

Living with uncertainties in fisheries and environmental research

Australasian Applied Statistics Conference (GenStat & ASReml)

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The University of Queensland

The frontier race

Space



Maximum Economic Yield (MEY)

The Australian federal government is in the process of introducing MEY-based management for 26 fish species (2008)

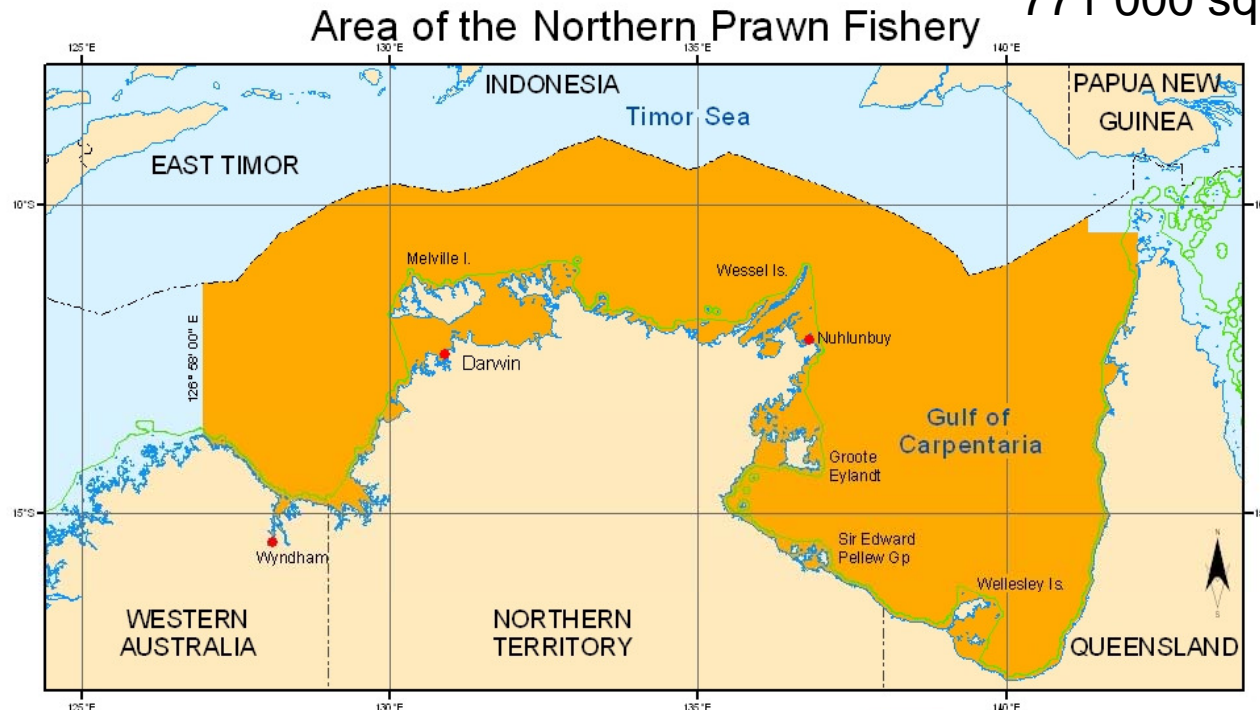
scampi, squid, scallops and bugs

9 species of prawns

Map of the Northern Prawn Fishery

(source: AFMA Report)

771 000 square km



- LEGEND**
- Northern Prawn Fishery
 - Land and coastline
 - Limit of Coastal Waters (3nm)
 - Treaty / Median line

