

Nature-based responses to climate change: estuary restoration and conservation in an urban industrial setting

Summary

The Port River is South Australia's major port (see Figure 1). Large industries, housing and other developments along its banks impact the Port River and Barker Inlet estuary. The estuary was once a highly interconnected ecosystem of seagrasses, mud flats and shellfish, with fringing mangroves and samphires. The area is one of the most vulnerable in South Australia to inundation.

With greatly improved water quality, nature-based solutions including restoring seagrass beds and shellfish, and trialling a 'Living Shorelines' approach (using mangroves, rocks, shellfish, seagrass, samphire) have become feasible. The need for these interventions is more urgent than ever, given the lack of public funds for implementing climate adaptation plans.

Keywords

Living Shorelines, climate change, seagrass, shellfish reef restoration, estuary conservation

Originally the Port River and Barker Inlet Estuary (see Figure 1) was a highly interconnected ecosystem, based on seagrasses, mud flats and shellfish (including native oysters, *Ostrea angasi*), with fringing mangroves and samphires, supporting the local Kaurna people.

The colony of South Australia was settled via Port Adelaide on the Port River. The river remains a working port and home to major industry including a cement plant, three gas fired power plants, as well as defence and maritime companies. Over the years, dredging, infill and development have led to loss of habitat and drastic reductions in water quality. Recently, some major sources of pollution have been removed, resulting in ongoing improvements in water quality and an improving aquatic environment. While this is good news, some risks persist and need to be

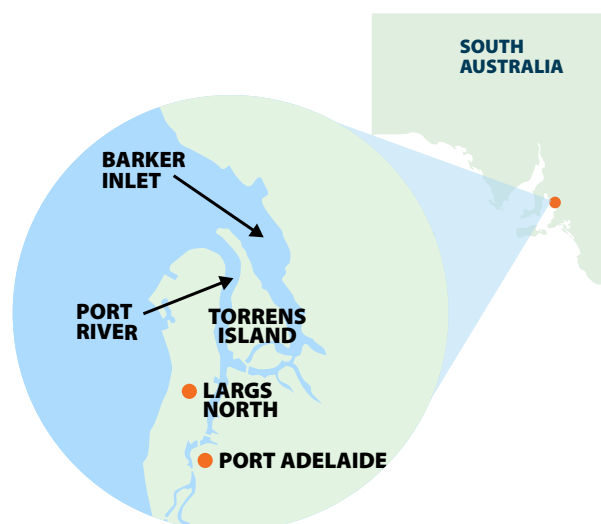


Figure 1: Port River, South Australia. Source: © NCCARF.

better managed, e.g. dredging. New risks are arising: Port Adelaide is one of the most vulnerable areas in South Australia to inundation, with major flood events in 2009, 2014 and 2016, and this vulnerability is likely to increase in the future linked to sea-level rise, land subsidence and the prospect of increased rainfall intensity.

[AdaptWest](#), the regional climate adaptation plan, maps scenarios associated with existing risks to the estuary. In the development of AdaptWest, it was apparent that there were inadequate local and State government funds to address even the *existing* climate related risks and homeowners and businesses were bearing the risks and losses. It was in that context that the Estuary Care Foundation SA Inc was formed to raise community awareness and trial nature-based responses.

Identifying a nature-based solution

Following a field trip with [The Nature Conservancy](#) (TNC) in the United States, Peri Coleman of Delta Environment Consulting addressed the [Port Adelaide Environment Forum](#) on the concept of 'Living Shorelines' – a management technique that uses plants and other natural elements to stabilise coasts and waterways (see Figure 2).

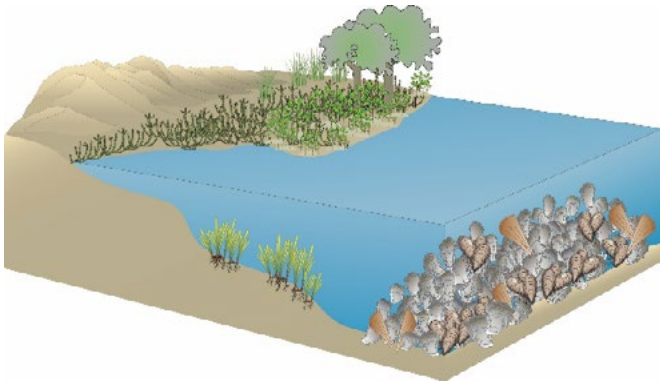


Figure 2: Drawing of a Living Shoreline. © Peri Coleman, 2015.

Peri suggested that Living Shorelines could be implemented along the Port River, in the Inner Harbour and West Lakes. Forum attendees were excited by this possibility, including restoring shellfish reefs to the Port River. The first meeting of the Port River Shellfish Restoration Group was held in January 2016.

