Marine Biodiversity Hub
National Environmental Science Programme
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Seagrass (wirriya jalyanu): giving life to sea country of Shark Bay (Gathaagudu)

Researchers at The University of Western Australia (UWA) are working with the Malgana Aboriginal Corporation and rangers to assist the natural recovery of seagrasses affected by an extreme marine heatwave at Shark Bay.

The International Union for Conservation of Nature World Heritage Site of Shark Bay, known as Gathaagudu (two waters) to Malgana Traditional Owners, is a place of extensive seagrass meadows. The World Heritage Site is unique in that it has been declared on the basis of all four natural values: exceptional natural beauty, outstanding record of early life forms, significant ongoing ecological and biological processes, and significant natural habitats for in-situ conservation of biological diversity.

Seagrass (wirriya jalyanu) diversity

Shark Bay is home to more than 1500 marine species and some of the largest seagrass meadows on Earth. Seagrass is not the same as seaweed; seagrass is a flowering plant while seaweeds are algae, which do not produce flowers. The ancestors of seagrasses are land plants which moved back into the sea, evolving the ability to live in salt water ~100 million years ago.

About 72 seagrass species have been identified in the world. At least 12 of these are found in Shark Bay. This is in contrast to other regions of the world where fewer species grow together. Some seagrasses in Shark Bay are tropical species and others

Seagrass meadows at Shark Bay. Image: Angela Rossen

normally occur in cooler temperate waters. The primary genera found in the bay are *Posidonia*, *Amphibolis*, *Halodule*, *Cymodocea* and *Halophila*. The two most commonly seen are the cool water species: *Amphibolis antarctica*, also known as wire weed, and *Posidonia australis* or ribbon weed.

Studies show seagrasses started growing in Shark Bay about 8,000 years ago. These meadows are the foundation of the rich and productive ecosystem, which includes dolphins, turtles, dugongs, black snapper, sea snakes, crabs, molluscs and many more animals with and without backbones (invertebrates).

Above left: A healthy seagrass meadow (*Amphibolis antarctica*). Image: Matthew Fraser

Above: Wire weed seedlings spend several weeks to months floating with the currents and tides, before eventually sinking to the seafloor and catching hold of something to grow on. Image: Rachel Austin

Left: Wire weed seedlings washed up on the high tide. The grappling hook at the base of the seedlings enables them to attach to seagrass, seaweeds, and hessian, although many of the young plants wash up on beaches around Shark Bay. Image: Elizabeth Sinclair

Seagrass habitat

The Shark Bay seagrass ecosystem covers some 4000 square kilometres of sea country. The sheltered bays, shallow waters and sandy seafloor are perfect conditions for seagrasses to grow. The seagrasses slow water flow and trap sediment, creating crystal clear waters.

At Faure Sill – a sandbar that crosses the eastern gulf of Shark Bay from Peron Peninsula to the mainland – the water depth is about one metre. 'Tiger stripes' visible from the air are formed by wire weed trapping sediment, as the seagrass 'moves' by colonising more areas, heading southward by one millimetre per year. The banks and sills reduce water flow into Hamelin Pool, which lies at the southern end of Shark Bay. Rates of evaporation exceed annual rainfall, creating a hypersaline environment for stromatolite formations to grow. These are the oldest lifeform on the planet.

Although they are not a hard substrate like coral reefs, seagrasses form large single or multispecies meadows. Epiphytic seaweeds, crustaceans and other invertebrates depend on seagrass as a place to attach and find food. Blue swimmer crabs use seagrass meadows as their home, feeding on small fish, other crustaceans and even seagrass seeds. Dead seagrass decomposes and provides food for filter feeders, including clams and cockles.

Fish species including trumpeters and saltwater whiting (mulhagarda) also depend on seagrass meadows for food and protection, as do shags (wanamalu) and mullet (mulgarda). Dolphins feed in and around seagrass meadows. Green sea turtles and dugongs feed heavily on seagrass, and tiger sharks (thaaka) eat turtles and dugongs. Studies have shown the presence of sharks increases seagrass growth. This is because the grazers' fear of sharks keeps them moving. A healthy ecosystem requires all parts of the system to be in balance.

Many of the smaller, tropical seagrass species grow in the shelter of the large temperate species, protected from grazers. One tropical seagrass species, *Halophila spinulosa*, is particularly beautiful and its meadows wax and wane over the years, disappearing and reappearing.

Seagrasses need a lot of light for photosynthesis. They take carbon dioxide out of the water, using it to grow leaves and rhizomes, and release oxygen into the water for animals to breathe. 'Blue carbon' includes buried organic carbon beneath the sea floor. This greenhouse gas filtering process by seagrasses accounts for 5% of all the carbon stored in the world.

It can take years for large seagrasses to colonise an area, and individual plants can live hundreds and maybe thousands of years as they form large clones. Clonal plants replicate themselves through vegetative extension of rhizomes (stems) and shoots, and do not need to reproduce seed to cover an area.

Many modes of reproduction

It is spectacular to find the flowers, fruits, seeds and seedpods of seagrasses. Like flowering land plants, the pollen is carried in the water column to the stigma of another flower for fertilisation to occur. Some seagrass species have large fruit or pods which float quite a distance before opening and releasing tiny seeds that settle on the seafloor. Some of these tiny seeds are eaten by dugongs as they dig up the sand. Wire weed has viviparous seedlings which grow continuously even while dispersing through the water.