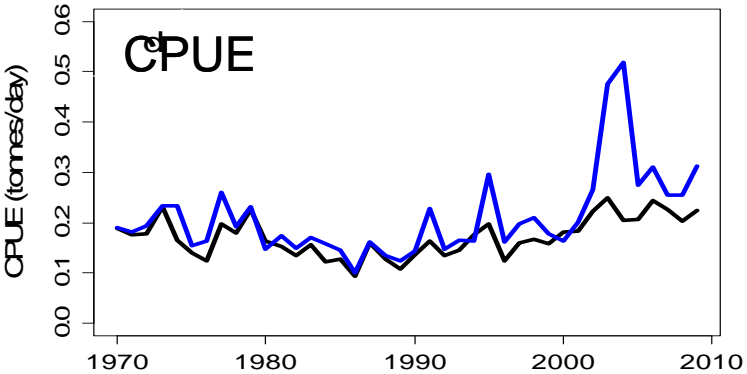
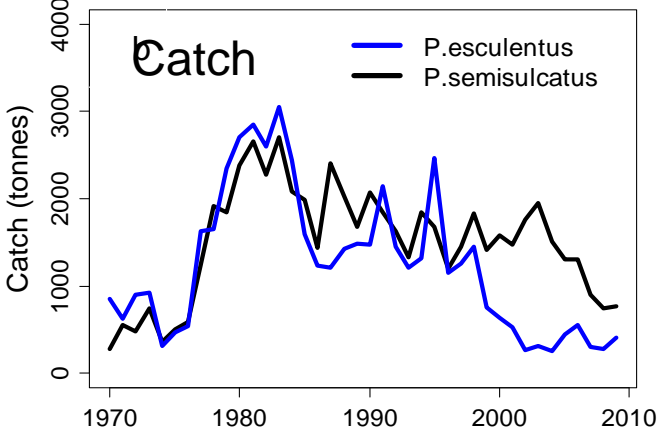
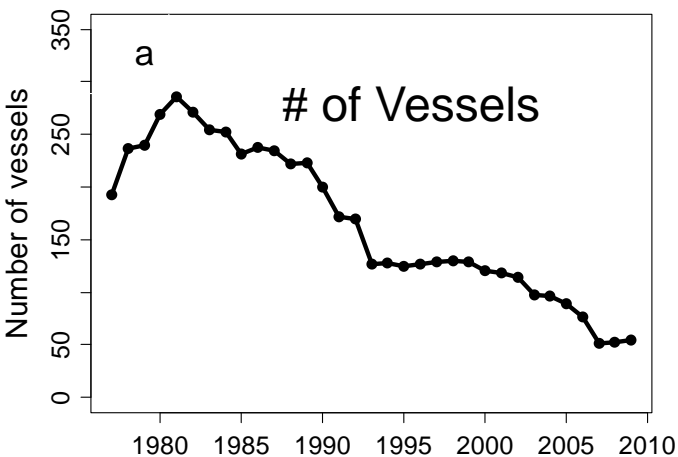
Mercator Projection
 Latitude of true scale: 12° S
 Longitude of Central meridian: 135° E
 Datum: GDA94



