Department of Primary Industries
primefact

Coastal saltmarsh

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What is coastal saltmarsh?

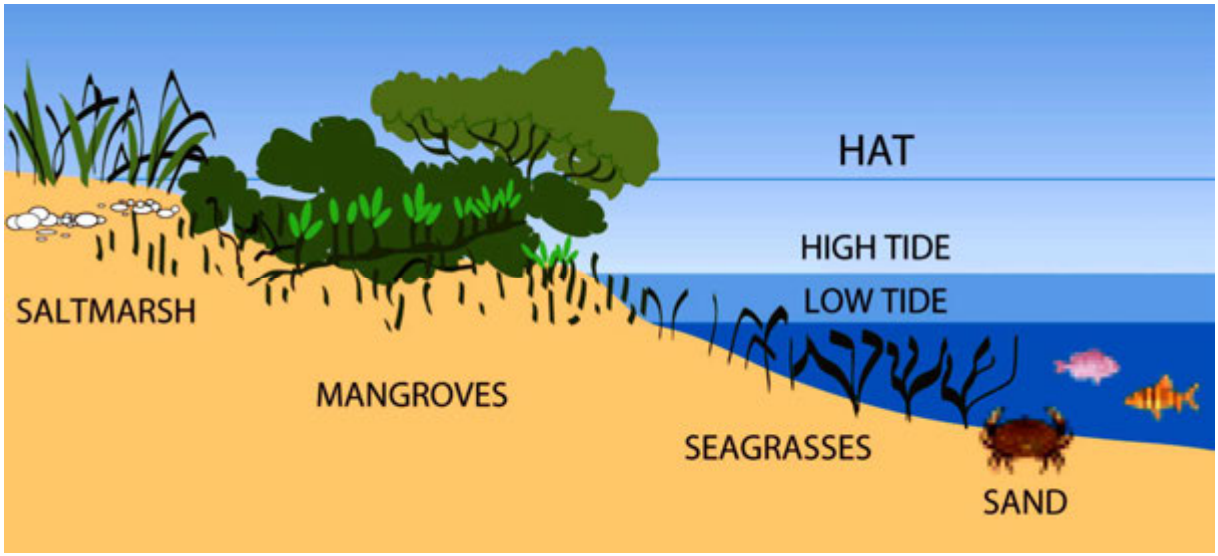
Coastal saltmarsh (also referred to as saltmarsh) is an intertidal community of plants, such as sedges, rushes, reeds, grasses, succulent herbs and low shrubs that can tolerate high soil salinity and occasional inundation with salt water. The term 'saltmarsh' is used to describe individual plants, groups of plants and the general estuarine habitat dominated by these plants.

Saltmarsh occupies the high tide zone on sheltered soft substrate foreshores of coastal lakes and estuaries, often occurring behind mangroves (Figure 1). It is usually only intermittently inundated by medium to high tides. Saltmarsh plants are adapted to hypersaline conditions which most other vegetation cannot tolerate.

Saltmarsh areas are characterised by low vegetation interspersed with bare patches or salt pans (although these are not common in New South Wales). Distribution of coastal saltmarsh is influenced by the combination of elevation, salinity and frequency of inundation. Coastal saltmarsh can range from narrow fringes of one or two species of plants on steeper shorelines to almost flat expanses of multiple species extending hundreds of metres in width. Saltmarsh can also occur along estuary foreshores many kilometres inland from the sea entrance. Saltmarsh communities can be dominated by a single plant species or occur as a mosaic with the biodiversity of plant species increasing in higher elevation areas which are less frequently inundated.

Saltmarsh plants reproduce sexually by flowering and producing seed (which is spread by birds, insects, wind or tidal flow), or asexually by cloning individual plant parts or lateral spread into adjacent areas through the production of new rhizomes.

Figure 1. Common aquatic habitat zones in an estuary



Source: Adapted from Kailola et al. *1993 (*HAT = Highest Astronomical Tide)*

Figure 2. Coastal saltmarsh dominated by Samphire (*Sarcocornia quinqueflora*), southern NSW



Photo: T. Daly.

Why is coastal saltmarsh important?

As with mangroves, coastal saltmarsh have historically been undervalued and considered by many to be boggy swamps and wastelands of little practical use. As a result, many saltmarsh areas have been drained, reclaimed, become degraded from a range of human activities or otherwise lost.

Our understanding of the ecological value of this habitat has greatly improved over the past few decades and coastal saltmarsh communities are now regarded as significant ecological communities that provide key habitat for fish and a range of other fauna.

Saltmarsh serves four important and basic ecological roles. It:

1. provides habitat
2. provides food
3. acts as a buffer and filter of nutrients; reducing erosion and maintaining water quality
4. is a carbon sink.

