Extreme marine heat wave effect on invertebrate fisheries in Western Australia

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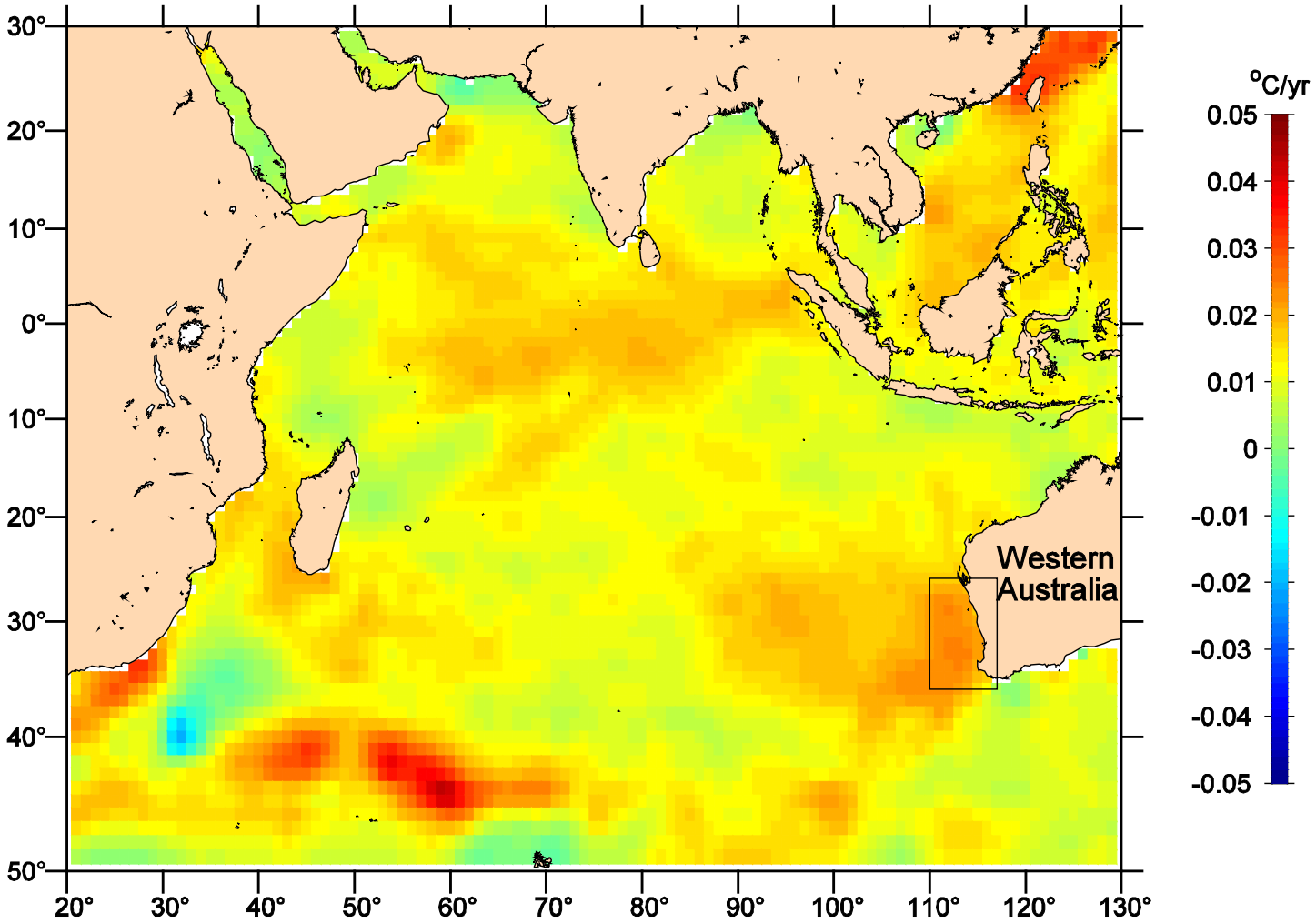
National Research FLAGSHIPS Wealth from Oceans
CSIRO

Government of Western Australia
Department of Fisheries

Overview

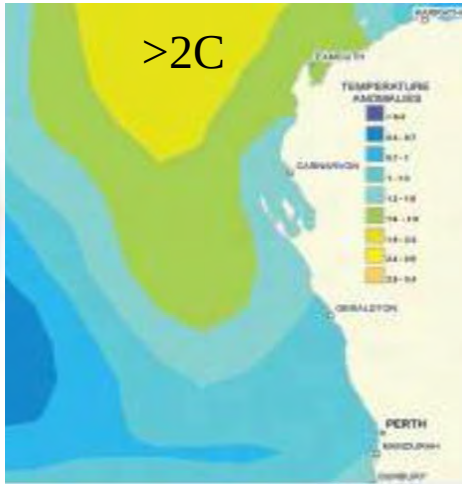
- Marine heat wave summer 2010/11 to 12/13
- Cause of heat wave
- Effect on marine environment
- Effect on invertebrate fisheries
  - Research/management/industry adaptation

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

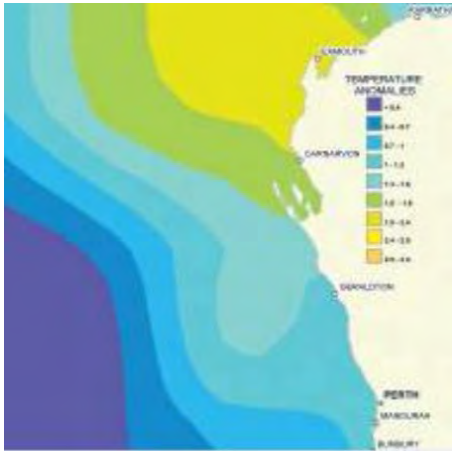


Marine heat wave: SST anomalies

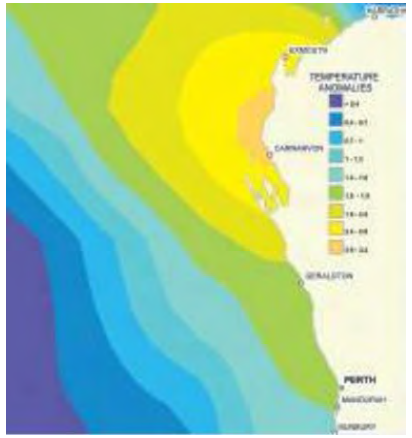
(associated with very strong La Niña)



