

Using a fishery to mitigate the impacts of climate change

Dr Katie Cresswell



Longspined sea urchins, *Centrostephanus rodgersii*

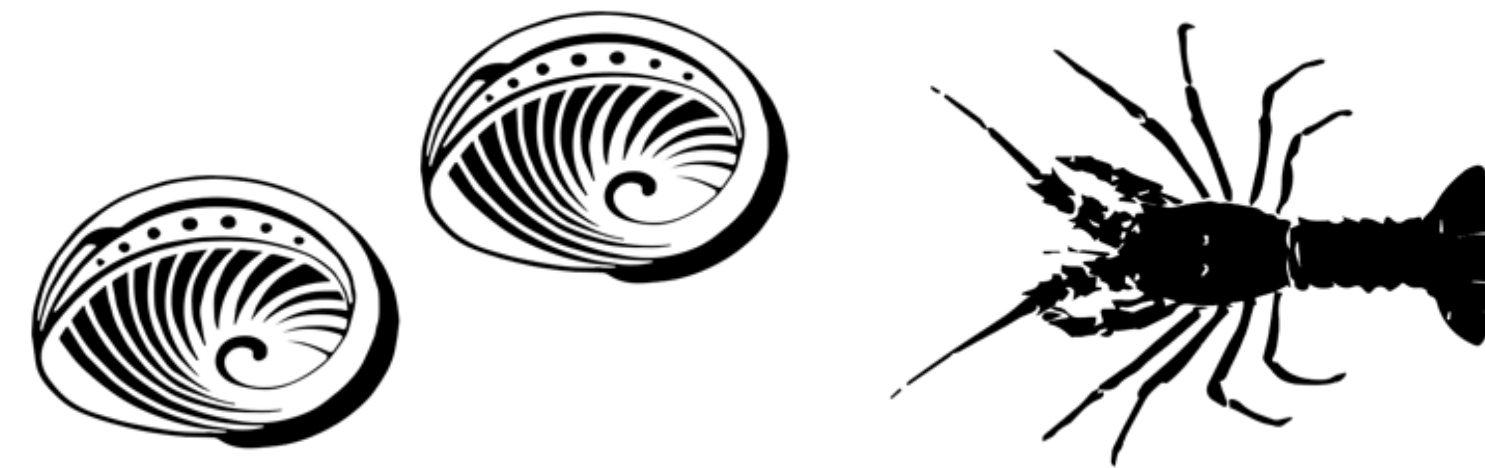
Climate-driven range-extension from NSW

Create "urchin barrens" at high densities (>700g/m²)

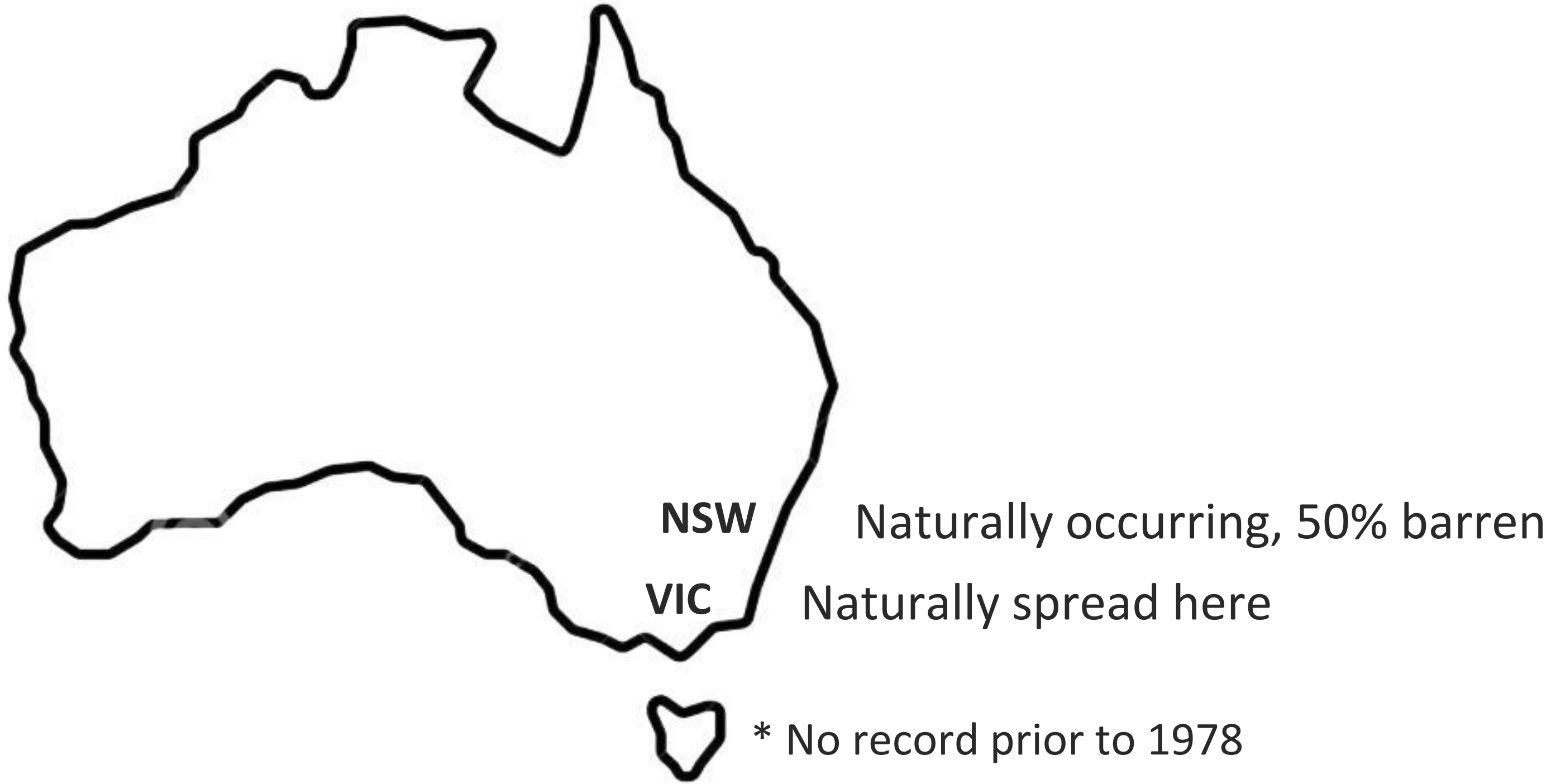
- Density must be 10x lower (<70g/m²) for kelp regrowth from barren



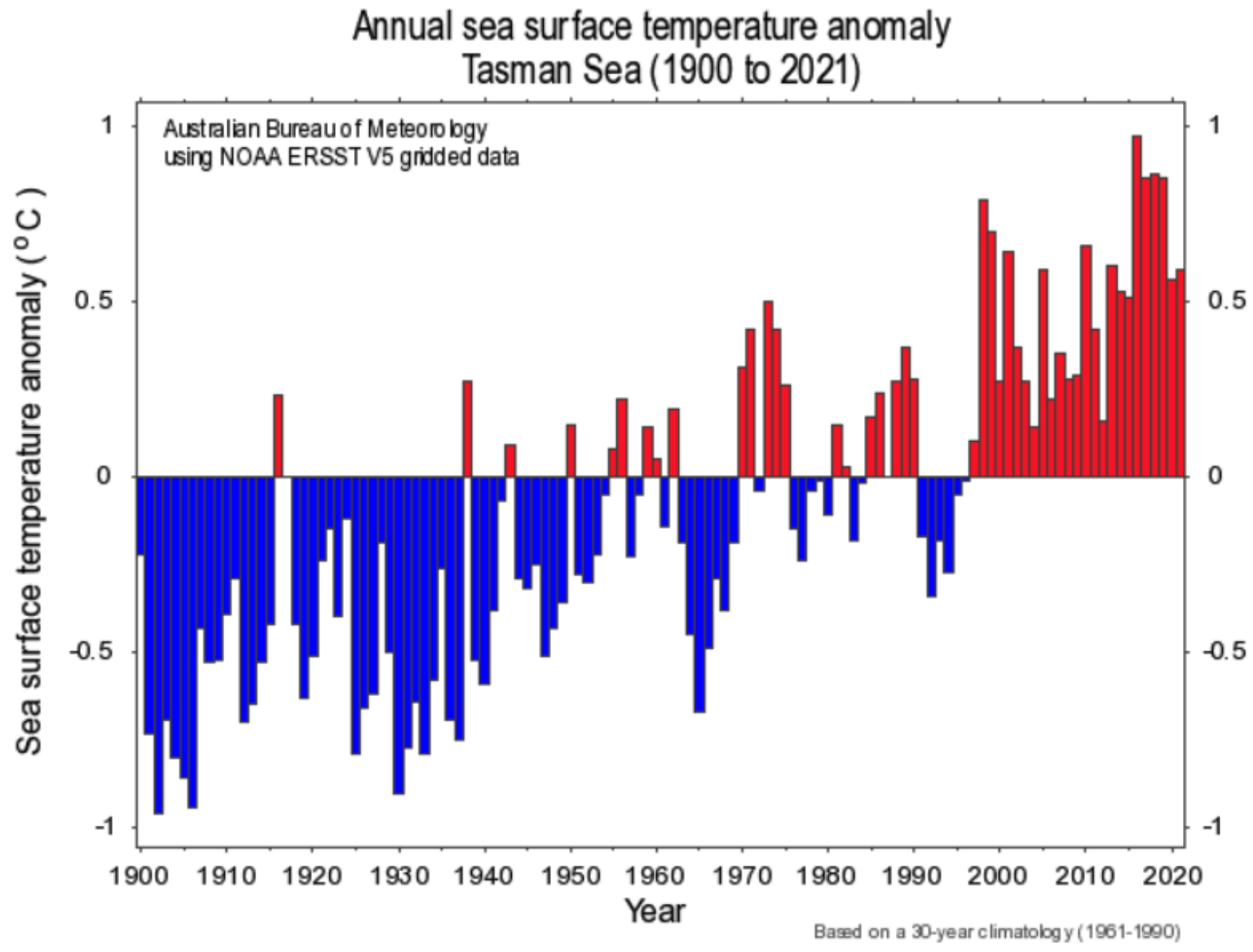
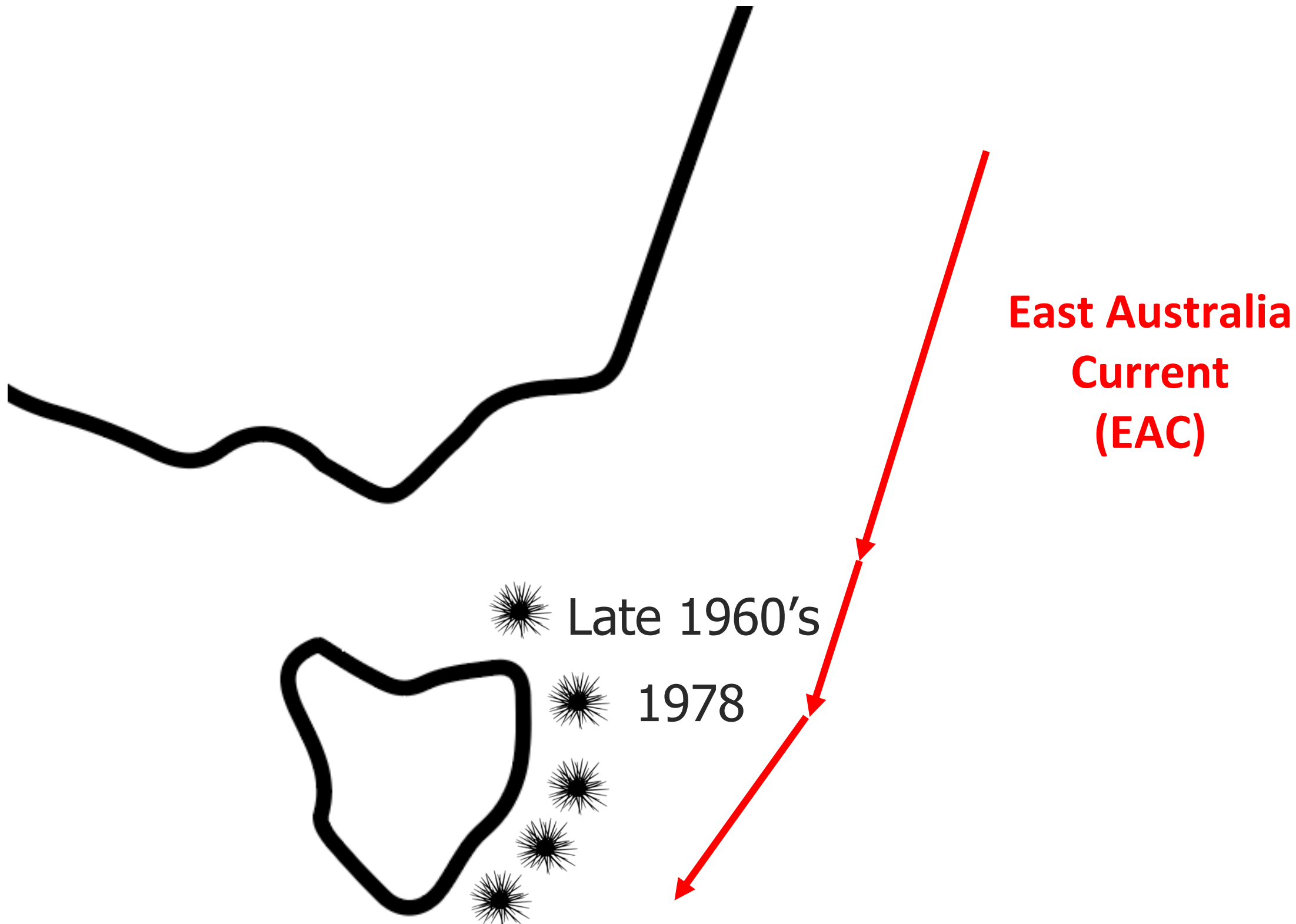
No longer healthy/productive habitat, including for valuable fished species