Saltmarsh as habitat

Saltmarsh provides habitat and shelter for fish, especially juveniles and smaller fish species, when it is inundated during higher tides. Studies have recorded over 40 species of fish inhabiting tidal saltmarsh areas. These include commercially and recreationally important species such as Yellowfin Bream, Sand Whiting, Mullet, Garfish, eels and crabs. Many smaller fish such as perchlets, glassfish, hardyheads, blue-eyes and gobies are also commonly found in saltmarsh.

Saltmarsh often acts as a temporary refuge or 'nursery' for juvenile and smaller fish as larger fish predators often avoid entering saltmarsh due to the shallow water and denseness of the vegetation. Some species, such as Common Galaxias (*Galaxias maculatus*), also deposit their eggs in saltmarsh vegetation.

Saltmarsh provides habitat for many other fauna including birds (eg. White-fronted Chat, kites and harriers), bats, kangaroos, wallabies and aquatic and terrestrial insects and invertebrates. Saltmarsh also provides summer feeding and roosting habitat for many migratory wading bird species, such as the Sharp-tailed Sandpiper and Marsh Sandpiper.

Saltmarsh as a food source

Saltmarsh supports a variety of invertebrates, including crabs, prawns, molluscs, spiders and various other insects. These invertebrates are preyed upon by many species including birds and finfish during high tides. For example, Yellowfin Bream feed on crabs and prawns while small fish such as gobies feed on mosquito larvae. Crabs and their larvae (*zoeae*) have also been shown to be a significant food source for fish inhabiting saltmarsh. Worms, gastropods (snails), insects and plant detritus are also important opportunistic food sources for fish when inhabiting saltmarsh.

Saltmarsh vegetation provides basic inputs of carbon and nutrients to estuaries, primarily in the form of dead leaves and stems. Decaying pieces of plant detritus become part of the food chain when they are broken down/colonised by bacteria and fungi which convert the carbon into more easily digestible carbohydrates and proteins. Tidal currents, wind and waves disperse this material throughout the estuary which can then be taken up by filter feeders such as mussels or oysters and surface feeders such as crabs and finfish.

Saltmarsh also assists the natural decomposition of seagrass wrack which can accumulate on estuary foreshores. Saltmarsh plants provide a structure upon which the dead seagrass material can be suspended in the air which allows it to dry and break down more rapidly than would otherwise occur. Conversely, seagrass wrack also promotes the growth of saltmarsh plants as it provides them with a mulch cover which shades the soil, retains moisture and provides essential organic matter and nutrients to the underlying soils. However, seagrass wrack can also smother areas of saltmarsh if washed up in large densities following major storm events.

Saltmarsh acts as a buffer; reducing erosion and maintaining water quality

Saltmarsh protects estuary foreshores by absorbing the energy of wind and wave action and providing a natural buffer that helps minimise erosion. Saltmarsh provides a buffer between the terrestrial and aquatic environments; trapping and stabilising sediment, dampening the effects of floodwaters, collecting and recycling nutrients and contaminants from runoff, thus also helping to maintain water quality. With predicted increases in storm surge intensity and rising sea levels associated with climate change, saltmarsh will become increasingly important in protecting estuary foreshores.

Saltmarsh as a carbon sink

Saltmarsh, along with seagrass and mangroves, sequester and store large quantities of carbon both in plants and in the sediment below them (known as ‘blue carbon’). In some cases this carbon has been stored for thousands of years. Protection of saltmarsh ensures that this accumulated carbon is not released as carbon dioxide into the atmosphere contributing to climate change.

Figure 3. Coastal saltmarsh dominated by Samphire (*Sarcocornia quinqueflora*) with mangroves in the background



Photo: Kelleway et. al. (2007).

Where does coastal saltmarsh occur?

Saltmarsh occurs throughout Australia's coastal region, covering a total area of over 13,500 km^2. The largest areas of saltmarsh are found in northern Australia (Queensland, Northern Territory and Western Australia).

Although saltmarsh occurs throughout coastal Australia, it has greater species diversity in the higher latitudes of southern Australia. In the tropical areas of northern Australia there are less than 10 species of saltmarsh plants, while over 250 species of saltmarsh and foreshore fringing vegetation have been recorded in New South Wales.

Coastal saltmash in New South Wales

Saltmarsh can be found in estuaries along the entire New South Wales (NSW) coastline covering a total area of over 72 km^2. The largest area of saltmarsh occurs in the Hunter/Central Rivers region (Table 1). Saltmarsh plant species diversity is greater on the south coast of NSW than on the north coast, with Jervis Bay being the northern limit for many species. On the north coast of New South Wales, saltmarshes are dominated by a few plant species such as Saltwater Couch (*Sporobolus virginicus*), Samphire *(Sarcocornia quinqueflora)* and rushes including Sea Rush *(Juncus kraussii).*

