Healthy seagrass meadows thrive in the nearshore waters between Wedge Island and the Beagle Islands of the Turquoise Coast region. The Jurien Bay Marine Park fulfils an important role in the conservation of these seagrasses, which form such a characteristic part of the shallow coastal regions of Western Australia.

Sometimes, the only encounter people have with seagrass is with smelly piles of rotting brown 'wrack' washed up on the beach, a most unpleasant experience! This is unfortunate because, when alive in their underwater 'meadows', seagrasses form attractive, vibrant green stands of flourishing plants. Seagrasses are vital to the health of coastal ecosystems in Western Australia, playing an important role in the complex nearshore marine web of life. Seagrass meadows harbour a wealth of marine life, from simple sedentary sponges to foraging fish, and many marine algae. Seagrasses play an essential role in stabilising sandy areas and shorelines, as their strong, intricate root systems trap and bind sediments, and reduce the turbidity of the water. Compared with many land plants, seagrasses grow rapidly, with some species shedding their leaves every few months.

Grasses of the sea

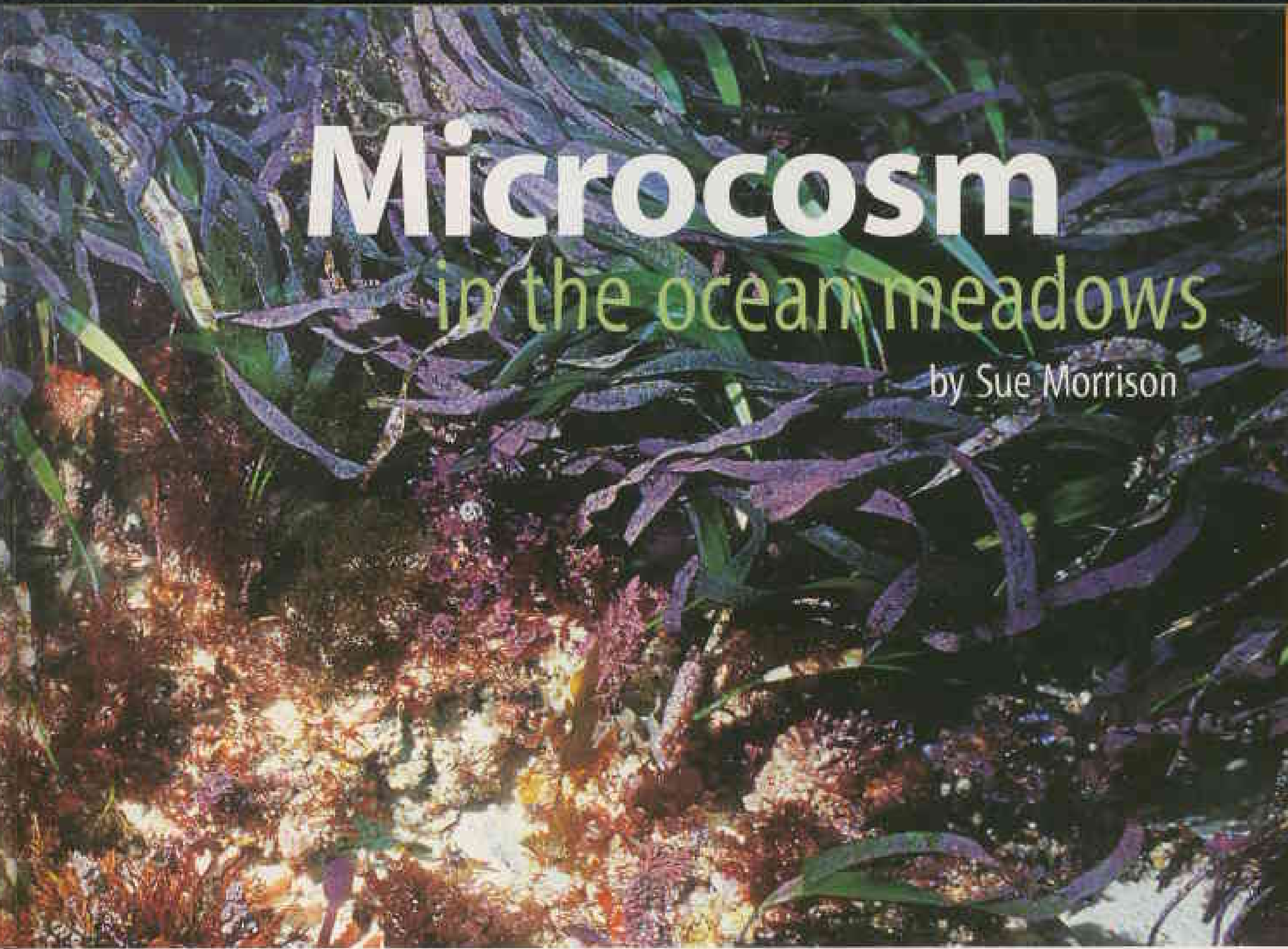
The seagrass meadows of the Turquoise Coast are generally in excellent condition. They are predominantly found inside the fringing limestone reefs, and tend to be dense stands of one to three species of strapweed and/or wireweed. Seagrasses associated with smaller and more exposed sand patches are usually much sparser and tend to be dominated by paddleweed, with patches of strapweed, wireweed, eelgrass and manatee grass.

