translating**nature**into**knowledge**

A KEY PREY/PREDATOR INTERACTION UNDER CLIMATE CHANGE: SIGNALS FROM A 'EARLY WARNING' FISHERY WITHIN A 'GLOBAL HOTSPOT REGION'

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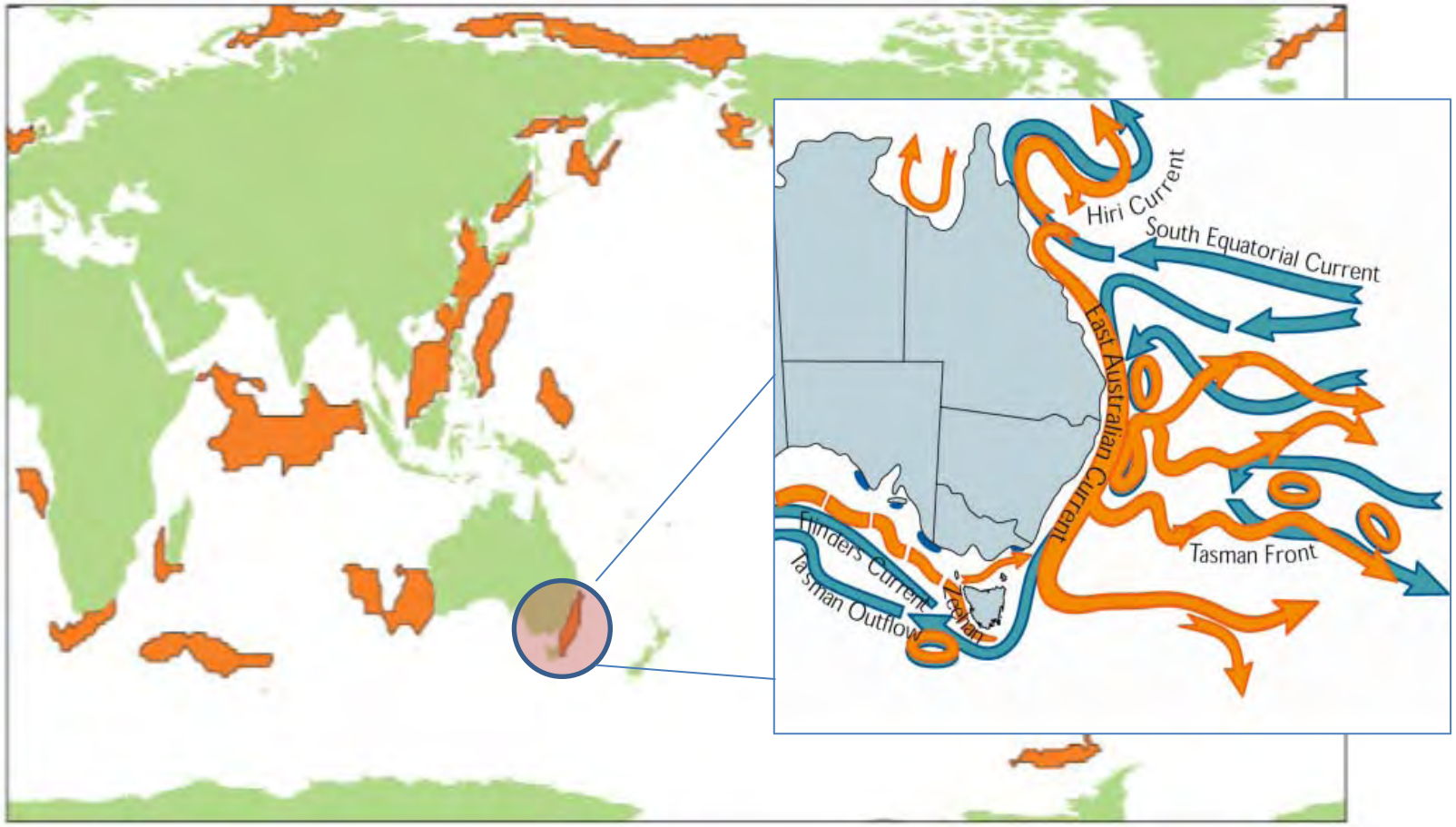
Second International Symposium: Effects of Climate Change on the World's Oceans

OUTLINE

- Background
- Methodology
- Results – Discussion
- Further work-broader PhD project

BACKGROUND

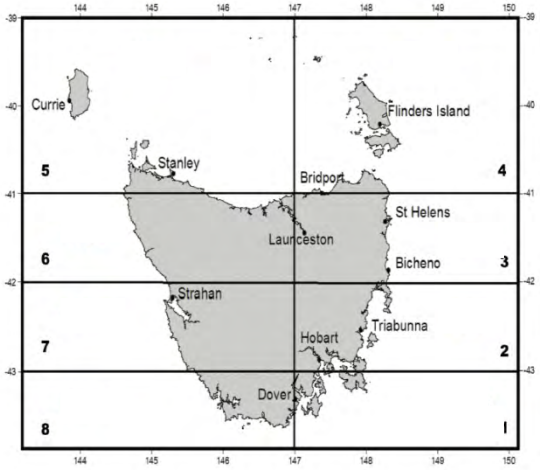
Ocean warming hotspots areas in the top 10% for rate of