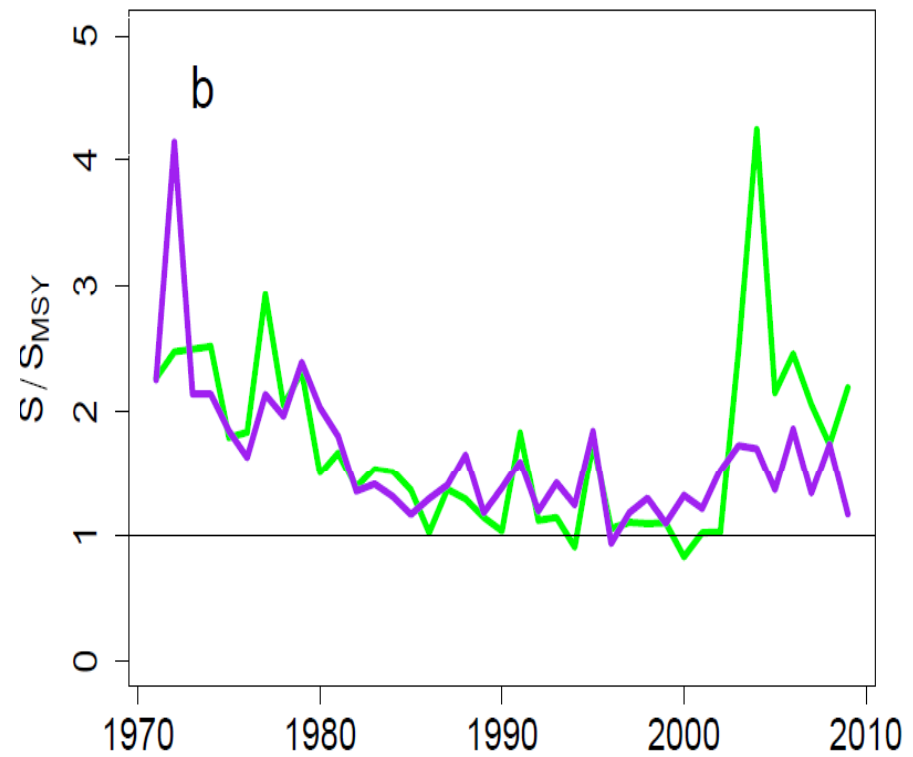
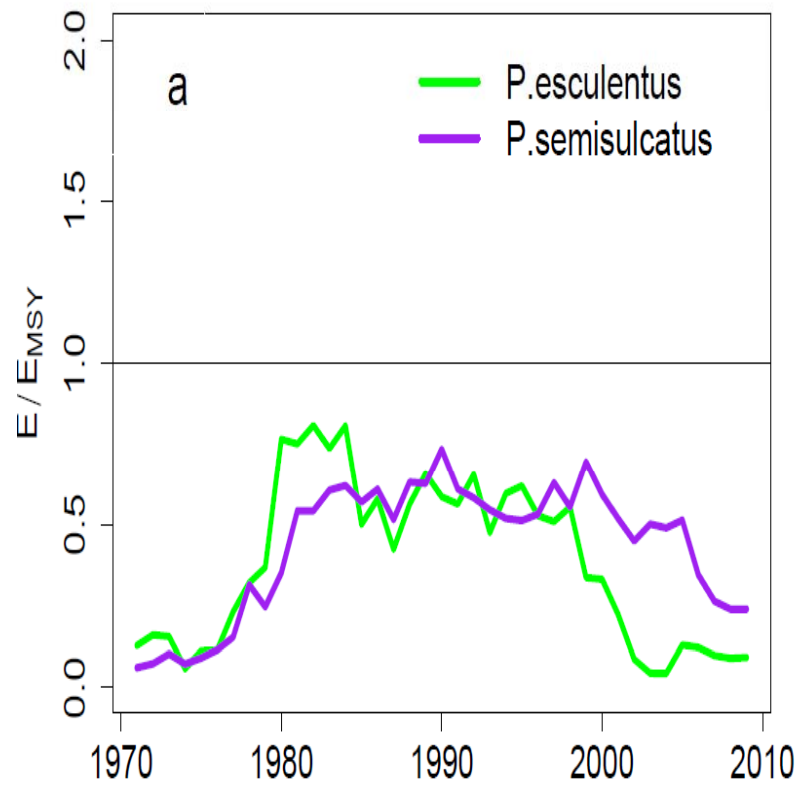
- NOTES:**
1. The area of the Fishery is sourced from the Northern Prawn Fishery Management Plan 1995.
 2. Within this fishery, arrangements exist between the Commonwealth and WA, NT and QLD, whereby the Coastal Waters of these States are deemed part of the AFZ.
 3. The maritime zone boundaries shown on this map are sourced from AMBIS 2001 (v1.1) (October 2001).

© Commonwealth of Australia 2003
 Produced by the National Mapping Division of Geoscience Australia,
 for the Australian Fisheries Management Authority, March 2003.
 MP 00/493.13.1

