Developing the first stage of an evidence-based artificial reef risk assessment tool

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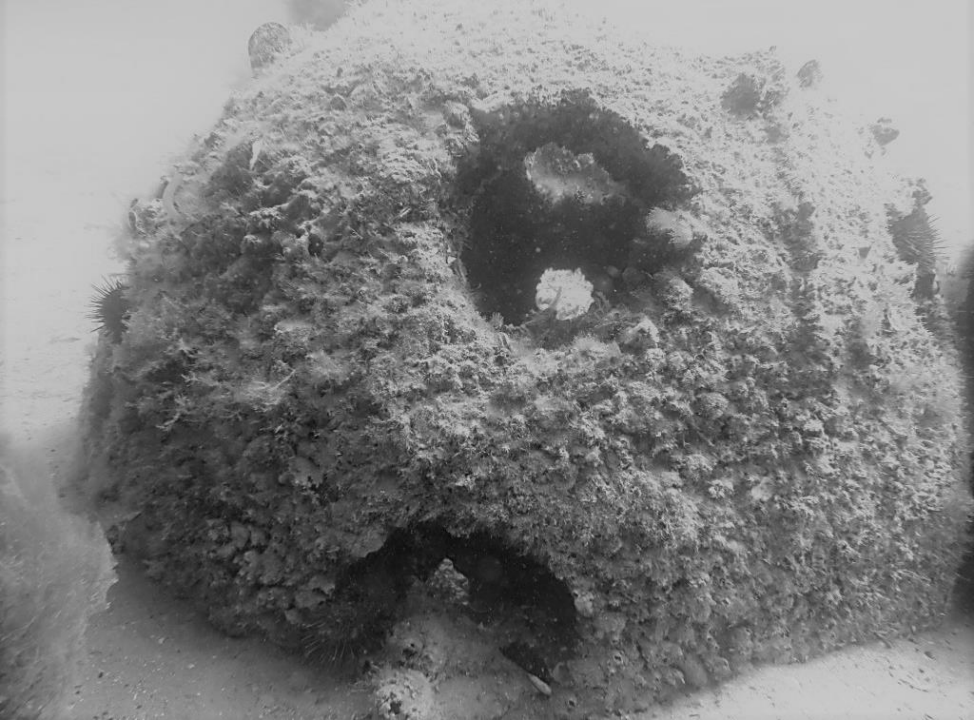
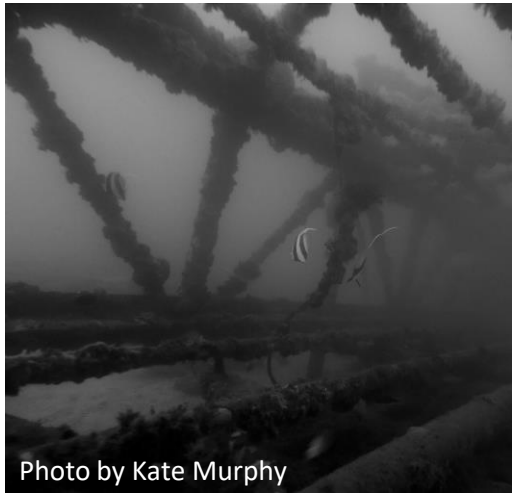


Artificial reefs (ARs), commonly defined as man-made structures deliberately placed in the marine environment to mimic some function of a natural reef

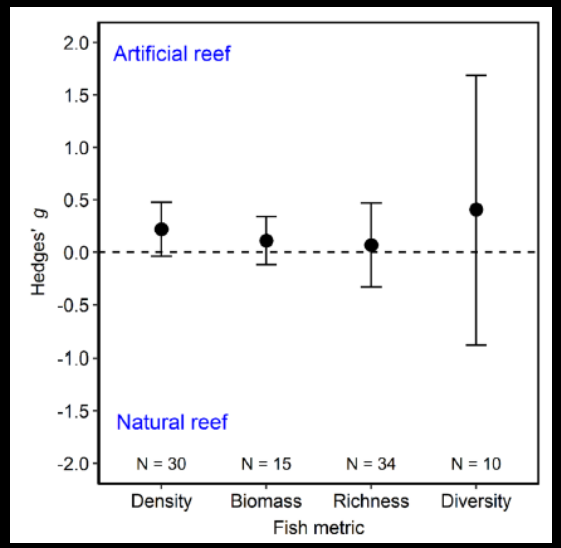
Habitat restoration, species conservation, fisheries enhancement, shore protection & recreation

