

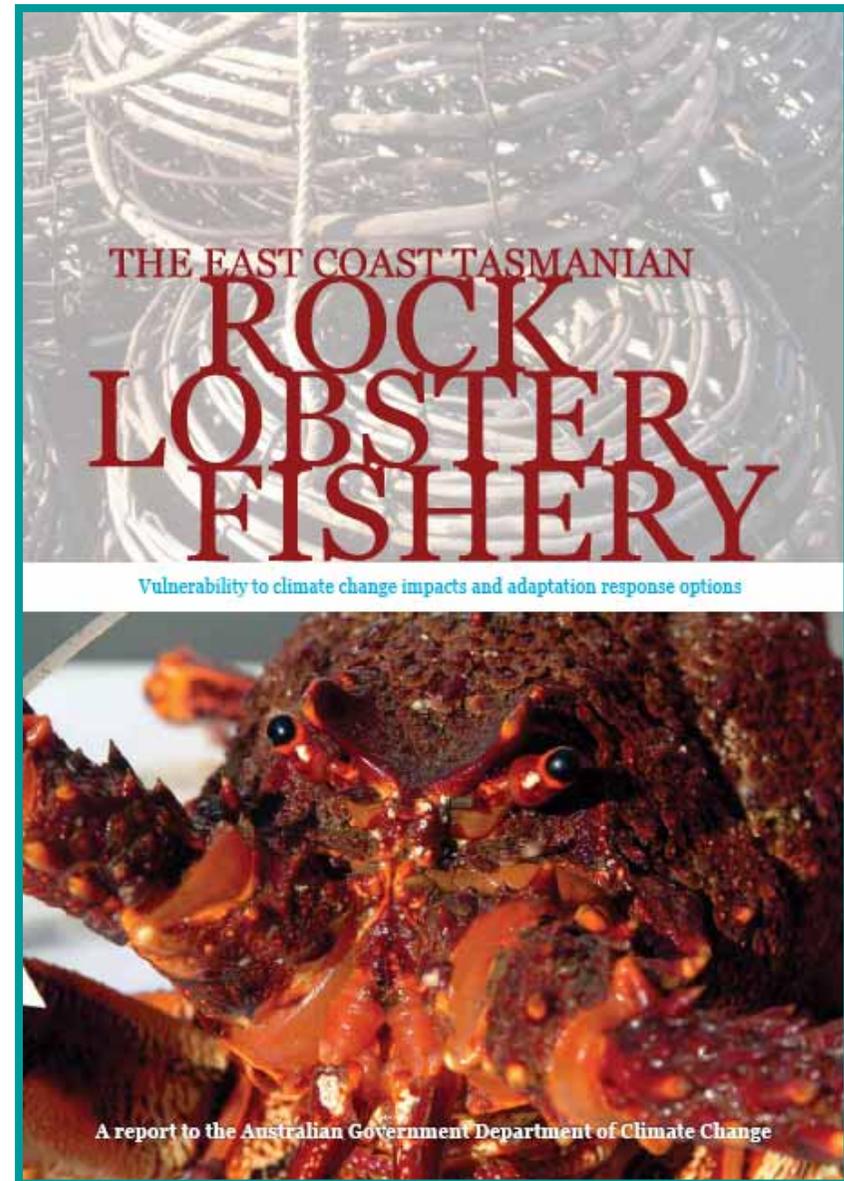
An integrated approach to assessing climate change impacts and adaptation options in fishery systems

