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Seagrasses

Photograph: J Gilligan

Figure 1. *Posidonia*, *Zostera* and *Halophila* species of seagrass growing together.

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WHAT ARE SEAGRASSES?

Seagrasses are a unique group of specialised marine plants. They have evolved from land plants and are adapted to living and reproducing entirely within sea water. Seagrasses occur in sheltered areas and shallow waters, growing in soft sediments such as sand or mud.

Seagrasses generally look like land grasses. The leaves are either strap-like or oval-shaped and they grow from rhizomes (underground stems).

Seagrass can easily be confused with marine macroalgae (seaweed). However, there are many important differences between the two. Unlike seaweed, seagrasses produce flowers, fruits and seeds during their reproductive cycle, and have specialised plant tissue which allows them to absorb nutrients from soft sediment and transport it internally.

In low nutrient environments, seagrasses have a competitive advantage over seaweed because their roots and specialised plant tissue allow them to access higher nutrient concentrations available from the sediment rather than from the water.

Figure 2. *Posidonia australis* flower.

Photograph: J Hannan

There are thought to be less than 70 species of seagrasses worldwide, about half of which are present around Australia's coastline. Australia's coastline contains the largest, most diverse seagrass assemblage in the world.

WHY ARE SEAGRASSES IMPORTANT?

Seagrasses serve three key functions:

1. they provide habitat for fish and other aquatic fauna,
2. they help to reduce erosion and improve water quality, and
3. they are a source of food for fish and other aquatic fauna.

1. Seagrass habitat

Seagrasses directly and indirectly support many coastal fisheries by providing important habitat for juvenile and adult fish. Many commercially and recreationally important fish species such as bream, luderick, leatherjackets, snapper and sea mullet live in seagrass habitats for all or part of their life cycle. Seagrass beds are also used by fish to spawn and as shelter from predators.

Seagrass leaves act as a host for epiphytes (algae, protozoans) and also for epizoa (encrusting animals) by providing a surface area on which they can grow. In turn, some species of fish graze on these organisms.

Dead seagrass, termed 'wrack', when washed ashore, is an important habitat and food source for small invertebrates such as crabs, which in turn may act as a food source for fish. Wrack is also an important source of nutrients and helps to reduce erosion and desiccation of the soil in adjacent saltmarsh communities.

2. Seagrasses reduce erosion and improve water quality

The leaves and upright stems of seagrasses act as baffles, reducing water speed adjacent to the sediment surface. This allows suspended particles in the water to fall to the bottom, thus encouraging the build-up of bottom sediments and helping to improve water quality. Their rhizomes and rootlets help to bind sediment, thereby providing protection against wave-induced erosion, which can assist in protecting shorelines. Epiphytes that grow on the fronds of seagrass are also important in filtering water and improving water quality.

Photograph: J Gilligan©

Figure 3: A nudibranch (slug) inhabiting *Halophila* seagrass.

3. Seagrasses are a food source

Seagrasses produce organic matter by converting sunlight into plant tissue that becomes a source of energy in the ecosystem. The energy conversion is either direct, when aquatic fauna graze on the plant material, or indirect when detritivores (such as crabs and worms) consume pieces of dead or dying material, or when epiphytic algae utilise dissolved organic matter and nutrients leached from the seagrasses.

Relatively little of the living seagrass tissue is consumed directly by grazers. Instead, most of the tissue produced by seagrass organic production is either transformed into detritus and consumed, or is further broken down, transported and used by other adjacent shallow-water communities. Few temperate Australian fishes (garfish, leatherjackets and some crabs) are known to ingest large quantities of seagrasses.

The majority of seagrass enters the food chain as particle-sized detritus through the following steps:

1. Over time, water turbulence and leaf-eating animals mechanically break up the dead and decaying leaves. Organic matter leaches into the water during the process of leaf break-up.
2. Bacteria and fungi decompose the broken down plant material.

