Marine estate ecosystems

What are marine ecosystems?

An ecosystem consists of all the plants and animals that live in an environment with non-living things like soil, water, and air, they work together to form a bubble of life.

The marine estate contains many different ecosystems where living and non-living things interact. Each ecosystem is different, and they are defined by their unique biotic (living) and abiotic (nonliving) factors.

Biotic factors include plants, animals and microbes. Abiotic factors include the amount of sunlight in the environment, the amount of oxygen and nutrients dissolved in the water, proximity to land, depth and temperature.

Examples of marine ecosystems include; estuaries, saltmarshes, open oceans, mangrove forests and coral reefs.

Coral reef (Ian Shaw)

Estuary (Michael Van Ewijk/DPE)

Habitat

An organism's habitat is its home. All the things that plants and animals need to survive can be found in their habitat, just like we find them in our homes. Air to breathe, food to eat, water to drink and a safe place to shelter and reproduce. A healthy habitat has all these things.

Estuaries

An estuary is where our rivers meet the ocean. Salts and nutrients from the ocean mix with the nutrients from the freshwater, and, as a result, estuaries are among the most productive places in the marine estate. Estuaries are also often protected from strong weather events as they extend inland, making them important breeding grounds for many varieties of fish.

Due to their mix of freshwater, access to the open ocean and fertile environment, estuaries have supported human occupation for thousands of years. Unfortunately, this also means that estuaries are constantly threatened by development and pollution.

Estuarine ecosystems can include several important habitats, such as mangroves, saltmarshes, seagrass meadows and oyster reefs.

Coastal lakes (Jessica Robertson/DPE) and Clarence River estuary (John Lugg/DPE)

Estuaries are where our rivers meet the ocean.

Estuaries can be used for aquaculture, recreation or as ports for fishing fleets.

Mangrove forest

Mangroves are a group of trees and shrubs that live in the coastal intertidal zone where they are flooded with saltwater daily. They grow in fine sediments deposited by rivers and tides and are extremely important ecosystems.

In Australia, mangrove forests line approximately 11,000 kilometres of coastline, that's about 18% of mainland Australia's coast. More than half the world's mangrove species are found in Australia.

Mangrove trees have a unique growth form, including aerial structural roots and exposed breathing roots. This helps them cope with regular tidal inundation and a lack of oxygen in the soil. The nest of exposed roots anchors them in the soft mud, traps sediments, and builds a layer of mud underneath them. These roots also slow the impact of waves and provide shelter for aquatic life.

Mangroves have other adaptations that help them survive their salty living conditions. For example, some species have glands in their leaves that excrete salt. Others store salt in their leaves and drop their leaves when there's too much salt. They can even turn their leaves on hot days so that the large surface is not exposed to the sun.

Another key adaptation is the ability to drop floating seed pods that the tide and currents take away, allowing the seed to germinate away from the parent tree.

Structural aerial roots trap sediment (DPI)

Life in a mangrove forest

Many animals rely on mangrove forests for food and shelter. As the tree grows, it drops leaves into the water. Detritivores, such as microbes, worms and crabs, feed on the fallen plant material. Mussels, oysters and barnacles attach themselves to the mangrove roots and feed on the tiny particles left behind by the other detritivores. Fish then come in to feed on the worms, crabs and shellfish and find shelter in the calm waters under the roots.

Wader birds, such as herons and egrets, will feed on the exposed mudflats seeking out shrimp and crabs. Other birds, such as spoonbills or ibis, will dig deep into the mud looking for worms. Filter-feeding molluscs like mussels and pipis become food for birds like oystercatchers with strong beaks for breaking through shells. Larger fish move under the mangroves when the tide comes in looking for invertebrates like crabs or shrimp and eating smaller fish.