The Estuary Care Foundation was subsequently formed to shepherd the Shellfish Restoration project and related projects. The key priorities of the Foundation have become:

- shellfish reef restoration
- seagrass monitoring and restoration
- trials of Living Shorelines
- community education and engagement

Shellfish Reef Restoration

After being introduced to the idea of shellfish reef restoration, local environmentalists looked at the Port River from a new perspective, finding thousands of molluscs and mussels on posts, bridges and pontoons (see Figure 3). Later, masses of Pacific oysters were identified in the river system. On the beachfront, native oysters *Ostrea angasi* were identified on pinna shells washed in from Gulf St Vincent after winter storms.



Figure 3: Mussels in Inner Harbour, Nov 2015. Photo: © Kym Murphy.

Coincidentally a local couple knew of the [Billion Oyster Project](#) (BOP) in the Hudson River and were keen, as public health practitioners, to see the Port River return to a swimmable river and to follow BOP's lead in engaging schools, communities and local businesses.

Some web searching revealed that trials of shellfish reef restoration with native oysters (*Ostrea angasi*) were underway in Port Phillip Bay through The Nature Conservancy (TNC). Dr Chris Gillies, National Marine Manager of TNC Australia, encouraged the possibility of shellfish reef restoration in the Port River and a link was formed to the national [Shellfish Reef Restoration Network](#).

Members of the Network including Chris Gillies and Dr Anita Nedosyko of TNC, Dr Heidi Alleway of Primary Industries and Regions South Australia (PIRSA), Professor Sean Connell and Dr Dom McAfee, University of Adelaide and Dr Xiaoxu Li, South Australian Research and Development Institute (SARDI) have subsequently provided invaluable advice and support.

The Shellfish Restoration Group has brought together interested community members from the Port Adelaide Residents Environment Protection Group, the South Australia Malacological Society and the South Australia Marine Life Society.

While a medium-term goal is to establish shellfish reefs, the more immediate focus has been to determine if *Ostrea angasi* (see Figure 4) could again survive in the estuary and if its survival is possible both as adults and as spat. The Foundation secured a Community NRM grant in November 2016 that has enabled the investigation to be undertaken as a citizen science project.

With PIRSA approval, three hundred and twelve *Ostrea angasi* (approx. 60 mm in size) went into sixteen oyster baskets across six sites on 31 May 2017 (see Figure 5). The intent was to involve multiple stakeholders in the trial and to use sites that might offer varying environmental conditions. The six sites are owned or controlled by private businesses and government agencies, and were secured with agreements around access.

The oysters were first marked, weighed, measured (centre, 30 degrees left and 30 degrees right) and photographed to determine their shell area.



Figure 4: *Ostrea angasi*, Flinders Ports site 12 July 2017. Photo: © Steve Reynolds.



Figure 5: The six sites for *Ostrea angasi* trials. © Google Maps.

Within two weeks visible shell growth was apparent. Subsequently most of the oysters have survived and grown, some have spawned, and some spat has been collected and is now being grown out.

To gather a year's worth of data, the project group counted and measured the oysters in July and September 2017 and February and May 2018. While growth rates have varied across sites, there has been a constant average growth rate in the weight of the oysters (see Figure 6).

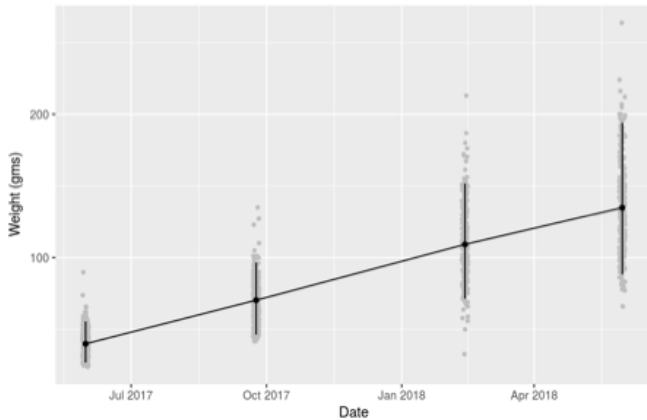


Figure 6: Weight change measured over all oysters as part of the Port Estuary Angelsi Oyster Trial. © Catherine McMahon

Shellfish reefs increase biodiversity, as observed by Foundation volunteers in the tiny habitat of the oyster baskets. Some of the marine organisms attracted within the baskets or on the oysters themselves include shrimp, tiny mussels, a seahorse, a cuttlefish, crabs, limpets and a pygmy squid.

Looking forward, short-term plans include deploying bagged, clean, recycled shell as substrate for small scale reef restoration trials. Lessons are being learnt from Ocean Watch, which is undertaking small scale trials with [bagged shell in Sydney Harbour](#), acting as mini Living Shorelines.

Seagrass restoration

The Estuary Care Foundation is especially interested in the intertidal and subtidal *Zostera* beds which would have previously occurred throughout the Port River and Barker Inlet (see Figure 7).



Figure 7: Zostera in Barker Inlet in September 2017. © Ted Wojtkowski.

