

Workshop on multi-use and eco-features for breakwater maintenance and upgrade works

Workshop report Ballina 10 March 2020

MARINE ESTATE MANAGEMENT AUTHORITY



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More information

Marine Estate Management Authority www.marine.nsw.gov.au

Acknowledgments



Department of
Primary Industries



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Cover image: Montage of multi-use and eco-engineering features used in NSW coastal infrastructure
Cover photo sources: P Dwyer, L Mamo, Google Earth, Ron Main and Adrian Toovey

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Introduction

Breakwaters are large pieces of coastal infrastructure used to control the position of river entrances or create sheltered harbours or beaches. By reducing wave action, directing river flows and sand movement, some breakwaters cause other unintended or undesirable impacts. Yet, many breakwaters have become special places for nearby residents and visitors. They can be especially great places for people to walk, sightsee and fish.

This workshop was part of a Marine Estate Management Strategy action focused on gathering information to develop conceptual guidelines that highlight ways to maximise the benefits from breakwaters and minimise the impacts. This approach aligns with the vision for the NSW marine estate: *a healthy coast and sea, managed for the greatest wellbeing of the community, now and into the future.*

Workshop

The workshop investigated opportunities to maximise multi-uses and eco-features on existing breakwater infrastructure during maintenance and upgrade works. It was held at the Ballina Surf Club on 10 March 2020. The workshop brought together 23 practitioners with a variety of roles relevant to the management and maintenance of breakwaters. Attendees included:

- government managers of public infrastructure
- design engineers, individuals involved in onsite project management of works
- marine biologist scientists
- hydrologists
- government agency staff involved in environmental impact assessment.

Attendees, and another 13 individuals who expressed interest in the workshop but were unable to attend, were asked to provide comment on the draft conceptual guidelines developed for this project. A list of all invitees is attached to this report.

An important benefit of the workshop was building of personal relationships across the diverse skillsets to foster collaborations and embed a multi-disciplinary approach into breakwater maintenance.

Presentations

Six presentations were delivered as part of the workshop. The speakers kindly agreed to their slides being included as attachments of this workshop report.

Workshop discussion

Mr Craig Dengate from GHD conveyed two sessions investigating:

- key design features and intent
- key considerations
- relevant examples and references for a suite of multi-use and eco-features (Table 1, below).

The information collected during these sessions directly inform the development of the conceptual guidelines and an audit of structures along the NSW coastline. These documents are the primary output of this project.

Following the workshop GHD followed up some points raised in the workshop with relevant attendees. Later, a draft of the guidelines was shared with all invitees seeking their comment before the project was finalised in late 2021.

Table 1: Focus areas for improved breakwater maintenance and upgrade outcomes

Eco-features	Multi-Use Features
1. Submerged habitat	6. Aquatic recreation
2. Intertidal habitat	7. Land-based recreation
3. Terrestrial habitat	8. Water access
4. Remediation and restoration	9. Education
5. Monitoring	10. Cultural preservation
	11. Aesthetics
	12. Land-use activation

Collaborative opportunities to consider

Discussions at the workshop highlighted several possible collaborations that will be investigated further.

- Hanbars trials:
 - modify the current casting technique to enable a ~0.3-metre hole to be incorporated into a hanbar unit when cast. The hole can be used for lifting and re-lifting the unit and, when deployed in a submerged setting, operate as a sheltering habitat feature for fish such as the threatened fish species Black Cod
 - application of different surface treatments to be created when hanbar units are cast
 - use of reagents to achieve different colours within the hanbar units when cast to create different ecological niches along the breakwater.
- Progress deployment of the CoastSnap program with Environment Energy and Science (EES) to collect data on changes to the condition beaches adjacent to breakwater infrastructure, and potentially amass photos of breakwater condition.

Broader application

While this Marine Estate Management Strategy project has a focus on breakwaters, attendees and organisers agreed that many of the multi-use and eco-features are suitable for incorporation into works to maintain estuarine training wall infrastructure. Further investigations of training wall opportunities are beyond the scope of this project, however, this important point will be stressed in the guidelines.