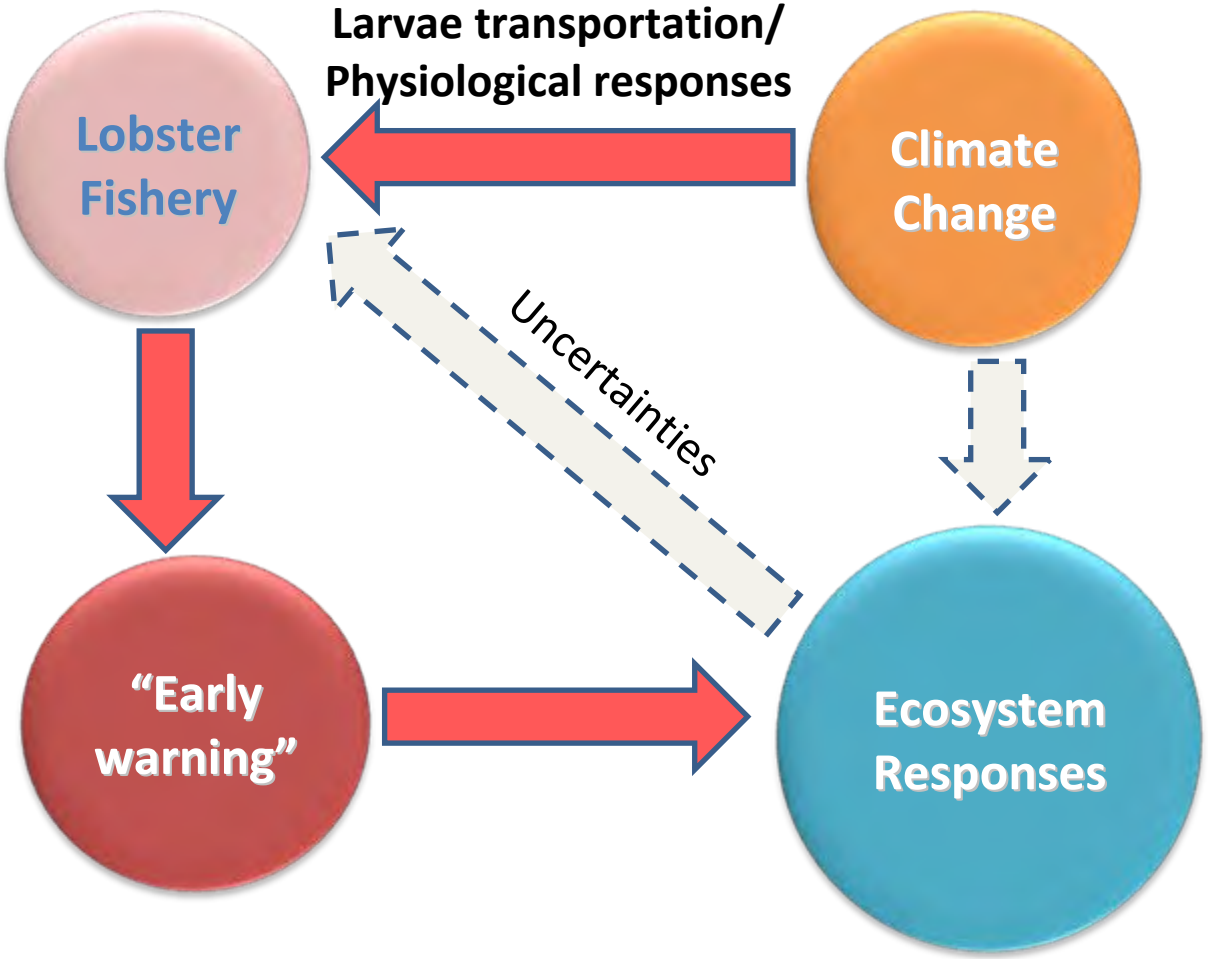
Tasmania: 3.8x global average rate of warming

(Hobday & Pecl, in review)

The Tasmanian Southern Rock Lobster Fishery and Climate Change



'Lots more octopuses caught now'
(Fisherman's perception)



Changes in abundance/distribution of lobster keystone predators

Pecl et al., 2009

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Main predators of the Southern rock lobster in Tasmania

Draughtboard shark
(*Cephaloscyllium laticeps*)

