National Research FLAGSHIPS Climate Adaptation

CSIRO

tafi
Tasmanian Aquaculture and Fisheries Institute

IMAS
INSTITUTE FOR MARINE AND ANTARCTIC STUDIES

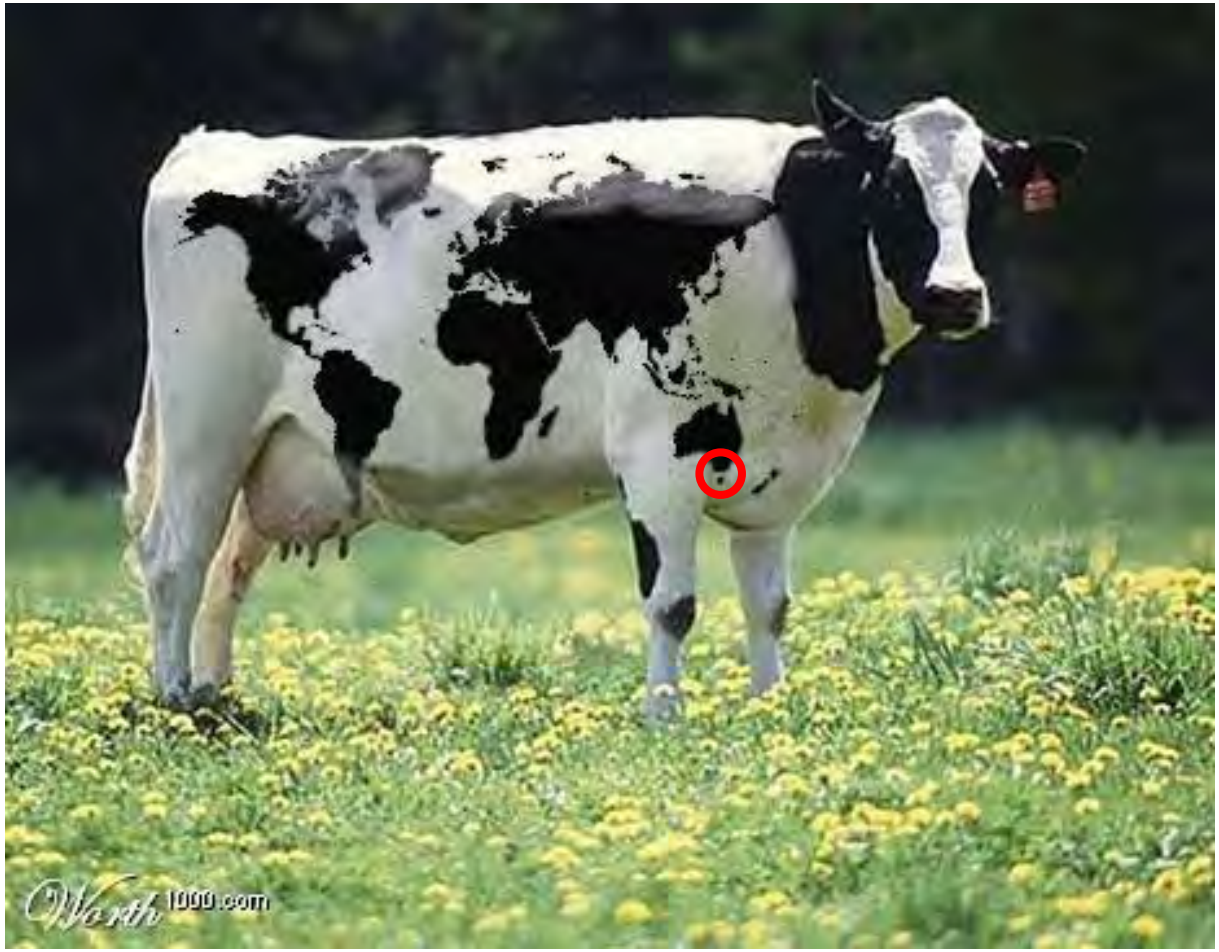
UTAS

Tasmania
Explore the possibilities

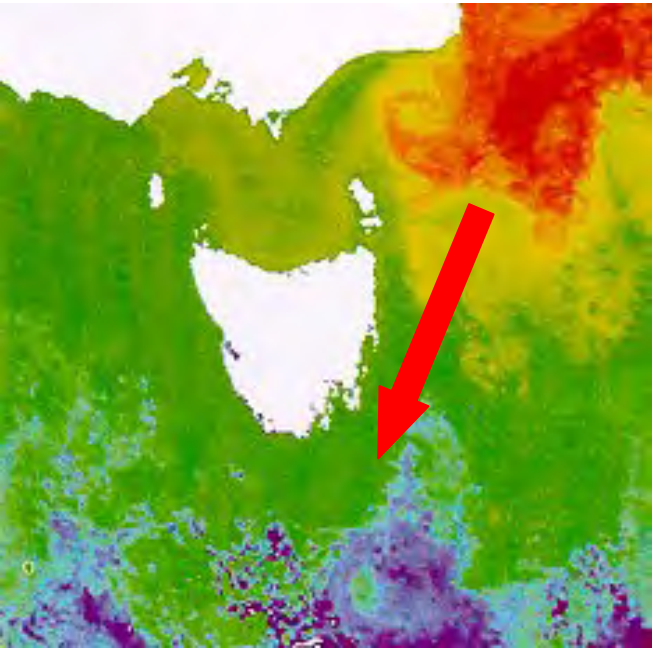
Climate driven changes in marine assemblages in SE Australia: a southern hemisphere 'hotspot'

Stewart Frusher, Gretta Pecl, Alistair Hobday, Craig Johnson, Zoe Doubleday

TAFI is a joint venture between the State Government and the University of Tasmania


Worth1000.com

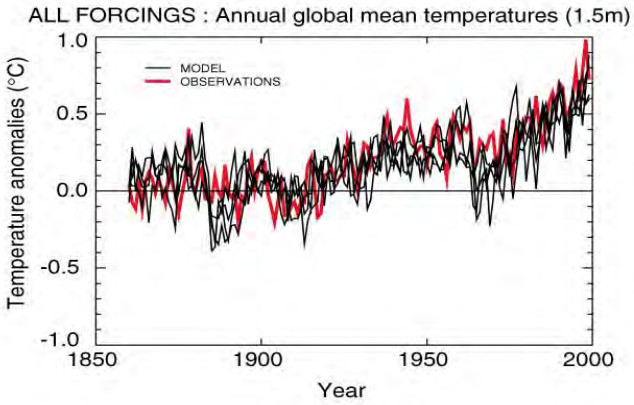
Climate change in SE Australaia



SE Australia is predicted to be the fastest warming region in the southern hemisphere

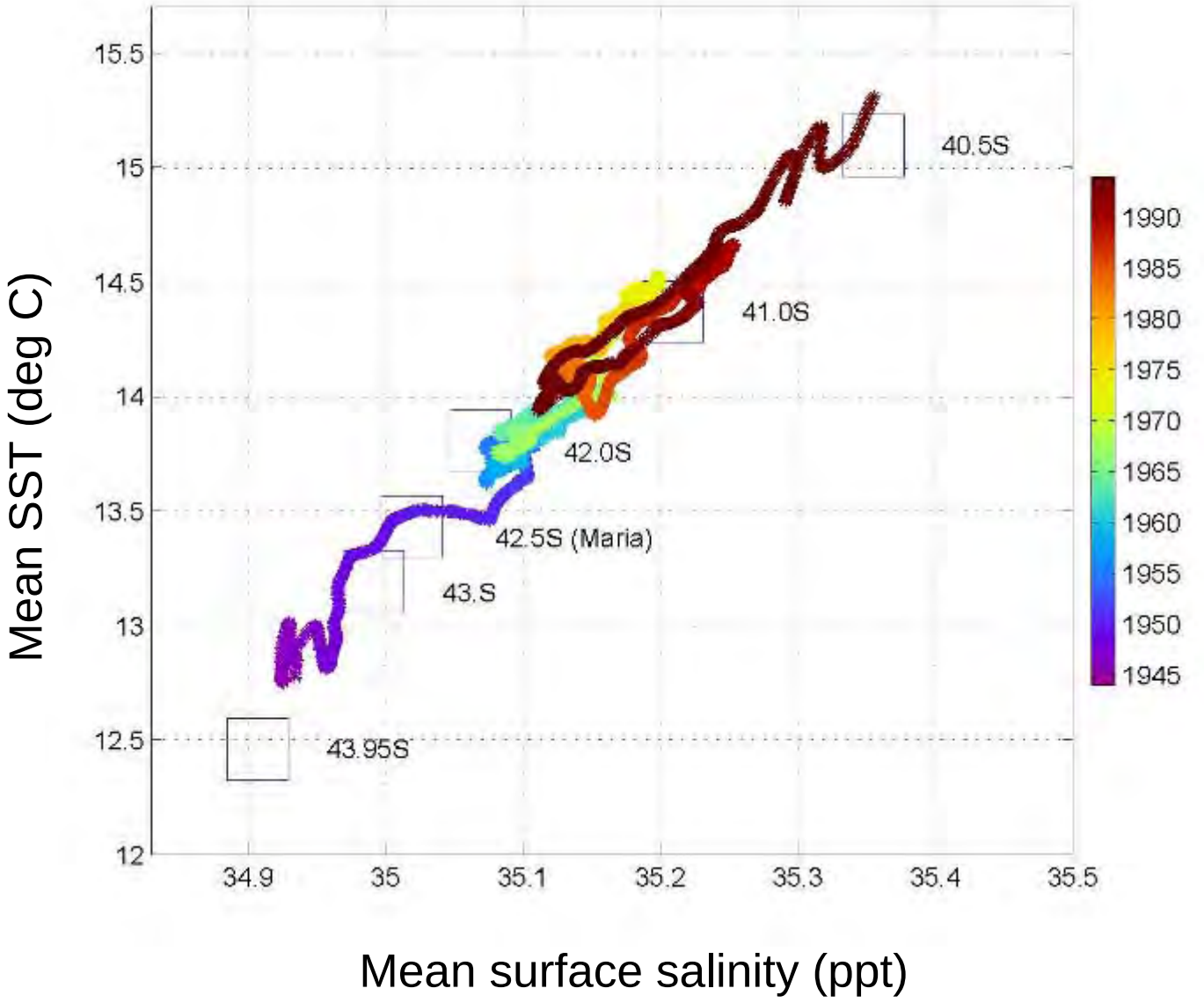
Water temperature predicted to rise by 3^0C to 5^0C

