



Professor Gretta Pecl
Healthy marine systems need collaboration and cooperation across sectors

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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*)



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
- Critical for ecosystem structure & function, fisheries productivity, coastal protection & carbon sequestration
- These ecosystem services are extremely likely to decline with continued warming
- New occurrences or increased prevalence of disease, toxins and viruses are evident

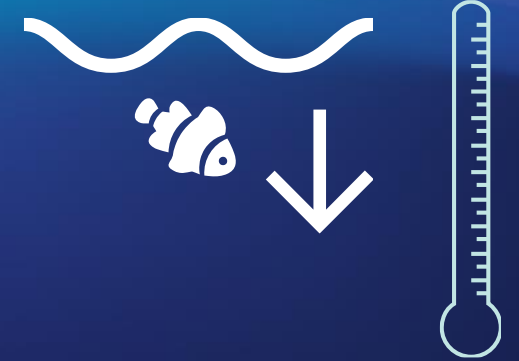
Climate-driven global re-distribution of species



Poleward movement
17km dec⁻¹ on land
72 km dec⁻¹ in ocean
(Poloczanska et al. 2013)



Higher elevations

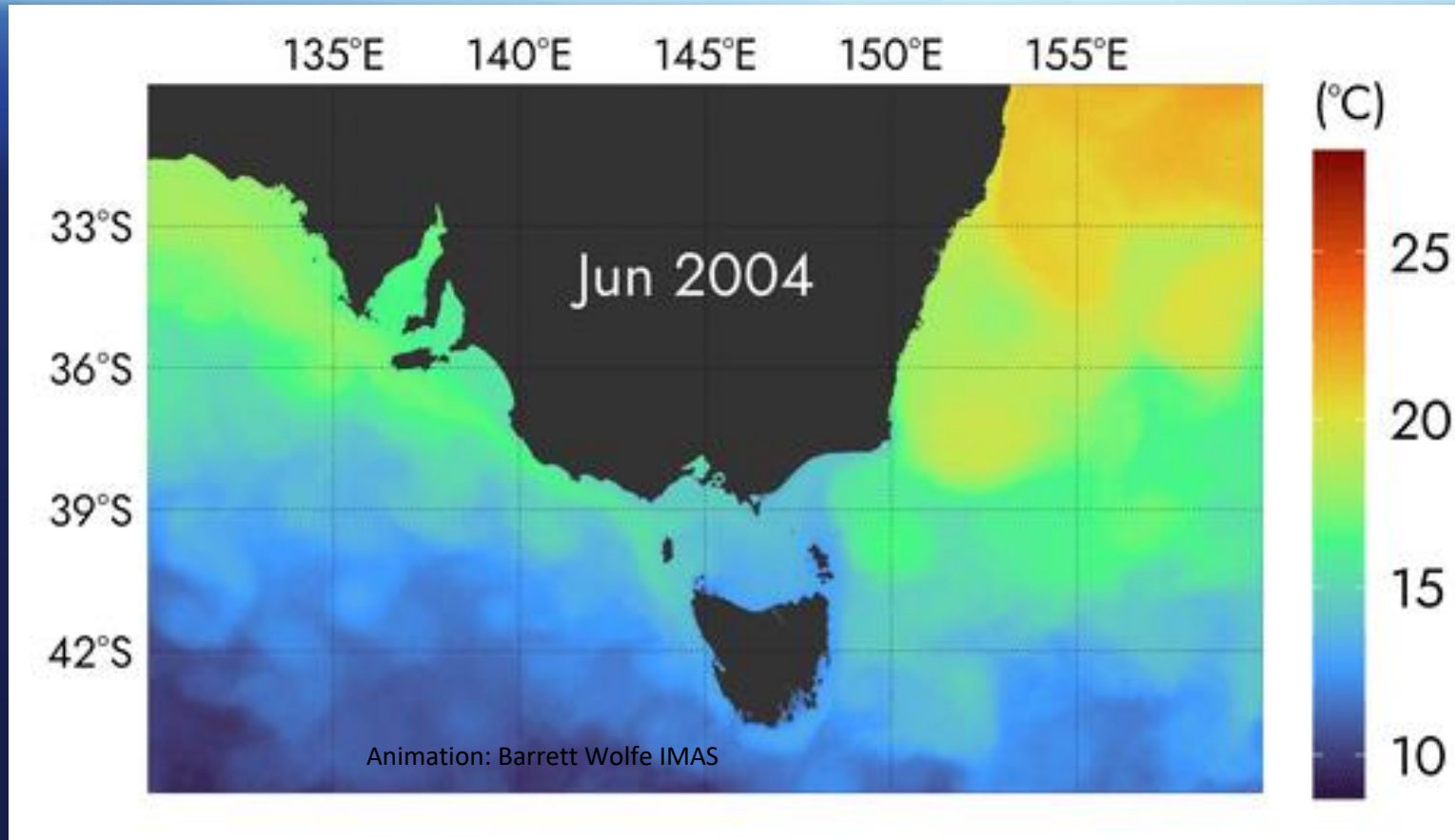


Deeper in ocean
(Dulvy et al. 2008)

Shifts greatest where climate has warmed the most
