How precise are estimates of spawning area and spawning biomass of sardine off southern Australia?

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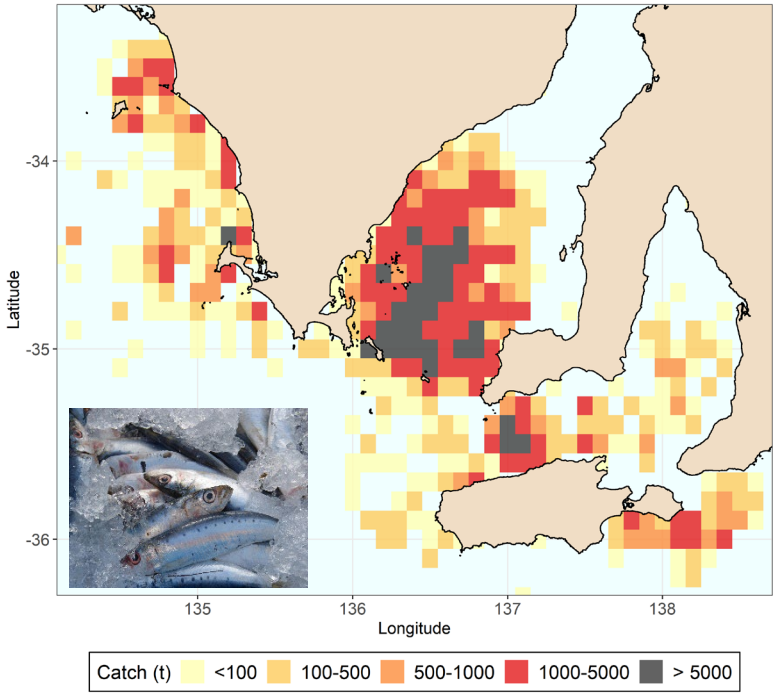
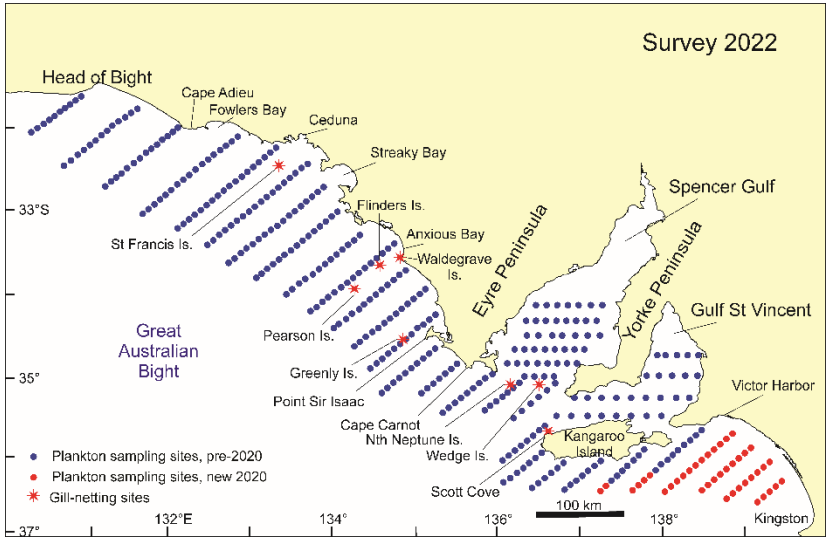
SA Sardine Fishery



Broad Scale Spawning Biomass Surveys



- Largest fishery by volume in AUS
- 1st TACC set in 1992: 1,000 t
- TACC in 2022: 45,000 t

- Used to set TACCs in SASF
- Each covers ~120,000 km^2
- 23 surveys since 1995

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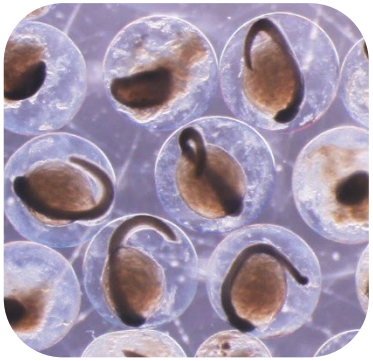
Daily Egg Production Method (DEPM)

$$\text{Spawning Biomass} = \frac{P_0 \times A}{(R \times S \times F')}$$



- P_0 = **Mean Daily Egg Production**
- A = **Spawning Area**
- R = **Sex Ratio (by Weight)**
- S = **Spawning Fraction**
- F' = **Relative Fecundity (i.e. Fecundity/Weight)**

