



Gretta Pecl & lots of collaborators

Marine climate change challenges & adaptation

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Key messages for Australia from IPCC AR6

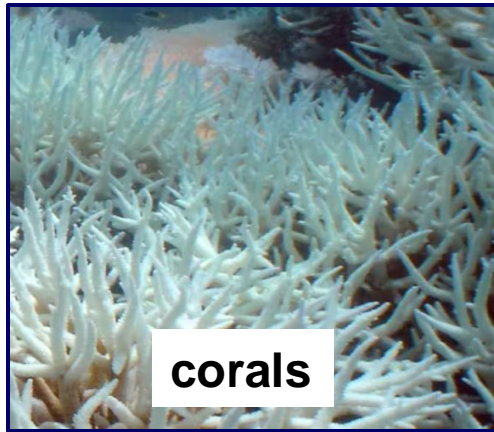
Climate trends and extreme events have combined with exposure and vulnerabilities to cause major impacts for many natural systems, with some experiencing, or at risk of, irreversible change (*very high confidence*)



Justin Gilligan

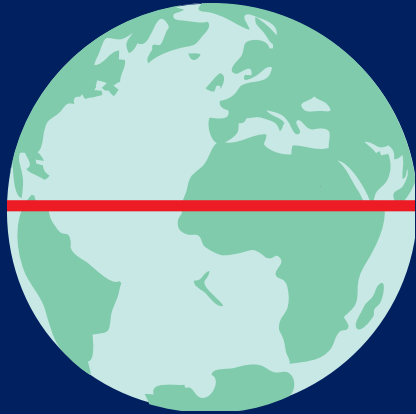
Major changes in species distributions

Extreme climatic events (2011 to 2017) led to abrupt & extensive mortality of key habitat-forming organisms along over 45% of the coastline (*high confidence*)



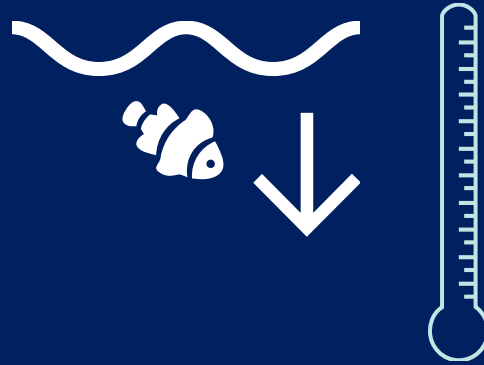
- Loss of kelp species Australia-wide totals at least 140,187 ha.
- Habitat species of critical importance for ecosystem structure and function, fisheries productivity, coastal protection and carbon sequestration
- These ecosystem services are extremely likely to decline with continued warming.

Climate-driven global re-distribution of species



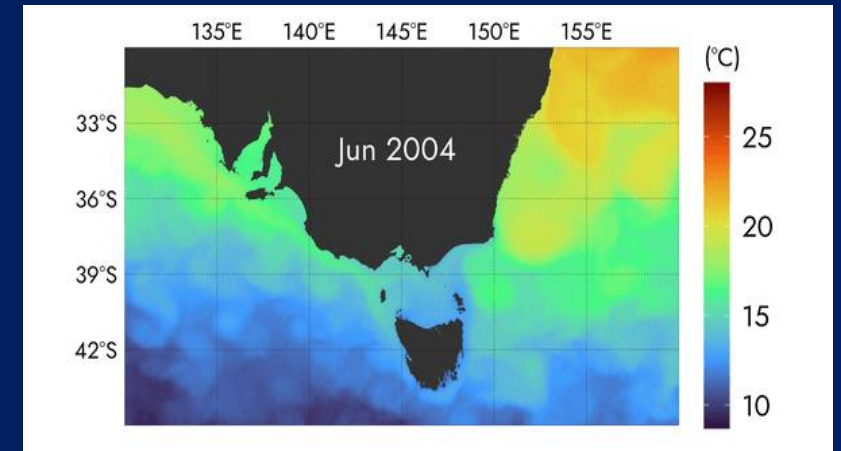
17km dec⁻¹ on land
72 km dec⁻¹ in ocean

(Poloczanska et al. 2013)