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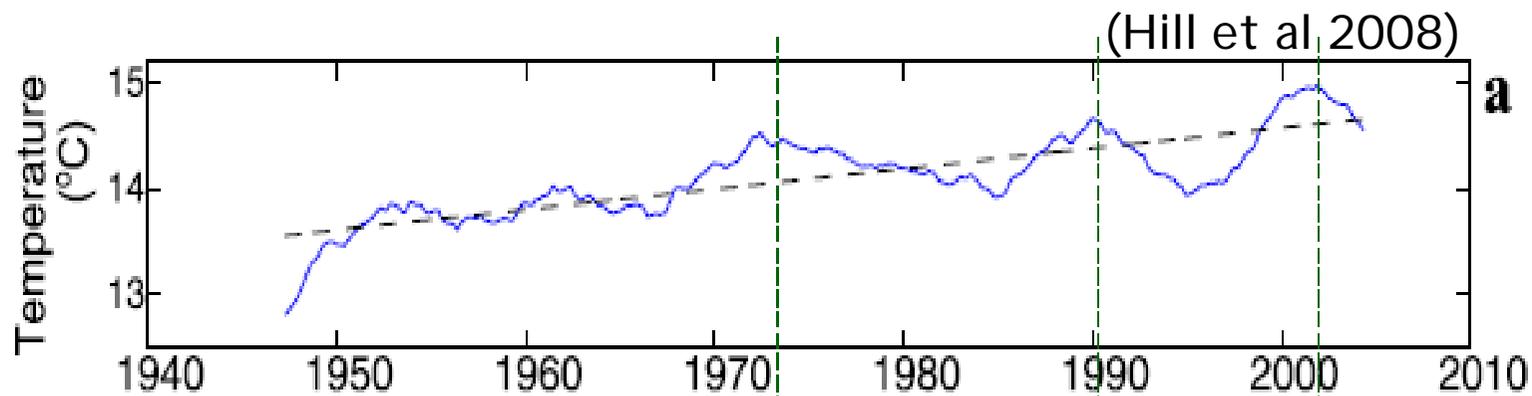
East Coast Rock Lobster Fishery Case Study

- Tender from the Department of Climate Change (DCC)
- One of six case studies to support the National Coastal Vulnerability Assessment (NCVA)
- Desktop study using existing information
- Preliminary findings, report due for release soon



Why choose the Tasmanian rock lobster fishery as a case study?

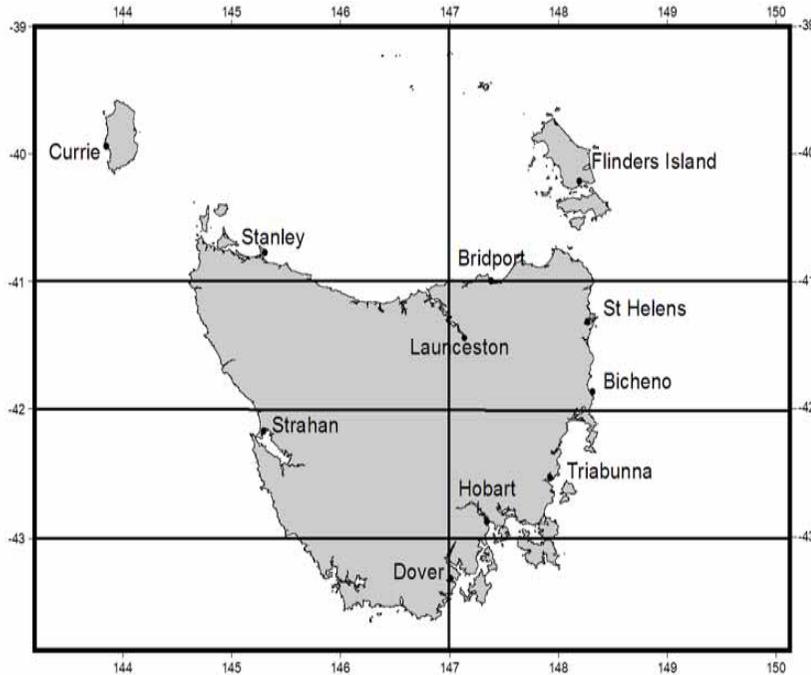
- climate change variability (*past, present* & future)
- significance of the system at risk
- availability of existing data



Recorded SST temperature at Maria Island

Area of significant change in the past & predicted
'hot-spot' in the future

Rock lobster - 2nd most important fishery in Tasmania



- \$72M 2008/09, employs 700 people
- 30,500 recreational licenses
- Major ports for commercial fishery distributed around the state

Research approach

- Correlations between key variables (growth, recruitment, catch rates) and physical drivers associated with climate change (temperature, currents)
- Evaluate likely distribution and abundance using SST climate projections at 2030 & 2070 based on 'medium' and 'high' scenarios
- High scenario is the one we are tracking