(3.8 X global average)



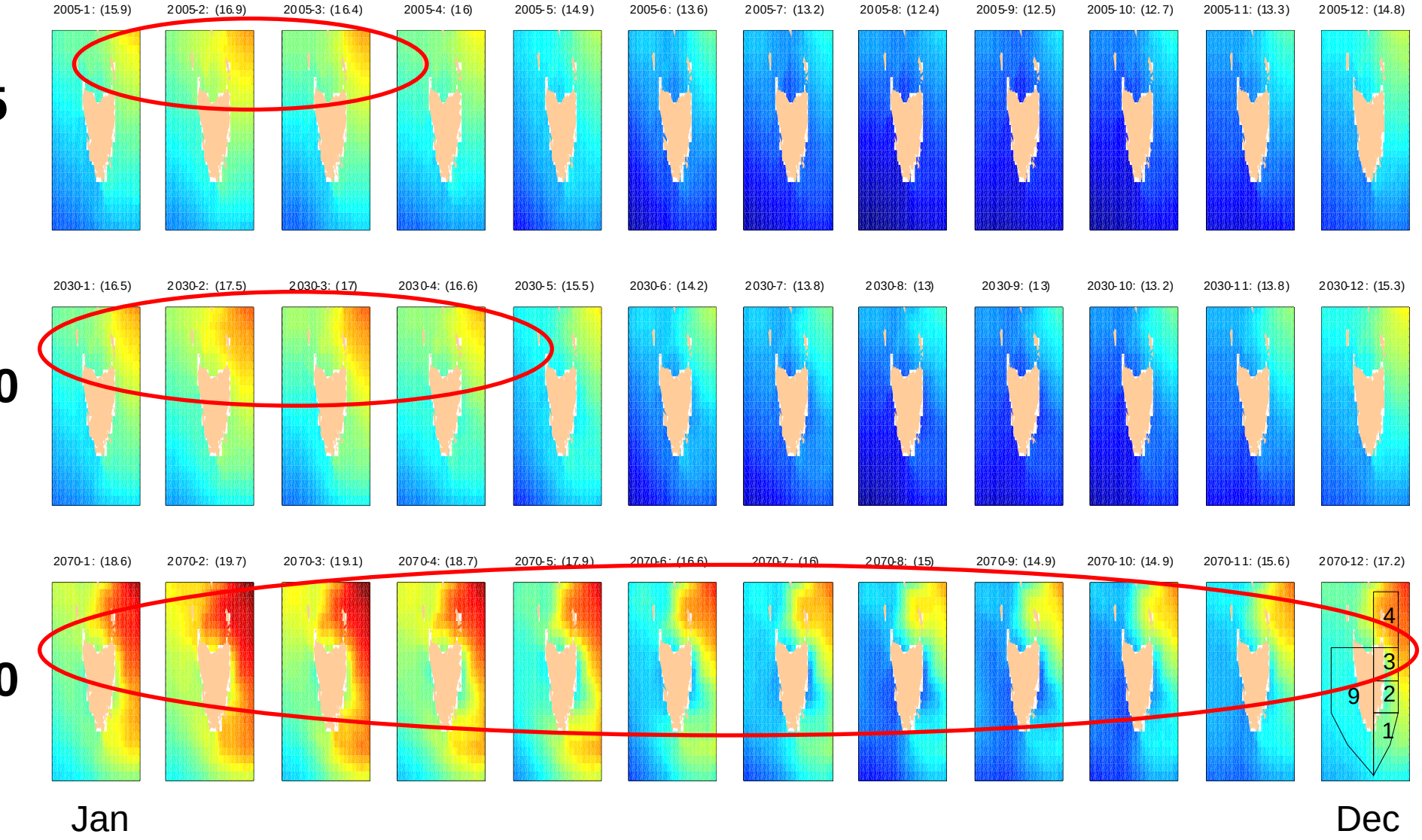
Increase in strength and southern penetration of East Australian Current

Climate Change Signal – Maria Is. [Eastern Tasmania]



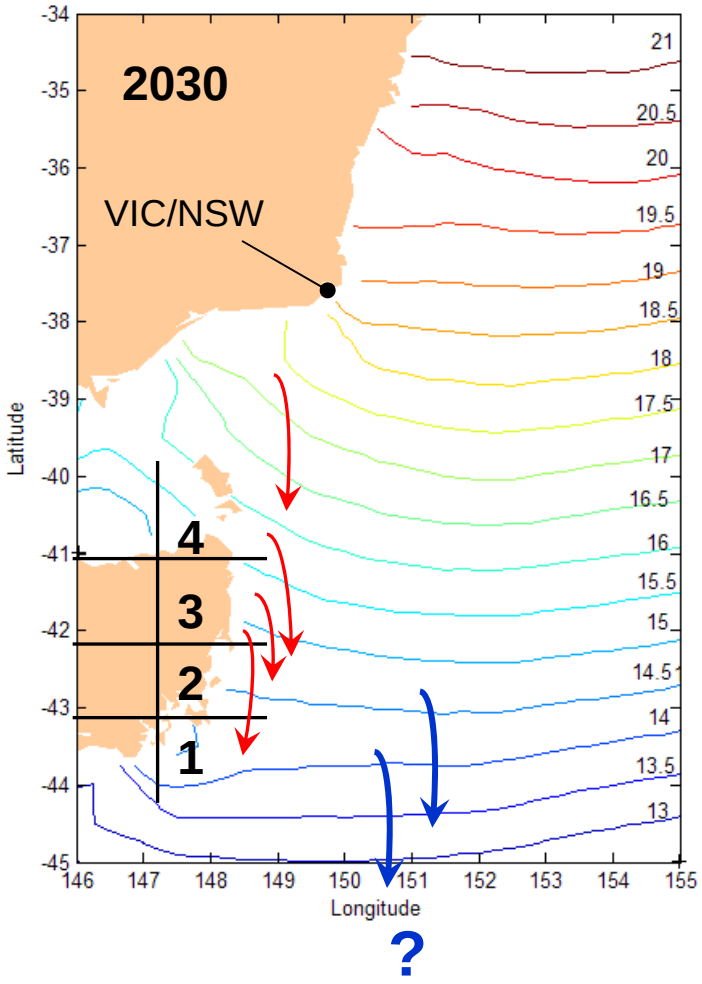
After Hill et al. (2008). *Geophys. Res. Lett*. 35: L08602, doi: 10.1029 / 2007GL032912