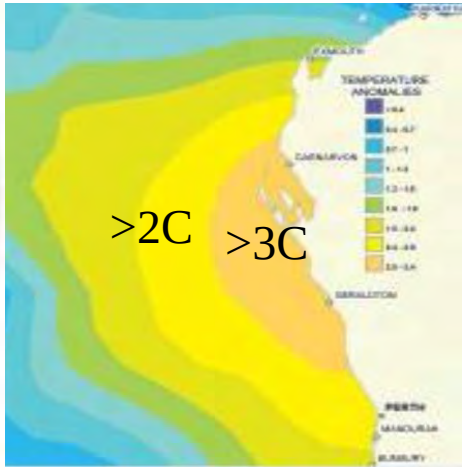
Nov 2010



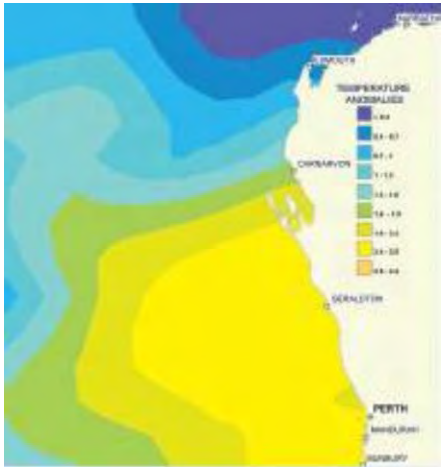
Dec 2010



Jan 2011



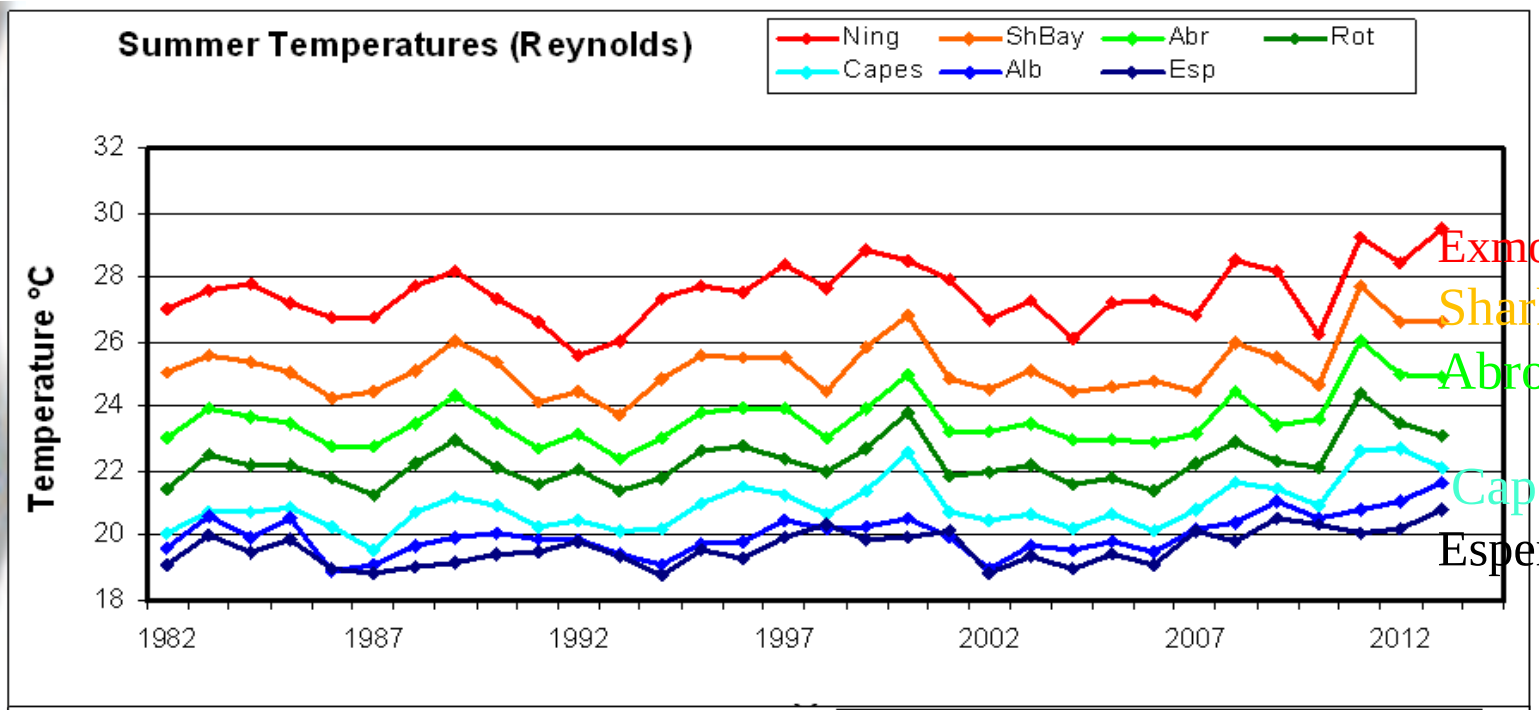
Feb 2011



Mar 2011

- 2000 km coast
- 4-5^{o}C anomaly at many locations

Pearce & Feng 2012



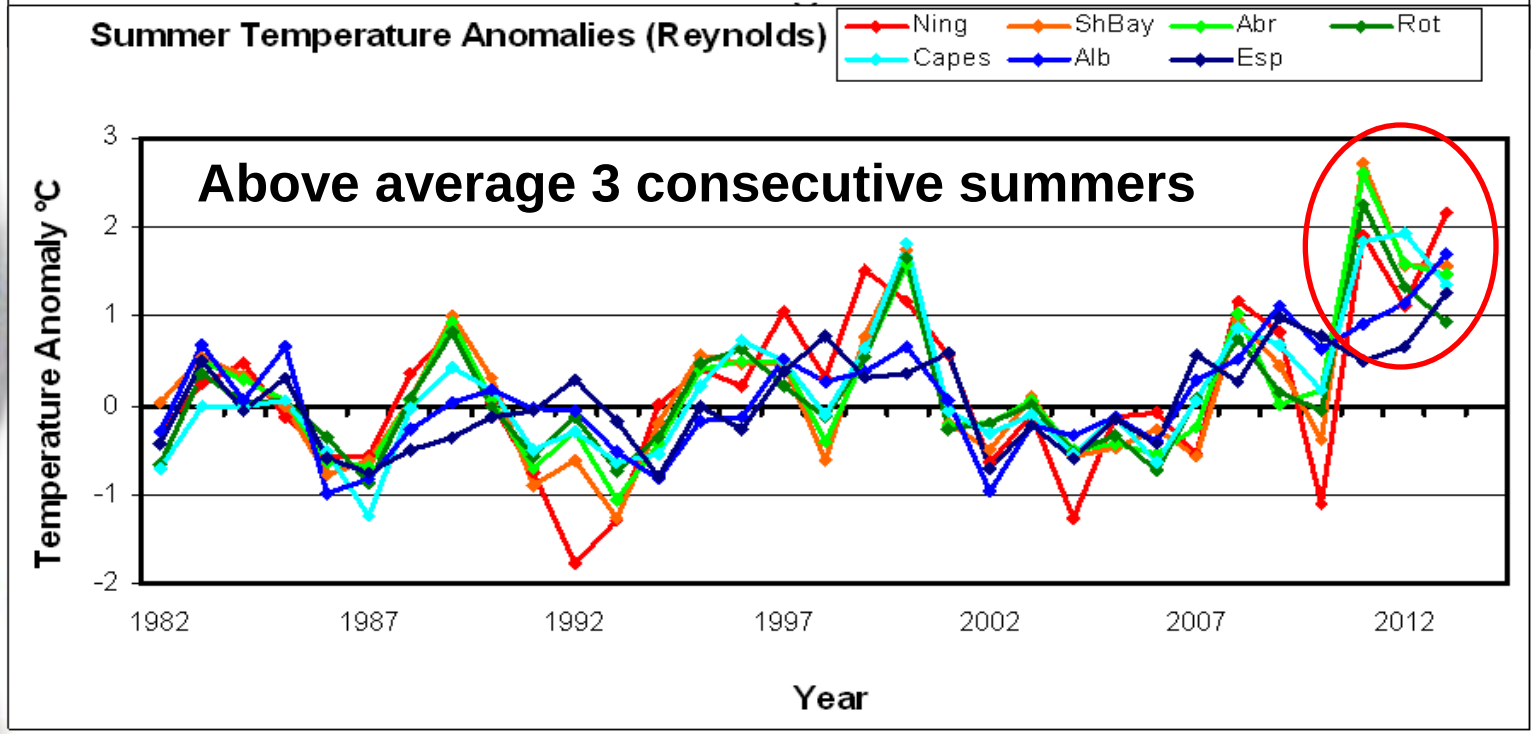
Exmouth

Shark Bay

Abrolhos

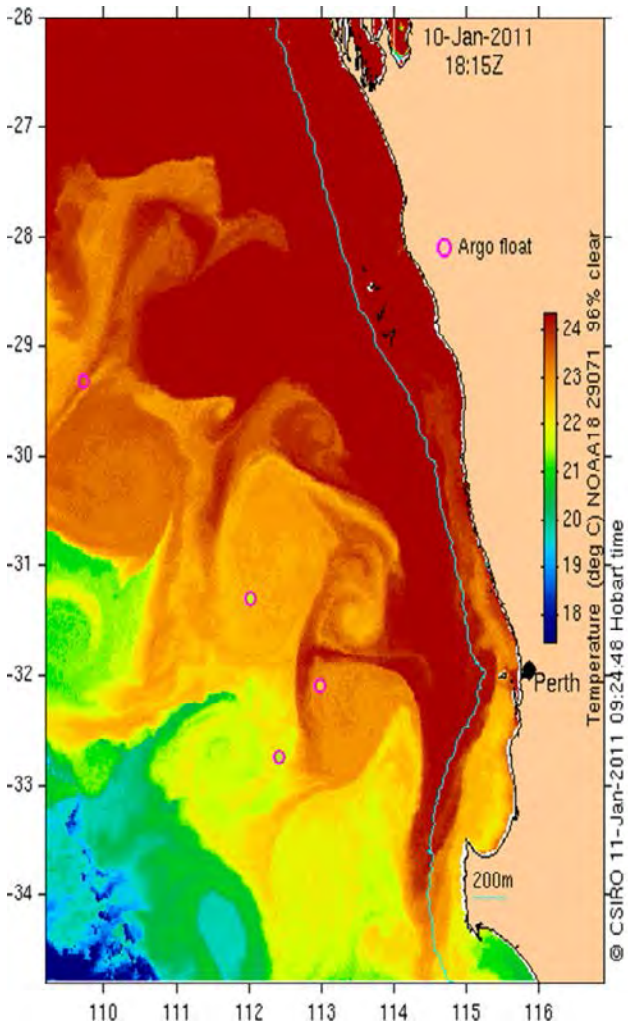
Capes

Esperance



Marine heat wave: perfect storm

- Seasonal to decadal processes aligned
- Strong Leeuwin Current (strong La Niña)
- Multi-decadal strengthening of tropical Pacific climate
- Long-term SST increase
- High air-sea heat flux
- Calm wind conditions late Feb (deoxygenation of water)



Effect on Marine Community

Immediate effects

- Tropical species range extension south
- Seagrass/algae habitat
- Coral bleaching
- Fish kills – particularly abalone (*Haliotis roei*)

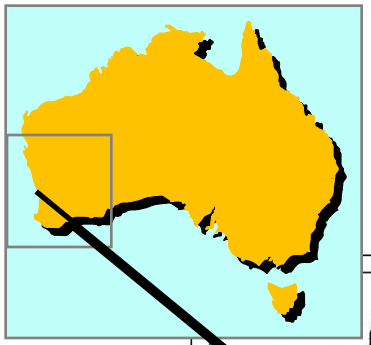
Effect on recruitment of invertebrate fisheries