Workshop Photos



Photos of presentations being delivered at the workshop

This workshop was funded by the NSW Government under the Marine Estate Management Strategy. The ten-year strategy was developed by the NSW Marine Estate Management Authority to coordinate the management of the marine estate. www.marine.nsw.gov.au

Workshop invitees and attendees

	Name	Agency	Role	Based in	Attended
Convener	Craig Dengate #	GHD (Convenor)	GHD Consultant Engineer	Sydney	Yes
Asset owner managers	Kim Bowra	MIDO	MIDO, Director	Tweed	Yes
	Andrew Mogg	MIDO Director	Asset Owner Policy	Sydney	Yes
	Gary Clark	Crown Lands	Asset Engineer / Manager	Newcastle	Yes
	Katherine Kerr	MIDO Tweed Sand Bypass	Tweed Sand Bypassing Scheme	Ballina	Yes
	Megan Gallagher	Crown Lands	Asset Manager	Ballina	Yes
	Kevin Morton	MIDO Assets Manager	Asset Manager Planner	Newcastle	No
	Nathan Handley	MIDO Engineer	Asset Engineer / Manager	Newcastle	No
	Andrew Ling	Crown Lands	Asset Env Manager	Newcastle	Yes
	David Hopper	MIDO Env Manager	Asset Env Manager	Newcastle	No
	Chris Voisey	Qld Project Manager (Marine Special Projects)	Asset Owner Manager	Brisbane	Yes
Scientists	Heath Folpp #	DPI Fisheries	Researcher Fishing Enhancement	Coffs Harbour	Yes
	Lea Mamo #	SCU PhD Candidate	Researcher Nereia	Coffs Harbour	Yes
	Brendan Kelaher	SCU Professor	Researcher	Coffs Harbour	Yes
	Melanie Bishop #	Macquarie University	Researcher	Sydney	Yes
	Rebecca Morris #	Melbourne University	Researcher	Melbourne	Yes
	David Harasti	DPI Fisheries Researcher	Researcher Black Cod, Seahorses	Port Stephens	No
	Melinda Coleman	DPI Fisheries Researcher	Researcher	Coffs Harbour	No
	Kate Thornborough #	DPI Fisheries	Social Scientist	Sydney	Yes
Hydrologists	Edward Couriel	MHL	Consultant Hydrologist	Sydney	No
	Indra Jayewardene	MHL	Consultant Hydrologist	Sydney	Yes
	Lara Hess	MHL	Consultant Hydrologist	Sydney	Yes

	Name	Agency	Role	Based in	Attended
Government agency Environmental Assessment Managers	Patrick Dwyer #	DPI Fisheries	Env Assessment	Wollongbar	Yes
	Jonathan Yantsch	DPI Fisheries	Env Assessment North	Wollongbar	Yes
	Scott Carter	DPI Fisheries	Env Assessment Central	Port Stephens	Yes
	Carla Ganassin	DPI Fisheries	Env Assessment South	Wollongong	Yes
	Danny Wiecek	EES, DPIE	Coast and Estuary Officer	Wollongong	No
	Marc Daley	EES, DPIE	Coast & Estuary Team	Wollongbar	Yes
	Marcus Riches	DPI Fisheries	Environmental Assessment	Wollongbar	Yes
	Andrew Page	DPI Fisheries	Marine Park Operations	Byron	No
	David Maguire	DPI Fisheries	Marine Park Operations	Byron	Yes
Communication	Lesley Diver	DPI Fisheries	Communications	Wollongong	Yes
Site Project Managers	Richard Goode	Soil Conservation Service	Construction Engineer	Taree	No
	Greg Crisp	Crown Lands Inlet Surveys	Inlet Surveys		No
	Adam Kostrz	Soil Conservation Service	Construction Engineer	Grafton	No
	Andrew Hartley	Consultant	Coastal Engineer	Brisbane	Yes

Workshop on multi-use and eco-features for breakwater maintenance and upgrade works

Date: 10 March 2020

Time: 9:30 – 2:30pm

Lunch provided

Location: Dirrawong Room (Room 3)

Ballina Surf Club

65 Lighthouse Pde BALLINA

Further information:

Craig Dengate, GHD (craig.dengate@ghd.com)

Patrick Dwyer, DPI Fisheries 0407 264 391

PROGRAM

9:30 – 10:45 Setting the scene 10 min presentations covering:

1. Eco and Multi-Use features: Coffs Breakwater and *Nereia* (Lea Mamo)
2. Sydney Institute of Marine Science & World Harbour research project (Melanie Bishop)
3. Insights from a Victorian approach (Rebecca Morris)
4. Recreational fishing enhancement opportunities on breakwaters (Heath Folpp)
5. Social and cultural values, and, opportunities on breakwaters (Kate Thornborough)
6. An audit of multi-use and eco-features on NSW breakwaters (Patrick Dwyer)

Morning Tea

The rest of the day will be a workshop convened by Craig Dengate (GHD) aiming to drawing on the group's diverse experience with eco and multi-use features and breakwaters to refine:

1. Key Design Features & Intent
2. Key Consideration
3. List Examples & Reference

12:30 – 1:15 Lunch

Reconvene to consider the remaining eco and multi-use features

2:30 Conclusion

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Workshop Presentations

Coffs Breakwater upgrade and a threatened seaweed

Lea Mamo (Southern Cross University)



Coffs Breakwater upgrade and a threatened seaweed


Lea Mamo, Brendan Kelcher, Melinda Coleman, Patrick Dwyer

Hard coastal protection: present & future



- Diverse historical purposes
- Pressures: coastal population & climate change
- One option: upgrading of existing infrastructure


The Coffs Harbour Northern Breakwater



- Built in 1924
- Social, economic and cultural values


Safety issues

- Regularly overtopped by waves



Safety issues

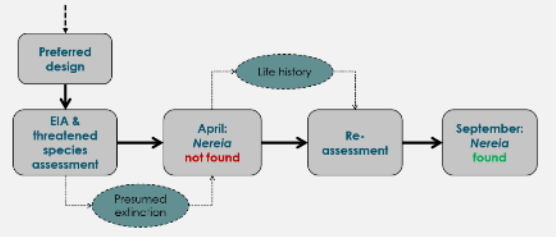
- Regularly overtopped by waves
- Life threatening to the public
- Danger to infrastructure and vessels



Breakwater upgrade

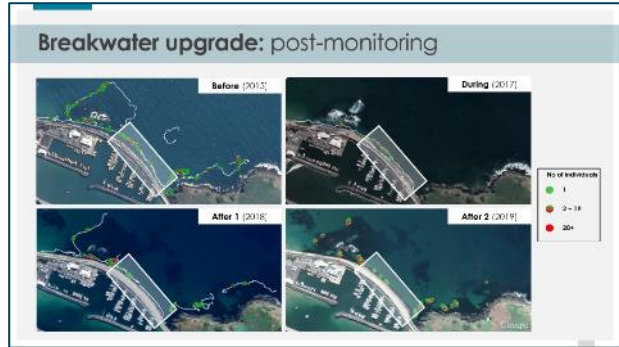
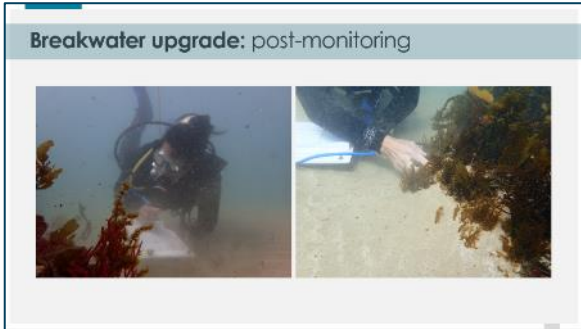
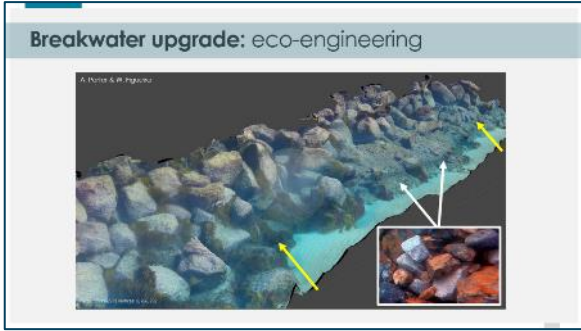


