Effect of climate change on fisheries in Western Australia

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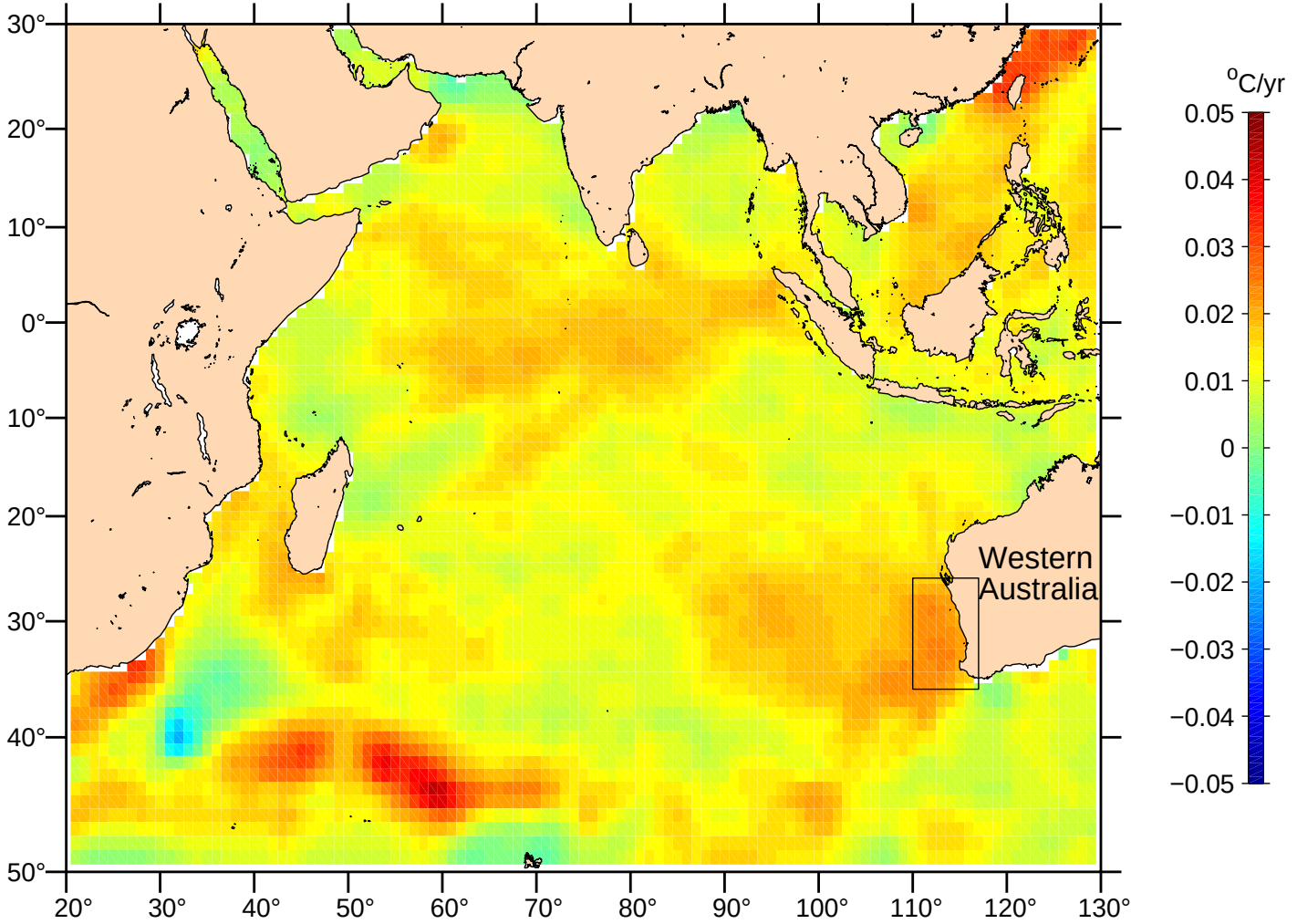
Department of Fisheries
Government of Western Australia

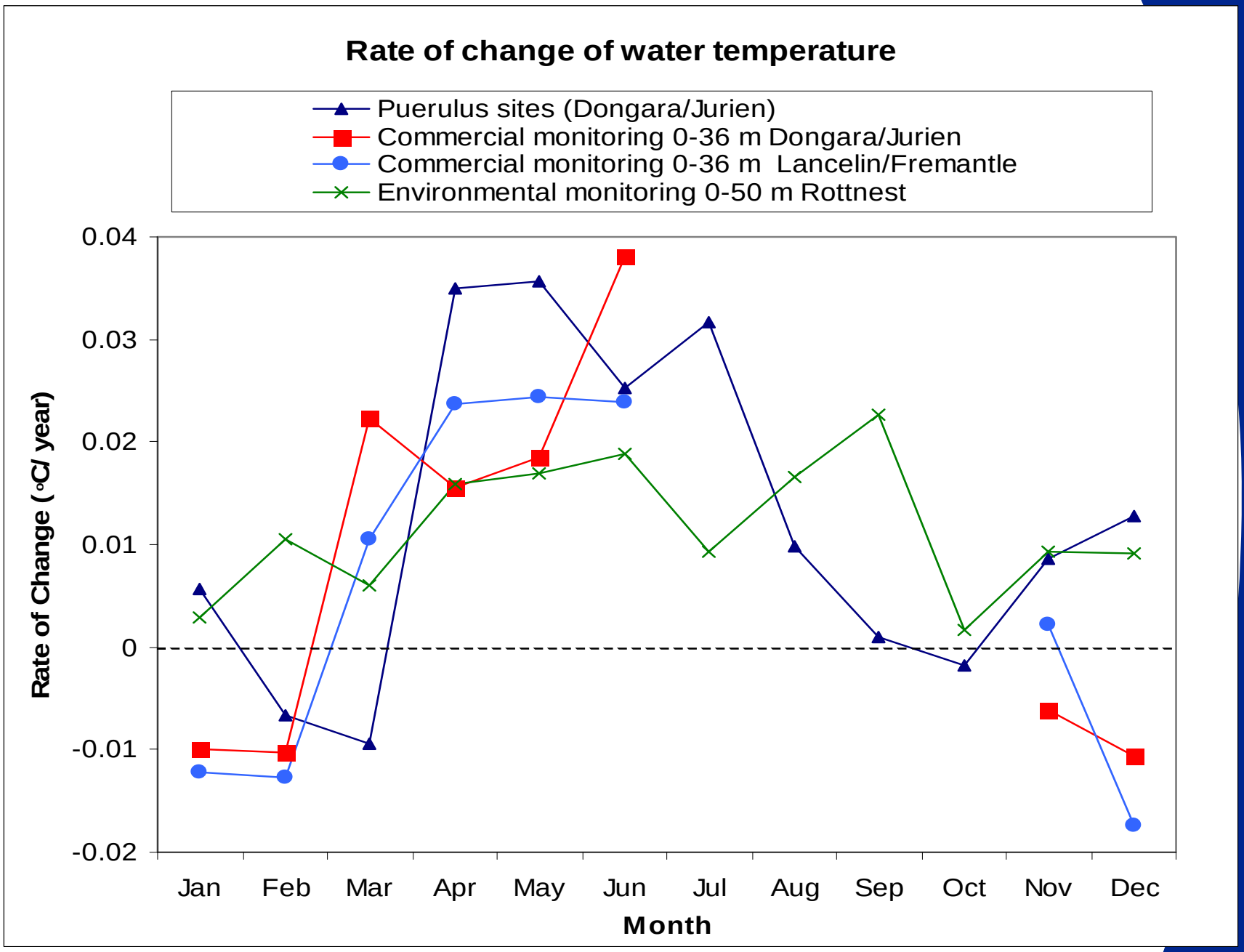
Overview

1. **Environmental trends: climate change effects?**
   - Water temperature & salinity
   - ENSO influence on Leeuwin Current
   - Westerly winds (winter/spring)
2. **Climate change effects on rock lobster fishery**
   - Puerulus settlement: abundance & distribution
   - Size at maturity
   - Size of whites migration
3. **Environment – fisheries relationships**
   - Scallop, dhufish, tailor, white bait
4. **Future Research**
   - Environmental trends (WAMSI Node 2)
   - Potential fisheries trends

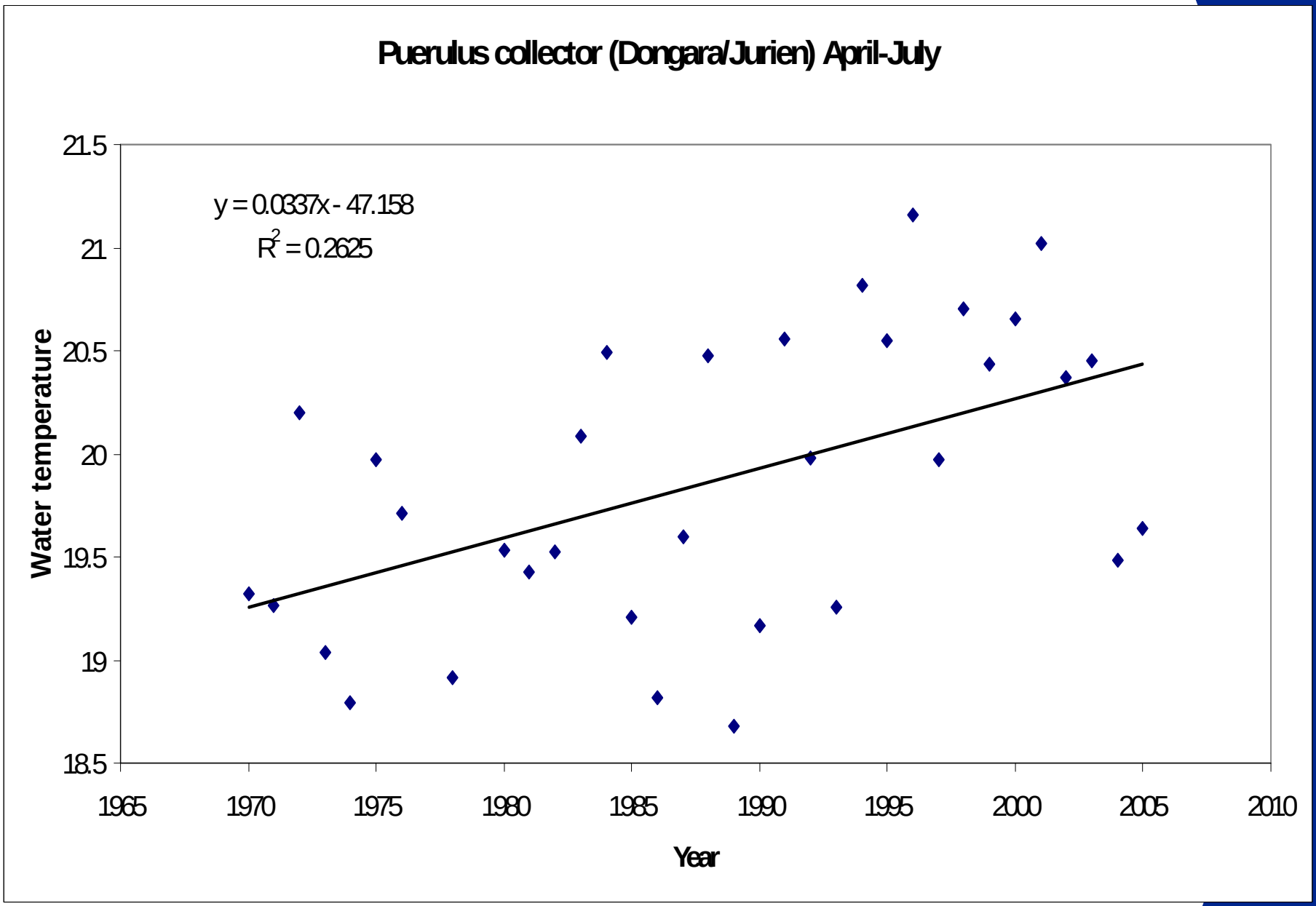
Rate of warming (°C/year) 1951 – 2004 (Pearce & Feng, 2007)