Table 1. Distribution of saltmarsh in New South Wales

NSW region	Number of estuaries with saltmarsh	Area (km^2)
Northern Rivers – Queensland border south to the Camden Haven River	34	22.3
Hunter/Central Rivers – Manning River to Brisbane Water	10	32.7
Hawkesbury Nepean – Hawkesbury River including Broken Bay and Pittwater	1	2.9
Sydney Metropolitan – Narrabeen Lagoon to Port Hacking	7	1.9
Southern Rivers – Towradgi Creek to the Victorian border	62	12.6
Total	**114**	**72.4**

Distribution of saltmarsh species is usually zoned from low to high elevations. The zone where each species occurs is determined by tide levels, frequency of inundation and the soil conditions (e.g. salinity). In New South Wales, the most commonly occurring dominant species at the lower more frequently flooded elevations is Samphire (*Sarcocornia quinqueflora*), with Saltwater Couch (*Sporobolus virginicus*) dominating the mid level saltmarsh, and Sea Rush (*Juncus kraussii*) and Bare Twig Rush (*Baumea juncea*) usually dominating the drier plant communities at higher elevations.

Figure 4. Seablite (*Suaeda australis)*



Photo: T. Daly.

Table 2. Characteristics of the 10 saltmarsh species listed under the *Fisheries Management Act 1994*

Common name: Bare Twig Rush **Scientific name:** *Baumea juncea* **Distinguishing features:** • Grows in mostly brackish or saline swamps, on sandy soils in coastal areas except for isolated occurrence at Boonoo Boonoo Falls. • Slender perennial with smooth tall straw-like stems – 20 to 90 cm high. • Slim leaves at base of plant. • Several small flower clusters – usually red-brown to grey-brown. • Flowers Spring to Summer. **Distribution in NSW:** Entire coast *Photo: T.Rodd.*	
Common name: Creeping Brookweed **Scientific name:** *Samolus repens* **Distinguishing features:** • Grows on margins of brackish or salty coastal streams, lakes and swamps. • Small herb with erect to creeping stem – 5 to 60 cm long. • Stem usually wrinkled or warty. • Leaves – 2 to 8 mm wide. • Flowers are usually white but occasionally pale pink. • Flowers September to April. **Distribution in NSW:** Entire coast *Photos: T.Rodd.*	 
Common name: Knobby Club-rush **Scientific name:** *Ficinia nodosa* *(previously known as Isolepis nodosa)* **Distinguishing features** • Widespread on coastal sand, beside sea and lakes. • Slender perennial with smooth tall straw-like stems – 15 to 100 cm high. • Small leaves reduced to orange-brown sheaths. • Small, hemispherical, soft, spiked flower – 7 to 20 mm in diameter. • Flowers in Spring. **Distribution in NSW:** Entire coast *Photo: T.Rodd.*	

Common name: Prickly Couch

Scientific name: *Zoysia macrantha*

Distinguishing features

- A sand and soil stabiliser on dunes and the margins of salt swamps.
- Small perennial grass 5 to 25 cm long – small blade-like leaves up to 5 mm long.
- Small purplish flowered spikelet on tall stalk.
- Flowers in Summer.

Distribution in NSW: Entire coast

Photos: T.Rodd.





Common name: Samphire, Glasswort

Scientific name: *Sarcocornia quinqueflora.*

Distinguishing features:

- Mostly in coastal areas and frequently in habitats periodically inundated by salt water.
- Ground dwelling succulent looking plant with upstanding tips – up to 30 cm high.
- Typically has flower clusters comprising of five to nine buds.
- Generally green in colour but can have red tinge.

Distribution in NSW: Entire coast

Photo: T.Daly.



Common name: Saltwater Couch
Sand Couch, Nioaka

Scientific name: *Sporobolus virginicus*

Distinguishing features

- Perennial tussock grass from 10 to 50 cm in height with fine hairs on the leaves.
- Creeping horizontal stems, vegetative and flowering shoots arising singly from underground stem.
- Flowers are green or purple, present throughout the year.

Distribution in NSW: Entire coast.

Photo: C. Baxter.



Common name: Seablite

Scientific name: *Suaeda australis*

Distinguishing features:

- Grows on coastal or estuarine shorelines or salt marshes.
- Can grow to a height of 1 m, with a spreading habit and branching occurring from the base.
- Leaves up to 40 mm long – succulent, linear, and flattened.
- Leaves are light green to purplish red.
- Flowers in Summer and Autumn.

Distribution in NSW: Entire coast.

Photo: T. Daly.



Common name: Sea Rush

Scientific name: *Juncus kraussii*

Distinguishing features:

- Grows in coastal districts – Often dominant in saline or brackish wetlands.
- Large, tough, tussock forming perennial rush – 0 to 150 cm long.
- Hard, narrow cylindrical leaves.
- Dense clusters of small reddish-brown flowers, or small hard reddish-brown nut-like fruits, near the tops of the stems.
- Leaves are dark green with a sharply pointed tip.
- Flowers from Spring to Summer.