- Uncertainty of SB estimates - well known
- Review 1995-2019: *Ward et al. 2021, ICES JMS*
  - Good understanding of uncertainty around ***P_0, R, S, F'***
  - Outcome: Parameter values calculated from all historical data rather than annual estimates increase precision of SB
- Spawning area ***A***: the key parameter for Sardine in South Australia

$$SB = A \times \frac{P_0}{(R * S * F')}$$

$$= A \times \sim 4.5\text{t per km}^2$$

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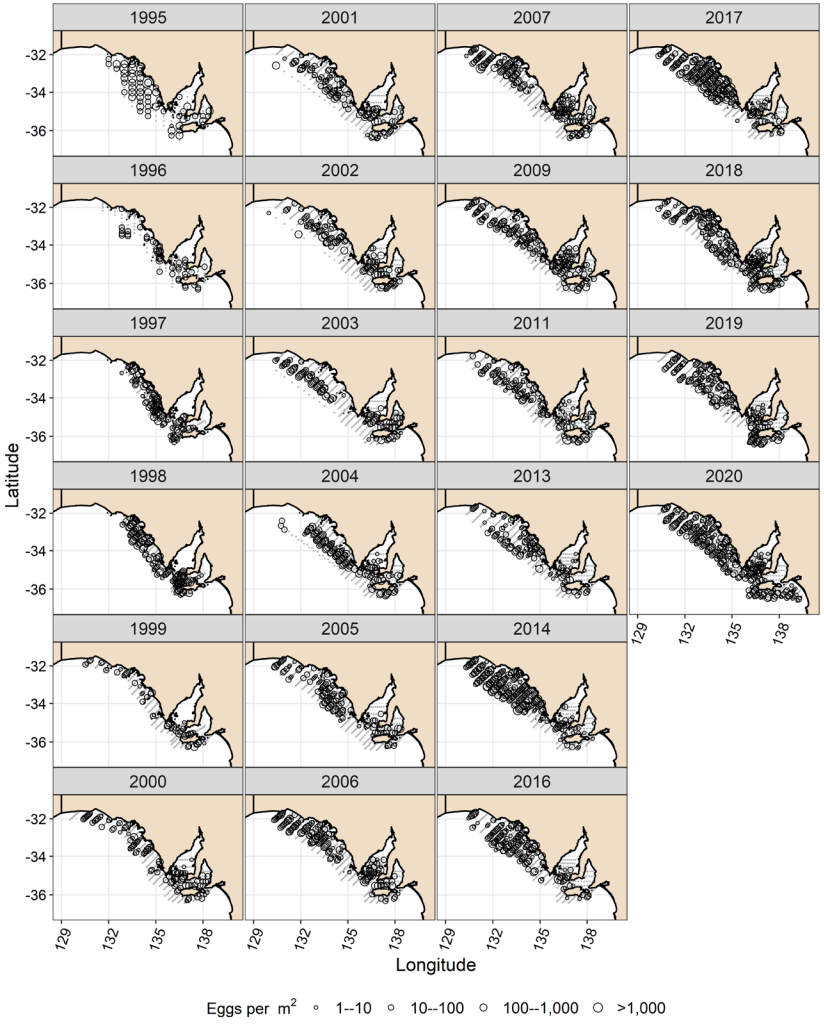
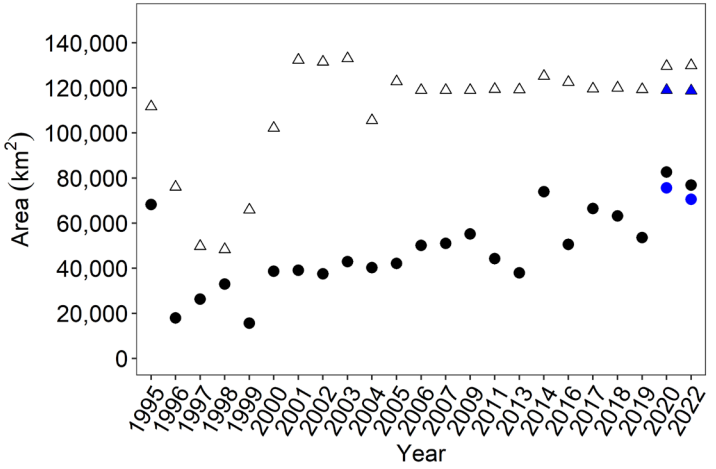
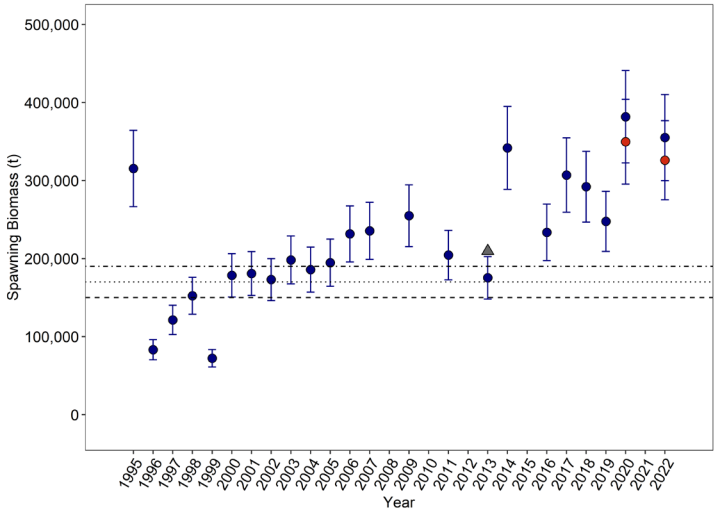
DEPM in South Australia