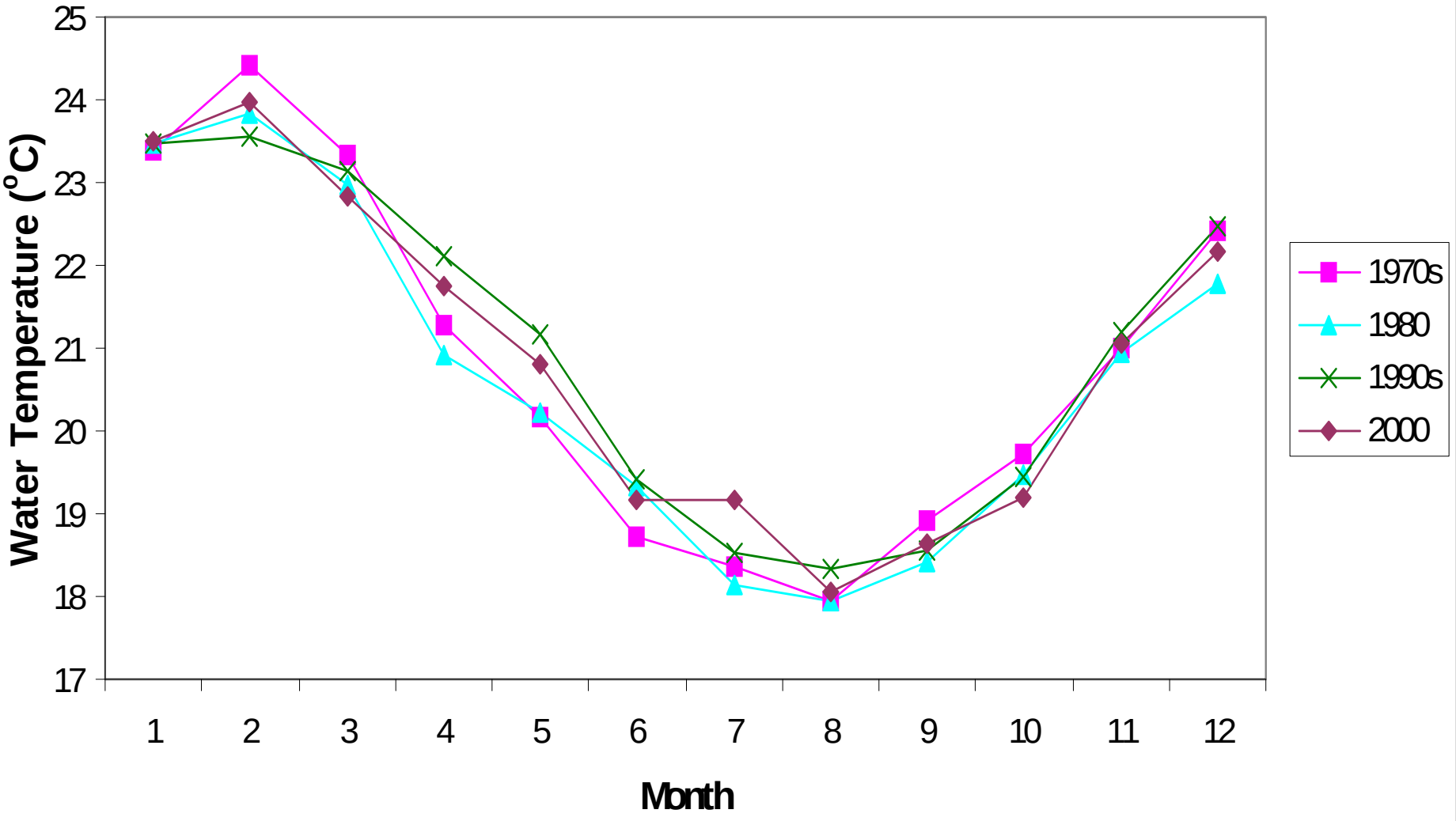
Fish for the future



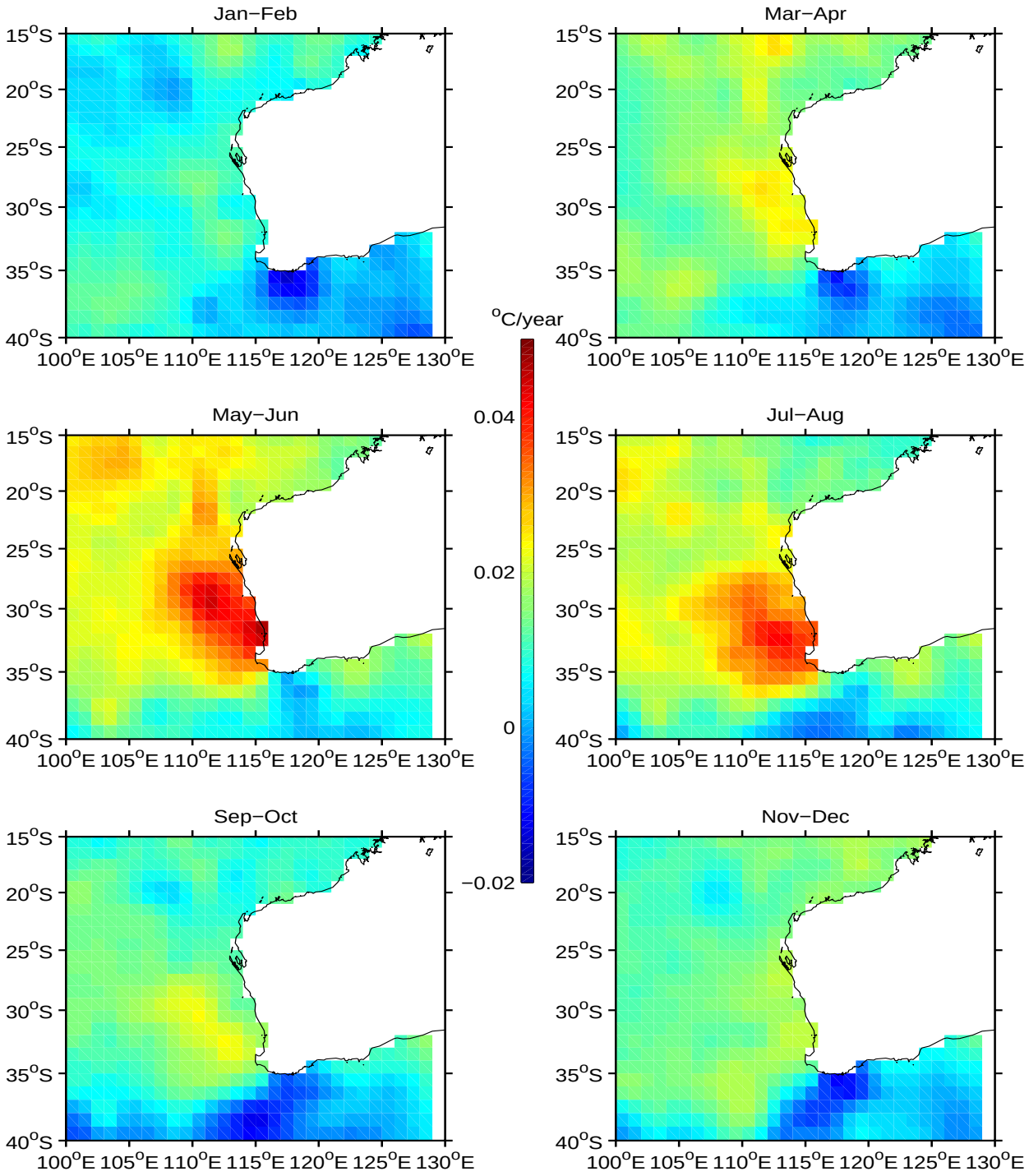
Caputi et al. (2009)



Caputi et al. (2009)



Caputi et al. (2009)



SST increase per year

HadISST (1970-2006) by M. Feng in Caputi et al. (2009)

Fish for the future

Female with tarspot (sperm) & eggs

Life History, stages

Phyllosoma larvae

Migrating ‘white’ & non migrating ‘red’