All artificial structures act as habitats



Artificial reef performance

- Only ~50% are successful (Baine, 2001)
- Artificial reef supports a similar fish matrix to natural reef (Paxton et al., 2020)



Paxton *et al.* (2020) Frontiers in Marine Science

- Fish community composition can differ between artificial and natural reefs (Komyakova et al., 2019)

Artificial reefs & Impacts

- Pollution (physical or chemical)
- Loss of natural habitat
- Change in hydrodynamics
- Change to sensory environments
- Invasive species
- Ecological Traps

Airoldi et. al., (2015) Diversity & Distribution 21:755-768; Heery *et al.* (2017) JEMBE 492: 31-48


Photo by Kate Murphy


Photo by Simon Talbot

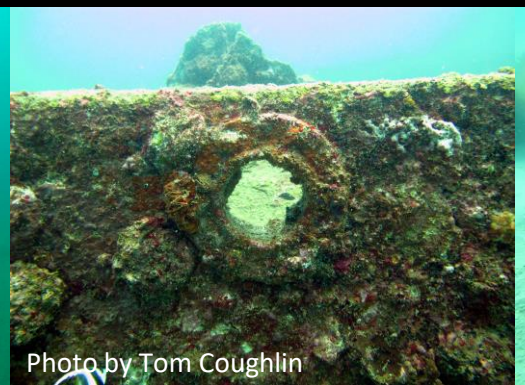
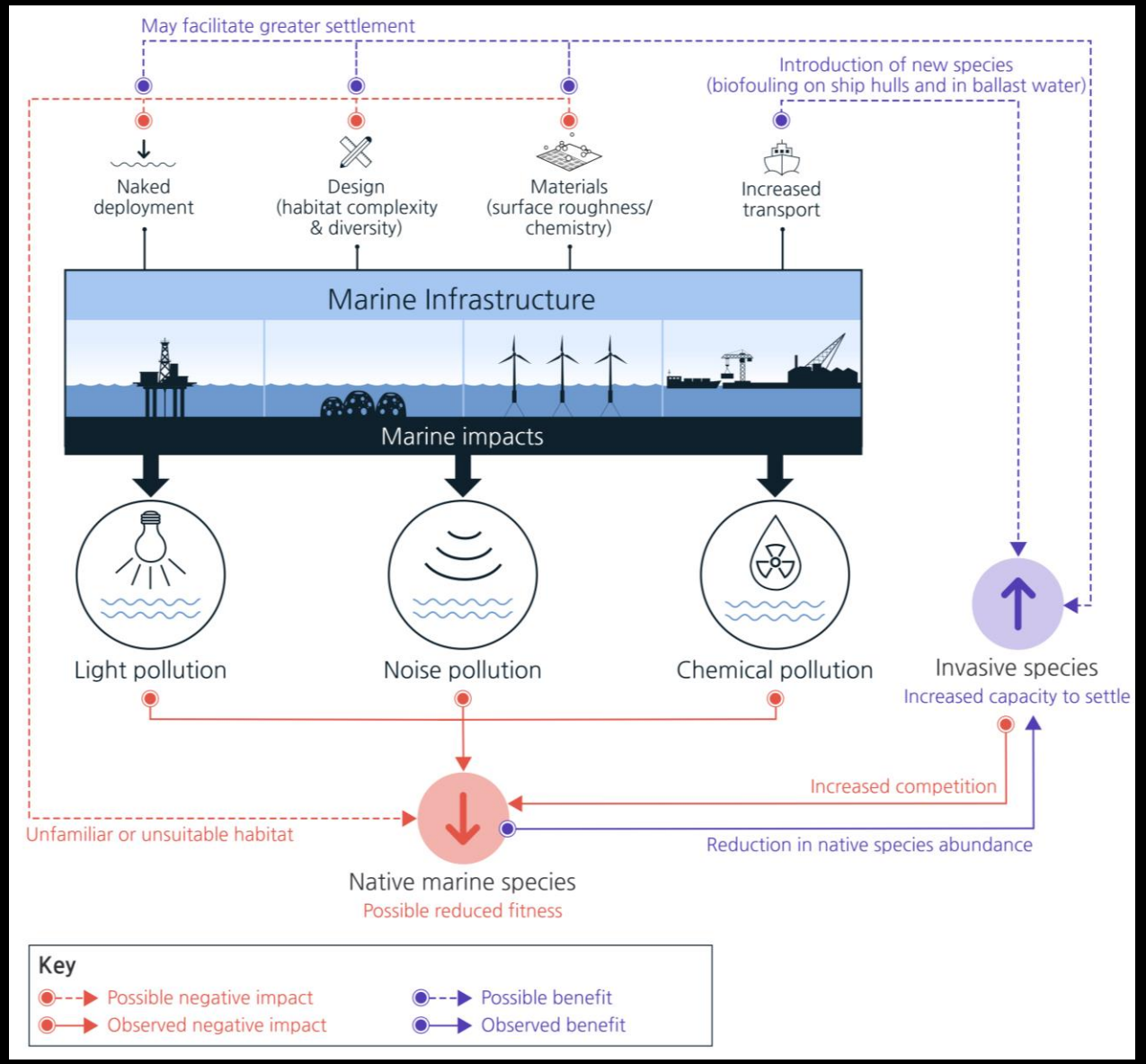