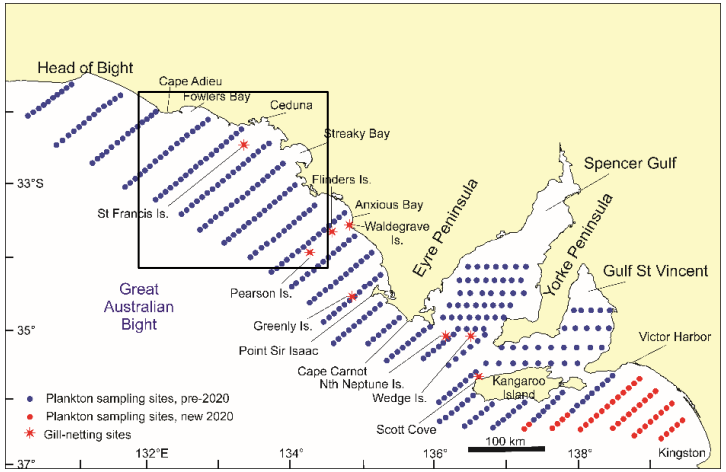


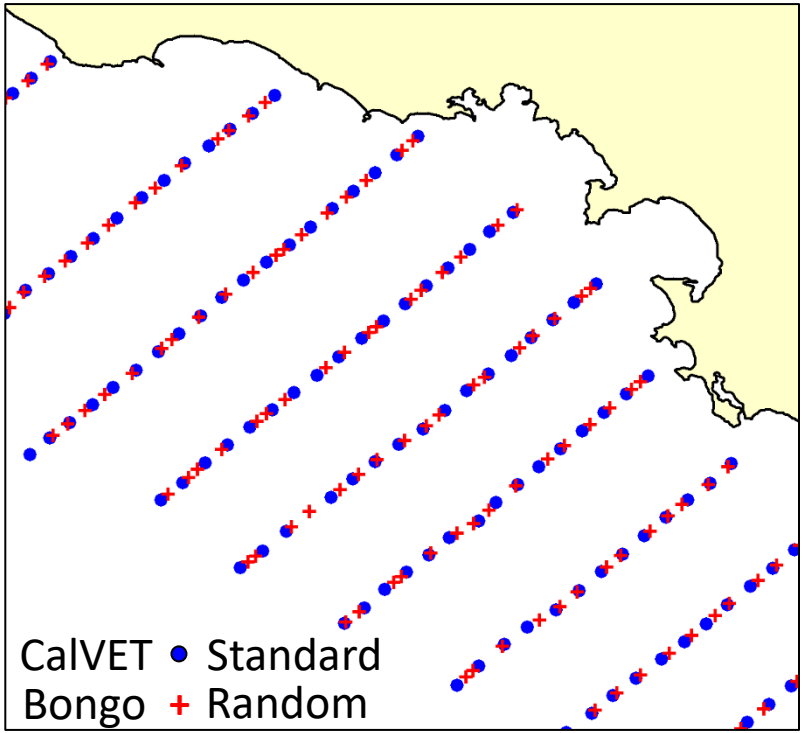
- DEPM applied off SA since 1995
- Review 1995-2019: Ward et al. 2021, ICES JMS
- Spawning area: the key parameter
- *A:* proxy for SB (proportional)