Seagrass meadows

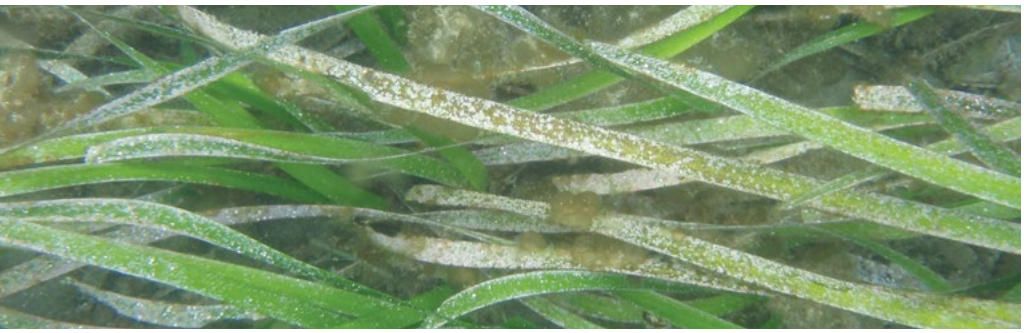
Seagrasses are a unique group of specialised marine plants. They have evolved from land plants and are adapted to living and reproducing entirely within seawater. Seagrasses generally look like land grasses. The leaves are either strap-like or oval-shaped and grow from rhizomes (underground stems).

There are six species of seagrass in NSW:

- *Posidonia australis* – Strapweed
- *Zostera muelleri* subsp. *capricorni* (synonymous to *Z. capricorni*) – Eelgrass
- *Zostera muelleri* – Eelgrass
- *Heterozostera nigricaulis* – Australian grass-wrack
- *Halophila ovalis* – paddle weed
- *Halophila decipiens* – paddle weed

Seagrasses are not seaweed, which is a type of algae. Seagrasses produce flowers, fruits and seeds just like other flowering land-based plants. They can also transport nutrients around their plant tissue.

Seagrass communities are one of the most productive and dynamic ecosystems. Occurring in sheltered areas and shallow waters, seagrasses grow in soft sediments such as sand or mud. Seagrass in these shallow, warm environments provides essential habitat for juvenile and adult fish and other small aquatic life. Seagrass is food for larger marine creatures, such as sea turtles and dugongs (in northern Australia). Due to their ability to trap



Above: *Zostera capricorni* (Geoff Kelly/DPI)
Left: *Posidonia australis*

Seagrass meadows under threat

Seagrass meadows are an important ecosystem in NSW. Most estuaries have some cover of seagrass, but due to the extreme pressures from human interaction in these locations, seagrass meadows are declining.

In NSW, *Posidonia australis* is listed as endangered in Lake Macquarie, Brisbane Waters, Pittwater, Sydney Harbour, Botany Bay and Port Hacking estuaries. This means that human and environmental activities have severely impacted it and it is in danger of disappearing forever.

Several problems face the long-term survival and health of seagrass meadows.

- Human pollution – high nutrient levels, often due to agricultural and urban run-off, cause algae blooms that shade the seagrass. Reduction in light decreases seagrass growth and can kill whole populations.
- Suspended sediments also reduce light. This sediment can come from land development run-off and through drains. Boating activity may also stir up sediment, reducing light levels.
- Damage to the leaves, stems and roots by boat propellers, trawlers' nets, moorings, dredging and artificial structures such as jetties and pontoons.

Saltmarshes

Saltmarshes occur in the upper coastal intertidal zone where the saltwater meets the land. On average, the edges of saltmarshes get inundated at high tide, whereas the higher reaches only get flooded once or twice a year.

The nutrient-rich, salty, wet ground of saltmarshes makes the soil low in oxygen and filled with decomposing matter. They play an important role in filtering water, providing habitat for many species and stabilising the coastline.

Saltmarshes are dominated by salt-tolerant (halophytic) plants, such as samphire, saltbush, and other herbs, grasses and shrubs. These plants are essential to the stability of the saltmarsh because they trap and bind sediments.

Species of migratory birds protected under federal legislation and international treaties, such as the sharp-tailed sandpiper, often roost and feed in saltmarsh during their stay in Australia. This makes Australia's sub-tropical and temperate coastal saltmarshes very important marine ecosystems. They are listed as an Endangered Ecological Community in NSW.

