Longline catch indices show variable fit to density of inshore rockfish (*Sebastes* spp.)

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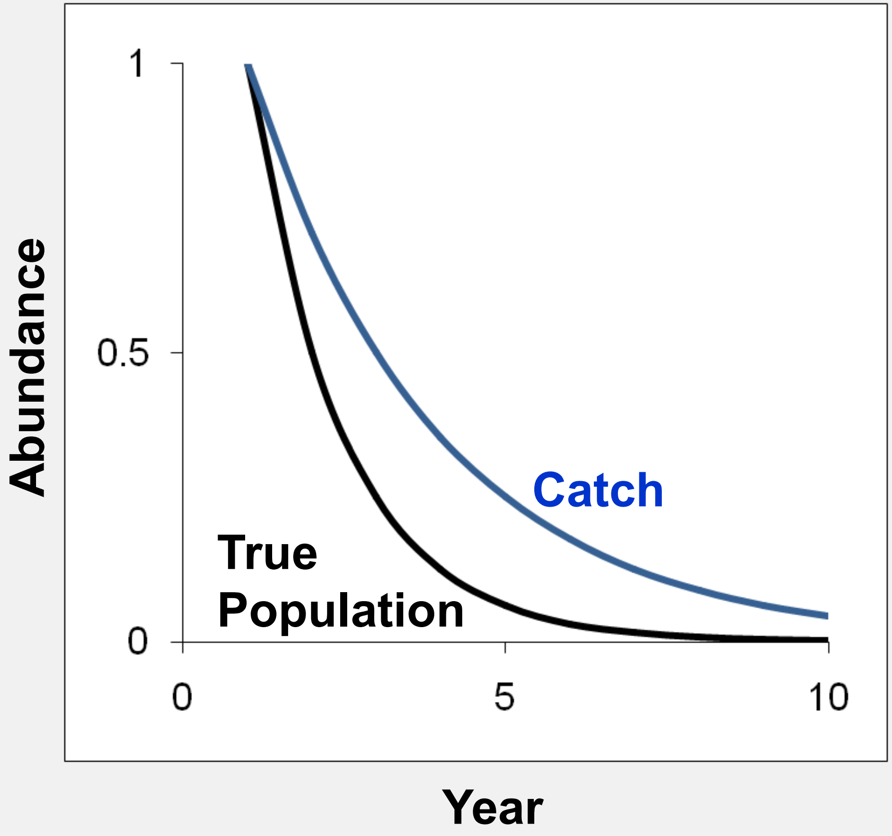
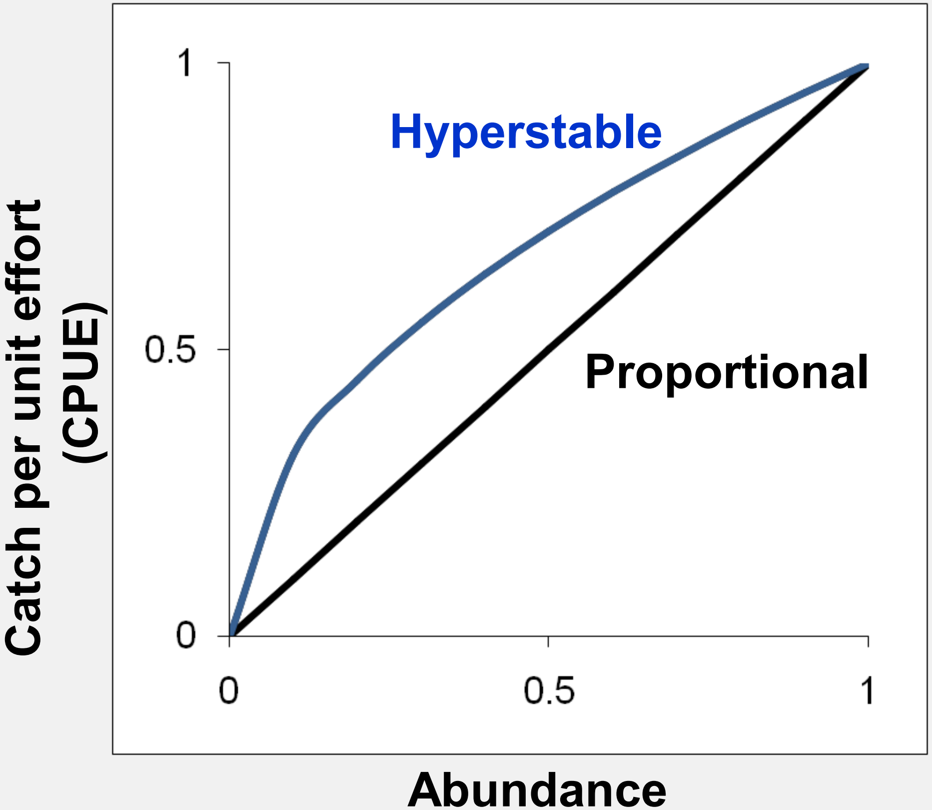
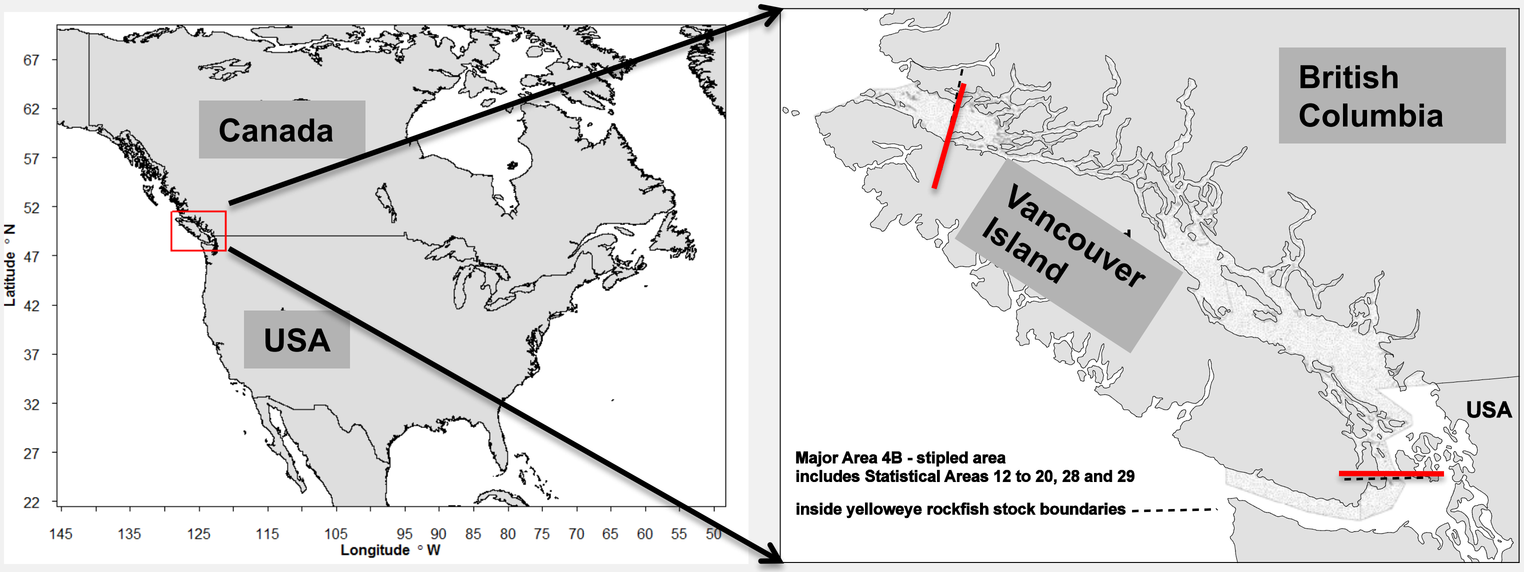
Does catch reflect abundance?