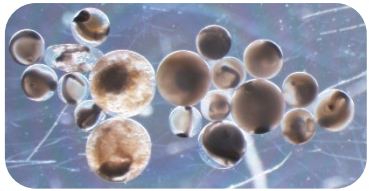


Replicating a DEPM Survey



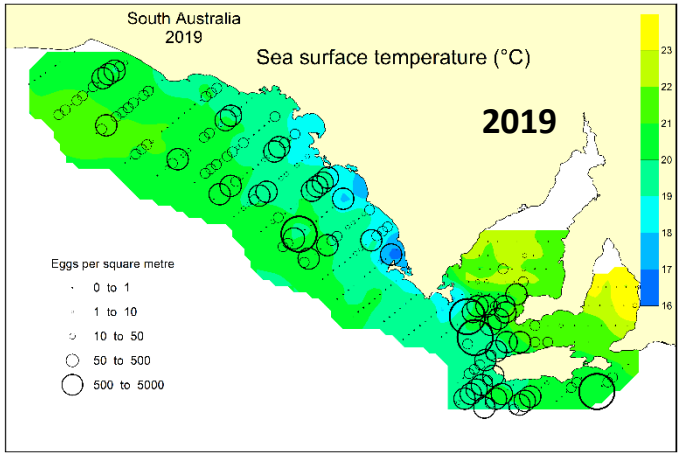


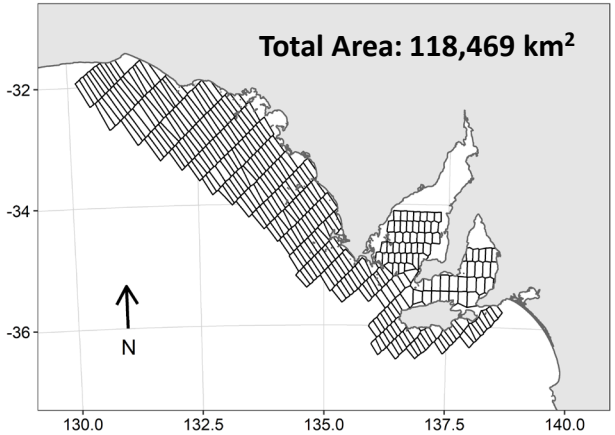
- Initially done 2019 - collect samples for DNA metabarcoding
- Random samples added either +/-2.5nm from a standard site
- Bongo - larger nets - sample 5x amount of water than CalVET
- Aim: to get species less common than sardine
  - But also interested in ***A*** question