Climate-driven range-extension of Longspined sea urchins



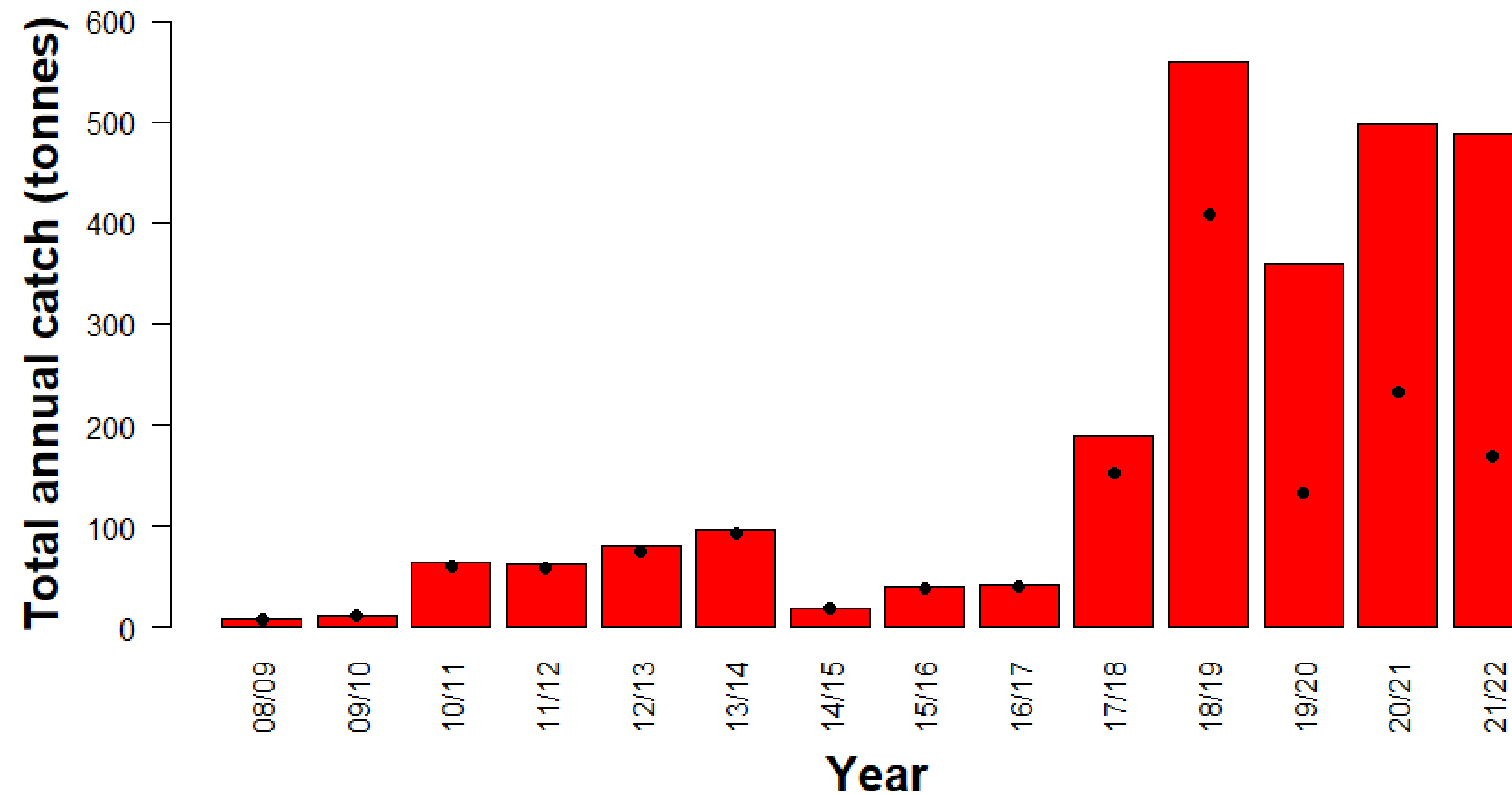
Climate-driven range-extension through EAC



Prompted action: research and a commercial fishery

Surveys 2001, 2017, 2021

 **Urchin density**
Barrens cover



~2500 tonnes removed total

>2000 tonnes in the last 5 years



The model

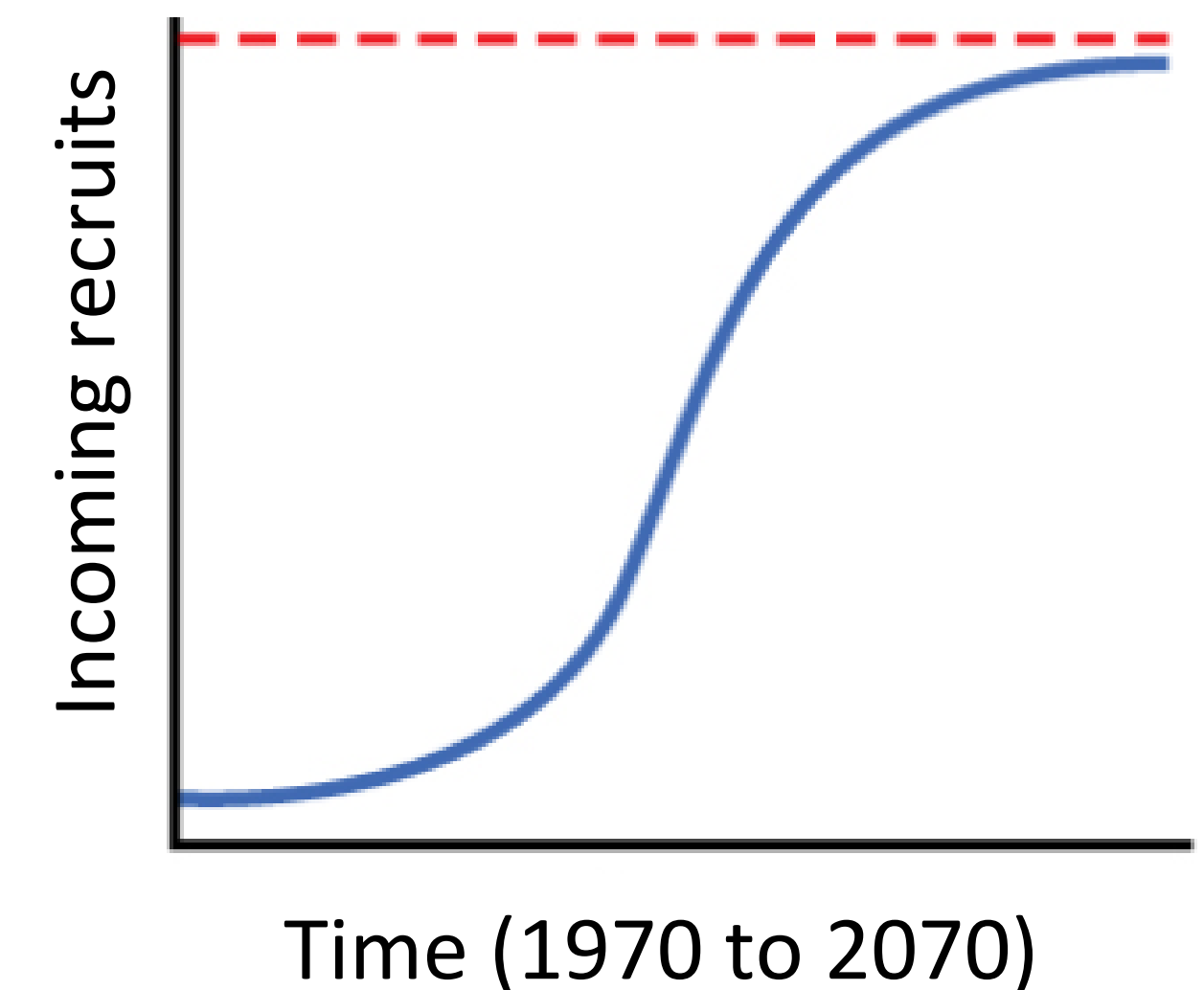
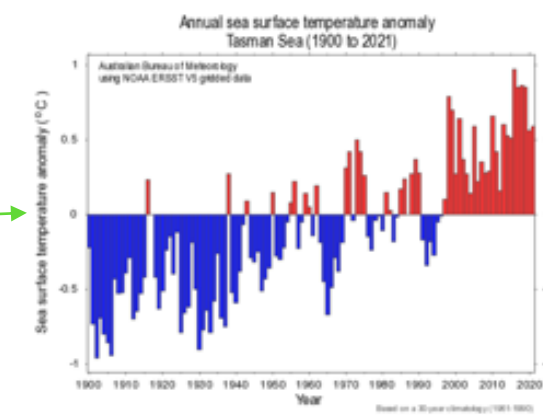
- A size-structured stock assessment model, depth to 6-26m for 9 regions east coast Tasmania
- We fit the model using Rstan to a sigmoidal recruitment function, varying parameters a , b and c

