

Shellfish Reef Restoration

A guide to help local government embed Shellfish Reef Restoration into a Coastal Management Program

Marine Estate Management Authority

Shellfish reef restoration – improves water quality, enhances habitat and helps to support healthy, vibrant coastal communities.

WHAT ARE SHELLFISH REEFS?

Shellfish reefs (or oyster reefs) are complex, intertidal or subtidal three-dimensional living structures which are formed from clusters of living oysters, mussels and old shell. Shellfish reefs occur on soft sediments or rocky areas, as low-profile beds or as high-profile reefs. Native reef-forming oyster species in NSW include Sydney rock oyster (*Saccostrea glomerata*), Angasi or native flat oyster (*Ostrea angasi*), Leaf oyster (*Isognomon ephippium*), Pearl oyster (*Pinctada albina sugillata*), blue mussel (*Mytilus (edulis) galloprovincialis*) and hairy mussel (*Trichomya hirsuta*).

WHY ARE SHELLFISH REEFS IMPORTANT?

Shellfish reefs are a distinct ecological community which provide a wide range of ecosystem services to coastal communities. Shellfish reefs provide complex structural habitat which supports many other marine species including other molluscs, crustaceans and fish species.

Shellfish reefs protect shorelines by buffering wave energy and enhancing sediment deposition. Reefs create stable conditions which promote the growth of other marine habitats such as seagrass beds and saltmarshes.

Shellfish reefs also provide critical water filtration services; improving water clarity which further encourages the growth of marine plants such as seagrass.



Image 1. A fringing Sydney rock oyster reef

WHERE HAVE SHELLFISH REEFS GONE?

Australia's coastal environments have changed considerably since European arrival. The cumulative effects of increasing urbanisation, industrialisation and land use intensification coupled with outbreaks of oyster disease have decimated shellfish reefs.

In Australia, it is estimated that 99% of Angasi oyster reefs and 92% of Sydney rock oyster reefs are 'functionally extinct'¹. The loss of these significant ecosystems is not confined to Australian waters. Globally over 85% of reefs have been lost or severely degraded¹ making shellfish reefs the world's most degraded marine ecosystem.

In NSW, small shellfish populations, such as shoreline oysters, still exist in most bays and estuaries but at very low densities compared to the pre-European period.

As identified in the state-wide Threat and Risk Assessment (TARA)² natural shellfish reefs (see

subtidal rocky reef environmental asset³) still face considerable pressure from several contemporary threats. These include climate change impacts such as sea temperature rise and ocean acidification; and impacts of land use intensification such as urban stormwater discharge and agricultural diffuse source runoff.

The loss of natural shellfish reefs and the ecosystems services they once provided continues to contribute to the decline in coastal waterway health, reducing water quality and significantly impacting coastal and marine biodiversity.

'Originally the oysters extended from Darling Harbour to the Flats in more or less quantities, but a few years back they became almost extinct from over-dredging' Inspector of Oyster Beds, 1877

HOW CAN WE BRING SHELLFISH REEFS BACK?

Many NSW estuaries have obvious signs of good natural shellfish recruitment but a limiting factor for developing a reef is clean settlement substrate for larval shellfish (called spat). In these estuaries the most economical and effective method for shellfish reef restoration is introducing hard substrate (rock and/or sterile shells) to the estuary or nearshore floor, in an area and time of good natural settlement rates of shellfish larvae.

For estuaries where natural settlement of shellfish larvae is limited, or for rare species such as the subtidal Angasi oyster and Leaf oyster, hatchery-reared spat are 'seeded' onto clean recycled shell and this is later placed on constructed rock reef bases.

Over time, given the right conditions, these juvenile oysters grow and reproduce, creating a self-sustaining complex ecosystem with all the attributes of a natural shellfish reef.

Shellfish reef restoration has been successfully implemented overseas (USA, Germany, Netherlands, UK), and now also in NSW and other Australian states.

WHY RESTORE SHELLFISH REEFS?