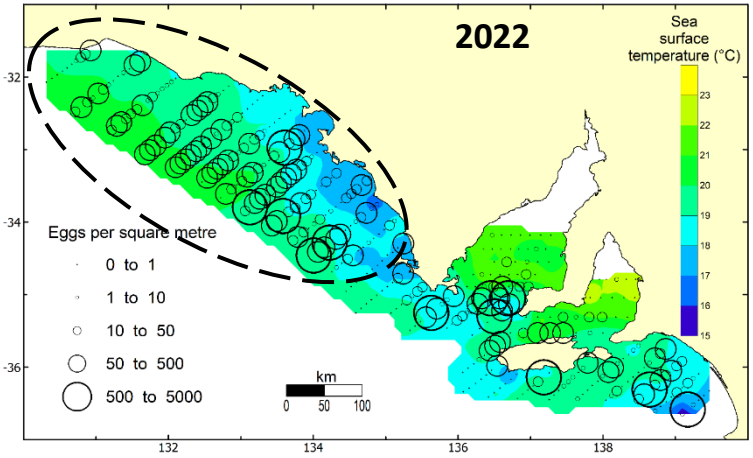
Replicated sampling: 2019 & 2022

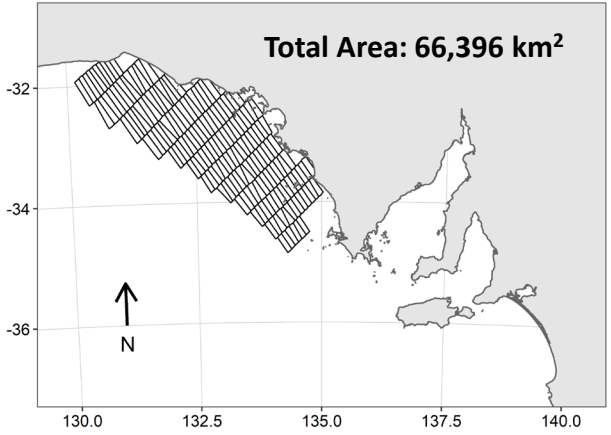
CalVET vs. Bongo 2019:





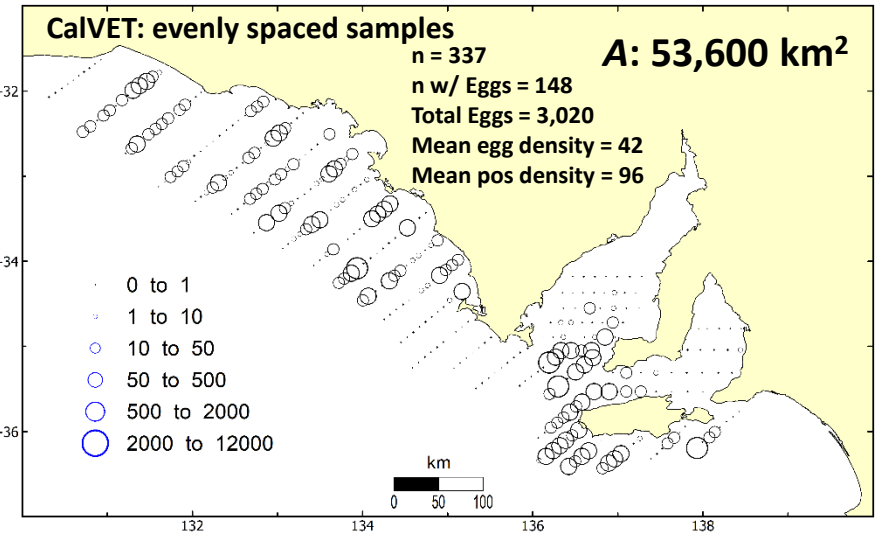
CalVET vs. CalVET: 2022

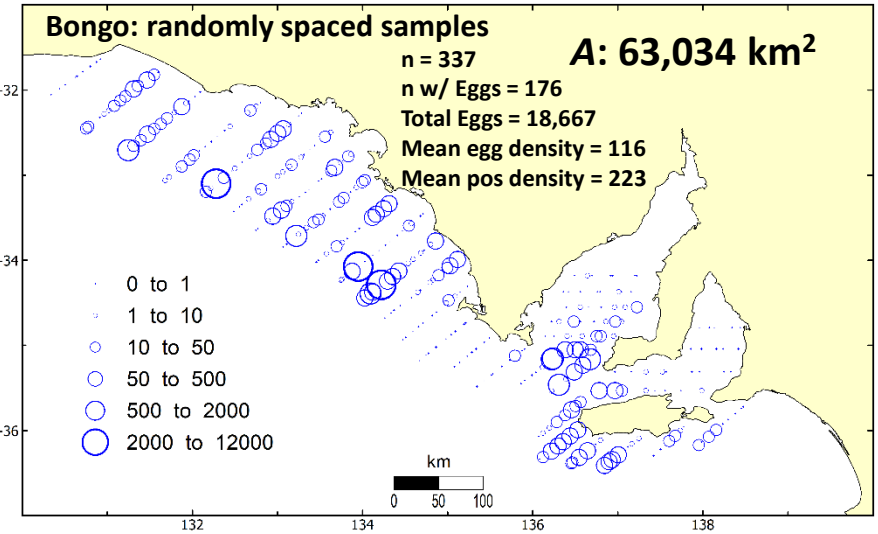


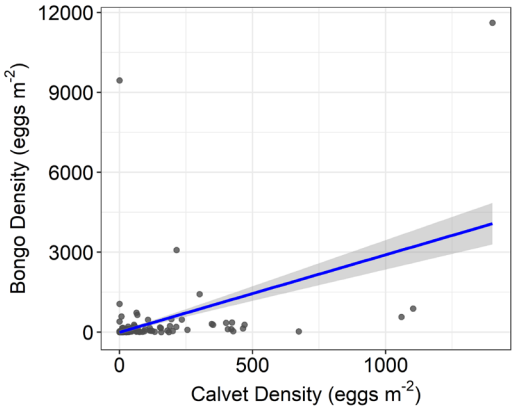


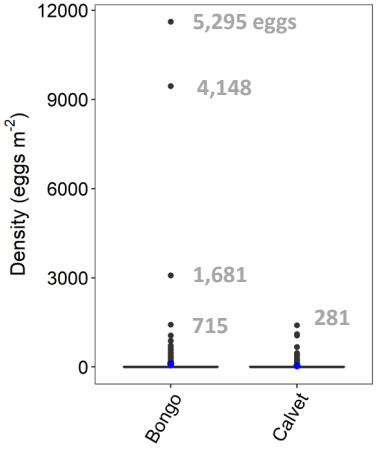
CalVET vs. Bongo: 2019

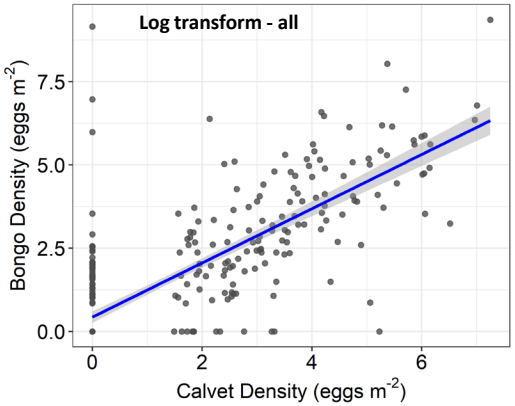
Total Area: 118,469 km²

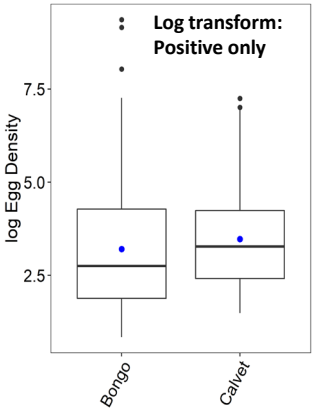






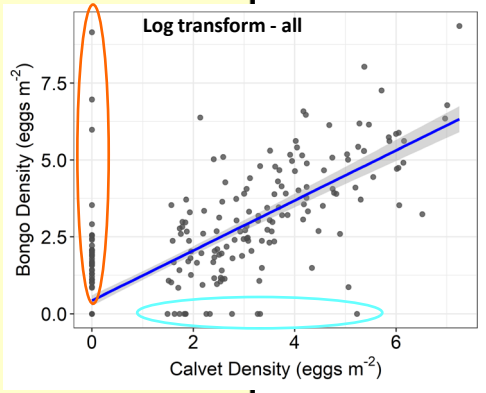






CalVET vs. Bongo

South Australia
2019



Eggs per square metre

- 0 to 1
- 1 to 10
- 10 to 50
- 50 to 500
- 500 to 5000

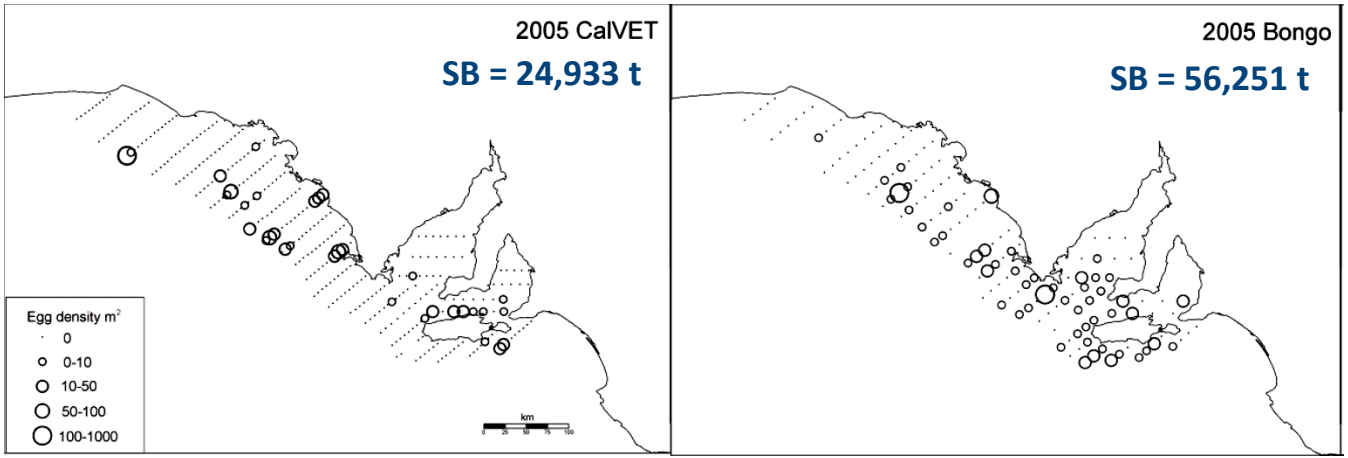
- CalVET & Bongo both positive
- CalVET positive only (9)