Photo by Tom Coughlin

Factors impacting success



Komyakova et al. 2022 *Science of the Total Environment*

Photos by Kerry Borgula

Challenge

- Narrowing the gap between the science and the user

- Creating an easy-to-use, accessible first stage evaluation of chances of success of an artificial reef deployment.

Study aims

Light pollution

Noise pollution

To develop a risk assessment matrix and a first-generation prototype of an easy-to-use risk evaluation tool to enable identification of the risks associated with AR deployments in terms of ARs functioning as marine habitat.

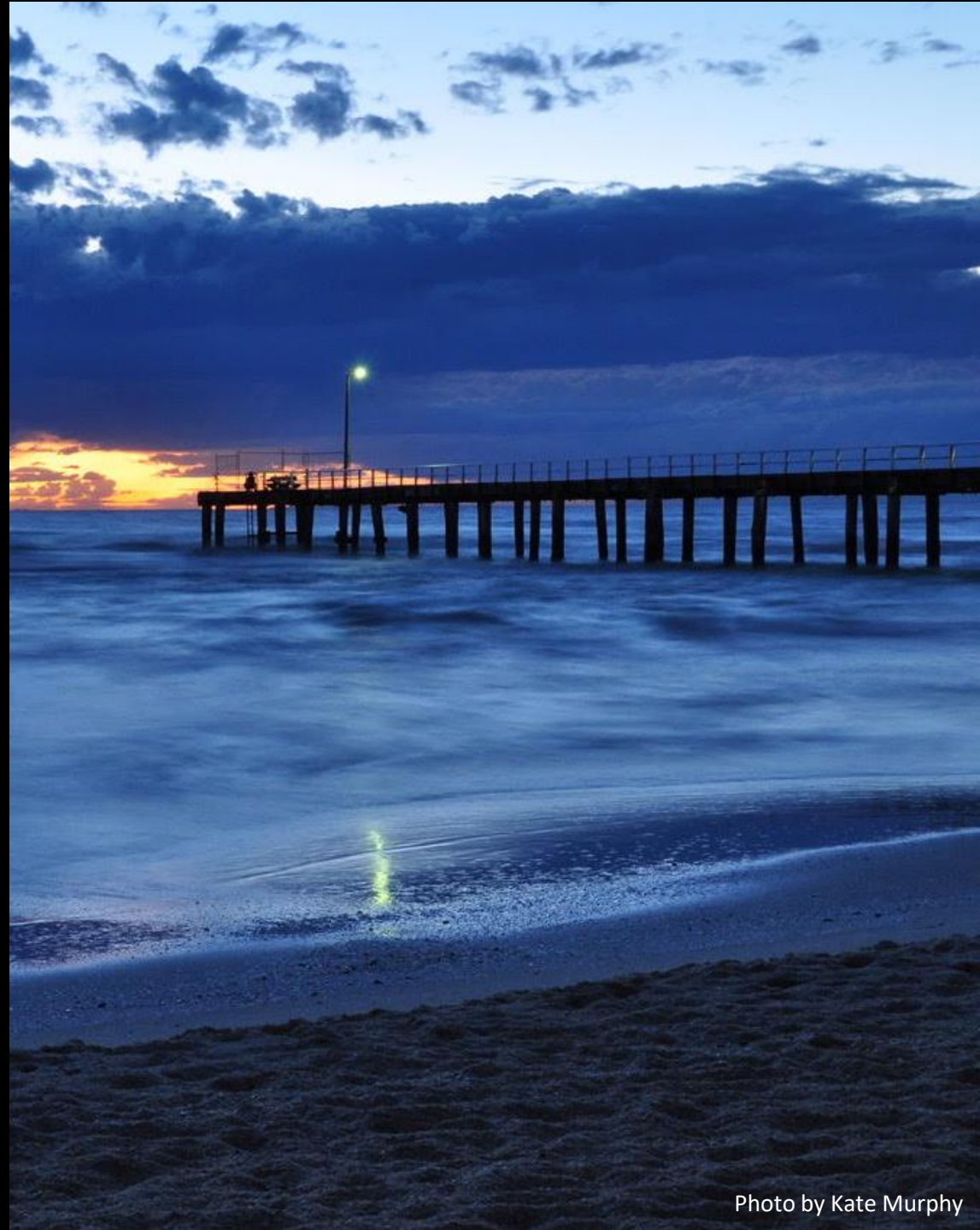


Photo by Kate Murphy

Systematic literature review

Table 1: Search terms constructed using Boolean logic used in a systematic literature investigating the impact of light pollution and noise pollution on fish and invertebrates in the marine environment.

Topic	Search Terms
Light	TITLE-ABS-KEY ((“light” OR "artificial light" OR "light pollution") AND ("fish" OR "invertebrate") AND ("impact" OR "exposure impacts" OR "mortality" OR "fitness" OR "reproduction") AND ("marine") AND NOT ("aquaculture"))
Noise	TITLE-ABS-KEY (("noise" OR "noise pollution" OR "sound") AND ("fish" OR "invertebrate") AND ("impact" OR "exposure impacts" OR "mortality" OR "fitness" OR "reproduction") AND ("marine") AND NOT ("aquaculture"))

Published after 2007 (n = 22)
Final sample n = 17

Published after 2015 (n = 72)
Final sample (n = 29)

Systematic literature results

A)