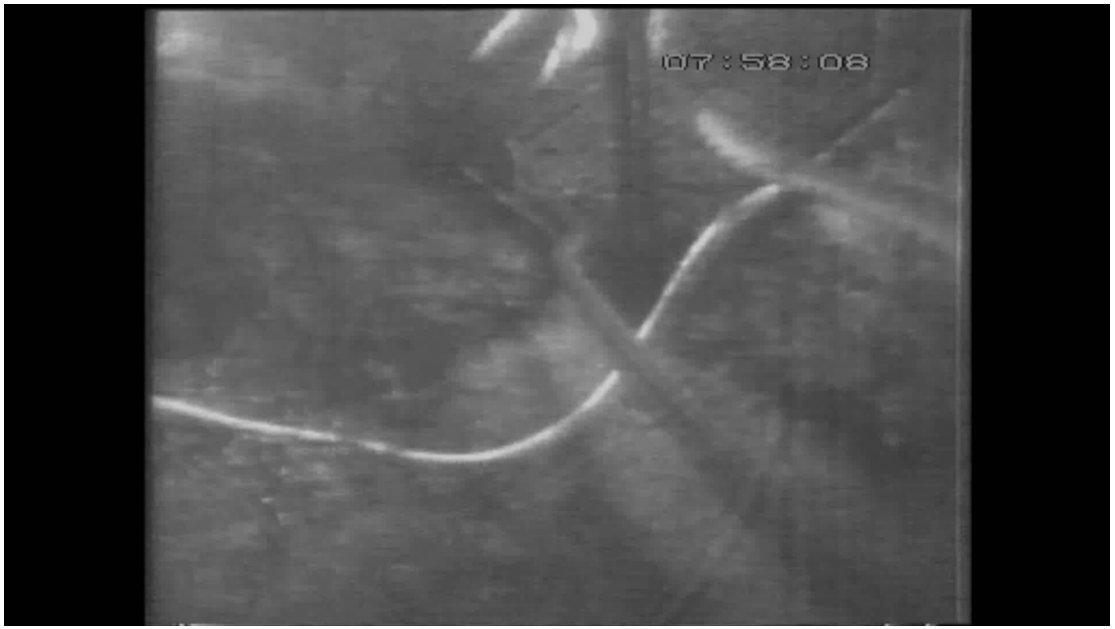
Maori octopus
(*Octopus maorum*)

Blue throat wrasse
(*Notolabrus tetricus*)

Mills et al., 2009 (MEPS)

The Rock lobster – Octopus interaction in Tasmania

Tasmanian lobster pot



In situ observation in a marine reserve
(J. Semmens, unpublished data)

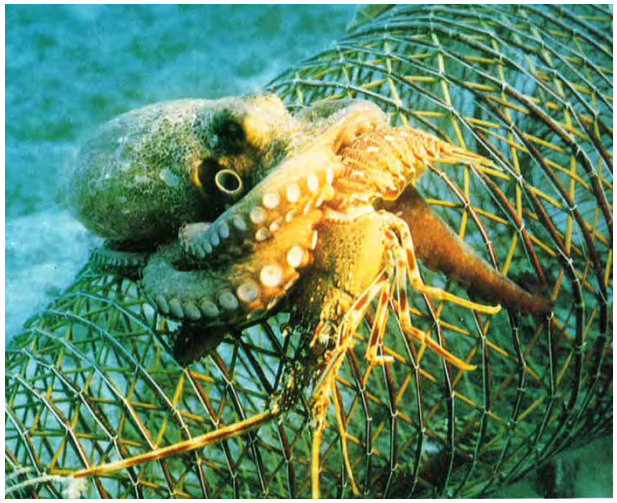
Lobster mortality rate in pots by octopus ~ USD$ 1.45 million for the Tasmanian lobster fishery !

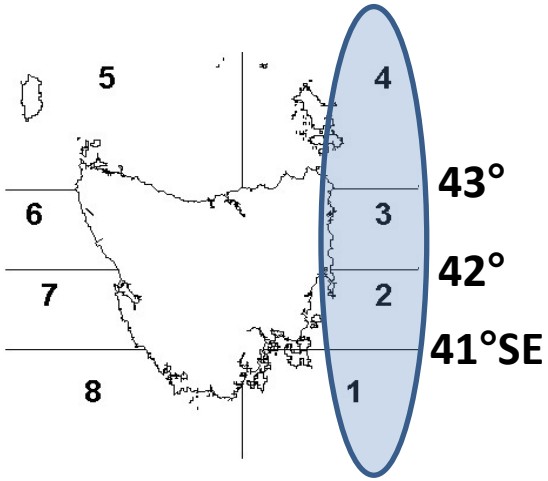
Octopus as a predator:

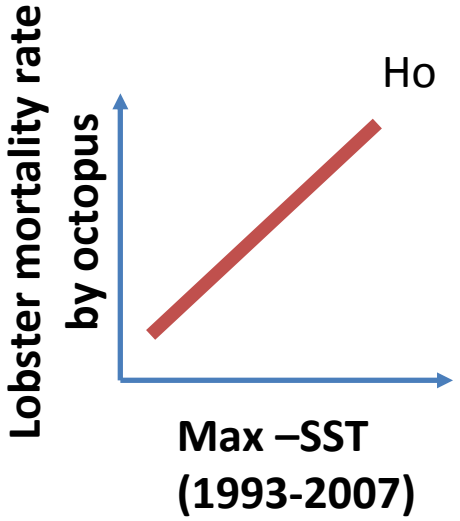
→ **Short life span + fast growth + voracious predator**