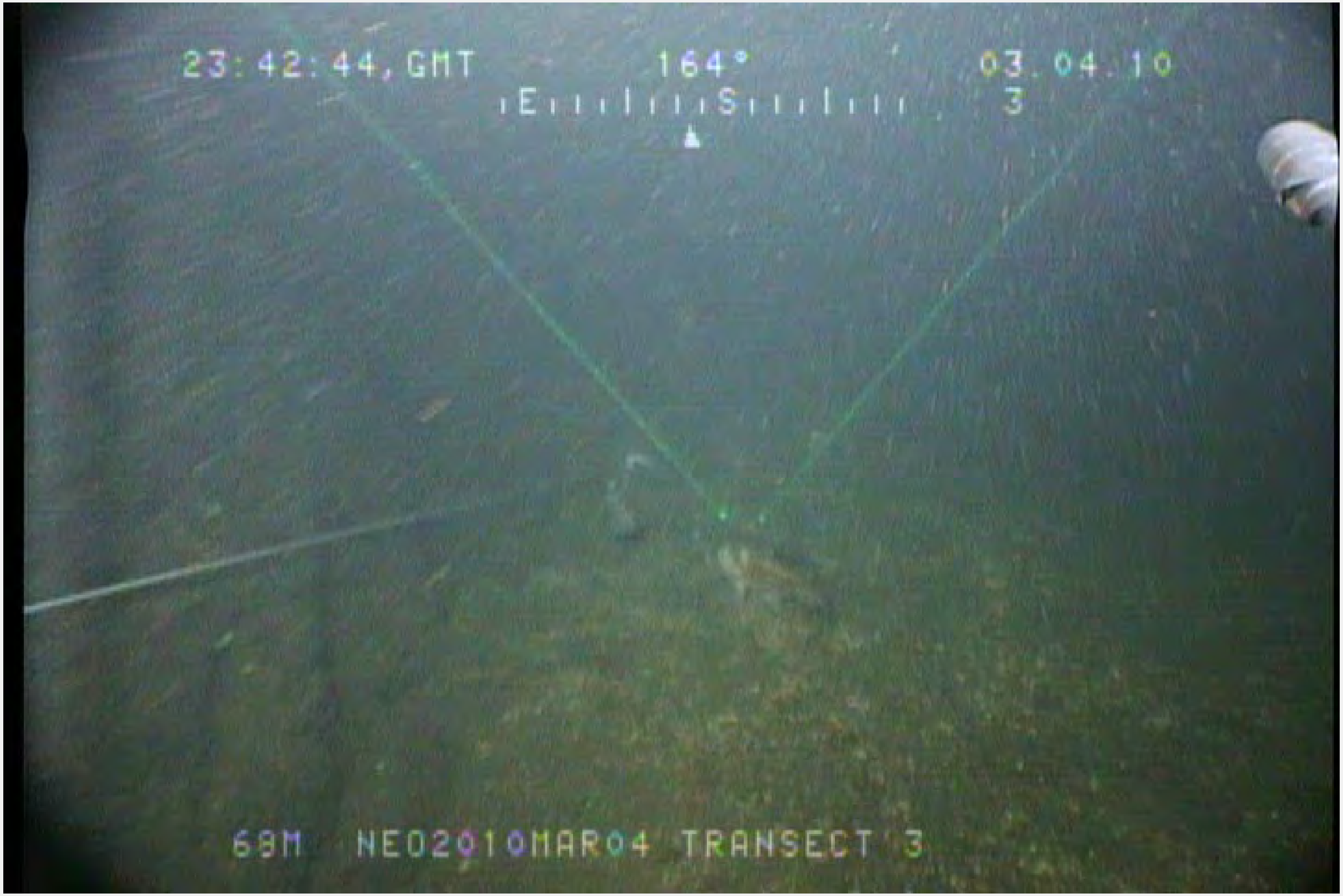
Based on Hilborn and Walters (1992)

