

# The Monthly

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A reef history of time

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## The effort to restore Australia's once-vast oyster ecosystems



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pumping sand. Instead it was spreading several hundred tonnes of stone across the sea floor to create the foundation for an oyster reef.

The project, which follows the construction of an even larger reef off the town of Ardrossan on the Yorke Peninsula, is just one of a much larger program of shellfish reef restoration being undertaken by The Nature Conservancy at sites in Western Australia, Victoria, South Australia and Queensland. For the project's coordinator, marine biologist Anita Nedosyko, it is a vital step towards reconstructing a critically endangered ecosystem. "Shellfish reefs are the most threatened of marine environments," she says, citing US research showing that globally 85 per cent of such reefs have been destroyed by human activities. But it is also a project of intense historical significance that has the potential to transform the way we think about both the past and the future of Australia's coastal environment.

Although most people rarely consider the importance of oysters outside the culinary context, they are a foundational part of the coastal environment. A single oyster can filter as much as 100 litres of seawater a day, removing sediment, phytoplankton and other organic matter from the water. This material is either consumed as food or expelled as pseudofaeces that sink to the bottom. The removal of organic matter leaves the water clearer and cleaner, and allows sunlight to penetrate more effectively, improving the health of seagrass and other plant life, while the pseudofaeces provide nutrition to bottom-dwelling species such as shrimp, crabs and other invertebrates. The result, Nedosyko says, is like installing "a well-stocked fridge ... Suddenly you have all this food that would never have been available to these small creatures, which are at the bottom of the food chain, and once they're flourishing you then get all the higher-order species of fish that feed off them."

These effects also multiply rapidly as the number of oysters increases: a single hectare of healthy oyster reef can filter an astonishing 2.7 billion litres of seawater annually, and support the production of 375 kilograms of fish each year. These benefits are already obvious on other reef restoration projects. "On one of our reefs in Port Phillip Bay you now see up to a thousand juvenile snapper. Before, the seabed was just bare sand, but it now supports a diverse ecosystem of marine life that find shelter and food."

Yet oysters do more than clean water and fertilise seagrass. Like coral, their shells accrete and accumulate, binding together to form complex structures. In the case of species such as the Sydney rock oyster, *Saccostrea glomerata*, these rise vertically on exposed surfaces in the intertidal zone. In deeper water, such as that off Glenelg, flat oysters such as *Ostrea angasi* – known variously as the Australian flat oyster or Southern mud oyster – form thick reefs rising from the sea floor. Yet irrespective of species, the nooks and crannies of these structures shelter an astonishing abundance of life: one square metre of oyster reef can provide a home for more than 16,000 invertebrates.

Oysters and oyster reefs have also long been of immense significance to Indigenous Australians. As the huge middens found at many locations along the coastline attest, oyster meat was a source of food for many communities, while the shells were used to create fishhooks and cutting tools.

This abundance of oysters and their importance to Indigenous Australians was noted by many early European explorers and invaders. When Captain James Cook landed in Botany Bay in 1770, he noted "Vast heaps of the largest Oyster Shells I ever saw", later observing that "On the sand and Mud banks are Oysters, Muscles, Cockles, etc., which I believe are the Chief support of the inhabitants, who go into Shoald Water with their little Canoes and peck them out of the sand and Mud with their hands, and sometimes roast and Eat them in the Canoe, having often a fire for that purpose". Likewise, in Port Jackson in 1788 Lieutenant William Bradley described the "great quantity" of oysters of "amazing size"; and in 1802 Matthew Flinders said "heaps" of oyster shells "were frequent along the shores", and wrote of his cutter returning "loaded with Oysters".

Many Indigenous communities also retain detailed knowledge about oysters, and the location of The Nature Conservancy's reefs are informed by discussions and consultations with traditional owners. Yet it is only in the past decade that an appreciation of the full scale and significance of pre-invasion oyster reefs has begun to emerge within the broader scientific community. One of the central figures in this process of historical reconstruction is South Australian ecologist Dr Heidi Alleway. Now a researcher at the University of Adelaide, Alleway stumbled on this gap in the historical record while working on her PhD. "I was originally interested in King George whiting, but as I went through the archives I started to notice all of these references to oyster fishing. That resulted in me finding a series of fisheries department reports about oysters from the early 1900s, and legislation to regulate the industry."