Distribution in NSW: Entire coast

Photo: T. Daly.



Common name: Streaked Arrowgrass

Scientific name: *Triglochin striata*

Distinguishing features:

- Grows in periodically inundated saltmarshes or shallow saline aquatic habitats.
- Perennial, rush-like plant, green or brownish in colour.
- Leaves are soft, cylindrical – 10 to 20 cm long and hairless.
- Individual flowers have short stalks and are present during the warmer months.
- **Distribution in NSW:** Entire coast

Photos: Department of Primary Industries Victoria – http://vro.dpi.vic.gov.au





Common name: Swamp Weed

Scientific name: *Selliera radicans*

Distinguishing features

- Grows in saltmarshes and bordering lakes and streams in southern New South Wales.
- Woody perennial herb, ground dwelling stems to 50 cm long.
- Thick smooth, fleshy leaves.
- Flowers on stalks up to 20 mm high.
- Generally flowers Spring and Summer.
- **Distribution in NSW:** South from Gosford to Victorian border

Photo: Victorian Flora – www.victorianflora.wmcn.org



Text sources: http://plantnet.rbgsyd.nsw.gov.au, http://florabase.calm.wa.gov.au, http://www.dpiw.tas.gov.au, http://www.dpi.vic.gov.au, http://mc2.vicnet.net.au

Status of coastal saltmarsh in New South Wales

Many areas of coastal saltmarsh in New South Wales, particularly those near urban centres, have been lost or become fragmented and degraded during the last 200 years, as a result of reclamation, drainage works (floodgates), unrestricted stock access, weed invasion, dumping, stormwater runoff and damage from off-road vehicles.

It has been estimated that since 1950, most estuaries in southeast Australia have lost over a quarter of their saltmarsh with some estuaries losing up to 80 per cent. Recent studies of saltmarsh cover in specific estuaries in New South Wales showed that saltmarsh loss ranged from 12 per cent to 97 per cent, largely due to landward mangrove incursion into saltmarsh habitat. For example, saltmarsh areas within Berowra and Marramarra Creeks, tributaries of the Hawkesbury River, decreased by 38 per cent between 1941 and 1992, while in the Hunter River, the area of saltmarsh fell by approximately 52 per cent from 2,133 ha in 1954 to 1,112 ha in 1994. A field survey of the Parramatta River-Sydney Harbour estuary in 2006 found that more than 50 per cent of the total saltmarsh area of 37 ha was in poor condition.

Recent state-wide mapping indicates that the total area of saltmarsh habitat within New South Wales may have stabilised and has increased in some locations. A survey in the early 1980s recorded almost 60 km^2 of saltmarsh in NSW. A more recent survey has recorded over 72 km^2 of saltmarsh situated within 114 estuaries and embayments (Table 1). While the overall trend (an increase of 12 km^2) shows an apparent expansion at most locations, at least 20 estuaries were estimated to have lost ten per cent or more of their saltmarsh. Some of the overall increase may be a result of improved mapping techniques rather than actual expansion of saltmarsh and NSW Department of Primary Industries (NSW DPI) is undertaking further analysis and mapping to determine possible causes for these changes.

Due to the reduction in the extent of saltmarsh New South Wales and ongoing threats to its survival, Coastal Saltmarsh has been listed as Endangered Ecological Community (EEC) under the *Threatened Species Conservation Act 1995*.

Figure 5. Coastal saltmarsh, northern NSW



Photo: P. Dwyer.

Threats to coastal saltmarsh in New South Wales

As more people seek to live in the coastal zone and enjoy the surrounding natural waterways, the risk of further decline in saltmarsh increases. Greater pressure is placed on saltmarsh communities from both direct impacts (reclamation for development, mowing and off-road vehicle use) and indirect impacts (e.g. changes in natural tidal flow characteristics, pollution, weed invasion and sea level rise).

Threats to saltmarsh include:

- reclamation for development and foreshore protection works
- tidal barriers, drainage and flood mitigation works
- uncontrolled stock access
- use of off-road vehicles and trampling by people
- dumping of rubbish/waste and pollution
- mowing and gardening
- weed invasion
- illegal commercial harvesting for human consumption
- climate change, sea level rise and mangrove incursion.

Reclamation for development and foreshore protection works

In many areas saltmarsh has been reclaimed for developments including ports, airport runways, industrial facilities, marinas, construction of housing and tourist accommodation, roads, parks and sports fields. Water frontages are considered to be prime real estate and are often gained by in-filling saltmarsh. Saltmarsh in urban areas is often threatened by the activities of adjoining property owners who are not aware of, or don't value saltmarsh as part of a healthy estuarine environment.

Figure 6. Urban development encroaching on saltmarsh



Photo: E. Corfield.