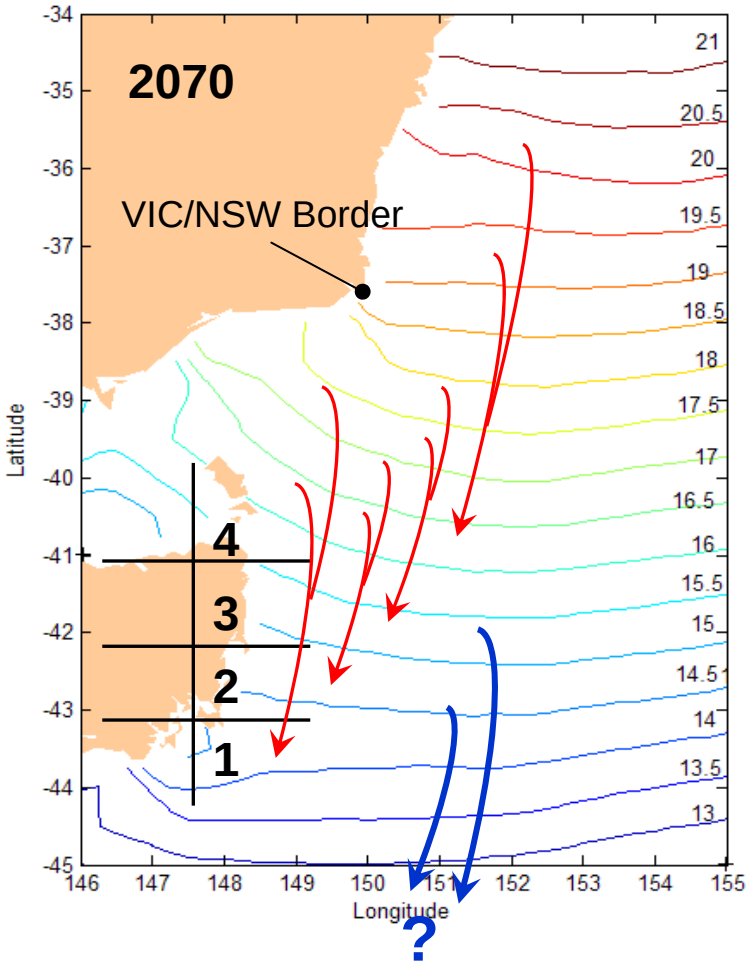
High scenario



Predictions – water temperature

Increased penetration of the East Australian Current

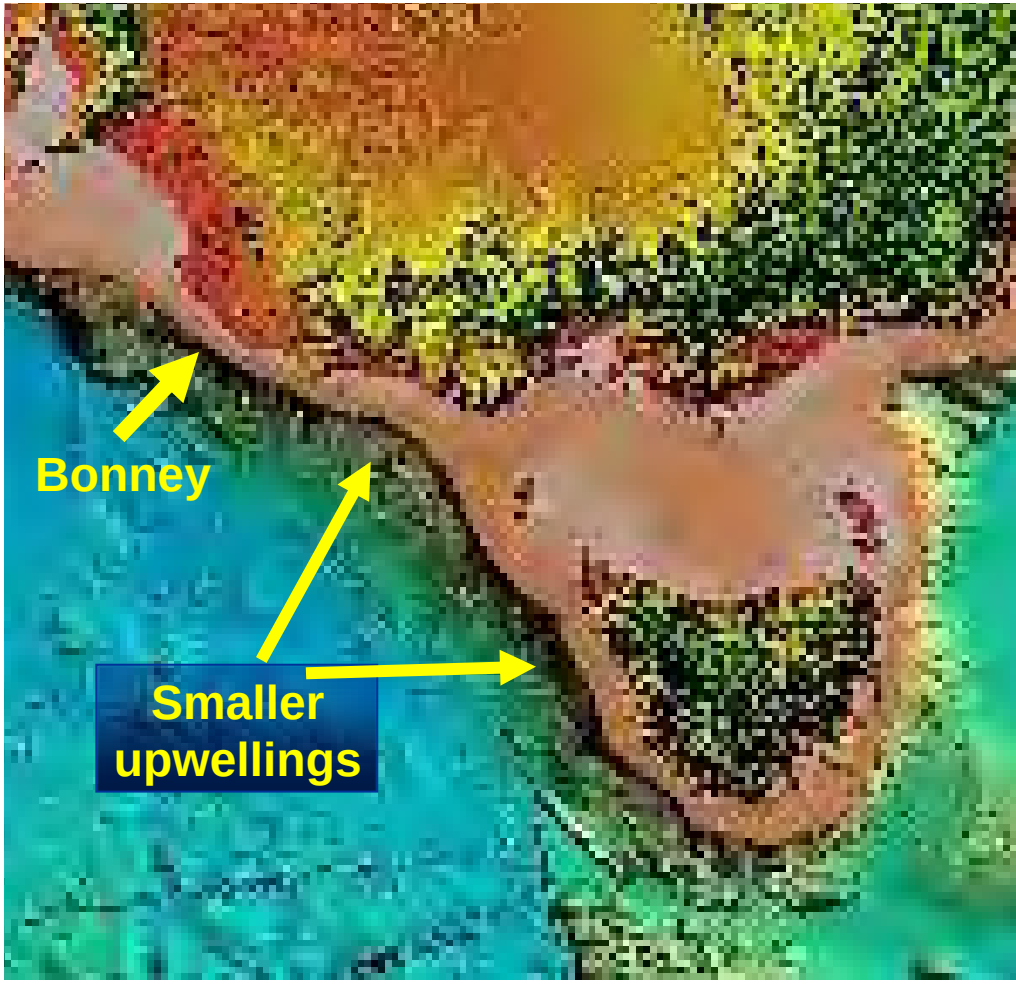




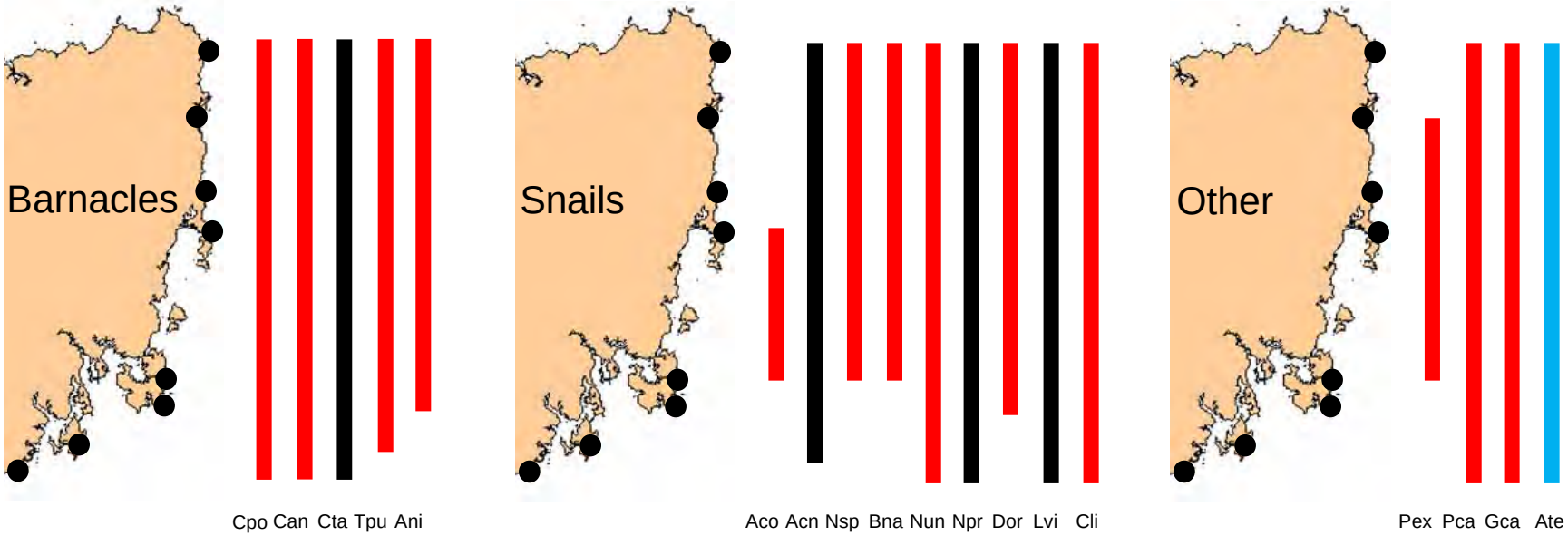
Where do these animals and plants go?

Influence of upwellings

Trend of increasing upwellings bringing cold water to coastal fisheries with declines in catchability and growth.



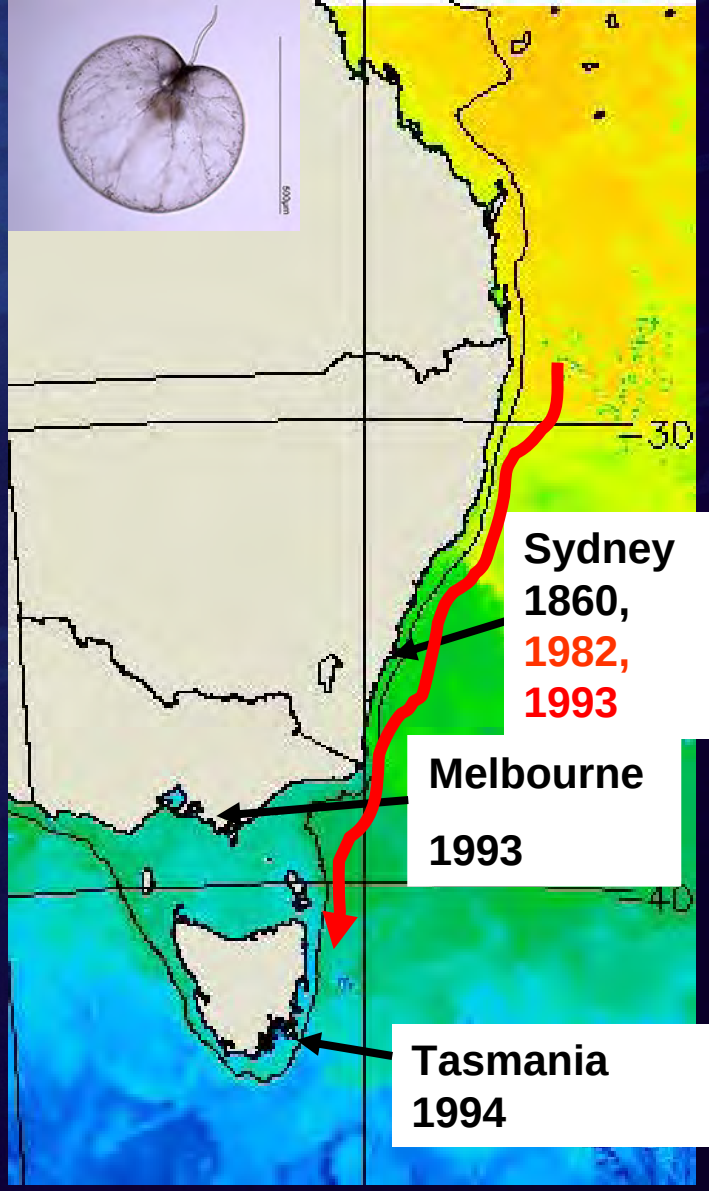
Range extensions: intertidal



Climate-driven range changes in Tasmanian intertidal fauna – 1950 - 2007

Nicole R. Pitt, Elvira S. Poloczanska, Alistair J. Hobday

Climate-driven range extension of *Noctiluca scintillans*



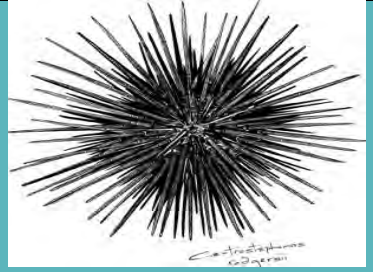
(Gustaaf Hallegraeff)

Changes in fish assemblages 1983-2009
Whole of Tasmania

Category	Number
Newly established	11
Expanded range	23
Abundance increase (mostly southward)	30
New record – extralimital vagrant	4
TOTAL	68

Last et al., submitted MS

Centrostephanus in Tasmania: Pattern of incursion



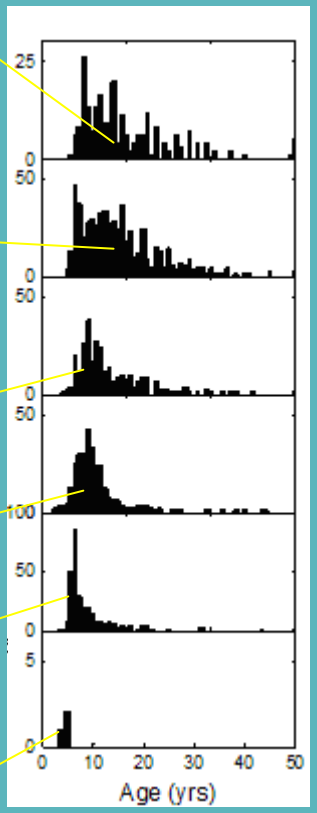
Tasmania

N

42.57 S

147.20 E

Mean age as of Jan 2006



20 y

18 y

16 y

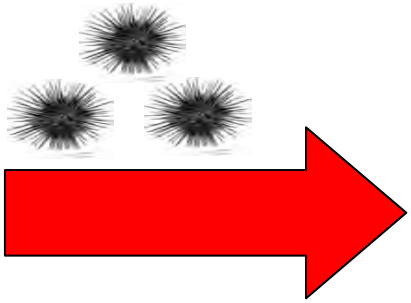
13 y

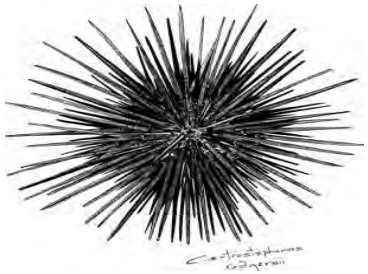
11 y

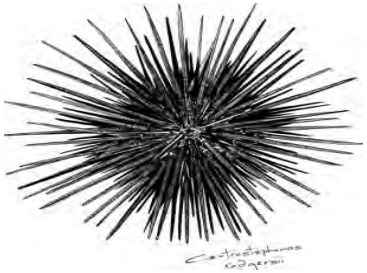
5 y

Ling, Johnson, Ridgway, Hobday, Haddon 2009. *Global Change Biology* 15: 719-731.