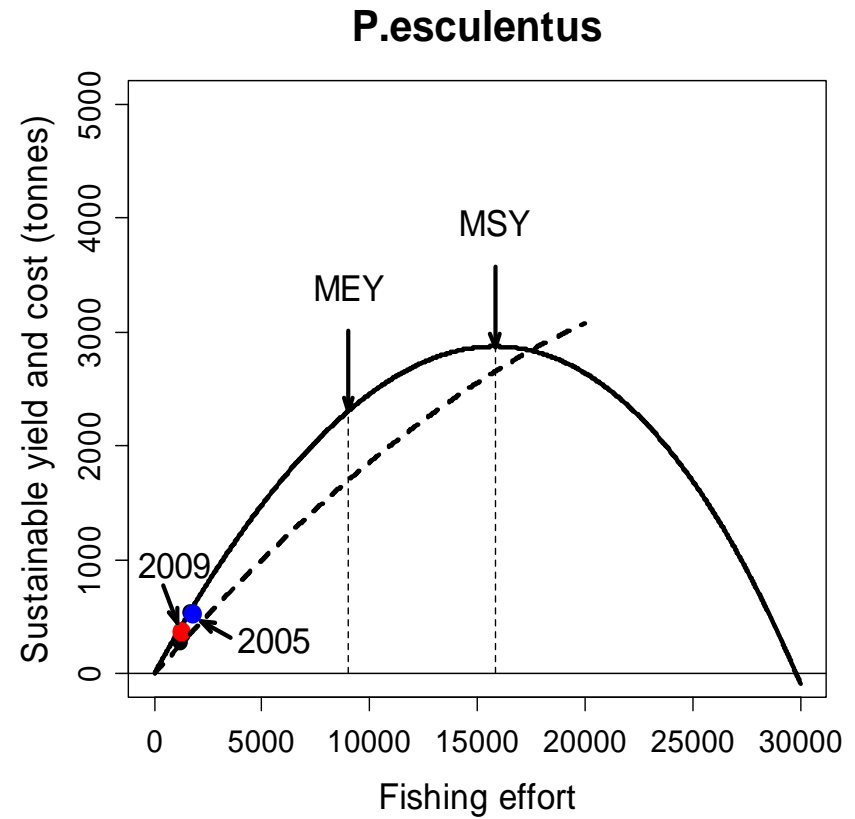
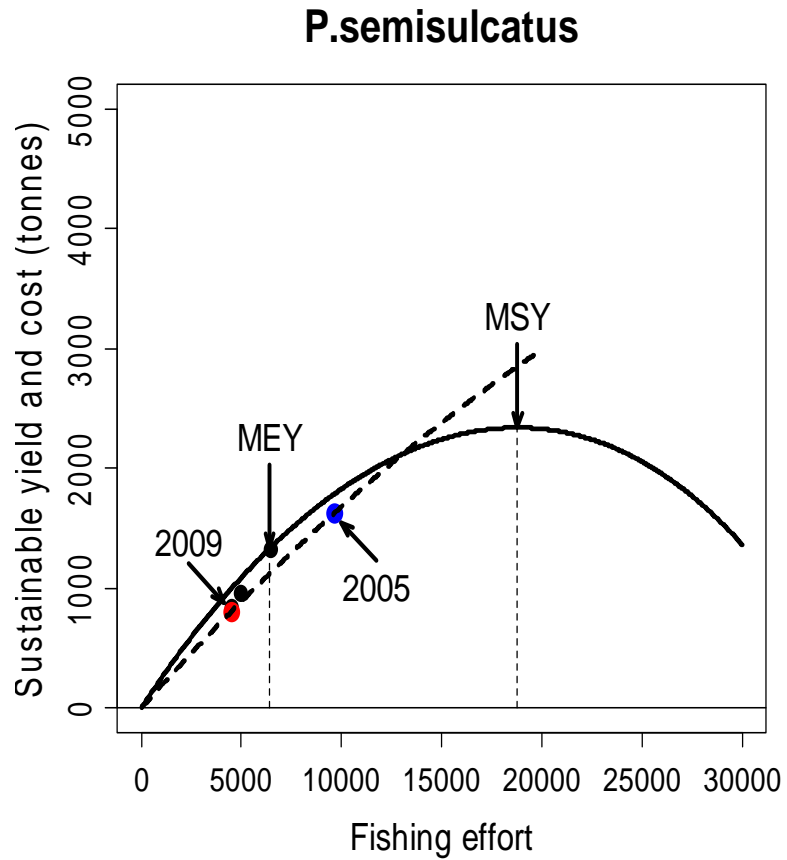
Historic Data