- Bongo positive only (39)

2005 Blue Mackerel CalVET vs. Bongo

Ward & Rogers 2007

CalVET
n = 334
n w/ Eggs = 35 ***A*** **= 11,840**
Total Eggs = 127
Mean egg density = 24

Bongo
n = 152
n w/ Eggs = 54 ***A*** **= 34,895**
Total Eggs = 512
Mean egg density = 18



Results Bongo vs CalVET

Bongo:

- Detect lower egg densities
- Higher ***A***

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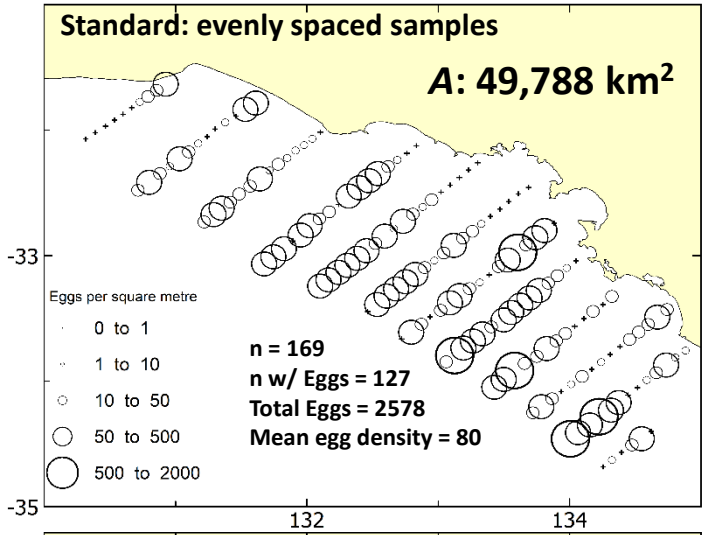
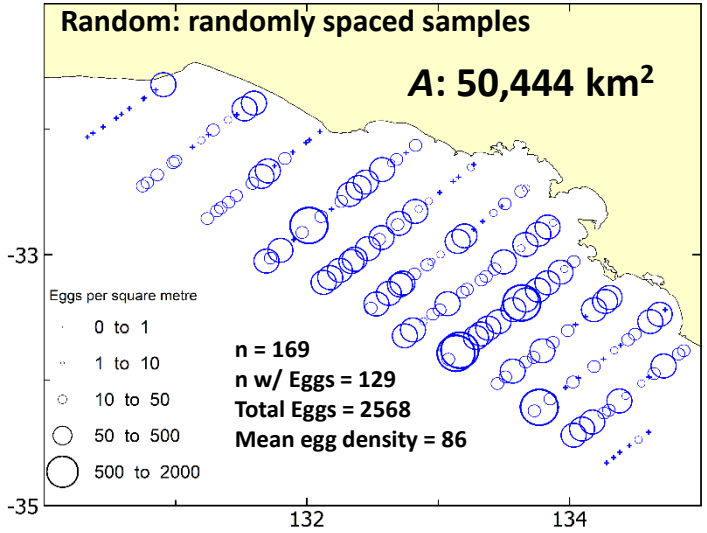
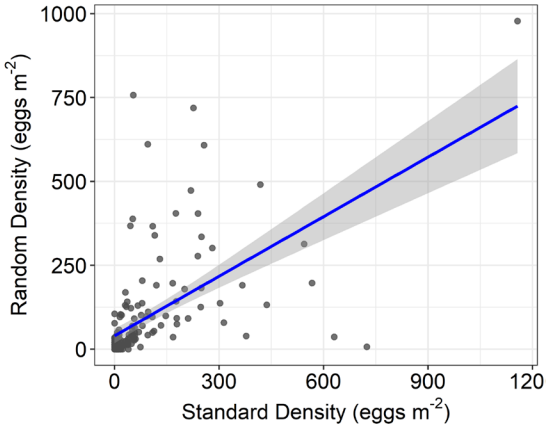
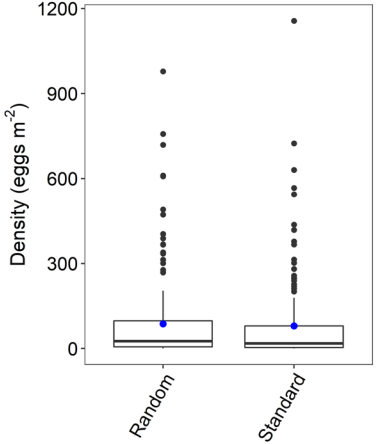
CalVET vs. CalVET: 2022

