitats are only periodically inundated by the highest tides, they grow in sediments or soils that are often waterlogged and extremely saline (with salt concentrations often well above seawater, due to evaporation). The plants that have adapted to such harsh conditions are diverse, coming from at least 25 families and show a convergent set of plant traits even though they are not necessarily closely related. Thus there seem to be only a few ways of living in such harsh conditions. The major plant associations found in our saltmarshes include the samphires or chenopod shrublands (typified by the samphire *Sarcocornia quinqueflora* and other succulents), salt-tolerant grasses (e.g. *Sporobolus virginicus*), sedges (e.g. the genus *Gahnia*) and herbfields (e.g. *Selleria radicans*). These vegetation formations are often separated vertically by only a few centimetres and may represent differences in soil porosity or salinity, to form complex mosaics of plant associations. At their lower points they may abut either mudflats (including those with intertidal seagrasses) or mangroves, whereas at their upper boundaries they may grade into coastal forest or shrublands (including arid saltbushes in the *Chenopodiaceae* family).

**Function**

As well as the plants that epitomise saltmarshes, they are also home to some quite specialised species of animals and other life forms. Animals with interesting adaptations include molluscs (especially pulmonate gastropods), crustaceans (especially burrowing crabs), insects and other arthropods more associated with terrestrial habitats. Occasional visitors include fishes (for feeding at high tide), birds (especially for roosting but also feeding opportunities) and bats.

Algae and microbes are common in saltmarshes, and unvegetated or bare sediment areas known as “salt pans” or “rotten spots” can be common and extensive in semi-arid areas; these may be similar to the sakkha of desert countries.

Saltmarshes provide an ecological service to the human population living on their shores in the form of some protection from storms and coastal erosion and as such need to be conserved as an integral part of SA coasts. It should be noted that, like mangroves, these coastal bioshields cannot provide complete protection; they must be part of regional plans to reduce the human risk, the loss of property and infrastructure and sustain ecological services to an acceptable level.

Saltmarshes can be restored depending on the severity of the natural hazards, the bathymetry, and the climate, the local land use, and the available options to survive extreme events. But it is neither an easy nor assured task, many restoration attempts around the world have only resulted in partial recovery of the character and values of natural saltmarshes. Saltmarshes warrant a place amongst all the coastal resources that the human population living along SA estuaries and coasts value and rely upon for their livelihood and quality of life.
Surprisingly given the importance of saltmarshes, Fairweather (1990), when reviewing the output of Australian marine ecological research through to the 1980s, identified saltmarshes (along with sandy beaches) as the least studied or understood of the major coastal habitats. The number of studies was much less than would be suggested by the prevalence (e.g. extent of coastline or area) of these habitats. That situation has improved to some extent over the last 20 years, to the point where a book summarizing what is known about this habitat in Australia (Saintilan 2009a) was published. Earlier treatments (e.g. Adam 1990) contrasted how little was known about saltmarsh in Australia with the situation in Europe or North America.

**Threats**

As coastal development and use by the expanding population continues, saltmarshes are more likely to be impacted. The human impacts on saltmarshes (often in conjunction with adjacent mangroves) are well discussed in Coleman (1998), Adam (2002), Connolly & Lee (2007), Adam *et al.* (2008), Fotheringham & Coleman (2008) and Saintilan (2009a). Here we list them with some discussion but these references add much further detail to this discussion.

**Development and pollution**

As for mangroves and other low-lying coastal habitats, early settlers and developers generally considered saltmarshes as wastelands - places to be filled in and put to “better” use after they were “reclaimed”. Thousands of hectares were thus converted to pasture, buried under rubbish tips or used for roads, industrial sites, playing fields, housing, car parks and other developments. The most widespread destruction of saltmarshes has resulted from filling to create dryland sites for coastal land uses by humans. This landfill can modify the local tidal range and thus patterns of inundation in any remnants that persist. Thus much of our remaining saltmarshes are poorly connected to the seas or otherwise suffering from disturbed hydrology. As for mangroves, once the landfilled area is in use, other environmental problems usually follow. Stormwater runoff, accidental spills of pollutants and discharge of treated or untreated effluent cause environmental problems in remnant saltmarshes.

Elevated nutrient levels, from sewage and stormwater discharges, could also affect saltmarsh ecosystems adjacent to outfalls or urbanised centres. Saltmarshes to the north of Adelaide have been used for the production of salt and are often impacted with bund walls to limit tidal inundation. Many of these saltmarshes do not receive anything like the natural degree of infrequent interchange of seawater at high tides. Through a lack of inundation, saltmarsh sediments may suffer from acid sulfate soil syndrome.