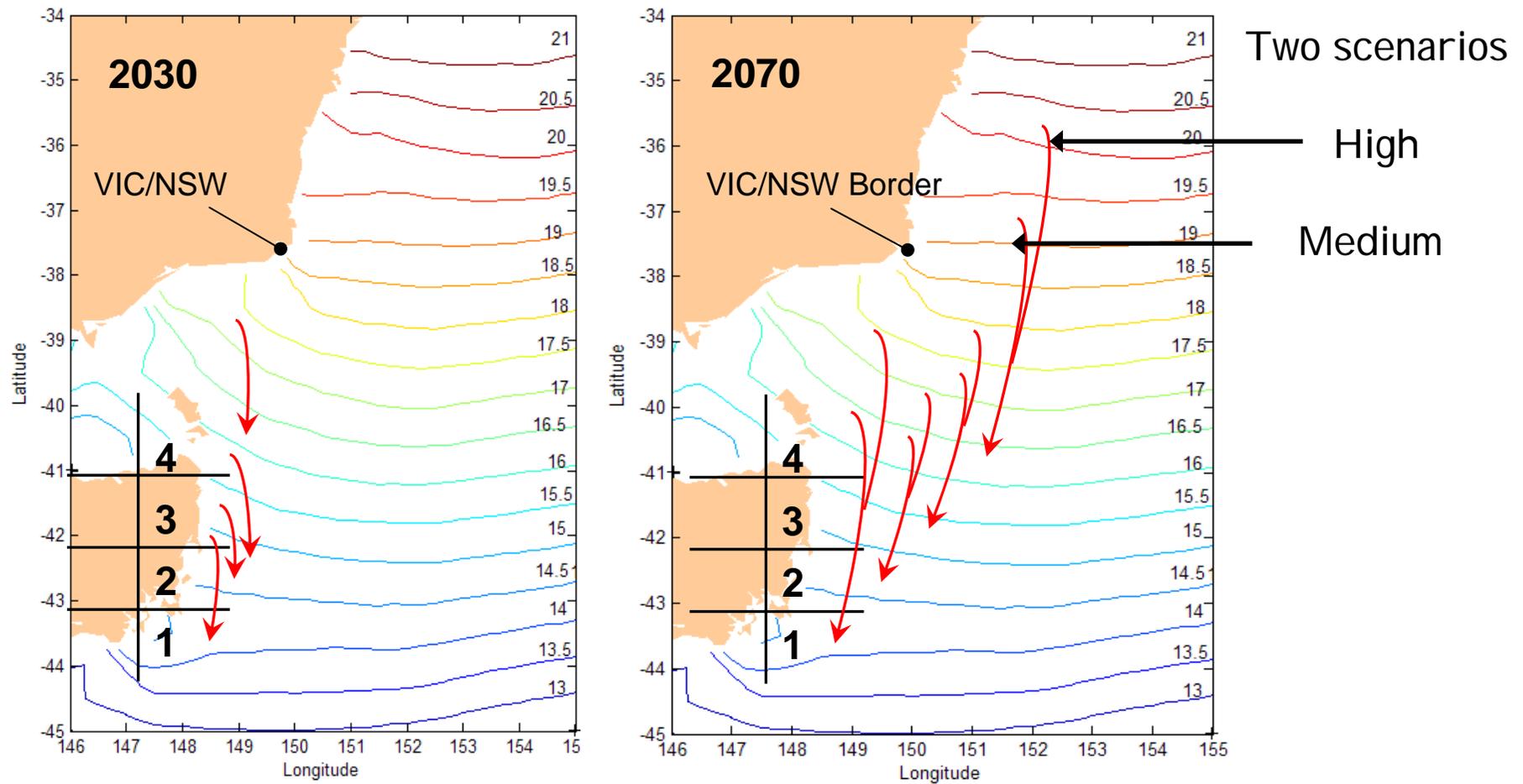
Multiple approaches to developing stock 'scenarios'

- 1) Relative 'temperature zone' movement
- 2) Relationship between recruitment to the fishery & temperature
- 3) Measured trends in puerulus settlement & temperature
- 4) Other ecosystem-level considerations (predator/prey & habitat)