→ **Environmental plasticity**

→**A case study linking environment and predator patterns**



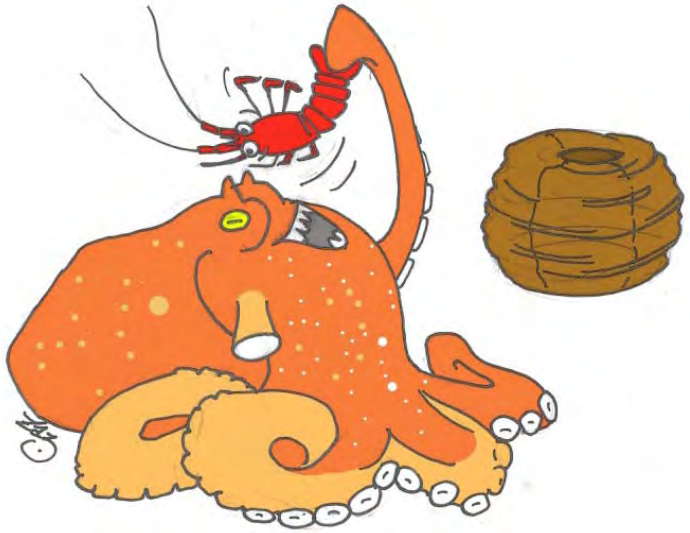




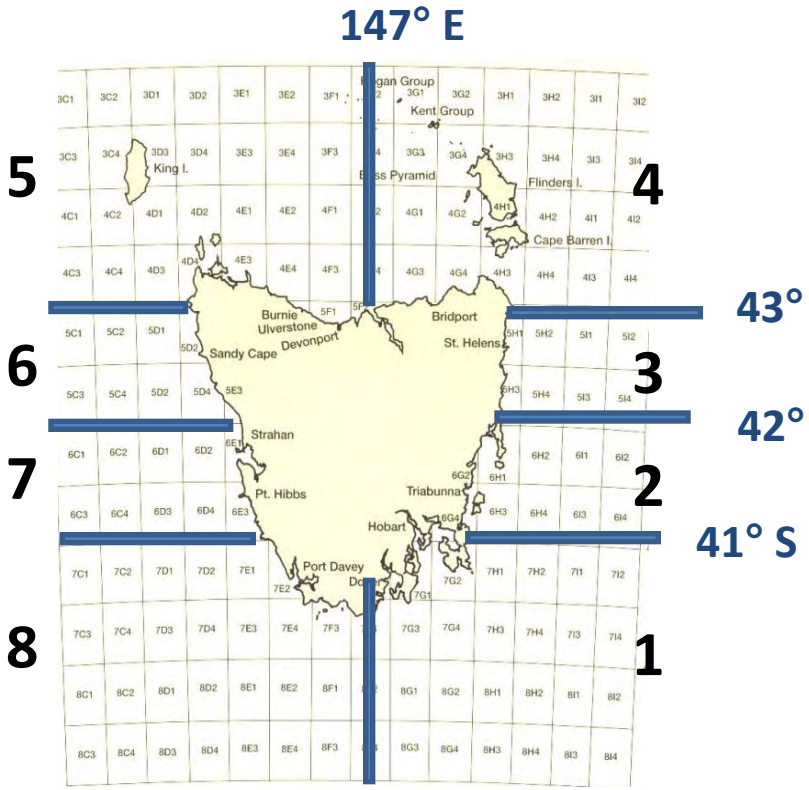
KEY QUESTIONS

Q1: Are there any spatial and temporal octopus predation trends around Tasmania?

Q2: Does temperature and fishing affect the lobster - octopus interaction in Tasmania?



METHODOLOGY



Lobster fishery blog ~ 17.5 X 17.5 km

✓**Lobsters killed by octopus/month:**

$$\frac{\text{No. Lobster killed by octopus}}{\text{pots lifted (depth < 32 m) month}}$$

✓ **Lobster catch rate:**

$$\frac{\text{No. Lobster}}{\text{pots lifted (depth < 32 m) month}}$$

✓**Satellite SST (Pathfinder, 4x4 km)**
Jan/2000 – Dec/2009

(1) Exploratory analysis of spatial and temporal trends for these regions;
(2) Multiple regression by time series