**Ecological degradation from land uses**

Housing projects can destroy large areas of saltmarshes, and straightening of meandering tidal channels causes changed tidal levels and reduced inundation and hence nutrient uptake for the remaining saltmarshes. Saltmarsh ecosystems remove nutrients from runoff as they cover large area that are occasionally flooded and drained by meandering streams that slowly release water to the sea. If these meanders are straightened out, for example for boating channels, the water passes more quickly to the sea and many saltmarshes will not be flooded as frequently with little chance for nutrients and organic matter to be retained and used in the saltmarshes. Bund walls are useful for flood mitigation but their environmental impacts include limiting the upward rise of flooding king tides and so result in disconnection and destruction of habitat in the area beyond the bunds. Hydrodynamic changes to saltmarsh habitats thus have multi-faceted and extreme impacts.
In many areas saltmarshes are grazed at levels beyond their natural use by kangaroos. Stock moving along pathways alters drainage lines and these acts as shallow channels that often remove water very quickly from flooded areas. Similar subtle changes to topography resulting in altered drainage also come from use of off-road vehicles or attempts at mosquito control via runnelling. Even a single vehicle pass can produce changes that can last decades, either removing (crushing) vegetation or creating lower paths that alter drainage lines and rates. Such damage can be readily seen across any saltmarsh surface so impacted.

**Pest species**
A number of weedy species of plants are found in saltmarshes close to urban land or otherwise impacted (e.g. from nutrient-rich runoff). These are few in number of species, however, because most land plants cannot tolerate saturated soils and many aquatic species cannot tolerate hypersaline soils. Invasive species e.g. *Spartina anglica* (being actively but destructively controlled by PIRSA Biosecurity at places like Middle Beach) or *Juncus acutus* are also of concern in some areas of the state. In the eastern states, invasion by mangroves can be an issue, especially in relation to altered sediment budgets from the catchment. In the future, interactions with any mangrove stands that expand under climate change could be a growing threat to saltmarshes.

**Climate change**
Carbon dioxide assimilation interacts in complex ways with aspects of saltmarsh physiology. Some saltmarsh plants have C4 or CAM metabolic pathways and these may do better under higher temperatures and increased CO₂ levels than C3 plants. Given that saltmarsh plants are already “on the edge” in regards to their water relations, increases in water-use efficiency may not be possible. The general trade off between water use and CO₂ acquisition means the saltmarsh response to high atmospheric CO₂ may not be easy to predict. Also saltmarshes naturally reach their zenith at mid-latitudes (Saintilan 2009b) and so a general rise in temperatures may not favour many species and probably not over the grey mangrove. The most likely effects of sea level rise will be to further squeeze saltmarshes into a narrowing space between the sea and human habitation and other structures. Reports of this “coastal squeeze” phenomenon are already coming from the eastern states (Saintilan 2009b).

**Vulnerability**
Saltmarshes in South Australia grow in most of our marine bioregions except for Eucla and Otway, but are most common in the bioregions around the Gulfs. Their inherent vulnerability is multiplied because they are squeezed between the sea and human land uses and because the
general public knows little of them. Unlike seagrass they are easily seen but were often thought of as a nuisance or a ‘wasteland’ and a suitable place for local rubbish dumps. As the coast is developed saltmarshes are often in the way and have been removed in some urban places, to be replaced by port facilities or residential or industrial use. Places where saltmarsh has been impacted by human disturbance include Barker Inlet (in relation to bund walls and other disruptions to hydrology); upper Gulfs (in relation to development, infrastructure and off-road vehicle usage); and smaller remnants throughout the state. Maps of South Australian saltmarshes can be seen at www.naturemaps.sa.gov.au.

Considerations for MPAs in South Australia
The uneven distribution of saltmarshes across the marine bioregions and the early but ongoing loss of these low-lying lands since South Australia was settled, suggest that remnant saltmarshes should be protected wherever they still persist. Thus a high level of protection from zoning is suggested for many saltmarsh areas.

South Australia lags behind other states in how much is known about our local saltmarshes, as illustrated by Saintilan (2009a), a multi-authored work covering most taxonomic groups of biota found in saltmarshes as well as pure and applied scientific questions about them: there was no contribution from SA. Local expertise can be found in Doug Fotheringham (of DENR Coastal Management Branch) and Peri Coleman (e.g. Coleman 1998; Fotheringham & Coleman 2008). The size requirement of a viable saltmarsh is unknown but should be considered when zoning or placing protection on them. There is virtually no literature about size dynamics and the faunal communities that live in saltmarsh of different sizes and the viable size of a whole marsh is never discussed.

In other parts of the world saltmarshes are known to be important for various endangered or threatened species and for the goods and services they provide; thus they are protected with varying degrees of success. But saltmarshes always suffer from the perception that they are swamplands that are good for little except growing mosquitoes!

Conclusion and recommendations
Saltmarshes grow along many parts of the coast of South Australia. To determine if human interventions in conservation of saltmarshes is having any effect, detailed mapping and monitoring must be repeated without delay. The earlier maps are not useful in measuring small changes in density, coverage or condition of saltmarshes but the later ones undertaken by DENR that are now part of the Saltmarsh and Mangrove data layer provide much better coverage and at a finer scale.

Monitoring should take the form of detailed mapping, and permanent transects and quadrats be put in place to answer specific questions on the success or otherwise of human intervention including MPAs. Sensitive areas of saltmarsh in marine parks should be zoned to prevent disturbances that will impact on them. A widespread educational program to alert the public to the importance of saltmarsh as feeding areas for fish, protection of the coast, and habitat for birds should be initiated. From this knowledge, more support for zoning and protection of saltmarshes will be gathered.

References