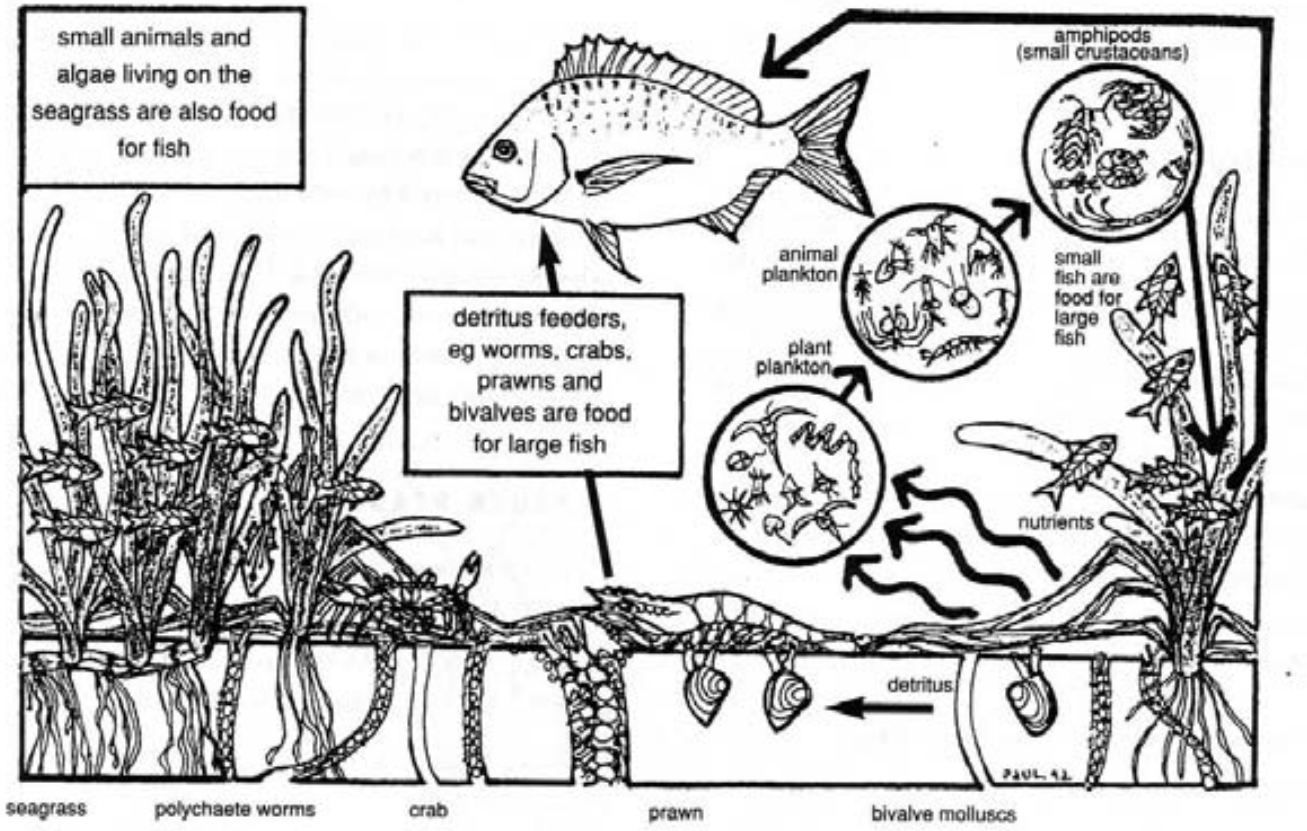

Figure 4. A simplified food chain in a seagrass community (Source: Smith *et al.* 1997)

3. Invertebrates such as crustaceans, molluscs and worms feed on the detritus.
4. These invertebrates in turn are consumed by fish.

WHERE DO SEAGRASSES OCCUR?

Seagrasses are a prominent feature of tropical and temperate coastlines of Australia. Seagrasses grow in nearshore environments, occurring predominantly in estuaries and sheltered embayments.

Australia has an estimated 51 000 km^2 of seagrass meadows within its waters. Current estimates indicate NSW has approximately 159 km^2 of seagrass, indicating it is a rare natural resource in this state.

The depth at which seagrasses grow varies. Like any plant, seagrasses need light to grow and are therefore usually restricted to areas where sufficient sunlight is available. In some parts of Australia, areas with consistently high water clarity enable seagrasses to grow down to depths of 12 metres.

The area of seagrass beds can be seasonally variable as some seagrasses die back during winter and re-establish in summer.

SEAGRASS IN NSW

Most NSW estuaries have some cover of seagrass. Barrier estuaries (an estuary featuring a sand barrier at the mouth) contain the largest seagrass beds. Four of these estuaries account for more than 50% of the total area of seagrass in NSW: Wallis Lake (30%); Clarence River (15%); Lake Macquarie (10%); and Tuggerah Lakes (7%).