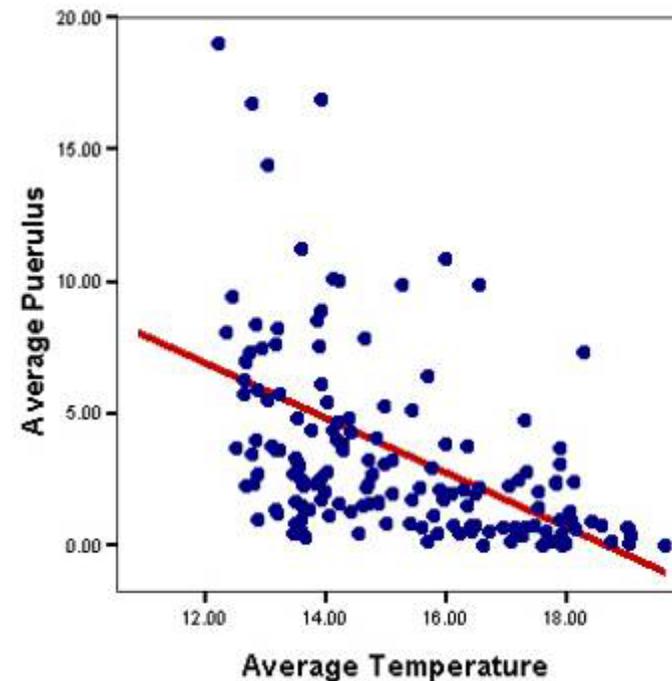
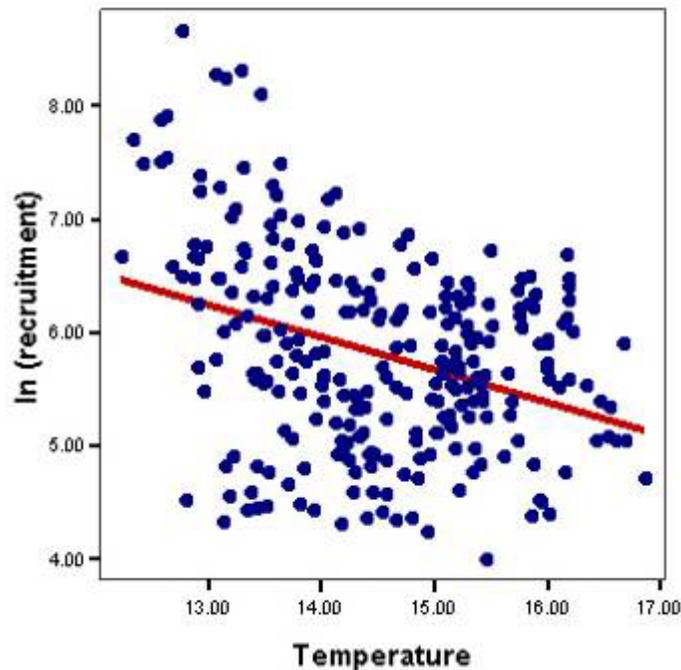
Uncertainties with ALL approaches - projecting into the future, based on past relationships!

Important to utilise multiple approaches and data from independent sources

Predicted spatial change in water temperatures



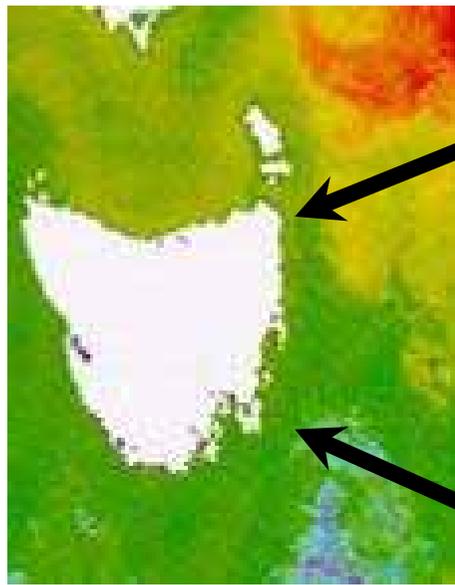
Recruitment & settlement trends of rock lobster in Eastern and SE Tasmania



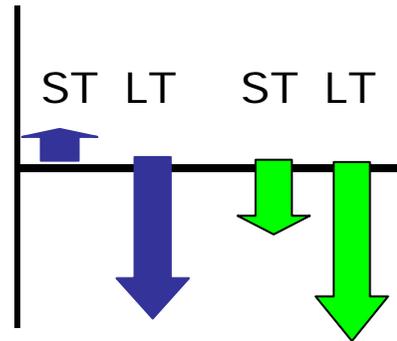
As temperature goes up, both recruitment (estimated from modelled log book data) AND settlement goes down