Just one aspect of climate change that affects humans

(Pecl et al 2017)

Rates of species shifts are linked to rates of warming

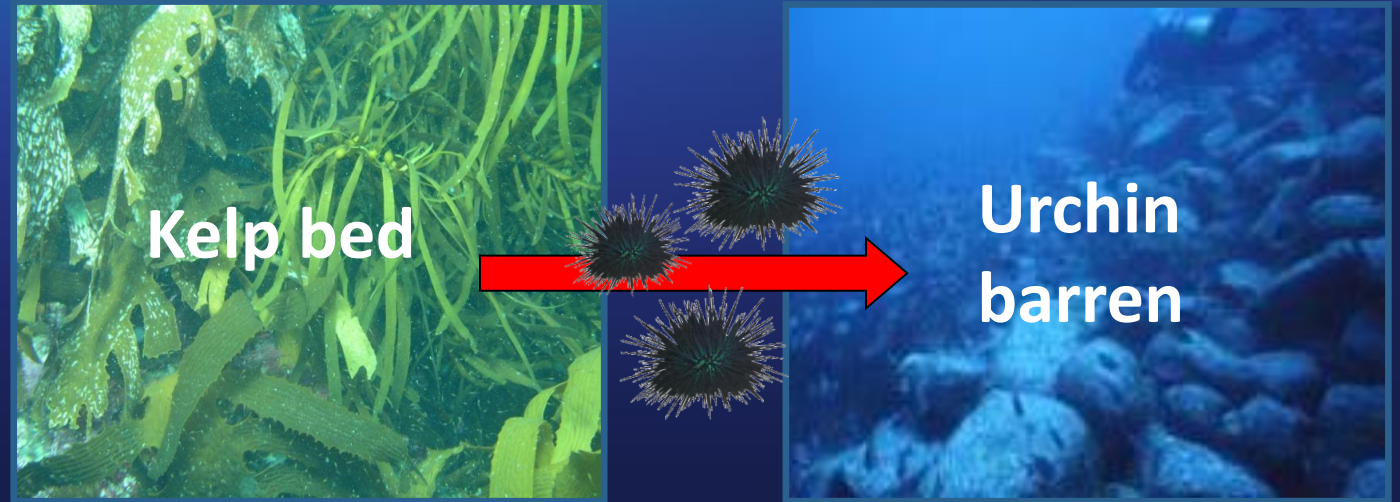


- SE Australia is a warming hotspot, in top 10% globally
- EAC shifted 350km further south in last 70 yrs
- SST increased by $\sim 0.20^{\circ}\text{C}/\text{decade}$ since 1950. Eight of the ten warmest years on record occurred since 2010.

Marine heatwaves increasing in intensity & duration –eg 2015/2016 event had peak intensity 2.5°C , duration 250 days (likelihood of this type of event has increased by about 50x)

Ecological consequences of 'shifters'

- Impacts *can* be equivalent to invasive species (Ling 2008)
- We don't know much about impact of multiple shifting species (Bonebrake et al Pecl 2017)
- 'Novel' ecosystems
 - Definition?
 - Stability, Structure & Function?
 - Human values? Management?

