GRASSES OF THE SEA

by Diana Walker

Imagine peeling back the shallow waters of Shark Bay. You would find a series of sandy basins lined with banks of green seagrasses - a huge underwater meadow. Seagrasses are the dominant organisms in Shark Bay, covering more than 4 000 square kilometres. They have changed the nature of the region's shallow seabed.

Shark Bay has the largest area of seagrass and largest number of species ever recorded in one place in the world. Elsewhere, one or two species cover large geographic areas. For example, there is only one species of seagrass found in most of North America and Europe. But in Shark Bay there are 12 species, and, in some places in the Bay, nine can easily be identified in a square metre.

Unlike other tropical and subtropical areas in the world which have small seagrasses, Shark Bay has lush, long seagrasses that cover nearly a third of the shallow Bay. This dense growth is not only a major source of photosynthetic production, but also provides a home and food for a rich diversity of marine fauna.

Here, zones overlap. Tropical species meet temperate species from the colder southern waters. Shark Bay provides the ideal breeding pool with its high light intensity, protection from large oceanic movements and lack of fresh water run-off.

Seagrasses resemble grasses that form lawns on land, but they are not closely related. They are green flowering plants with different leaf shapes connected to an underground runner, or rhizome, which grows through the sand. There are few species of flowering plants - perhaps 50 in the world - that manage to cope with a salty, underwater existence; most forms of plant life in the sea are seaweeds (algae), simple organisms with no roots or flowers.

Twelve species of seagrass grow in Shark Bay. The most abundant is wireweed (*Amphibolis antarctica*), covering nearly 3 700 square kilometres of the Bay's sandy bottom. This seagrass - one of two large species - forms meadows which look like underwater wheatfields. It has branched woody upright stems up to two metres long, with clusters of leaves at the end of each branch. The meadows make up a dense canopy, with 300 to 500 erect shoots and 4 500 leaf clusters for every square metre of sea-floor. The plant's leaf surface covers about 15 times the area of the sea-floor on which it grows. These leaves form platforms on which small seaweeds and animals can attach and grow. Sixty-six species of algae

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Inset: The ribbon weed of Shark Bay shares its home with small algae.
Photo - Diana Walker

Main: Seagrasses cover nearly a third of Shark Bay's shallow waters.
Photo - Van Worley

The Wooramel seagrass bank lies on the eastern shores of Shark Bay and is known dugong habitat.
Photos - *Right:* Clay Bryce, Lochman Transparencies. *Below:* Anthony Preen

Ribbon weed seagrass is home for many attached plants and animals.
Photo - Clay Bryce, Lochman Transparencies

Far right: Penicillus is one of the most abundant species of algae in Shark Bay.
Photo - Diana Walker

and about 40 animal species can be found on the wireweed of Shark Bay. These in turn are eaten directly by fish and smaller crustaceans such as amphipods, which form an important part of the food chain. The seagrass canopy is also a good hiding place for small fish and prawns.

Dugongs and turtles, as well as some fish and crustaceans, feed on the seagrass. Shark Bay is the only location in the world where dugongs feed on wireweed. This is the only place where the two species - one tropical, and the other more typical of colder climes - occur together, and in summer it is the only food available for dugongs. Most seagrass is not eaten directly, as these animals eat it, but is broken down into smaller particles. Bacteria and fungi associated with this decomposition form a high-energy food source that is rich in nutrients. The particles themselves are consumed by filter-feeding animals, which are also an important component in the food chains.

Ribbon weed (*Posidonia australis*) is the other large seagrass growing in meadows that cover about 200 square kilometres of Shark Bay. The ribbon-like leaves are home for many attached plants and animals. This species has a more extensive rhizome system than wireweed - up to 90 per cent of the plant resides below the sediment.

The meadows of wireweed and ribbon weed mostly contain only the dominant seagrass species, but in some areas with a less dense canopy, other smaller seagrasses form an understorey. Where the larger species are quite absent, these smaller species grow, often in varying combinations. They are also found with green seaweeds that can grow on sand. One of the most abundant species of algae is *Penicillus*, which resembles a small grey-green shaving brush.

Halodule uninervis, a smaller tropical seagrass species with straight, narrow leaves, occasionally forms meadows. At the mouth of the Wooramel delta lies a meadow of this seagrass covering about five square kilometres in fine black mud. The mass of these plants is high in summer but low in winter, when the water temperature falls from 26 to 17 degrees Celsius. This area is the most important summer feeding ground for dugongs.

Within the meadows, there are often

Small seagrasses such as paddleweed (*Halophila*) cover about four per cent of the Bay.
Photo - Diana Walker

small sand-patches, or blow-outs, which range from less than a metre in diameter to more than 30 metres. These may contain up to nine species of seagrasses: some of the most diverse seagrass assemblages ever recorded. There are good examples of these off Nanga, on the western side of Peron Peninsula, but they also occur throughout the Shark Bay waters.

Sand flats up to two kilometres wide fringe the Bay, representing the extent to which water is blown out of the Bay during summer by southerly winds. On aerial photographs they seem to be bare of vegetation, because of the absence of large seagrasses. However, they support many small seagrasses, particularly paddleweed (*Halophila*) and *Halodule*. Though small, these species are highly productive and are a preferred food source for dugongs when covered at high tide. They are very tolerant of high temperatures and the intense summer sunlight. The area covered by these species is about 500 square kilometres, or about four per cent of the Bay.

Patterns of seagrass growth are more obvious from the air than from under the water. Most conspicuous is the ridge and furrow structure of the Fauré Sill, a bank running between Peron Peninsula and the eastern shores of the Bay. The dark patches of seagrass form lines at right angles to the major tidal channels. As the tide rises, water flows along the channels then spreads across the banks, so that the lines of seagrass are parallel to the prevailing currents.