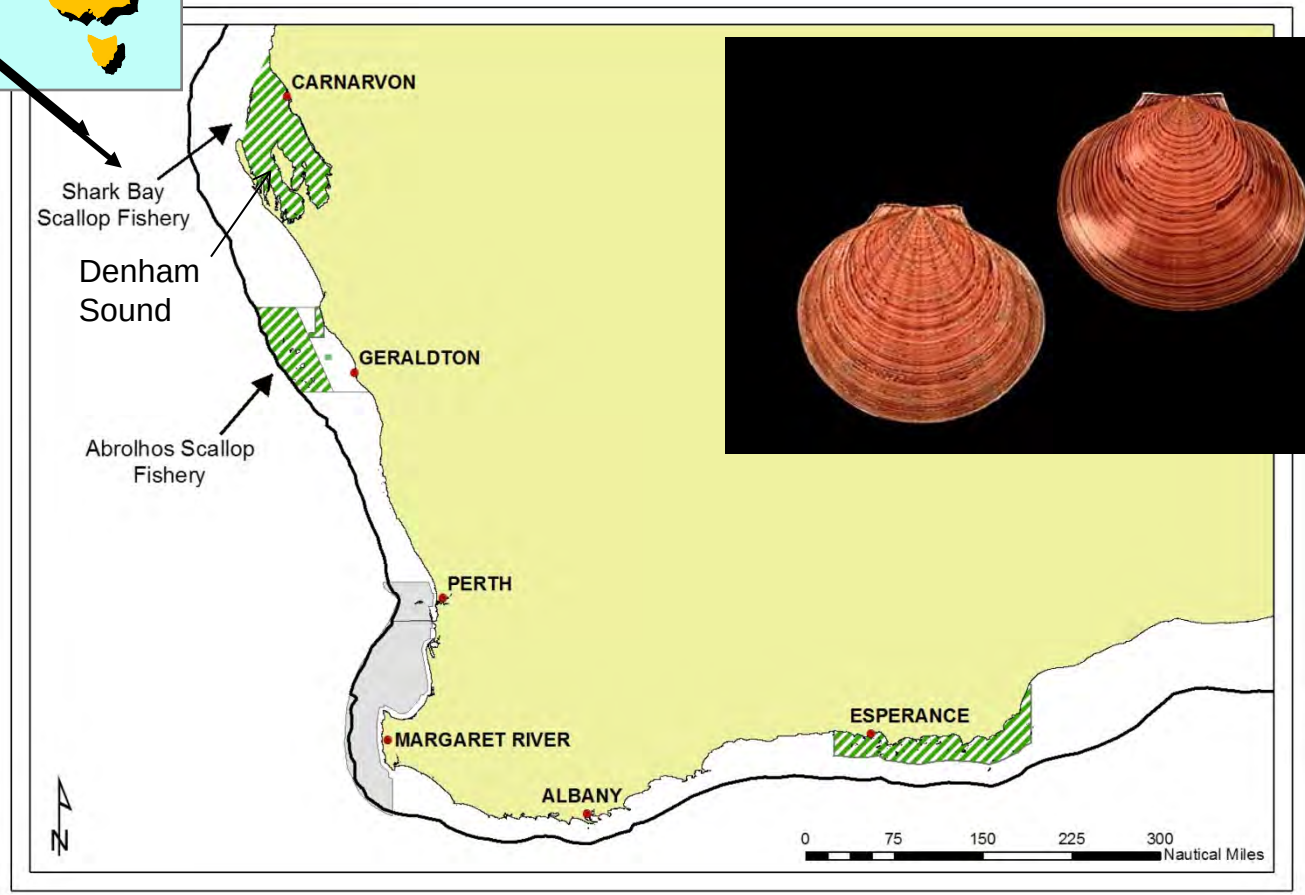
- Blue swimmer crab (*Portunus arma*tus)
- Scallop (*Amusium balloti*)
- King & Tiger Prawns (Penaeus latisulcatus & esculentus)

Mid-west Roei abalone 99% mortality: Feb 2011

Scallop fisheries

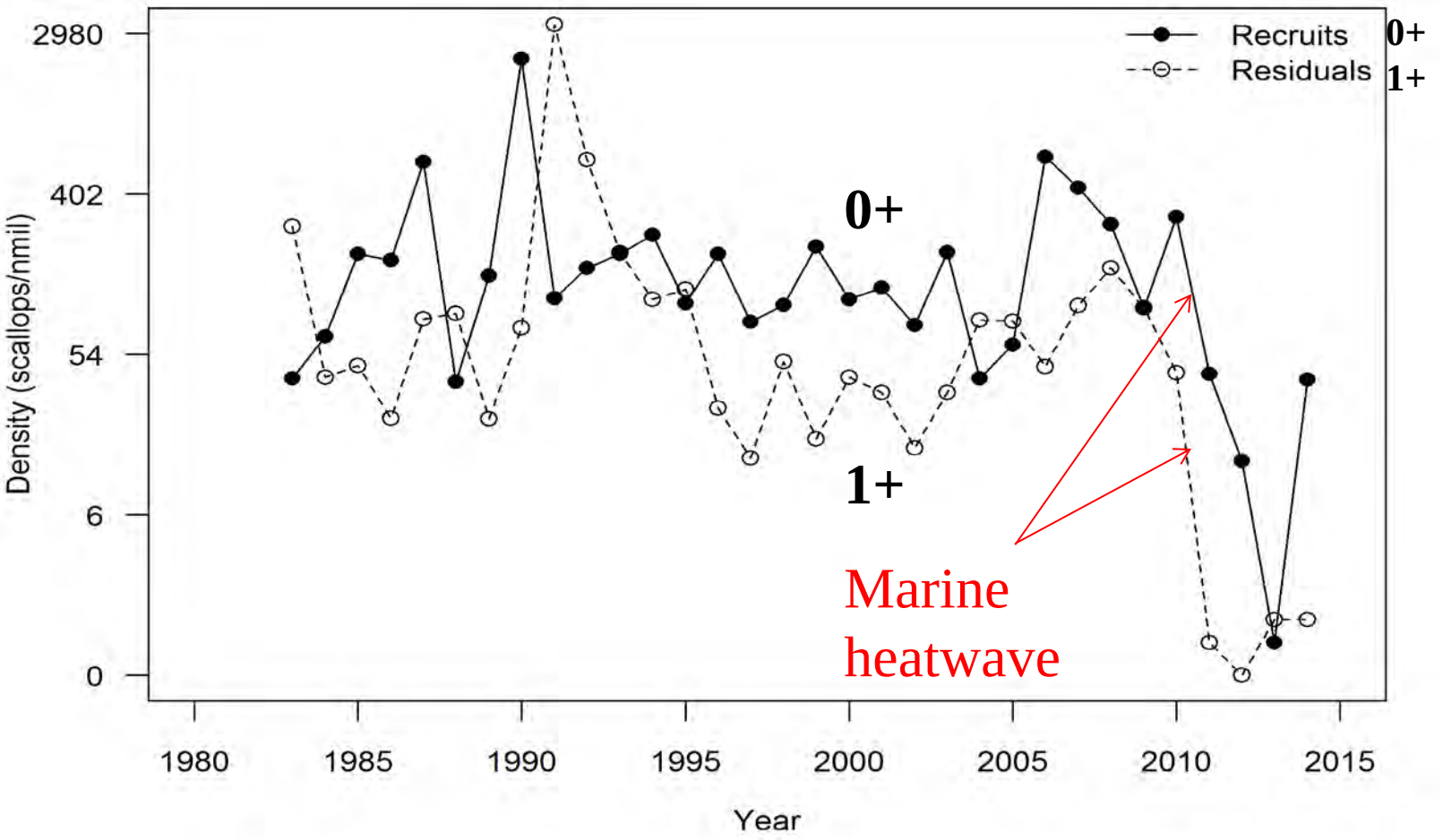
- 3 stocks affected by marine heat wave:
  Northern Shark Bay,
  Denham Sound,
  Abrolhos Is.