Breakwater upgrade: *Nereia*



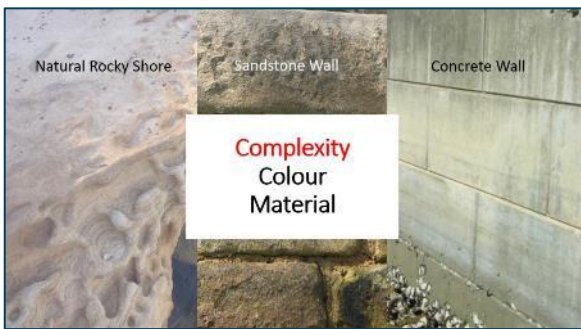
Breakwater upgrade: re-design





Sydney Institute of Marine Science & World Harbour Research Project

Melanie Bishop (Macquarie University)



WG2: GREEN ENGINEERING

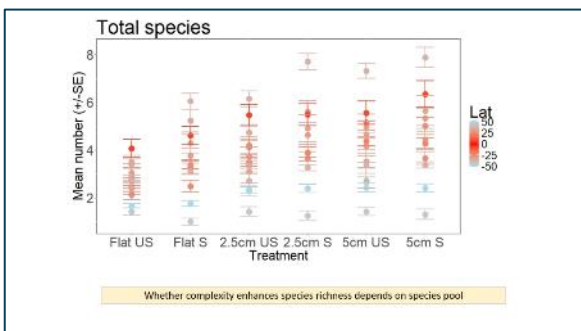
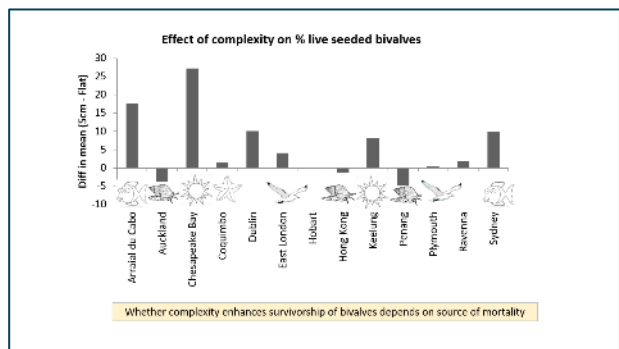
Are the effects of complexity spatially general?

Flat 2.5cm ridges 5cm ridges
Top view settlement Bottom view settlement Design by NewDesign Lab

WG2: GREEN ENGINEERING

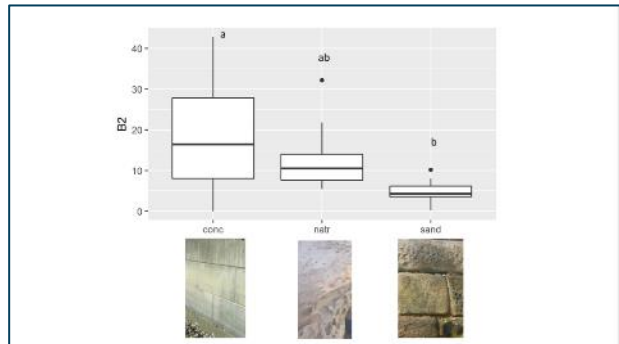
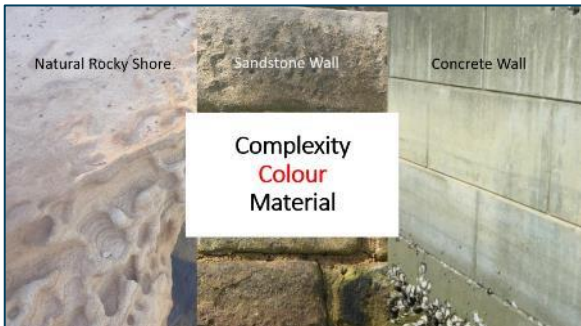
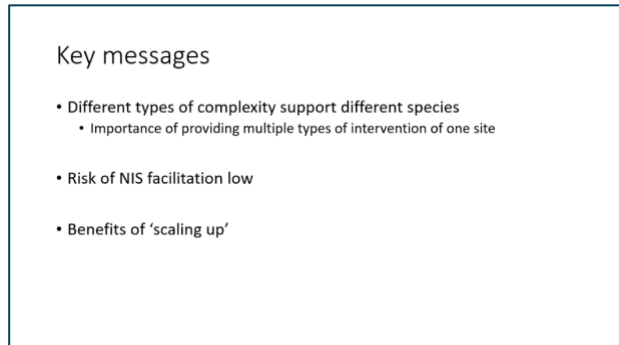
Experiment run in 15 harbours across the globe