An exception is Jervis Bay (6%), which is an open ocean embayment. Ocean embayments are characterised by marine waters and have little freshwater inflow and therefore, generally higher water clarity.

Intermittently closed and open lakes and lagoons (ICOLLs) are a prominent feature of the NSW coast. ICOLLs generally contain little or no seagrass. Their mouths are blocked for much of the time, creating conditions hostile to the growth of seagrass.

The distribution of different species of seagrass in NSW

There are six species of seagrass found on the NSW coastline. These are *Posidonia australis* (strapweed), *Zostera capricorni*, *Zostera muelleri*, *Heterozostera nigricaulis* (all three species are commonly called eelgrass or ribbonweed), *Halophila ovalis* and *Halophila decipiens* (both

Characteristics and distribution of NSW seagrasses

Common name(s)	Scientific name	Distinguishing features	Distribution in NSW
Strapweed	*Posidonia australis*	• Has the largest leaves of any seagrass in NSW in terms of leaf width and bulk. Thick, stiff, strap-like leaves 30–60 cm in length and 6–14 mm wide with rounded ends. • Leaves are bright green. • Occurs below mean low water mark. • Strong 2 cm diameter creeping rhizome. • Flowers in early spring. The buoyant green fleshy fruit are often found on beaches in late December.	Occurs in about 20 NSW estuaries, southwards from Wallis Lake to Twofold Bay.
Eelgrass or ribbonweed	*Zostera capricorni*	• The most common seagrass in NSW. • This species is found on tidal flats in most rivers and lagoons. • Leaves range from short narrow leaves to long wide leaves 1–50 cm long and 1–5 mm wide. • Leaves occur in bundles of 4–6 and leaf tip is rounded. • Olive green to brown in colour. • Has slender rhizome and upright reproductive stems.	Entire NSW coast
	Zostera muelleri	• Very similar to above, but generally smaller, narrower strap-like leaves with notched tips. • Leaves are up to 50 cm long and 1–5 mm wide.	Some estuaries south of Jervis Bay to the Vic border
	Heterozostera nigricaulis	• Very similar to above, but with leaves arising from upright stems (can be confused with reproductive stems of *Zostera* spp.), up to 50 cm long and 1–5 mm wide.	Some estuaries, south of Port Stephens to the Vic border
Paddleweed	*Halophila ovalis*	• Paired oval leaves, ranging from short narrow leaves to long wide leaves 1–5 cm long and 5–20 mm wide. • All leaves have a blunt apex and 4–5 longitudinal veins. • Bright green to brown in colour. • The delicate creeping rhizome is usually white and translucent.	Entire NSW coast
	Halophila decipiens	• Very similar to *H. ovalis*, except for fine hairs visible under a microscope. • Paired oval leaves, 1–5 cm long and 5–20 mm wide.	Entire NSW coast, but mainly in Sydney region

(Data source: West, 1989)

called paddleweed). The three most widespread species are *Zostera capricorni*, *Halophila ovalis* and *Posidonia australis*, respectively.

Z. capricorni occurs extensively along the coastline of NSW, with its distribution extending from the Tweed River, in northern NSW, to Mallacoota, near the border between NSW and Victoria (Vic). It coexists with *Z. muelleri* in the area between Jervis Bay, NSW to the Victorian border. *H. nigricaulis* grows from Port Stephens south to the Vic border.

The range of *H. ovalis* extends the length of the NSW coast. *H. decipiens* also occurs along the NSW coast but is chiefly found growing near Sydney, in the Hawkesbury Shelf Bioregion. *Halophila* species appear to be seasonal and despite the beds in some cases being extensive, the plants grow sparsely.

P. australis occupies fewer habitats than the *Zostera* and *Halophila* species along the NSW coast. It only grows in marine dominated conditions

Photograph: M Spencer

Figure 5. *Posidonia australis* (strapweed), the largest of the seagrasses with leaves up to 60 cm long.

Figure 6. *Zostera capricorni* (eelgrass or ribbonweed).

Photograph: C Roelfsema

Photograph: D Harasti

Figure 7. *Halophila ovalis* (paddleweed), the smallest of the seagrasses with leaves 1–5 cm long. Note: *H. decipiens* (inset) is very similar in appearence to *H.ovalis*, but has fine hairs only visible under a microscope.