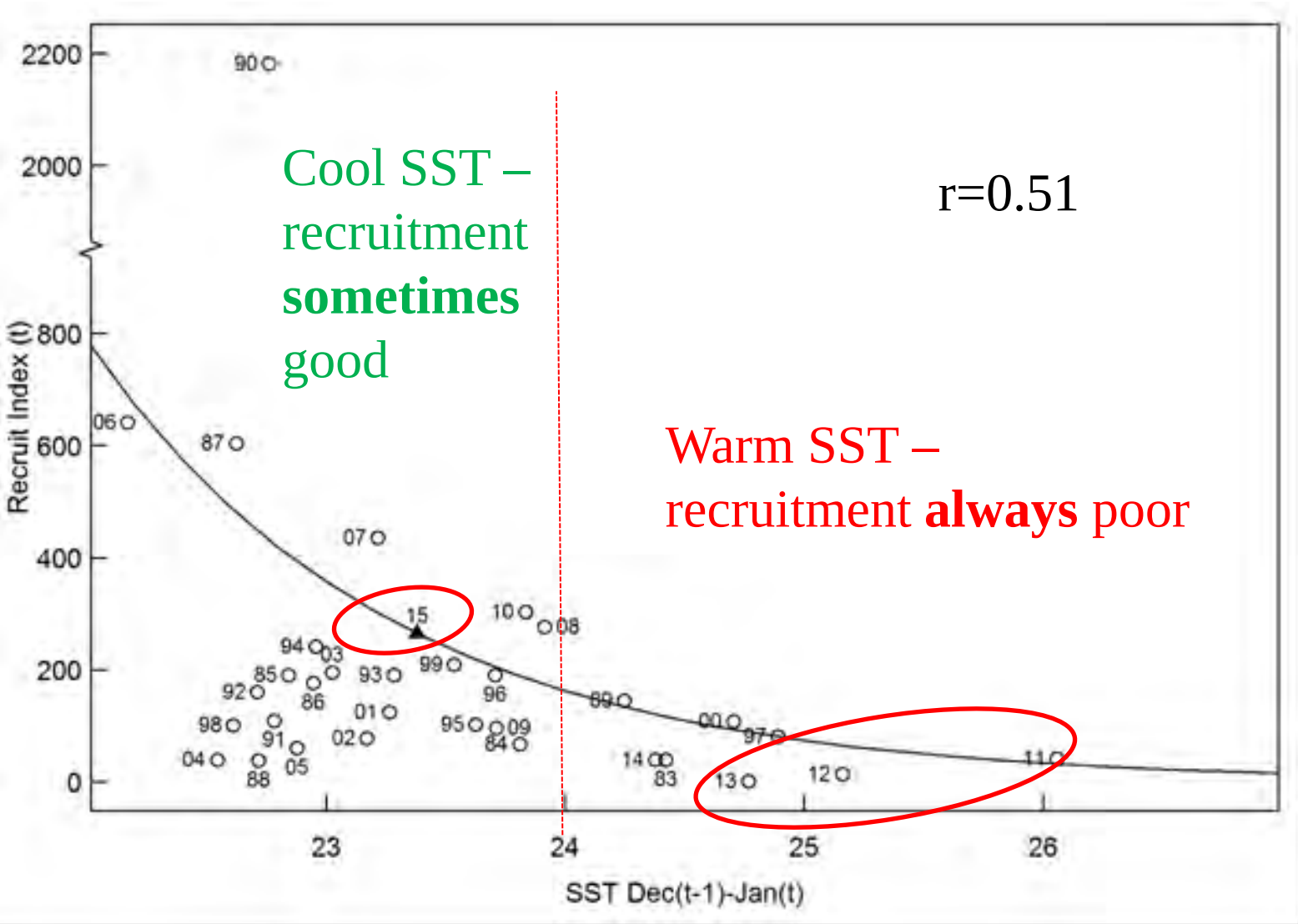
Shark Bay scallop pre-recruit survey

- Pre-recruits (0+) reliable catch predictor 4-6 months ahead
- Poor recruitment 2011-2013 (warm SST)
- Poor spawning stock 2012-14 (fishery closed)