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.

Left: Beach stone-curlew in a saltmarsh (Brett Vercoe).
Below: Towra Point (John Spencer/DPE)

Coastal dunes and beaches

There are 826 beaches in NSW. Beaches grow and erode all the time, but the dune systems behind our beaches are critical for their protection. They are natural buffer zones that reduce the impact of erosion. Dunes also protect inland areas from the onslaught of coastal storms.

Coastal vegetation has adapted to the changing and often harsh weather conditions associated with dune systems. Spinifex, for example, is salt tolerant and can trap wind-blown sand, assisting with dune formation.

Dune vegetation acts as a windbreak, traps sand particles and can grow up through the sand and continually produce new stems and roots as more sand is trapped and the dune grows.

Beaches and dunes are home to many species of birds, crustaceans and shellfish. Shorebirds, such as hooded plovers and pied oystercatchers, often nest on open beaches or at the base of dunes. They require undisturbed areas of sand, often completely unprotected, to lay their eggs as they feed along the shoreline.

A lot of natural marine debris gets washed up on beaches, such as wrack (seagrass), seaweed and shells. These items can host many insects and small crabs that feast on the decaying material. These insects and crabs also feed many of the shorebirds.

Unfortunately, a lot of human debris is also washed up on beaches or caught in dune vegetation. Usually plastics and rubber-based products. This can seriously threaten shorebirds and other animals living in the dunes.

Above: Pied oystercatchers, natural and human marine debris. Below: Coastal dune vegetation. (Kelly Coleman)

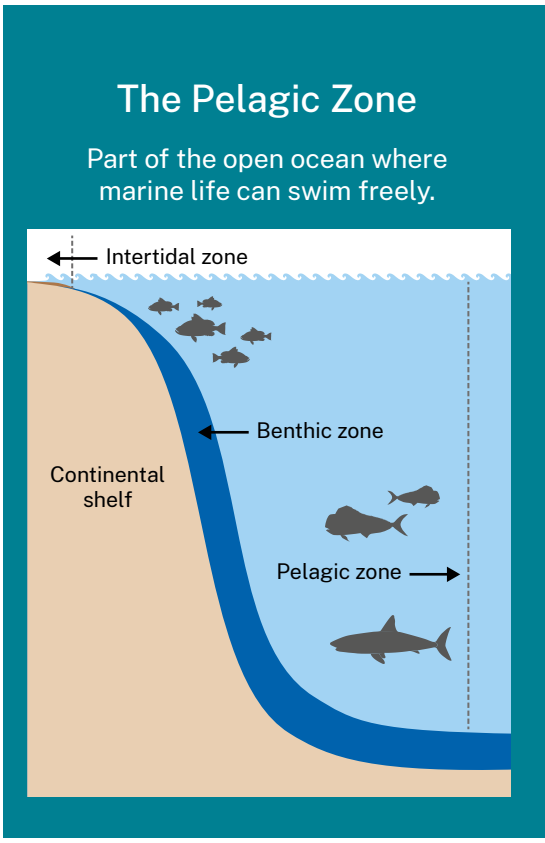
Open ocean

The open ocean ecosystem includes the region above the continental shelf. In the marine estate, this is up to 3 nautical miles, or 5.5 kilometres, off the NSW coastline. This is called the pelagic zone.

Open ocean ecosystems vary widely as the depth of the ocean changes. At the ocean's surface, the ecosystem receives plenty of light and oxygen, is fairly warm and supports lots of life. Many organisms we associate with marine ecosystems, such as whales, dolphins and sharks, live in the open ocean.

The further down we go in the ocean, the darker it gets, there is less oxygen available, the nutrients available as food changes, and the pressure increases. So not many species survive at the bottom, and those that do are very specialised and found nowhere else on the planet.