Shellfish reef restoration provides many benefits to an estuary and the coastal communities it supports, including:

- Enhanced biodiversity including key recreational and commercial fish species.
- Increased denitrification, removing nitrogen and reducing eutrophication of the water.
- Improved water quality via an oyster's natural filter-feeding activity.
- Enhanced estuary resilience through natural bank protection that can grow with sea level rise.
- Enhanced recreational and passive tourism opportunities.
- Creating jobs, boosting local economies.
- Positive community engagement and opportunities for citizen science.

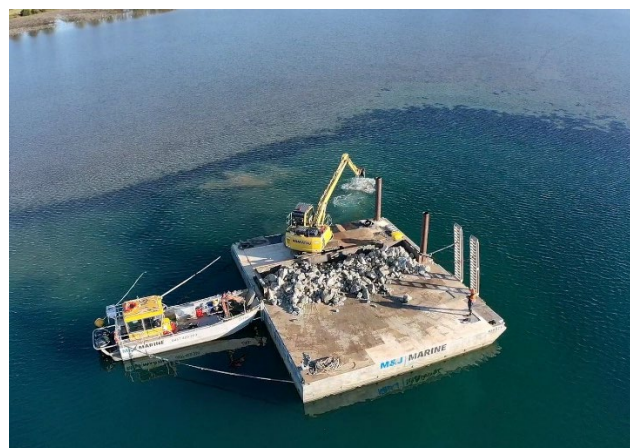


Image 2. Sub-tidal reef base construction at Wagonga Inlet 2022 (Image credit: Jay Maartensz)

SHELLFISH REEF RESTORATION AND THE MARINE ESTATE MANAGEMENT STRATEGY

Water pollution was identified as the number one threat to the marine estate in the state-wide Threat and Risk Assessment (TARA)². A number of actions were recommended to address this threat. The strategic restoration of shellfish reefs and their well-documented⁴ natural water filtration function and the added benefit of biodiversity enhancement is the focus of the landmark NSW Shellfish Reef Restoration Project.

This innovative project is being delivered under the Marine Estate Management Strategy (MEMS) Management Action 1.3 as part of Initiative 1 (Improving water quality and reducing litter for the benefit of marine habitats, wildlife and the community).

Key aims of project are:

- Increase awareness of shellfish reefs and support for future restoration projects in the coastal community and key stakeholders.
- Identify remnant reefs via a GIS mapping program.
- Facilitate stakeholders to plan and implement restoration projects across the coast, including their integration with other coastal restoration techniques such as 'living shorelines'.
- Identify suitable restoration regulatory pathways depending on site location including biosecurity, compliance, consultation and permission, maintenance, and navigation.
- Develop and trial restoration methods and additional native species via strategic research collaborations.
- Document evidence of shellfish reef restoration benefits to ecological, environmental, social, cultural, and economic outcomes.
- Increase understanding and integration of Aboriginal Sea Country knowledge of shellfish reefs into their restoration and management.
- Deliver the first large-scale shellfish reef restoration projects in NSW with project partners (Port Stephens and Wagonga Inlet)
- Monitor restoration efforts to document and measure restoration success.

The project is establishing a framework to efficiently deliver future shellfish reef restoration projects across the marine estate.

[Port Stephens Project](#) – 7.5 Ha of new intertidal Sydney rock oyster reef has been created in two remote areas of the Port Stephens-Great Lakes Marine Park. Over 55 million baby oysters naturally recruited in the first 2 years and were filtering nearly 7.5 million litres of water an hour!

[Wagonga Inlet Living Shorelines Project](#) – Integrating 2,700m² of intertidal and subtidal oyster reefs as part of a natural approach to coastal protection by using native plants and other natural elements to prevent erosion, rather than traditional methods such as rock walls.

HOW CAN SHELLFISH REEF RESTORATION BE EMBEDDED IN A COASTAL MANAGEMENT PROGRAM?

Coastal Management Programs (CMPs) are strongly aligned with improving outcomes for the marine estate. Shellfish Reef Restoration can assist with improving water quality and other key threats including loss of habitat, decreases in abundance and distribution of marine species (including fish) and foreshore erosion.