Paradoxically, seagrasses are more closely related to flowering land plants than to seaweeds (algae or macroalgae). Seagrasses are unusual plants because they are thought to have evolved on land and adapted to the sea at a later stage. They have retained the ability to flower and produce seeds, and the plants consist of rhizomes, roots, stems and leaves, similar to those of terrestrial grasses. Since there are no animals that pollinate underwater, seagrasses have developed incredibly large pollen grains that sink slowly in the water, thereby increasing their chances of falling on female flowers and fertilising them. Seagrass leaves have a very thin outer protective layer (cuticle) that allows the direct uptake of nutrients and gases from seawater, that are vital for production of food and energy by photosynthesis.

Most seagrasses are well adapted to living in soft sediments in nearshore areas along both tropical and temperate

Microcosm in the ocean meadows

by Sue Morrison

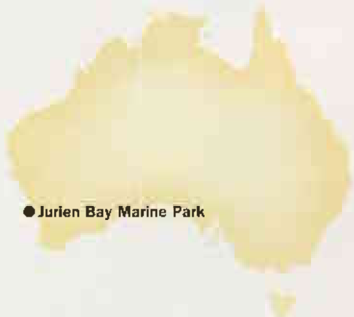


Above Thick-rhizomed thalassodendron.

Facing page
Left Pheasant shells graze on tiny plants that grow attached to seagrass.
Photo – Sue Morrison

coastlines. The greatest density and diversity of seagrasses in Western Australia is found in areas with semi-enclosed embayments (such as Shark Bay and Exmouth Gulf) and fringing coastal limestone reefs, such as those along the Turquoise Coast. Here, seagrass meadows, interspersed with patches of sand, form a broad and almost continuous band—one to five kilometres wide—along the shoreline from Wedge Island to Beagle Island. The region has a high diversity of seagrasses, with at least 11 of the 25 species known to occur in Western Australia. The Turquoise Coast region has predominantly temperate seagrass species.

Seagrasses are especially sensitive to three physical factors: water turbidity, water depth (and therefore light penetration) and water movement. Some seagrass species, such as southern strapweed (*Posidonia australis*), can only survive in shallow waters with abundant sunlight. Others, such as paddleweed (*Halophila australis*), require less light and can therefore live in deeper, less clear waters. The physical impact of water movement in extreme conditions, such as storms, affects



different species of seagrass to different degrees. Strapweed species have dense networks of rhizomes and roots deep in the sand, so they can tolerate strong wave action, and are infrequently uprooted in large quantities. Wireweed (*Amphibolis*) species have strong roots and stems, and can withstand a reasonable amount of rough water. However, paddleweed (*Halophila*), eelgrass (*Heterozostera*) and manatee grass (*Syringodium*), are shallow-rooted and relatively weak in structure, so are easily washed away in storms. Consequently, strapweeds and wireweeds are found in areas most exposed to wave action, while paddleweeds, eelgrasses and manatee grass thrive in more protected places. Areas that are deeper, and therefore have less wave action, tend to have denser beds of seagrasses.

