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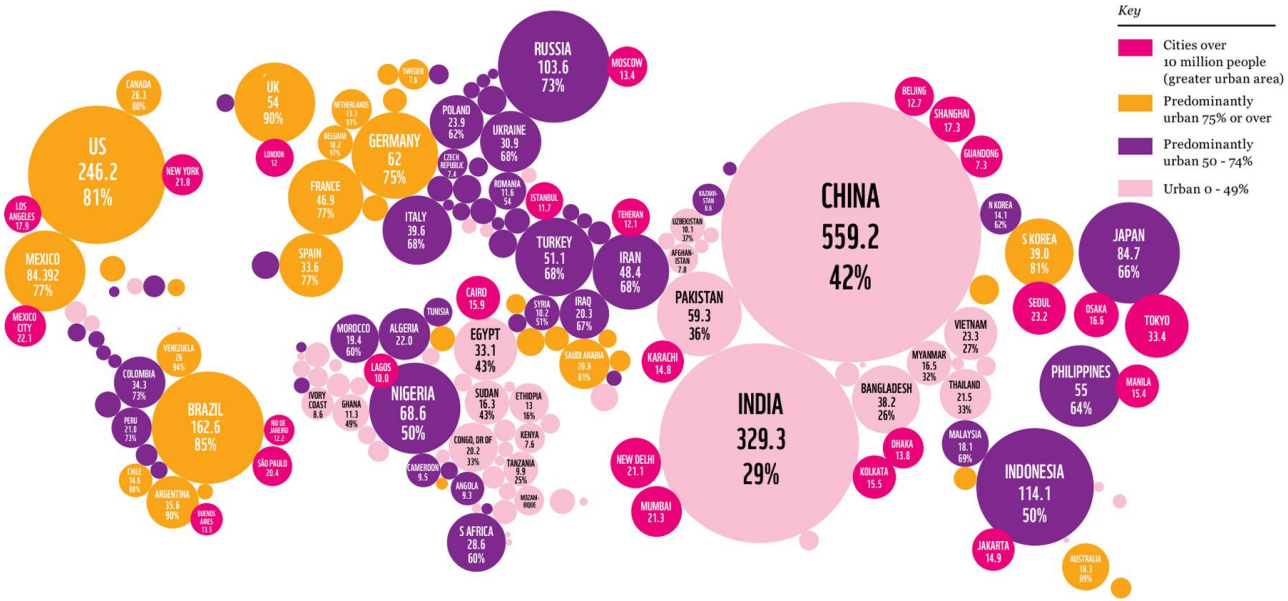
Eco-solutions for an urban ocean

A/PROFESSOR KATIE DAFFORN

The world is increasingly urban…



WWF (2012)

In 2050, global population estimated to reach 9.7 billion and two out of every three people will live in a city (UN, 2009)

Coastal cities and shoreline degradation

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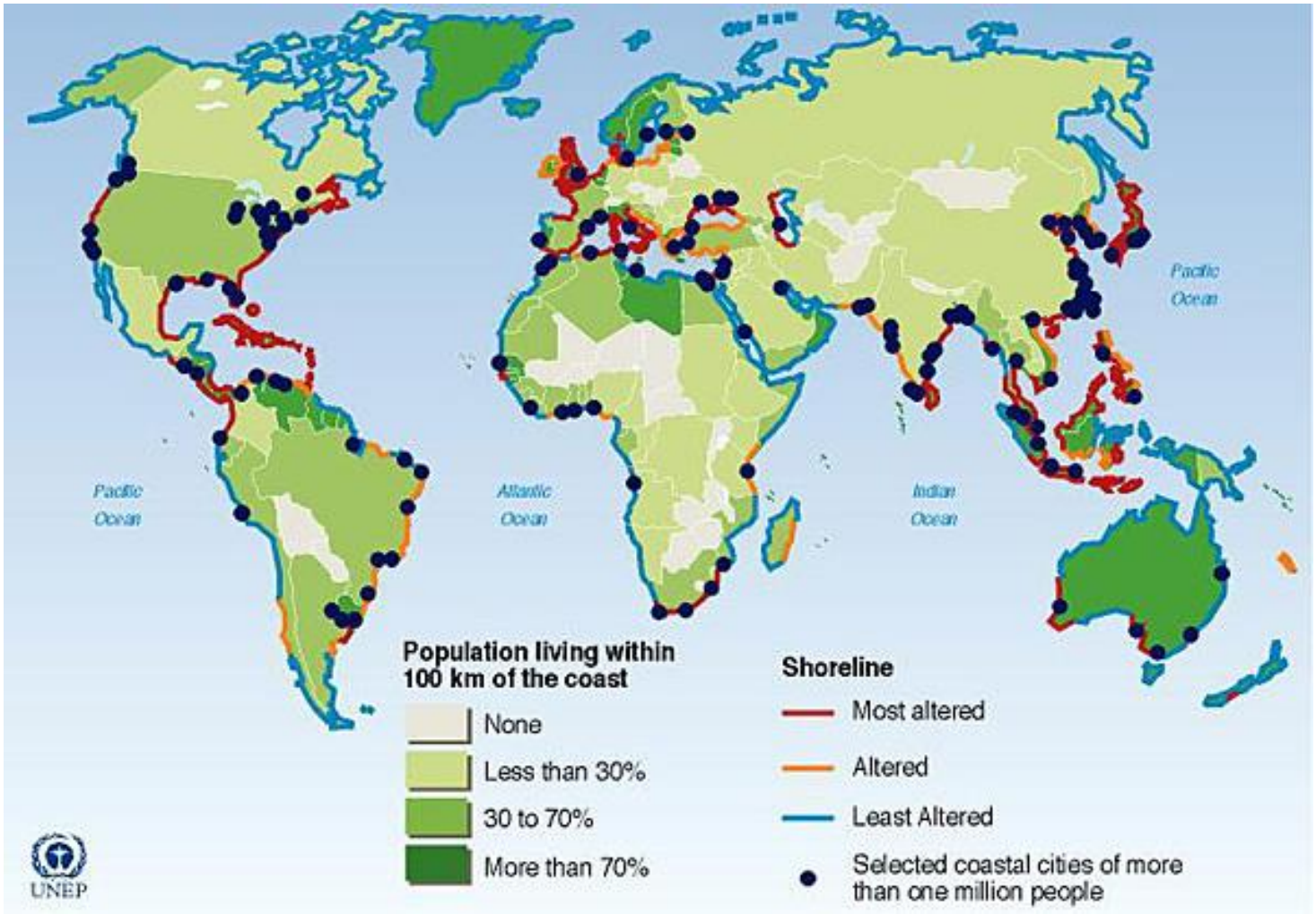

Bourke et al. (2001)

Can be “mega diverse”

Sydney Harbour has more fish species than entire UK coastline

Hong Kong is a biodiversity hotspot with > 5711 species

Chesapeake Bay has > 3600 species

Urban marine ecology

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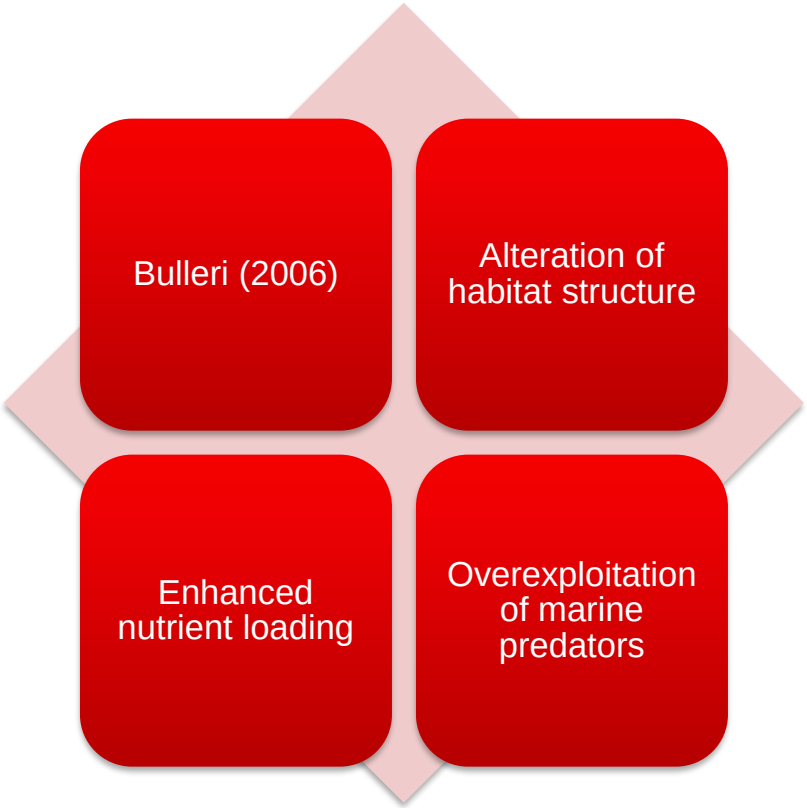
In 2006, Bulleri called for urban ecology to include the marine realm