Deeper in ocean

(Dulvy et al. 2008)



Shifts greatest where climate has warmed the most, like SE Australia

Animation by Barrett Wolfe, IMAS

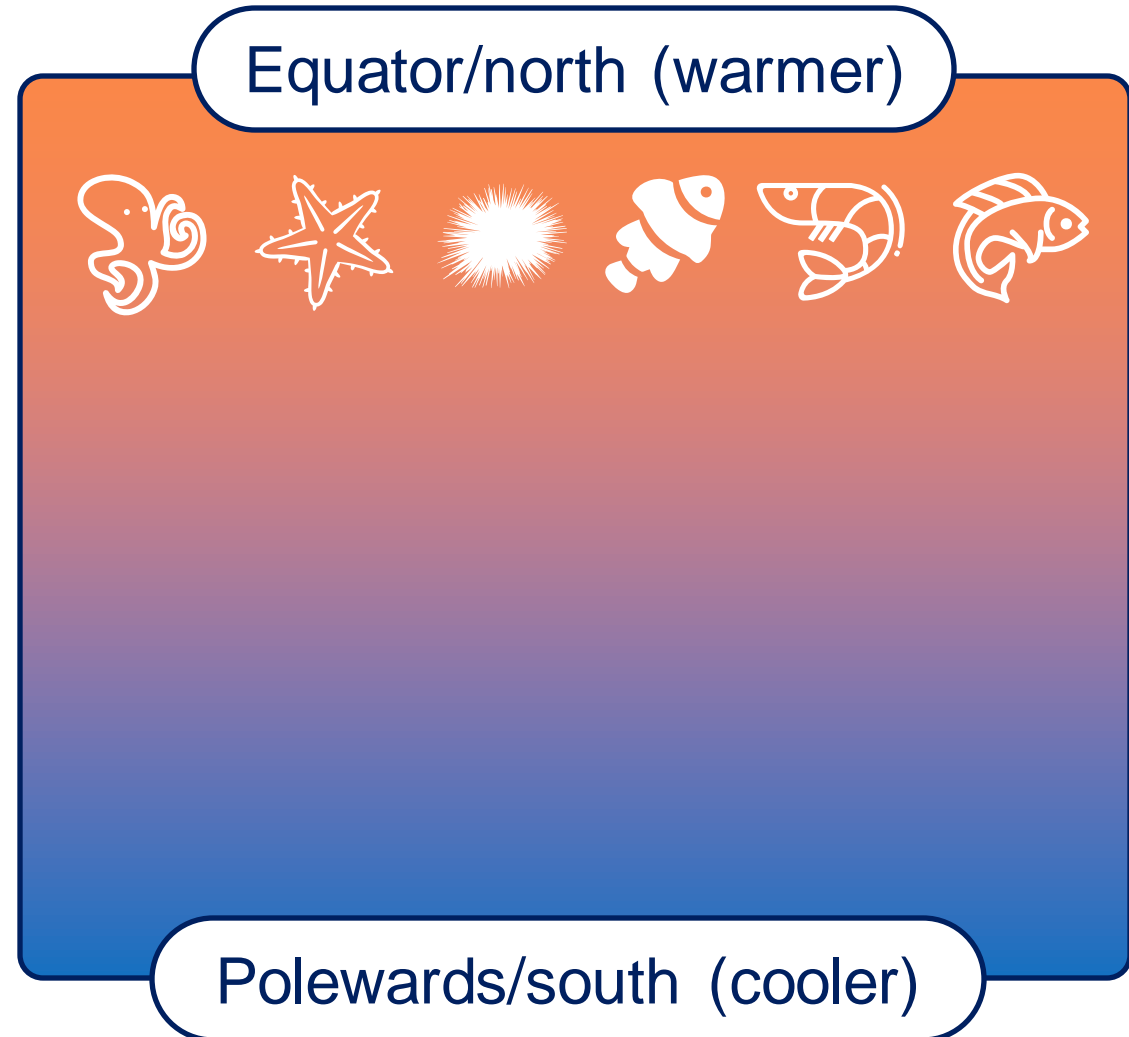
Just one aspect of climate change that affects humans & conservation