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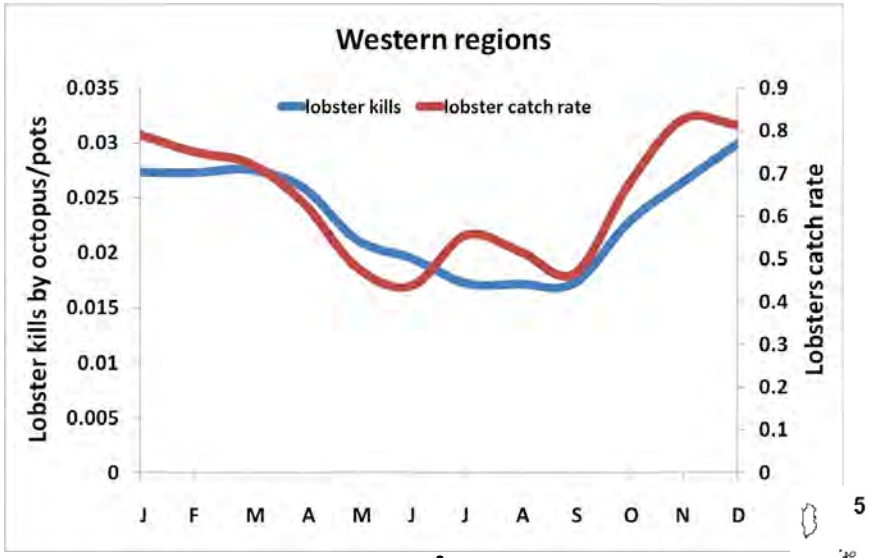
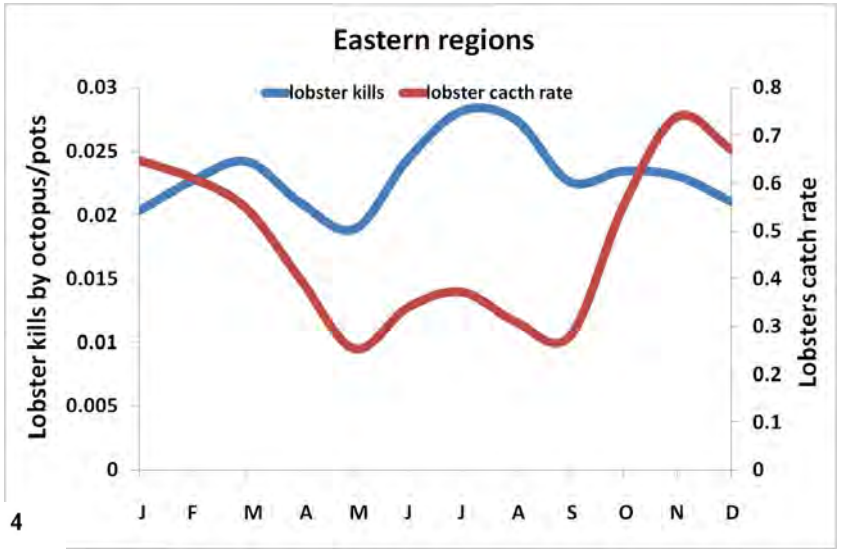
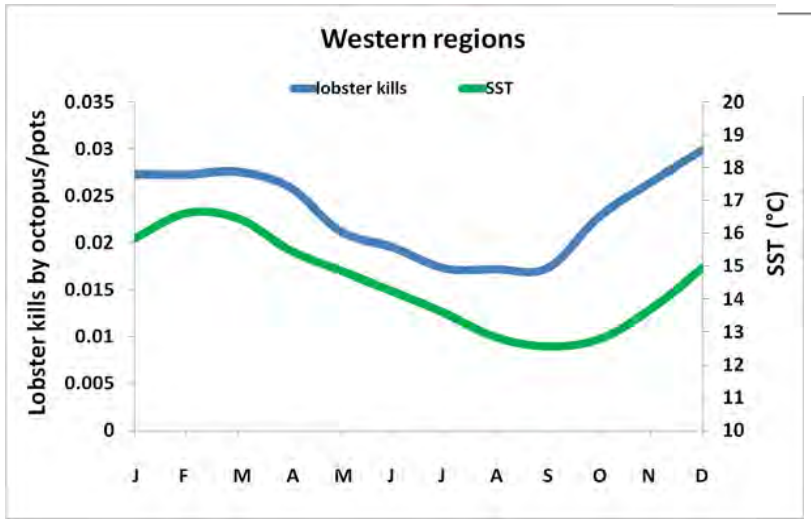
KEY RESULTS AND DISCUSSION