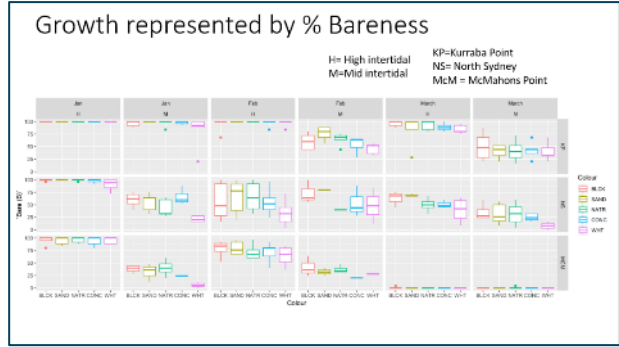
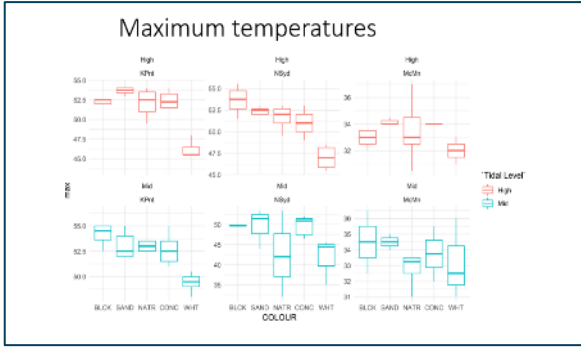
Australia: Sydney, Auckland, Hobart, Christchurch, Adelaide, Perth, Hong Kong, Auckland
Africa: Cape Town
Europe: Cardiff, Plymouth, Barcelona
Middle East: Dubai, Doha
North America: San Francisco, San Diego, Seattle
South America: Valparaiso, Montevideo, Rio de Janeiro, Cape Horn



Key messages

- Efficacy of 'greening' approaches varies spatially
- Bespoke approaches, developed with knowledge of local ecology likely to be most successful





- ### Key messages
- Colour varies markedly between natural and built surfaces
 - Colour may influence thermal environment, settlement and predator/prey interactions
 - Substrate colour also needs to be considered in eco-engineering interventions



Acknowledgements

Funding

Collaborators & Field Assistance

Follow the project:

[@LivingSeawalls](#) (Twitter)

[@livingseawalls](#) (Instagram)

Insights from a Victorian approach

Rebecca Morris (University of Melbourne)

Insights from a Victorian Approach
 Rebecca Morris
 National Centre for Coasts and Climate
 The University of Melbourne, Australia

Nature-based methods

Victorian Marine and Coastal Policy, March 2020

What are nature-based methods?
Why would we use them?
When should we use them?
What are examples?

What are nature-based methods?

Ecological Engineering

Hard Hybrid Soft

Nature-based

What are nature-based methods?

Drivers and hazards Mitigation process and response

Drivers: Sea level change, Storm surges, Currents, Waves and swell, Sediment supply

Hazards: Erosion, Flooding

Process: Build biomass, Sediment deposition, Increase shading and bedrock

Response: Increase elevation, Change in wave profile, Reduce attenuation

Morris et al. 2018

Why would we use nature-based methods?

ECOSYSTEM SERVICES
 The benefits people derive from ecosystems

Woods: In temperate zones, mangroves provide a natural barrier of dunes and reef.

Local protection: Seaweed mangroves can reduce sediment input to a beach, reduce wave attack on beach, and 'trap' sediment.

Water filtration: 2-3 hectares of mangroves may filter the pollutants of 1 hectare of agriculture.

Wetlands: They can store 2,000 kg of carbon per hectare, and can store 100,000 kg of sediment per hectare.

Waves regulation: Carbon storage potential of mangroves is 2-4x higher than that of tropical saltwater forest due to strong carbon storage in the soil. CO₂ emissions from ground mangroves are smaller than saltwater forest.

Fisheries: Mangroves support 5000 fish species and 100000 marine invertebrates.

Nature ecosystem services: Worth \$22.32 billion-\$27.59 billion per year, or \$1.4 million residential plots in 2020. \$22 billion per year.

When should we use nature-based methods?