Longline survey for inshore rockfish (*Sebastes* spp.)



Copper Yelloweye Quillback

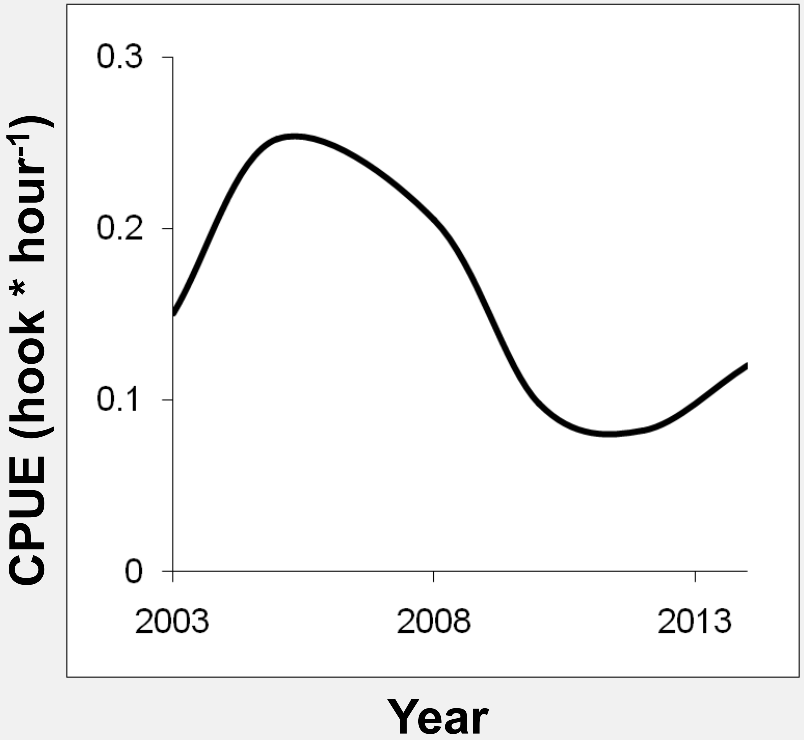
Inshore rockfish longline experiments



Inshore rockfish longline experiments

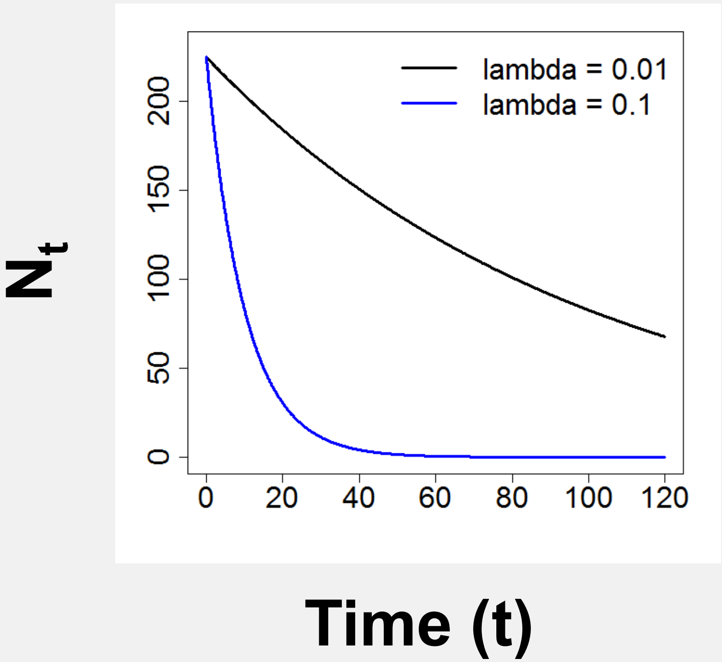
Competition from non-rockfish species

- Hooks deployed on the August 2010 survey:
  - 4.2% inshore rockfish
  - 19.5% spiny dogfish (*Squalus acanthias*)