Urban themes



Urban marine ecology

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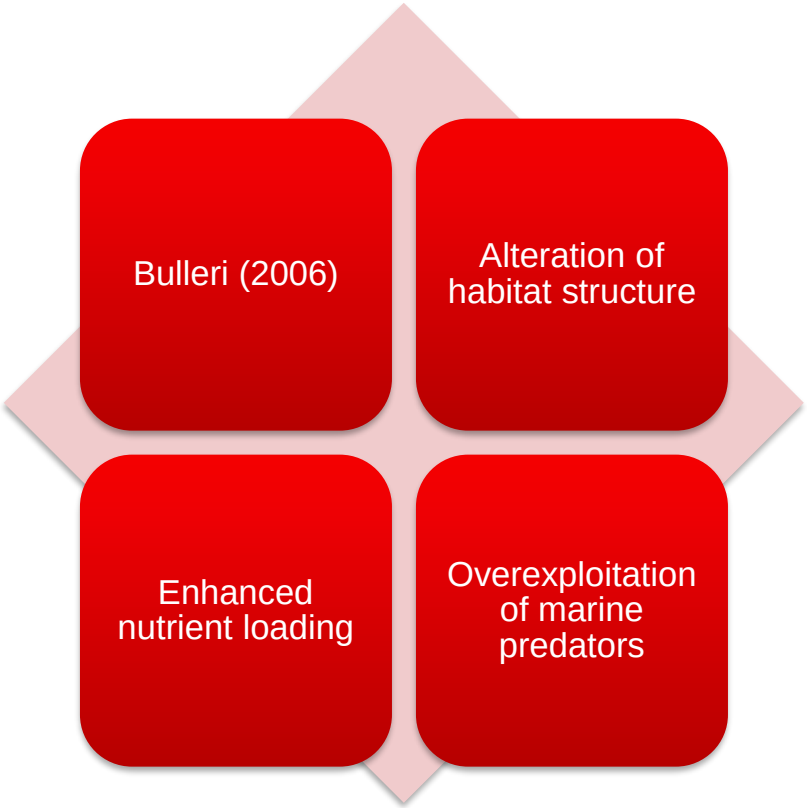
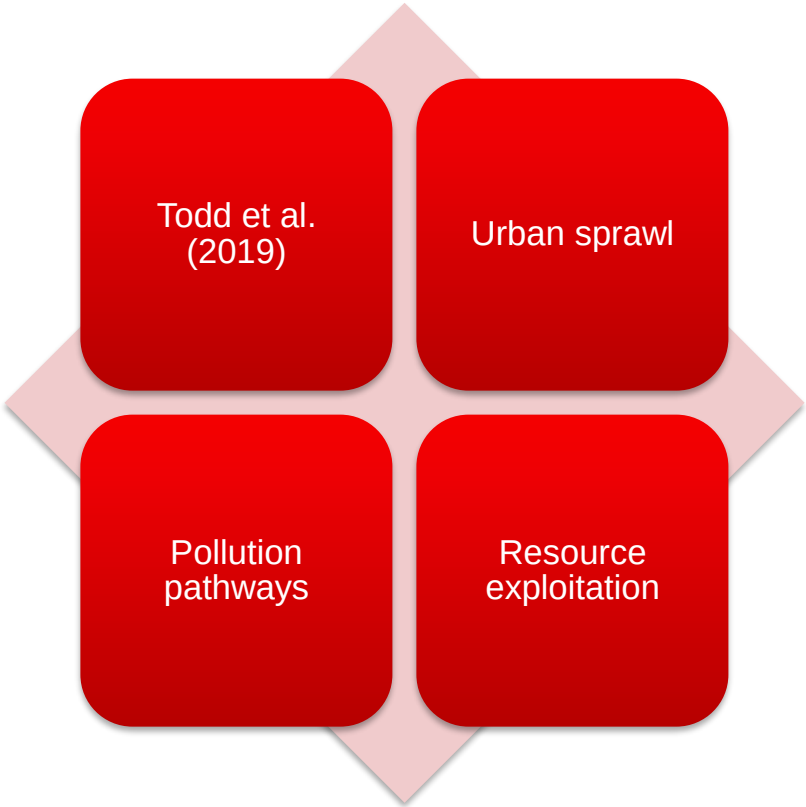
In 2006, Bulleri called for urban ecology to include the marine realm

In 2019, Todd et al. described urban marine ecology as “a field in its infancy, lacking theoretical and empirical foundation”

Urban themes





Urban marine ecology

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In 2006, Bulleri called for urban ecology to include the marine realm

In 2019, Todd et al. described urban marine ecology as “a field in its infancy, lacking theoretical and empirical foundation”

In 2021, a systematic review by Graells et al. found that only 5% of urban ecology research in the Web of Science focused on coastal marine ecosystems

Urban ecology at ITRS

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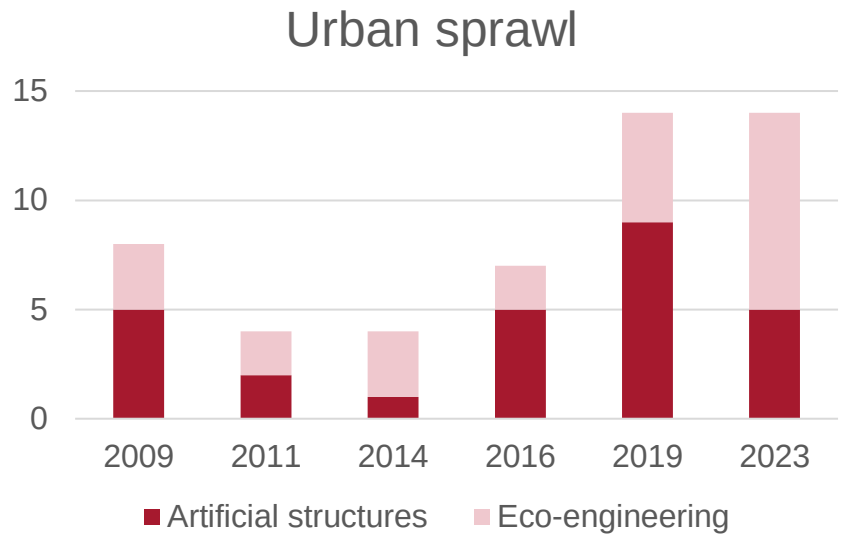
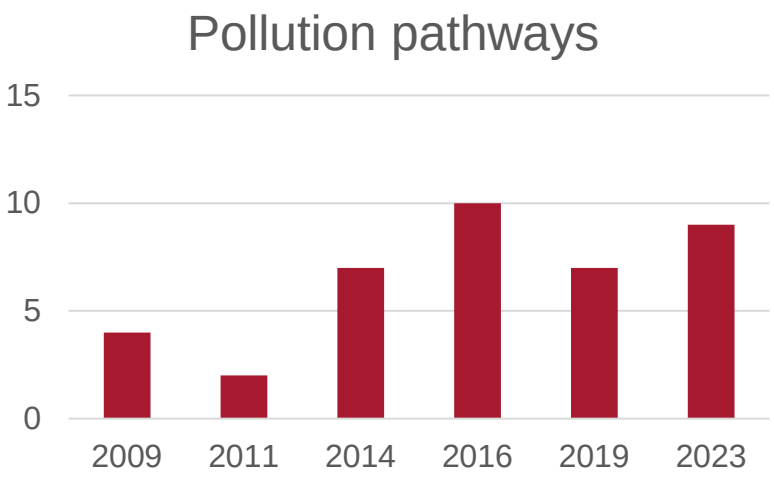
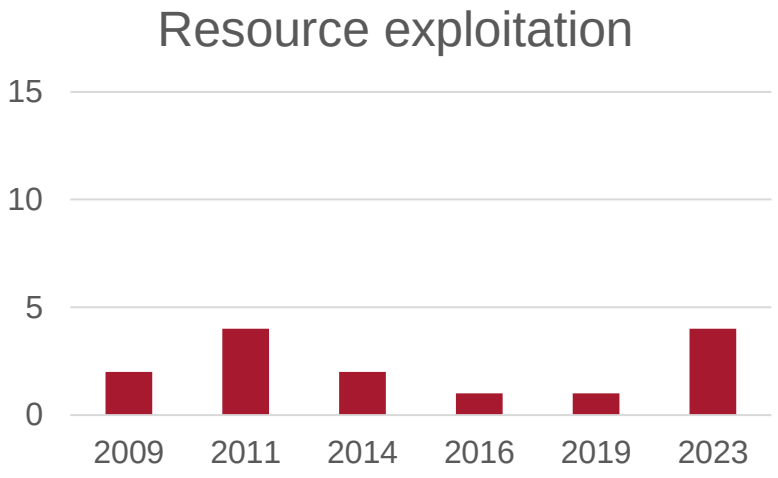
Using categories from Todd et al. 2019