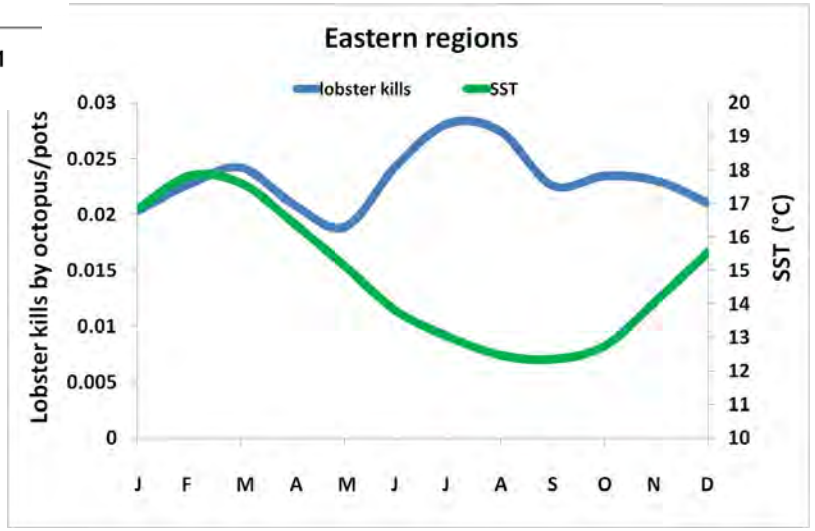


summer winter



summer winter





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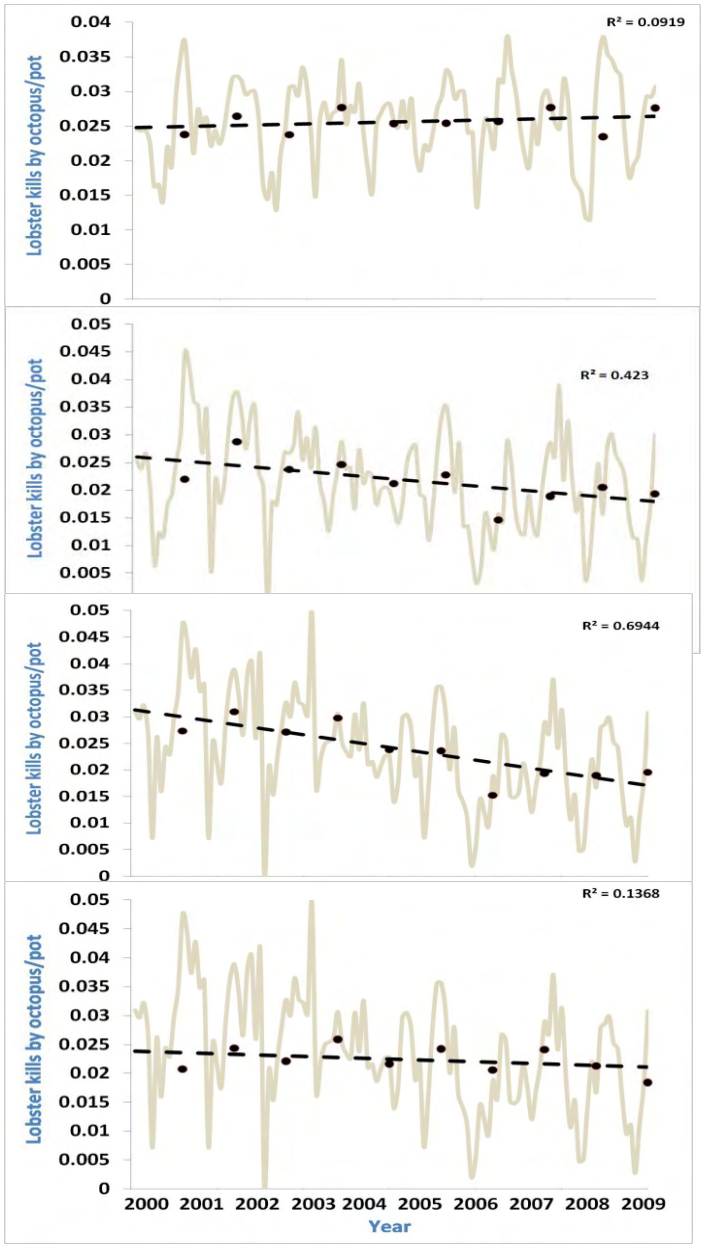
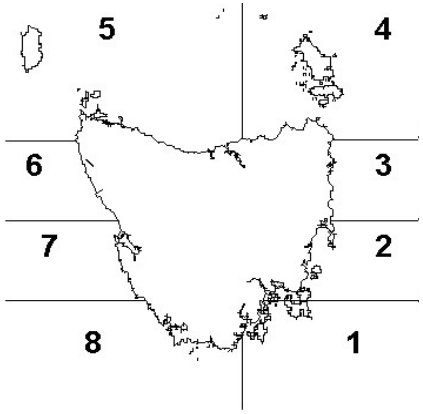
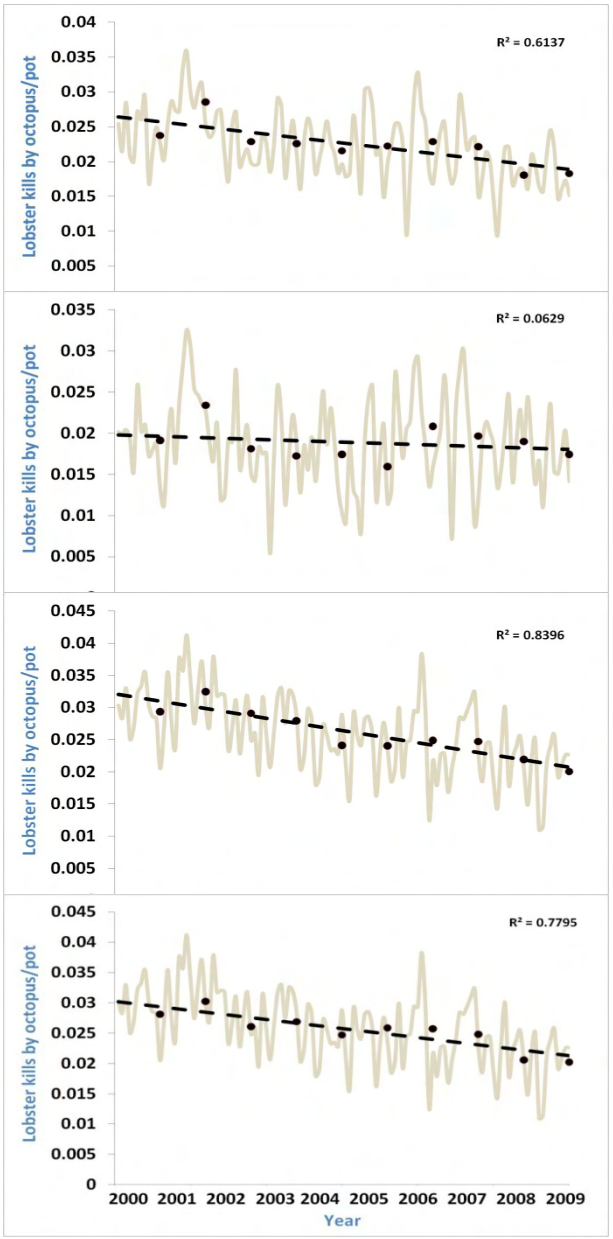
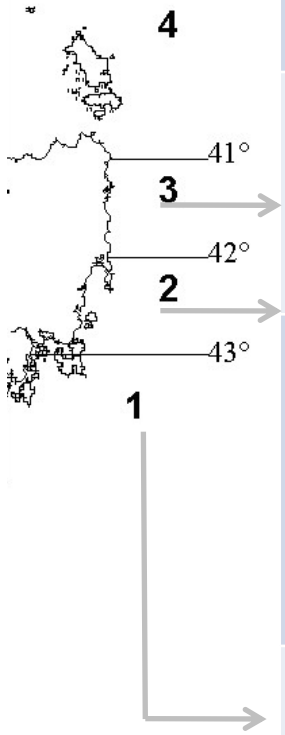
Lobsters killed by octopus - time series (2000- 2009)







