

A REEF LIKE NO OTHER: THE GREAT SOUTHERN REEF

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YOUNG REVIEWERS:



BRYSON

AGE: 9



SANKET

AGE: 10

Under the water, along the southern coastline of Australia, lies the Great Southern Reef—a reef that many people have never heard about. The water is colder than that of tropical reefs and instead of being built by corals, it is mainly formed by a specific type of brown seaweed known as kelp. Just like trees on land, kelp grow and cover large areas, forming underwater forests that are home for many kinds of fish, molluscs, crustaceans, and seaweed species. However, the Great Southern Reef is facing serious threats, mainly because of rising ocean temperatures. When the seawater becomes too warm, kelp can disappear, endangering the marine creatures that live in the reef ecosystem. It is difficult to protect something if people do not know it exists! This is why we need to raise awareness of how valuable this reef is. Can you help us spread the word?

THE GREAT SOUTHERN REEF

When you think about reefs, the first images that pop into your mind are likely those of astonishing tropical coral reefs, such as the Great

Barrier Reef in Australia. But what if we told you that not *all* Australian reefs are made of corals? Along the southern coastline of Australia lies another reef, which stretches across 8,000 km (Figure 1A) [1]. This reef is called the Great Southern Reef (GSR), and it is a system of rocky reefs connected by a specific type of seaweed called kelp.

Figure 1

(A) The Great Southern Reef spans five states across the southern coastline of the Australian continent (orange line): Western Australia (WA), South Australia (SA), Victoria (VIC), Tasmania (TAS), and New South Wales (NSW). (B) Numbers of species of each organism found on the Great Southern Reef. [Animal drawings courtesy of the Integration and Application Network, University of Maryland Center for Environmental Science (ian.umces.edu/symbols/)].

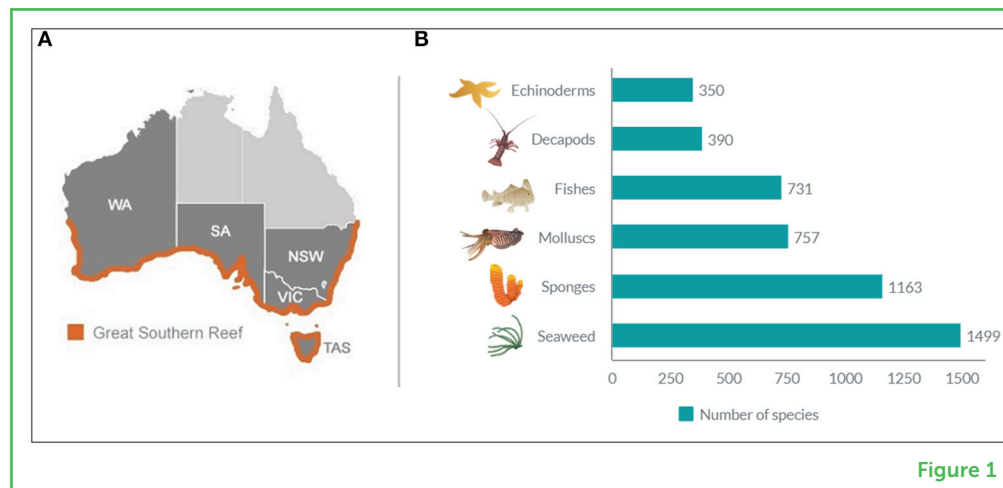


Figure 1

Kelp like being cold, which is why they thrive along the GSR. Unlike tropical reefs where the water is warm, the GSR is a temperate marine habitat, which means that the water is a mixture of cold water from the Southern Ocean and warm water from the tropics. This cold, nutrient-rich water makes the GSR an ideal place for kelp to grow—from the shallow areas near the coast to depths up to 50 m. When kelp grow and cover large areas, underwater forests are formed. A few of the most common kelp species that create forests along the GSR are golden kelp (Figure 2A), bull kelp (Figure 2B), and giant kelp (Figure 2C). Did you know that giant kelp is one of the fastest growing seaweed species on the planet, as it can grow up to 50 cm per day? These underwater forests are as important to the ocean as trees are to the land, because many marine creatures such as sponges, molluscs, crustaceans, fish, and echinoderms rely on these forests for food, shelter, and protection. Because of the important role of kelp forests in creating habitats that benefit other marine organisms, kelp are known as **foundation species** [2].

HOW MANY SPECIES LIVE ON THE GREAT SOUTHERN REEF?