$$R = \frac{c}{1 + \exp(-a(t - b))}$$

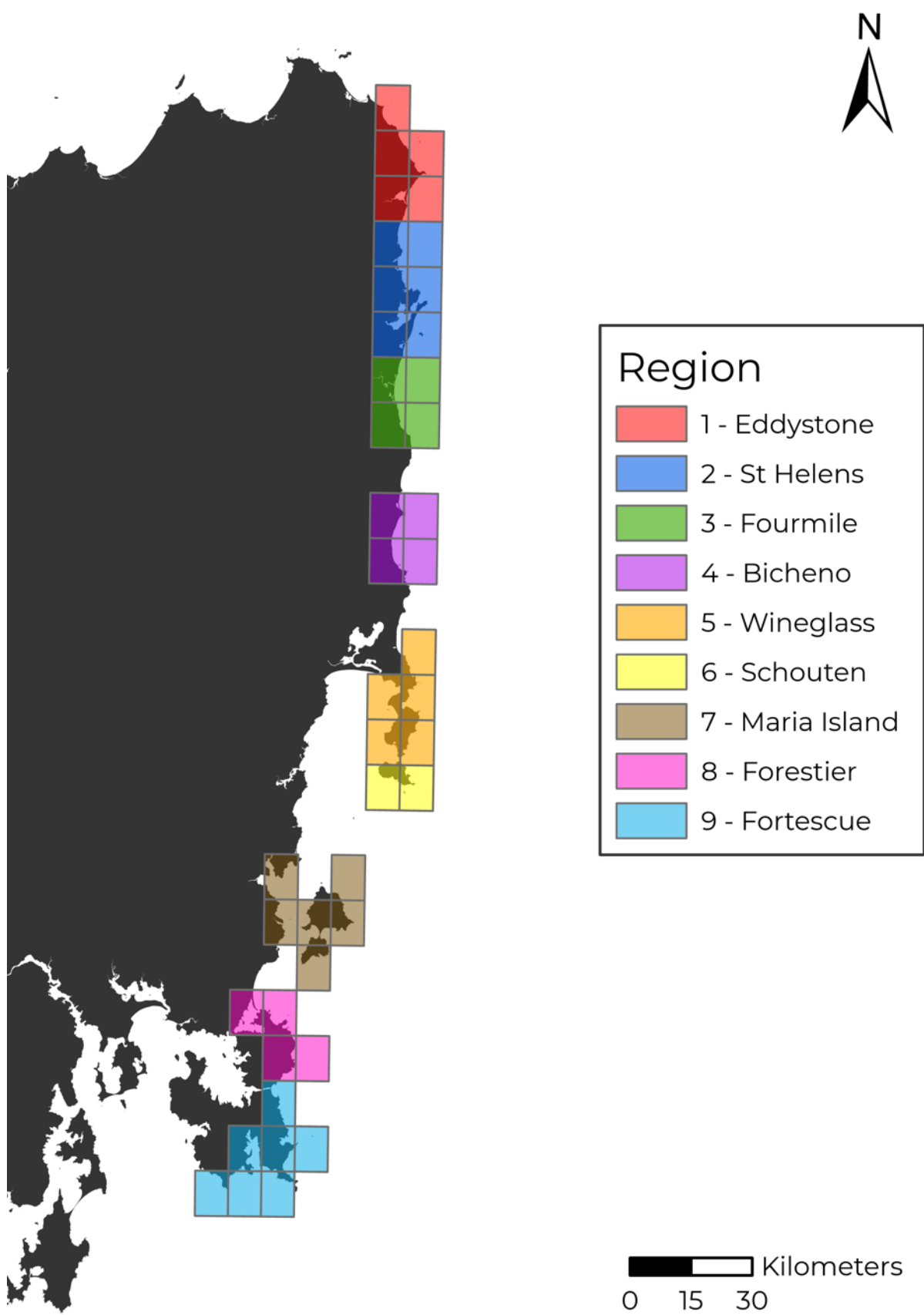
**Assume no relationship between spawning stock biomass and recruits

Incoming # recruits changes over time as a combination of

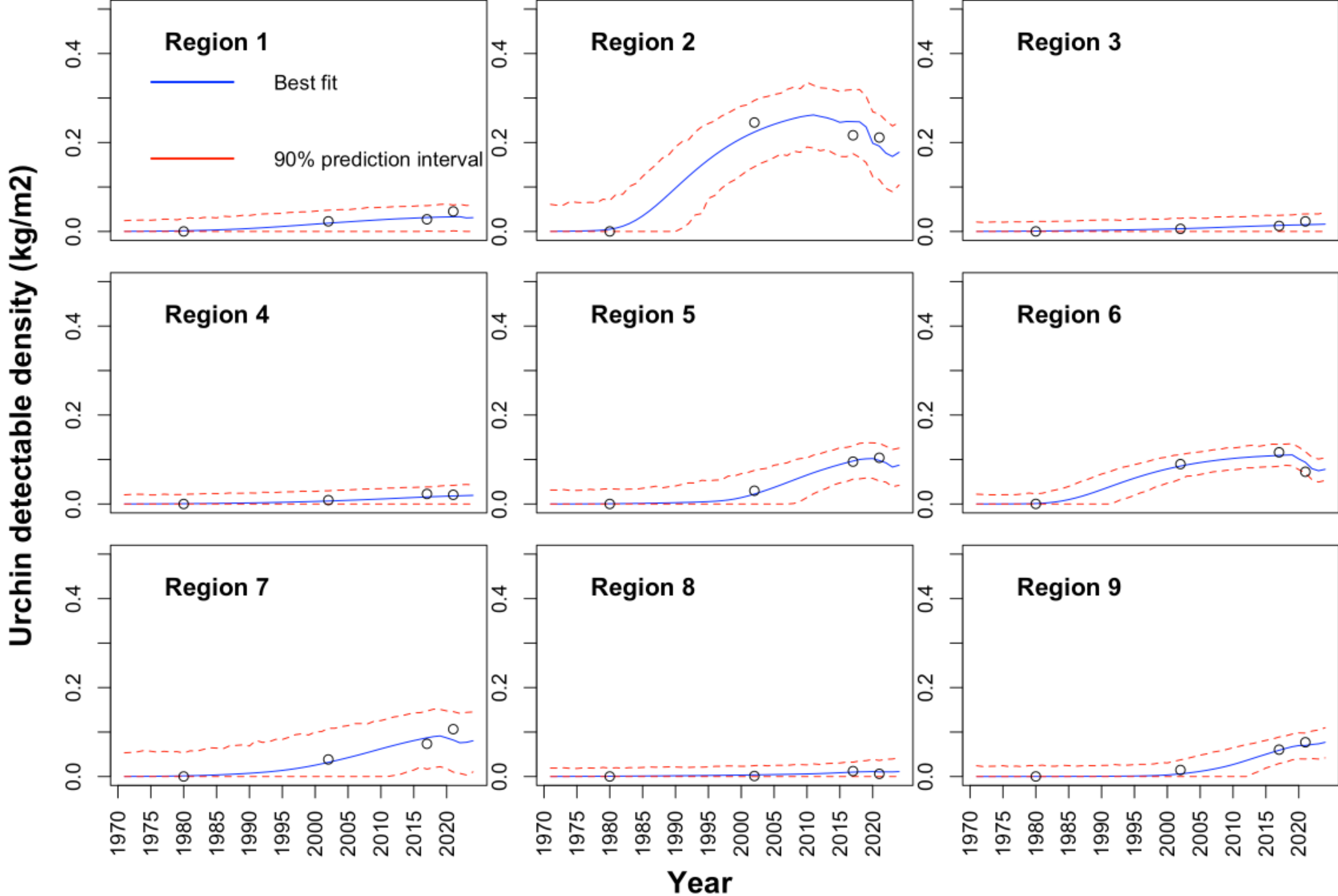
- Increasing temp (larval survival)
- Increasing reach of EAC
- Carrying capacity of reef for each region



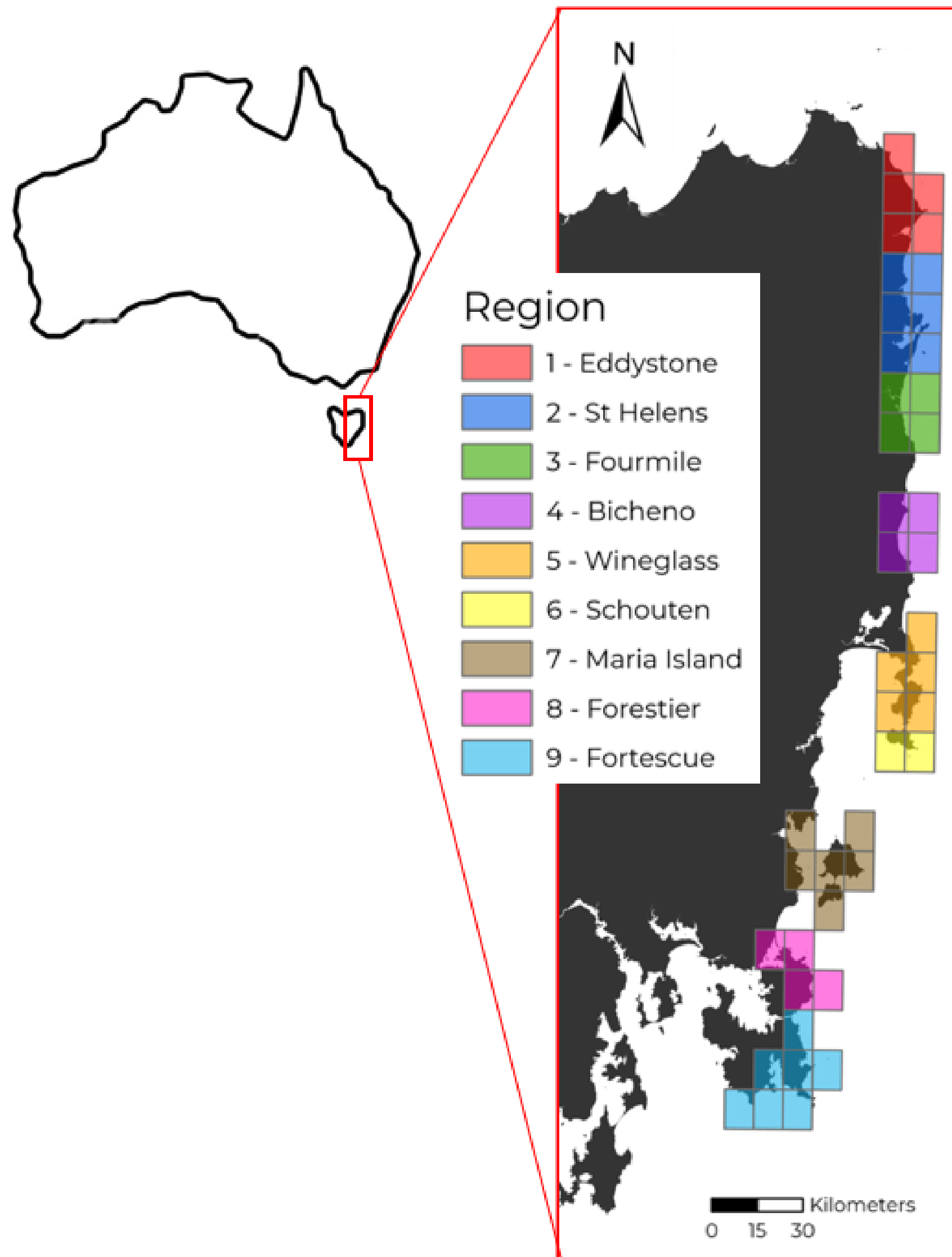
Where are we now?