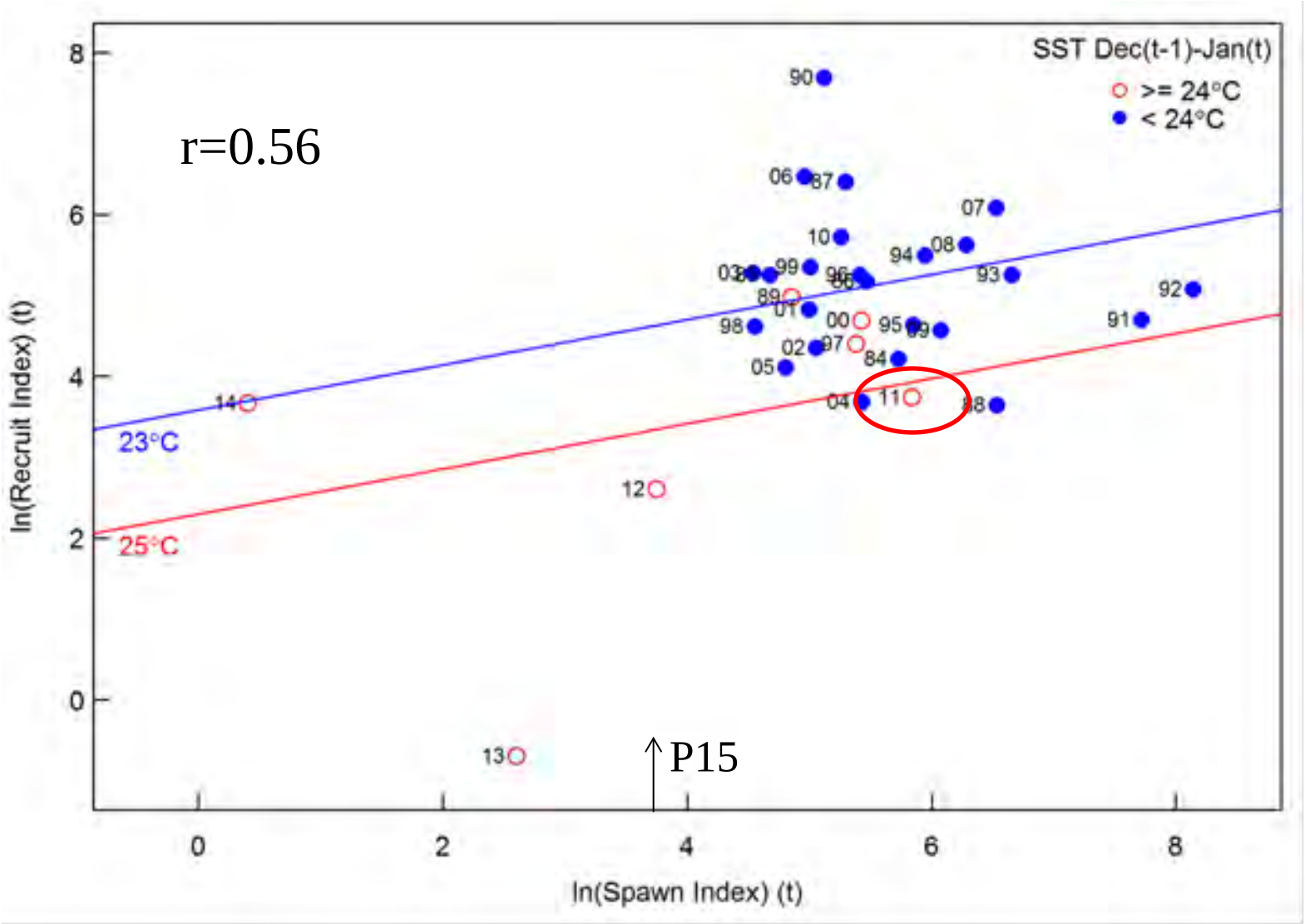


Shark Bay scallops pre-recruit (0+) v. SST

Counting daily rings - time/environment of good recruitment

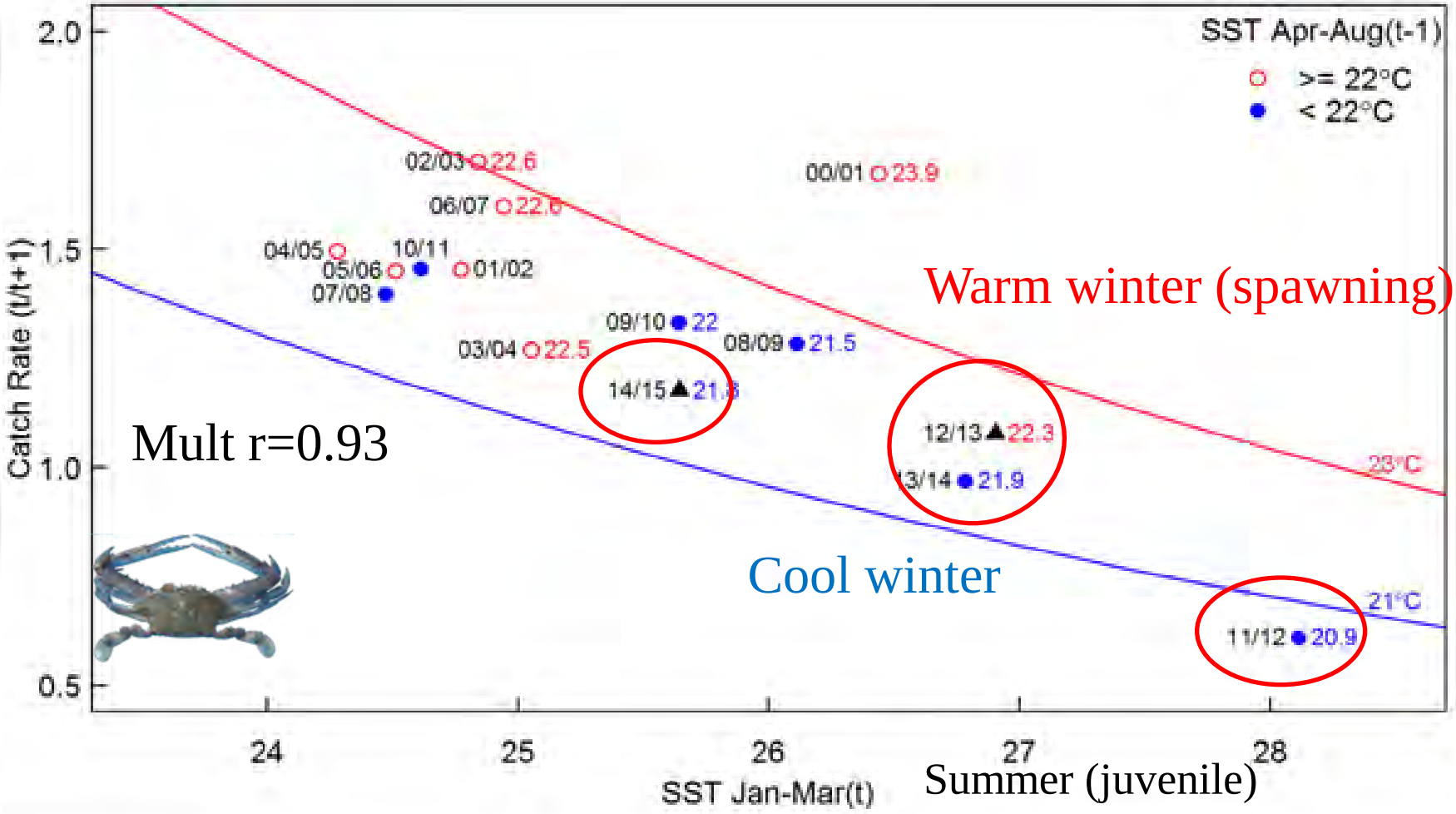


Scallops Shark Bay: Stock-recruit-environment relationship