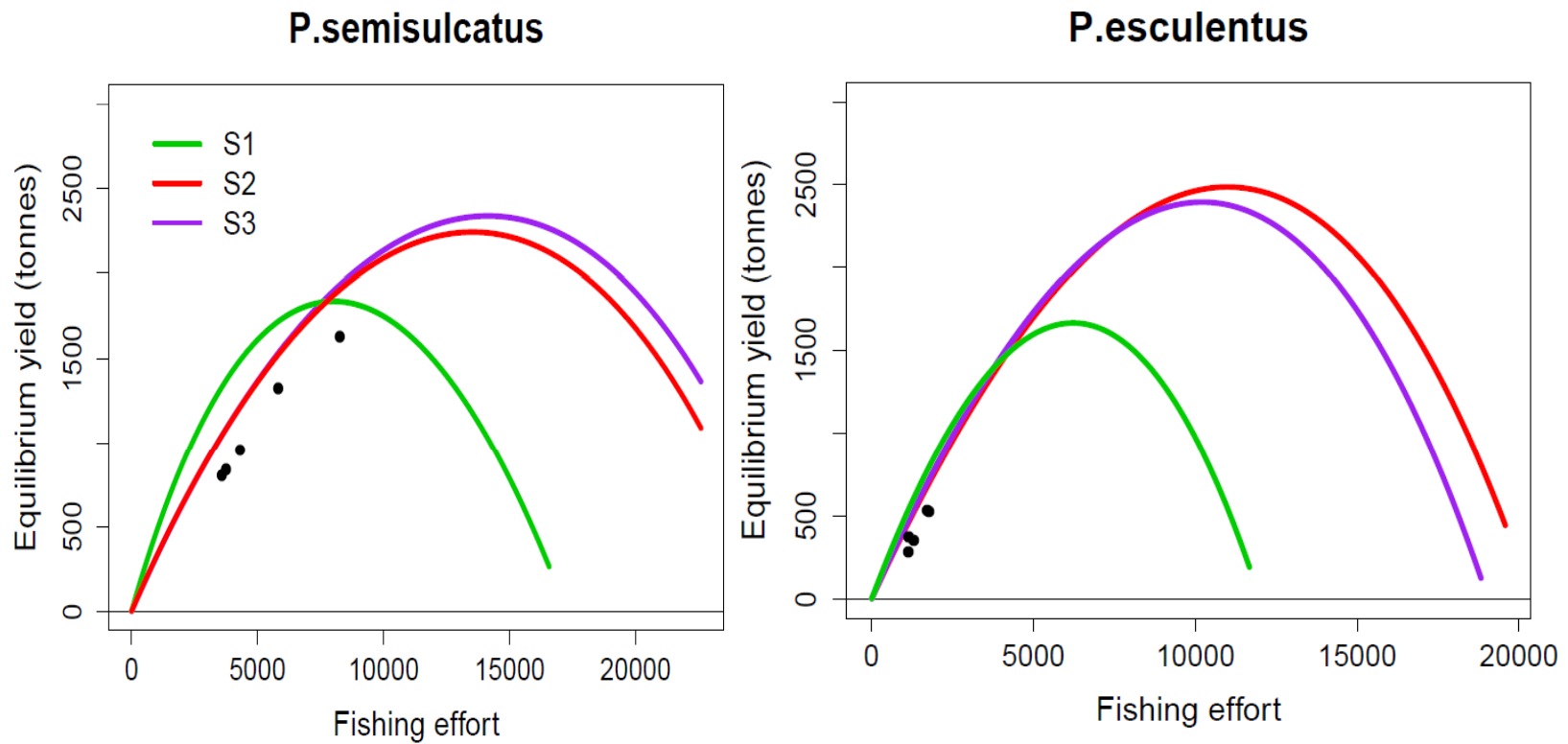
NPF: Health?