Above left: Ribbon weed flowers produce floating fleshy fruits from December to January.
Photo - Diana Walker

Above right: From the air, the extensive seagrass meadows are clearly visible.
Photo - Bill Bachman

Above: Wireweed is the most abundant seagrass in Shark Bay.
Photo - Diana Walker

UNDERWATER FLOWERS

Seagrasses flower underwater and produce thread-like pollen. The flowers' shapes are adapted to an aquatic environment and can hardly be recognised as flowers at all.

Wireweed flowers every year around October, and has an unusual form of reproduction, having separate male and female plants. Pollen is produced by the male flowers and is shed underwater. The thread-like pollen grains join up to form rafts and drift until they find and fertilise a female flower. The seedlings then develop from the female flower and remain attached to the 'mother' seagrass. Each seedling develops a 'grappling apparatus' and 'comb anchor', which catch on to other seagrasses or algae. By the time they detach from the mother in May, each seedling has about 10 leaves. Large numbers of seedlings may be collected from the drift, but very few will settle in a suitable area and grow up to form part of another meadow.

Ribbon weed (*Posidonia*) flowers are bisexual. Pollen forms in anthers, with the egg at the base of the flower. These flowers produce floating fleshy fruits from December to January.

BUILDING BANKS

Seagrasses play an important role in coastal stability. The well-developed canopy formed by the plants slows the rate at which water flows over the sea-

floor. A well-developed seagrass bed can negate the effects of a two-knot current, or a 0.6 metre-high wave. This reduction in water movement makes the seabed more stable. Sand particles do not move around, and particles in the water column drop under the canopy. As a result, large banks build up under the seagrass meadows, reducing the depth of the Bay.

Not only does the seagrass trap sediment, it also helps to form new material. Wireweed produces its new leaves in the centre of each leaf cluster and sheds the old leaves from the base. Older seagrass leaves are covered in a thin layer of calcium carbonate. This pink-white layer is deposited by coralline red algae, which make up to 20 per cent of the sediments of Shark Bay. The algae grow on the leaves, often covering them completely. The old leaves fall off the plant and most remain within the meadow. The organic matter of the leaf breaks down, and the calcium carbonate of the algae becomes incorporated into the sediments of the Bay. New leaves are produced continuously by the seagrass, and so form a 'conveyor belt' for the production of new sediment.

Over the past 5 000 years, the combined processes of producing calcium carbonate and trapping sediments have resulted in large banks of calcium carbonate being formed, such as the Fauré Sill. These banks may be up to 10 metres thick, thus accumulating faster than many coral reefs.

The build-up of these banks and sills has restricted the circulation of oceanic sea water. The combination of low rainfall, high evaporation and restricted circulation in the Bay results in a dramatic increase in salinity. The hypersaline waters of Hamelin Pool, for example, are twice as salty as normal sea water - conditions too salty for seagrasses to continue growing. However, they do provide suitable conditions for the development of stromatolites (see 'Lilliput's Castles' in this issue of *LANDSCOPE*).

Studies of Shark Bay's seagrasses were sparked by geologists from the University of Western Australia, who discovered their geological significance. This work was followed up by other sections of the university, which ran a large research program on the Bay's seagrass from 1982 until 1985. This work also concentrated on aspects of water chemistry and circulation in the Bay. However, there is much we do not know about the Bay's marine biology.

Further research on seagrasses has been carried out in the southern part of the State, especially in relation to pollution problems. Seagrass is very sensitive to the build-up of nutrients resulting from sewage outfalls, and industrial and agricultural wastes. Massive areas of seagrass have been lost from the Perth area (Cockburn Sound has lost 90 per cent of its seagrass) and from Princess Royal and Oyster Harbours in Albany. The significance of these losses has been studied by many scientists from the universities, State Government departments, CSIRO and the WA Museum.

Once the larger seagrasses have gone they don't come back. We need to look after seagrasses where they are - particularly in an environment like Shark Bay, where the whole marine system depends upon them. ◘

Top left and right: Coralline red algae grows on seagrasses, leaving a pink-white layer, which, as the leaves die and break off, contributes to the sediments of the Bay.
Photos - Diana Walker

Wireweed seedlings develop ways to catch on to other seagrasses or algae.
Photo - Diana Walker

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When European scientists first set foot on our shores they found a bewildering array of animals and plants. Péron the Explorer *takes an intimate look at the French scientist whose name lives in Western Australia's newest national park. See page 20.*

This tour of the Gascoyne's desert coast guides you through Shark Bay and WA's newest national park. See page 10.

Close to where the fictional Gulliver is believed to have been shipwrecked lives one of the world's oldest organisms. Lilliput's Castles, *on page 34, describes the creatures and the ecosystem they have built.*

Seagrass covers 3 700 square kilometres of the ocean floor around Shark Bay. Grasses of the Sea, *on page 42, takes us on a journey through these underwater meadows.*

At first glance, Shark Bay is dry, arid and inhospitable. But if you look more closely you discover its Hidden Treasures. *See page 16.*

F E A T U R E S

R E G U L A R S

C O V E R

Green turtles (Chelonia mydas), *the commonest turtles found along our coast, begin to congregate in the waters of Shark Bay from the end of July. The Bay is the southernmost nesting area for these long-lived animals. During summer, female green turtles lay their eggs on the white sandy beaches of Bernier, Dorre and Dirk Hartog Islands, and occasionally at the northern tip of Peron Peninsula. Illustration by Philippa Nikulinsky.*

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