Urbanisation has changed the global seascape

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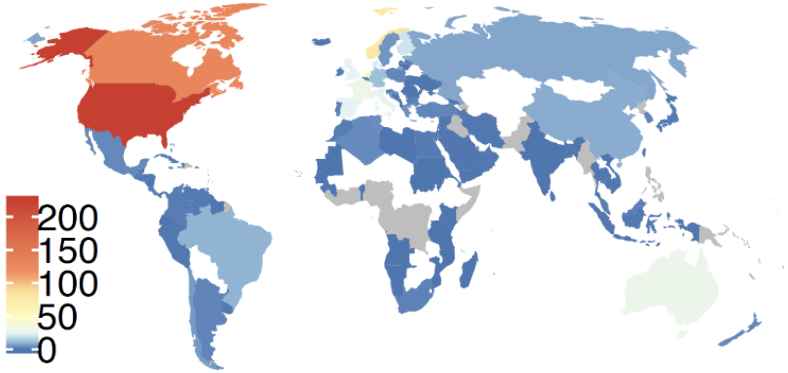
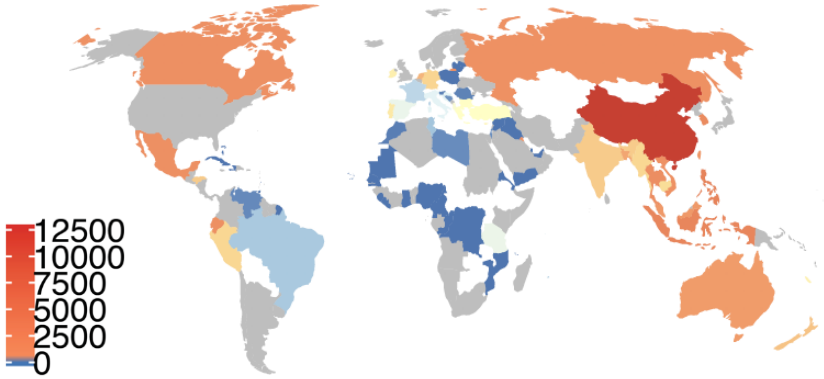
RECREATIONAL INFRASTRUCTURE (KM^2)



Bugnot et al. 2021, *Nat. Sust.*

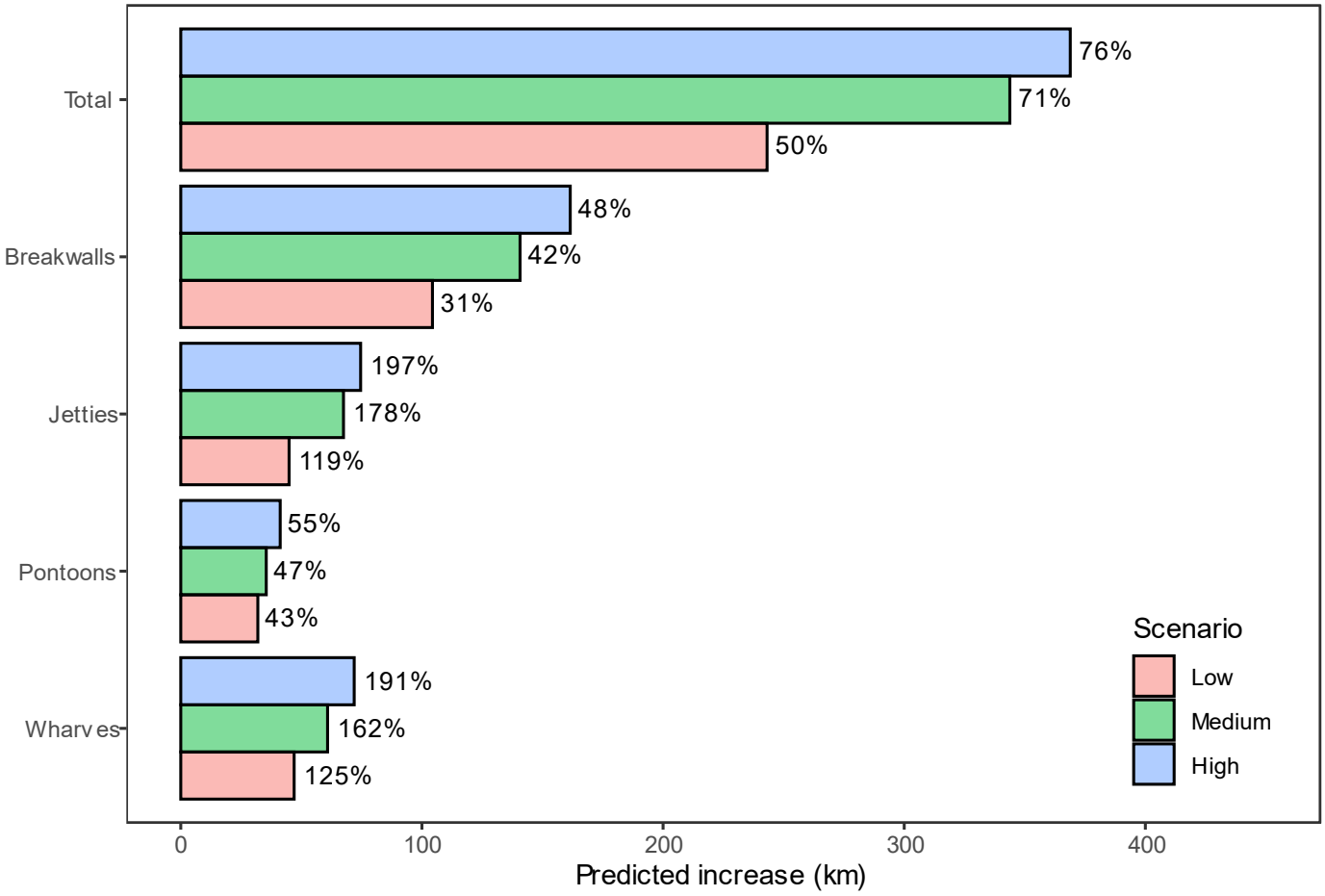
COMMERCIAL PORTS
(World Resources Institute, 2011)

AQUACULTURE (KM^2)