Response to temperature – growth and recruitment

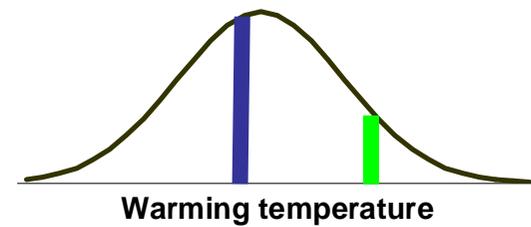
(ST = Short term, LT = Long term)



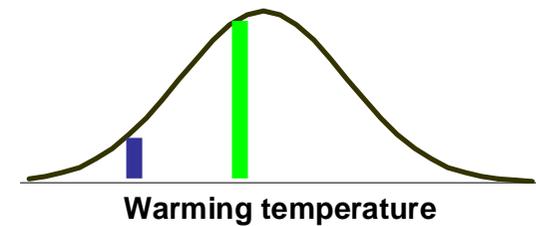
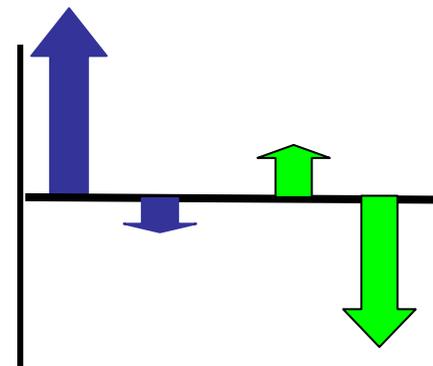
SOUTH - potential for initial gains before declining recruitment lowers biomass



Growth | Recruitment



Low adaptive capacity



High adaptive capacity

↑ Growth with ↑ temperature will
compensate for decreased recruitment
UP TO A POINT

improved
growth
(southern
regions)

Vs

Declining
recruitment
(all regions)

- Trade-off between ↑ growth and ↓ recruitment
- Biomass may increase *before* it decreases (mainly in the south)

Ecosystem-level considerations – predator/prey & habitat

Urchins eat kelp & other marine plants – inshore reefs turned into ‘urchin barrens’ with negative impacts on rock lobster, abalone & other reef species



- Temperature-specific development of *Centrostephanus* larvae
- Spawning period is winter (Aug/Sep)
- Larvae do not complete development when winter temperatures below 12°C

Ling, S.D., Johnson, C.R., Frusher, S.D. and King, C.K. (2008). Reproductive potential of a marine ecosystem engineer at the edge of a newly expanded range. *Global Change Biology*. 14: 907-915.

Increase in suitability of the environment for *Centrostephanus* to complete it's life cycle.