We do not know exactly how many species live on the Great Southern Reef, but this special place is home to thousands of marine organisms of all sizes and shapes. Yet, scientists believe that tens of thousands of species are still to be found and studied, which is very promising for the next generation of marine scientists, who will have the opportunity to make new discoveries. The GSR is a recognized **biodiversity hotspot** due to the many kinds of plants and animals that live there (Figure 1B). It

FOUNDATION SPECIES

Species that play an important role in creating and maintaining a habitat for other species.

BIODIVERSITY HOTSPOT

A geographical area with a high number of species that are at risk of destruction.

Figure 2

Most common kelp species of the Great Southern Reef: **(A)** golden kelp; **(B)** bull kelp; and **(C)** giant kelp.

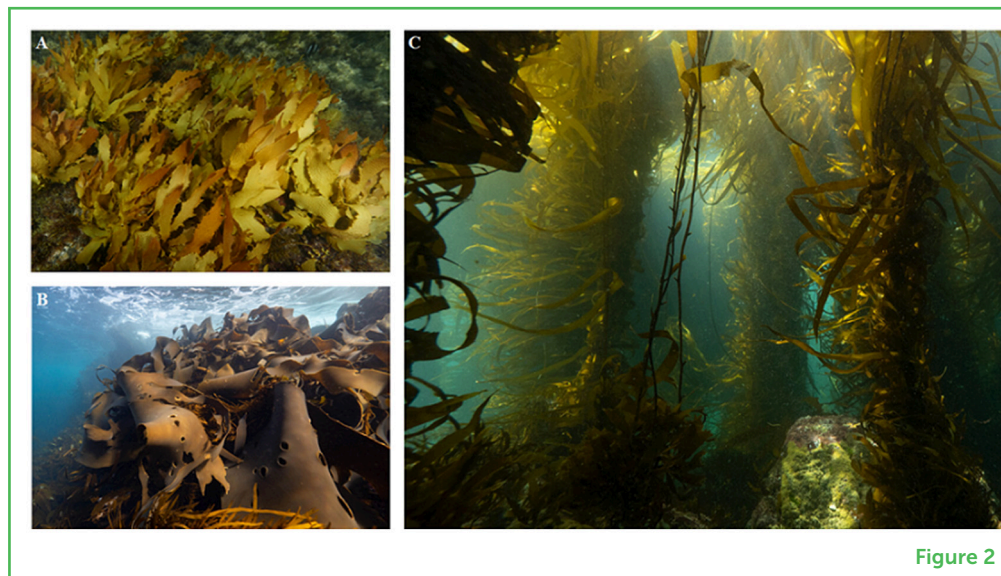


Figure 2

is home to 350 species of echinoderms, such as sea stars, sea urchins, and sea cucumbers; and 731 species of fish [1], including fishes that are commonly part of our diets, such as southern bluefin tuna, snapper, and Australian salmon.

The second most diverse group of organisms in the GSR is the sponges, with more than 1,000 species already known (Figure 1B) [1]. These sponges, which can be found in both shallow and deep water, are one of the simplest but also most colorful animals. They create vibrant habitats known as sponge gardens in the GSR, offering not only spectacular beauty for divers, but a very important habitat for marine animals.

Remember we said the GSR is mainly made up of seaweed called kelp? The GSR actually has many more seaweeds—in fact, it has the highest diversity of seaweeds and the highest number of **endemic** seaweed species in the world—meaning species that live *only* in that location [1]. These seaweeds are vital for keeping the GSR healthy, as they create a safe place that many marine animals can grow on, hide in, and eat from.

ENDEMIC

The term used to refer to species that live only in a specific geographic region.

PHOTOSYNTHESIS

Process by which plants, algae, and some types of bacteria use sunlight to produce oxygen from carbon dioxide and water.

WHY IS THE GREAT SOUTHERN REEF IMPORTANT?

The GSR provides benefits and resources to people, including oxygen, water, food, medicines, energy, and jobs (for example in fisheries, hospitality, and tourism). The kelp forest can also take up a huge amount of carbon dioxide from the atmosphere through **photosynthesis** and turn it into oxygen for marine animals—while at the same time reducing the impact of the climate crisis [3]. Kelp are a true underwater hero! As we mentioned, many of the kelp species residing in the GSR are endemic to this reef, but not only

seaweeds are endemic here—animals including the weedy seadragon, the southern dumpling squid, and the golden decorator crab are also endemic. These three species, which we will focus on below, also share an important trait: their fascinating ability to blend in with their surroundings, which allows to avoid predators and sneak up on their prey.