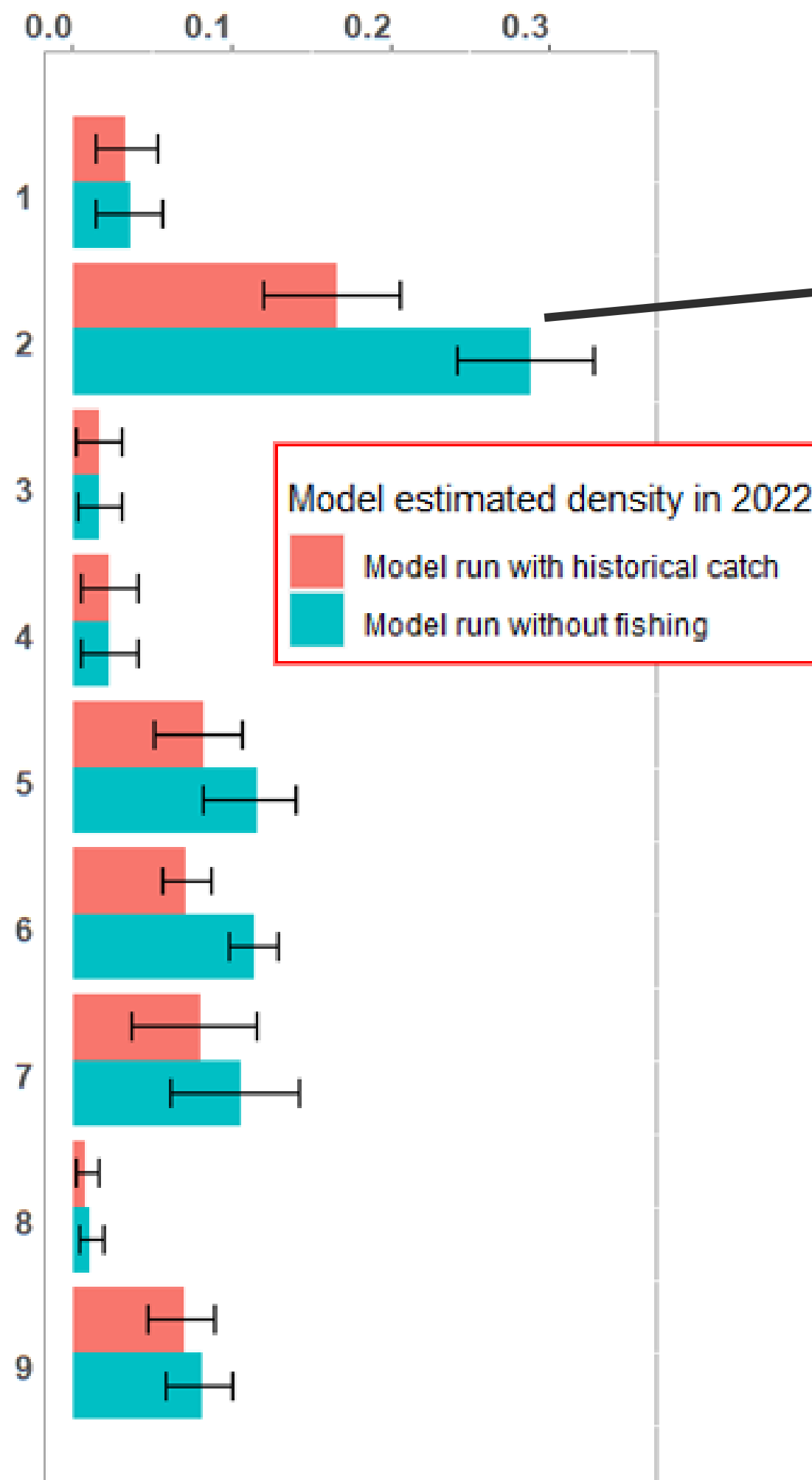
Best fit of model to survey data



What has been the impact of fishing?



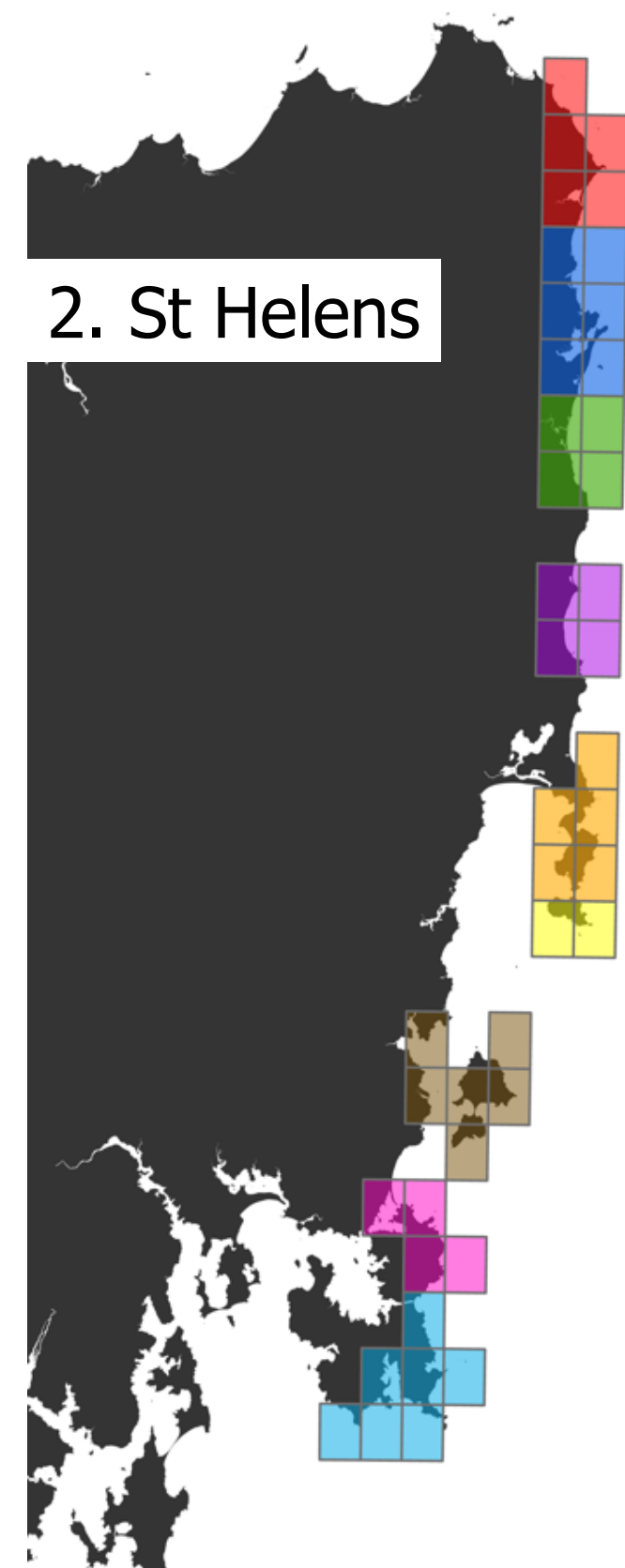
2022 Urchin density (kg/m²)



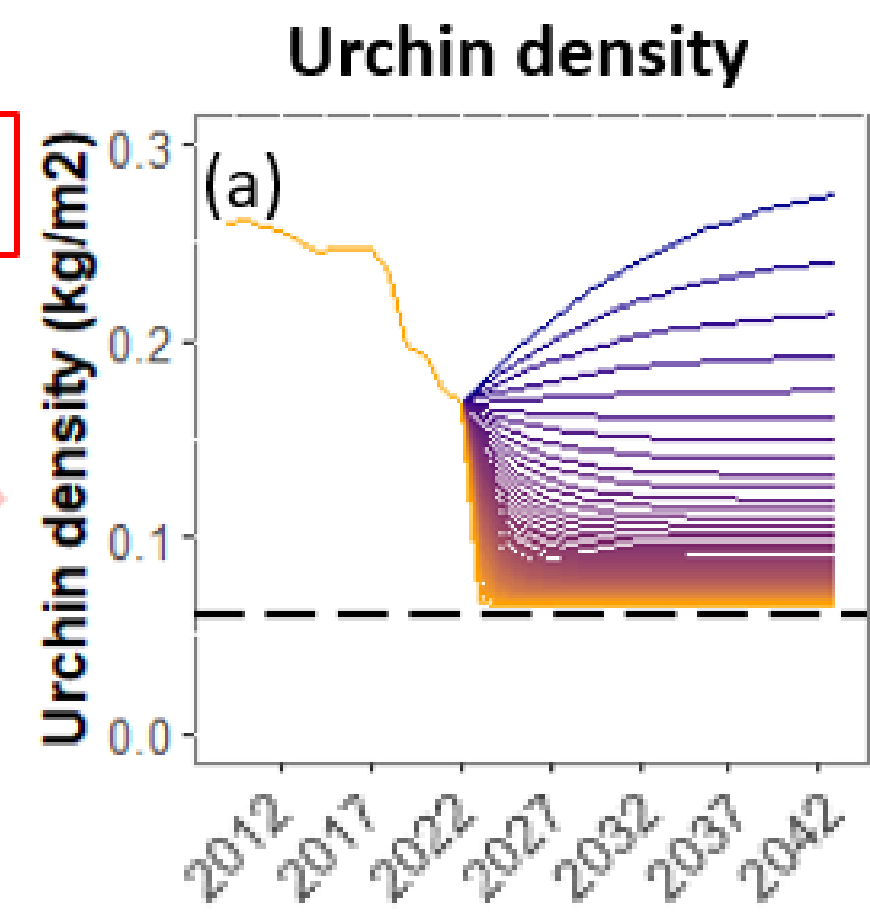
*In most heavily fished region, urchin density **almost halved** by fishing