Average winter (August) water temperatures



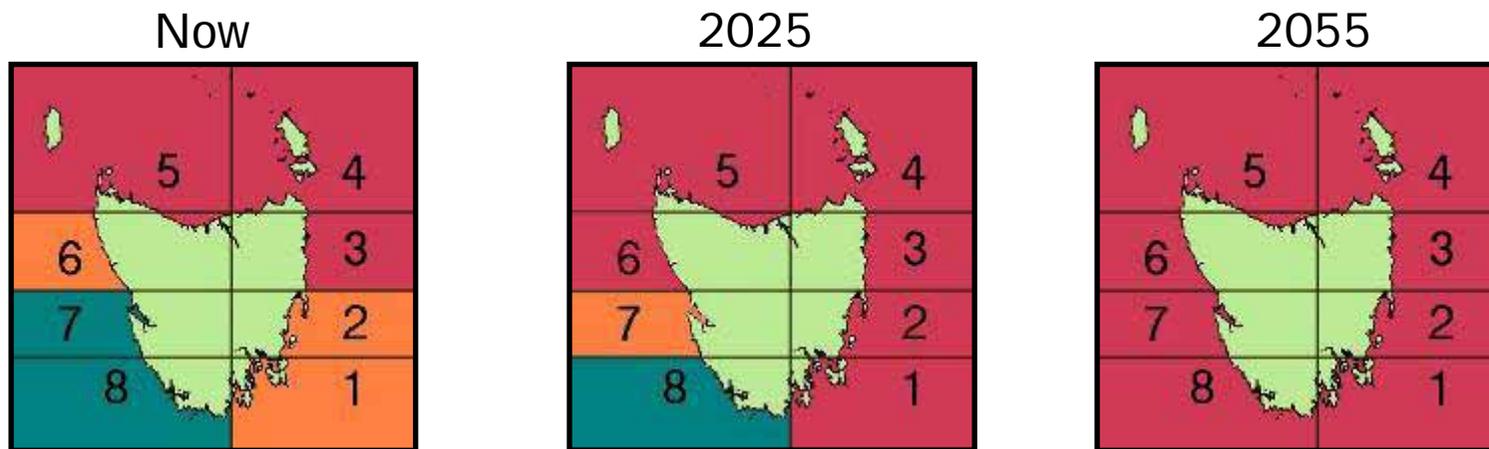
Greater than 12.5°C



Between 12°C & 12.5°C



Less than 12°C



Centrostephanus will be able to reproduce along the entire east and northern coasts by 2025 and along the entire Tasmanian coast line by 2055!! **Negative implications for many inshore reef species**

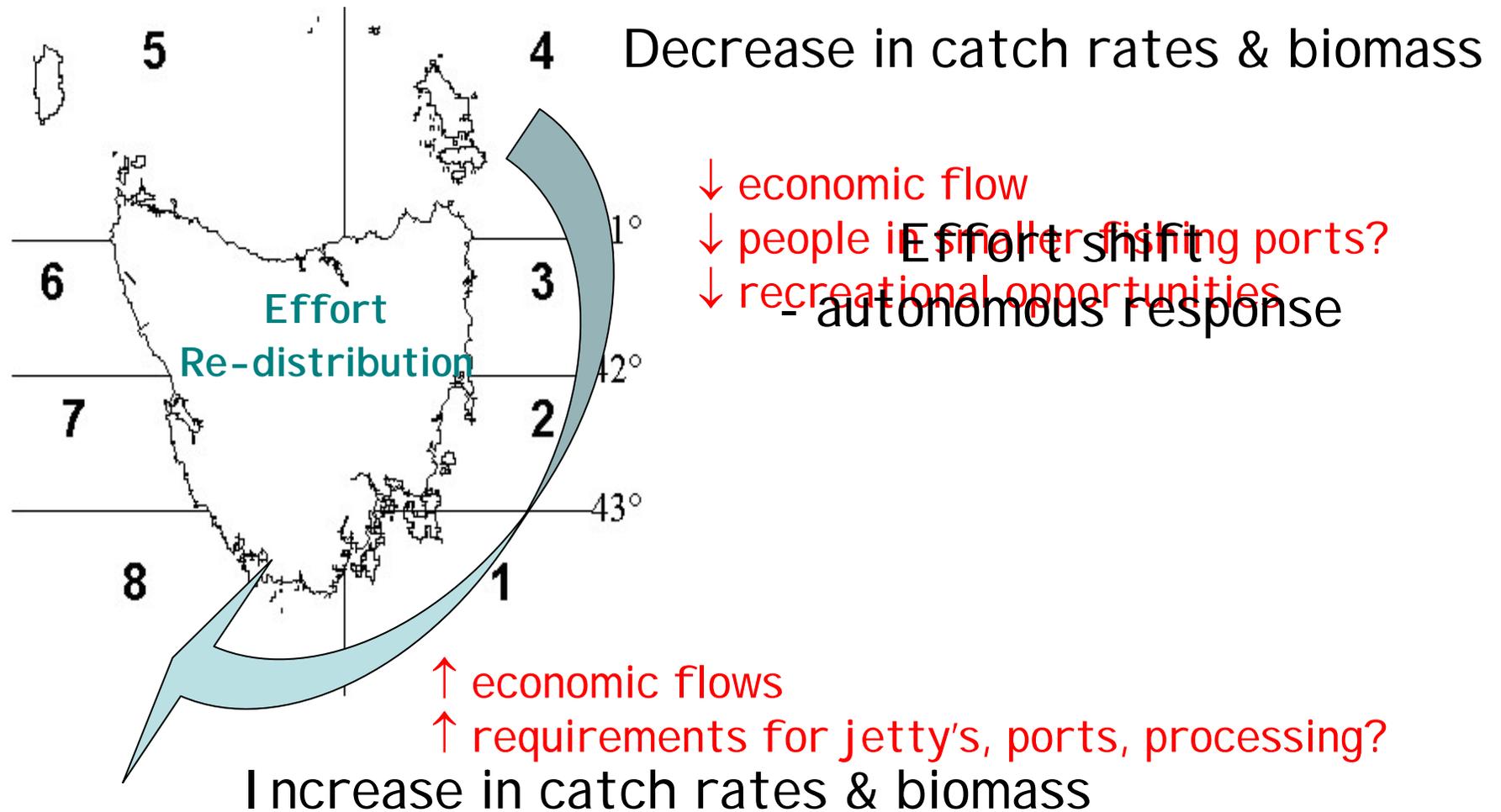
Temporal & spatial convergence of independent impacts