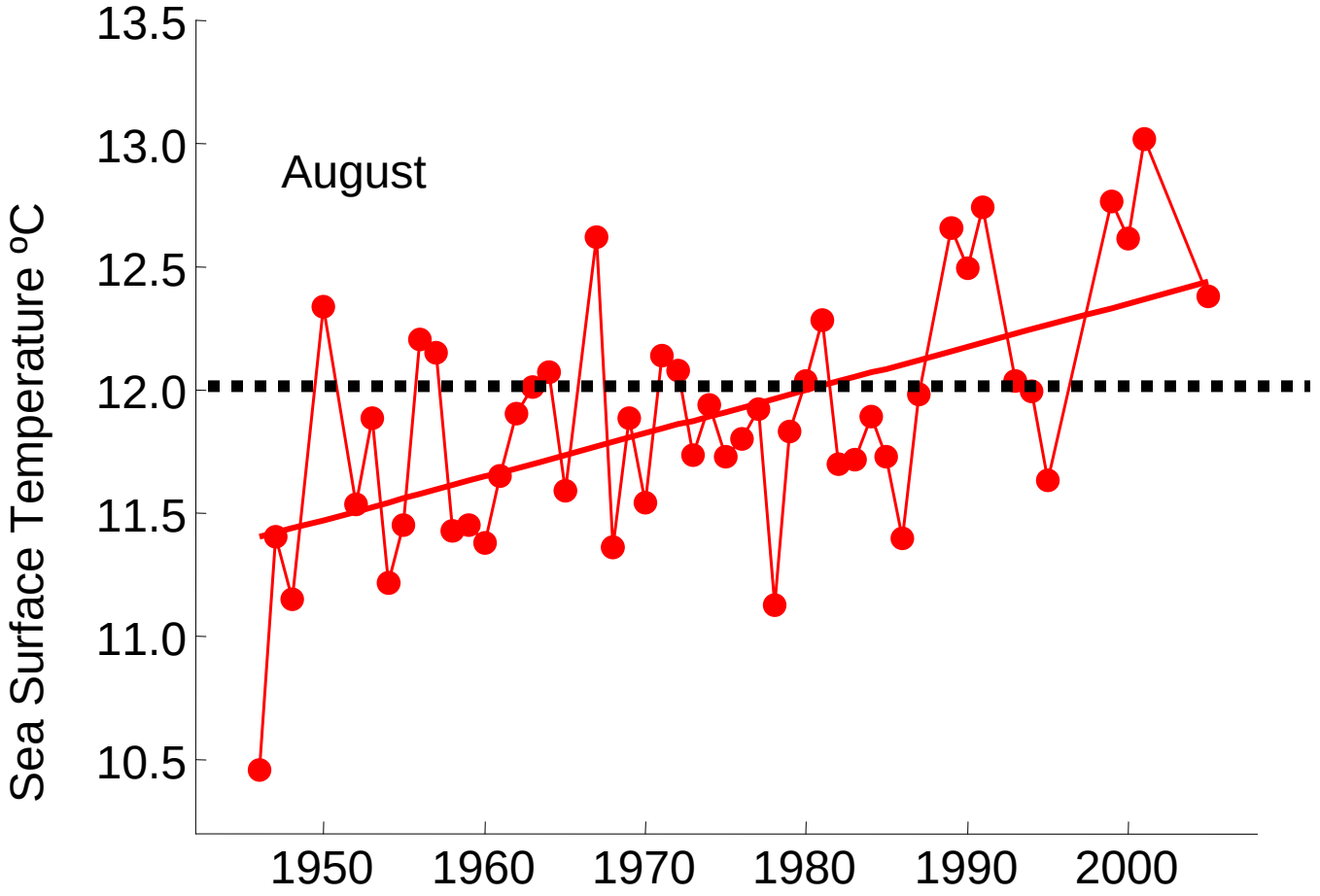
Abundance: *Centrostephanus rodgersii*







>12^{o}C during winter (August)



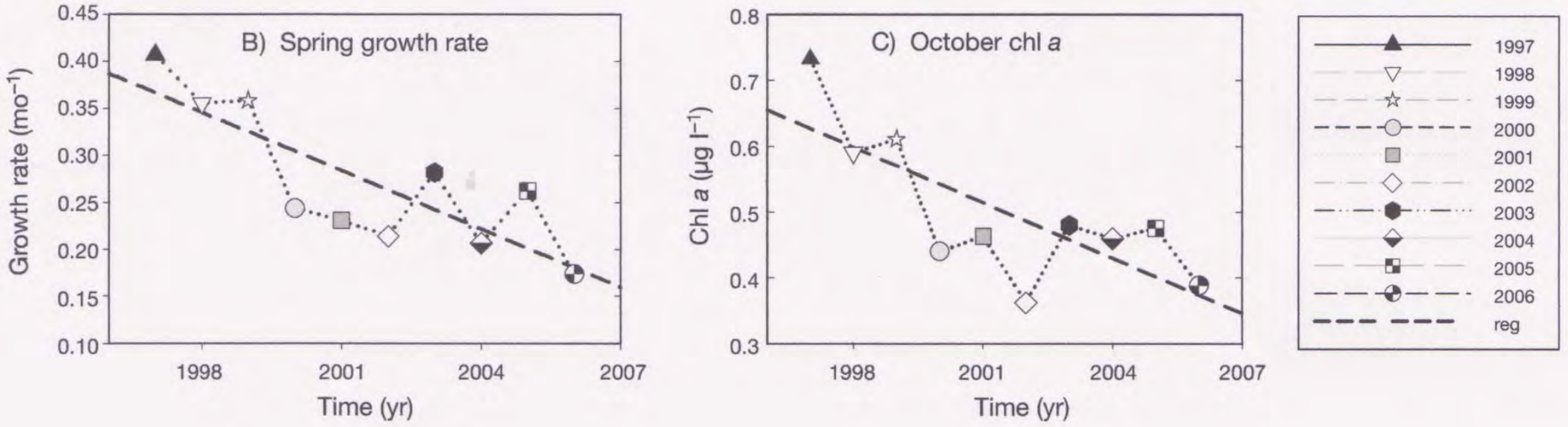
Environment increasingly favourable for *C. rodgersii* to complete life cycle in Tasmania = increasing risk of further 'barrens'

S. Ling PhD data

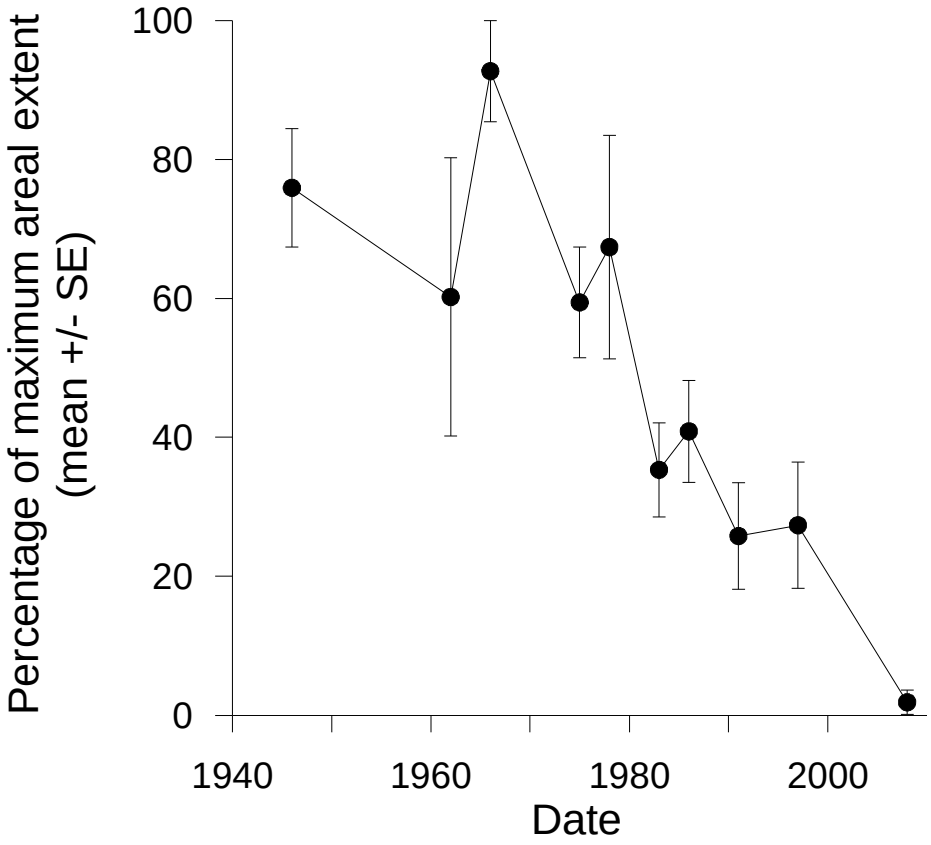
Abundance

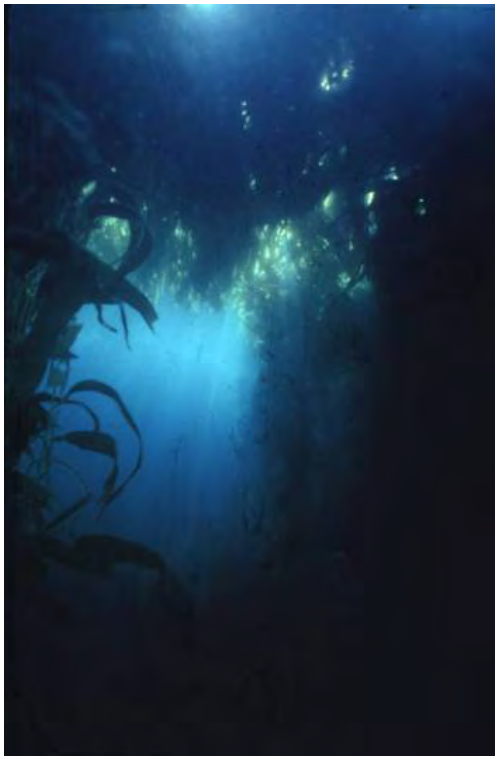
P. A. Thompson, M. E. Baird, T. Ingleton, M. A. Doblin, 2009
Long-term changes in temperate Australian coastal waters: implications for phytoplankton, MEPS

"The western Tasman Sea experienced a ~50% decline in the growth rate and biomass of the spring bloom from 1997 to 2007,"



Decline of *Macrocystis pyrifera* (dense canopy habitat)





Key Driver(s):

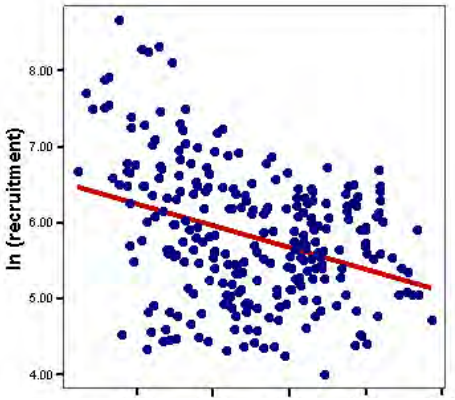
- temperature?
- nutrients?
- temperature * nutrients?