WEEDY SEADRAGON

While the weedy seadragon might resemble a dragon due to its color, tube-like snout, and long tail, the weedy seadragon does not breathe fire and it is not a mythical creature. Weedy seadragons are a type of fish—one of the most interesting fish species found in the GSR (Figure 3A). Life underwater is dangerous, especially for a weedy seadragon that cannot swim fast enough to escape danger. Rather than using speed, weedy seadragons blend in with seaweed due to their leaf-like appendages and their ability to change colors, which makes it challenging to spot them. They are often seen in seaweed forests and seagrass meadows but can even be found to depths of around 50 m [4].

Figure 3

Endemic species of the Great Southern Reef: (A) weedy seadragon; (B) golden decorator crab; and (C) southern dumpling squid.

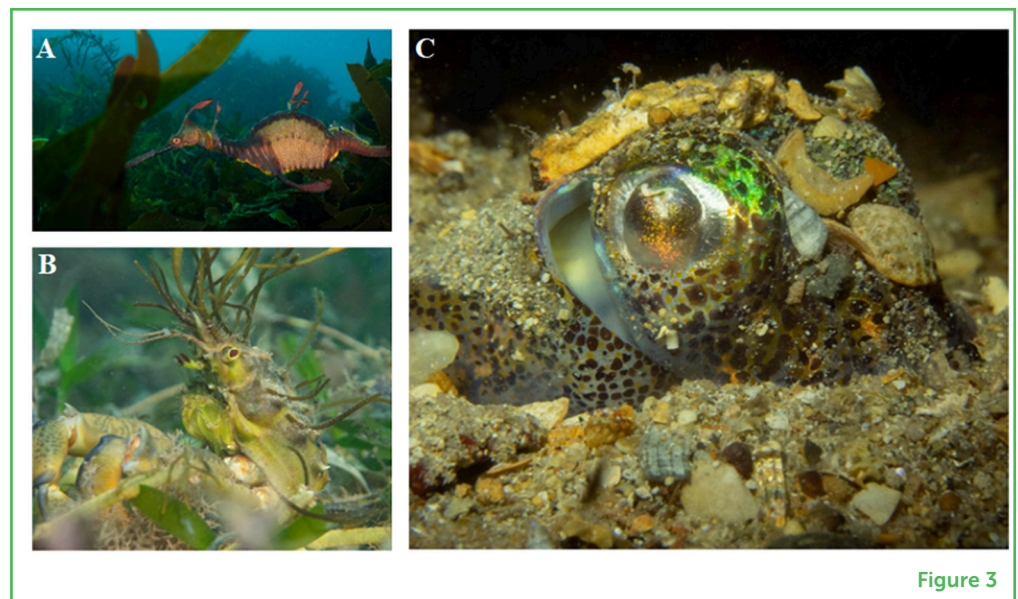


Figure 3

GOLDEN DECORATOR CRAB

As masters of camouflage (and perhaps the best-dressed creatures in the ocean), golden decorator crabs use their pincers to snip seaweeds and seagrasses from the environments, to cover themselves and hide from predators. This is possible due to the little hooks called setae that cover their shells (Figure 3B). When they want to be ultra-glamorous, they attach anemones to their bodies! While this might look fancy, they do not do it to win a “best-dressed” contest—they do it to avoid

SYMBIOTIC RELATIONSHIP

The close living arrangement or interaction between two or more species.

BIOLUMINESCENT

The term used to describe living organisms that emit light generated by a chemical reaction.

predators. The anemones contain toxic substances that protect the crabs from being eaten. In this **symbiotic relationship**, anemones also benefit because they can filter food from the water as the crabs move. The golden decorator crab can be often found in rocky intertidal areas, which are coastal areas exposed to air during low tide and generally submerged at high tide.

SOUTHERN DUMPLING SQUID

Have you ever eaten a dumpling before? If you have, you may be able to see why the southern dumpling squid got its name! These squid belong to a group of animals known as cephalopods (Figure 3C). They are small enough to hide along the seafloor during the day, using a glue-like substance to stick sand to their bodies. At night, they get a little more creative through a lifelong symbiotic relationship with **bioluminescent** (glowing) bacteria. These bacteria live in the gill cavity of the squid and obtain food from the squid. In return, the bacteria create light in the squid's belly so that the squid has no shadow. This allows the squid to be invisible to other animals, which is an excellent camouflage for escaping predators and hunting for prey on moonlit nights. The southern dumpling squid can be found in shallow seagrass beds and sandy areas in the coastal waters of the GSR.