Globally, ~50% of examined species are shifting (IPCC AR6)

Variation in timing & pace of species shifts

- Confounding factors, influences other than climate
- Detectability
- Not all species can/will shift – adapt, move or die
- Species shift at different rates

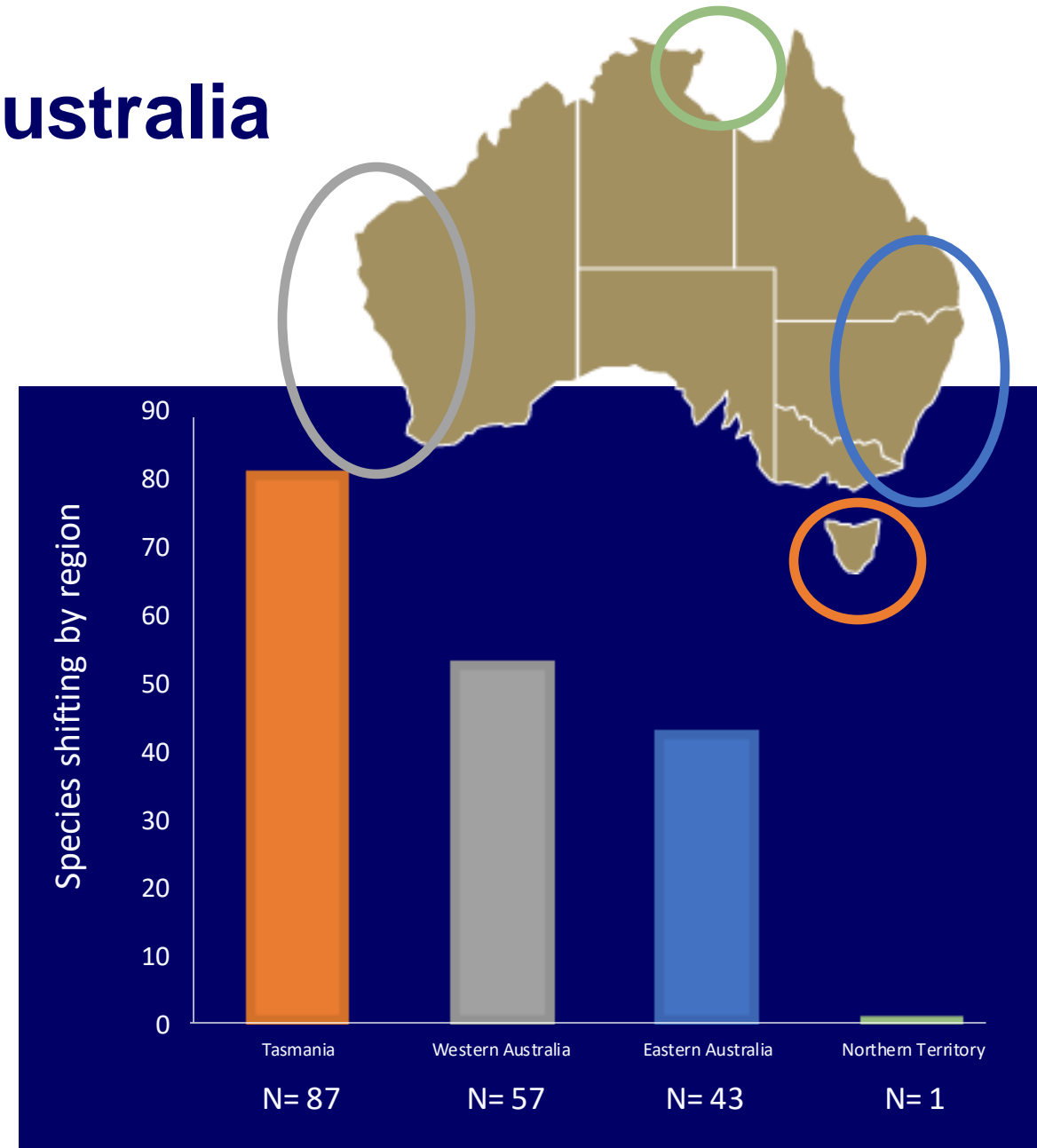
Contraction at northern edge & extension at southern edge



