

Western Australia is home to the world's largest plant – and it's underwater

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Known to the Malgana people as 'Wirriya jalyanu nhurra' or 'seagrass mob', *Posidonia australis* appears as expansive meadows across the salty waters of Gathaagudu (Shark Bay).

Throughout these marine meadows, masses of bright ribbon-like leaves emerge from the sandy seafloor, waving with the ebb and flow of the water. The meadows vary in size, often they seem endless, disappearing into the distance, as far as the eye can see underwater, and other times they are mixed with the sprawling wire weed (*Amphibolis antarctica*) and algae.

Healthy seagrass meadows provide habitat for vast communities of animals within the bay including cool and warmer water species and those which have cultural significance to the Malgana peoples, such as dugongs (wuthuga) and turtles (buyungurra).

Posidonia seagrass meadow in Gathaagudu (Shark Bay).
Photo: Rachel Austin



A mixed seagrass meadow. It's easy to find the bright green *Posidonia* ribbons amongst the sprawling fern-like fronds of wire weed (*Amphibolis antarctica*) and algae. Photo: Rachel Austin





Enormous seascapes appear endless on calm days where the horizon almost disappears into the sky. Professor Gary Kendrick (UWA) gets ready to collect seagrass samples in Shark Bay. Photo: Siegy Krauss

The Seagrass Research Laboratory at The University of Western Australia and affiliated researchers conducted a population genetic study to identify the best source of plant material (vegetative cuttings or seeds) for ecological restoration of meadows impacted by the marine heatwave of 2010/11 summer. The study involved genotyping shoots collected from ten meadows across Shark Bay. These were then quantified for genetic diversity within and among these meadows.

What we found was completely unexpected! Shoots from nine of the ten meadows were genetically identical, effectively a single organism. In fact, this single clone spanned over 180 km of water, making it the largest known organism on Earth! And to put it into context, this single clonal plant spans a distance greater than metropolitan Perth – further than Perth city to Bunbury!

What makes this particular plant so unique, other than its enormous size, is that it has 40 chromosomes, rather than the usual 20 found in its oceanic relatives, making it a polyploid organism. Diploid plants have two sets of chromosomes in the nucleus of their cells, while polyploid plants have more than two sets. Polyploidy has played a vital role throughout the evolution of plants, as polyploids typically have greater vigour and hardiness than their diploid progenitors (ancestors), although they are often sterile.

We suggest the increased vigour associated with polyploidy was critical in colonising new habitat when rising sea levels flooded Shark Bay following the last glacial maximum.

The new submerged habitat became increasingly salty making it a stressful environment for seagrass, apparently too stressful for the diploid progenitor(s). This is because seagrass meadows create their own environment as they mature and expand. Rhizomes or runners with new shoots extend outwards to cover the sandy seafloor. The leaves continuously filter particles out of the water where they accumulate on the sea floor. This process keeps the waters shallow and crystal clear. Seagrass leaves also reduce water flow, which is great for protecting coastlines, but in Shark Bay, a combination of reduced water flow, low rainfall, and high summer evaporation rates, means the water gets saltier, creating an extreme environment for local marine biodiversity.

All this takes time, and the world's largest plant, Shark Bay *Posidonia*, is estimated to be up to 4,500 years old. That means this meadow started growing at a time when the pyramids in Egypt were being constructed. The near pristine conditions in Shark Bay means that the plant has remained relatively undisturbed during its entire life including since European settlement.

Today this giant plant is largely protected within an IUCN World Heritage Area. However, its single largest threat comes from global climate change. Warming ocean temperatures, ocean acidification, and increasing frequency and intensity of weather events, such as marine heat waves and cyclones, all pose threats to its long-term persistence.

On a positive note, the large amount of genetic diversity contained within this polyploid plant does seem to confer a degree of tolerance to a wider range of environmental conditions relative to its diploid (seed-producing) parents. The giant *Posidonia* plant appears well-adapted to the harsh environment (wide salinity and temperature ranges under high light exposure). It has also shown some good signs of recovery since the devastating impacts of the 2010/11 marine heat wave.

Continuing research will highlight the role of important evolutionary processes, such as polyploidy, hybridisation, and mutation in enabling responses to new and changing environments, and how this knowledge benefits conservation and ecological restoration. ■

Acknowledgement of Country

Permission to conduct research on Gathaagudu, Malgana Land and Sea Country, was provided by the Malgana Aboriginal Corporation prior to making field collections. 'Wirriya jalyanu nhurra' comes from language shared by Malgana Elder Auntie Ada Fossa, *may she rest in peace*.

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Further reading

Edgeloe JM, Severn-Ellis AA, Bayer PE, Mehravi S, Breed MF, Krauss SL, Batley J, Kendrick GA, Sinclair EA. (2022) Extensive polyploid clonality was a successful strategy for seagrass to expand into a newly submerged environment *Proc. Roy. Soc. B* 289, 20220538

Sinclair EA, Edgeloe JM, Anthony JM, Statton J, Breed MF, Kendrick GA. (2020) Variation in reproductive effort, genetic diversity and mating systems across *Posidonia australis* seagrass meadows in Western Australia. *AoB PLANTS* 12, plaa038

Jane Edgeloe on SCUBA sampling *Posidonia* shoots from a deeper water meadow (~4m) in Shark Bay. Photo: Rachel Austin

From volunteer to Friends of Kings Park Summer Scholar and postgraduate student at Kings Park Science: 'My seagrass journey began in 2018 as an undergraduate volunteer SCUBA diver with the Seagrass Research group. I met Dr. Sinclair, who introduced me to the Summer Scholarship program where I learned how to extract DNA and generate genetic data to understand seagrass mating systems. My Master's thesis research used new population genomics methods to assess population structure of P. australis meadows in Shark Bay which led to our discovery of the world's largest plant!'

Jane Edgeloe, 2022.

