



© Natural England/Peter Wakely

Saltmarsh at Lymington, Hampshire

27. Coastal saltmarsh

Climate Change Sensitivity : **High**

Introduction

Saltmarshes are particularly sensitive to the combined impacts of sea level rise, storm events and human responses to these, as they occupy a narrow strip between the marine and terrestrial environments. Saltmarsh can be lost due to coastal squeeze, where they are inhibited by hard sea defences and unable to roll back naturally. Saltmarshes exist as part of a wider coastal sedimentary system, so factors influencing the function of estuaries and barrier coasts will impact on this element of the intertidal habitat, with the potential for abrupt changes (Mieszkowska, 2010).

Relative sea level rise (taking account of isostatic changes), storm events, and changes in the availability and movement of sediment are already having effects on saltmarsh, and climate change projections indicate that this will increase. The impacts of a rising sea level on saltmarsh community composition and area are likely to be greater than those of temperature and rainfall. Saltmarsh communities are adapted to a transient environment, and where there is sufficient sediment may accrete vertically (Hughes 2004) or migrate inland given the accommodation space (Mossman et al 2013), so there is potential for adaptation measures to reduce risks.

Habitat Description

Coastal saltmarshes comprise the upper, vegetated portions of intertidal mudflats, lying approximately between mean high water neap tides and mean high water spring tides.

The development of saltmarsh vegetation is dependent on the presence of intertidal mudflats and is usually restricted to comparatively sheltered locations in estuaries, saline lagoons, behind barrier islands, and on beach plains. Saltmarsh vegetation consists of a limited number of salt tolerant (halophytic) species adapted to regular immersion by the tides, together with a range of plants that are more widespread, but which can tolerate infrequent immersion (Glycophytes) (Rodwell 2000). A natural saltmarsh system shows a clear zonation according to the frequency of inundation. At the lowest level, the pioneer glassworts *Salicornia* spp can withstand immersion by as many as 600 tides per year, while the upper marsh only experiences occasional inundation on the highest tides and is more species-rich.

Saltmarsh plant communities can be divided into species-poor low-mid marsh, and the more diverse communities of the mid-upper marsh. There are regional variations, which can reflect the age of the saltmarsh and the types of management that is present or has occurred in the past. Where grazing has been practised, saltmarsh vegetation is shorter and dominated by grasses. At the upper tidal limits, saltmarsh communities grade into driftline, swamp or transitional communities which can only withstand occasional inundation. Saltmarsh communities are additionally affected by differences in climate, the particle size of the sediment, freshwater seepages into the intertidal zone and, within estuaries, by decreasing salinity in the upper reaches. Saltmarshes on fine sediments, which are predominant on the east coasts of Britain, tend to differ in species and community composition from those on the more sandy sediments typical of the west. The northern limits of some saltmarsh species also influence plant community variation between the north and south of Britain.

Saltmarshes are an important resource for birds and other wildlife. They act as high tide refuges for birds feeding on adjacent mudflats, as breeding sites for waders and gulls, and the seeds of annual saltmarsh plants provide a source of food for passerine birds, particularly in autumn and winter. In winter, saltmarshes with shorter vegetation (often also grazed by livestock) are used as feeding grounds by large flocks of wildfowl. Areas with high structural and plant diversity, particularly where freshwater seepages provide a transition from fresh to brackish conditions, are particularly important for invertebrates. Saltmarsh creeks and flooded areas at high tide also provide sheltered nursery sites for several species of fish, which exhibit a high degree of site fidelity and a degree of seasonal use (Green et al 2009).

Since medieval times, many saltmarshes and associated intertidal areas have been reduced in extent by land claim. As a consequence, many saltmarshes now adjoin arable land, and the upper and transitional zones of saltmarshes are scarce in England. Sites still displaying a full range of zonation are particularly valuable for nature conservation.

Saltmarshes are concentrated in the major estuaries of low-lying land in eastern and north-west England and on the border with Wales, with smaller areas in the estuaries and sheltered parts of the coast of southern and north east England. There are an estimated 32,462 ha of saltmarsh in England.

Potential climate change impacts

Saltmarsh is one of a number of coastal habitats that are threatened by rising sea levels and increased storm events, combined in some area with isostatic change. The impact of sea level rise is exacerbated by hard sea defences which prevent new habitat from forming to replace what is lost.