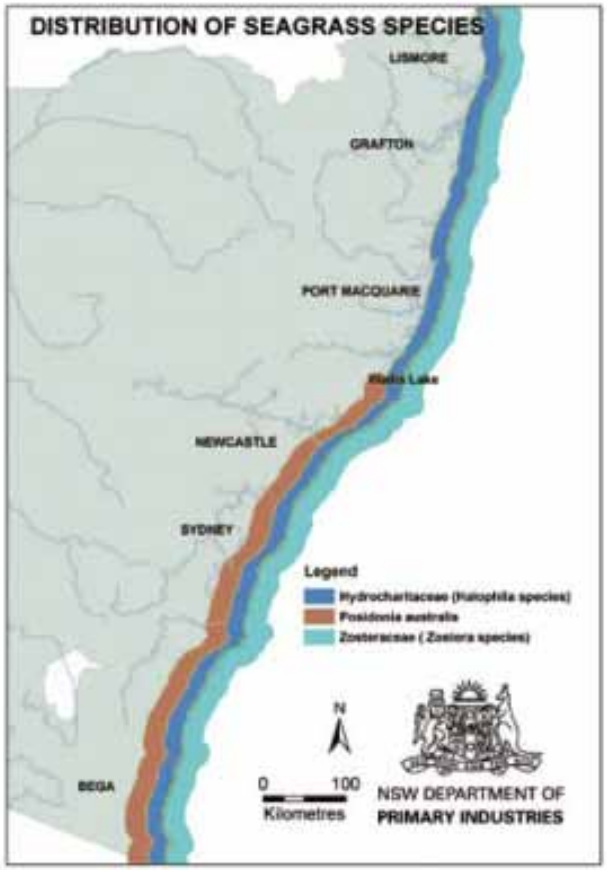

Figure 8. Seagrass distribution in NSW

where the sediments are stable. *P. australis* extends from Wallis Lake to the NSW/VIC border.

The strict definition of seagrasses excludes another similar group of plants, namely *Ruppia* spp. (commonly called sea tassel). These do not necessarily live in marine waters and are pollinated above the water surface. They are typically found in brackish (salt diluted) waters, such as ICOLLs, rather than in sea water. There are three *Ruppia* species in NSW: *Ruppia maritima*, *Ruppia megacarpa* and *Ruppia polycarpa*.

Status of seagrasses in NSW

Surveys of seagrasses in NSW were conducted in 1985 and 2005. The most recent survey has shown that the total area of seagrass increased slightly from 154 km^2 to 159 km^2. Of the 144 estuaries surveyed in 2005, 64 recorded a net increase in seagrass area, 52 a net decrease and change was not detectable in another 16. The remaining 12 estuaries had no seagrass either in the past or at present. In some cases the losses were of the order of 10 hectares or less, whereas in other cases some tens of hectares were lost. Further investigations are needed to determine the causes of the increases or losses in seagrass area within each estuary.

WHAT DESTROYS SEAGRASSES?

Seagrass beds are extremely fragile habitat that can be easily destroyed. Various natural pressures, such as storms, floods and diseases, and human-induced stressors, particularly coastal development that includes physical disturbance (dredging and reclamation), sediment and nutrient runoff, invasive species, some fishing practices, algal blooms, and global warming, can cause widespread seagrass declines.

Seagrass beds are often damaged directly by boating-related activities and by dredging and reclamation. Foreshore structures such as pontoons and jetties can shade seagrass, causing indirect damage. Stormwater outlets can cause physical scouring of seagrass beds and can smother seagrass with sediment.

Photograph: J Hannan

Figure 9. Jetties shade seagrasses and associated boating activities can damage them as well.

A significant factor responsible for the loss of seagrass is a decline in water quality caused by poor catchment management practices. Fine particles of soil transported to estuaries by rivers and creeks can increase turbidity levels. This in turn reduces sunlight penetration to the seagrass leaves and the plants eventually die from an inability to photosynthesize (i.e. to create energy and food for their survival).

Similarly, elevated nutrient levels in estuaries and coastal embayments caused by stormwater runoff and sewerage discharges promote the growth of epiphytic algae on the fronds of seagrass plants. This also reduces sunlight penetration to the seagrass leaves and limits photosynthesis in the plant, leading eventually to its death, or at the very least, an impairment of its health.

HOW CAN YOU HELP TO PROTECT SEAGRASSES?