Shifts in distribution around Australia

- At least 198 species from 9 phyla have shifted distributions around Australia since 2003
- Tasmania main hotspot for range shifts, 88% were range extensions
- Western Australia - heatwaves facilitating range extensions (fish) and contractions (algae)
- Eastern Australia - larger proportion of range contractions - 23% species

Also new occurrences or increased prevalence of disease, toxins and viruses

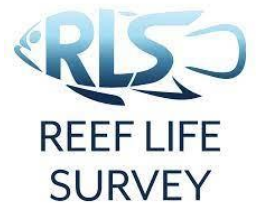




10 years of important citizen science contributions from Australian fishers, divers, and scientists



iNaturalistAU



Funded by NESP Marine and Biodiversity Hub and a range of contributing organisations

redmap
SPOT. LOG. MAP.

NEW SOUTH WALES REPORT CARD

Over the past decade, Redmap (Range Extension Database & Mapping Project) has recorded out-of-range marine species with the help of observant citizen scientists across the state.

Marine species are moving further south

The East Australian Current (EAC), which transports warm, tropical water south along the coast of New South Wales, has strengthened over the past several decades. As a result, south-eastern Australia is one of the fastest warming regions of the world's oceans. In response to warming waters, some marine species are extending their ranges south. In recent years, the New South Wales community has spotted many species south of their usual ranges. For example:

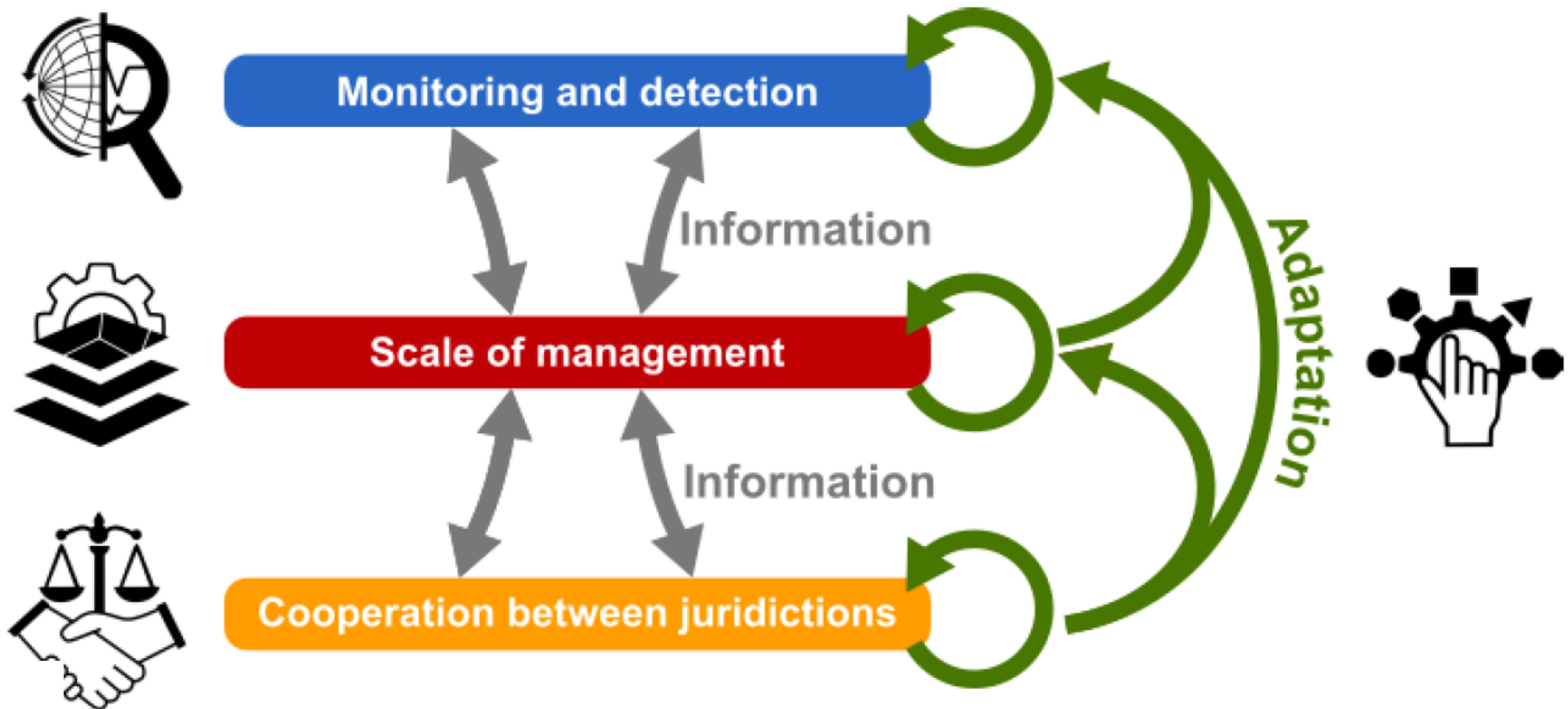
1. In 2013 SCUBA divers first spotted a lionfish (Pterois volitans) near Sydney, which has been multiplying since. Several tropical fishes have been spotted in the coral reef, including Devils Dorsally (Pteropodidae) and Lionfish.
2. Dogfish Tuna (Sphyrna tiburo) usually live in tropical waters north of the Queensland border, but this highly prized fish has been surprising anglers and spearfishers with several catches along the New South Wales coast since 2015.
3. Each spring, tropical juvenile fishes carried by the EAC appear along the New South Wales coast. Now, these tropical recruits are being spotted much further south than previously reported, for example the Bluegill (Lutjanus fulviflamma) near Warrumbungle, about 300km south of its recognised range limit.