Multiple regression by time series outputs



Region	Coefficients	Estimates	% Variation (#)	Multiple R-squared
4	*Intercept* *Lobsters kills (lag-1)* *Lobsters kills (lag-2)* *Lobsters kills (lag-3)*	0.0015429 * 1.8625868 *** -1.3691789 *** 0.4318178 ***	- 89.78 8.30 1.83 0.08 (residuals)	**0.9287**
3	*Intercept* *Lobsters kills (lag-1)* *Lobsters kills CPUE (lag-2)* *SST (lag-6)*	5.654e-03 *** 1.541e+00 *** -7.189e-01 *** -1.585e-04 ***	- 82.87 15.30 1.74 0.09 (residuals)	**0.9208**
2	*Intercept* *Lobsters kills (lag-1)* *Lobsters kills(lag-2)* *Lobsters kills(lag-3)* *Lobsters (lag-5)* *SST (lag -4)*	-7.062e-04 1.873 *** -1.250 *** 3.085e-01 *** 1.482e-03 *** 1.062e-04 **	- 91.37 7.23 0.44 0.62 0.32 0.03 (residuals)	**0.9733**
1	***Intercept*** ***Lobsters kills (lag-1)*** ***Lobsters kills (lag-2)*** ***Lobsters kills (lag-3)*** ***Lobsters (lag-5)***	0.0004843 1.8875170 *** -1.3426986 *** 0.3859111 *** 0.0021414 ***	- 88.28 9.68 1.213 0.78 0.04 (residual)	**0.9659**

Significance codes: 0 *' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**

(#) From ANOVA (Mean Sq. by factor/Total Mean Sq.)

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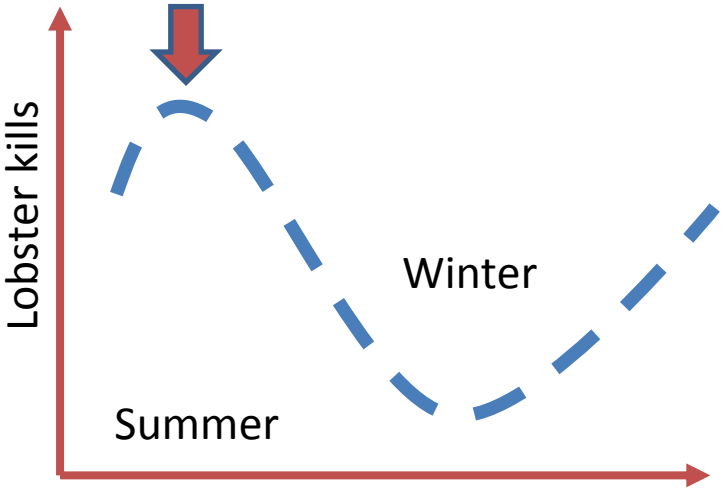
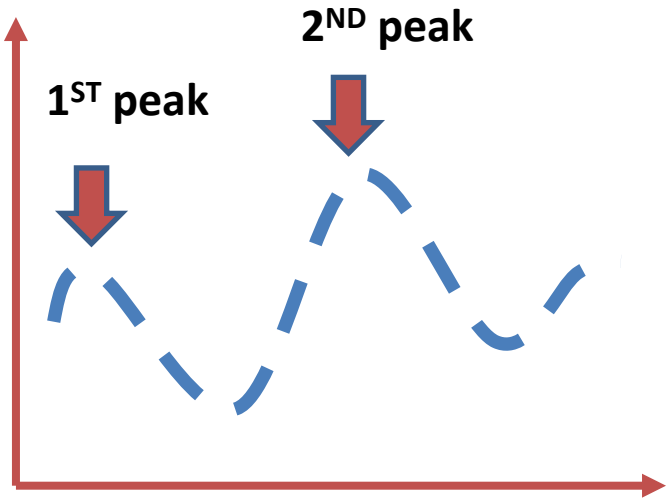




I. Are there any spatial an temporal trends ?(Q1):

✓ Summer peaks may be related with higher temperatures (seasonality pattern) in both Eastern and Western coast;

✓Winter peak may be related with a higher lobster catch rate;

✓ Octopus predations was decreasing mostly in Eastern regions (75%) - higher fluctuations in western regions;