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

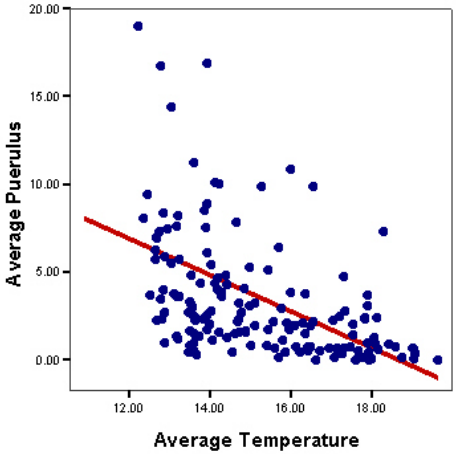
Two data sets:

Assessment model hindcast estimates

- 8 assessment areas since 1970
- Based on recruitment to fishery (legal size class)



- Puerulus settlement
  - Monitored since 1991
    - Bicheno
    - Iron Pot (Derwent Estuary)
    - Recherche Bay
    - Flinders Island (since 1996)



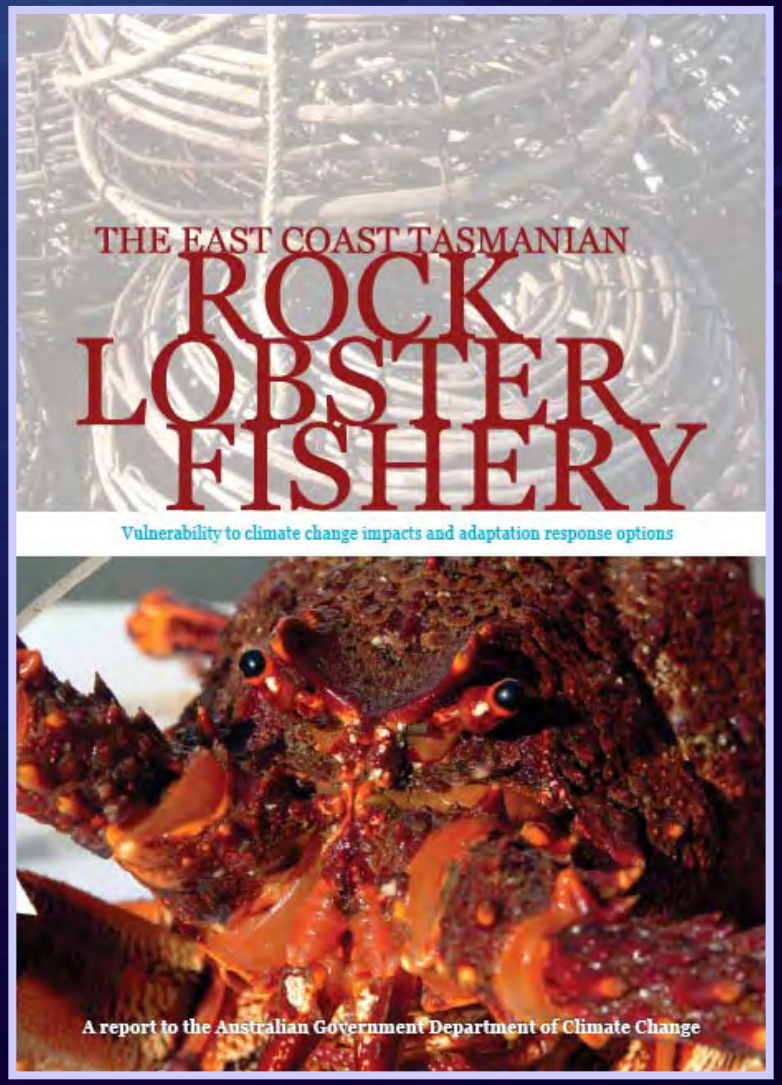
As temperature goes up, both recruitment (estimated from modelled log book data) AND settlement goes down

East Coast Rock Lobster Fishery Case Study

- One of six case studies to support the National Coastal Vulnerability Assessment (NCVA)

- Selected as case study because hotspot for cc & important fishery

- Recruitment
- Growth
- Predator-prey interactions
- Distribution of resource
- Distribution of fishing effort



12:00 Monday

www.climatechange.gov.au/publications/coastline/east-coast-rock-lobster.aspx

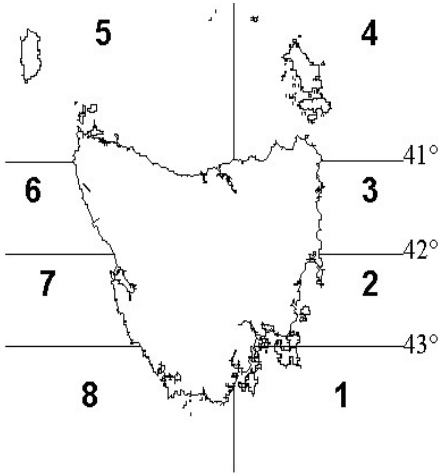
Species interactions:

+ 0.41

+ 0.33

+ 0.22

+ 0.42



+ 0.55

+ 0.62

+ 0.70

+ 0.69

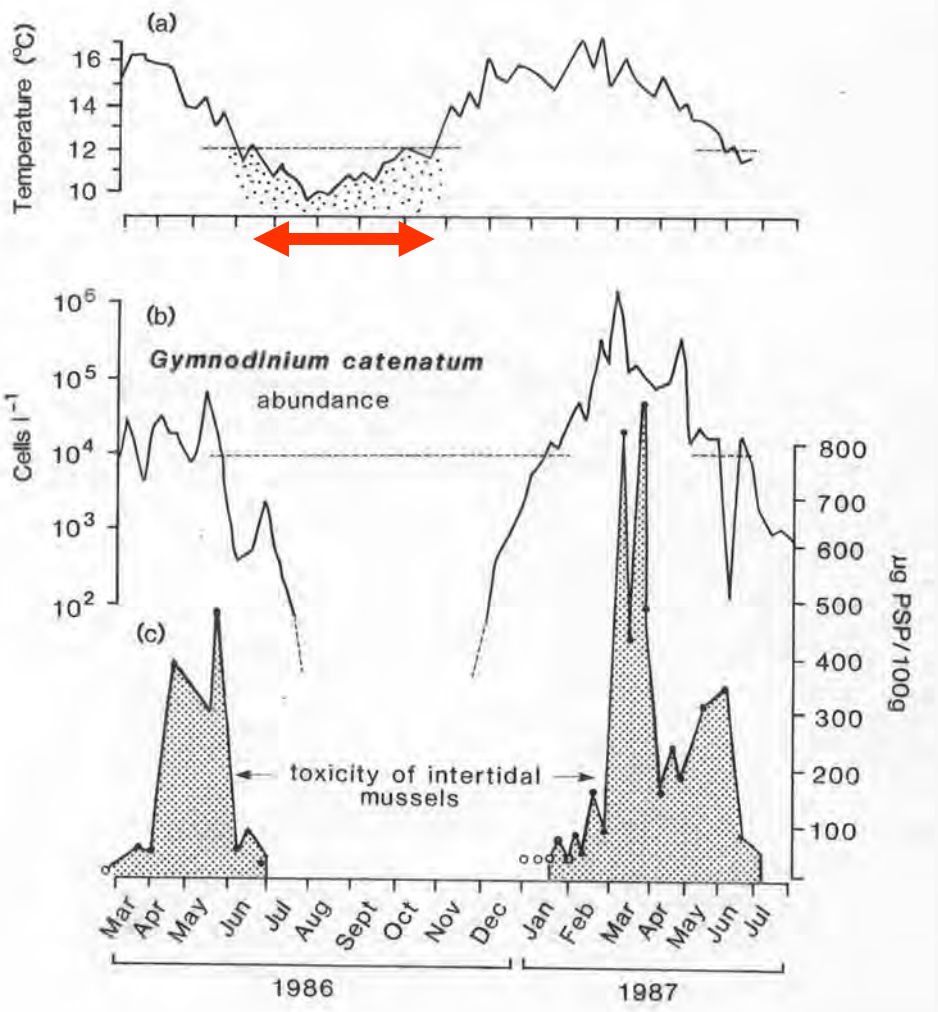
- Catches recorded in lobster fisher's logbooks

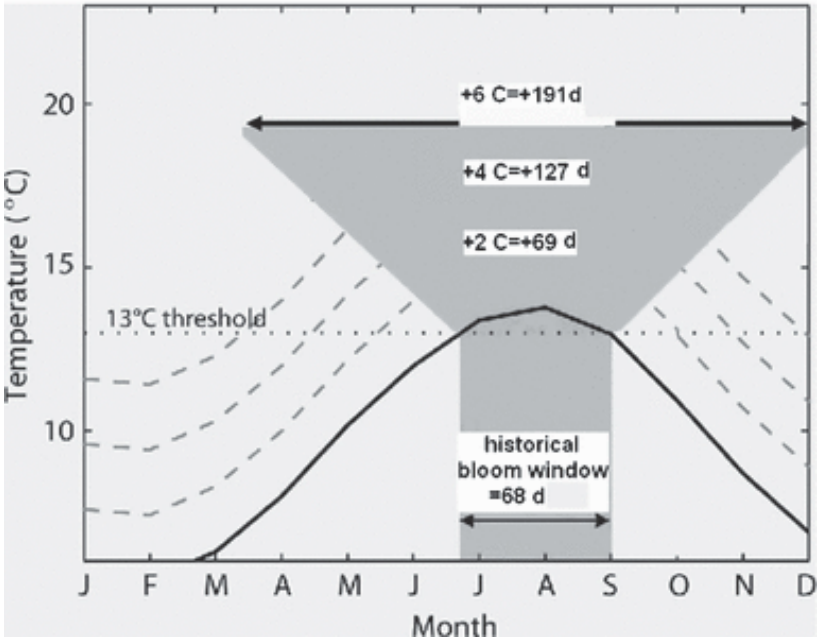
- +ve correlation between increased number in traps and water temp
    - Across all regions
    - Greater on east coast