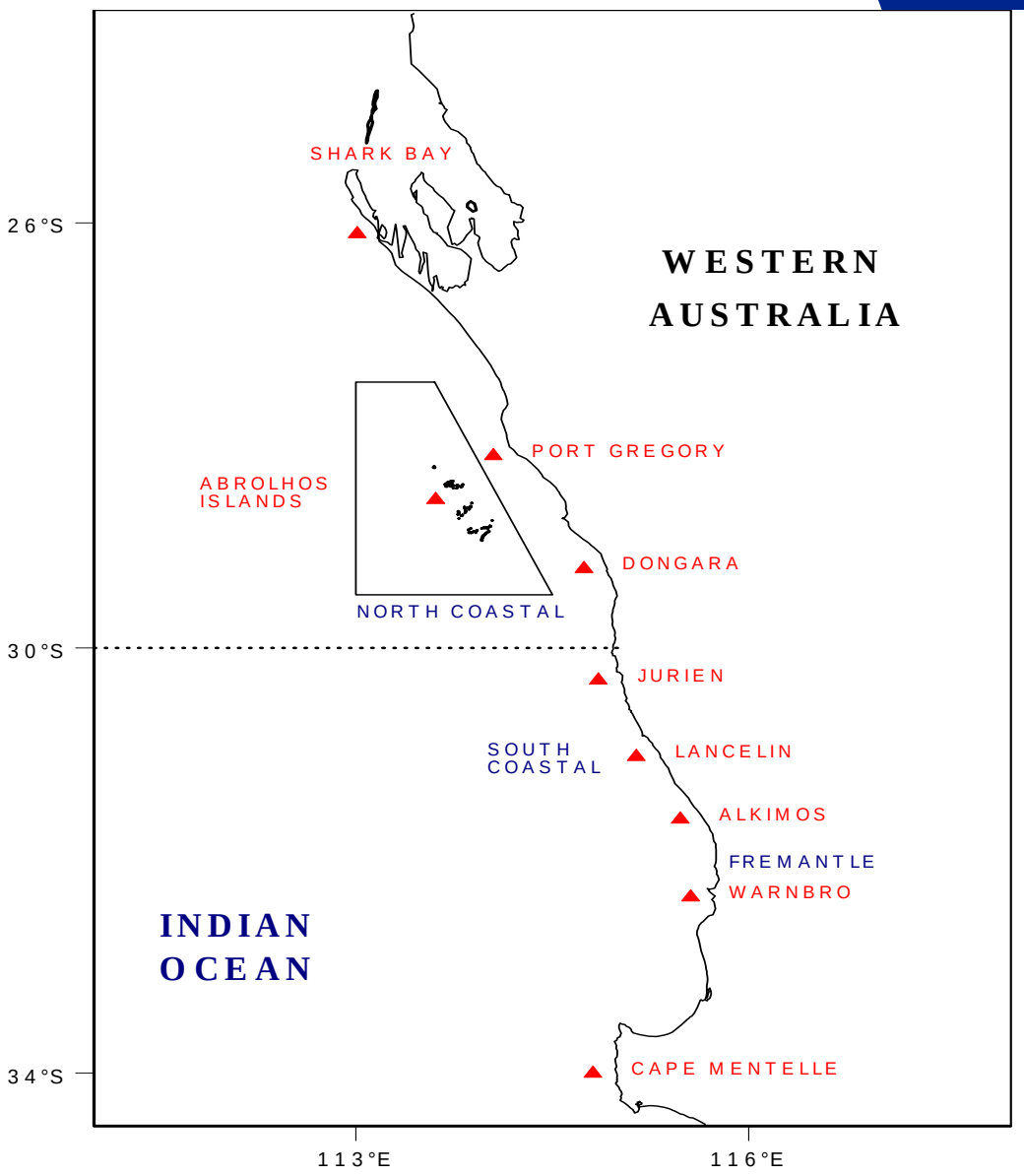
Puerulus

Puerulus collector (rope fibre)

Phillips 1972

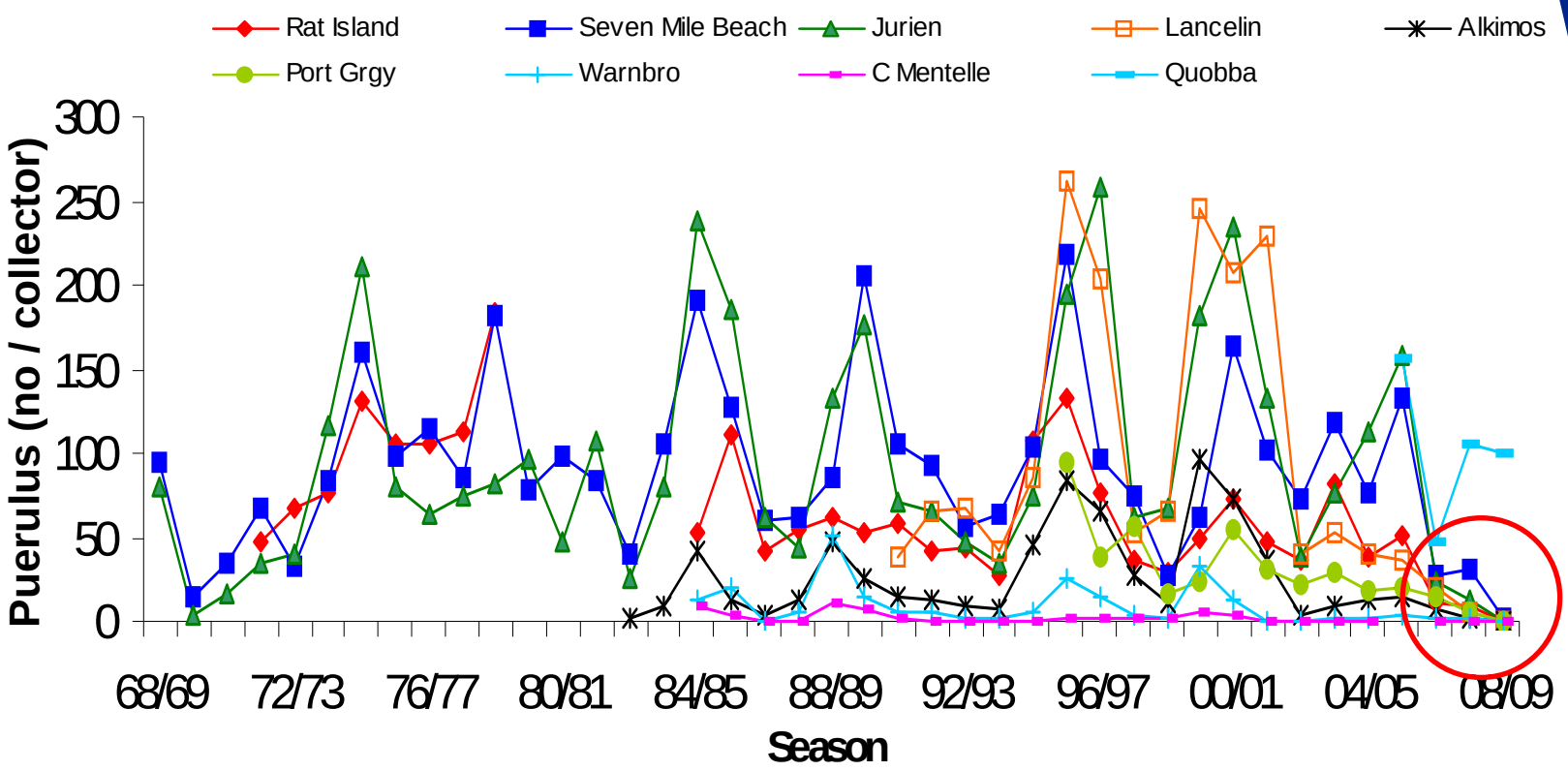
Rock lobster fishery

- 3 Fishing zones
- 9 Collector sites



F Fish for the future

Long-term annual Puerulus Settlement (all sites)



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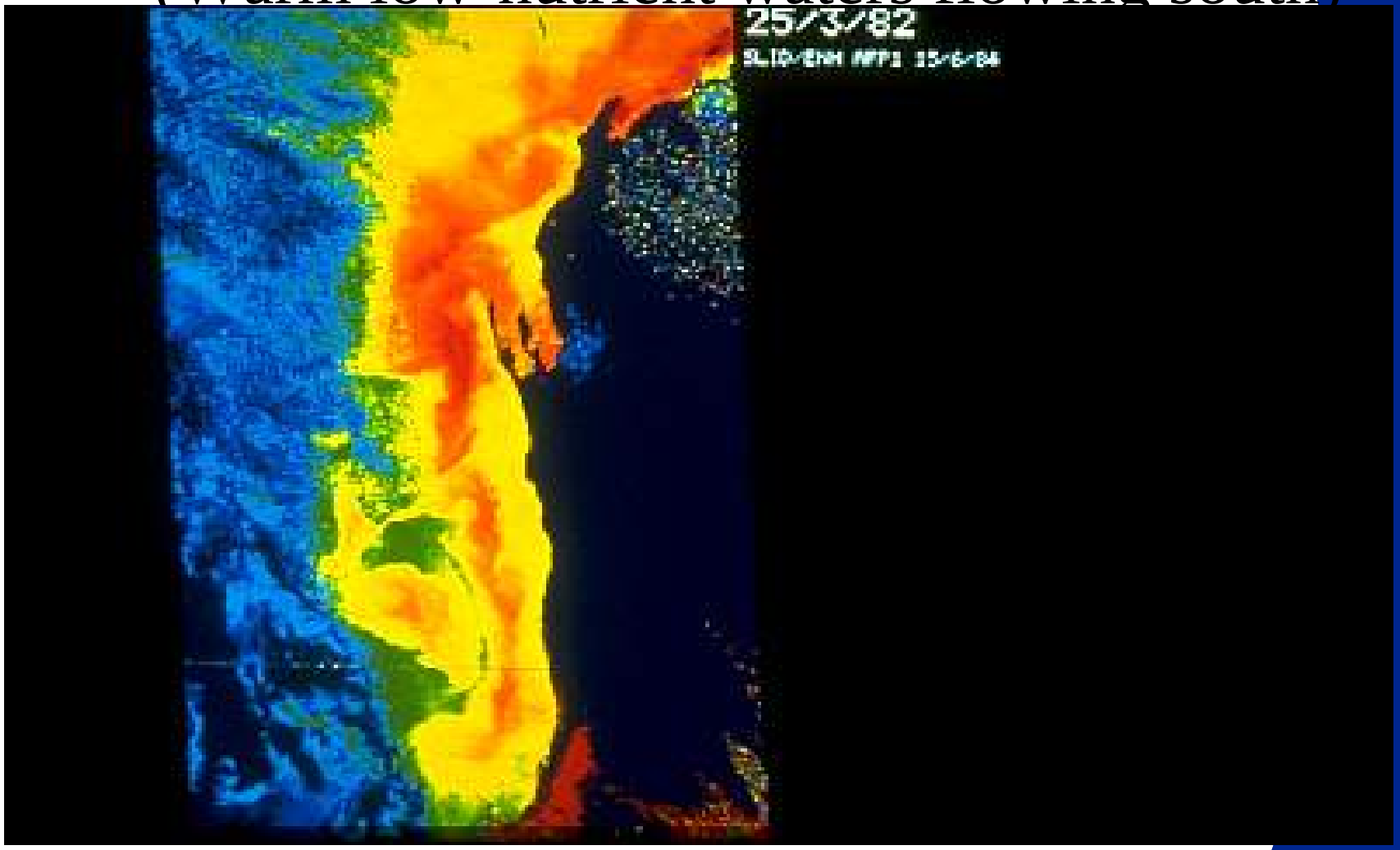
Leeuwin Current