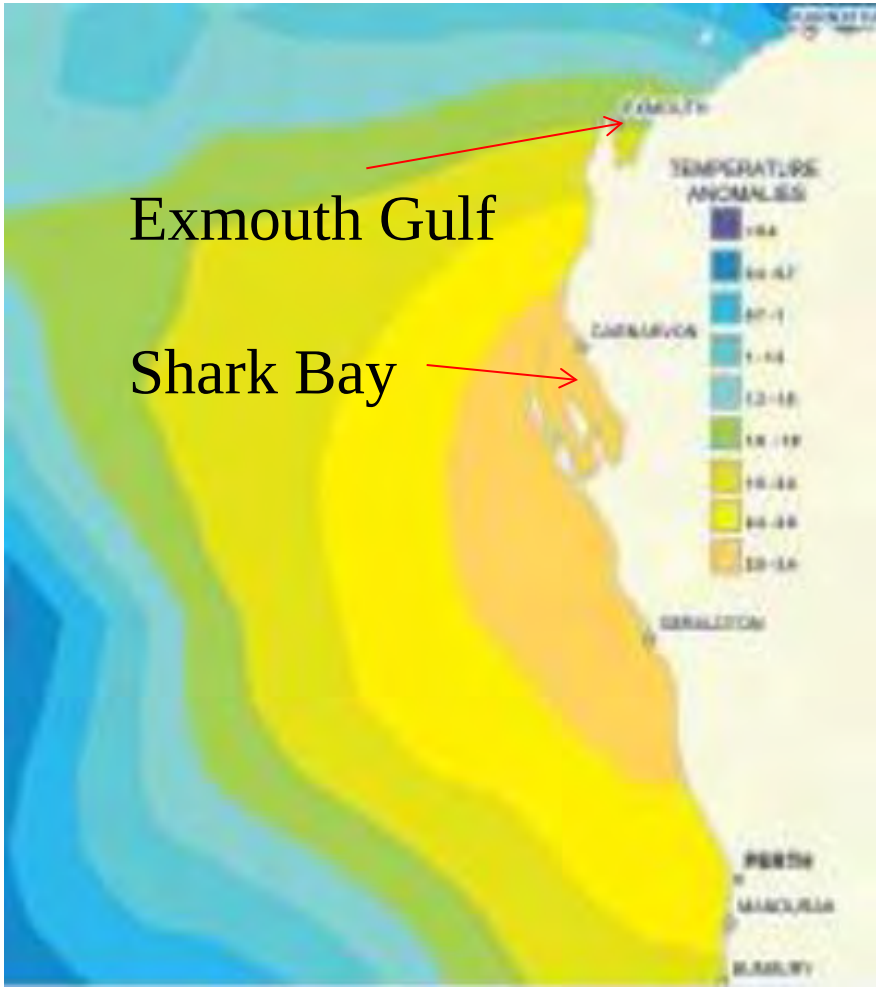
Shark Bay crab recruitment v. SST

- Warm SST summer (juvenile) negative effect
- Cold SST autumn/winter (spawning) negative effect
- Fishery closed for 2 years