Alleway dug through early fisheries records and other historical sources in an attempt to reconstruct the locations and size of these lost reefs. What she found shocked even her. Only two centuries ago the Australian coastline was surrounded by an extensive network of oyster reefs, almost all of which are now gone. Indeed of 118 identified flat oyster reef systems, only one remains, and of 60 commercially viable rock oyster reef systems, only eight remain, suggesting approximately 90 per cent of rock oyster and 99 per cent or more of flat oyster beds have disappeared. On the South Australian coast alone, reef systems covering at least 1500 kilometres have been entirely wiped out.

This process of destruction was brutally swift. Although data is limited, that which exists is startling. In Victoria's Western Port in the 1850s, 10 tonnes of oysters were being dragged from the sea floor every week. Similarly in southern Queensland in 1891, almost 2000 tonnes were extracted, while in South Australia, even as the industry was failing in the 1890s, some 1.2 million oysters were removed in a single year. This destruction was compounded by the use of dredging to collect the oysters (which destroyed the physical structure of the reefs) and the use of the shells as a source of lime for building. By 1853 governments in South Australia and Tasmania had passed legislation attempting to regulate the industry, with similar acts passed in the other colonies in following decades. Yet despite these early attempts at regulation, wild oyster fishing had largely ceased by the end of the 19<sup>th</sup> century in most parts of the country.

What might these reefs have looked like? Some sense of their scale can be gleaned from deposits found along the Murray River in South Australia. Five million years ago, during the warmth of the Pliocene, when sea levels were many metres higher, what is now the Murray Basin was a shallow sea, or estuary, extending well over 100 kilometres inland, in which oysters thrived. The reefs made by these fossilised oysters still survive in many places, some of them 75 to 150 metres wide and 6 to 8 metres thick.

Alleway's discovery of a lost world hidden in plain sight has echoes of the work of historians such as Bill Gammage and Bruce Pascoe. Yet she confesses to finding the revelation deeply confronting: "To realise this had been there and we knew nothing about it was very stark."

Alleway argues this historical amnesia is emblematic of what Canadian marine biologist Daniel Pauly has dubbed "shifting baseline syndrome", or the gradual change in accepted environmental norms over time, as the experience of previous conditions pass out of collective memory, and loss and degradation become normalised. "We have quite low expectations for the productivity of coastal areas in southern Australia," she says, "and while we talk a lot about kelp and seagrasses, it's clear it was much more complex and diverse in the past." But it is also symptomatic of a larger process of colonial heedlessness and rapacity. As Nedosyko puts it, "Indigenous people were here for more than 60,000 years. Just think about that timescale, how long they protected and looked after the marine environment. And then within a few decades white colonisation destroys this entire ecosystem."

Neither Nedosyko nor Alleway believe it is possible to recover what was lost. But projects such as the reef at Glenelg have the potential to protect us in an increasingly uncertain future. Cleaner water and greater biodiversity make marine ecosystems more resilient, and they help to prevent toxic algal blooms and their devastating effects on fish life. Oyster reefs and seagrasses also protect coastlines by stabilising coastal hydrology and absorbing wave energy, offering a highly cost-effective way to protect shorelines from the effects of rising sea levels and more frequent storms. And more stable coastlines are better able to sustain coastal wetlands and mangroves, which not only support greater biodiversity but are also up to 50 times more effective at sequestering carbon dioxide than forests. Even more remarkably, intertidal oyster beds help protect the animals that inhabit them from extremes of temperatures, providing breathing space for vulnerable species. These effects underline the critical role of ecosystem restoration in any successful climate strategy. But they also offer another reminder that, in a rapidly heating world, our chances of surviving the future often depend on a better understanding of the past.