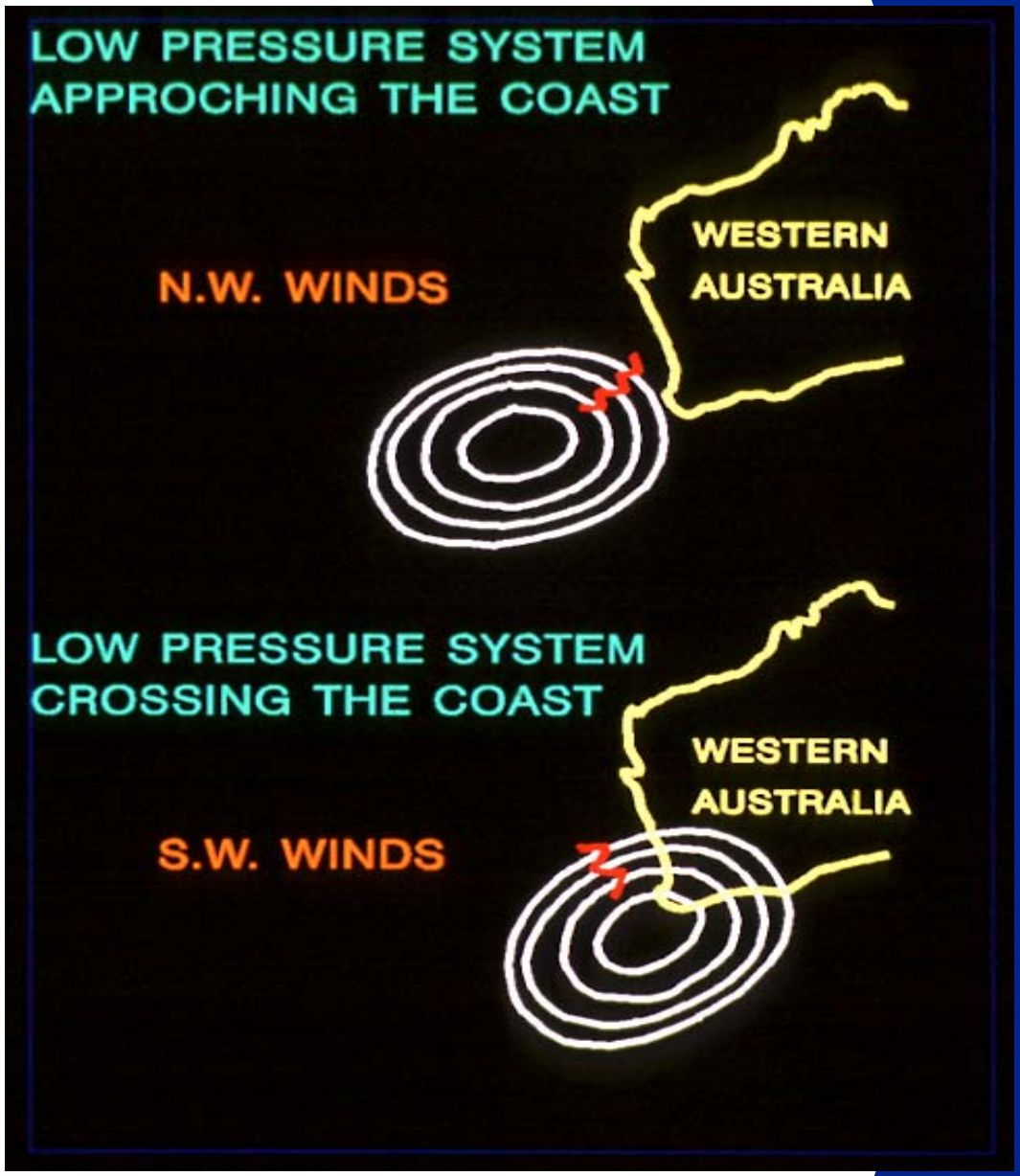
(Warm low-nutrient waters flowing south)

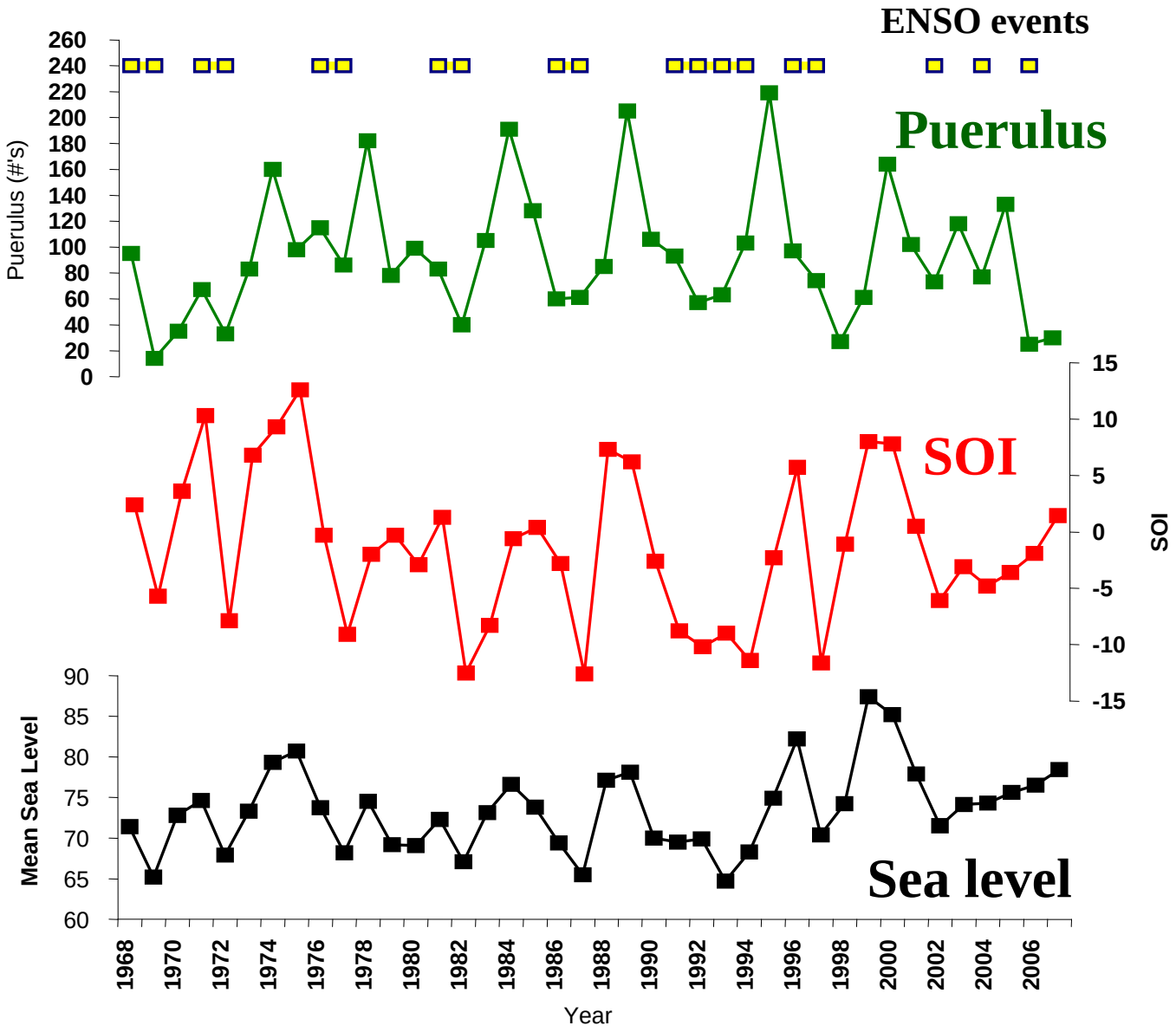


Westerly winds affect puerulus settlement

(Caputi & Brown 1993)