Cause	Consequence	Potential impacts
Sea Level Rise	Altered coastal dynamics and changes to the amount of sediment supplied	<ul style="list-style-type: none"> ■ The area of saltmarsh is likely to be reduced or lost. ■ Where sediment loading is sufficient, rates of vertical accretion can keep pace with sea level rise (Hughes 2004; Mossman et al 2013). ■ Where space exists inland migration of salt marsh can also take place, but this is restricted in many parts of England by hard sea defences.
	Increased frequency of inundation and water-logging	<ul style="list-style-type: none"> ■ Inundation and water-logging can result in an increased area of exposed mud, leading to greater susceptibility to invasive plants and erosion; increased water-logging at low tide; and potential impacts on soil processes and community composition (Davy et al 2011).
	Increased erosion	<ul style="list-style-type: none"> ■ Erosion at seaward margin, with no sediment transfer higher into the marsh, can cause plants to die back. ■ A steepening of the marsh and foreshore profile, which could lead to more wave energy reaching the saltmarsh (Mossman et al 2013). ■ A reduction in the area of saltmarsh where accretion is at a slower rate than sea level rise. ■ Increased fragmentation and internal dissection as creeks erode.
	Potential construction of new sea defences, and existing hard defences maintained to higher standards.	<ul style="list-style-type: none"> ■ A rise in flood defence standards could result in existing sea wall being enlarged and encroaching directly on saltmarsh, while new defences could result in changes to sediment dynamics and lead to the accumulated destruction of marshes. The loss of fronting marsh will increase the wave energy reaching sea walls, with impacts on maintenance costs.
Increased annual average temperatures	Changes in the relative climate space available to saltmarsh species	<ul style="list-style-type: none"> ■ Changes to community composition, with an increase in graminoid²⁰ species over forbs²¹ (Gedan & Bertness 2009). ■ Potential loss of suitable climate space for some key saltmarsh species eg Sea purslane <i>Atriplex portulacoides</i>, common saltmarsh grass <i>Puccinellia maritima</i> and ■ Annual seablight <i>Suaeda maritima</i> (Holman & Loveland 2001). ■ Sea heath <i>Frankenia laevis</i>, sea lavender (<i>Limonium vulgare</i> and <i>L. humile</i>) and common cord-grass <i>Spartina anglica</i> have the potential to expand from their current southerly distribution (Holman & Loveland 2001, Mossman et al 2013). ■ Sea purslane is potentially the physiognomic dominant of saltmarshes and has been found to rapidly dominate some newly created managed realignments (Mossman, Davy & Grant 2012). Expansion of this potentially dominant species may lead to a shift in community structure.

²⁰ Grasses, sedges and rushes

²¹ Herbaceous species

Cause	Consequence	Potential impacts
Hotter summers	Increased evaporation	<ul style="list-style-type: none"> Increased salinity in the upper zones of marshes could result in changes to community composition and vegetative dieback (McKee et. al. 2004).
Drier summers	Drought	<ul style="list-style-type: none"> Drier conditions could lead to vegetative dieback in upper marshes, and changes in community composition due to competition from grassy species (Ewanchuk & Bertness 2004).
In combination	Increased nutrient loading due to increased erosion and run-off from adjacent agricultural land	<ul style="list-style-type: none"> Increased nutrient loading could lead to an increase in late-successional species and the dominance of graminoid species, such as sea couch <i>Elytrigia atherica</i> (van Wijnen & Bakker 1999; Bobbink & Hettelingh 2011, Mossman et al 2013).

Adaptation responses

Although saltmarshes are sensitive to climate change, provided they have sufficient sediment supply and adaptation space they have considerable ability to adapt to changes in sea level. Being a component of dynamic coastal systems, adaptation is likely to focus on maintaining the natural coastal processes that provide the sediment to support saltmarsh, ensuring sufficient space is available for saltmarsh to develop naturally and migrate inland, and identifying sites for managed realignment to compensate for habitat lost. It may also include the restoration of the coastal flood plain by removing or breaching artificial structures.

Some of the potential adaptation options for this habitat are outlined below.

- Act to eliminate or reduce non-climate change associated erosion, for example that caused by altered drainage flows, contamination, removal of sediment by dredging, or wash from shipping.
- Manage recreational pressure to minimise erosion and damage to saltmarsh vegetation. Consider using sediment re-charge to reduce the rate of erosion of vulnerable areas of saltmarsh, where longshore drift of sediment has been disrupted by human activity (French and Burningham 2009).
- Minimise surface erosion through flexible management. For example, where grazing is appropriate to the site, adjust stocking density and the timing of grazing regimes in response to seasonal variations in growing conditions, and ensure that overgrazing does not reduce the potential for accreting sediment (taller vegetation tends to trap more sediment: Andresen et al. 1990).
- Ensure that adaptation through the use of hard defences does not adversely affect coastal dynamics and increase the threat of coastal squeeze.
- Develop and implement management plans that respond to predicted changes along the whole coast not individual sites in isolation.
- Anticipate and develop approaches to managing the landward movement of marshes by identifying and protecting priority sites for realignment projects.
- Ensure adequate space and promote policies that allow a continued supply of sediment (eg from eroding cliffs) for replenishing saltmarsh, through strategic coastal planning.
- Adjust the boundaries and interest features of protected sites as coasts evolve, and aim to enlarge functional units.



The Alkborough Flats re-alignment scheme in North Lincolnshire will reduce flood risk and create new habitats.