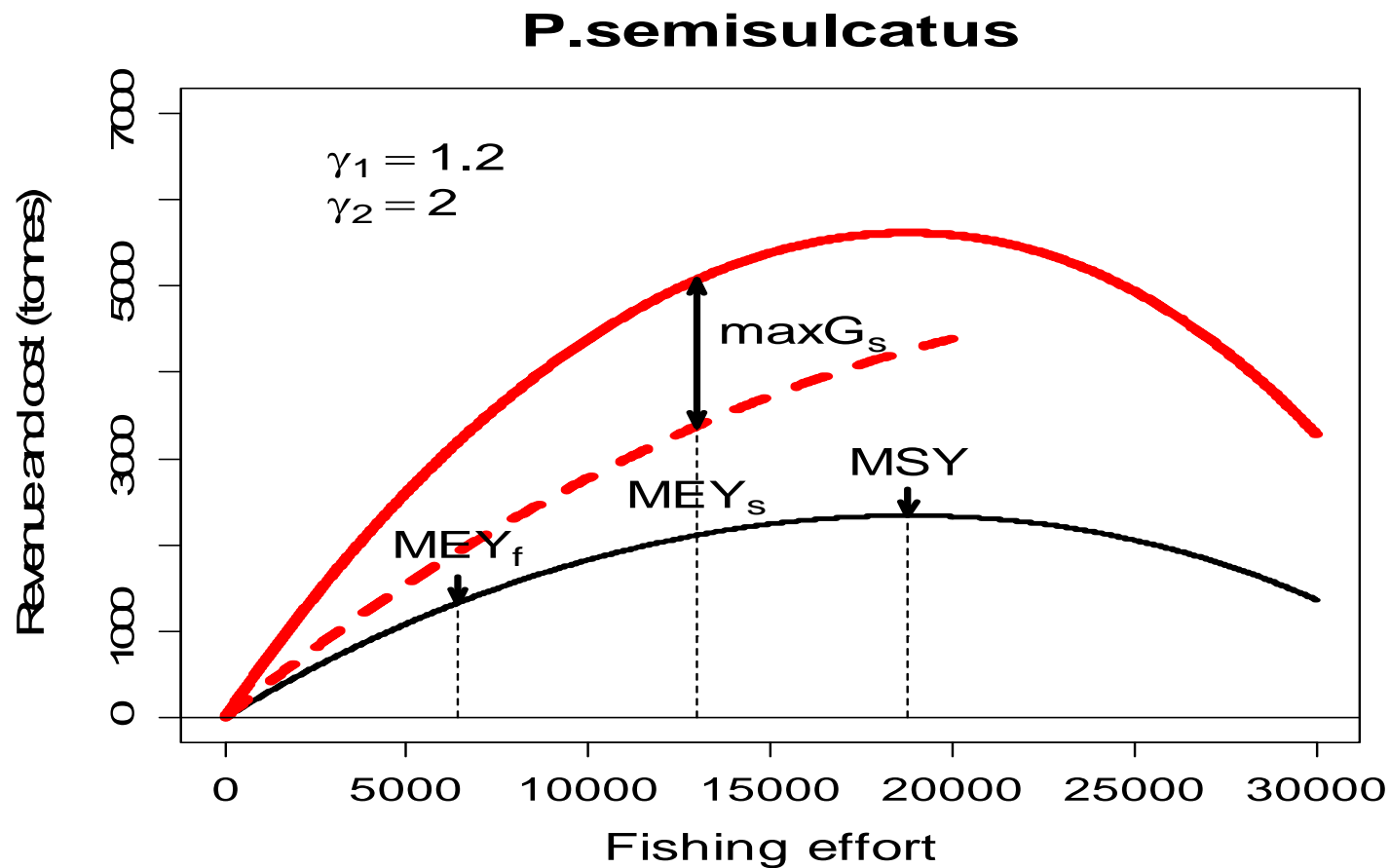
NPF: MSY/MEY



Sustainable Yield



MSY in Enlarged Inference Domain vs traditional MSY



The space-time race



$$\Delta\tau = \sqrt{\Delta t^2 - \frac{\Delta r^2}{c^2}}$$

Space heterogeneity and movement models

Mathematics is always indispensable!

Spatial distributions

Grid-based with
fixed/random effects



Improvement will lead
to more accurate stock
assessment

The frontier race

Space



The frontier race

Space



Random fields

Stationary models for the covariance function
for the random field Z

$$\text{Cov}\{Z(\vec{x},s), Z(\vec{y},t)\} = K(\vec{x}-\vec{y},s-t)$$

at any locations x and y and observations times s
and t .

Spatio-temporal model with nugget effects

$$\text{Cov}(\vec{y}) =$$

$$\sigma^2 \left[\nu_1 I_{ST} + \left\{ (1 - \nu_1) (\nu_2 I_T + (1 - \nu_2) \Gamma) \right\} \right]$$

$$\otimes \left\{ \nu_3 \mathfrak{I}_S + (1 - \nu_3) \Delta \right\}$$

ν_1 : prop meas error

ν_2 : nugget prop in time

ν_3 : nugget prop in space

Surface Chlorophyll-a water quality data analysis

Gaussian spatio/temporal decay

$$\sigma^2=0.246, v_1=0.16, v_2=0.45, v_3=0.43$$

decay rate in time: $\gamma=96.4$ days,

decay rate in space: $\delta=0.08$ km

Statistics & bikinis

- “**Statistics** are like **bikinis**. What they reveal is suggestive, but what they conceal is vital”
- Even the owners and operators may not full aware of the true.
- Your educated common sense should lead you to your knowledgable recommendations/decisions

Effort Allocation for Multi-species Moreton Bay Prawn Fishery:

Catches consist of

bay prawn (greasyback) (37%), brown tiger (28%), eastern king (17%) and other prawn species (18%).

Tiger, greasyback, Eastern Kings,



Kindly provided by Tony Courtney, DEEDI

YG WANG: The University of
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Tagged king prawn



Kindly provided by Tony Courtney, DEEDI

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How do we catch them?



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Thank you