- Storms crossing coast
- Late winter/spring





Updated from Pearce & Phillips 1986

Fish for the future

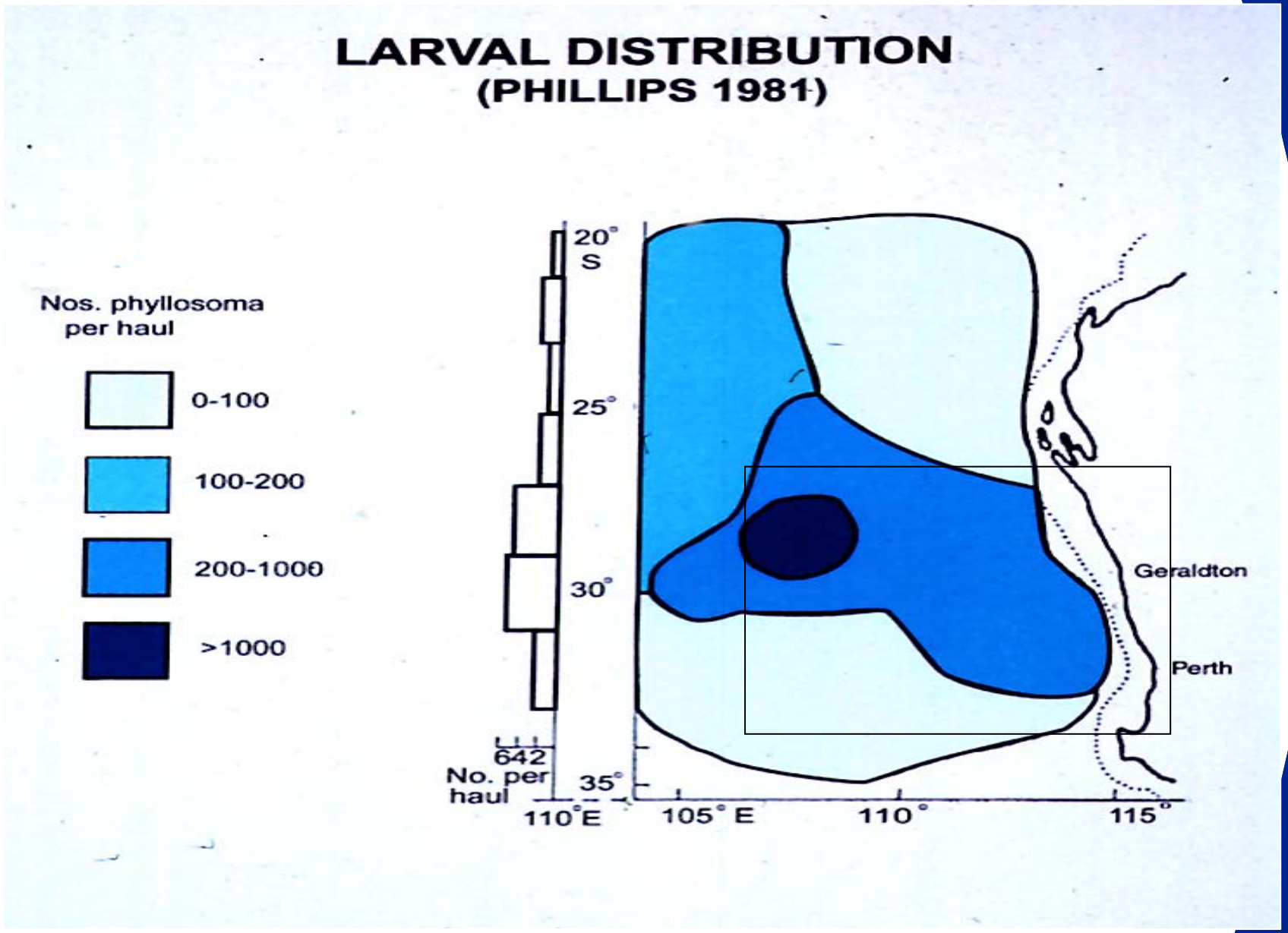
Frequency of ENSO events

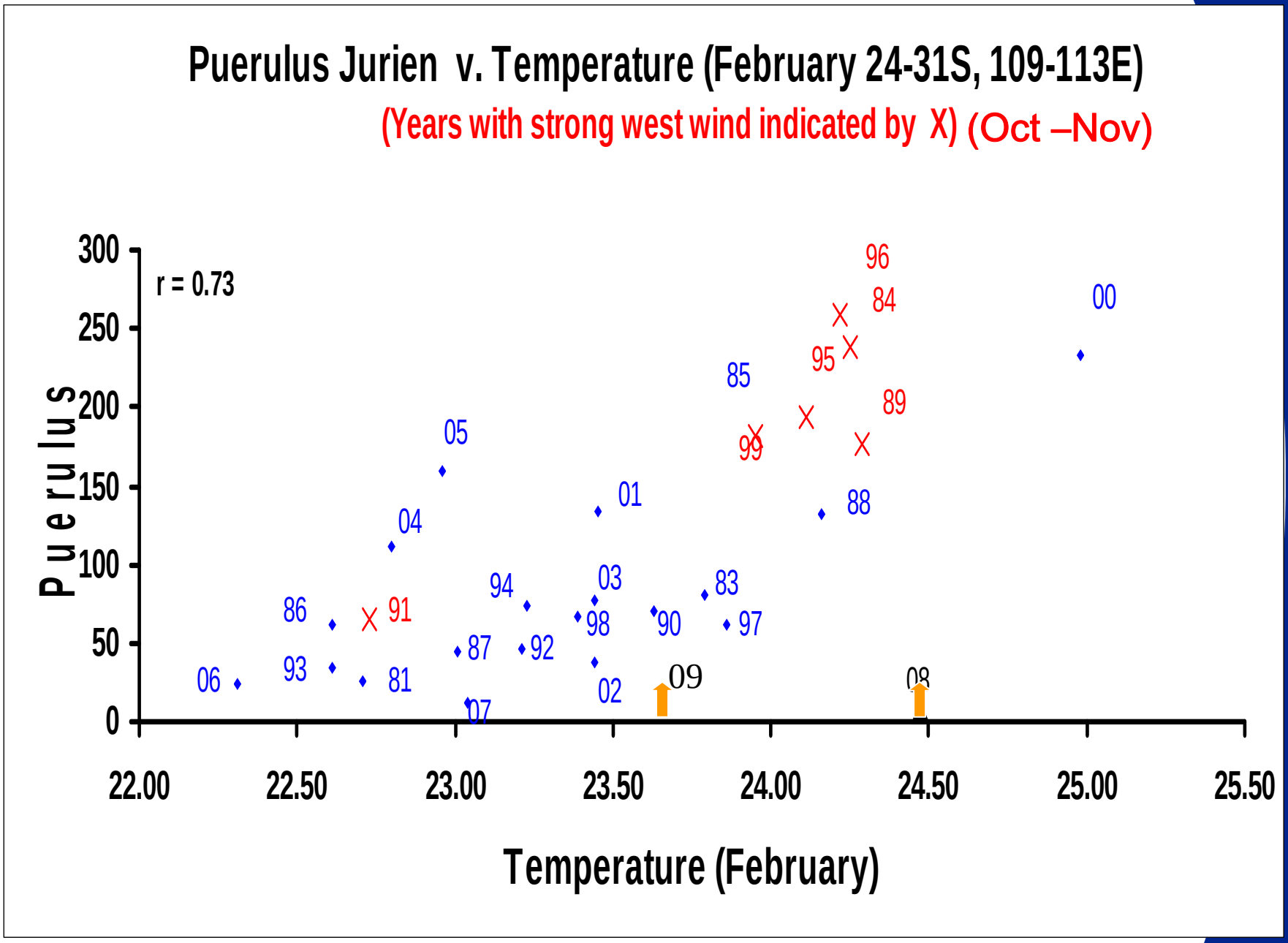
- 8 events in 18 years (1991-2008)
  - 1 in 2 years
- 5 events in 20 years (1971-1990)
  - 1 in 4 years
- Cause?
  - Climate shift (Pacific Decadal Oscillation)
  - Climate change

Strong Leeuwin Current effect on Puerulus abundance & distribution

- Warmer temperature (lower salinity)
  - effect on larval survival & growth?
- Stronger eddy structure
  - retaining larvae close to the coast?
- Higher productivity with stronger eddies
  - Increased larval survival & growth?
- Strong southerly flow of water
  - Spatial distribution of puerulus