Intensity of HAZARD (LOW to HIGH)

URGENCY of asset protection (LOW to HIGH)

Matrix: Soft (Low hazard, Low urgency), Hybrid (Low-Mid hazard, Mid urgency), Hard (High hazard, High urgency)

What are examples of nature-based methods?

Intensity of HAZARD (LOW to HIGH)

URGENCY of asset protection (LOW to HIGH)



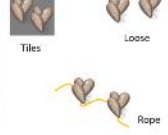
Examples: A (High hazard, Low urgency), B (High hazard, Mid urgency), C (High hazard, High urgency), D (Low hazard, Low urgency), E (Low hazard, Mid urgency), F (Low hazard, High urgency)

Breakwaters creating shellfish reefs

Photos showing breakwater construction and a completed shellfish reef.

Logos: VICTORIA, Geelong, VERULITY

Breakwaters creating shellfish reefs

Tiles Loose

Rope

Breakwaters creating shellfish reefs

Engineering:
 Drone surveys
 Sediment volume
 Shoreline position
 Breakwater integrity
 Beach profiles
 Wave attenuation

Ecological:
 Mussel surveys
 Density
 Recruitment
 Size
 Benthic assemblage
 Seagrass surveys

Social:
 Community questionnaire



Breakwaters creating shellfish reefs

Sediment volume

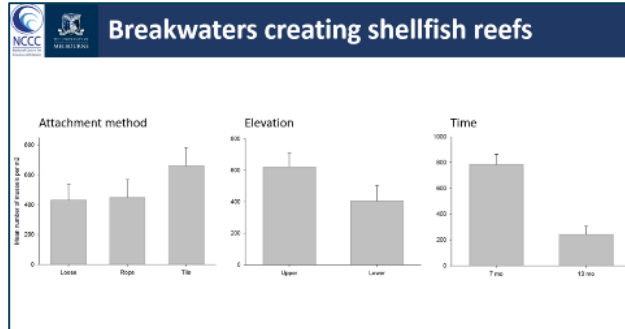


Gain
Loss

04/18 – 08/18
 Net gain 108m³

08/18 – 01/19
 Net gain 113m³

Total net gain
 221m³



Hybrid mangrove living shorelines




Hybrid mangrove living shorelines



1. Engineering the pods
2. Community consultation
3. Pod deployment
4. Mangrove planting



Hybrid mangrove living shorelines – Rock fillets




Engineering:
 Drone surveys
 Sediment volume
 Shoreline position
 Rock fillet structure
 Bank profiles
 rSFS
 Wave attenuation

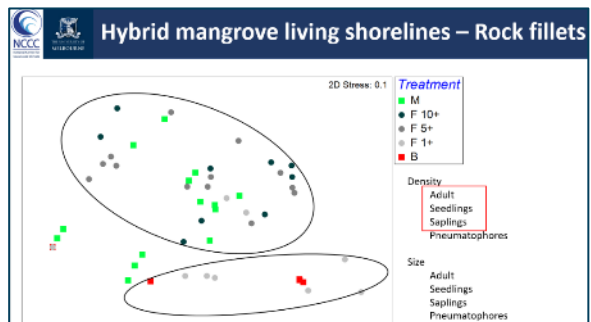
Ecological:
 Mangrove density
 size
 Blue carbon
 Fish stable isotopes