- New species invasion (*Octopus tetricus*)

Phenology

Gymnodinium catenatum toxic dinoflagellate blooms Tasmania

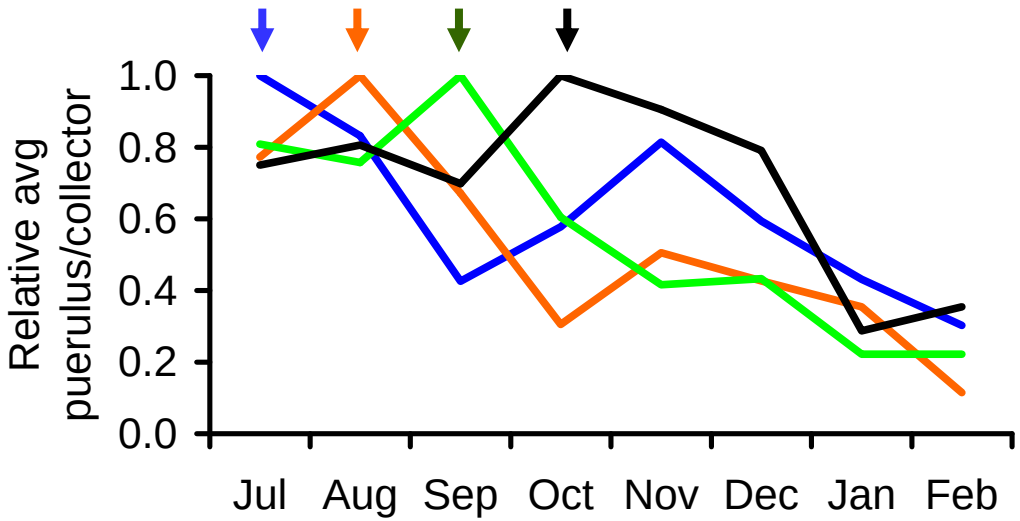




Seasonal bloom window expands

Moore (*Alexandrium*, Bay of Fundy)

Rock lobster recruitment – monthly Puerulus settlement trends



1991-1994

1995-1998

1999-2002

2003-2006

Monthly pattern of peak puerulus settlement has shifted to later in the year

Due to changes in the timing and positioning of currents around Tasmania

Climate change programs and major initiatives

Click to register an account, or sign in here

redmap
SPOT. LOG. MAP.

Newsletter? Enter your email here. JOIN

HOME | MARINE SPECIES | TASMANIAN SIGHTINGS | LOG A SIGHTING | RESOURCES | LATEST NEWS | ABOUT REDMAP | tafi

What's on the move in Tasmanian waters?

Mahi mahi

Also known as dolphin fish, this species is very bright with colourful blues and yellows which fade quickly upon death. Older male fish have a steep forehead, like a lump (hump headed). Log this species wherever it is spotted in Tasmanian waters.

No. of sightings: 1
Latest sighting: Lawfish
Location: Fishing Block 6H4

FIND OUT MORE

Check it out on the map

WHAT IS REDMAP? FIND OUT MORE

Redmap, a new and interactive website, invites the Tasmanian community to spot, log and map marine species that are uncommon in Tasmania, or along particular parts of our coast.

PHOTO GALLERY

Send us your photos!

TEACHER RESOURCES

Welcome educators! In our teaching resources section we have provided some interesting worksheets and lesson ideas to help inspire your students. Please read the background information provided, it tells the story of how Tasmanian scientists are addressing the challenges of climate change and contributing to science on a global scale.

LATEST NEWS

- Win a $50 voucher from Mures Lower Deck!
- Redmap is now live!
- The Redmap launch

Find out more...

LOG YOUR SIGHTING

15:15 Wednesday

NCCARF
National
Climate Change Adaptation
Research Facility
Adaptation Research Network
MARINE BIODIVERSITY AND RESOURCES

Marine Adaptation Network



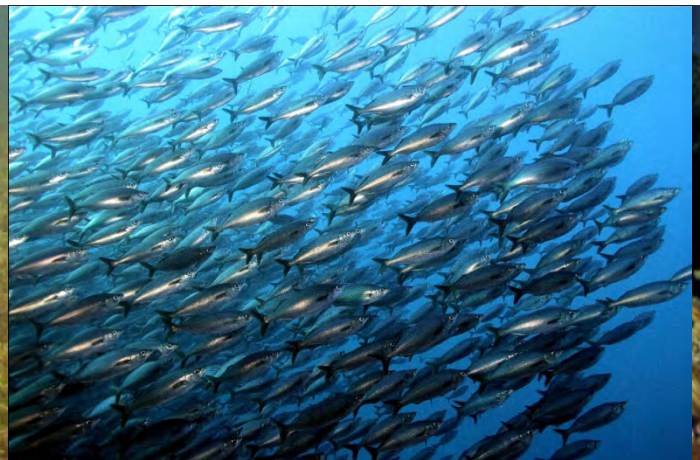
"An interdisciplinary network that will build adaptive capacity and adaptive response strategies for the effective management of marine biodiversity and natural marine resources under climate change."

www.nccarf.edu.au/marine/

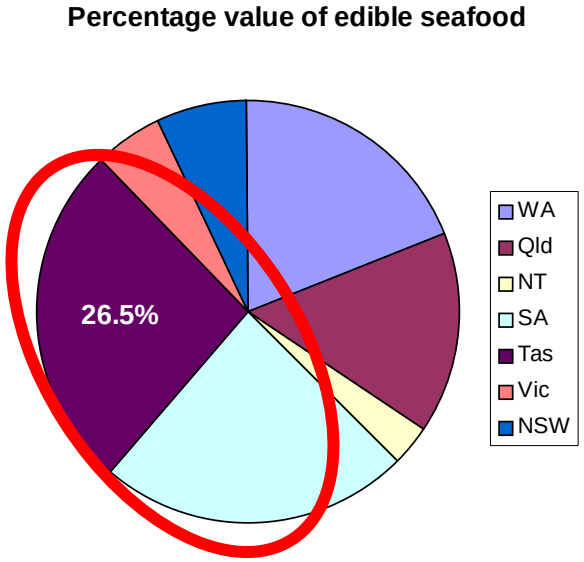
South Eastern Australia Adaptation of Fisheries and Fisheries Management to Climate Change Program

Program Vision

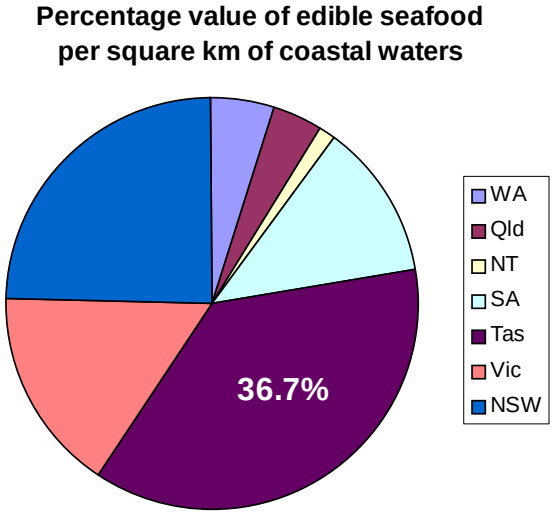
A program to prepare marine fisheries (recreational, commercial and indigenous) and aquaculture sectors, and fisheries management for a changing climate in the south-eastern Australia region


Importance (ecological, cultural, economic) of these marine ecosystems to your region.



Over 50% of Australia's seafood production by value comes from the SE



Over 75% of Australia's seafood production comes from States which are impacted by East Australian Current

Why is this important to Tasmania

Tasmanian produces the highest value of edible seafood nationally (26.5%). ABARE 2007.

Seafood contributes significantly (approximately a third) to the value of Tasmanian agricultural production.Griffiths, H.

Tasmania has the second highest participation rate (29.3%) in recreational fishing nationally (after Northern Territory). Henry, G. W., and J. M. Lyle. 2003.

Tasmania has the most diverse communities of temperate biodiversity and is considered a region of potential biodiversity decline. Anon. 2008.

Climate change is significant to Tasmania's marine resources and biodiversity

Island communities are potentially more vulnerable as they have a greater reliance on marine based industries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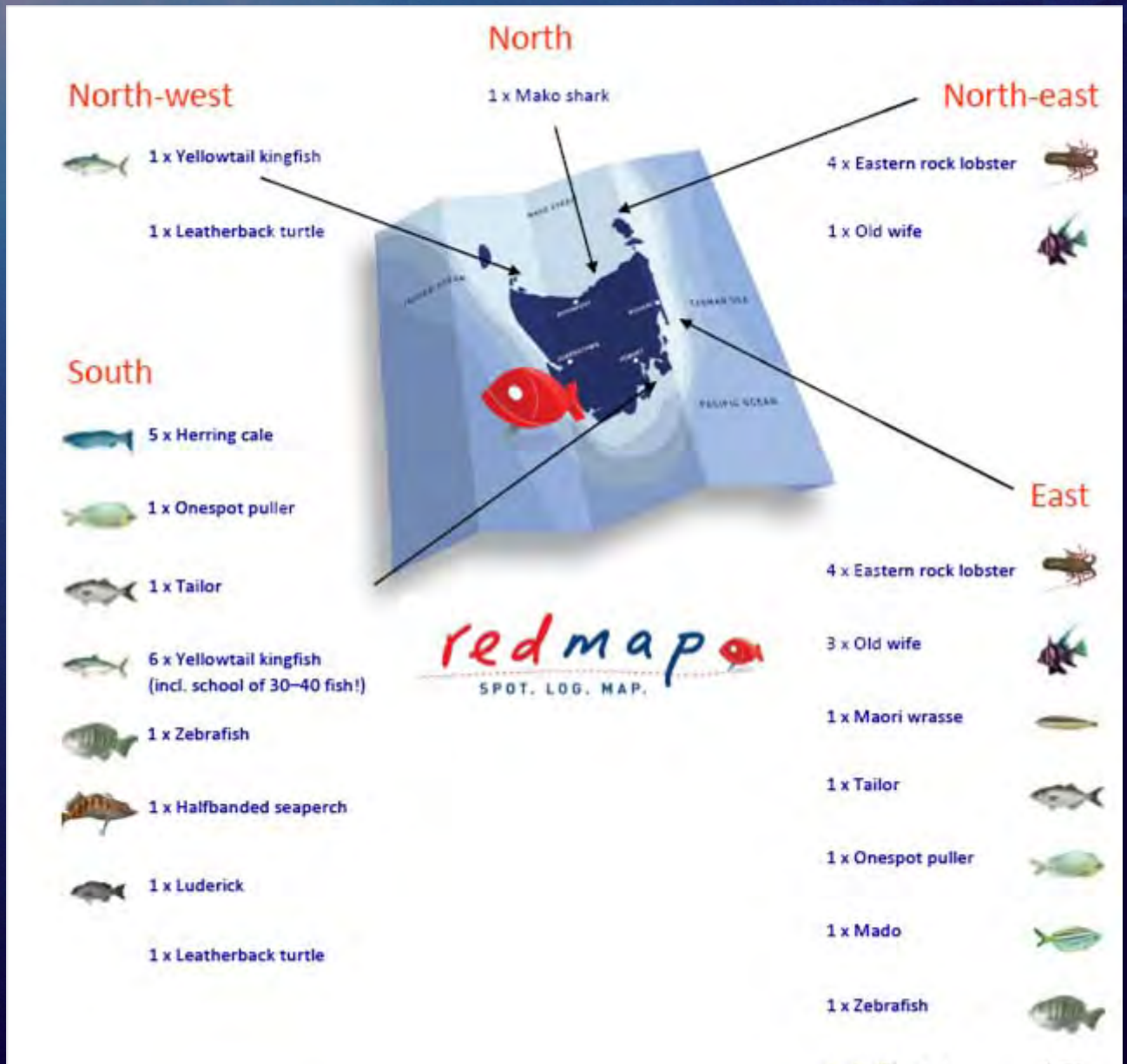
Nutrients and productivity