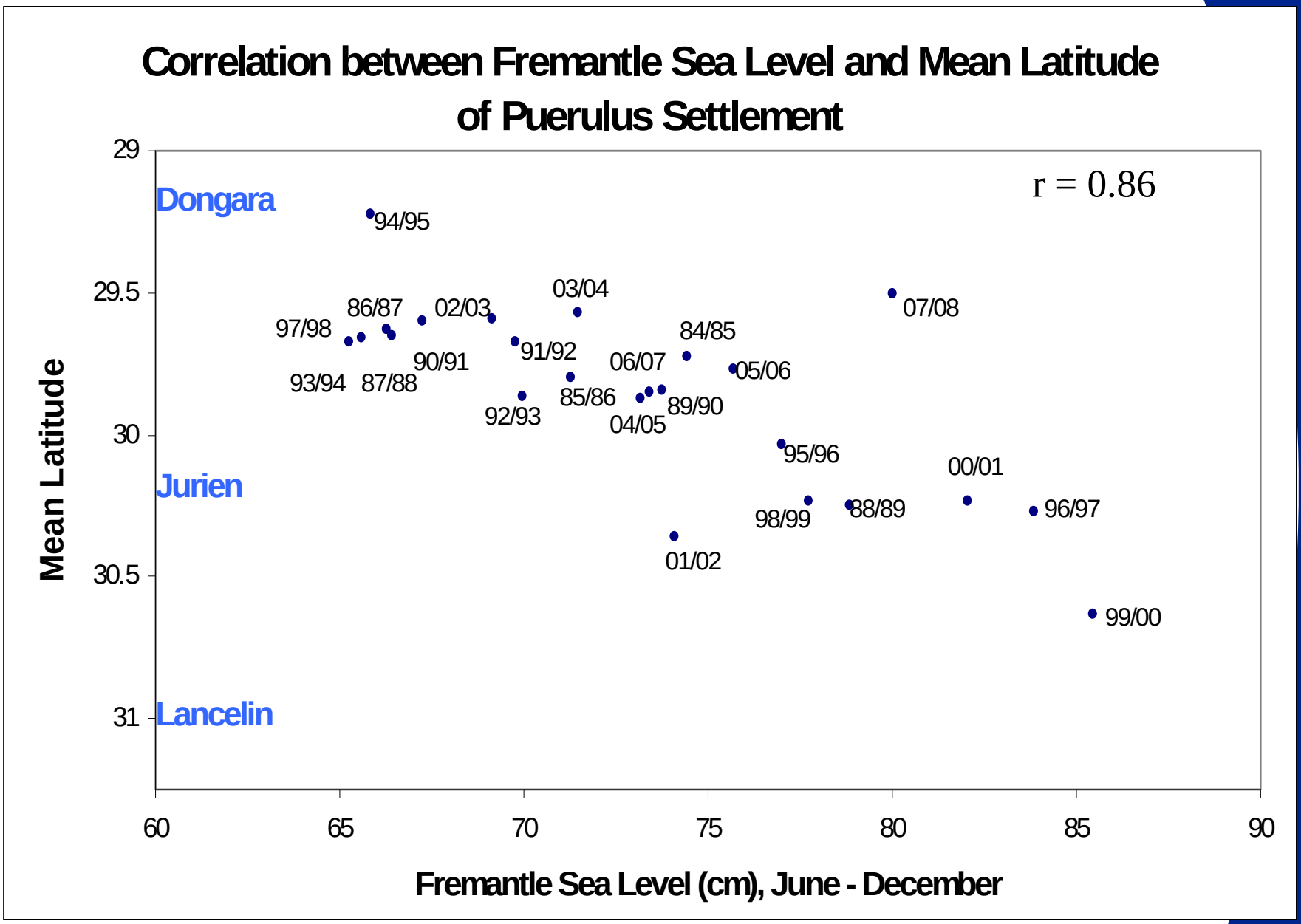
Western rock lobster





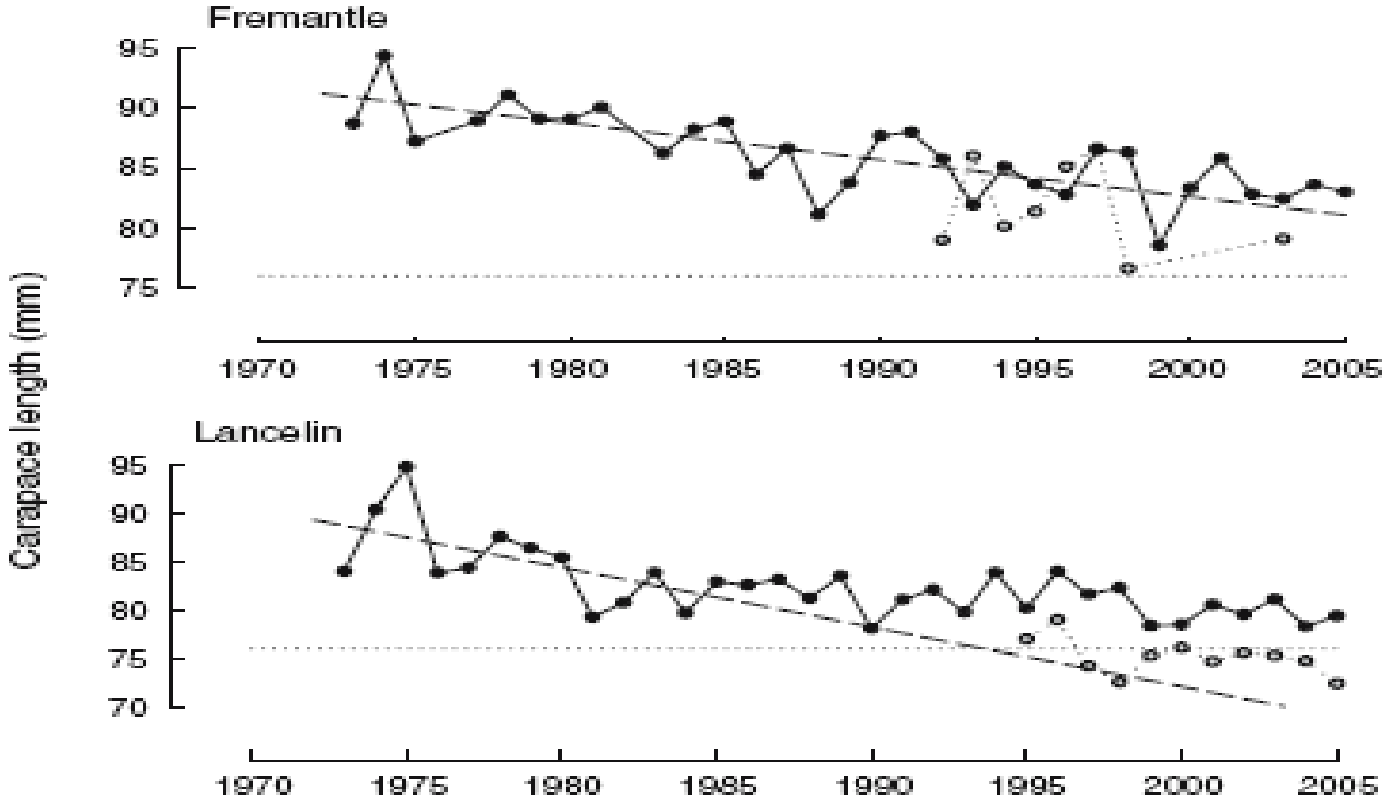
Update from Caputi et al. 2001

Fish for the future


Correlation between Fremantle Sea Level and Mean Latitude of Puerulus Settlement
r = 0.86
Dongara
Jurien
Lancelin
94/95
03/04
07/08
86/87
02/03
97/98
84/85
91/92
90/91
06/07
05/06
93/94
87/88
85/86
89/90
92/93
04/05
95/96
00/01
98/99
88/89
96/97
01/02
99/00
Mean Latitude
29
29.5
30
30.5
31
60
65
70
75
80
85
90
Fremantle Sea Level (cm), June - December

Caputi (2008)

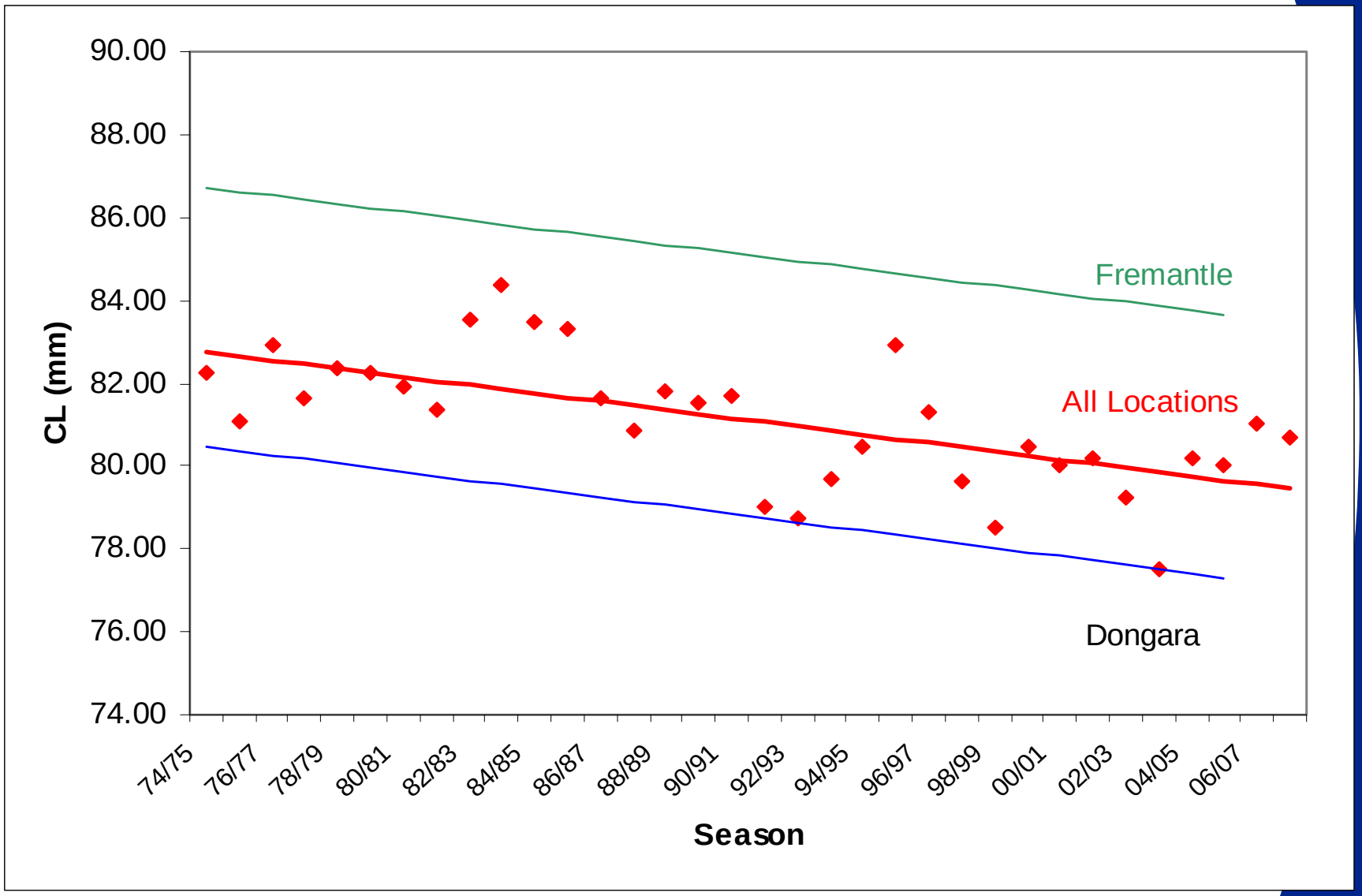
Mean carapace length of smallest 10% mature females
(Melville-Smith & de Lestang 2006)



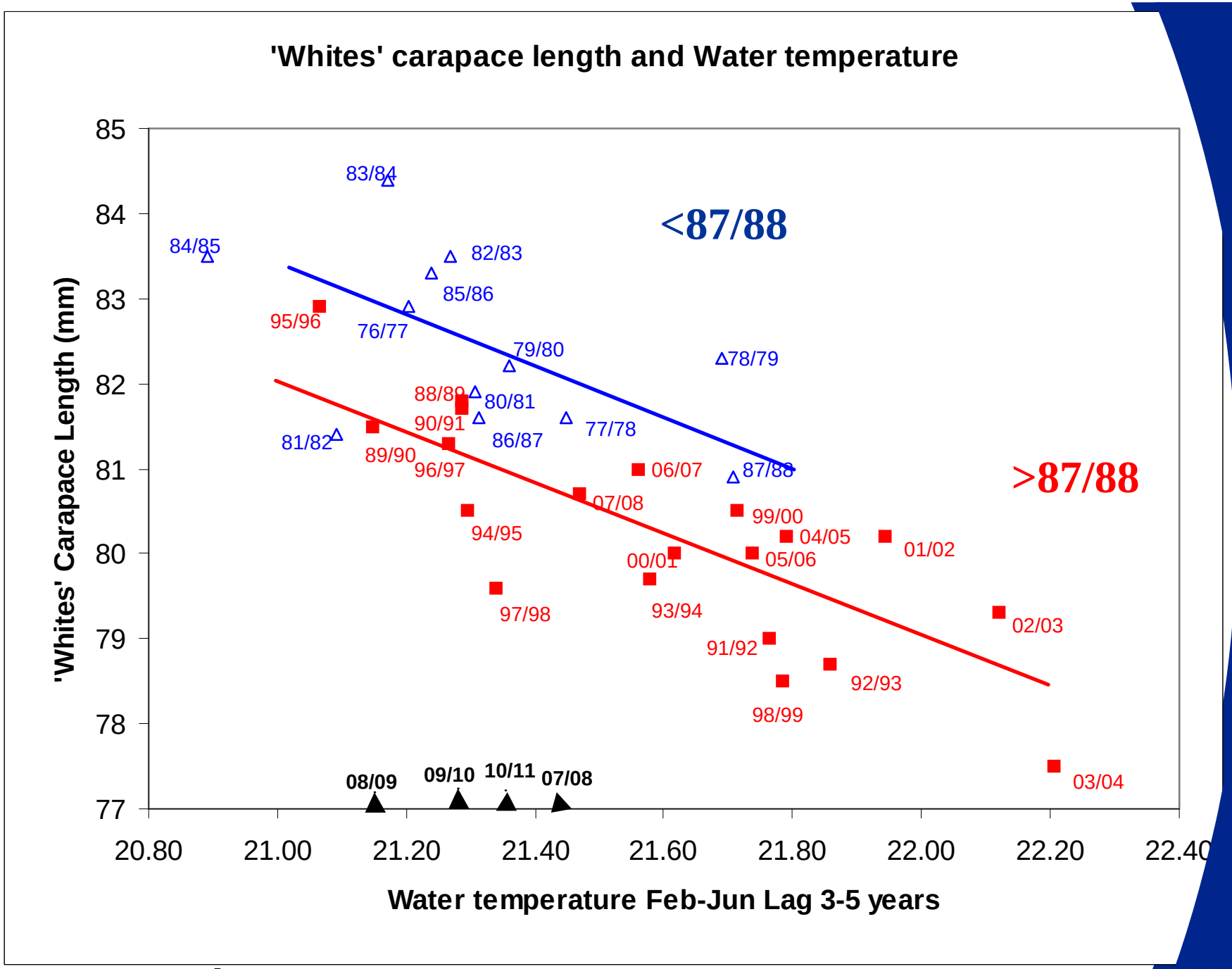
- Smaller size mature females north due to water temp