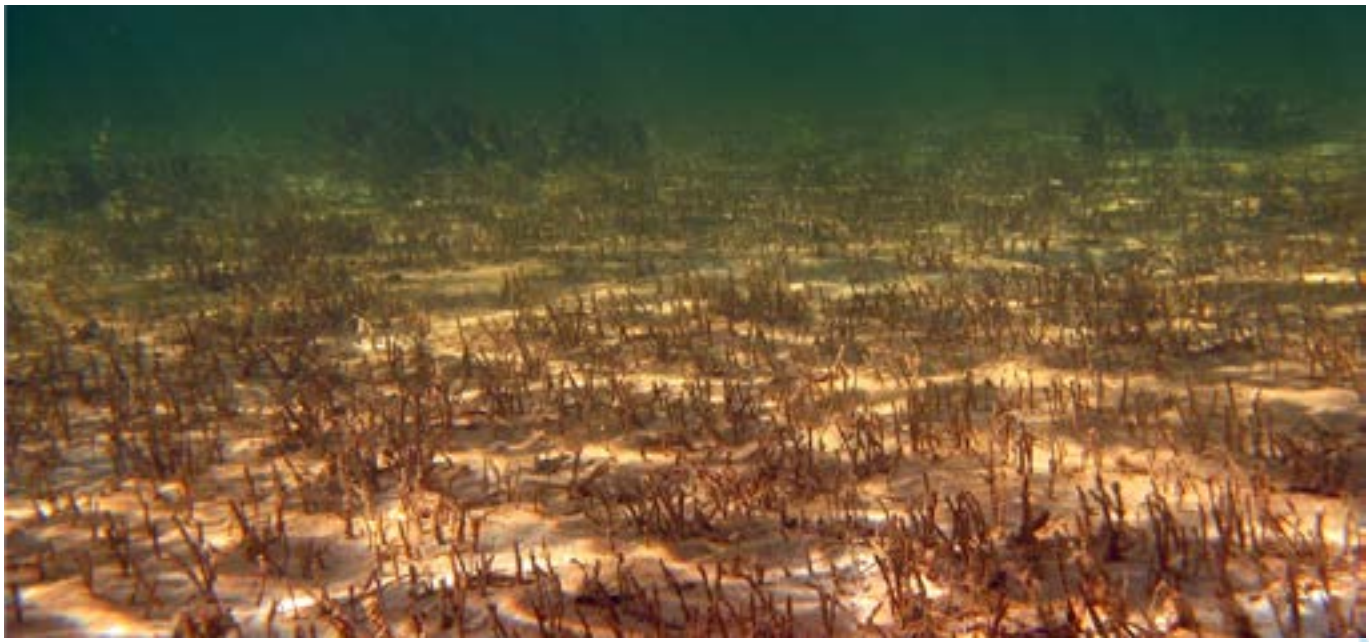
A damaging marine heatwave

In the summer of 2010/2011, a marine heatwave affected the west coast of Australia. The waters in Shark Bay warmed up so much that many seagrass plants lost their leaves and died. About one third of the bay's seagrasses died or were severely impacted. When large amounts of seagrass die, the effects cascade through the food web, with loss of grazers such as turtle and dugong, omnivores such as crabs, carnivores such as sea snakes, and filter feeders such as the Shark Bay scallop. Up to nine million tonnes of carbon is estimated to have been released in this heatwave event.

Cultural values

The Malgana people are saltwater people, living around the water for the majority of their existence. They have inhabited Gathaagudu for more than 30,000 years, living alongside the seagrass meadows, gathering food and developing an extensive understanding of seasons and cycles. Today, much of Malgana land is sea country, with cultural heritage preserved under the extensive seagrass meadows that thrive in the shallow waters. The widespread loss of seagrass resulting from the marine heatwave caused declines in many species, including those of cultural significance. These include green sea turtles (buyungurra), dugong (wuthuga), shags (wanamalu) and bottlenose dolphins (irrabuga).

Left: Bleached *Posidonia* leaves after exceptionally low spring tides. Image: John Statton



Below: Defoliation of *Amphibolis antarctica* following the marine heat wave. Image: Matthew Fraser.

Assisting seagrass recovery

Since the heatwave, UWA scientists have been working to understand the best way to assist recovery of these lost and damaged meadows. They partnered with Malgana Rangers in a project funded by the Australian Government's National Environmental Science Program Marine Biodiversity Hub. This partnership has enabled traditional knowledge and skills focused on managing country to be integrated with western science, with a view to bringing these meadows back to full health.

Malgana Rangers and scientists have participated in four training workshops to develop and trial simple, cost-effective methods to assist the recovery of seagrass. The methods use adult plants, seeds and seedlings, depending on the species.

There is a high rate of survival of adult transplants of wire weed and ribbon weed. Seed-based methods are limited for ribbon weed as seed production is low and unpredictable. Other methods include the use of 'seagrass snaggers' to promote natural recruitment of wire weed seedlings. These are long, sand-filled, hessian socks that seedlings attach to via the natural 'grappling hooks' at their base.

Measuring the success of a restoration project takes time. However, seaweeds and algae are starting to grow on seagrass transplants, tropical seagrasses are colonising the surrounding bare sand, and fish and invertebrates are starting to use the new habitat.

Above left: Malgana Ranger Nick Pedrocchi and UWA researcher John Statton deploy a seagrass snagger. Image: Gary Kendrick

Left: Colonisation of a *Posidonia* restoration site by *Halodule uninervis*, a fast-growing tropical seagrass species. Image: Gary Kendrick

Further information

Marine Biodiversity Hub

www.nespmarine.edu.au

Project E6: Assisting restoration of ecosystem engineers through seed-based and shoot-based programs in the Shark Bay World Heritage Site

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