SALTMARSH

Saltmarshes are coastal wetlands that are flooded and drained by tidal salt water. They form in sheltered, low-energy environments such as harbours, estuaries and behind spits.

Saltmarshes are found on the upper part of mudflats in the intertidal zone, near to the shoreline. An intertidal zone is an area above sea level at low tide and underwater at high tide. Typically, they are very flat and covered in plants, with numerous muddy channels and inlets cutting through them.

Because saltmarshes are frequently submerged by the tides and contain a lot of decomposing organic material, oxygen levels in the sediment can be extremely low—a condition called anoxia. Bacteria which thrive in these anaerobic conditions produce the sulphurous rotten-egg smell that is often associated with marshes and mudflats.

Saltmarshes are an extremely important food resource for breeding and wintering wading birds and wildfowl. They support internationally important numbers of bird species, as well as providing nursery sites for several species of fish. Many of the plants growing on saltmarshes are not found elsewhere and are adapted to cope in the salty environment. Areas of saltmarsh with high plant diversity are also important for invertebrates.

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Saltmarsh at North Hayling island

Saltmarsh in Chichester Harbour

Chichester Harbour has the largest area of saltmarsh in the South-East region and is the 7th largest area in Britain.

There are 10 significant saltmarsh sites in the Harbour, with the largest at Gutner, Hayling Island. These saltmarsh areas are not only a rich store of food for bird, fish and invertebrate species but are also important as a site for waders such as curlew, godwits, redshank and dunlin to roost, rest and preen. Sadly, these vital refuges are now relatively rare in the UK because the areas of saltmarsh have declined (see section below on threats for the reasons for this).

Saltmarsh at Itchenor, Chichester Harbour

Saltmarsh formation and succession

A saltmarsh is formed when bare mud is colonised over time by plants and gradually the land rises above sea level. This takes place in a series of stages called succession. The succession in a saltmarsh is called a halosere and many of the plants adapted to living there are halophytes ('salt- plants').

1: The First Stages

Saltmarshes start life as mudflats. In areas of sheltered tidal water, like a harbour, the sediment held in the water settles out and builds up. In the early stages of development before colonisation with flowering plants, microscopic blue-green algae (cyanobacteria) thrive on the surface of the mud. Their presence will help to glue the mud particles together. Larger algae such as gutweed (Enteromorpha spp), sea lettuce (Ulva spp) and wracks (Fucus spp) also help to stick the mud together and trap more sediment.


Bladderwrack


Mudflats


Gutweed


Glasswort

2: Pioneer Species

Pioneer species are plants which first colonise a new area of bare soil or rock and can survive the harsh conditions. In the saltmarsh pioneer species include glassworts (Salicornia spp) and cord grass (Spartina spp). Their seeds can then germinate and colonise the mud. The roots of these pioneer plants help to further consolidate the mud and their upper parts also help to trap sediment. It has been estimated that spartina can add 8-10 cm of mud a year to a saltmarsh. Decomposition of the plants over winter adds organic matter, nutrients and minerals to the muddy soil.


Cord grass

Wikimedia Ed Stikvoort

3: Competition

Over time, as the decaying vegetation adds organic matter, the mud becomes less stressful for plants. As the height of the mud increases with pioneer plants trapping the sediment, the mud spends more time out of seawater. These more favourable conditions: less inundation and higher levels of nutrients, mean other less hardy species such as sea aster (Tripolium pannanium), saltmarsh grass (Puccinellia maritima) , sea lavender (Limonium vulgare) and sea purslane (Halimione portulacoides) can colonise and the pioneer species may be squeezed out by competition. However, if there is a hollow or pool in these higher areas you will find the pioneer plants such as glasswort again.


SALTMARSH GRASS


SEA LAVENDER


SEA ASTER
Wikimedia Stefan Jnaer


SEA PURSLANE


Upper saltmarsh zone with reeds and rush

4. Stabilisation and Climax

The species that have survived the competition stage will not be competing strongly with one another anymore as they all occupy different niches. Each species occupies its own niche, and therefore avoids having to compete strongly with other species. Above high-water rush and reed species colonise. The climax vegetation of saltmarsh succession is deciduous woodland. The type of vegetation at this stage is determined by the climate of the area, wind speeds and direction, animal grazing, pH, temperature and other factors. In Chichester Harbour the climax species would be oak (Quercus robur) woodland, but rising sea levels combined with sea defences and land use for farming mean climax succession is not present. The constraint placed on saltmarsh by sea defences, preventing it from naturally moving landward is called coastal squeeze.