Some simple ways to help protect seagrasses are:

- Avoid anchoring in, or mooring boats over seagrass beds.
- Avoid travelling across seagrass beds in boats at low tide in order to minimise the potential for propeller damage.
- Protect river bank vegetation by controlling stock access to creeks and drainage lines and replant native vegetation to prevent bank erosion and downstream movement of sediment.
- Design riverfront structures such as jetties, boat ramps and seawalls to avoid shading or physical damage to seagrass beds.
- Ensure dredging and reclamation projects are sensitive to adjacent seagrass beds.
- Replace decking of jetties with mesh decking to allow sunlight penetration to underlying seagrass beds.

Photograph: J Hannan

Figure 10. Mesh decking can be used to reduce the impacts of shading on seagrasses.

- Avoid walking through seagrass areas at low tide.
- Avoid digging for bait in seagrass beds.
- Promptly report sewer overflows.
- Maintain septic tanks and pumps so that they do not leak.

PROTECTION OF SEAGRASSES IN NSW

NSW Department of Primary Industries (NSW DPI) has management responsibility for fish and marine vegetation, including seagrasses, under the *NSW Fisheries Management Act 1994* (FM Act). Any development or activity that may harm seagrass must be referred to NSW DPI.

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

Harming seagrass

The FM Act sets out provisions to protect marine vegetation (mangroves, seagrass and seaweeds whether alive or dead) 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. A permit is required from NSW DPI to harm marine vegetation, including seagrasses.

The maximum penalty for harming marine vegetation, including seagrasses, without a permit is $220 000 for a corporation or $110 000 for a person.

Collecting seagrass

NSW DPI will generally not issue permits for collecting live or dead seagrass from the water. Exemptions may be considered for the purpose of scientific research or marine life rehabilitation. Collecting will generally not be permitted from declared Intertidal Protected Areas, Aquatic Reserves and Marine Parks (see the NSW DPI website www.dpi.nsw.gov.au for the location of marine protected areas in NSW).

NSW DPI will allow persons to remove up to 20 kg/day of dead seagrass (wrack) from beaches or the intertidal zone for personal use (e.g. as compost, fertiliser) without a permit. If a person or organisation wishes to collect quantities of wrack exceeding 20 kg/day then a permit will be required under Clause 66 of the NSW *Fisheries Management (Aquaculture) Regulation 2002* and may be issued on a case-by-case basis.

Persons or organisations wishing to collect seagrass for commercial use will also require a permit under Clause 66 of the NSW *Fisheries Management (Aquaculture) Regulation 2002* and may be issued on a case-by-case basis.

Rehabilitating seagrass

The rehabilitation of seagrass is a challenging activity as conditions for seagrass growth (e.g. water depth, light, sediment type) must be suitable for recolonisation.

As a general rule, NSW DPI has a 2:1 habitat replacement policy, meaning that if a habitat is harmed, damaged or removed, then compensation

must be provided for double the amount that originally occurred.

Transplanting of seagrasses is generally not supported as research has shown that to date the majority of attempts to transplant seagrass in NSW have failed.

Although the leaves of seagrasses grow quickly, almost 2 cm a day, the rhizome (underground stems) grows relatively slowly. As a result, once seagrass meadows are damaged, recolonisation is very slow. Regrowth of *P. australis* is of particular concern because it does not readily recolonise areas from where it has been eliminated. For this reason, more stringent policies are applied to the approval of activities impacting on this species.

CONTACT DETAILS

Report activities harming seagrasses by contacting your nearest NSW DPI Fisheries Office or Fishers Watch Hotline on 1800 043 536.

For further information, contact NSW DPI's Aquatic Habitat Protection Unit regional offices:

Conservation Manager – North Region

NSW Department of Primary Industries
1243 Bruxner Highway
Wollongbar NSW 2477
Phone: (02) 6626 1200

Conservation Manager – Central Region

NSW Department of Primary Industries
Locked Bag 1
Nelson Bay NSW 2315
Phone: (02) 4982 1232

Conservation Manager – Sydney Region

NSW Department of Primary Industries
PO Box 21
Cronulla NSW 2230
Phone: (02) 9527 8411

Conservation Manager – South Region

NSW Department of Primary Industries
PO Box 97
Huskisson NSW 2540
Phone: (02) 4441 8969

Conservation Manager – South Region

NSW Department of Primary Industries
PO Box 17
Batemans Bay NSW 2563
Phone: (02) 4478 9103

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