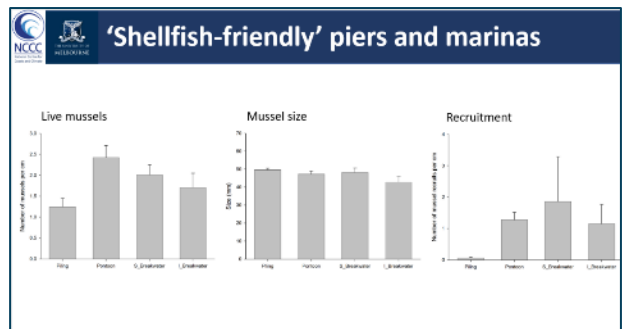
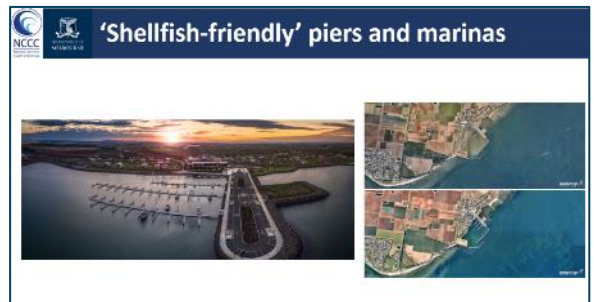
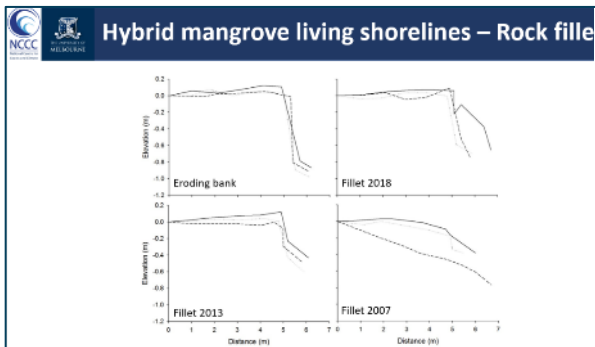
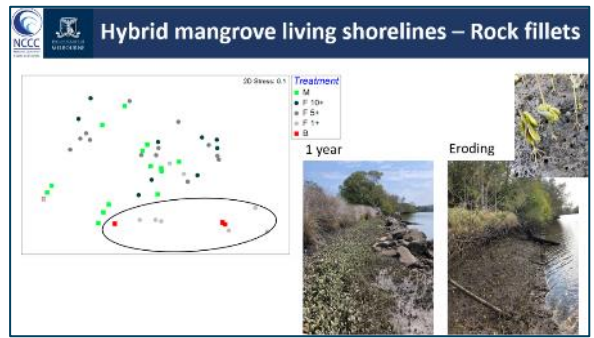
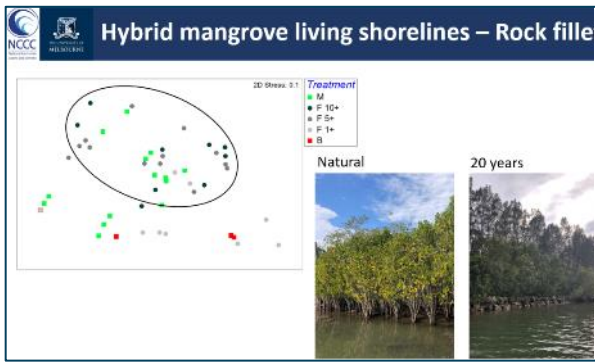
Rock fillets
 • 1 year
 • 5 years
 • 10+ years

Eroding bank

Fringing mangroves


Image: MetCoast Council






Estuarine man-made structures and recreational fishing

Heath Folpp (DPI Fisheries)

 Department of Primary Industries

Estuarine man-made structures and recreational fishing



Dr Heath Folpp - NSW DPI Fisheries

Importance of Recreational Fishing in NSW

Recreational fishing generates about \$3.4 billion expenditure into the NSW economy each year *

Supports about 14,000 jobs *



Importance of Recreational Fishing in NSW

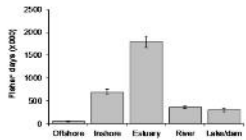

806,000 people (over the age of 5) go fishing in NSW each year
11.9% of NSW population



Residential Stratum	Participation Rate (%)*
Sydney	8.7
Hunter	15.4
Illawarra	18.2
Richmond Tweed	18.3
Mid North Coast	17.5
Central West/North West	15.8
Far West/North West	18.8
South East Coast	20.7
Riverina	20.2

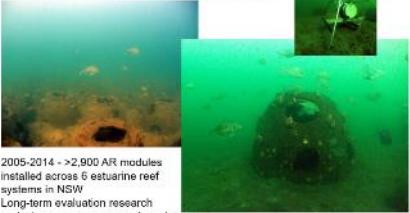
West et al – Rec Fishing survey 2013-14

The vast majority (79%) of recreational fishing activity in NSW concentrated in marine waters – with estuaries accounting for over half (56%) of total effort





When dissected – in estuarine waters 65% of effort occurs from man-made structures

DPI - Estuarine Artificial Reefs (2005 to 2014)