Saltmarsh with sea defence interrupting

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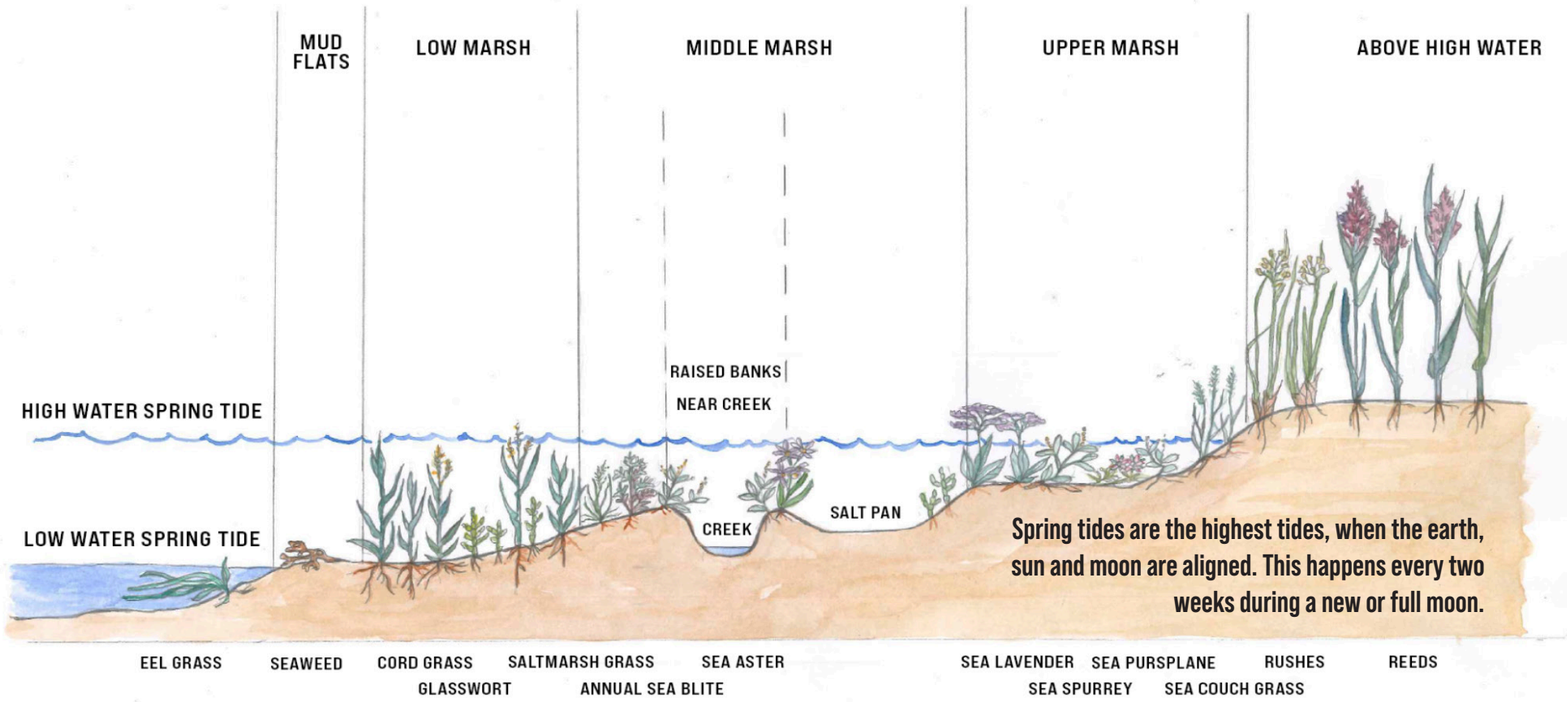
Saltmarsh zones and species succession

As succession takes place over time, different zones in the saltmarsh system represent the different seral stages of succession.