CITIZEN SCIENCE HELPS DETECT SPECIES RANGE SHIFTS

Thank you to New South Wales' citizen scientists (beachcombers, boaters, divers, and fishers), who since 2012 have been logging "out-of-range" species sightings like those above with Redmap. These observations can provide an early indication of how species distributions are changing, improving our ability to predict and prepare for the challenges and opportunities range extending species may deliver. By contributing to citizen science programs like Redmap, anyone with a camera can become an "ecological detective", helping to uncover which species are on the move and how their local regions may be changing in response to ocean warming.

Funded by the NSW Marine Estate Management Strategy Climate Change Initiative and NESP

Key drivers that shape future outcomes of redistribution



(Melbourne-Thomas et al Pecl 2021, Reviews in Fish Biology & Fisheries)

Persecuting, protecting or ignoring biodiversity under climate change

Brett R. Scheffers^{1*} and Gretta Pecl^{2,3}

A climate-driven global redistribution of species is currently underway. As species alter their geographical distributions under climate change, many will not only cross into new habitats but also new geopolitical areas. In this Perspective, we discuss the historical archetypes of managing species redistribution—persecution, protection or ignorance—which points to diverse decisions and outcomes based on a balance of societal and ecological valuation. We build the case for increasing transboundary monitoring and management of species, and for shared governance agreements that are global in scope, consisting of legally binding and biologically defensible contracts among partner countries, in what would be a critical step for the future conservation of all species.



Ecological values
+ Society values

Conservation
outcomes/action

**Future decisions
under climate change**



Some implications of climate-driven biodiversity changes cannot be adapted to

“When kelp and weed beds are dying and the rainbow kelp shells are depleted in rapid numbers, then women feel the cultural loss of governance and connections to sea country”

(tebrakunna country and Lee 2017).