Microcosm in the meadow

Although they are generally unremarkable in appearance, organisms that are attached to seagrass leaves play an extremely important role in seagrass ecology. These organisms include microscopic bacteria and single-celled plants (periphyton), algae and attached animals (epiphytes). Tiny animals also live in the sediment between the seagrass rhizomes (infauna), and slightly larger animals live among the leaves above the sediment (epibenthic fauna). There are complex, finely balanced interactions between these organisms. They all depend upon one another for survival, food and health.

Left Strapweed and wireweed.

Below left Dove shells (*Pyrene bidentata*) graze on plants and animals that grow on seagrass (epiphytes) but not on the seagrass itself.
Photos – Sue Morrison

The epiphytes, and some of the periphyton, growing on the seagrass leaves photosynthesise and, therefore, produce more plant material. However, if these organisms grow big enough to heavily shade the seagrass leaves from direct sunlight, they will limit photosynthesis in the seagrass leaves and be detrimental to the seagrasses. Dense epiphytes also weigh down seagrass leaves and make them more susceptible to being ripped out of the sediment during heavy storms. One way in which seagrasses overcome this problem is by regularly shedding old leaves and their attached organisms. Seagrasses are assisted in the control of algal epiphytes by the epibenthic fauna. These small animals, which include tiny top shells, small crustaceans and worms, graze on the epiphytes and usually maintain them at population densities that enable the seagrasses to survive. These small grazers, especially the crustaceans, are very important food for larger invertebrates and fish, because they convert plant material into matter that is easily digested by their predators.

Grass grazers

In tropical waters, dugongs and turtles are the primary grazers of seagrasses, but in temperate waters no large animals—and very few small animals—feed directly on seagrasses. Seagrass grazers along the Turquoise Coast include sea urchins (*Amblypneustes pallidus*), carrot shells (*Campanile symbolicum*), spider crabs (*Naxia aurita*), swimmer crabs (*Nectocarcinus integifrons*), juvenile rock lobsters (*Panulirus cygnus*), rough leatherjackets (*Scobinichthys granulatus*), fan-bellied leatherjackets (*Monacanthus chinensis*) and juvenile toothbrush leatherjackets (*Acanthaluteres vittiger*). The omnivorous leatherjackets are thought to target epifauna, but incidentally consume moderate quantities of seagrass leaves. It is estimated that only around 10 per cent of seagrass carbon is eaten directly. These animals also need to include other food—such as periphyton (diatoms and bacteria) and epiphytes (coralline algae and small seaweeds)—in their diet, because seagrasses don't supply all of their required nutrients.

Some animals feed only on nitrogen-rich periphyton and epiphytes which grow on the seagrasses. These include the tiny top shells (*Cantharidus, Thalotia, Prothalotia* and *Phasianotrochus* species), pheasant shells (*Phasianella australis*), dove shells (*Pyrene bidentata*), turban shells (*Astralium squamiferum*), some polychaete worms and small crustaceans such as amphipods, isopods and shrimps.

These animals are important, as they limit the growth of epiphytes and prevent them from 'smothering' the seagrasses. This balance can be upset by nutrient enrichment of the waters, enhancing the growth of epiphytes. There may be insufficient grazers to control the increased epiphytes, and the seagrasses eventually die due to lack of light and nutrients (used up by the epiphytes). Nutrients may increase due to natural causes or, more often, human activities, such as fertiliser run-off from

land adjacent to rivers, or sewage outfalls. Once destroyed, some seagrasses can be extremely slow to re-establish, such as some *Posidonia* and *Amphibolis* species, or fail to re-establish at all.