Many animals in the open ocean rely on plankton as food. Zooplankton are tiny animal-like plankton that is food for many other small and large marine animals, such as whales. Phytoplankton (plant-based organisms) stay close to the surface and photosynthesise, which means they turn sunlight and carbon dioxide into energy for themselves and release oxygen. They are the source of about half the oxygen in the atmosphere, making phytoplankton incredibly important for all life.



Humpback whale off Coffs Harbour (Kelly Coleman)

Rocky shores

Rocky shores are one of the many intertidal zones where the land meets the sea. They are unique habitats shaped by a combination of waves, tides and the type of rock present.

Along our coastline, you will often come across rocky shores and headlands. In NSW, 33% of the coastline is comprised of rocky shores. These sites are exposed to the harshest of coastal conditions as waves pound against them with ferocious energy, and they are exposed to the sun and wind.

Rocky shores might consist of platforms, boulder fields and rock pools. Each provides habitat opportunities for different types of plants and animals, and each presents its challenges for survival.

Some rocky shores are strongly contorted and broken, while others form flat or horizontal platforms and reefs. Every rocky headland type has a wide range of habitats and microhabitats, available for colonisation by animals and algae.

These dynamic environments are home to a great diversity of wildlife. Snails, limpets, sea stars, sea squirts, anemones and sea urchins are all commonly found on rocky shores. Many fish, crabs and shrimp thrive in these environments. At low tide, the exposed sea life is an easy meal for many birds, such as oystercatchers who feed on mussels, crabs and worms found in and around the rock pools.

Right: Crab and turban snail (Kelly Coleman).
Below: Munmorah State Conservation Area (John Spencer/DPE)

Oyster reefs

Shellfish reefs include oyster reefs and mussel beds that provide important habitat for fish, such as yellowfin bream and invertebrates, and increase local marine biodiversity. These reefs also play a big role in maintaining water quality by filtering the water.

Oysters are incredible filter feeders. They eat by pumping large quantities of water through their gills. They remove algae and other particles, making the water clearer for seagrasses and other marine life. One oyster can filter up to 150 litres of water per day.

Once abundant along our coasts, 97% of oyster reefs have been lost due to overexploitation, pollution and disease. Governments and non-government organisations are now restoring the once lost oyster reefs to help re-establish these important habitats.

Above: Fullerton Cover oyster reef, Port Stephens (greatlakesadvocate.com.au). Below: Fish swimming in an oyster reef (Shane Chalker), Oyster reef restoration, Stockton.

For more information

Click or Scan the QR Codes

Where have our reefs gone?
Infographic

Benefits of oyster reefs
Infographic

Oyster filtration in action
Video

Oyster reef restoration project – Port Stephens
Video

Ecosystems under threat

Threatened species in the marine estate

A threatened species is an animal, plant or ecological community (a community of species) whose numbers have dropped so low they struggle to survive. As a result, they are in danger of becoming extinct.

Species in the marine estate that are under threat include:

- green sea turtle
- grey nurse shark
- pied oystercatcher
- White's seahorse
- *Posidonia australis* seagrass.

Threatened marine estate ecological communities

An ecological community is a naturally occurring group of native plants, animals and other organisms living in a unique location. An ecological community can be at risk of extinction if there is a significant reduction in its distribution or a decline in ecological function.

Ecological communities in the marine estate that are under threat include:

- mangrove forests
- saltmarshes
- seagrass meadows.

Threatening processes

Threatening processes can include:

- habitat loss or change
- invasive species predation and/or competition
- climate change
- changes in fire or flood regimes
- human interference – fishing, boating, foot traffic in sensitive areas, construction in or around waterways
- domestic animals – dogs and cats, livestock
- changes in water quality – salinity, turbidity caused by runoff and erosion
- pollution – waste, marine debris, road runoff, air pollution
- diseases.

Many plants, animals, and communities live in and around the marine estate and are under threat by one or more of these threatening processes. These threatened species and communities require our help to ensure their survival.

Left: Green sea turtle (Dr David Harasti).
Below: Grey nurse shark (Klaus Stiefel) and White's seahorse (Dr David Harasti).