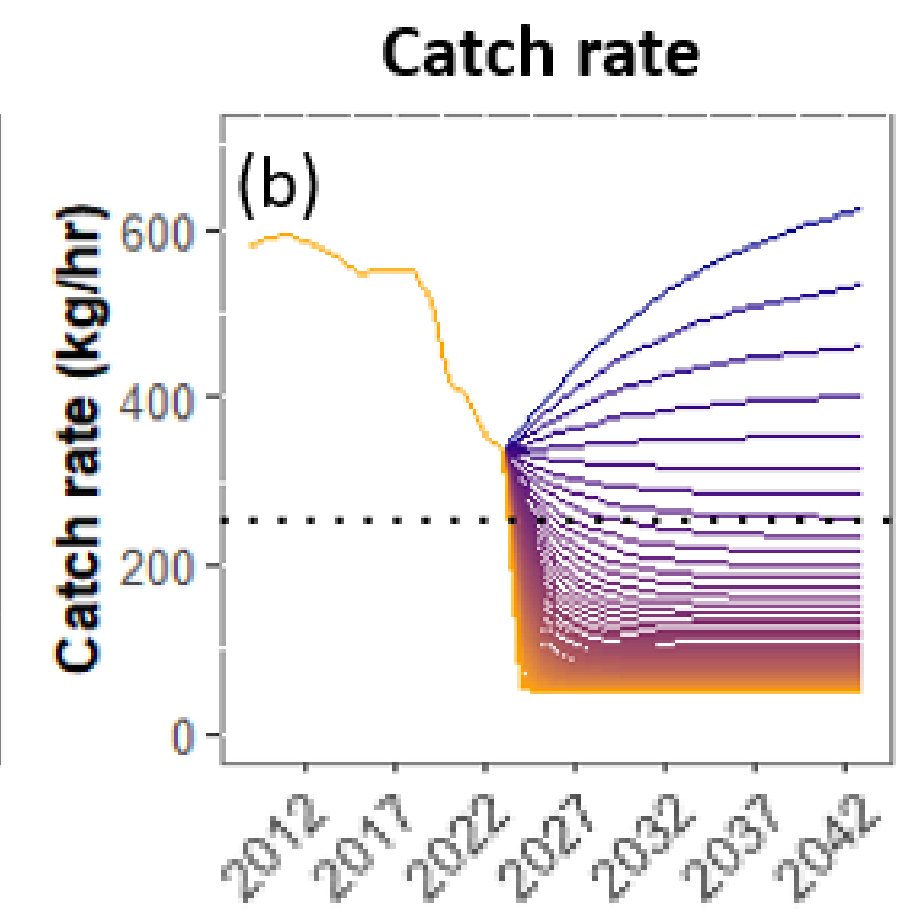
What could be the impact of fishing?



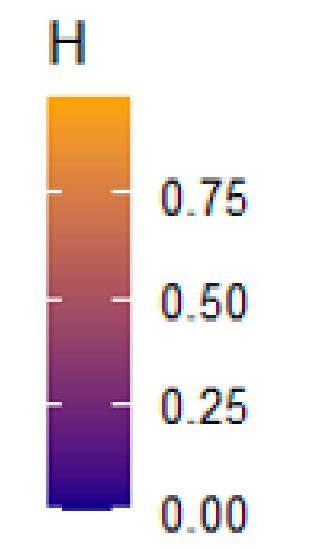
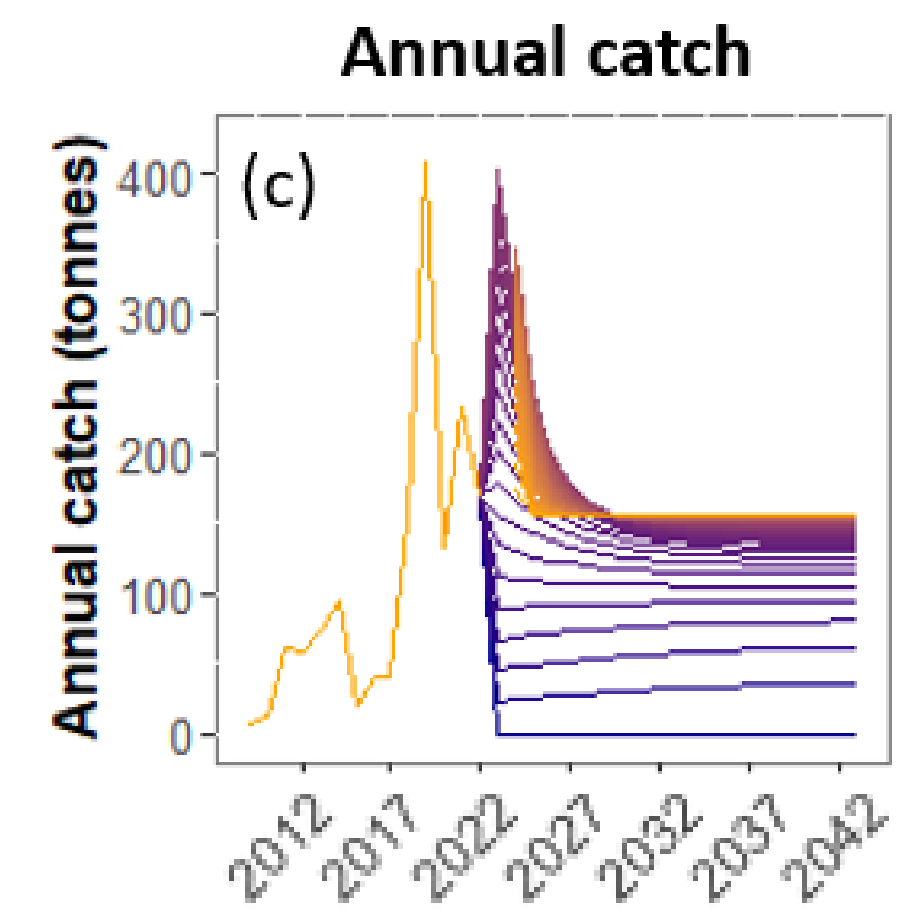
Region 2
High



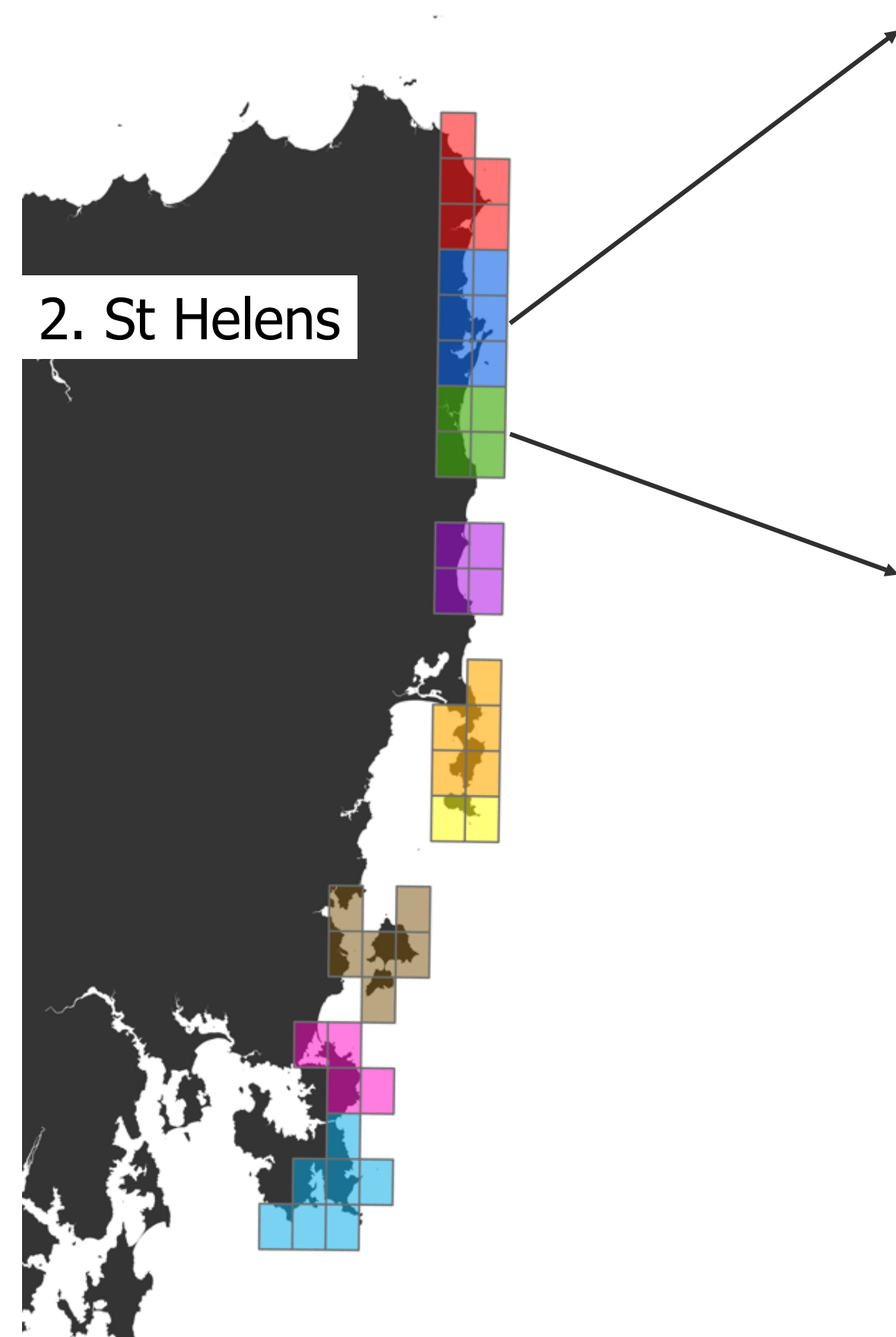
Dashed line is ecological target, 70g urchin/m²