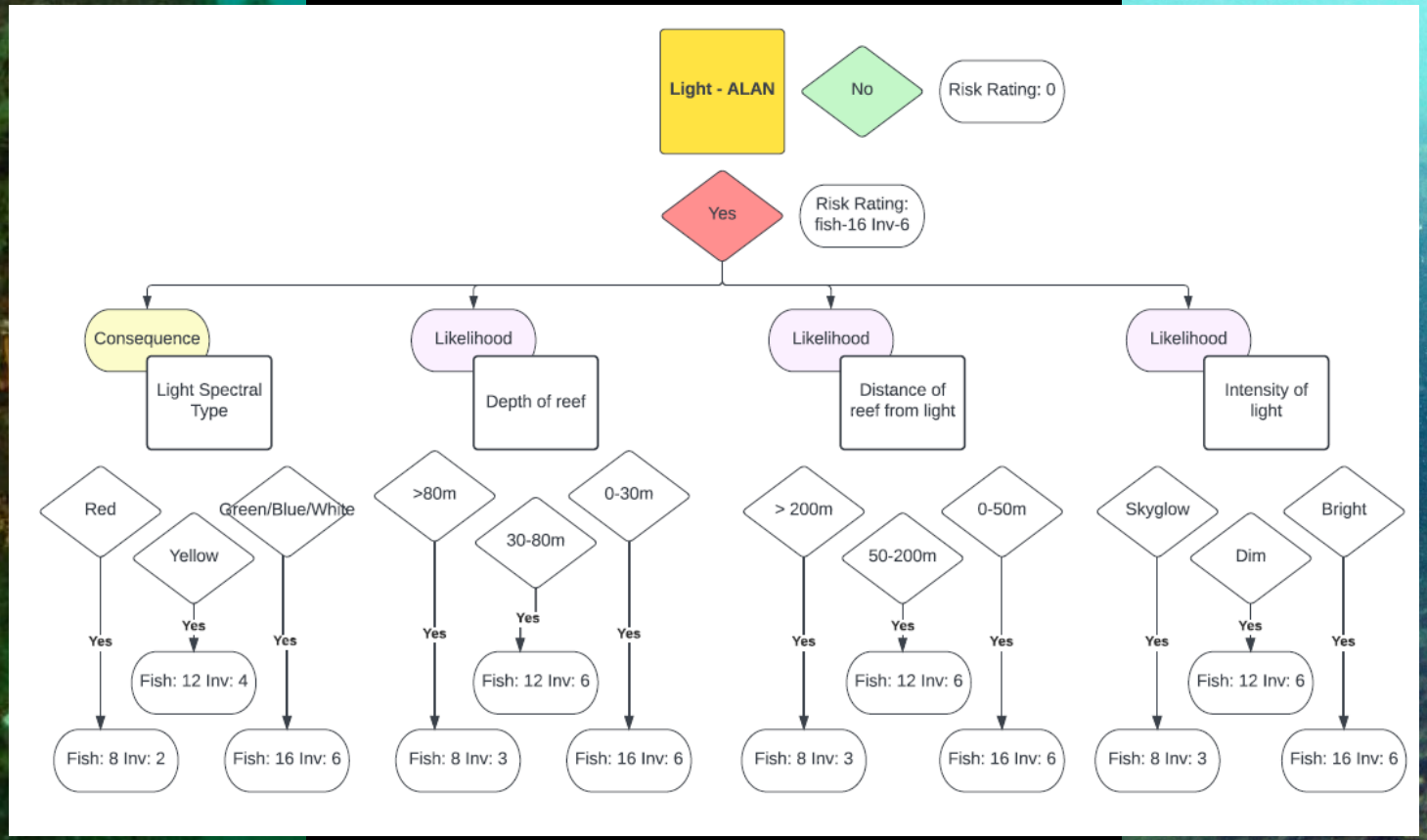
	Consequence			
Risk Ratings	Low	Moderate	High	Severe
Unlikely	1	2	3	4
Possible	2	4	6	8
Likely	3	6	9	12
Almost Certain	4	8	12	16

B)

	Consequence			
Light	Low	Moderate	High	Severe
Unlikely				
Possible			Inv	
Likely				
Almost Certain				Fish

ALAN	# of studies	Low	Moderate	High	Severe
Fitness	5	1 - No change to lobster heartrate.	1 -increased stress.	1 - lower growth rate. 1 - increase stress and metabolism. 1 – change to epifaunal community composition.	2- increased mortality.
Behaviour	2	1 - lower abundance and higher activity of fish.	1 - higher settlement in non-ALAN areas.	2 - changes to diel vertical migration. 1 - selection for dark areas.	
Larval Development	4	1 - higher weight and survival rates.			3 - larval mortality.
Reproduction	2	1- no difference in spawning frequency.		1 - less frequent spawning.	

Decision tree



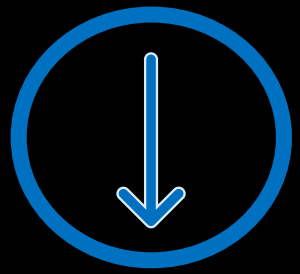
Mitigation measures

Spectra type

- Warm light = lower impacts (Fobert et. al., 2021).
- Red light = attenuates faster (Davies et. al., 2020).

Distance from the light source

- Significantly reduced impacts when at least 200m away (Ludvigsen et al. 2018, Berge et al. 2020)



Reef depth

- Light impact detectable down to 80m (Ludvigsen et al. 2018).

Light intensity

- Greater light intensity = greater impacts

Steps forward

Inclusion of other variables

Stakeholder engagement

Addition of interactive consequences

Continuous addition of current best knowledge


Photo by Kate Murphy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Thank you for your attention.

Any questions?