PROTECTING THE GREAT SOUTHERN REEF

Some say that the GSR is Australia's best-kept secret, but we want to share this secret so that the world can learn about the beauty and importance of the GSR. Unfortunately, like other coastal marine environments, the GSR is in trouble—mainly because of climate change. After a marine heatwave, in which the water temperature became warmer than normal for an extended period, scientists observed a huge loss of kelp forests in some regions of the GSR. Remember we mentioned that kelp like the cold? When it is too hot, kelp can easily get stressed by heat, becoming vulnerable to diseases that can lead to its decline. When kelp disappear, the marine life that depend on them for survival also disappear, including the fish and other marine animals that humans consume. Many of these species use the kelp forest as a nursery grounds, where juveniles can find food and protection from predators.

The GSR is both valuable and fragile. There is still a chance to protect this amazing ecosystem, if we minimize human impact by restricting activities that stress the reef—such as overfishing and coastal development. This could be achieved by creating more marine parks and sanctuaries along the GSR. Another easy and effective way to protect the reef is by talking about it. Share what you learnt about the GSR with your family, friends, and teachers. Let them know that

this reef is a real underwater treasure that must be cared about and protected. Together, we can keep [Australia's southern reef](#) great!

REFERENCES

1. Bennett, S., Wernberg, T., Connell, S. D., Hobday, A. J., Johnson, C. R., and Poloczanska, E. S. 2015. The "Great Southern Reef": social, ecological and economic value of Australia's neglected kelp forests. *Mar. Freshw. Res.* 67:47–56. doi: 10.1071/MF15232
2. Layton, C., Coleman, M. A., Marzinelli, E. M., Steinberg, P. D., Swearer, S. E., Vergés, A., et al. 2020. Kelp forest restoration in Australia. *Front. Mar. Sci.* 7:74. doi: 10.3389/fmars.2020.00074
3. Filbee-Dexter, K., and Wernberg, T. 2020. Substantial blue carbon in overlooked Australian kelp forests. *Sci. Rep.* 10:12341. doi: 10.1038/s41598-020-69258-7
4. Klanten, O. S., Gaither, M. R., Greaves, S., Mills, K., O'Keeffe, K., Turnbull, J., et al. 2020. Genomic and morphological evidence of distinct populations in the endemic common (weedy) seadragon *Phyllopteryx taeniolatus* (Syngnathidae) along the east coast of Australia. *PLoS ONE.* 15:e0243446. doi: 10.1371/journal.pone.0243446

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YOUNG REVIEWERS



BRYSON, AGE: 9

I love reading facts about animals. I am excited about school, especially art and math. I also love my cats and chickens and love watching movies. I speak two languages: English and Dutch.



SANKET, AGE: 10

Hi, my name is Sanket. I am 10 years old. I live in Southern California and go to Clara Barton Elementary school. I am in 5th grade. My favorite subjects in school are science, social studies, history, and maths. I like snow sledding and basketball. I also like to know about different countries of the world.

AUTHORS



CÁTIA FREITAS

Catia Freitas is a marine biologist and a Ph.D. student at Deakin University, in Australia. She loves stories, especially those about the ocean and she is investigating how to use children's picture books to teach young children about the marine environment. Her hope is to give children the opportunity to relate with meaningful stories to build a stronger connection with the ocean. She is particularly fascinated about the Great Southern Reef, and her goal is to help raising awareness and protection of this valuable and endangered reef system in Australia.

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MADI O'BRIEN

Madi O'Brien is a marine biologist who is deeply passionate about protecting our marine environments through education and awareness. She has recently investigated the prevalence of marine science programs through informal education settings on the Great Southern Reef, Australia. She is currently working in the ecotourism industry as a snorkel supervisor and educator, connecting people to the ocean through snorkeling with wild dolphins, seals, and fish on the Great Southern Reef. In her spare time, you will find her immersed in the water either freediving, scuba diving, or surfing.



STEFAN ANDREWS

Stefan Andrews is a marine biologist, film maker, and educator from South Australia's Yorke Peninsula. As the director of ocean science communication media service provider Ocean Imaging, he has a passion for stimulating interest in ocean conservation through imagery, art, and storytelling. Stefan has produced a number of award-winning short documentaries which have been screened globally. In recent years he has been dedicated to raising the public profile of Australia's kelp forests in his role as the director of education and impact with the Great Southern Reef Foundation.

**PRUE FRANCIS**

Prue Francis is a marine scientist at Deakin University, in Australia. She loves learning about the ocean and has a keen interest in learning more about the different types of seaweed found in Australia. Prue lives in a small coastal town where she explores the Great Southern Reef with her family by going snorkeling, swimming, and beachcombing. Prue has also co-authored a children's picture book that is all about the Great Southern Reef!