Wrack and ruin

Another important facet in the seagrass food web is the fate of dead seagrass material. As the leaves decay, they break down into small particles. Up to 80 per cent of seagrass detritus remain in the seagrass beds, while the rest is washed away. Detritus is rich in nutrients, including carbon, and is consumed by microorganisms, worms and small crustaceans (detritivores) that live in or on the sediment. The faecal matter from these animals often contains more nutrients than the seagrass leaves because of additional microorganisms in it. Larger detritivores, such as the soft sea cucumber (*Stichopus mollis*), consume this faecal matter, and in turn other invertebrates eat their faeces. These invertebrates are preyed upon by carnivores, and so on along the food web.

Dead seagrass leaves are frequently washed onto beaches as wrack, where they, along with algal wrack, fulfil an important part of the food web cycle. The fibrous material from southern strapweed is very tough, and by means of wave action is often rolled into curious oval-shaped fibre balls that can persist for some time on the seabed, or end up on beaches.

A small number of invertebrates are able to live in the deep black, smelly, sulphide-rich sediment that is very low in—or devoid of—oxygen, frequently found under weed beds. These include the small heart urchin (*Echinocardium cordatum*) and the bivalve *Divalucina cumingi*. They can survive because special bacteria in their gut utilise chemical energy released when sulphides and oxygen react to form sulphates. These chemoautotrophic bacteria produce organic matter from this process.

Seagrass inhabitants

Along the Turquoise Coast, bivalves such as the razor clam (*Pinna bicolor*) and pearl oyster (*Electroma georgiana*) live partially buried in the sediment among the seagrasses. Solitary sea squirts including the sea tulip (*Pyura australis*), the large red-lipped ascidian

Top Fan-bellied leatherjacket.
Photo – Ann Storrie

Above Paddleweed.
Photo – Sue Morrison

(*Herdmania momus*) and the small *Polycarpa viridis* also anchor themselves in the sediment among seagrasses. However, colonial ascidians, particularly *Botrylloides* species, frequently grow as epifauna attached to seagrass leaves. Bryozoans also grow as epiphytes. Encrusting bryozoans (*Membranipora* species) are hard to see and form thin, whitish films over the leaves. The tufted bryozoan

Left Hermit crabs, such as *Paguristes purpureantennatus*, are common in seagrass beds.

Centre left Colonial ascidians (*Botrylloides* species).

Below left Southern dumpling squid.
Photos – Sue Morrison

(*Orthoscuticella ventricosa*) resembles brown seaweed, with its clusters of delicate curled branches. Another epiphyte common on seagrasses in the region is the foraminiferan *Marginopora vertebralis*. These are the tiny disc-shaped structures often seen attached to strapweed. They are single-celled organisms called protozoans. Much of the fine calcareous sand on beaches is comprised of dead foraminiferan shells.

Some animals feed on a combination of epiphytes and mobile epifauna (small mobile invertebrates). Small crustaceans, particularly a shrimp (*Macrobrachium intermedium*), are important predators on the smaller grazers, and are themselves extremely important in the diet of fish and larger crustaceans. Hermit crabs, such as *Paguristes purpureantennatus*, are common in seagrass beds. They are easily spotted, as they like to live in the huge carrot shells, and can be seen lumbering along in their protective, if heavy, homes. Hermit crabs mainly feed on algae, but can also be predatory or scavenge.

Some sea stars are opportunistic feeders and have a varied diet. *Nepanthia crassa*, for example, feeds on epifauna, algae and decaying animals and plants. Similarly, the short-spired sea star (*Meridiastra gunnii*) feeds on red algae, sponges, molluscs, ascidians and dead matter.

The celebrated western rock lobster (*Panulirus cygnus*) leaves the security of the reef at night to search for food among seagrass and algae. It is omnivorous, consuming algae, small invertebrates and large molluscs such as limpets and abalone. It also excavates some bivalves from the sediment, detecting these buried molluscs with

Right The swimming anemone (*Phylctenactis tuberculosa*). *Photo – Ann Storrie*

chemosensory receptors on its front legs. The western rock lobster only remains close inshore for part of its life history. After hatching, near the edge of the continental shelf, the juvenile larvae drift in the open ocean up to 1000 kilometres offshore for eight to 10 months. In late winter or early spring, they are carried back to shore by currents, and settle on inshore reefs where they develop into adults. Most of the commercial catch is about four years old. At five years of age, they migrate to slightly deeper waters (30 to 150 metres), where they live and breed for up to 20 years.