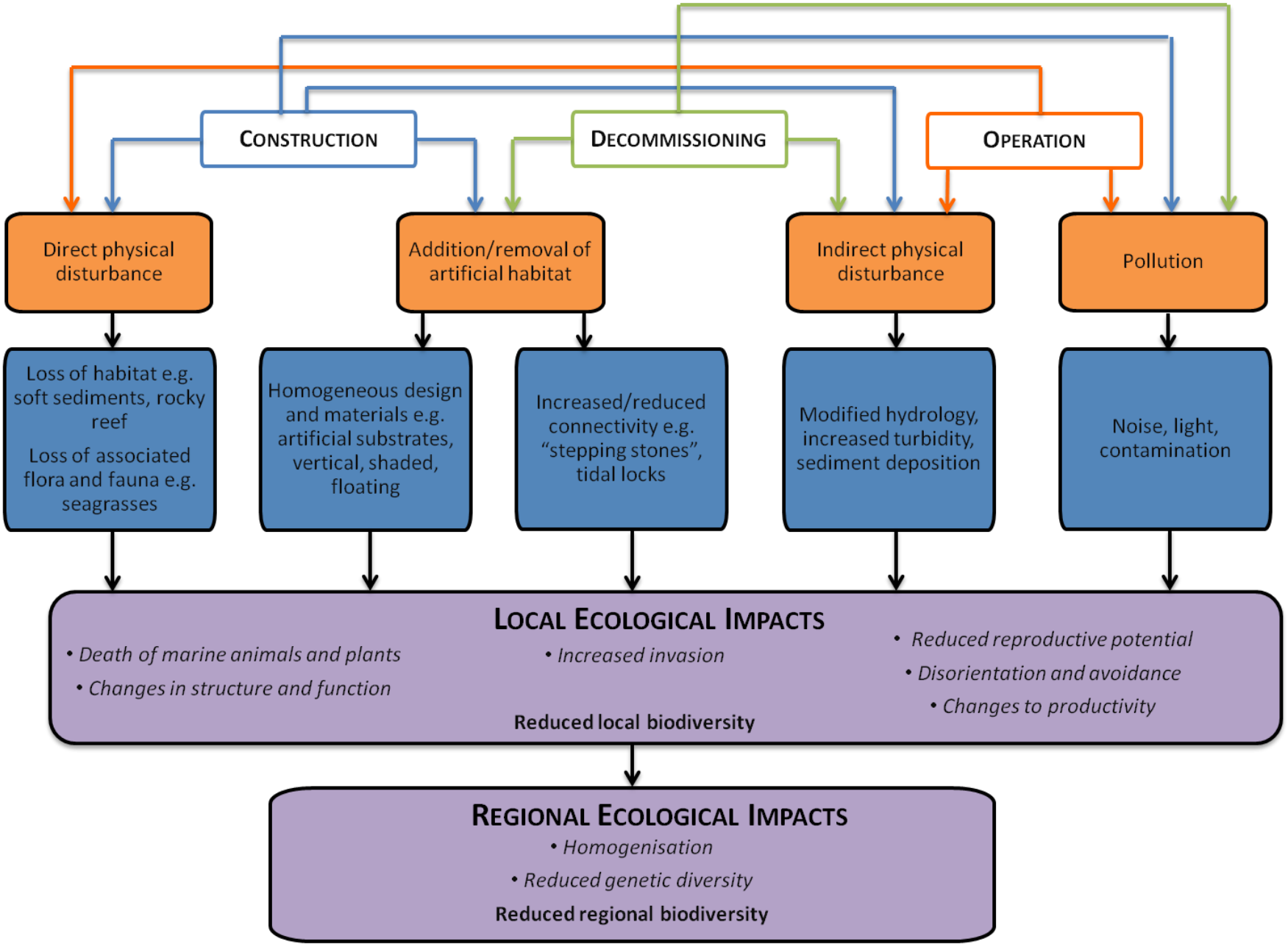


And the future is looking concrete…

50-76% EXPANSION OF COASTAL INFRASTRUCTURE OVER 25 YEARS

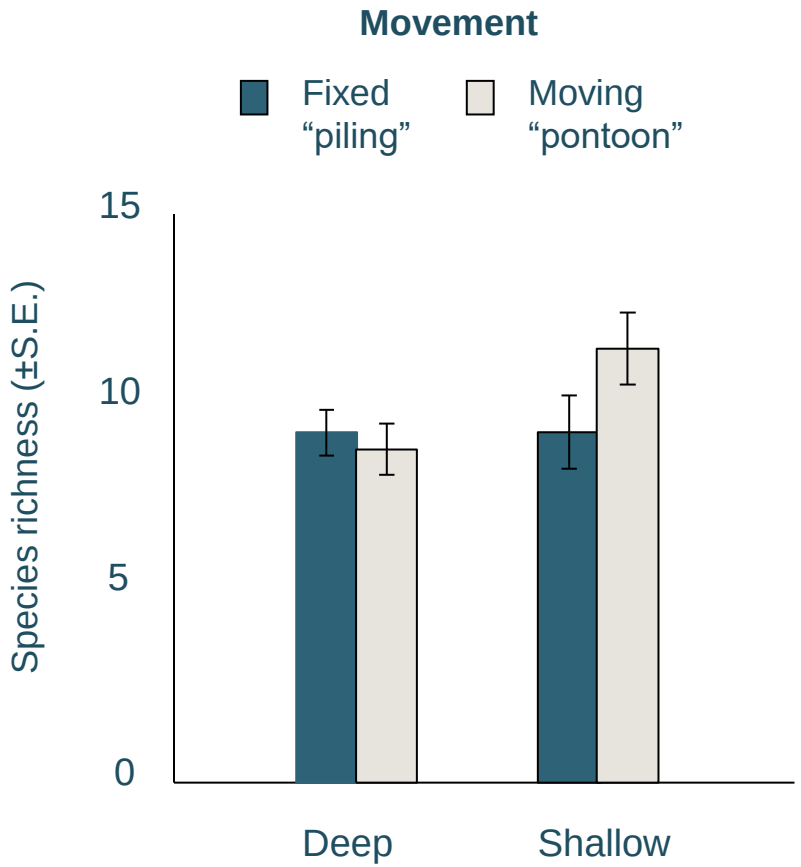


Floerl et al. 2021, *Nat. Sust.*



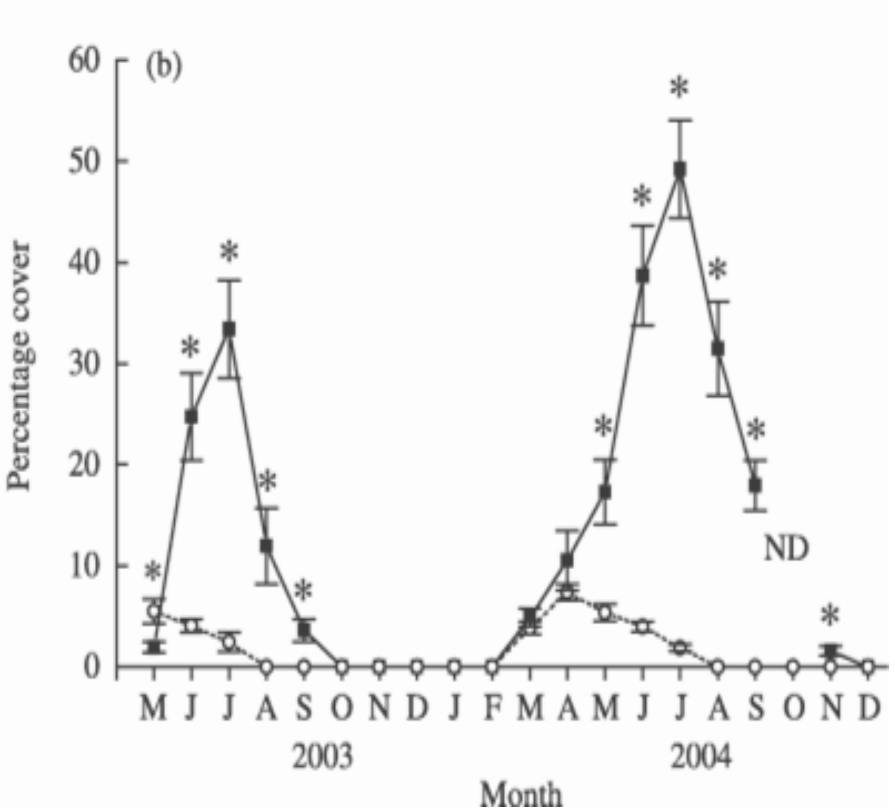
Dafforn et al. (2015) *Frontiers in Ecology and the Environment*