As it occupies low-lying areas, saltmarsh is also often disturbed by the construction and maintenance of utility easements, stormwater and drainage infrastructure such as pipelines, concrete canals and sewage pumping stations. Construction of foreshore roads, footpaths and boardwalks also impact on saltmarsh.

Foreshore protection works such as sea walls and rock revetments that restrict the area available for saltmarsh are a threat to the future of saltmarsh communities, particularly as sea level rises.

"AS MORE PEOPLE SEEK TO LIVE IN THE COASTAL ZONE AND ENJOY THE SURROUNDING NATURAL WATERWAYS, THE RISK OF FURTHER DECLINE IN SALTMARSH INCREASES."

Figure 7. Reclamation of saltmarsh



Photo: M. Proctor.

Figure 8. Reclamation of saltmarsh



Photo: P. Dwyer.

Tidal barriers, drainage and flood mitigation works

Changes to tidal flow, drainage and the hydrology of estuaries to reclaim land and mitigate flooding can have major impacts on saltmarsh leading to their decline. Inundation with freshwater for extended periods can kill many succulent saltmarsh species such as Samphire. In areas where freshwater becomes too dominant, saltmarsh plants can be replaced by brackish and freshwater reed species such as the Common Reed (*Phragmites australis*). Developments or activities (such as floodgates, flood mitigation works and artificial openings of estuary entrances to the sea) which have the effect of permanently draining water from a saltmarsh or which impede normal drainage and tidal influence are likely to degrade saltmarsh and lead to the loss of the habitat.

Uncontrolled stock access

Where saltmarsh occurs on private foreshore land, it is often used by landowners or land managers as pasture for livestock. However grazing has significant impacts on saltmarsh plants and can change the distribution of some species as they may be more palatable and are grazed more heavily than others.

Ongoing trampling of saltmarsh by stock and feral animals also disrupts saltmarsh by creating gaps in dense areas of vegetation, killing plants, especially succulent species, and preventing them from regenerating or re-establishing. Stock trampling can destroy plant root systems and compact the soil, severely impacting on the habitat value of saltmarsh areas. Pugging of the soil caused by stock can result in water ponding and can exacerbate mosquito nuisance. Pugging can also limit the movement of fish within saltmarsh habitat and create gaps that encourage colonisation by weeds. Introduced pasture species growing adjacent to saltmarsh also often compete with saltmarsh plants and prevent them from expanding and migrating into foreshore areas they would normally occupy.

Figure 9. Stock grazing in saltmarsh and mangroves



Photo: T. Daly.

Use of off-road vehicles and trampling by people

Many saltmarsh areas occur close to urban settlements and are accessed by people for a variety of recreational activities. However, the use of off-road recreational vehicles, including trail bikes, four wheel drive vehicles and mountain bikes, in foreshore areas can cause significant damage to saltmarsh plants. Recreational vehicle use often leaves deep wheel ruts, compacts the soil, alters drainage and results in a reduction in crabs, invertebrates and other fauna that inhabit saltmarsh. People walking through saltmarsh areas and creating informal walking tracks can also trample and destroy saltmarsh plants.

Trampling and vehicle use can cause long-term damage, especially to low-growing, succulent species and to smaller more fragmented patches of saltmarsh, which can gradually lead to their degradation and loss. Regeneration of damaged saltmarsh can be very slow and ongoing impacts from heavy vehicle use can completely eradicate saltmarsh plants. For example a recent study estimated that recreational vehicle use was responsible for the loss of over 21,000 square metres of saltmarsh along the Georges River in the Sydney region.

Figure 10. Off-road vehicle damage to saltmarsh



Photo: A. Lugg.

Dumping of rubbish/ waste and pollution

Saltmarsh habitats, particularly those near urban centres, are commonly degraded by the illegal dumping of domestic and industrial rubbish, including building rubble, soil and garden wastes.

Low lying saltmarsh areas also act as depositional sinks which accumulate various pollutants and litter from both the water and land.

Stormwater drains often directly empty into saltmarsh discharging various pollutants (especially litter, sediment, nutrients) altering salinity levels and spreading weeds. Excessive nutrients entering estuaries can also lead to the over abundance of algae that can smother and kill the underlying saltmarsh vegetation over time. Oil spills and toxic chemicals leaching from rubbish, or washing into waterways from roadways or escaping from boats can damage saltmarsh.

With increasing human populations living in foreshore areas adjacent to saltmarsh, there can also be growing pressure on local authorities to control nuisance insects such as mosquitoes through spraying of pesticides which can pollute saltmarsh habitats and kill other native invertebrates that occur in these habitats.

Mowing and gardening

Saltmarsh areas adjacent to urban development are often impacted by mowing and the planting and watering of gardens and lawns, largely done for aesthetic reasons. Regular mowing directly destroys succulent saltmarsh species and disrupts the flowering and growth of grassy saltmarsh plants. It can also kill or displace fauna living in the saltmarsh. Planting and watering of gardens and lawns adjacent to saltmarsh also provides terrestrial plant species with a competitive advantage, such that over time they may spread and replace saltmarsh species on estuary foreshores.