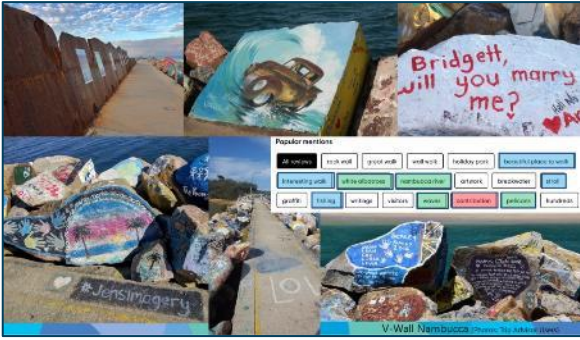
2005-2014 - >2,900 AR modules installed across 6 estuarine reef systems in NSW
Long-term evaluation research project - numerous peer reviewed publications



Key considerations




- Social - access (safety?)
- Physical - Hydrodynamics of site - scour and inundation of structure, impacts on existing hydrology
- Biological/Ecological – inferences from DPI project.



<ul style="list-style-type: none"> • Safety <ul style="list-style-type: none"> • Overtopping • Railings • Lighting • Uneven surfaces • Public liability issues • Accessibility <ul style="list-style-type: none"> • Uneven surfaces • Lighting (night use restrictions) • Narrow footpath • Lack of wayfinding signage 	<ul style="list-style-type: none"> • Multi-use/resolve resource use conflict <ul style="list-style-type: none"> • Overcrowding • Lack of multi-use accommodation • No arrival experience
---	--

Safety

Surface works

- Uneven surfaces - public liability

Railings

- Specific features or length

Signage

- Wayfinding, interpretive, informative/education (navigate and discover points of interest about local flora and fauna, geography, Aboriginal and European history)

Protection from overtopping

- Walls built up





Other accessibility measures

- Platforms (wildlife viewing, fishing, water access, etc.)
- Ramps and steps along breakwater
- Lighting

Multi-use/reduction of resource use conflict

- Platforms (fishers, divers, surfers, wildlife)
- "Arrival experience" (monument, look out/viewing platform, installation, etc.)
- Seating
- Lighting
- Bins
- Bike racks
- Decorative installations on infrastructure
- Shelter
- Photo points
- Artwork (light-touch vs all encompassing programs)

Nearby measures

- Parking
- Boat ramps
- Fish cleaning stations
- Access to freshwater (taps, drinking fountains, etc.)

Environmental programs

- It is important to the community to preserve the marine environment
- There are several programs that can boost social values, e.g. Living Seawalls Project, CoastSnap, etc.

Living Seawalls Project photos.wa.gov.au
CoastSnap Project photos.wa.gov.au

Social value and metrics

- Counters on breakwater – metric of use, economic estimates.
- Web cam installation – use metrics (useful for planning), identify resource use conflict issues
- Social media engagement

Questions

Contact: Kate Thornborough
Social Research, Marine Ecosystems Unit, Fisheries NSW
Kate.Thornborough@dpi.nsw.gov.au

NSW Breakwaters: an audit of multi-use and eco-features

Patrick Dwyer (DPI Fisheries)

NSW A Marine Estate Management Strategy Project

NSW breakwaters: an audit of multi-use and eco features

Patrick Dwyer

Coastal infrastructure

Preliminary list
~76 structures

- 12 harbours
- 26 trained river entrances
- 5 groynes / groyne fields

Infrastructure owners

Most structures (1830-60s; 1900s; 1960-70s)

- Newcastle Harbour, Port Botany, Port Kembla, Port of Eden
- Shell Cove
- Orphan structures

Primary purpose

- Shipping transport → Trawling → Tourism
- Shipping transport
- Residential / Tourism / Recreation
- Orphan infrastructure
- Primary purpose no long justifies cost & impact

Orphan infrastructure

Secondary Purposes: ocean swim, fishing

Secondary purposes

★ Workshop venue
Reliant on the breakwater

1884 Map of Richmond Estuary

★ Workshop venue
Reliant on the breakwater

Upgrades / maintenance . . . mitigation hierarchy

At the design stage, carry out initial implementation of the mitigation hierarchy

Design 1	Avoidance	Minimization	Restoration	Offsets
Design 2	Change in design	Avoidance	Minimization	Restoration
Design 3	Change in design/implementation	Avoidance	Minimization	Restoration
				Offsets

CERTAIN → Certainty of environmental outcome → UNCERTAIN