Shallow, floating structures promote invasion



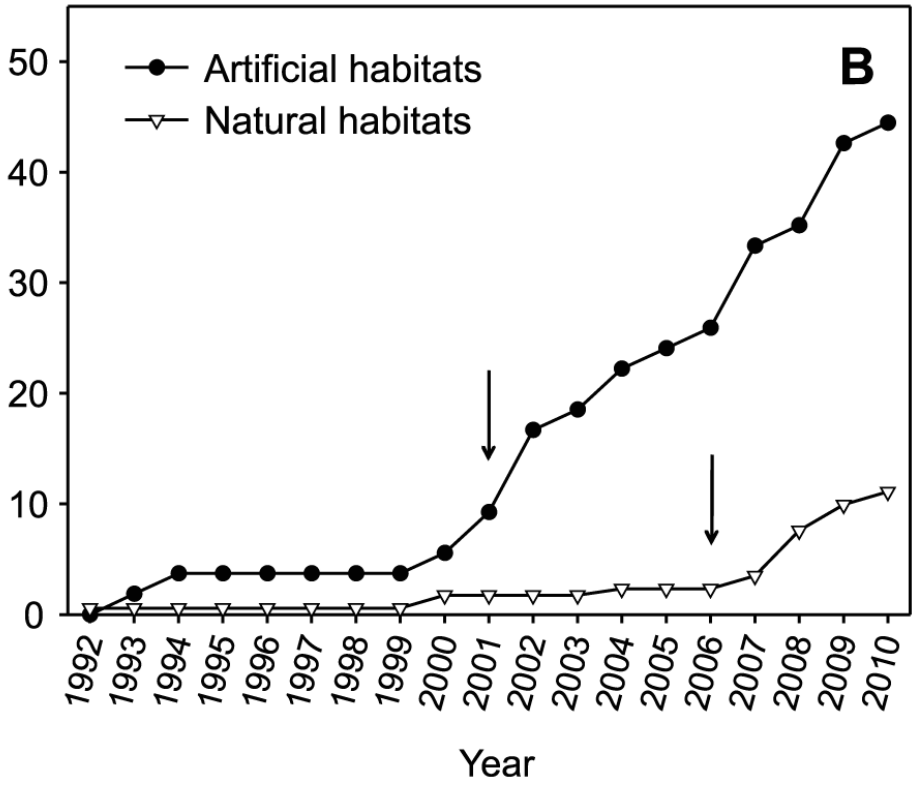
Dafforn et. al (2009) *Biofouling*

Sheltered coastal defence infrastructure provide habitat for non-indigenous algae



Bulleri et. al (2005) *Journal of Applied Ecology*

Northward range shift of non-indigenous coral facilitated by artificial habitats



Serrano et. al (2013) *PLoS ONE*

Eco-engineering invasion resistant structures

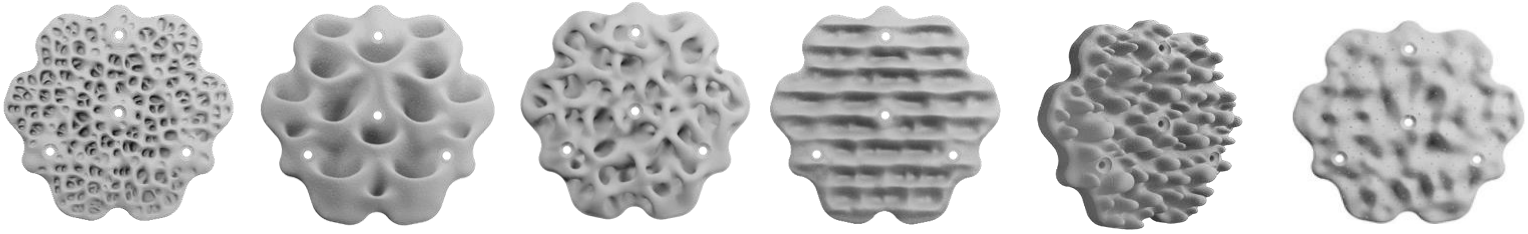
1) Enhancing the native community
   a. Protective habitats
   b. Actively gardening/seeding ecologically relevant native species on structures
2) Increasing light availability
3) Limiting NIS growth with materials or coatings that prevent fouling
4) Favouring the design of fixed surfaces rather than floating ones
5) Minimizing physical disturbances to structures

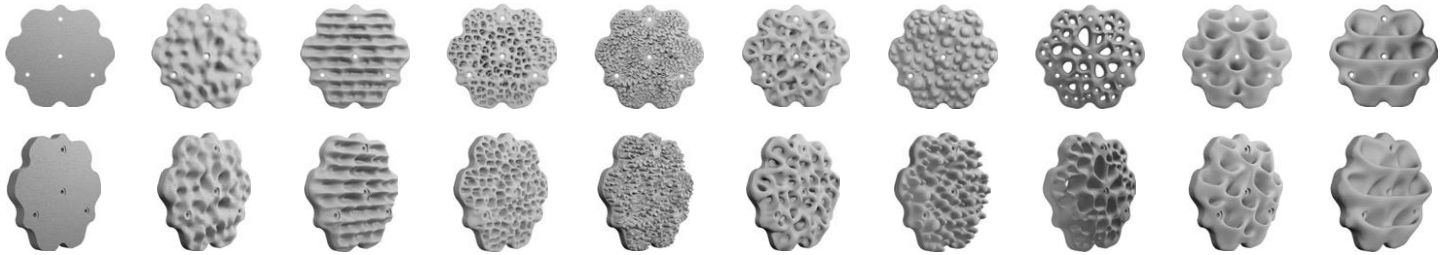
Airoldi et. al (2015) *Diversity and Distributions,*
Dafforn et al. (2015) *Frontiers in Ecology and the Environment*