Fish for the future

Standardized Migrating ‘Whites’ Mean Carapace Length

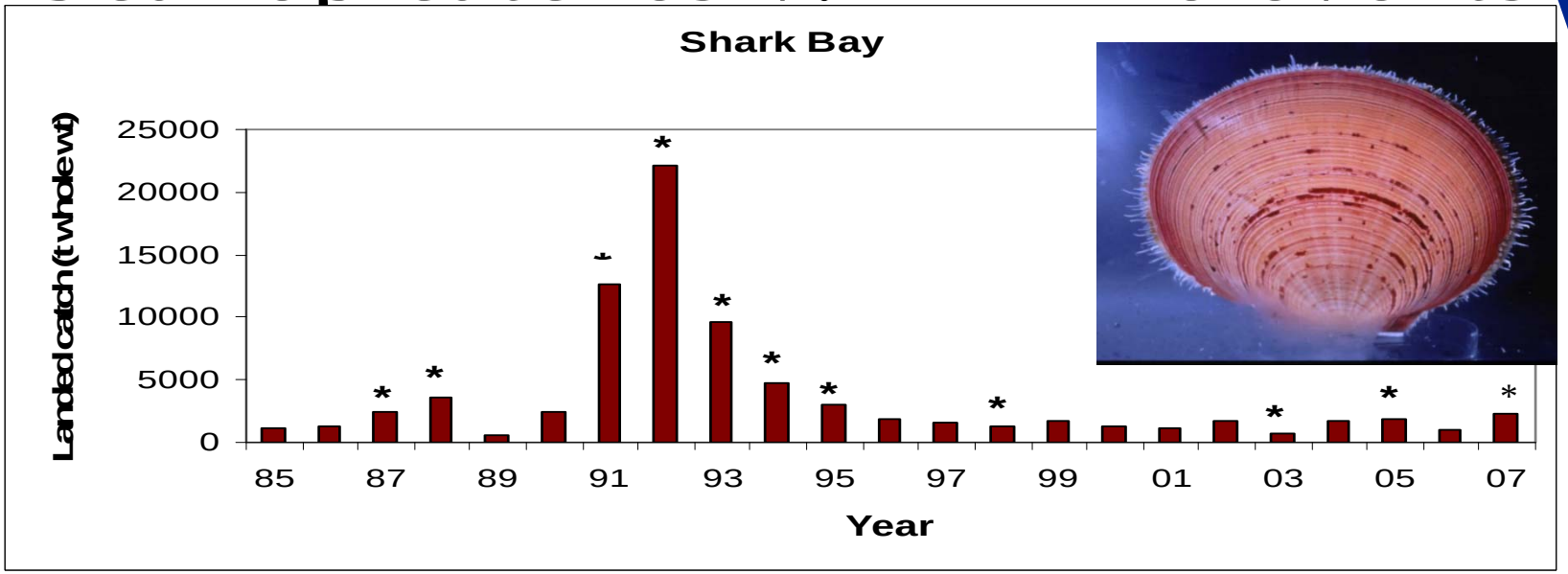


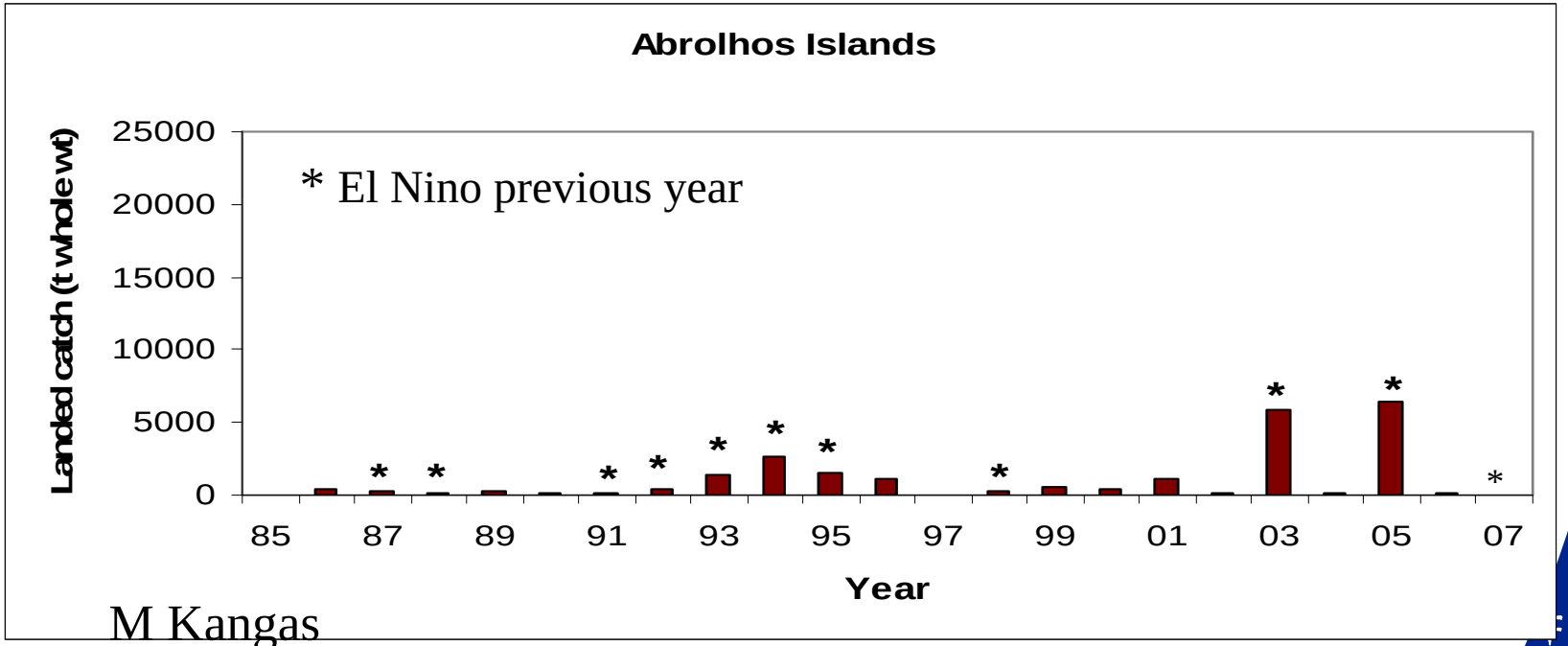
Caputi et al. in prep.



Caputi et al. in prep.

Scallop catches v. El Nino events





M Kangas

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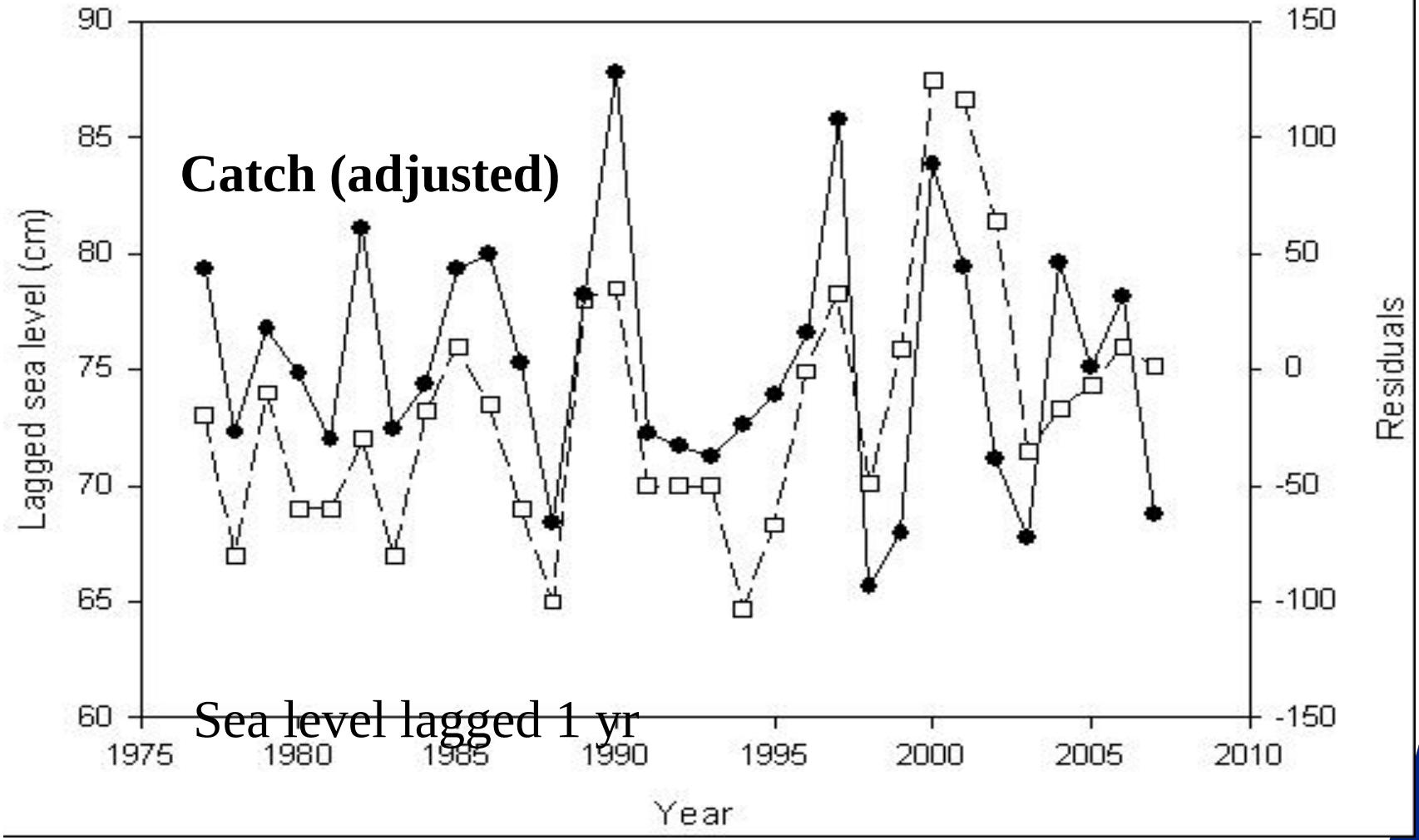
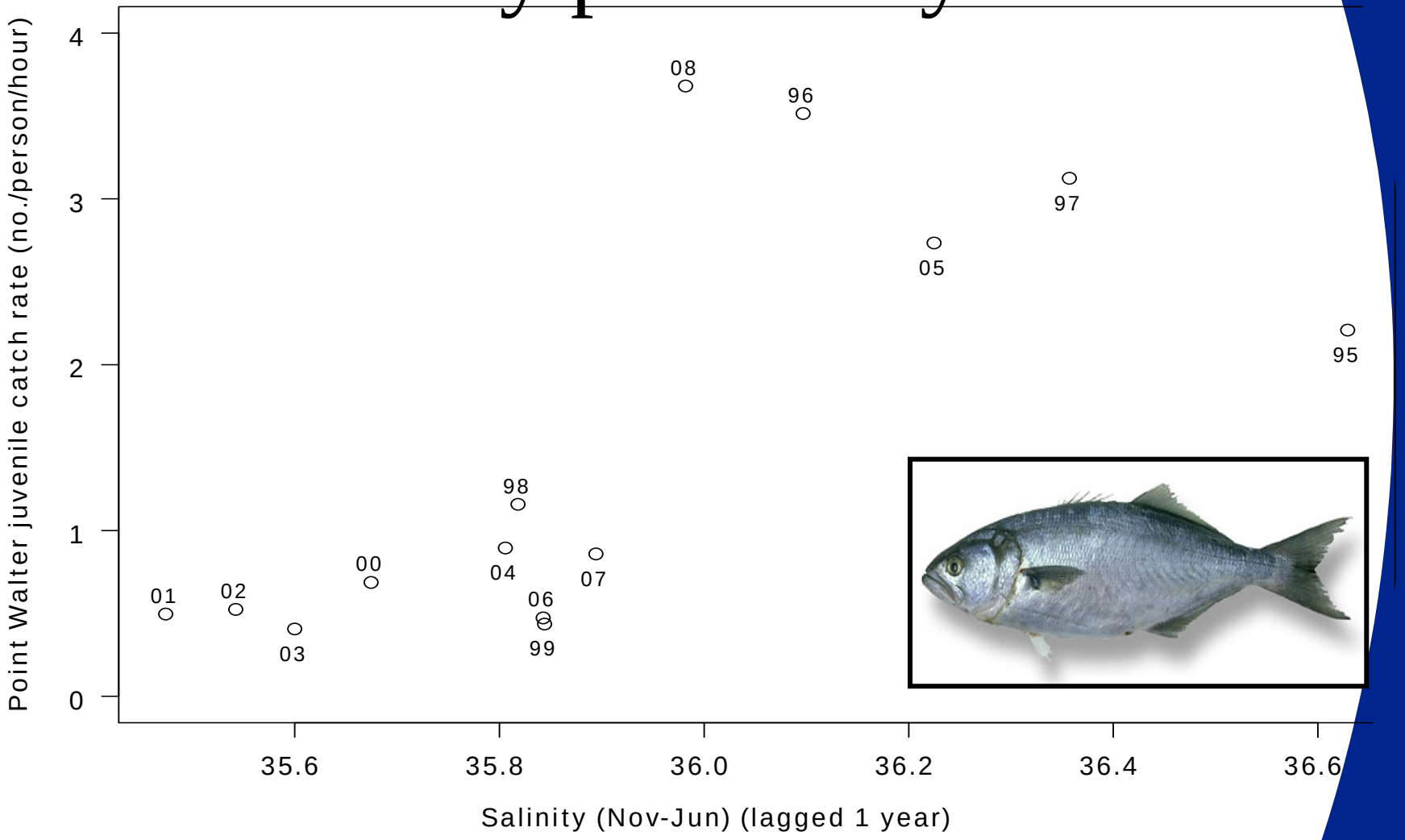
White bait v. Leeuwin Current