Figure 11. Mowing is a threat to saltmarsh adjacent to urban areas



Photo: C. Baxter.

Weed invasion

Several weeds of concern have invaded saltmarsh areas in New South Wales and have the potential to spread widely and displace native saltmarsh plants. The most significant of these include the Spiny Sea Rush (*Juncus acutus*), Groundsel Bush (*Baccharis halimifolia*), Cord Grass (*Spartina anglica*), Pampas Grass (*Cortaderia selloana*) and Largeleaf Pennywort (*Hydrocotyle bonariensis*).

Illegal commercial harvesting for human consumption

Illegal harvesting of some saltmarsh species for commercial use is an increasing concern in NSW. For example, Samphire (*Sarcocornia quinqueflora*) is known to be illegally collected for sale to some restaurants as an accompaniment to seafood (labelled as Marsh Samphire).

Figure 12. Spiny Sea Rush (*Juncus acutus*) invading native saltmarsh



Photo: A. Lugg

Climate change, sea level rise and mangrove incursion

Saltmarsh along the NSW coast is at risk from climate change and rising sea levels. Increased air and water temperatures, and changes to rainfall, storms, tidal regimes and freshwater inputs caused by climate change are likely to alter the distribution and abundance of saltmarsh species and the overall structure of saltmarsh communities.

Urban, industrial and rural development along the New South Wales coast has limited the areas where saltmarsh can colonise. As sea levels rise, the distribution of saltmarsh will be constrained by topography and structures such as seawalls, roads and buildings. In many places saltmarsh will be left with nowhere to migrate to, resulting in its loss from some coastal sites.

Where saltmarsh is constrained along its landward edge by urban development, rock walls or elevated topography, it can be impacted by landward-shifting mangroves, and over time, it will eventually be displaced by them.

The increasing trend of landward movement of mangroves into saltmarsh environments is a major threat to saltmarsh habitat in NSW. The incursion of mangroves into saltmarsh is due to a number of interconnected factors which vary between estuaries. These include changes to sediment and nutrient inputs (caused by changed land uses) resulting in increased sedimentation, as well as land subsidence, sea level rise and changes to annual rainfall and tidal regimes.

Loss of saltmarsh habitat would have significant impacts on water quality, coastal foreshore protection from waves and storms, with flow on effects to fisheries production and tourism associated with fishing and healthy estuaries.

Figure 13. Mangrove incursions into saltmarsh



Photo: C. Baxter.

Protection of coastal saltmarsh in New South Wales

Fisheries Management Act 1994

The NSW Department of Primary Industries (NSW DPI) is responsible for the management of fish and marine vegetation under the *Fisheries Management Act 1994* (FM Act) and associated regulations.

Because of their importance as habitat for fish, saltmarsh are now protected in NSW under the *Fisheries Management Act 1994* (Table 2). Under the *Fisheries Management (General) Regulation 2010* saltmarsh is defined as an assemblage of species of marine vegetation that includes one or more of the 10 species of plants listed in Table 2 occurring on public water land or the foreshore of public water land that is below the Highest Astronomical Tide (HAT).

Any development or activity (such as those requiring approval under Parts 4 or 5 of the *Environmental Planning & Assessment Act 1979*) that may harm saltmarsh on public water land or the foreshore of public water land that is below the HAT must be referred to NSW DPI for approval. The FM Act does not apply to any acts or activities that are authorised under the *Threatened Species Conservation Act 1995* (e.g. via a licence to harm a threatened species or ecological community) or on land within national parks, nature reserves and other areas reserved under the *National Parks and Wildlife Act 1974*.

The FM Act and regulations set out provisions to protect marine vegetation, including saltmarsh, from 'harm'. 'Harm' under the FM Act means gather, cut, pull up, destroy, poison, dig up, remove, injure, prevent light from reaching or otherwise harm the marine vegetation, or any part of it. Activities listed as harmful to marine vegetation, including saltmarsh, also include any activity that obstructs or alters the tidal flows, the driving or operation of a vehicle and the grazing or movement of stock.

A permit is required under the FM Act from NSW DPI to harm any marine vegetation, including saltmarsh as described above. NSW DPI will review the environmental assessment (including the Threatened Species Assessment of Significance or '7 part test' under Section 5A of the *Environmental Planning and Assessment Act 1979*) submitted with the permit application and will generally not approve developments or activities that are likely to significantly harm saltmarsh without adequate mitigation or compensation measures in place. In accordance with the requirements of Part 5 of the *Environmental Planning and Assessment Act 1979*, NSW DPI is required to consult with, or seek the concurrence of, the Minister for the Environment or the Director-General of the NSW Office of Environment and Heritage (OEH) on all proposals where a significant impact on threatened saltmarsh species or ecological communities is likely.