1a) Protective habitats

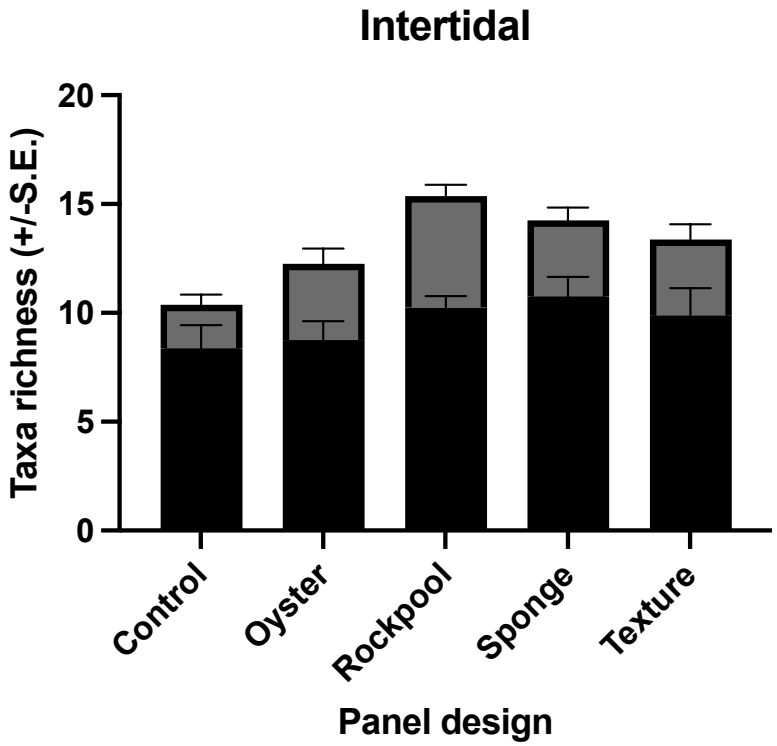
Living SEAWALLS

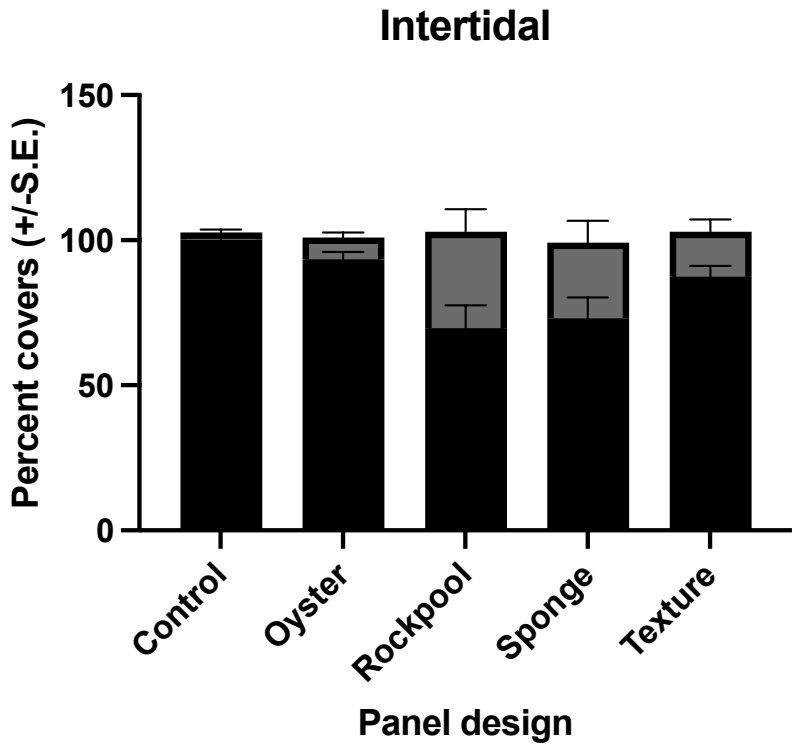
REEF DESIGN LAB

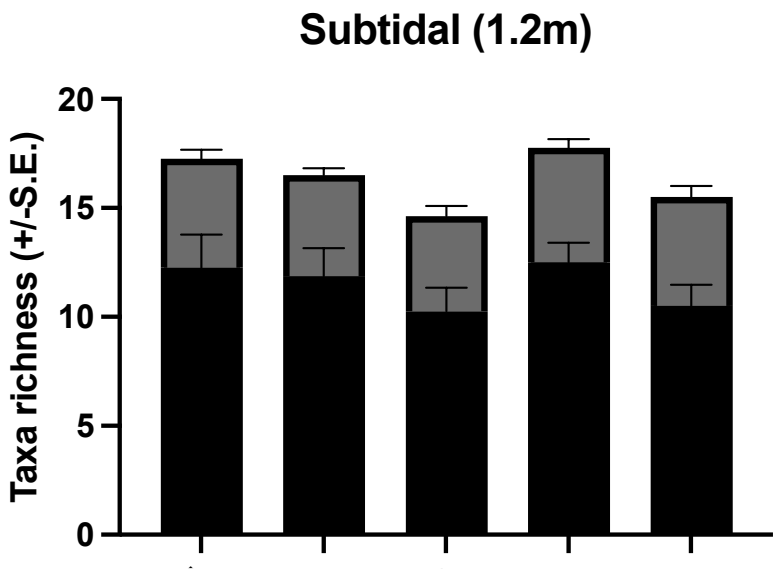


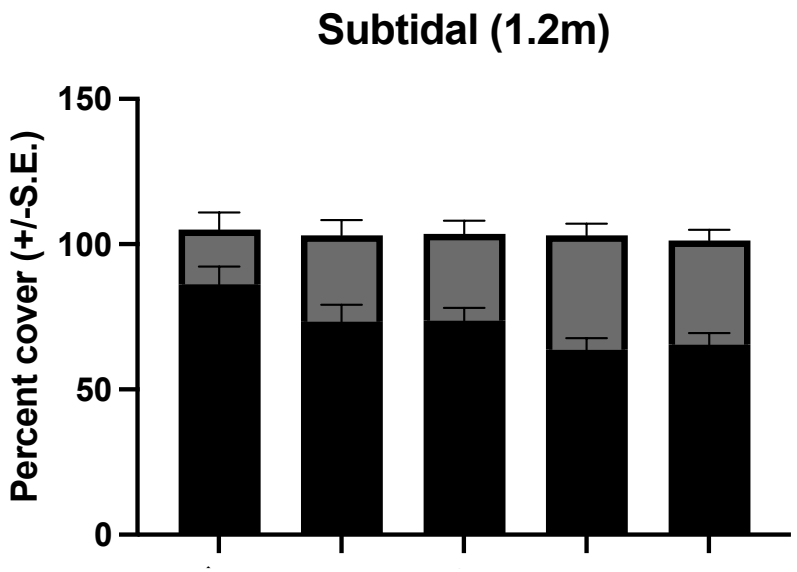


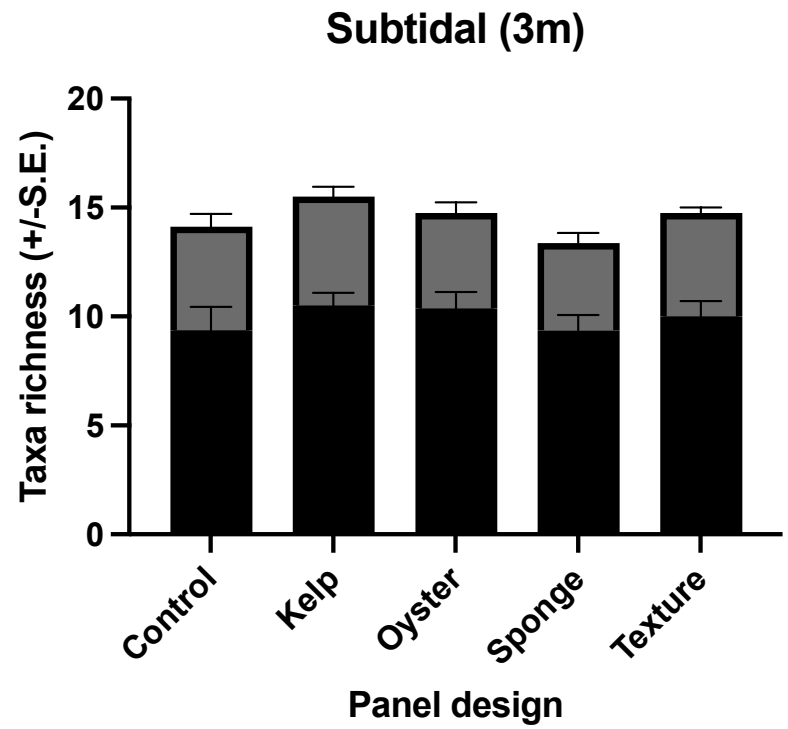
NIS richness and cover greatest on rockpool design