Relevant Environmental Stewardship options

Maintenance of coastal saltmarsh (HPO5)

Restoration of coastal saltmarsh (HPO6)

These options aim to maintain and restore coastal saltmarsh. The management will depend on the particular conditions on a site. It could include light grazing, restrictions on grazing, controlling damaging activities associated with public access, or dealing with accumulations of normal coastal litter.

Further information and advice

Environment Agency (2007) [Saltmarsh management manual](#).

Environment Agency [Shoreline Management Plans](#).

Garbutt, A & Wolters M. (2008). [The natural regeneration of salt marsh on formerly reclaimed land](#). *Applied Vegetation Science*, 11 (3). 335-344.

JNCC (2008) UK BAP habitat description [Coastal Saltmarsh](#).

Relevant case studies

[Abbotts Hall Farm – Essex Wildlife Trust](#)

The Abbotts Hall Farm project on the Blackwater Estuary is a special managed realignment scheme, and has demonstrated how farming and nature conservation can work side by side.

[Medmerry managed realignment scheme](#)

The Medmerry managed realignment scheme has created a major new sea defence in West Sussex, which improves the standard of flood protection and creates important new intertidal wildlife habitat and recreational opportunities.

[Alkborough Flats Tidal Defence Scheme](#), South Humber Estuary.

Key evidence documents

Andresen H, Bakker JP, Brongers M, Heydemann B & Urmler U. (1990). Long-term changes of salt marsh communities by grazing. *Vegetatio* 89: 137-148.

Bobbink, R. & Hettelingh, J.P. (2011) Review and revision of empirical critical loads and dose-response relationships. Coordination Centre for Effects, National Institute for Public Health and the Environment (RIVM), www.rivm.nl/cce.

Ewanchuk PJ & Bertness MD (2004). The role of waterlogging in maintaining forb pannes in northern New England salt marshes. *Ecology*, **85**, 1568–1574.

French JR, Burningham H (2009) Restoration of an eroded estuarine foreshore using cohesive dredge material, Orwell estuary, UK. *Journal of Coastal Research*, SI 56 (Proceedings of the 10th International Coastal Symposium), 1444-1448. Lisbon, Portugal, ISSN 0749-0258.

Gedan KB & Bertness MD (2009) Experimental warming causes rapid loss of plant diversity in New England salt marshes. *Ecology Letters*, **12**, 842–848

Green BC, Smith DJ, Earley SE, Hepburn LJ, Underwood GJC (2009) Seasonal changes in community composition and trophic structure of fish populations of five salt marshes along the Essex coastline, United Kingdom. *Estuarine Coast Shelf Science* 85:1–10.

Harrison, P.A., Berry, P.M. and Dawson, T.P. (Eds.) (2001). [Climate Change and Nature Conservation in Britain and Ireland: Modelling natural resource responses to climate change \(the MONARCH project\)](#). UKCIP Technical Report, Oxford.

Holman IP & Loveland PJ (2001) [REGIS-Regional Climate Change Impact and Response Studies in East Anglia and North West England](#). MAFF Project No. CCo337.

Hughes R, (2004) Climate change and loss of saltmarshes: consequences for birds. *Ibis* **146**, 21–28.

McKee KL, Mendelsohn IA & Materne MD. (2004) Acute salt marsh dieback in the Mississippi River deltaic plain: a drought induced phenomenon? *Global Ecology and Biogeography*, **13**, 65–73.

Mieszkowska, N. (2010) Intertidal Habitats and Ecology in MCCIP Annual Report Card 2010-11, MCCIP Science Review, 20pp. www.mccip.org.uk/arc.

Mossman HL, Davy AJ & Grant A. (2012) Does managed coastal realignment create salt marshes with 'equivalent biological characteristics' to natural reference sites? *Journal of Applied Ecology*, doi: 10.1111/j.1365-2664.2012.02198.x.

Mossman HL, Grant A & Davy AJ. (2013) 10. [Implications of climate change for coastal and inter-tidal habitats in the UK](#). Terrestrial biodiversity climate change impacts report card technical paper.

Rodwell, J.S. 2000. British Plant communities Volume 5: Maritime communities and vegetation of open habitats. CUP, Cambridge.

Suchrow S, Pohlmann, N, Stock M, & Jensen K (2012) Long-term surface elevation changes in German North Sea salt marshes, Estuarine, Coastal and Shelf Science, **98**, 71-83.

Thorne KM, Takekawa JY & Elliott-Fisk DL. (2012). Ecological Effects of Climate Change on Salt Marsh Wildlife: A Case Study from a Highly Urbanized Estuary. *Journal of Coastal Research*, **28**,1477-1487.

UK Marine Monitoring and Assessment Strategy (2010). Charting Progress 2 Healthy and Biological Diverse Seas Feeder report. (Eds. Frost, M. & Hawkrige, J). Published by Department for Environment Food and Rural Affairs on behalf of UKMMAS. 682pp.

van Wijnen, H.J. & Bakker, J.P. (1999) Nitrogen and phosphorus limitation in a coastal barrier salt marsh: the implications for vegetation succession. *Journal of Ecology*, **87**, 265-272.