This illustration shows a cross section of a typical saltmarsh in Chichester Harbour, moving up the shore from the mudflats to above high water (where high tides rarely reach). It shows the seral stages, with different plants colonising each zone and the height of the tidal sea water submerging the saltmarsh. At the lowest level, the pioneer glassworts Salicornia species can withstand immersion by as many as 600 tides per year, whereas species of the upper marsh can only withstand occasional inundation.

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How are plants adapted to cope with the conditions found in saltmarsh?

Saltmarshes are extreme environments for organisms to live in and are affected by specific abiotic factors - the non-living physical and chemical elements in an ecosystem.

The 4 abiotic factors affecting saltmarsh:

1. Salinity of sediment (mud/soil): Normally water flows into the roots of a plant by a process known as osmosis. The water in a root cell is in a more concentrated solution (less water, more solute) and therefore has a lower osmotic potential. Water in the soil is in a more dilute solution and has a higher osmotic potential. Water flows from a higher osmotic potential area to a lower potential area therefore water will flow from the soil into the root. In the saltmarsh, seawater deposits salts in the sediment so that the soil water solution here has a lower osmotic potential. Consequently, any rooted plant will have problems getting water by osmosis in this soil.

2. Waterlogged soil: Waterlogging means that the air spaces within the soil are filled with water instead of air. The roots of plants need oxygen from the air for respiration. Long-term waterlogging results in anaerobic conditions in which anaerobic bacteria thrive and create the characteristic black mud. Using chemosynthesis rather than photosynthesis they leave complex sulphides in the mud. This anoxia, as it is called, is toxic to plants.

3. Drag and scour from the tide: The tidal movement across the surface causes a sideways drag on the plant. With two tides a day this will work back and forth possibly uprooting the plants. The water contains sand and mud particles, and this can scour the plants like being buffed with sandpaper.

4. Submerged underwater: Living in a tidal environment means plants may be submerged for part of the day, with less light for photosynthesis and making gas exchange more difficult.

Adaptations of Saltmarsh plants

Saltmarsh plants are halophytes: plants that can thrive in saline soil and cope with being submerged in saltwater. Halophytes have a variety of adaptations to overcome the challenging abiotic factors of living in saltmarsh environments. Below are 3 examples of how different plants have adapted.

Common Cord Grass (Spartina anglica)

illustrations and text by Sue Ogilvy

Cord grass is found on the mudflats and the low marsh. Spartina angelica is now the commonest Spartina species in the UK and is a hybrid of a Spartina introduced from North America and a native species.

Common Cord Grass adaptations:

- There are 2 types of roots: 1. fine and horizontal root-like stems (rhizomes) for access to oxygen near the surface of the mud 2. deep roots to anchor the plant in mud preventing drag from the sea.
- Special spongy root tissue with large air spaces to improve the oxygen supply for respiration. Roots pass oxygen into the surrounding mud so it becomes less toxic.
- Leaves have a thick cuticle (outer skin) helping the plant to tolerate long periods of submersion.
- Salt glands on leaves, secrete salt onto the leaf surface to expel excess salt.
- Leaves are shed if they contain too much salt.
- Sunken stomata (holes on the leaf surface for gas exchange) and curved leaves reduce water loss.

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Sea Purslane (Halimione portulacoides)

Sea purslane is a low growing bushy plant found on the banks of creeks and in the upper marsh. This plant is a refuge for saltmarsh insects and spiders.

Sea Purslane adaptations:

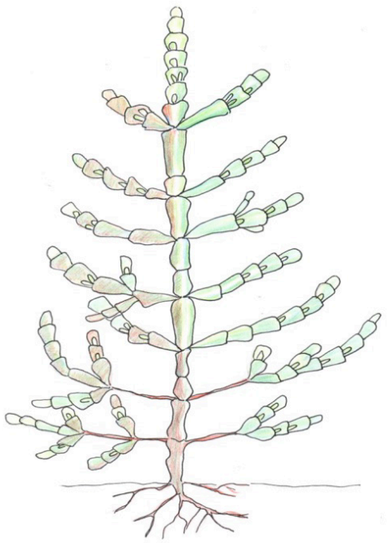
- Leaves have hairs which reduce water loss by transpiration.
- Whitish leaves reflect sunlight, allowing plants not to overheat. Saltmarshes are exposed to high levels of sunlight.
- Slightly succulent leaves store water.
- Salt glands on leaves, secrete salt onto the leaf surface to expel excess salt.
- Leaves are shed if they contain too much salt.