The maximum penalty for harming saltmarsh without a permit is $220,000 for a Corporation or $110,000 for a person.

Policies and guidelines applicable to the protection of saltmarsh can be found on the Department's website at www.dpi.nsw.gov.au or can be obtained from NSW DPI offices – refer to contact details at the back page.

Threatened Species Conservation Act 1995

Coastal saltmarsh located in the NSW North Coast, Sydney Basin and South East Corner bioregions is listed as an Endangered Ecological Community (EEC) under the *Threatened Species Conservation Act 1995* (TSC Act). Although over 200 plant species can occur in the Coastal Saltmarsh EEC, it is often characterised by the presence of one or more of the 10 species of saltmarsh plants listed as marine vegetation under the FM Act and in the NSW Scientific Committee's Final Determination for this EEC.

Several plants which occur in NSW coastal saltmarsh are also individually listed as threatened species under the TSC Act including Round-leaf Wilsonia (*Wilsonia rotundifolia*) (endangered), Australian Salt Grass (*Distichlis distichophylla*) (endangered) and Narrow-leaf Wilsonia (*Wilsonia backhousei)* (vulnerable). Saltmarsh also provides habitat for several threatened fauna species and populations listed under the TSC Act.

A licence is required under the TSC Act for any actions likely to damage the Coastal Saltmarsh EEC, or the habitat of any other threatened species, population or ecological community that inhabits saltmarsh. A licence is not required if the damage resulted from an act that was approved or authorised under the *Environmental Planning & Assessment Act 1979* (including the issuing of a permit under the FM Act) or several other Acts as outlined in Sections 118D or 118G of the *National Parks and Wildlife Act 1974* (see www.legislation.nsw.gov.au).

Policies, guidelines and further information applicable to the Coastal Saltmarsh EEC and threatened species listed under the TSC Act can be found on the OEH website at www.environment.nsw.gov.au or can be obtained by phoning 131 555.

SEPP 14 (Coastal Wetlands)

Many areas of coastal saltmarsh in NSW are also listed under the State Environmental Planning Policy (SEPP) No.14 – Coastal Wetlands. The policy applies to coastal areas outside the Sydney metropolitan area and identifies over 1,300 mapped wetlands of high natural value from Tweed Heads to Broken Bay and from Wollongong to Cape Howe.

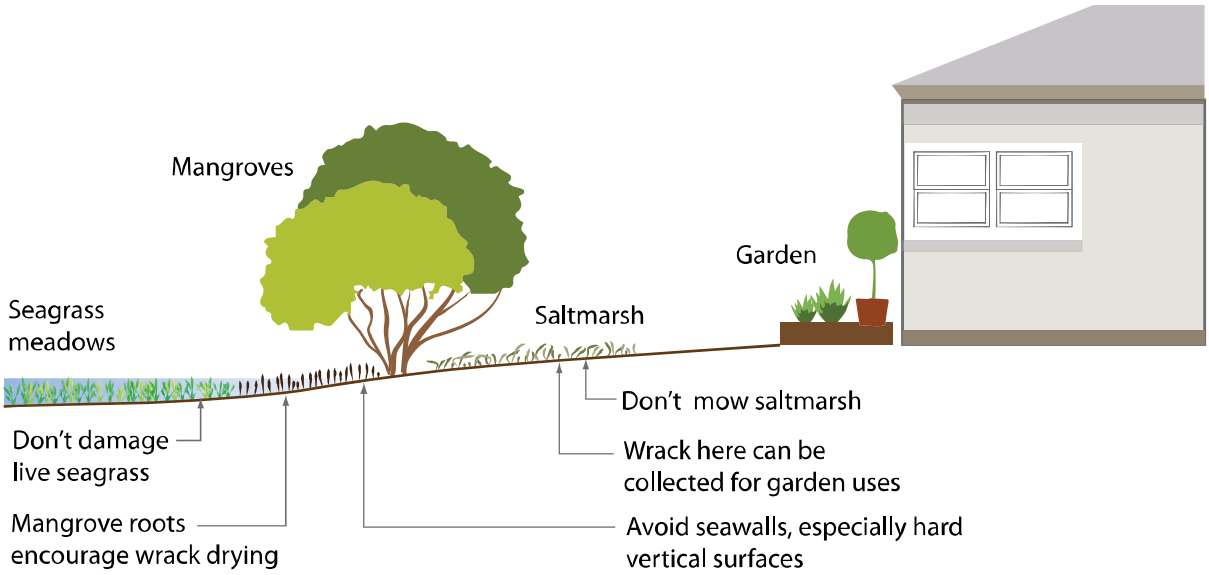
Land clearing, levee construction, drainage work, filling or any other developments may only be carried out within these wetlands with the consent of the local council and the agreement of the Director General of the Department of Planning and Infrastructure. Such development also requires an Environmental Impact Statement (EIS) to be prepared and lodged with the development application. Further information on SEPP 14 is available at the Department of Planning and Infrastructure's website at www.planning.nsw.gov.au.