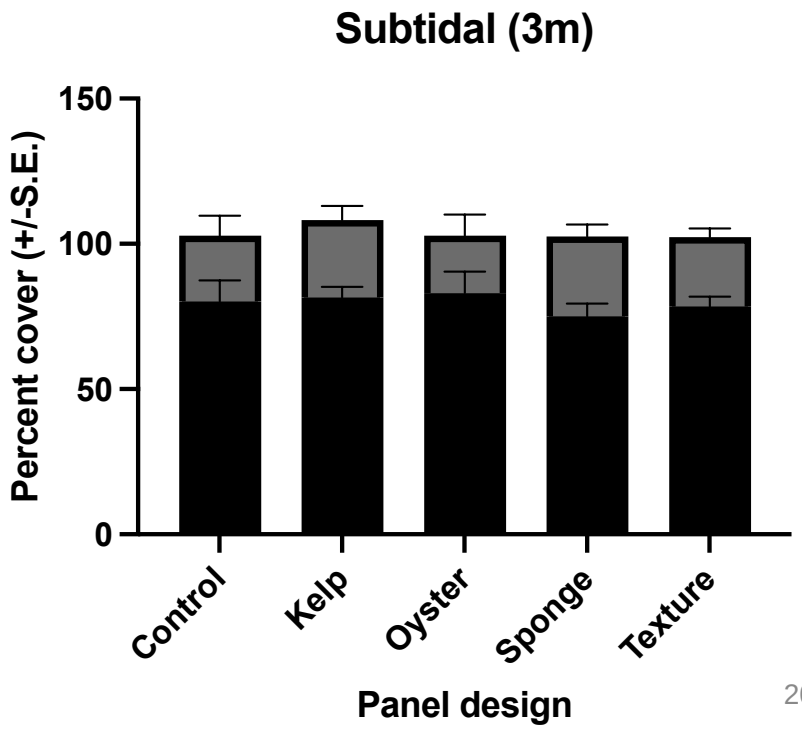


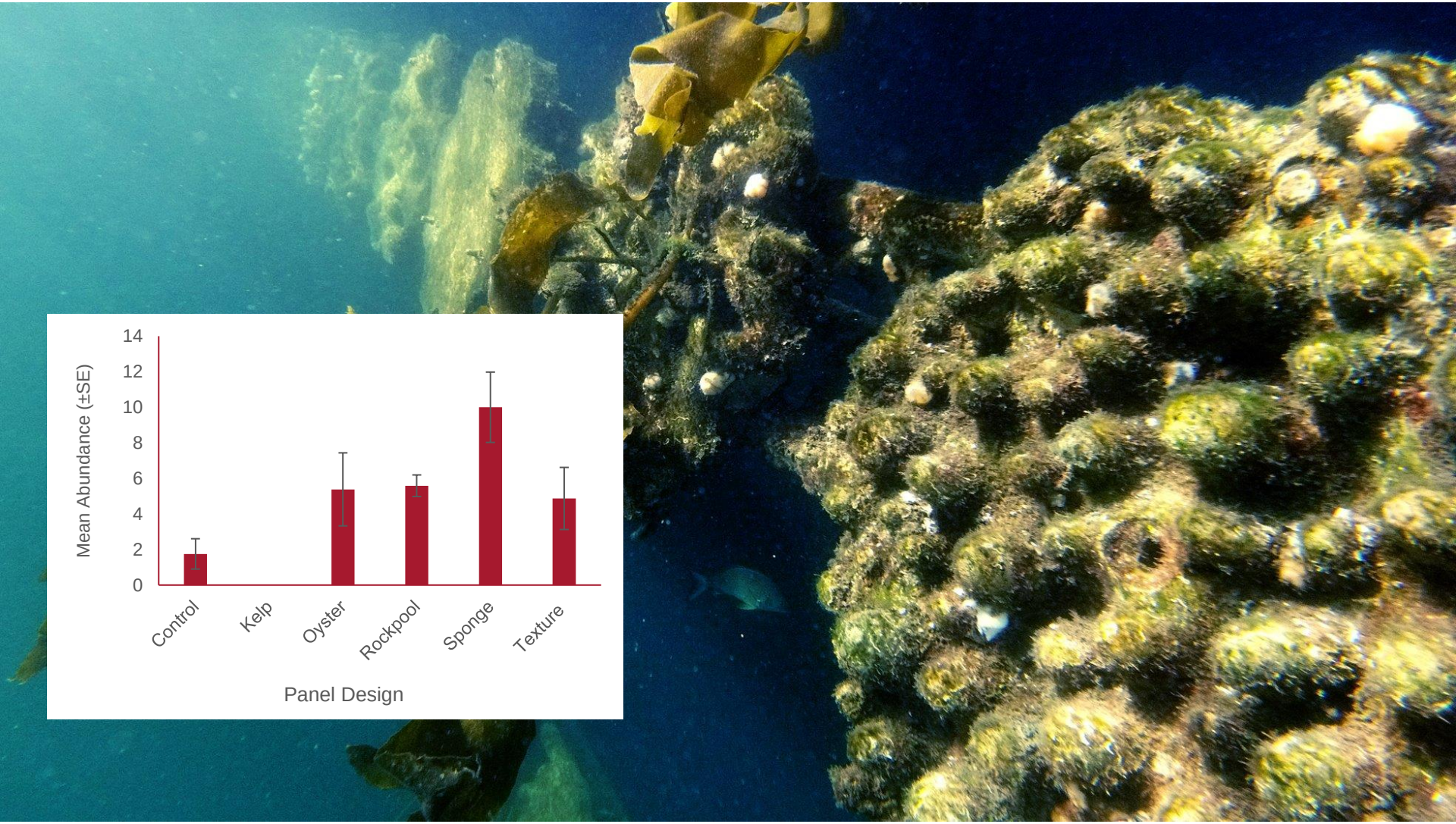



Subtidal (1.2m)
Taxa richness (+/-S.E.)
20
15
10
5
0


Subtidal (1.2m)
Percent cover (+/-S.E.)
150
100
50
0


Subtidal (3m)
Taxa richness (+/-S.E.)
20
15
10
5
0
Control
Kelp
Oyster
Sponge
Texture
Panel design


Subtidal (3m)
Percent cover (+/-S.E.)
150
100
50
0
Control
Kelp
Oyster
Sponge
Texture
Panel design


Mean Abundance (±SE)
14
12
10
8
6
4
2
0
Control
Kelp
Oyster
Rockpool
Sponge
Texture
Panel Design

1b) Seeding native species

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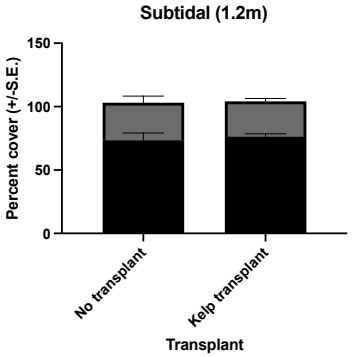
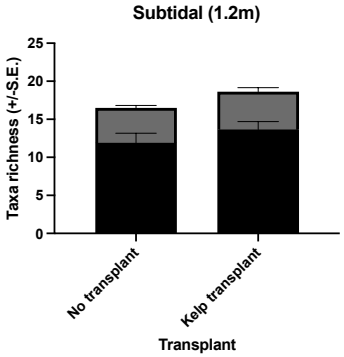
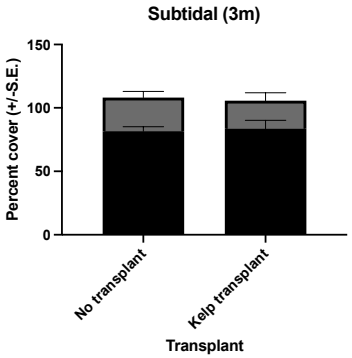
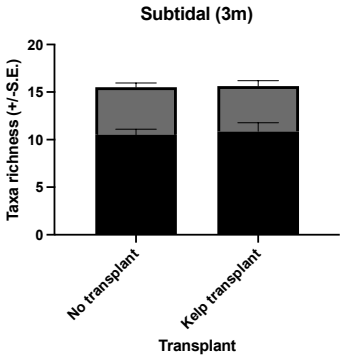
1b) Seeding native species









2) Increasing light availability

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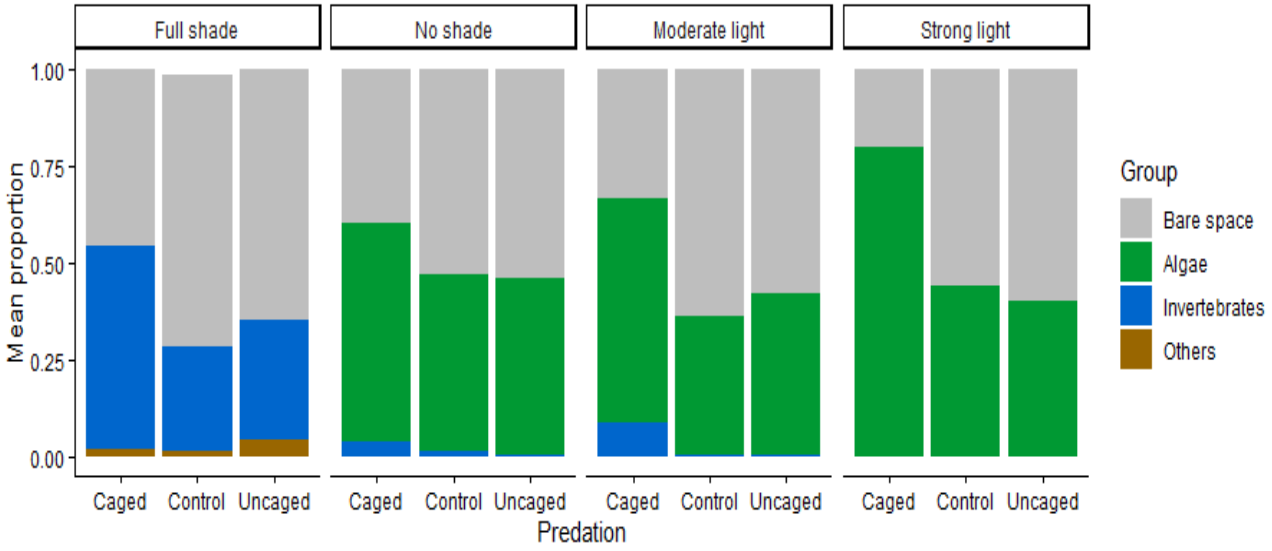
Full shade | Natural light | Moderate light | Strong light