Some of the more cryptic carnivores inhabiting seagrass beds are the cnidarians, such as anemones and hydroids. Hydroids, such as *Stereotheca* species, often grow on seagrass leaves, whereas the sand anemone (*Heteractis malu*) usually buries itself in sand near the base of seagrass leaves, with just the tentacles visible. The swimming anemone (*Phylctenactis tuberculosa*) is able to move around rapidly on the seabed or drift in the current. At night, it crawls to elevated spots to facilitate catching passing prey. It uses stinging cells on the tentacles to trap animal plankton, which is then conveyed to the central mouth.

Many of the carnivores found in seagrass meadows are larger, mobile animals that move in and out of the meadows. They are known as epibenthic fauna, and include crustaceans, molluscs, echinoderms and fish. The popular edible blue manna crab (*Portunus pelagicus*) is common in seagrass areas. It is an active carnivore, but also scavenges dead material.

Cephalopods are extremely active predators with good eyesight and are particularly active at night. The southern calamary squid (*Sepioteuthis australis*) is a fast, voracious predator that hunts fish and crustaceans. Smaller squid, including the southern bottletail squid (*Sepiadarium austrinum*) and striped pyjama squid (*Sepioloidea lineolata*), hunt among the seagrass fronds. Giant cuttlefish (*Sepia apama*), the largest of all cuttlefish, can reach a metre long. They are abundant, as can be seen by the large numbers of cuttlebones washed up on beaches along the Turquoise Coast. The gloomy octopus (*Octopus tetricus*) eats crustaceans and shellfish, and piles of discarded mollusc shells often surround its home.

The estuary catfish (*Cnidoglanis macrocephalus*) is often seen foraging at night for bivalves and crustaceans. The long-headed flathead (*Leviprora inops*) and southern blue-spotted flathead (*Platycephalus speculator*) are predatory fish that often ambush their prey from lying half-buried in sand, with just their eyes and mouth visible. They are frequently found in shallow sandy areas among seagrass beds. A larger predator is the western wobbegong (*Orectolobus* species), which lives in coastal reef and weed areas. It actively hunts small fish and invertebrates.

While seagrasses might not look as interesting as reefs to the untrained eye, we must treasure these grasses of the sea, not just for their intrinsic value, but for supporting a rich diversity of plants and animals, which are in turn driving forces of the marine ecosystems of south-western Australia.

Sue Morrison, a scientist at the WA Museum, has coauthored the CALM books *The Marine Life of Ningaloo Marine Park and Coral Bay, Wonders of Western Waters* and *Beneath Busselton Jetty*. She can be contacted on (08) 9427 2700.

A forthcoming book, *The Turquoise Coast*, written and photographed by Sue Morrison, Ann Storrie and Peter Morrison, will be published by CALM in early 2006 as a guide to the wildflowers, wildlife, history, towns and marine and terrestrial reserves of the area.

Volume 21 Number 2 SUMMER 2005-06

contents

Regulars

Publishing credits
Executive editor Caris Bailey
Editors Rhianna King, David Gough.
Contributing editor Carolyn Thomson-Dans.
Scientific/technical advice
Keith Morris, Chris Simpson, Robert Powell, Bruce Maslin, Michael Bodsworth, Val English.
Design and production Maria Duthie, Natalie Jolakoski, Tiffany Taylor, Gooitzen van der Meer.
Illustration Gooitzen van der Meer.
Cartography Promaco Geodraft.
Marketing Estelle de San Miguel
Phone (08) 9334 0296 *Fax* (08) 9334 0432.
Subscription enquiries
Phone (08) 9334 0481 or (08) 9334 0437.
Prepress and printing Lamb Print, Western Australia.
© ISSN 0815-4465

Visit NatureBase at www.naturebase.net

Published by the Department of Conservation and Land Management, 17 Dick Perry Avenue, Kensington, Western Australia.

Government of Western Australia
Department of Conservation and Land Management
Conserving the nature of WA