Lenanton 2009

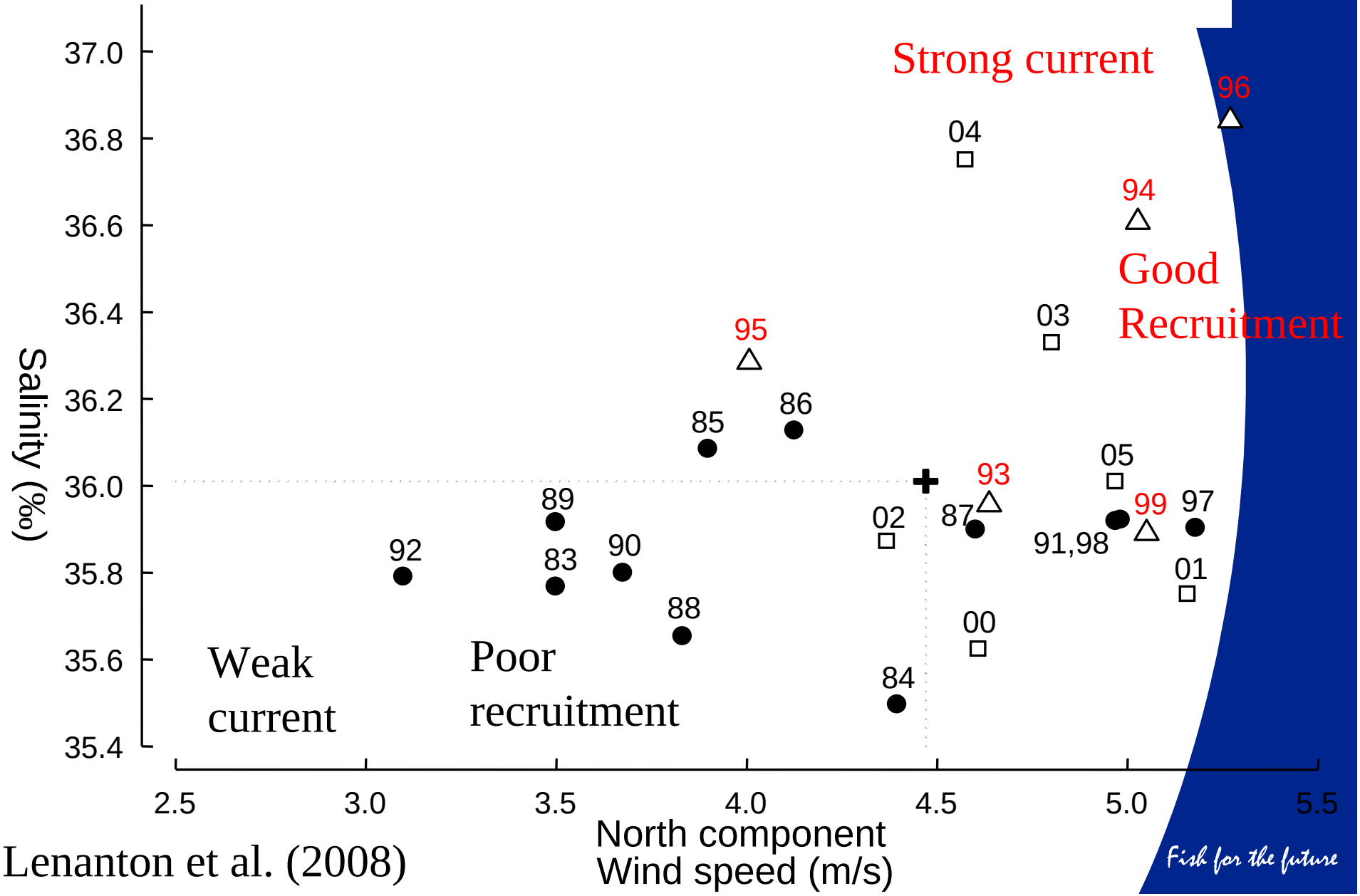
Fish for the future

Tailor: Recruits 0+ (Feb-Apr) v. Salinity previous year



Ayvazian et al.

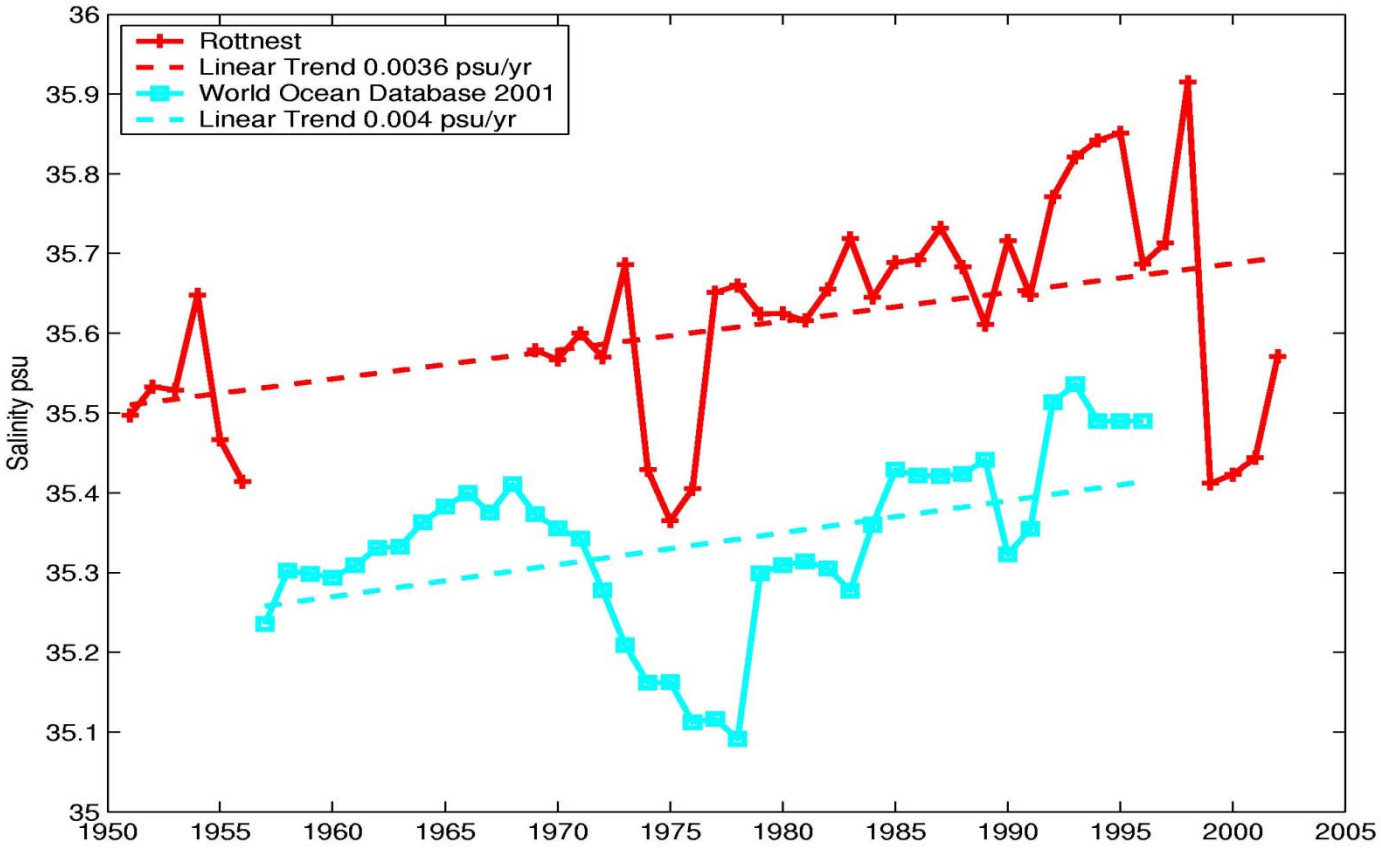
Dhufish v. Capes current (Dec-Feb)



Lenanton et al. (2008)

Fish for the future

Salinity trend (1950-)



Pearce and Feng (2007)

Future climate trends/Research

- Poloczanska et al. (2007) CSIRO Mk3.5 model
  - Waters around Australia will warm
    1-2^{o}C (2030s) & 2-3^{o}C (2070s)
  - Westerly winds in southern Australian waters weaken
- Higher frequency of ENSO events?
  - Weak Leeuwin Current?
- WA marine climate change study (WAMSI Node 2)
  - Indian Ocean, Leeuwin Current, coastal site
- Effect of environmental trends on fisheries
  - Rock lobster/other fisheries: Positive/negative effects
  - Stock assessment/management