Harris, Davies, Nunez and Meyers (1988) Interannual variability in climate and fisheries in Tasmania. *Nature* 333: 754-757.

- **Strong westerly winds drive colder, nutrient rich sub-Antarctic waters up the east coast of Tasmania**
- **Increased spring blooms – increased productivity (10X)**

Lots of sightings so far!

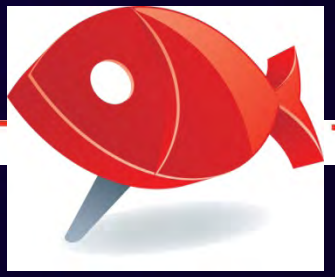


Great photos submitted to 'verify' sightings

Redmap works because it is so simple - fishers like telling people what they caught and divers love taking photos!

Success so far….

- over 7,000 hits on the site
- 37,000 page downloads
- Visits from 85 countries
- Several hundred ‘members’
- Bulletin boards & digests around the world
- Radio, tv, print media
- Many emails requesting more stuff!
- Community sightings
- Great ‘verified’ sightings



Clearly

Not surprising as Tasmania is situated in the fastest warming region of the southern hemisphere

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Marine is significant to Tasmania

Climate change is significant to Tasmania's marine resources and biodiversity

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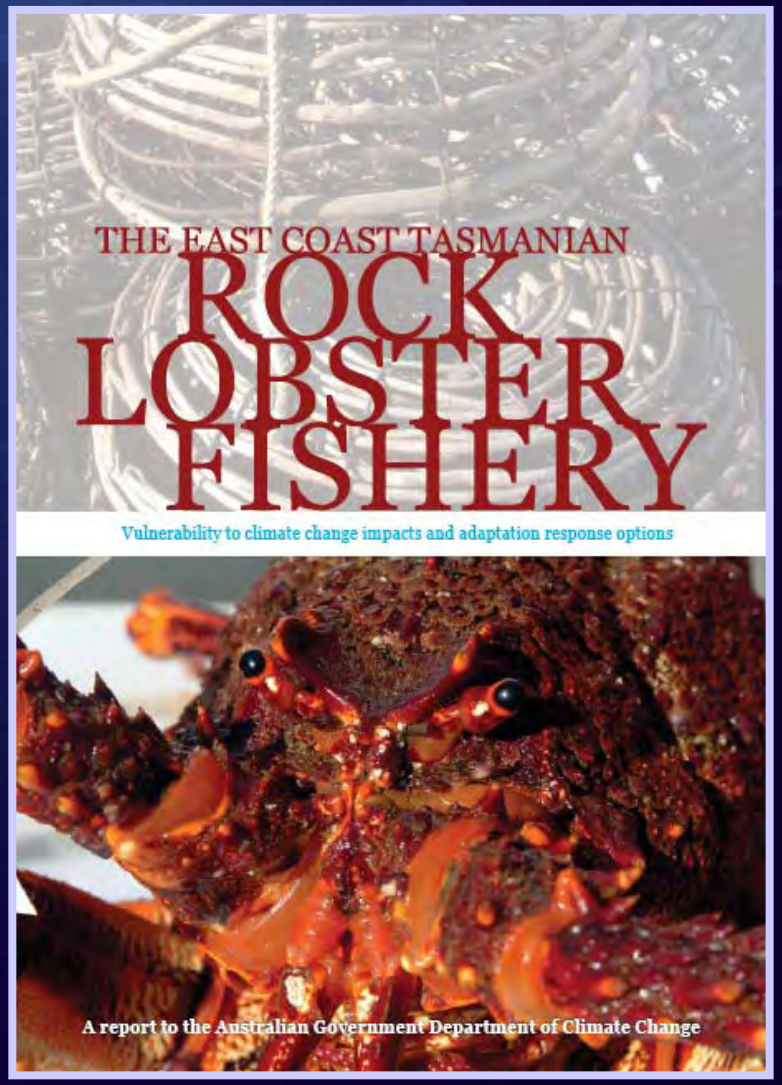
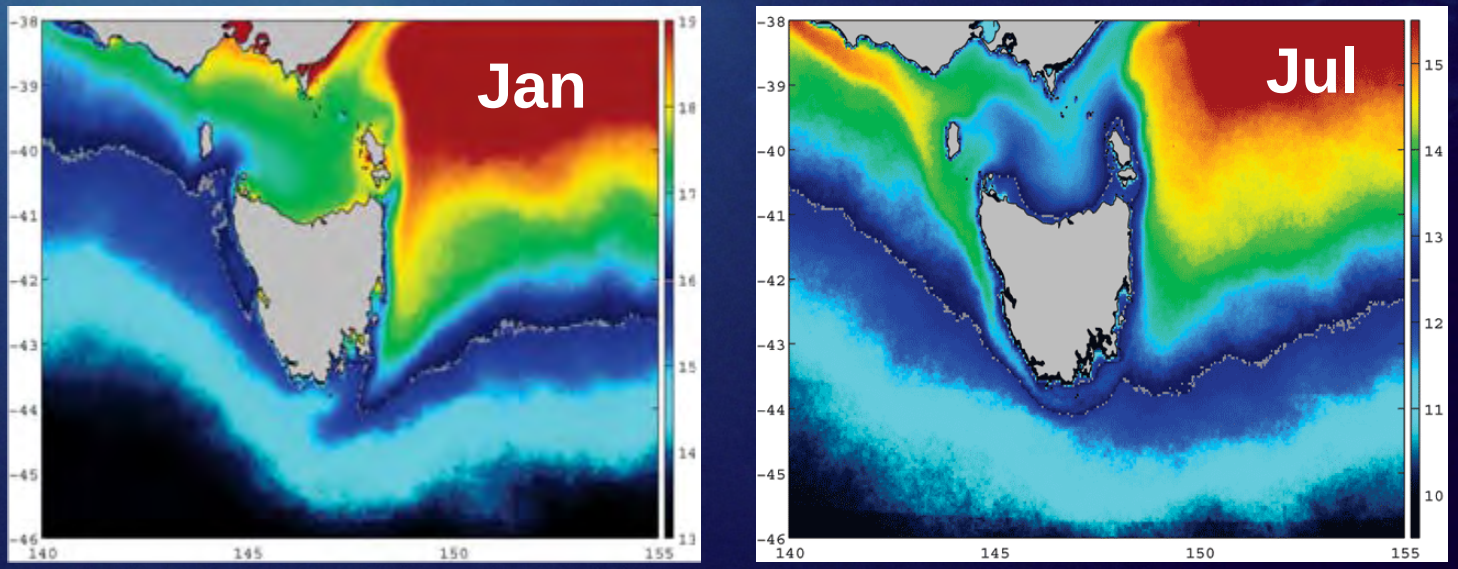


www.climatechange.gov.au/publications/coastline/east-coast-rock-lobster.aspx

Highest-ever winter water temperatures recorded

Tasmania's east coast is recording its highest-ever winter water temperatures - up to 1.5ºC above normal – due to a strengthening and significant extension of the Leeuwin Current curling around the southern tip of Tasmania and reaching as far north as St Helens.



Source: Ridgway, K. 2007 Journal of Geophysical Research, C - Oceans

How does this affect productivity of Tasmania's fisheries, aquaculture and biodiversity: recruitment, survival, growth, catchability, available habitat etc?

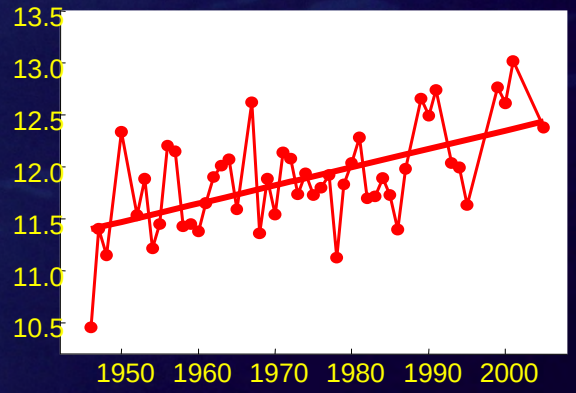
Tasmania is uniquely located at the interface of Australia's eastern and western boundary currents and the southern ocean.

These combine to produce:

Seasonal variation

Annual variation

Long-term signals



Contrast + hotspot = opportunity to understand the drivers of global warming

Tasmania is an ideal laboratory to understand the impacts and adaptation of animals AND people to climate change

IMOS

But what about the “bits in-between”?