Water quality improvements in the river have been linked in part to the closure of a soda ash facility in early 2014. Qualitative observations by Dr Jason Tanner, SARDI, in early 2017 indicate that *Zostera* is returning to some areas along the western shore of Torrens Island, suggesting the water quality is adequate for restoration.

The Foundation has established a monitoring program for *Zostera* along the west side of Torrens Island with support from volunteers. Base data are being sought prior to proposed Flinders Ports dredging in 2019.

The Foundation has secured some small grants (from Adelaide and Mount Lofty NRM, Coast Protection Board and City of Port Adelaide Enfield) for a seagrass restoration trial, using bagged shell and translocated seagrass, along the shoreline north of Snowden's Beach, (at Largs North) on the Port River.

Trials of Living Shorelines

The [AdaptWest](#) plan includes both soft and hard infrastructure measures as 'priority adaptation options' including the establishment of Living Shorelines.

Living Shorelines seemed a potential solution for the eroding seawall of a local conservation reserve (Mutton Cove Conservation Reserve). However, planning for this initial trial was disrupted by a major storm in May 2016 that breached the seawall (see Figure 8).



Figure 8: May 2016 storm breaking Mutton Cove levee bank. © Jean Turner.

Without any examples of constructed Living Shorelines in South Australia, the guidelines for [Environmentally Friendly Seawalls](#) by the NSW Office of Environment and Heritage, and projects such as in Kogarah NSW, have provided invaluable information.

The Foundation is focussing its Living Shorelines trials on the Inner Harbour. While an application in January 2017 to the National Disaster Resilience Program for trials was unsuccessful, another application is being submitted.

Community education and engagement

The Foundation aims to enhance understanding and appreciation of the Port River and the estuary, and to increase community involvement.

Estuarine habitats, especially mangroves and samphires, can still be derided as swamps. The ideas of estuary restoration and 'blue carbon' are relatively new to the public. So, the Foundation has sought common cause with other organisations, to progress project delivery and build awareness of key concepts and projects, beginning with potentially supportive audiences.

Presentations have been made to local organisations e.g. Rotary, U3A. The Shellfish Restoration Project was exhibited at the 2017 World Environment Fair and Science Alive. Other publicity has been generated through articles in our local yachting club magazines and engagement with arts and community projects.

The Foundation has hosted a series of successful public meetings:

- *Resilience of Gulfs, Coasts and Estuaries* with Dr Christine Shepard and Dr Mark Dumesnil, The Nature Conservancy, December 2016
- *Making a Difference: Aquatic Habitat Restoration* with Craig Copeland, the founder of OzFish Unlimited, August 2017
- *Working Together for a Healthy Coast: The Best Defence Against a Changing Climate* with Todd Miller, North Carolina Coastal Federation, February 2018.

Barriers to action

Events in the natural environment

The storm of May 2016, during which an anticipated tide of 2.7 m at Outer Harbour became a 3.9 m tide, overturned months of planning work on the Mutton Cove project, and raised concerns as to how quickly climate risks would materialise, and what might be possible with nature-based solutions.

While it seemed that the millions of feral Pacific Oysters, feral blue mussels and molluscs could potentially colonise substrate to form reefs, and so protect shorelines, the outbreak of Pacific Oyster Mortality Syndrome (POMS) has impacted the feral Pacific Oysters. PIRSA proposes to introduce a POMS-resistant variety.

Community support and involvement

While local community members have been enthused about conservation and restoration of the local estuary, some people are sceptical because they see the river as a degraded waterway. Impressions of the river are still strongly shaped by past polluting activities.

It is not straightforward as to how and when to inform the public about shellfish projects. While community engagement is seen as important for success, there is a risk that local shellfish and native oysters in trials could be 'harvested'.

Project support and management

There has been a lack of political interest in climate adaptation measures at the State and Federal levels. There is a paucity of State Government funding for large scale coastal protection works and stormwater management and many needs remain unmet.

Extensions have been needed for grant funds, given the time needed for approvals, and the changed circumstances that arise in doing such projects.

Lessons learned

For success:

- Enjoy the connection to place and the opportunities to see and learn about it
- Engage as many relevant stakeholders as possible, inform them early in the process and keep them informed throughout
- Allow lots of time for government permits to be considered and granted
- Formal signed Deeds may be needed with site holders as well as insurance for volunteers and public liability
- Locals and volunteers enjoy the potential of a project with positive outcomes; this then requires organisation of and insurance for volunteers (we benefit from insurance for volunteers provided through the State environment department)
- Be prepared to live with lots of ambiguity and seek to keep yourself and volunteers buoyant in periods of uncertainty
- Be open to offers of support
- Volunteers have been very generous with their time and expertise e.g. the Foundation's website was created totally by volunteers
- There is some grant support from the Department for Environment and Water for small-scale proof of concept trials
- Small amounts of funding can achieve a great deal and leverage additional support.

Further information

Estuary Care Foundation website. Accessed 19 June 2018. [Available online at: <http://estuary.org.au>].

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