Dotted line is lower CPUE of fishery 250 kg/m²

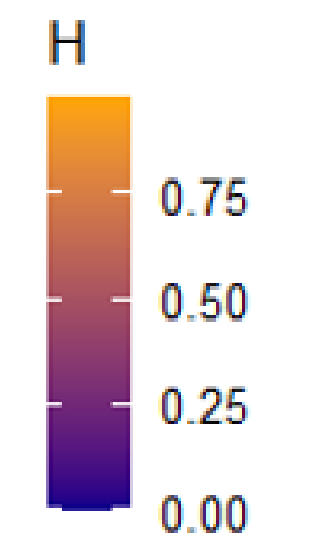
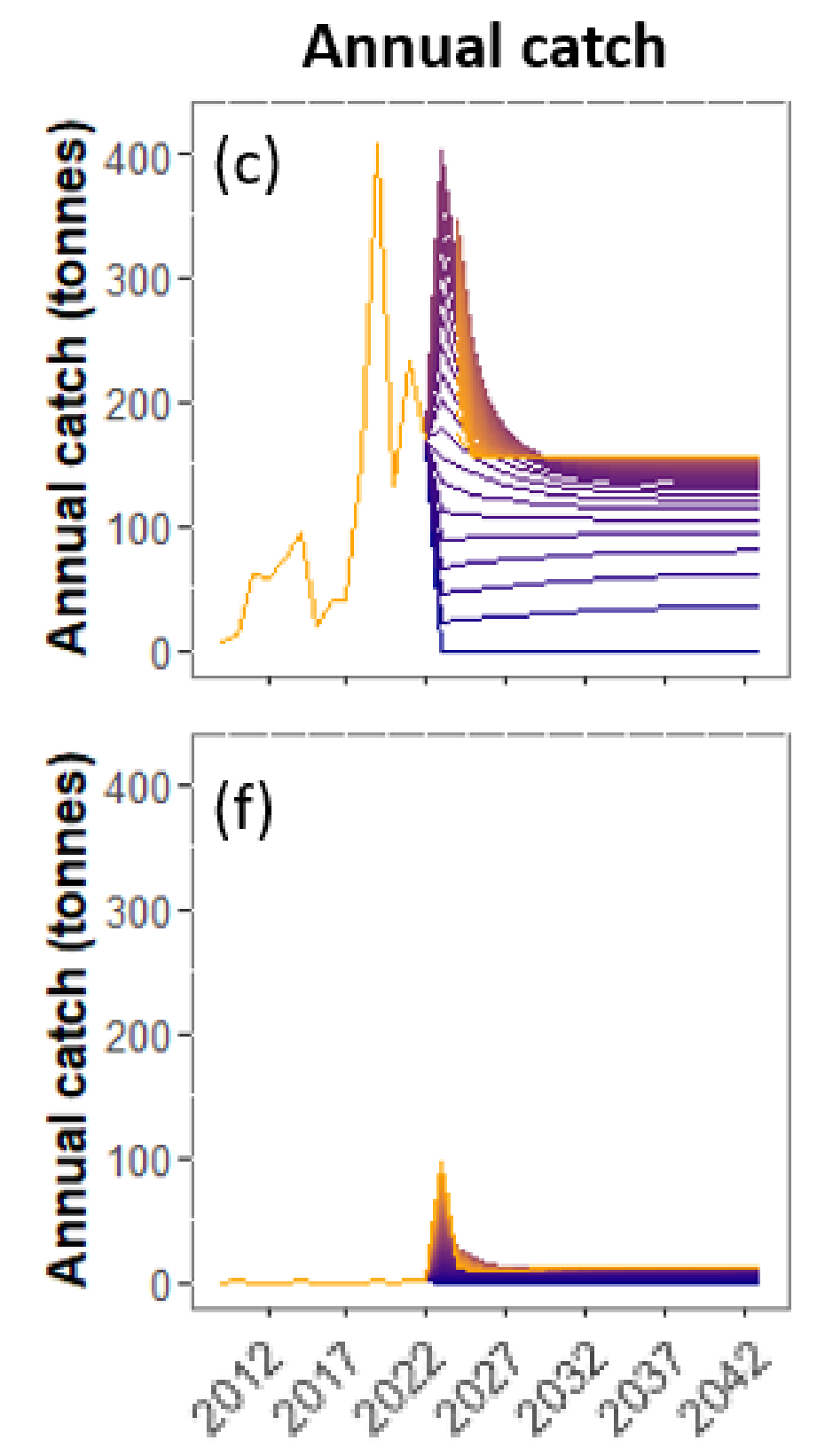
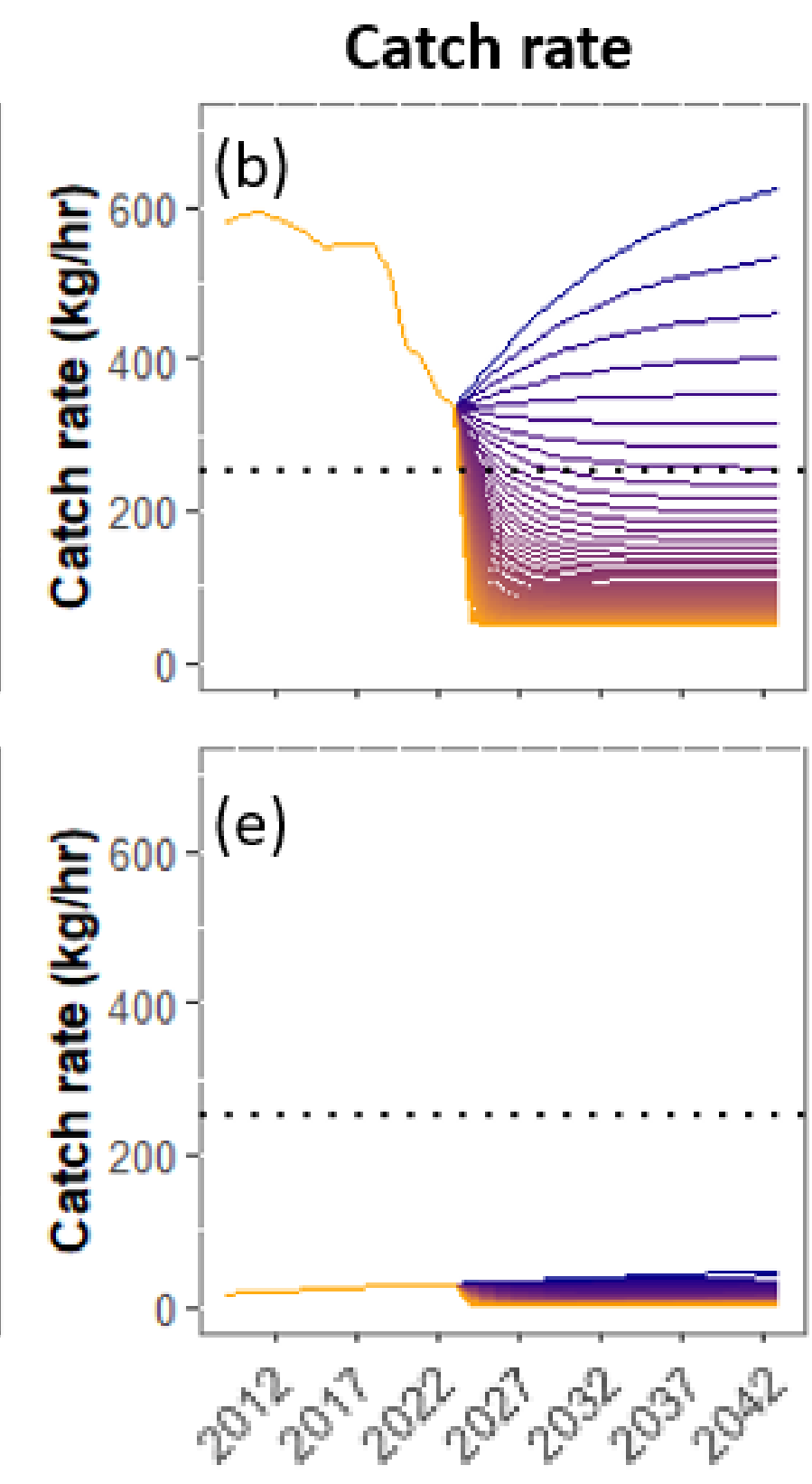
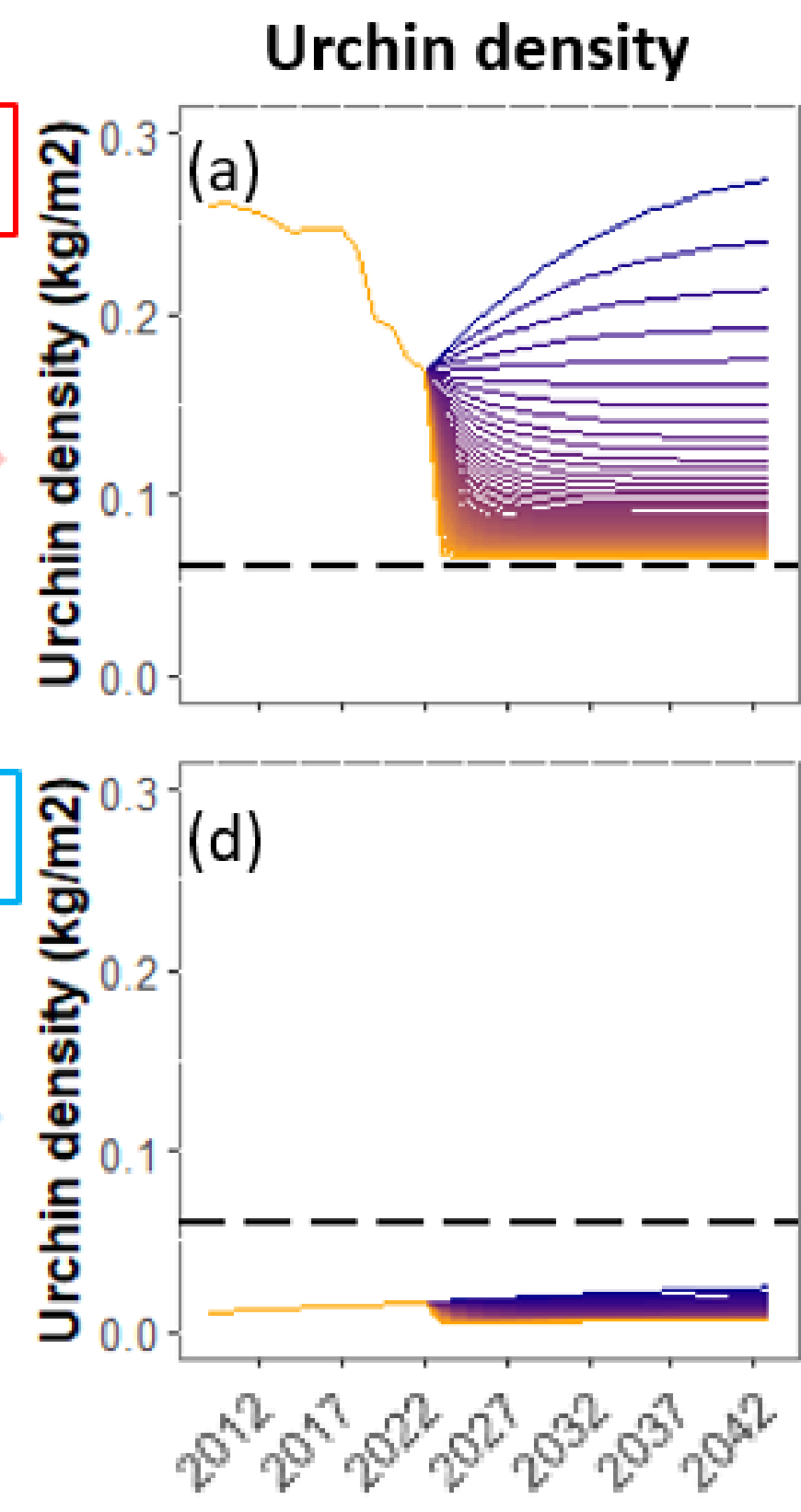


What could be the impact of fishing?