✓Octopus by-catch analysis is needed to understand the interaction dynamic;

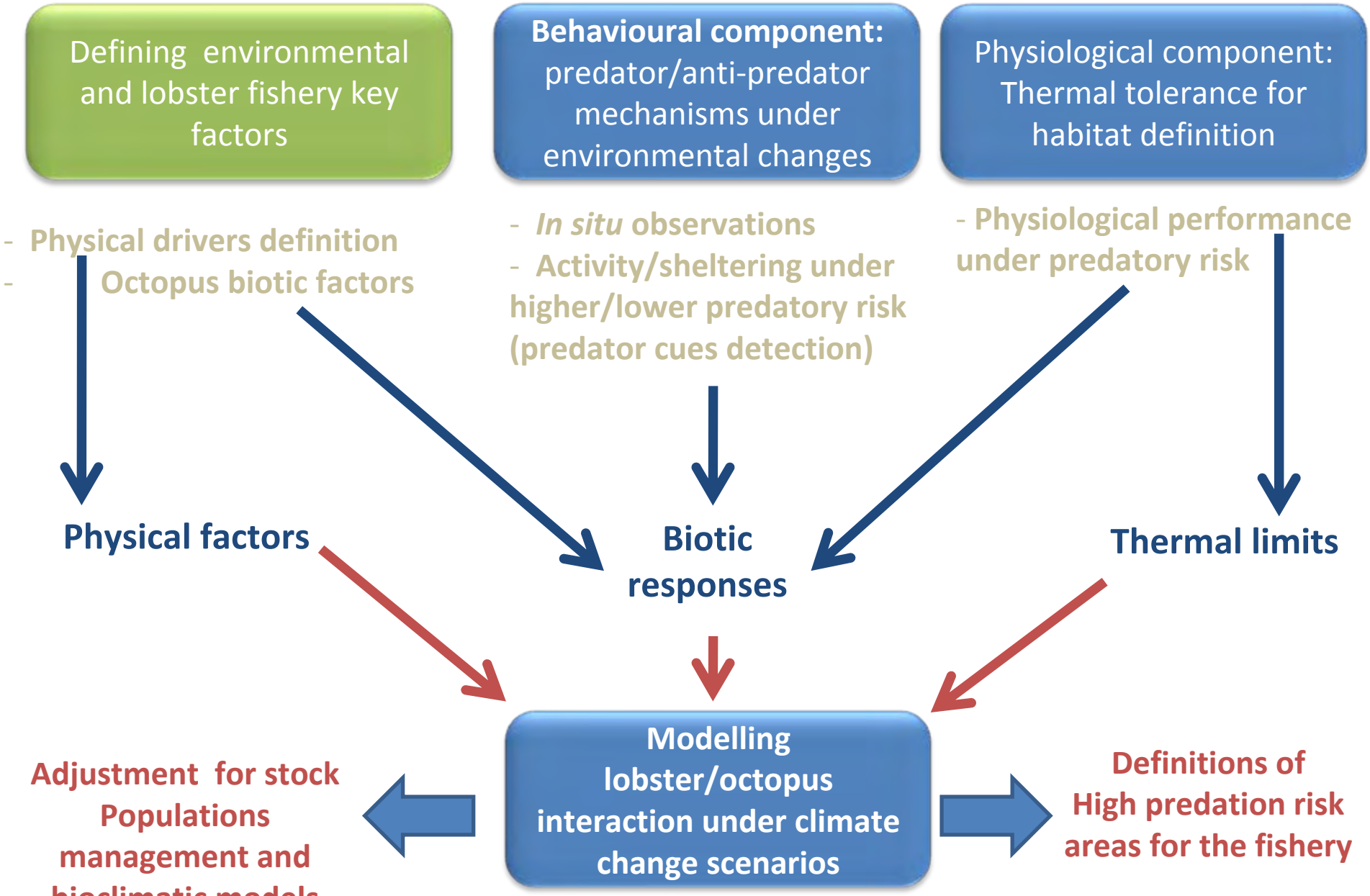
II. Does temperature and fishing affect this interaction?

✓SST and lobster abundance had a minor effect on octopus predation in target regions;

✓SST's effect may be related with the intensification of the Eastern Australian Current. Including sea bottom temperature in the analysis may improve our understanding;

✓ Time series analysis shows that there was an effect of previous mortality events (lag 1, 2, 3 and 5), which gives us some ideas about the dynamic of this interaction (a quick interaction?).

✓ What is the potential for conflicts and trade-offs to arise from simultaneous harvesting of food web components (e.g middle-trophic level), particularly predator and prey populations? (EBFM, Baum et al., 2006).


Defining environmental and lobster fishery key factors
Behavioural component: predator/anti-predator mechanisms under environmental changes
Physiological component: Thermal tolerance for habitat definition
- Physical drivers definition
- Octopus biotic factors
- *In situ* observations
- Activity/sheltering under higher/lower predatory risk (predator cues detection)
- Physiological performance under predatory risk
Physical factors
Biotic responses
Thermal limits
Modelling lobster/octopus interaction under climate change scenarios
Adjustment for stock Populations management and bioclimatic models
Definitions of High predation risk areas for the fishery

MANY THANKS FOR YOUR ATTENTION

(많은 감사)

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