Consideration for range-restricted endangered species

Red handfish (*Thymichthys politus*)

- Critically endangered, endemic to Tasmania
- Population size 100 adults (wild)
- Key threats: habitat loss (urchin overgrazing) & warming
- Limited dispersal ability & can't naturally track temperature changes

Strategies for building resilience

1. Population recovery (intervention): captive-raised and released individuals
2. Habitat management & augmentation: Threat mitigation and seaweed re-planting
3. Insurance populations: Captive populations, translocation, eDNA to locate extant populations
4. Building capacity and mitigating disturbance through community engagement



Jemina Stuart-Smith, Andrew Trotter, Tyson Bessell, Rick Stuart-Smith, Neville Barrett

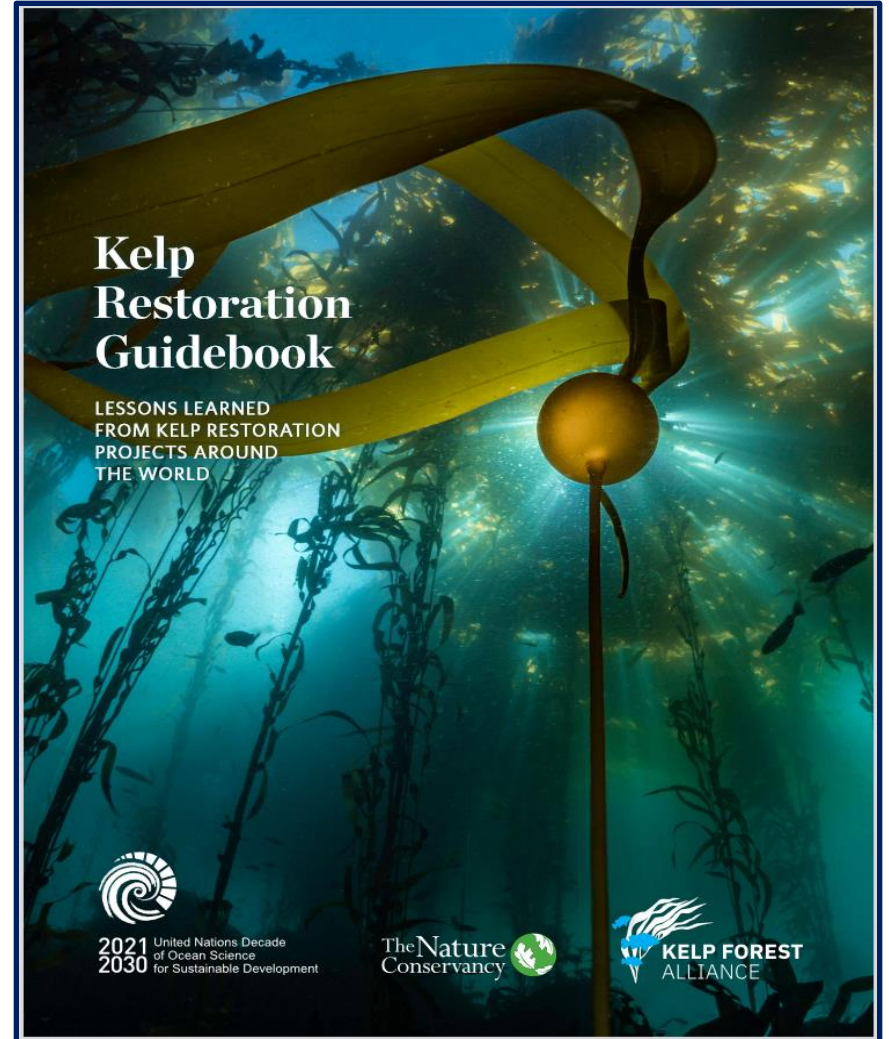


Restoration of key habitats, eg Giant Kelp

- Lab-rearing of thermally tolerant kelps
- Transplanting back into lost wild habitats
- Very labour & \$ intensive
- Mixed but promising results so far!