Hook-based exponential model

$$N_t = N_0 * \exp(-\lambda * t)$$

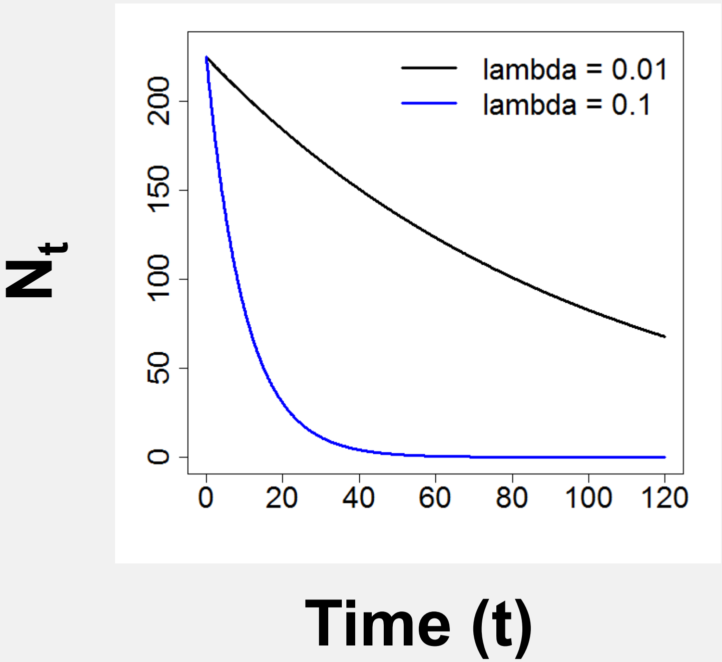


λ = instantaneous rate of bait loss (relative abundance index)
N_t = Number of baited hooks at time t
N_0 = Number of baited hooks deployed at $t = 0$

Hook-based exponential model

$$N_t = N_0 * \exp(-\lambda * t)$$

$$\lambda = \lambda_{Target} + \lambda_{Non-target}$$



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Hook-based exponential model

$$N_t = N_0 * \exp(-\lambda * t)$$

$$\lambda = \lambda_{Target} + \lambda_{Non-target}$$

$$C_{Target} = \frac{\lambda_{Target}}{\lambda} * N_0 * (1 - \exp(-\lambda * t))$$

λ = instantaneous rate of bait loss (relative abundance index)
N_t = Number of baited hooks at time t
N_0 = Number of baited hooks deployed at $t = 0$
C = Number of individuals (e.g. in Target species) caught at time t

Hook-based exponential model

$$N_t = N_0 * \exp(-\lambda * t)$$

$$\lambda = \lambda_{Target} + \lambda_{Non-target}$$

$$C_{Target} = \frac{\lambda_{Target}}{\lambda} * N_0 * (1 - \exp(-\lambda * t))$$

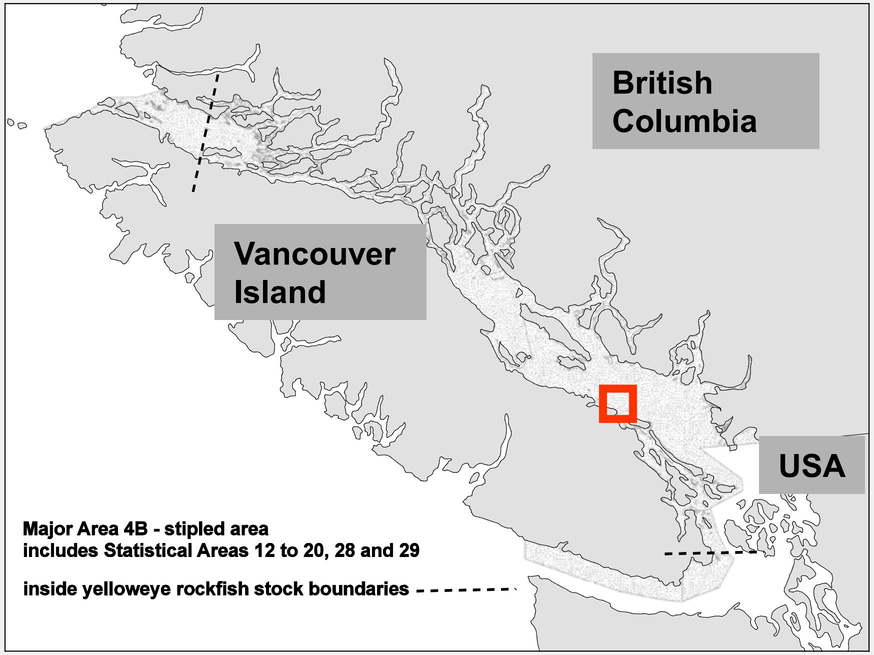
- Assumes λ is directly proportional to the true abundance
- Assumes λ is constant during the longline soak time (*t*)