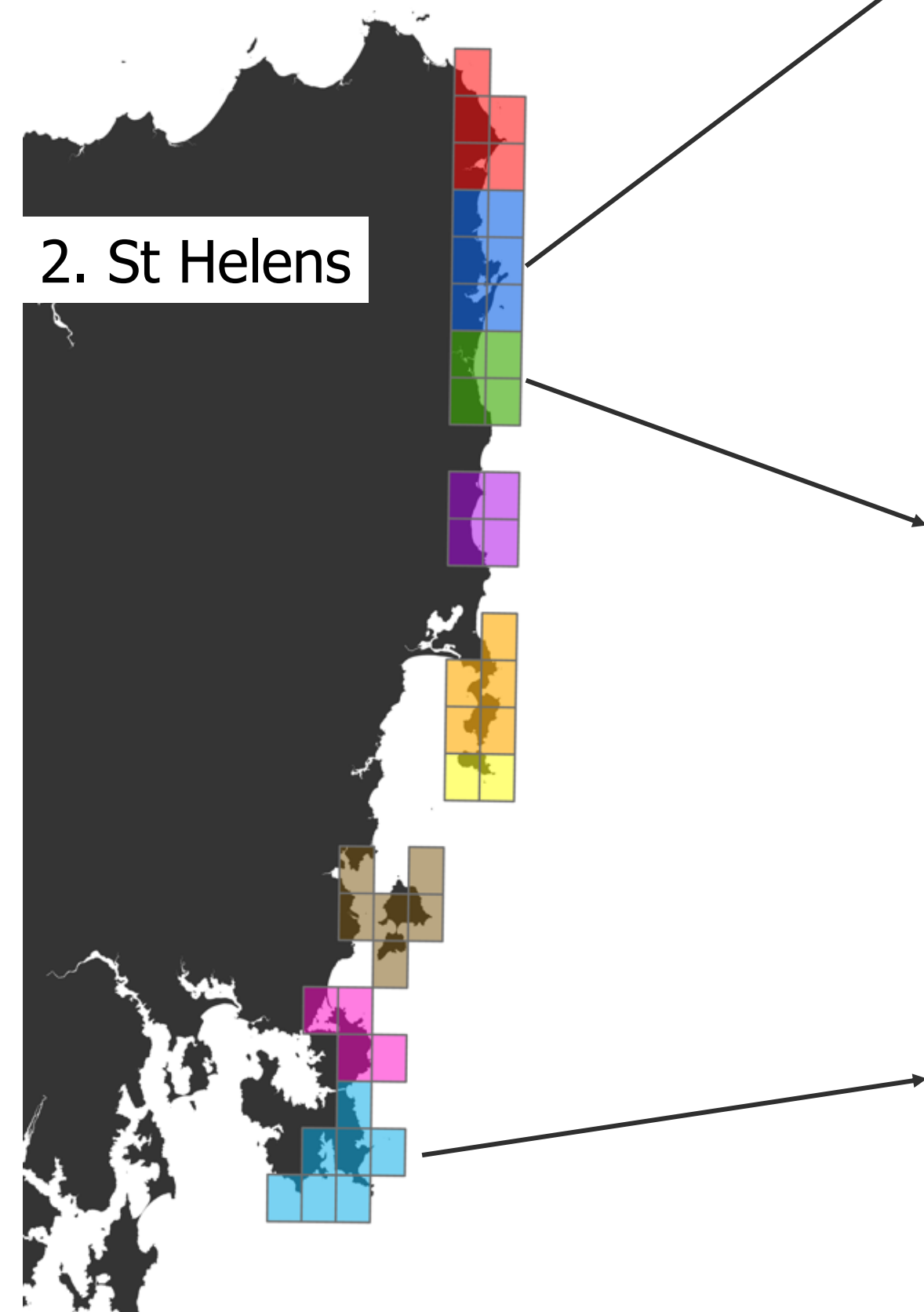


Region 2
High

Region 3
Low



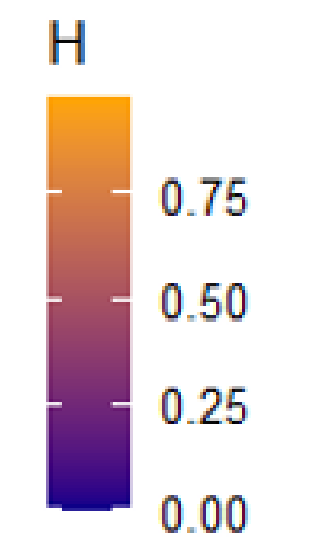
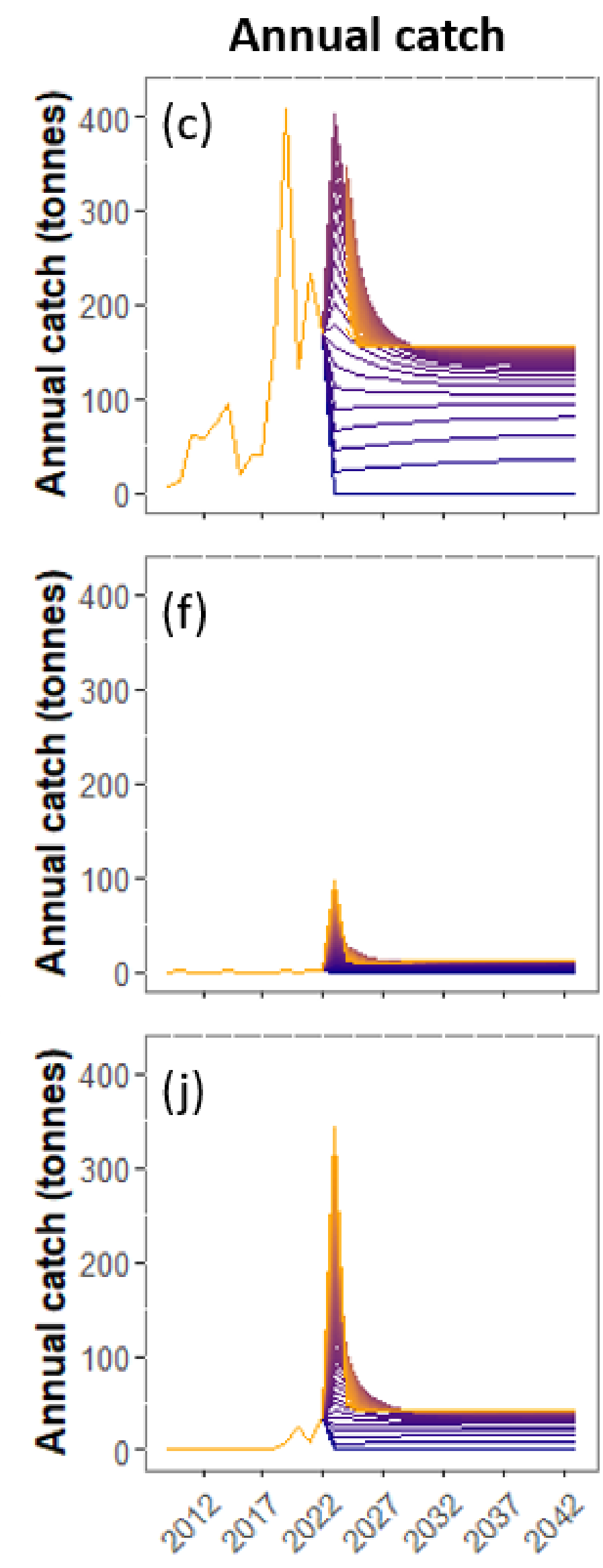
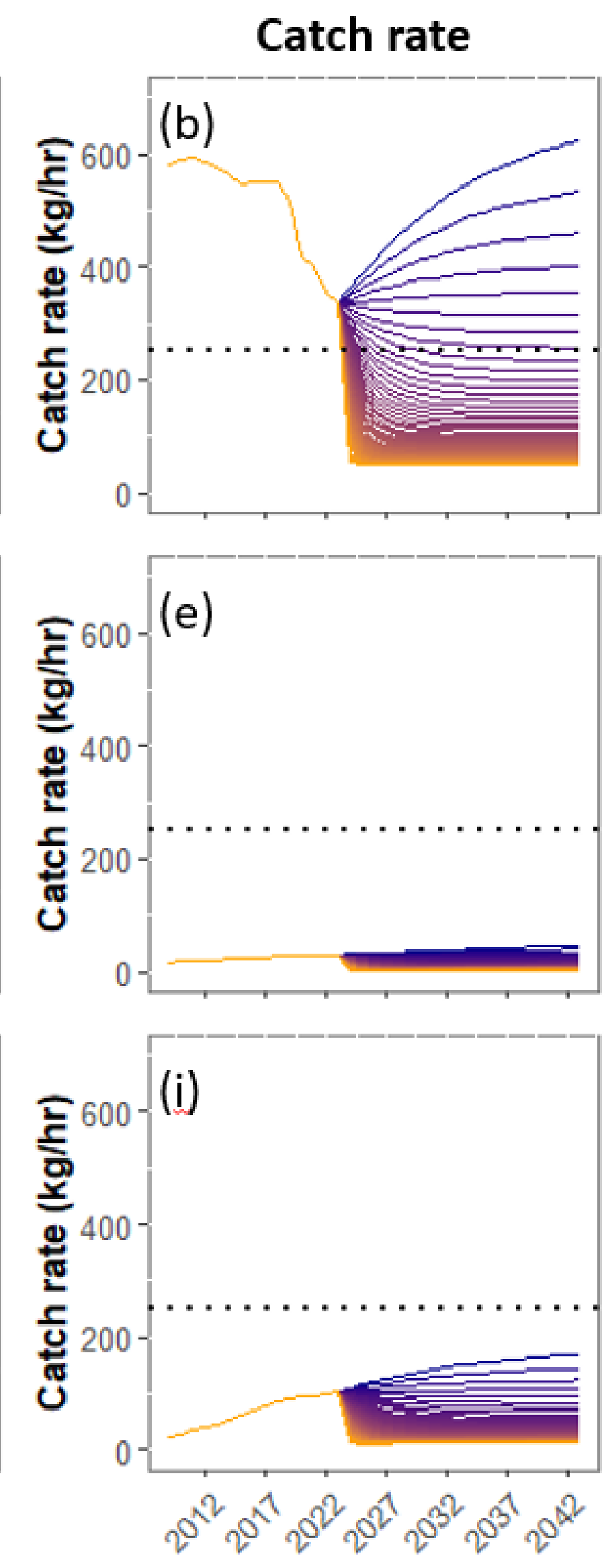
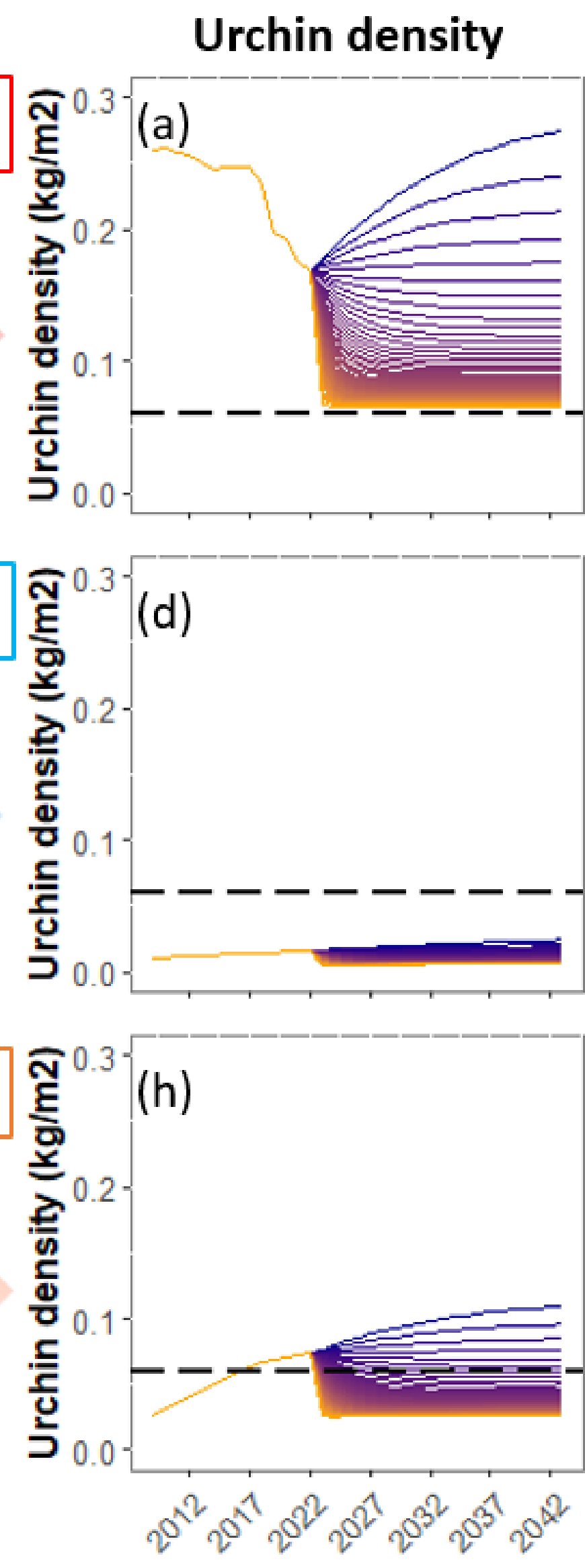
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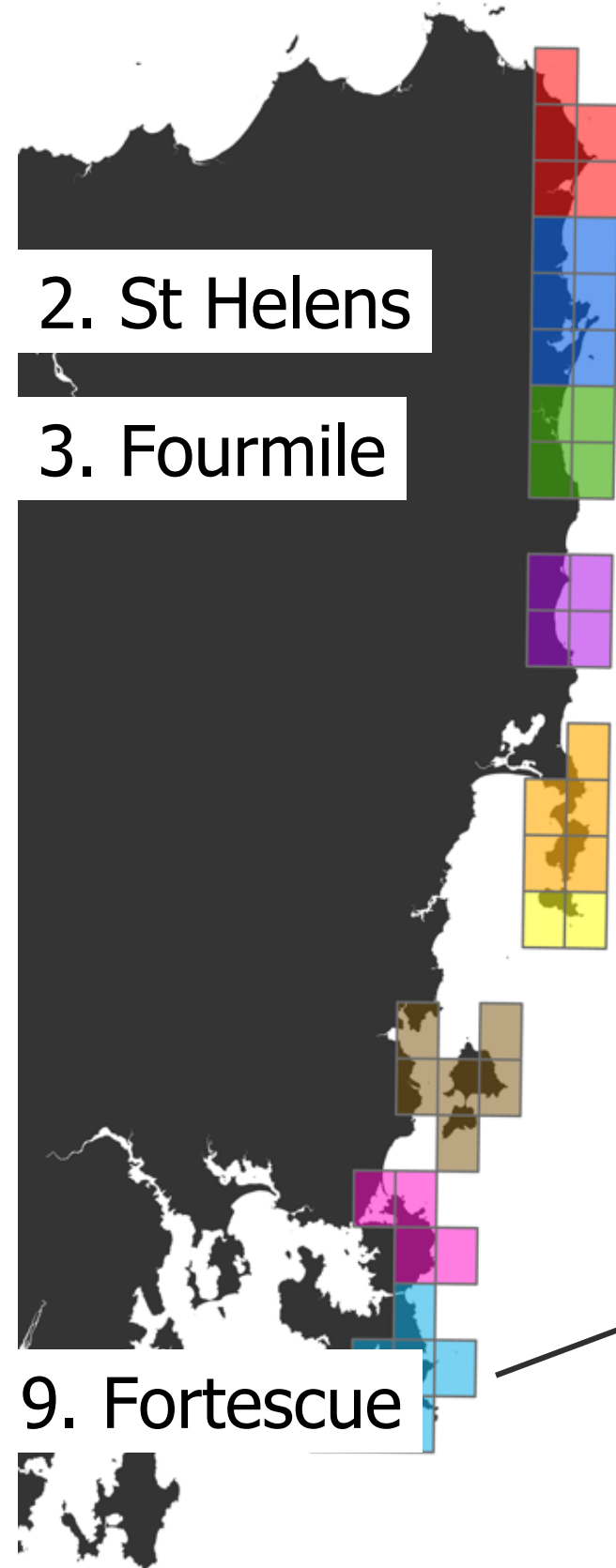