Filling in the "bits in-between"

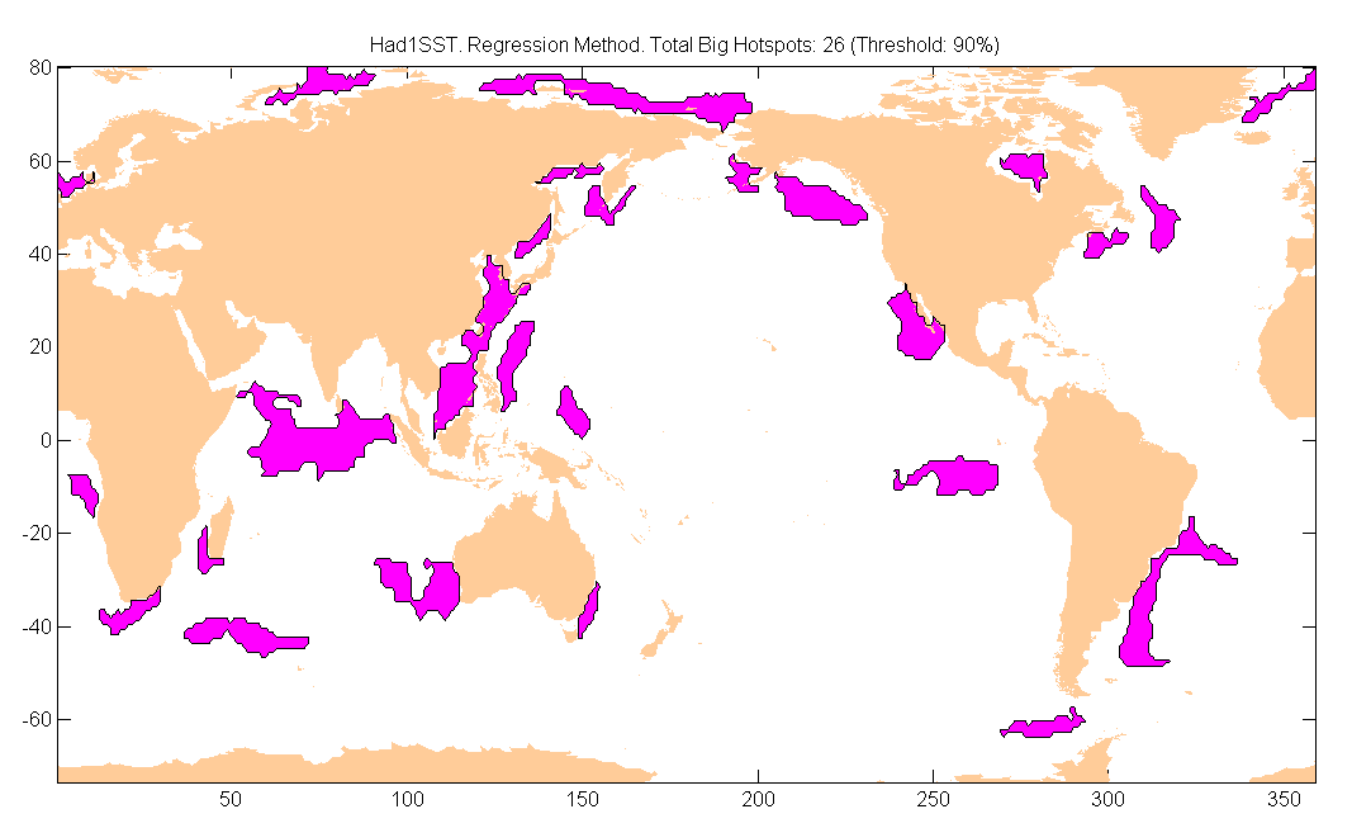
(Like REDMAP and Reef-Life Survey – there are many people who can help)

Can our marine users help with the "bits in-between"?

Connecting the TRLFA, TasIMOS and emII as a case study

Global Marine Hotspots

Regions currently/recently warming faster than 90% of the ocean



(Pecl & Hobday, in prep)

A Global Network of Marine Hotspots.

Workshop at "*Climate Change Effects on Fish and Fisheries: Forecasting impacts, Assessing Ecosystem Responses, and Evaluating Management Strategies***"**

Sendai, Japan, April 2010

Why are hotspots important?

- Early warning systems
  - First regions to show warming impacts
  - First regions to validate model predictions
  - First regions to develop and test adaptation options

The earth's natural laboratory for study global warming

Why is a network of global hotspots relevant to Tasmania's marine stakeholders?

- We can contribute knowledge to
- We can learn from
- We can share our experiences

Tasmania is a key member of a global community

. . . and climate change is a global issue

WE

ALL marine stakeholders

Managers

Fishers and aquaculturists

Scientists – biophysical, social, economic, political

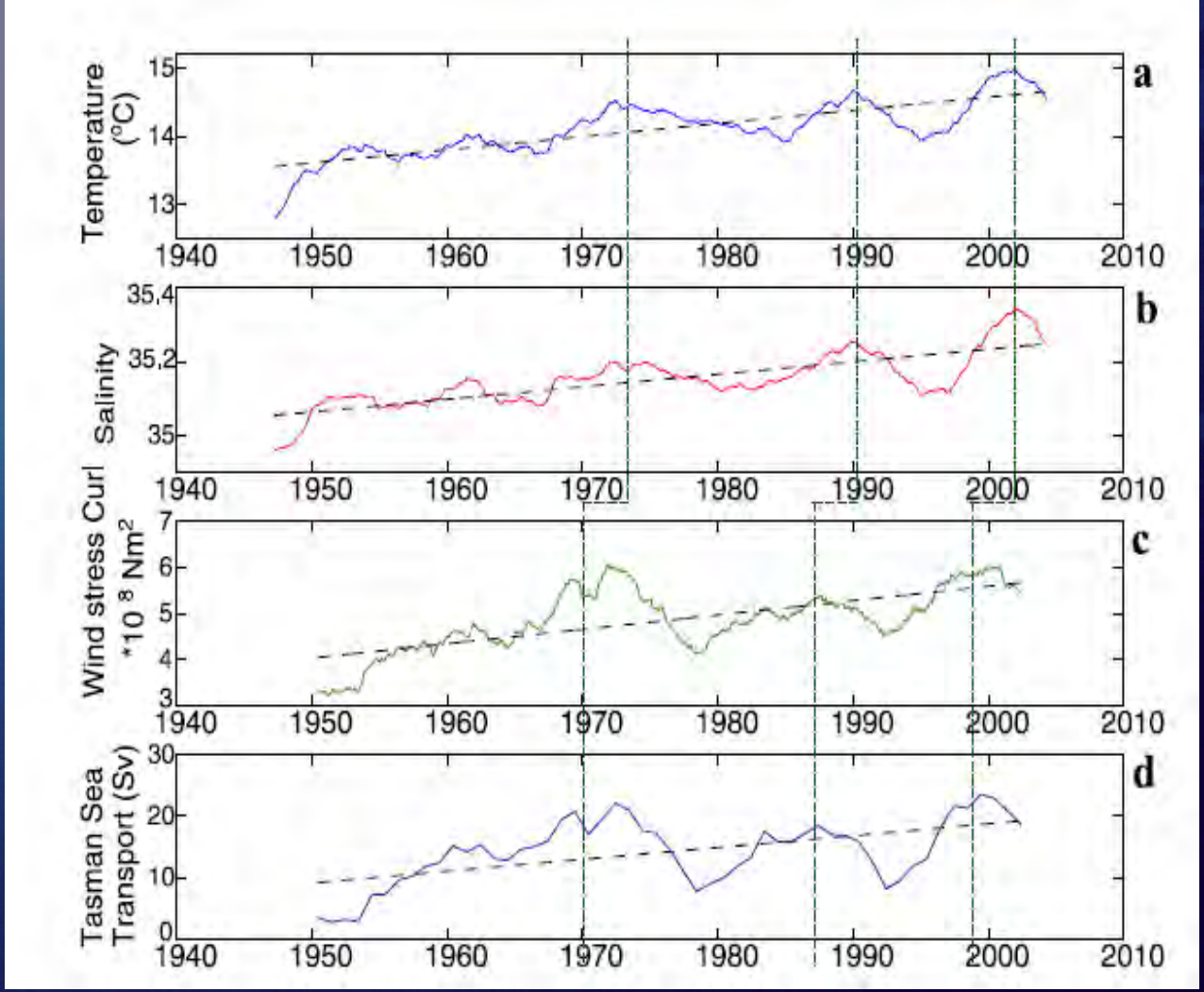
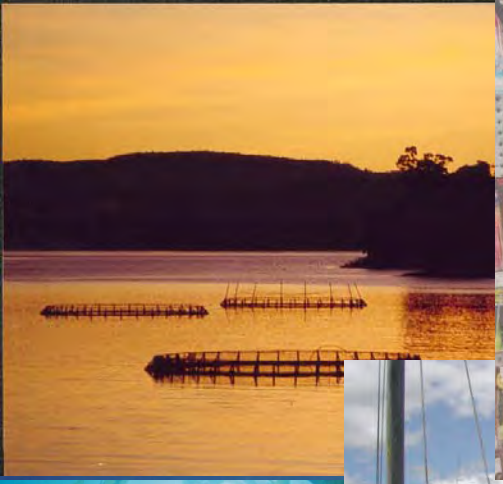


Figure 6: Low-pass filtered (a) sea surface temperature at Maria Island, (b) surface salinity at Maria Island, (c) South Pacific regional mean wind stress curl (20–50° S, 180–280° E), (d) net transport through the Tasman Sea. Black dashed lines show the linear trend. Green dashed lines illustrate the time lag between Maria Island temperature and salinity and South Pacific water transport.



FOR RENT: Summer holiday accommodation – suite family who enjoys fishing.

Our challenge is to understand how all users will be impacted and what there adaptation options and opportunities are.

It will be the combined impacts on all sectors (commercial, recreational, aquaculture, tourism and Alex's job) that will be important. Especially for our rural coastal communities

But . . . . we need the tools to link the biological system with the human system

(for baitfish: tuna = increased predation
for Alex: tuna = fishing gear sales)

Craig Johnson, Neil , Peter Steinberg (UNSW) and Neville Barrett: SS Fellowships

Title: Effects of climate change on temperate benthic assemblages on the continental shelf in eastern Australia

Aim: to develop bioclimate models to predict changes in these key habitats

Craig Johnson, Jeff Wright and Peter Stienberg (UNSW): ARC Discovery Grant

Title: Impacts of climate change on biogenic habitat-forming seaweeds in south east Australia

Aim: To address the effects of climate change on key habitat-forming seaweeds on rocky reefs in SE Australia