Research questions

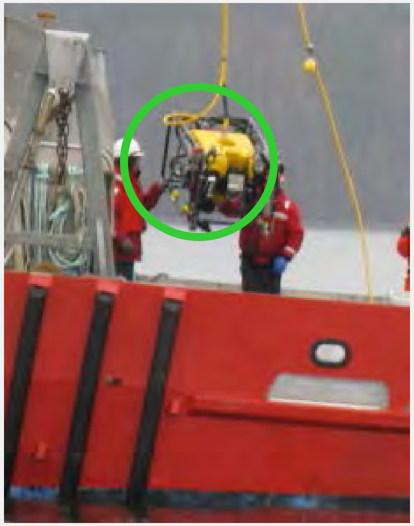
- Is there a linear relationship between the instantaneous rate of bait loss (λ) and the observed density of inshore rockfish?
- Does λ show a better fit with observed density than CPUE?
- Is λ constant over the soak time?

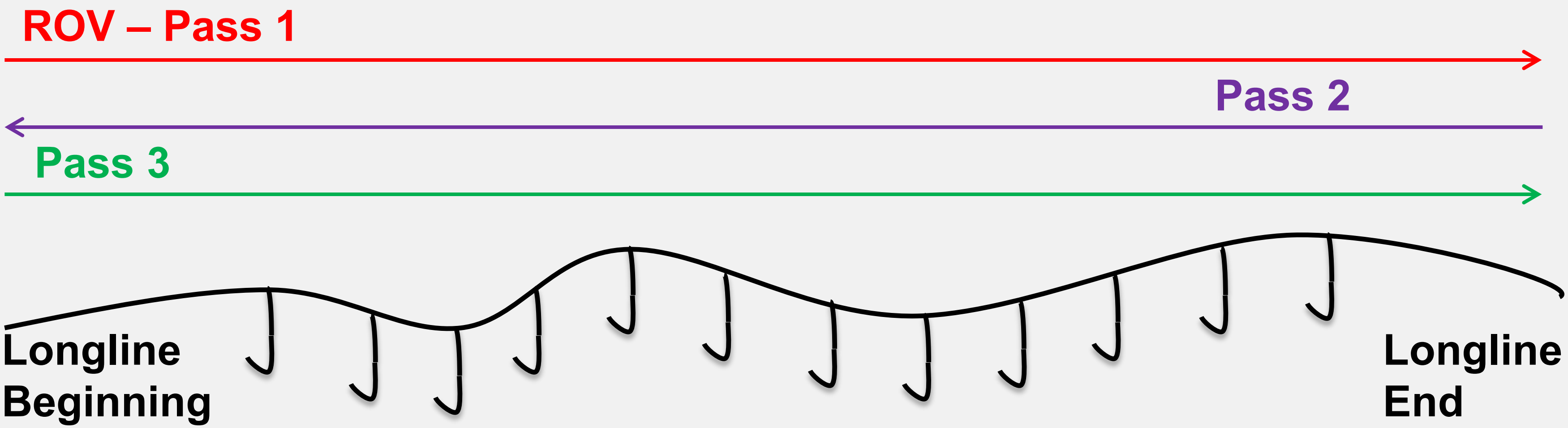
Methods: Field experiments

- Experimental longline sets (n = 13) in March 2010
- Varied inshore rockfish/ dogfish abundance
  - **Low hook occupancy (8% rockfish, 5% dogfish)**