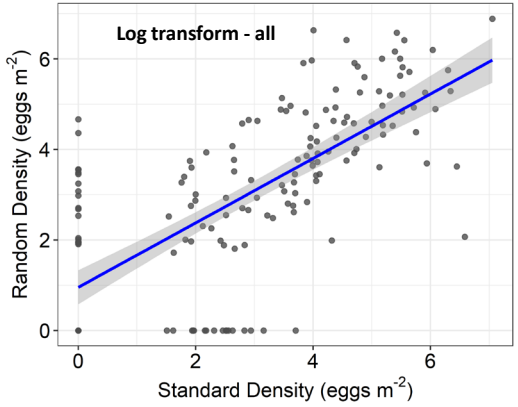
Total Area: 66,396 km²

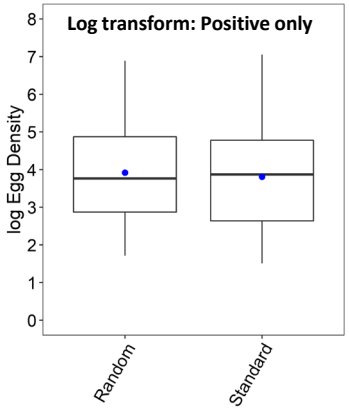












2022

CalVET vs. CalVET

Eggs per square metre

0 to 1

1 to 10

10 to 50

50 to 500

500 to 2000

Both positive

Standard positive only (17)

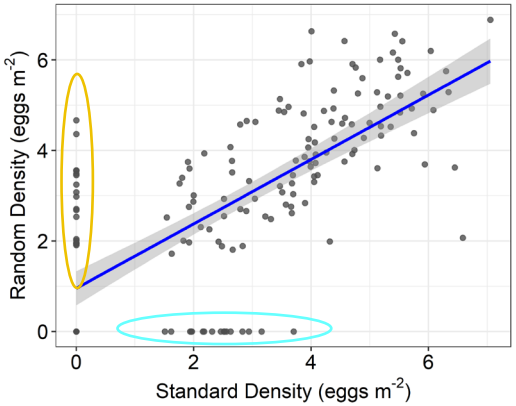
Random positive only (19)

-33

-35

132

134



Key Messages

Broad-scale Egg Surveys in South Australia:

- First & foremost:
  - Estimates of Spawning Area for Sardine can be replicated with considerable precision if using comparable sampling gear
- Bongo and CalVETs have different egg detection limits
- Bongo nets detect lower densities of Sardine eggs
  - Suitable for species with less abundant eggs, e.g. Blue Mackerel

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