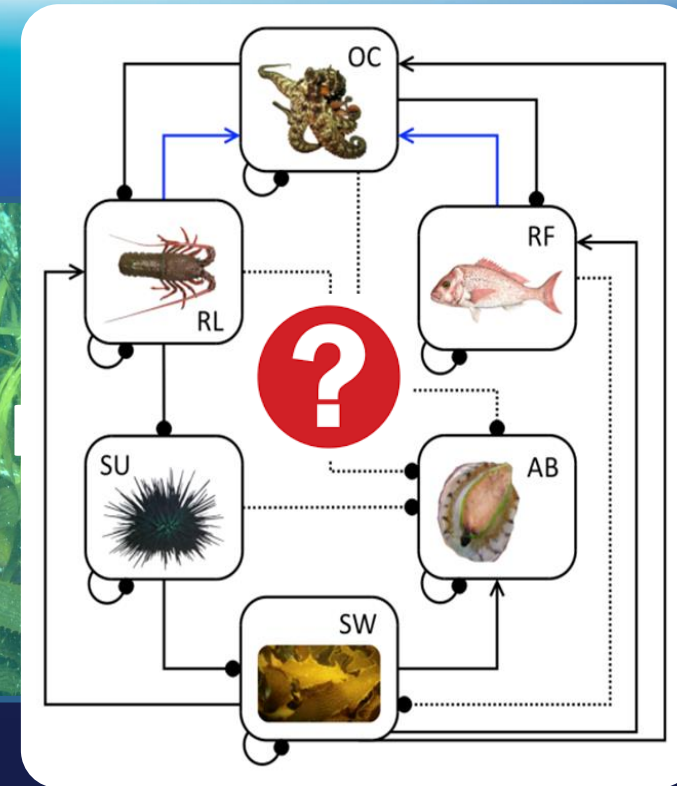


(Marzloff, van Putten, Pecl et al 2016)

50% of species are *already* shifting.... many links between species being broken & new ones forming

Ecological consequences of 'shifters'

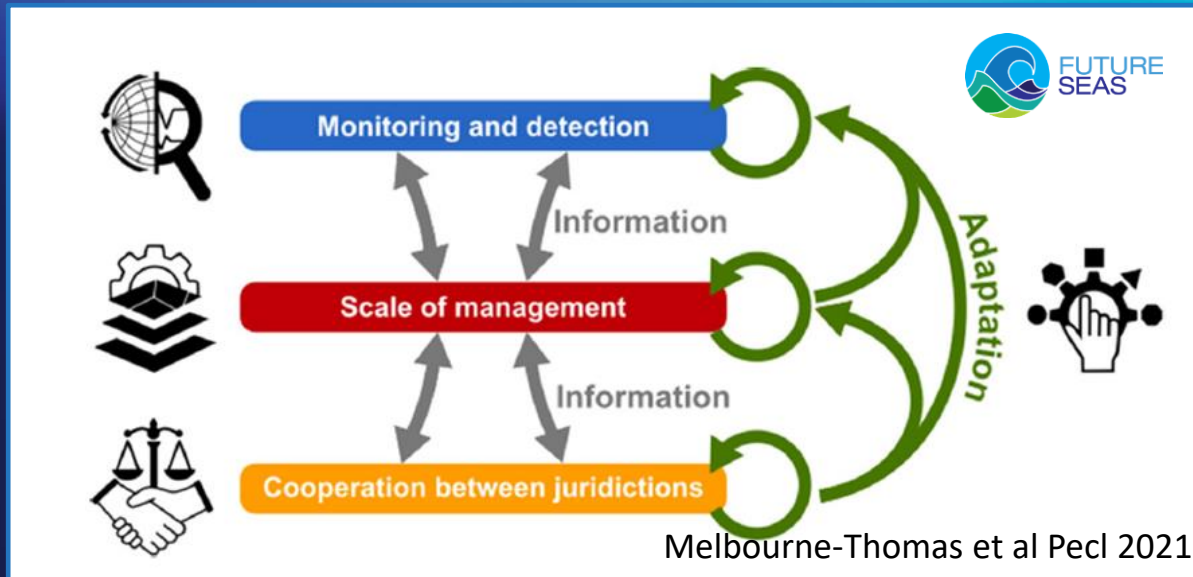
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(Marzloff, van Putten, Pecl et al 2016)

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'Protection' under constant change?