Glasswort (Salicornia spp)

Glasswort is found on mudflats and the low marsh. A pioneer plant (coloniser) of the saltmarsh, the commonest species is Salicornia europaea and one of several species known as samphire.

Glasswort adaptations:

- Fleshy succulent stems store water. The cell sap has a high level of salt (giving a low osmotic potential) so that water can pass into the plant by osmosis from the saline mud. Succulence makes the stems rounded and smooth and reduces drag.
- Tiny, scale like leaves reduce water loss. Photosynthesis is carried out in the green stems.
- Shallow roots allow it to obtain oxygen at the surface of the mud.
- Special spongy root tissue with air spaces, increase the oxygen supply for respiration.



Threats to Saltmarsh

Sea level rise - the sea is rising due to climate change. The land in the south of Britain is also sinking so the sea level is higher here. This is due to Isostatic rebound. During the last ice age, ice covered the north of Britain and so this area sank with the weight of the ice. Since the ice melted this area has slowly rebounded upwards and the south of Britain has sunk down.

Erosion - wave action (including wash from boats) can damage and erode the marsh.

Sea defences - defences to protect the land from the rising sea may be built on saltmarsh or they may change the movement of the sediment necessary to maintain saltmarshes and mudflats.

Dredging - maintains the channels but may also affect the movement of sediment and hence the state of the saltmarsh.

Coastal squeeze - ideally saltmarsh need to be able to 'move' in response to changing conditions. Many saltmarshes are being 'squeezed' between the rising sea and fixed flood defence walls. Coastal squeeze has led to a large decline in intertidal habitat (mudflats and saltmarsh) in the Solent. In recent years there has been a dramatic decline in the saltmarsh in Chichester Harbour. (Diagram of coastal squeeze)

Disturbance by people - recreational use, for example by trampling and creating informal footpaths, can damage saltmarsh.

Land claim for farming or building - since medieval times, saltmarshes have been enclosed for agricultural use or destroyed to make way for building ports, harbours and other infrastructure. Nowadays this happens only in special cases.