Region 2
High

Region 3
Low

Region 9
Medium





2. St Helens

3. Fourmile

9. Fortescue

Region 2

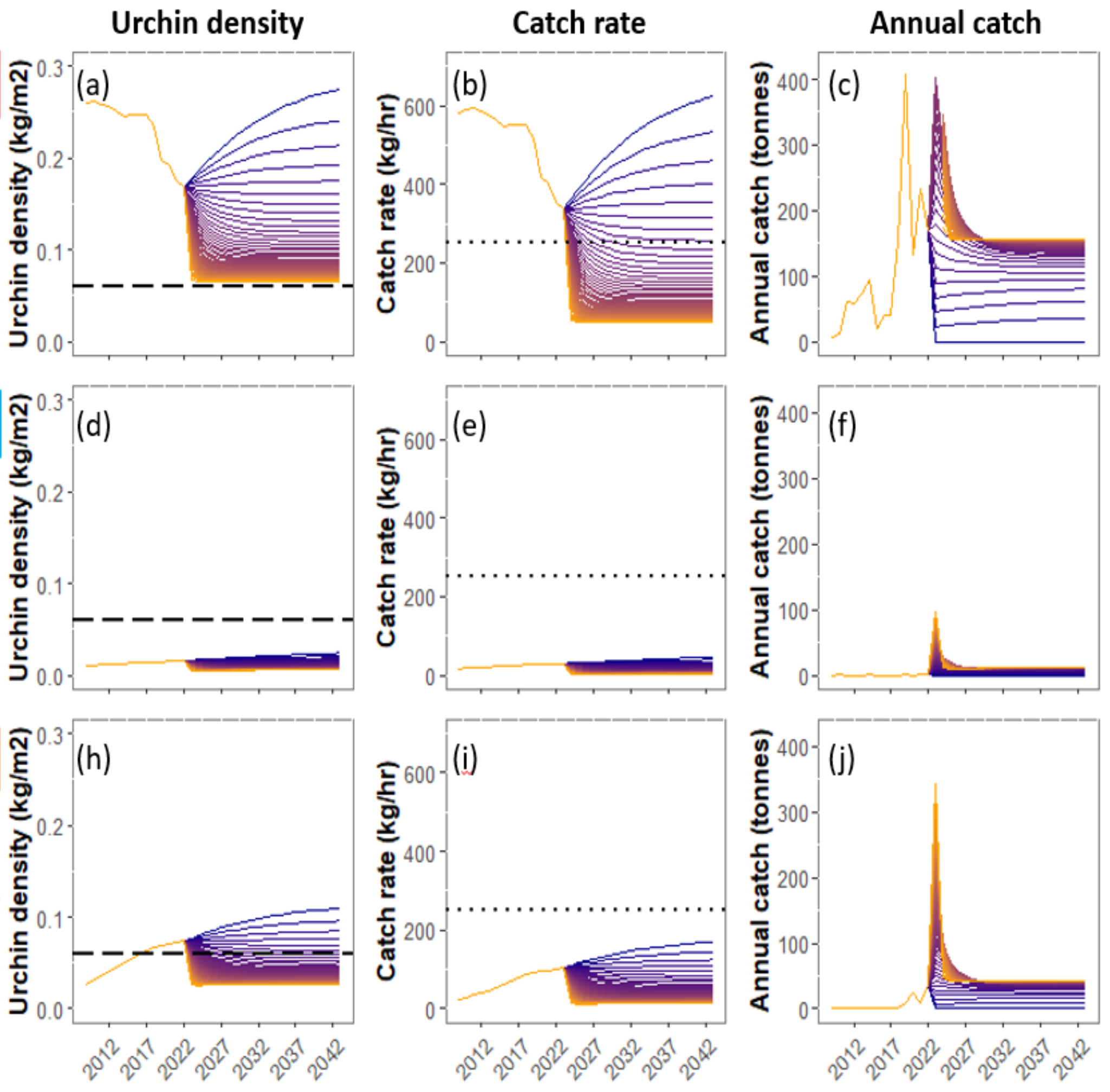
High

Region 3

Low

Region 9

Medium

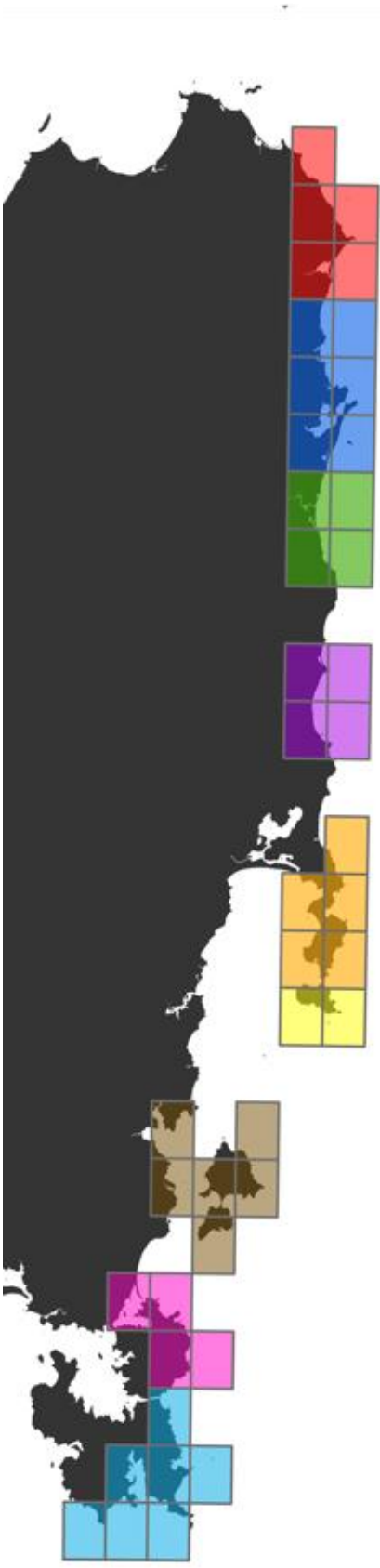




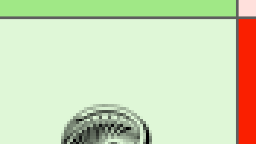















Management options:

Unlikely to reach ecological target, could try other target

Could do nothing for 5/10/20 years

Small annual removal could keep density in check, would need subsidy



		FISHING INTENSITY to reach eco target	HARVEST INCREASE NEEDED?
		-	
		Fishery region Can't reach eco target Decide on target	Sustainable fishery region?
		-	
		-	
		Same effort as 2022	\$
		DOUBLE effort of 2022	\$
		TRIPLE effort of 2022	\$\$
		-	
		5x effort of 2022	\$\$\$

Findings

- Not a smooth latitudinal gradient
- Using same approach in each region unlikely to succeed
- Some regions may not need immediate action
- Regular density surveys recommended
- If ecological threshold not possible, could try sustainable fishery target or other



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