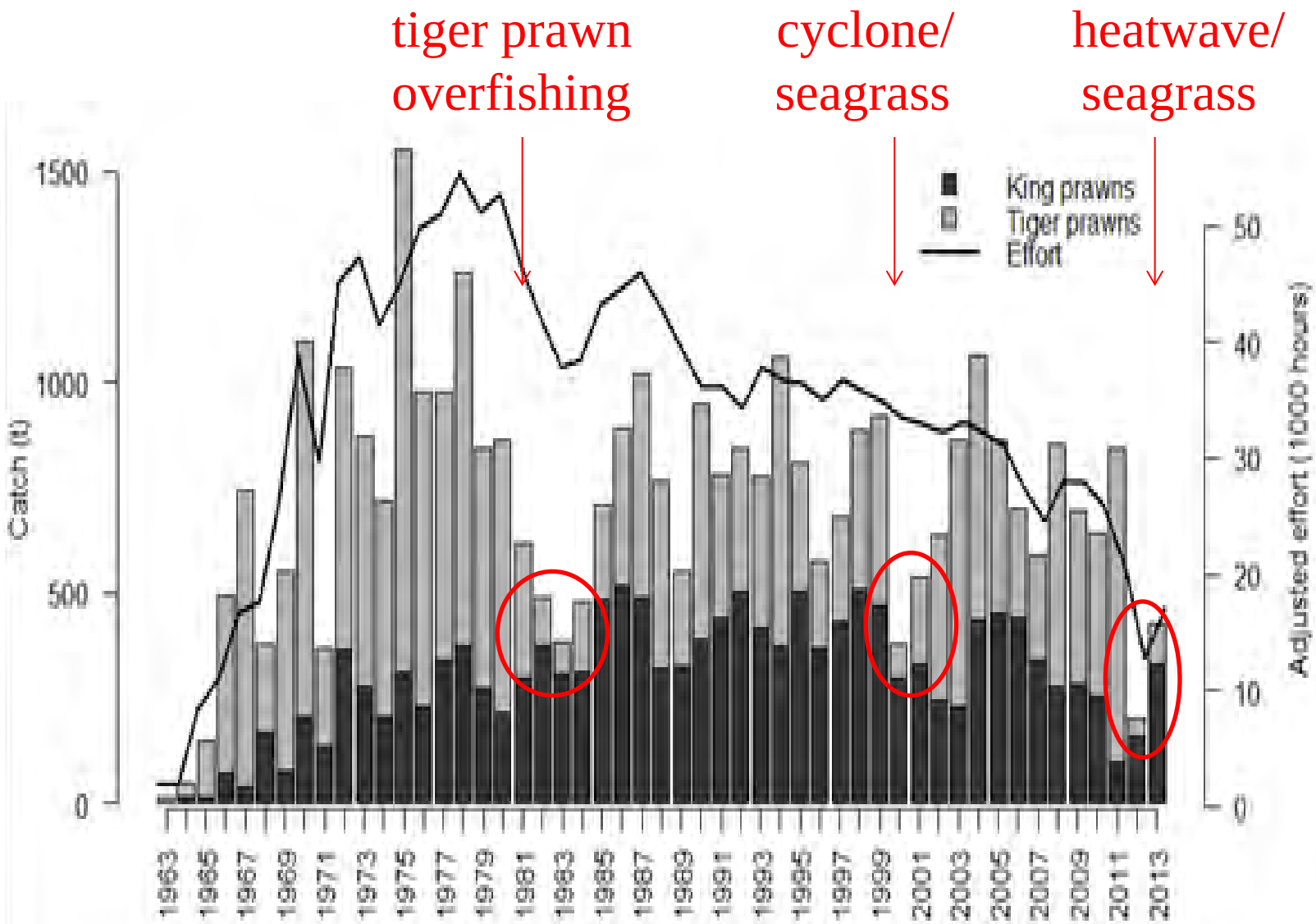


Prawn fisheries: Western Australia

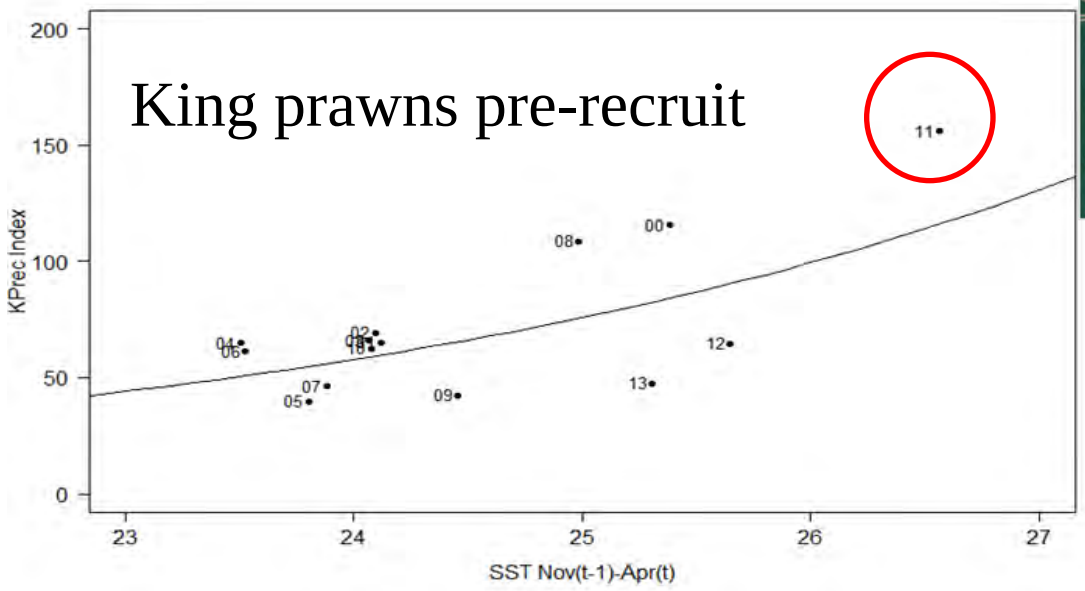
- Exmouth 2ºC warmer than Shark Bay
- Pre-recruit surveys



Exmouth Gulf prawn catch

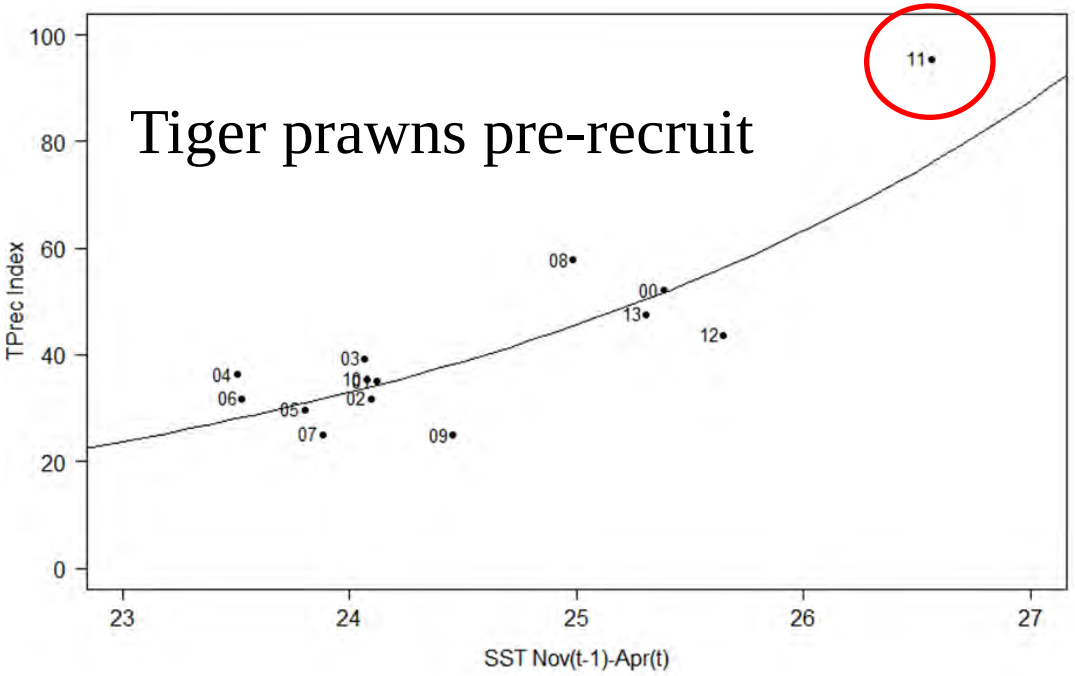


Warm SST negative effect on tiger & king prawns (reduced effort)



Shark Bay

Survey pre-recruit
v.
Water temperature



Research/Management adaptation

- Experience of dealing with extreme event
- Spawning stock protection
- Early detection important
  - Monitoring environment to understand cause
  - Monitoring pre-recruits (catch prediction)
  - Responsive harvest strategy
- Rebuilding strategies
  - Management: reduced catch/effort, closures
  - Restocking (abalone)