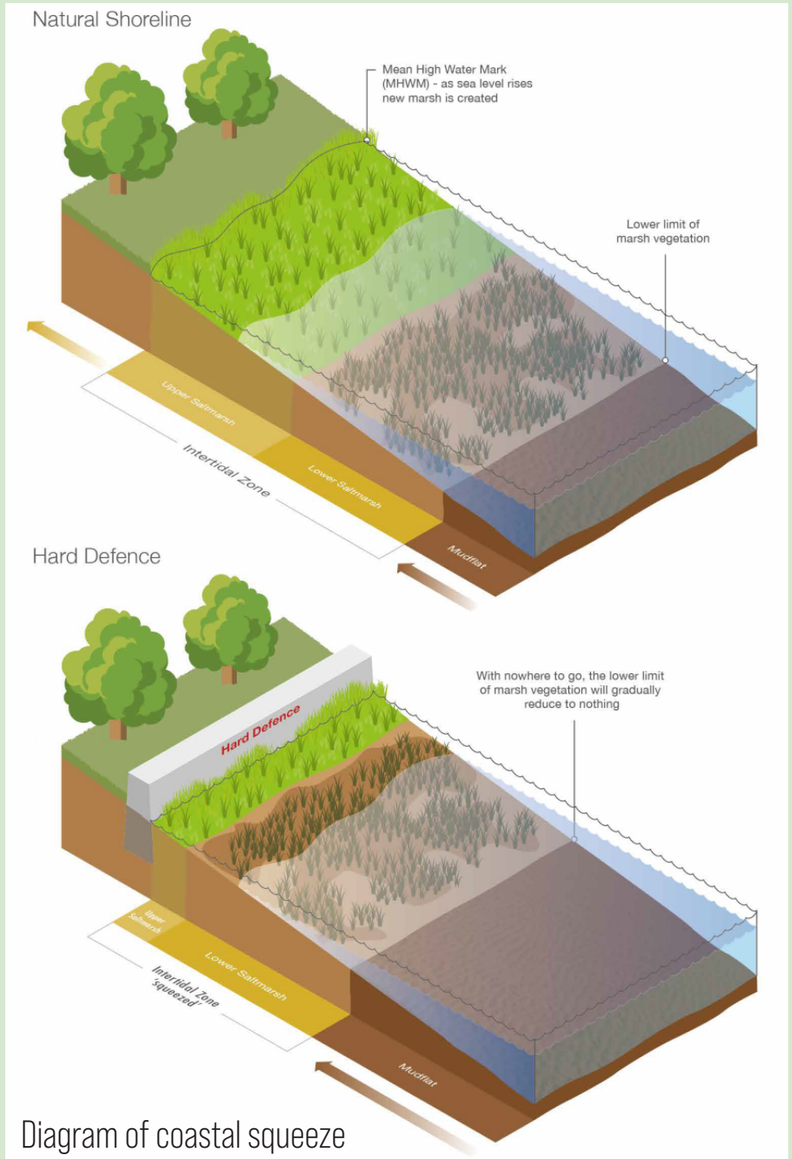


Diagram of coastal squeeze

Pollution from land or sea; oil, sewage, fertilizers, run off from old waste tipping - oil pollution can damage saltmarsh vegetation and whilst it usually recovers, sediment may be lost during the period of die-back. Water pollution from sewage and fertilizers can lead to eutrophication. This is the excessive growth of green algae, which may cause local problems of smothering on saltmarshes.

Grazing - can be beneficial if it controls coarse grasses, but sometimes it reduces the height of the vegetation and the diversity of plant and invertebrate species. This makes it less attractive as a breeding place for wading birds although they still use it in winter and when passing by on migration. Intensive grazing is a problem in some areas.

Colonisation by cordgrass - the small cordgrass, Spartina maritima, is the only species of cordgrass native to Great Britain. S. alterniflora, was introduced to the UK in the 1820s and hybridized with S. maritima to produce resulting in the hybrid cord grasses Spartina x townsendii and S. anglica, which have invaded and dominated most of the marshes along the south coast. Common cordgrass S.anglica, helps to stabilise mudflats but in many areas, it is potentially a threat to bird feeding grounds. As a result, attempts have been made to control it at several locations. However, in some areas it is dying back for reasons not fully understood, and this is exposing the mudflats to erosion and saltmarsh is being lost.

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Saltmarsh creation

New saltmarsh can be created. Coastal sea defences can be removed, and the sea allowed to flood fields which will eventually turn to saltmarsh. This coastal management technique, known as 'Managed Realignment', is more sustainable than traditional 'hard' sea defences, eases pressure from flooding and benefits wildlife. In Chichester Harbour saltmarsh creation can be seen at Thornham Point and Chidham, where managed realignment has established new intertidal mudflats and saltmarsh.

Saltmarsh creation at Chidham

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Saltmarsh wildlife

Bass - **Wikimedia Citron**

Saltmarshes are an important habitat for wildlife, providing shelter and food for many insects such as moths and crustaceans. Juvenile fish, such as bass, mullet and flounder use the sheltered creeks as nursery grounds. Many wetland birds hunt or graze on the saltmarsh and use the upper marsh for nesting sites.

Leaf beetle

Starwort moth caterpillar (David Green)

Little Egret

Matthew's Waincot Moth

A Saltmarsh Food Web

Brent goose

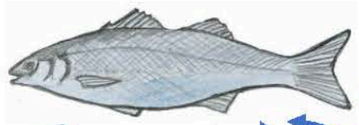
Tern

Curlew

Little Egret

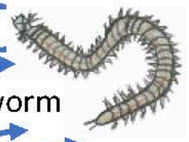
Oystercatcher

Shelduck

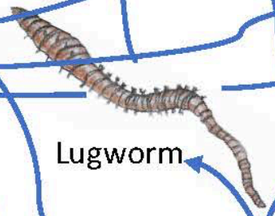


Large fish

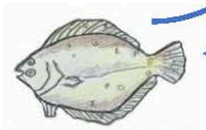
Shore crab



Ragworm



Lugworm



Small fish

Hydrobia

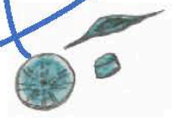
Mud shrimp

Cockle

Zooplankton

Eel grass, algae

Cord grass



Phytoplankton

Detritus, decaying plants and bacteria

Saltmarsh grass

Sea aster

illustrations and text by Sue Ogilvy