Aligning relevant CMP actions (such as addressing water quality, enhancing estuarine health, improving biodiversity and enhancing resilience to climate change) with this innovative restoration action may assist in future reef restoration implementation.

The following ideas may assist local government to embed shellfish reef restoration into a CMP at each preparation stage, where relevant:



Stage 1: Identify the scope of a CMP

- Recognise water pollution (identified in the TARA), habitat loss and decreases in marine species as key threats to the coastal environment area in your region.
- Consider including shellfish reef restoration as an innovative action to enhance water quality, restore habitat and boost estuary productivity.
- Include a member of the NSW Shellfish Reef Restoration project team and key local shellfish reef stakeholders (e.g. oyster farmers, Aboriginal communities) in your engagement strategy.
- Consider community connection to shellfish including the cultural connection of local Aboriginal communities.
- Refer to NSW DPI oyster reef mapping data available on the [Fisheries Spatial Data Portal](#) to determine spatial extent of oyster reefs and/or loss to inform or identify knowledge gaps.
- Link with the Port Stephens or Wagonga Inlet projects and other related interstate projects.



Stage 2: Determine risks, vulnerabilities and opportunities

- Adopt products from the [NSW DPI shellfish reef restoration](#) engagement program to engage with the community and key stakeholders.
- Consult and collaborate with NSW DPI and project partners to identify future opportunities and shared goals.
- Identify scenarios where shellfish reef restoration can support local social and economic change through enhanced water quality and fish production.
- Identify appropriate timing of shellfish reef restoration e.g. optimum spat fall season.



Stage 3: Identify and evaluate options

- Refer to the wealth of scientific literature on the socio-economic benefits of shellfish reef restoration (available from NSW DPI).
- Identify potential funding sources e.g. Coast and Estuary Grants, Environmental Trust, DPI's Flagship Habitat Action Grants or other environmental restoration programs. Explore collaborative opportunities under MEMS with the NSW DPI shellfish reef restoration team.
- Consider the feasibility, viability and acceptability of shellfish reef restoration using the prioritisation process established by NSW DPI and partners.
- Consider the legislative pathways identified by NSW DPI and engage relevant public authorities to determine its application to your coastal area.
- Refer to NSW DPI stakeholder engagement outcomes for relevant information.
- Consult with NSW DPI regarding project outcomes and other members of the Shellfish Reef Restoration Network (www.shellfishrestoration.org.au) for related studies.



Stage 4: Prepare, exhibit, finalise, certify and adopt the CMP

- Document partnerships with NSW DPI project team and other key stakeholders and keep them informed of the CMPs progress.



Stage 5: Implement, monitor, evaluate and report

- Adopt the [shellfish reef restoration planning and implementation](#) process developed by NSW DPI.
- Engage with key stakeholders to participate and assist in project delivery including possible incorporation of First Nations knowledge holders and citizen scientists.
- Consider the monitoring program established for the Port Stephens and Wagonga project sites and collaborative research programs.
- Inform stakeholders and the broader community of the outcomes of shellfish reef restoration.

WHERE CAN I OBTAIN MORE INFORMATION?

For more information on the NSW Shellfish Reef Restoration project and to access resources visit: marine.nsw.gov.au/projects/oyster-reef-restoration

The table below provides details of key contacts from the Shellfish Reef Restoration Team for each region.

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¹ Gillies C, McLeod I, Alleway H, Cook P, Crawford C, Creighton C, Diggles B, Ford J, Hamer P, Heller-Wagner G, Lebrault E, Le Port A, Russell K, Sheaves M and Warnock B. (2018) Australian shellfish ecosystems: Past distribution, current status and future direction

² NSW Marine Estate Threat and Risk Assessment Report 2016, WBN BMT for MEMA

³ NSW Marine Estate Threat and Risk Assessment – background environmental information, 2017, NSW Department of Primary Industries

⁴ Ehrich M. K., and Harris, L. A. (2015) A review of existing eastern oyster filtration rate models. Ecological Modelling 297, 201-212

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