- **Tipping point** in population dynamics (recruitment decline outstripping growth)
- **Ecological threshold** for the ecosystem (*Centrostephanus* barrens formation)
- Change in abundance of **keystone predators** (octopus)

Impacts greatest in the NE first, progressing down the coast

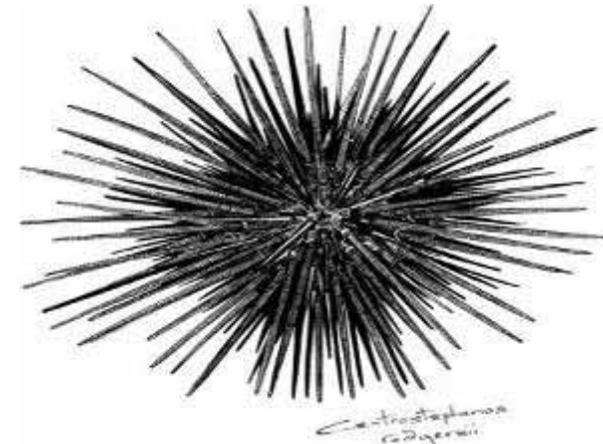


What do the impacts on the resource mean for human system?



Summary of predicted impacts

- Warmer waters may mean the east coast will be unable to support rock lobster populations of the same size as found today
- Less lobsters BUT faster growing (in southern regions)
- Lower recruitment in the north, NOT totally compensated by higher growth, so catch will shift south
- Declines in rock lobster biomass are predicted to occur initially in N/NE regions, before eventually also declining in the south
- Because of the mobility of the fleet, social and economic benefits/impacts will be regional. The south-western regions are predicted to increase and/or maintain catches longer than other regions
- The region most likely to support the fishery for longer is the south-west
- Ecosystem changes
 - Higher probability of barren formation
 - Increased prevalence of eastern rock lobster
 - Increased predation by octopus?



Assessed impact & vulnerability in ecological system...what about vulnerabilities in the human system?

- Risk perception exercise (MNB)
 - aimed at understanding how those in the industry feel and think about an issue
 - surveys and interviews with commercial fishers
- Fishers have varying perceptions on reality of climate change
 - about 40% say its not happening
 - about 30-40% say 'the jury is out'
 - about 20% think it is either happening or that 'something is up'



Capacity to adapt



- Regional management tools - identified increased need for spatial management options
 - control of effort in SW
 - protect large lobsters in NE & E (*Centrostephanus*)
- Inshore management options for recreational fishery (*Centrostephanus*)
- Communication tools – cc awareness and resource allocation issues
- Utilising multi-criteria analysis approach in current fishery management – facilitate incorporation of cc into core business

Key messages from case study

- Moving out of known space in terms of how processes, species & ecosystems impacted synergistically by temperature & other changes
 - *main factor to consider with climate change is greater uncertainty*
- Rock lobster fishery selected as a case study as data rich compared to other fisheries – yet STILL major data/knowledge gaps
- Assessment of adaptation options requires integrated approaches – social, ecological and economic – we need to develop skills and techniques in this area
- Adaptation is a long-term agenda, it will take time to quantify risks of impacts and build capacity to minimise costs and take advantage of any benefits
- Stakeholders' 'on the ground' assessments of issues, opportunities and imperatives needed to form a more complete picture of priorities and risks.
- Communication is important!!



Thanks!