Everything shifting = many decisions to make
Planning & preparation will be key

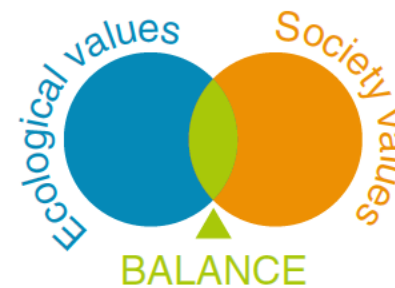
nature
climate change

PERSPECTIVE

<https://doi.org/10.1038/s41558-019-0526-5>

Persecuting, protecting or ignoring biodiversity under climate change

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



Ecological values
+ Society values

Conservation
outcomes/action

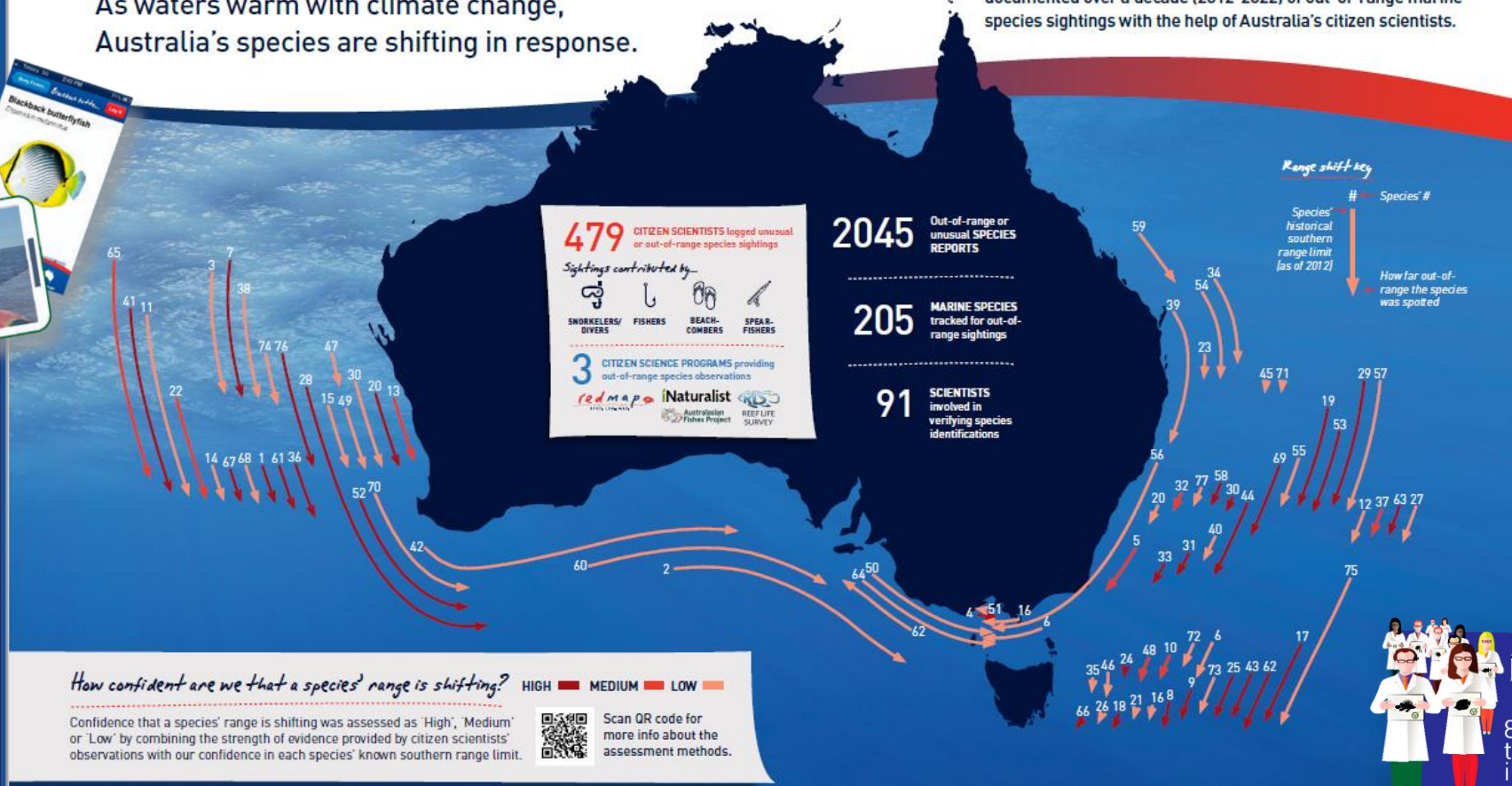
Future decisions
under climate change

WHAT'S ON THE MOVE AROUND AUSTRALIA?