How can we help to protect coastal saltmarsh?

Some simple ways to help protect coastal saltmarsh are:

- fence along the intertidal zone and prevent livestock access to saltmarsh areas
- design waterfront structures, such as boat ramps, jetties and foreshore pathways, to avoid or minimise impacts to saltmarsh
- avoid driving, walking or biking through saltmarsh areas
- avoid mowing saltmarsh or allowing garden plants, lawn clippings or weeds to spread into saltmarsh areas
- avoid stormwater discharges into saltmarsh areas
- avoid unnecessary modification of the foreshore
- seek advice and approval from NSW DPI, OEH or your local Council before constructing works along the foreshore (e.g. rock walls and other revetments, boat ramps, jetties etc.)
- establish buffer zones between saltmarsh areas and adjacent development
- dispose of rubbish, oils and chemicals in the correct manner
- identify and protect areas where saltmarsh can 'retreat' with sea level rise
- report activities harming saltmarsh by contacting your nearest NSW DPI Fisheries Office or Fishers Watch Hotline on 1800 043 536 or the OEH Environment Hotline on 131 555.

Figure 14. Protecting marine vegetation on estuary foreshores



Source: Adapted from illustration from Lake Macquarie City Council. Used with permission.

Rehabilitation of coastal saltmarsh

Along the coastline of NSW, rehabilitation projects are being increasingly conducted to help restore areas where fragmentation, degradation and loss of saltmarsh habitat has occurred. Actions that have been taken to protect and rehabilitate saltmarsh through natural regeneration include fencing to exclude cattle and other livestock, removal of weeds and dumped materials, preventing vehicle and pedestrian access, restoring natural tidal flow and diversion of stormwater. In some areas recovery of saltmarsh is being achieved by improvements to foreshore walking tracks, either by diverting them so as not to cross saltmarsh plants or constructing raised boardwalks to limit the impact of foot traffic.

An example of successful saltmarsh restoration is the Kooragang Wetland Rehabilitation Project in the Hunter River estuary on the New South Wales Central Coast. This project involved rehabilitating large areas of estuarine saltmarsh and mangrove habitats by restoring natural tidal flow through the removal of floodgates and exclusion of cattle grazing. Recovery and expansion of saltmarsh and mangroves in these areas was noticeable within a few years.

Weed removal is an important part of saltmarsh rehabilitation, especially in urban areas. Some weeds are relatively easy to remove, however the eradication of Spiny Sea Rush (*Juncus acutus*) is often difficult and costly as it usually involves physical removal with machinery and follow up treatment with herbicides.

In areas where remnants of saltmarsh are threatened by mangrove incursions, rehabilitation may involve regular and selective removal of mangrove seedlings to prevent their growth and spread into saltmarsh. Any removal of mangroves for this purpose requires a permit from NSW DPI.

In some areas, including sites in the Sydney region, rehabilitation and re-establishment of saltmarsh has required excavation and land reshaping to create the right elevation, gradient and tidal inundation for saltmarsh plants to grow and thrive. In these cases, it is also important to replace or add organic rich surface soils to the substrate and maintain correct soil salinity to ensure successful and faster growth of saltmarsh in the rehabilitated area.

Areas that have been completely denuded of saltmarsh will be slow to re-establish and may require introduction of plants by transplantation from other sites or from those propagated and grown in nurseries from native seed stock from the same estuary or a nearby estuary. As well as requiring appropriate approvals, any transplanting from natural saltmarsh areas must take into account the likely impact on the donor sites which could take several years to fully recover from the removal of plants, especially if taken from the higher elevation areas of the foreshore.

Generally, the most successful saltmarsh restoration is achieved by creating the right conditions of elevation, tidal inundation and salinity for natural regeneration or recolonisation of saltmarsh plants. Studies indicate that spontaneously appearing saltmarsh plants tend

to grow and flourish more successfully than those that are transplanted. However, the degree of success depends on a number of environmental and local factors at the rehabilitation site including elevation, tidal range, soil type and condition, and the removal of threatening impacts. It is vital that these circumstances be assessed prior to any regeneration attempt.

Further information on planning and implementing rehabilitation of saltmarsh is available in the *Saltwater Wetlands Rehabilitation Manual (*2008) which can be downloaded from the OEH website at www.environment.nsw.gov.au

As saltmarsh habitats are very fragile and it is protected in NSW waters, any saltmarsh rehabilitation projects on public water land should be assessed by your local NSW DPI Fisheries Conservation Manager and/or OEH to determine if a permit or licence is required before being implemented. See contact overleaf.

Figure 15. Transplanting of saltmarsh



Photo: C. Baxter.

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