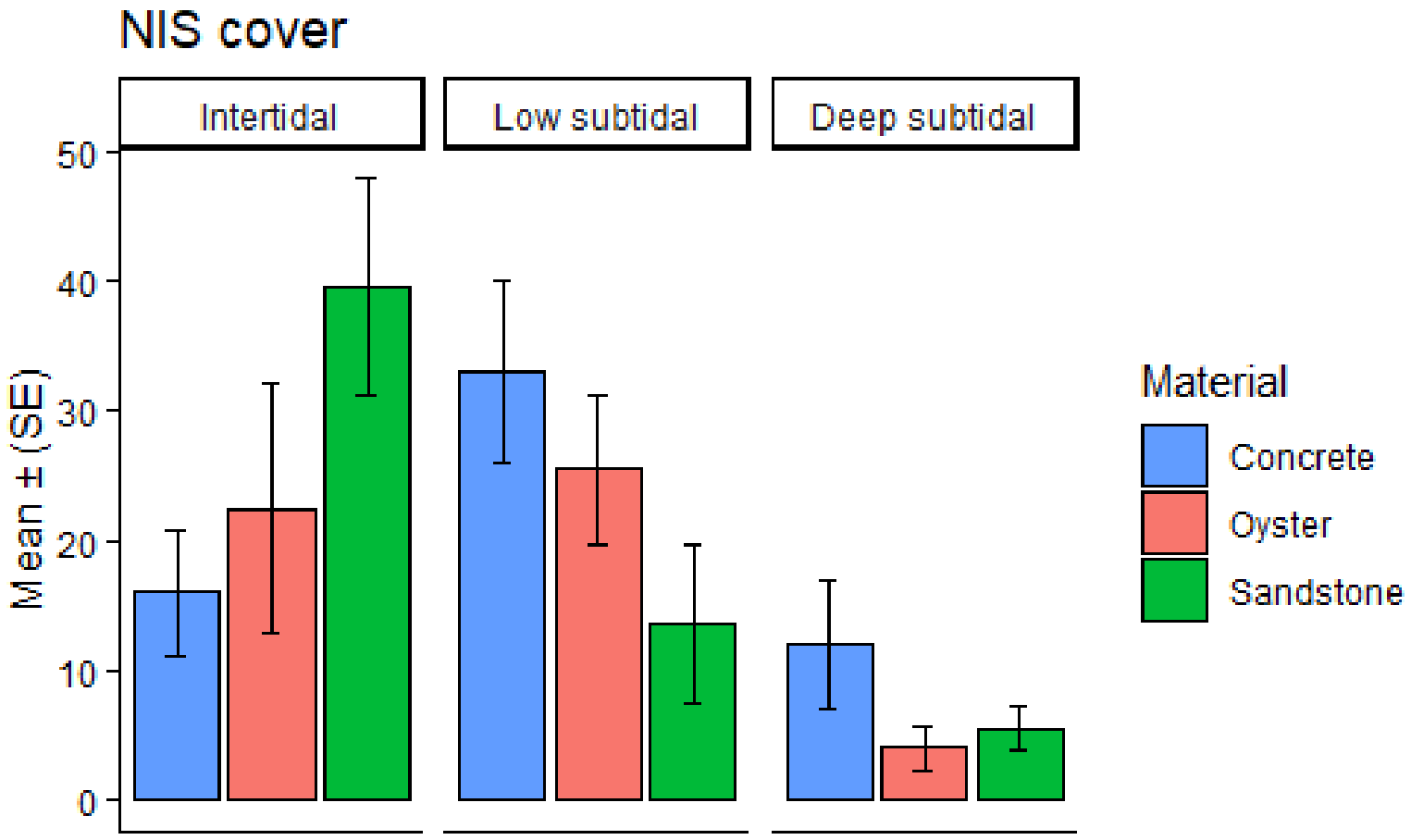


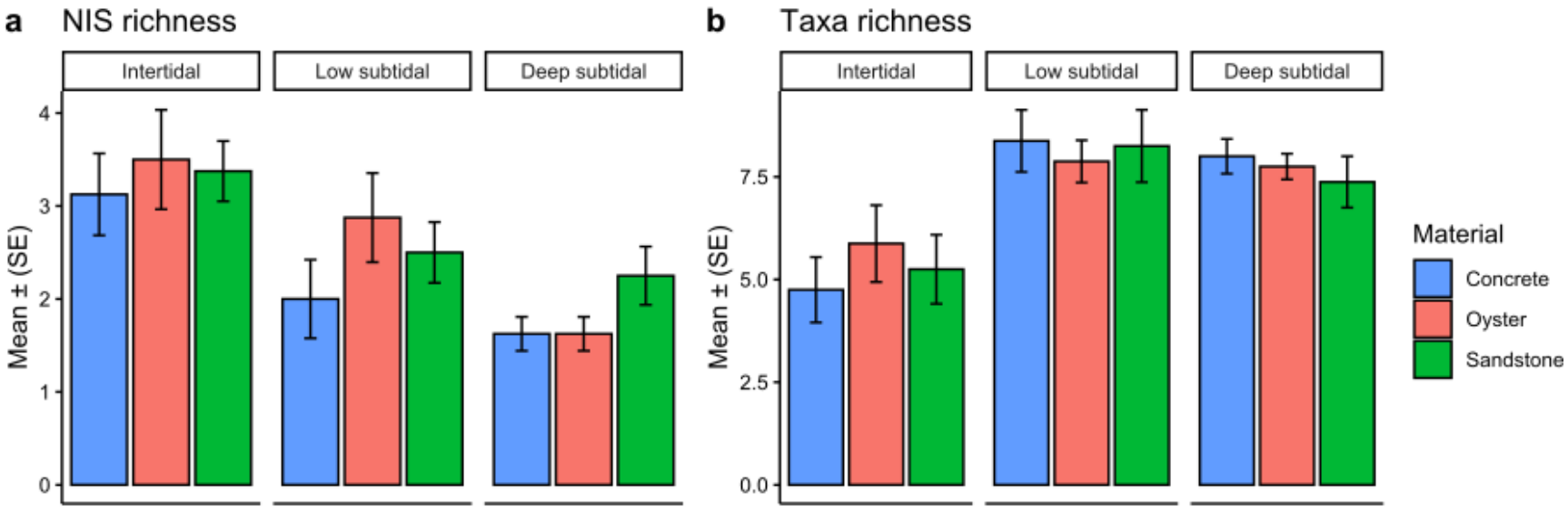
Schaefer et al. (in prep)

3) Limiting NIS growth with material selection

Greatest cover in the intertidal on sandstone materials



NIS richness decreased with depth



Eco-engineering invasion resistant structures

1a) Protective habitats facilitate native dominance

1b) Native seeding increases richness overall. Rockpools and sponge fingers facilitate some invaders

2) Increasing light availability shifts communities from invertebrate to algal dominance

3) NIS covers greatest on sandstone panels in the intertidal while richness decreased with depth

Acknowledgements

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Thanks to Gee for building a strong experimental foundation!

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