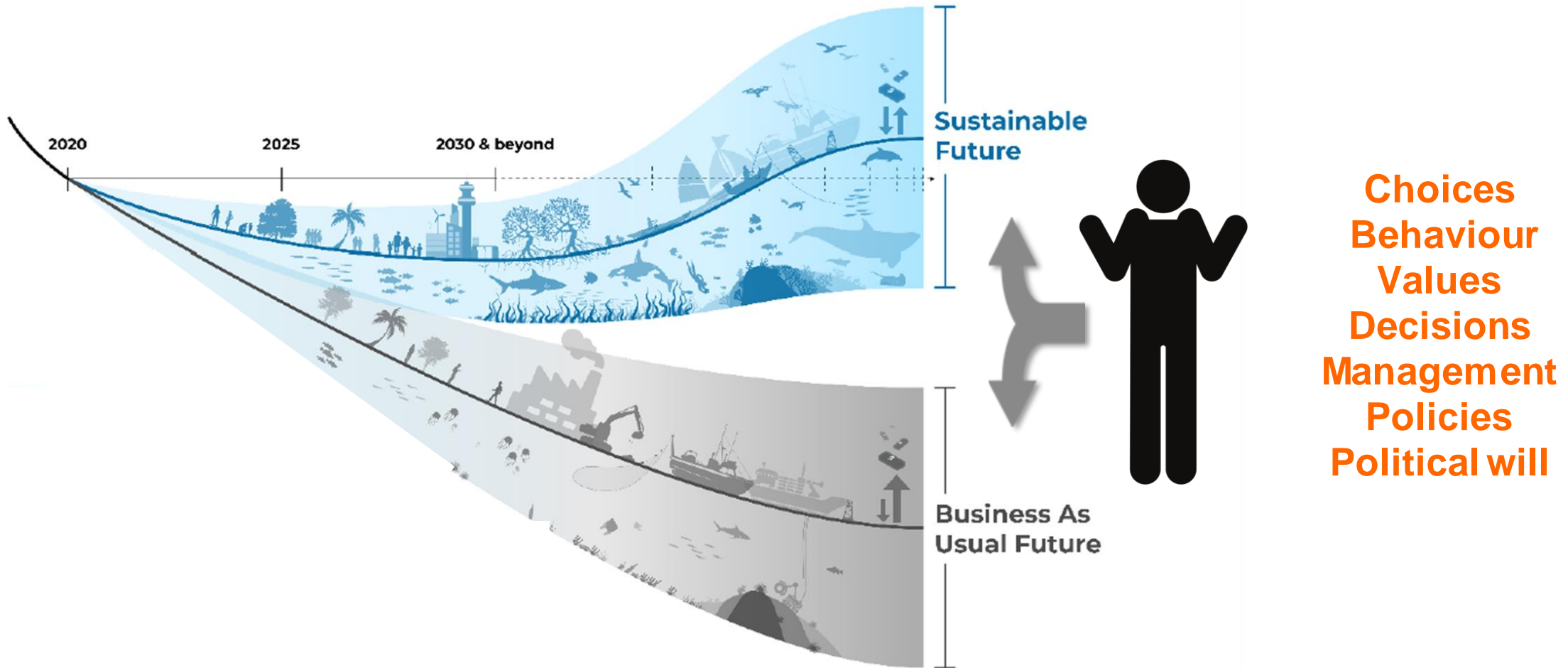
However.....

- Need to understand natural kelp forests first before we pursue restoration (the whole community & kelp)
- Consider why restoration needed at all (urchins, warming, urbanisation)?
- Restoration is hard - reinforces need to study/value/protect existing kelp forests



Kelp Restoration Guidebook: Lessons Learned from Kelp Restoration Projects Around the World
(FREE download, just google '*kelp restoration guidebook*')

Future is not fixed..... depends on our choices & actions



Safeguarding marine life: conservation of biodiversity and ecosystems.
Ward, Melbourne-Thomas, Pecl et al, 2021, Review in Fish Biology & Fisheries

Future Seas 2030

<https://futureseas2030.org/>



So what could/should we prioritise?



**Engagement, co-creation
& building trust**



**Governance & policy
for responsible,
equitable & effective
interventions**



**Creating a shared vision
of the future & a
mobilising narrative**

Thank you!

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Ocean literacy toolkit available at Future Seas website

Redmap Australia

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Curious Climate Tasmania

<https://curiousclimate.org.au/>



Future Seas 2030

<https://futureseas2030.org/>



Centre for Marine Socioecology

<https://marinesocioecology.org/>