redmap
SPOT. LOG. MAP.

As waters warm with climate change,
Australia's species are shifting in response.

Redmap (Range Extension Database and Mapping Project) has documented over a decade (2012-2022) of out-of-range marine species sightings with the help of Australia's citizen scientists.



Only effective for documenting new species coming in, and inshore diving/fishing habitats & offshore fishing

To monitor change comprehensively we need collaboration across sectors (rec & comm fishing, research, citsci etc)

Species redistribution brings many challenges & opportunities for marine species & human communities

- Species shifts are fundamentally changing natural & managed systems
- Species on the move – ‘status quo’ for the foreseeable future
- Almost everything is changing all at once
- We need mechanistic process-based understanding in order to project future changes
- Human systems are already having major challenges
- Adaptation (within limits) is possible BUT needs strategic planning



Thank you!

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Ocean literacy toolkit available at Future Seas website



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



Future Seas 2030
<https://futureseas2030.org/>

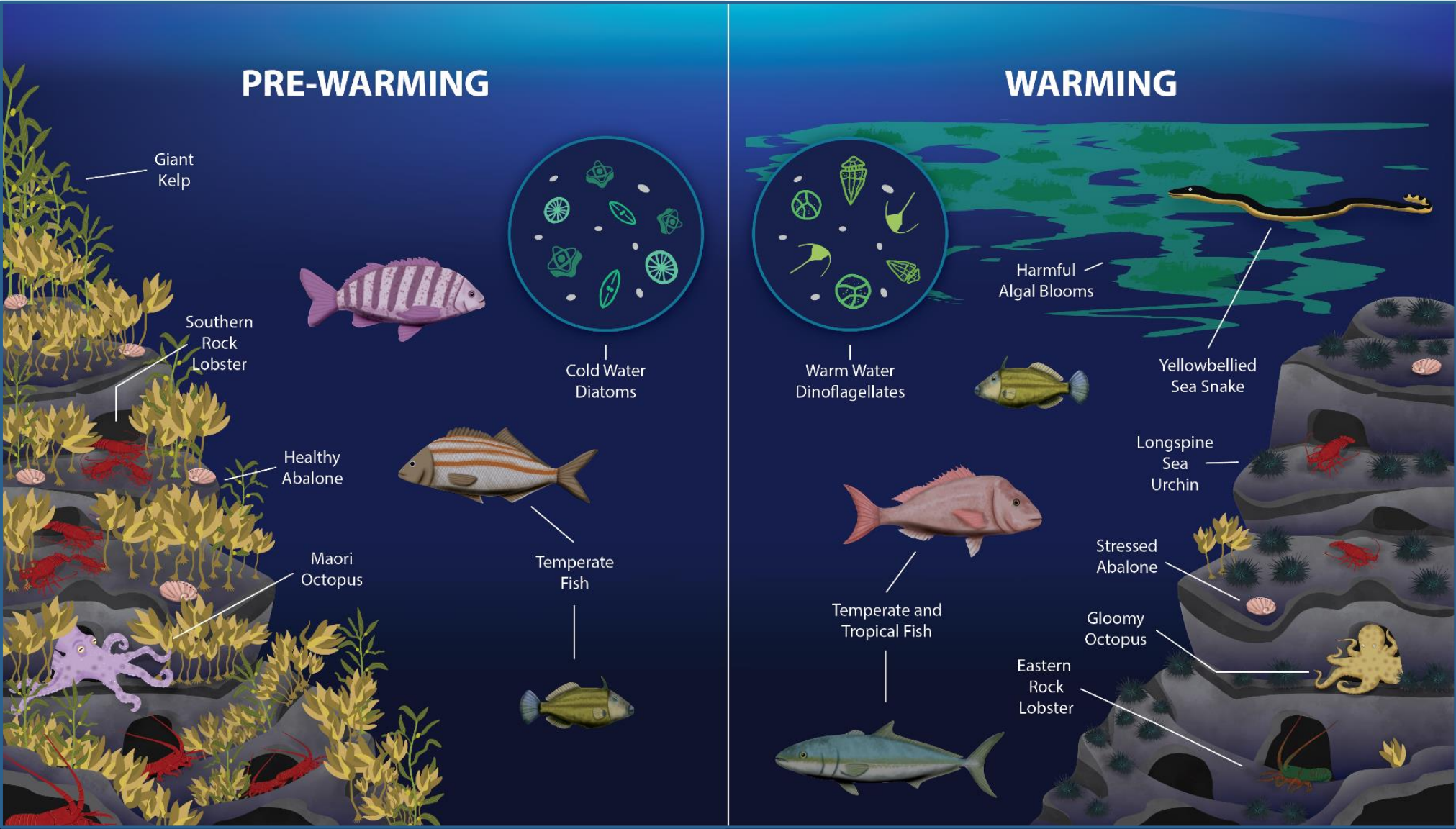


Centre for Marine Socioecology
<https://marinesocioecology.org/>



Significant changes linked to warming on the east coast of Tasmania

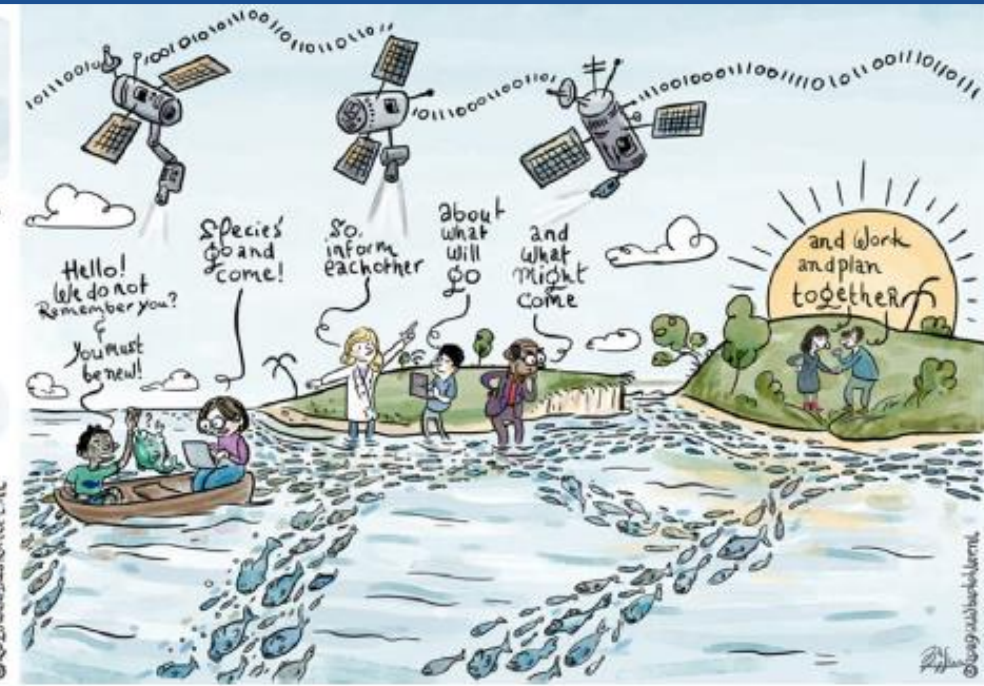
Pecl *et al.*, 2019





**Chasing our tails and our fish
(Business as usual)**

- Passive and reactive
- Unconnected information transfer
- Nationalistic/individualistic
- Growth economy
- Short-term planning
- Focus on sovereignty and access
- Lags between detection and response



**Dynamic adaptation to species on the move
(More sustainable)**

- Adaptive and proactive
- High information transfer (networked)
- Collaborative and cooperative (coordinated)
- Circular and shared economy (stewardship)
- Long-term planning
- Shared resources
- Real-time monitoring and adaptive management