Methods: Field experiments





Methods: Catch indices

- On-deck CPUE

$$CPUE_{i,s} = \frac{C_{i,s}}{nhooks_i * soak_i}$$

- On-deck λ (instantaneous rate of bait loss), calculated from catch proportions

$$\lambda = \lambda_{YE} + \lambda_{QB} + \lambda_{OT} + \lambda_{EM}$$

- Underwater (UW) λ, Bayesian estimation using time each hook was observed

CPUE and observed density

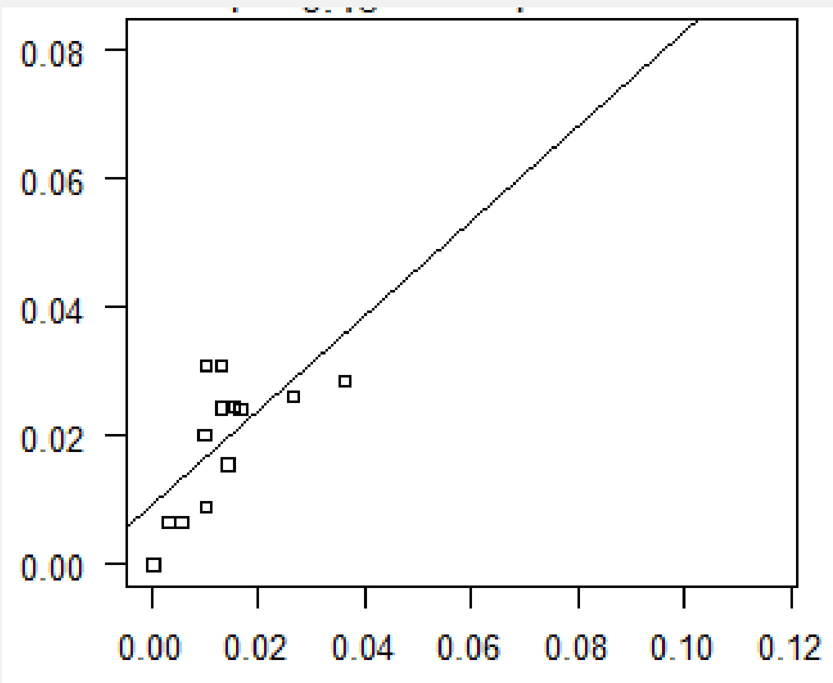
$r^2 = 0.46$

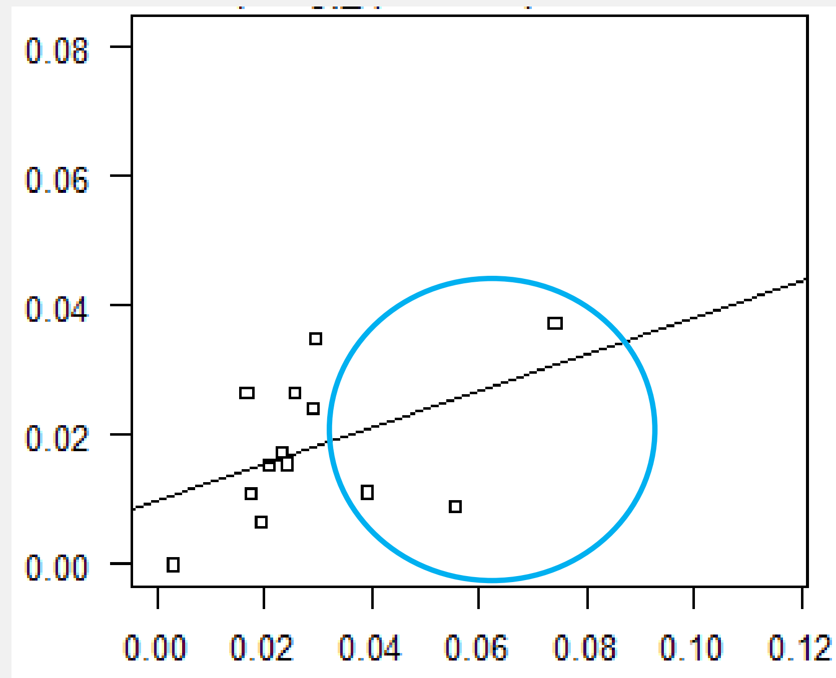
slope = 0.74

$r^2 = 0.21$

slope = 0.28

CPUE (hook * hour^{-1})





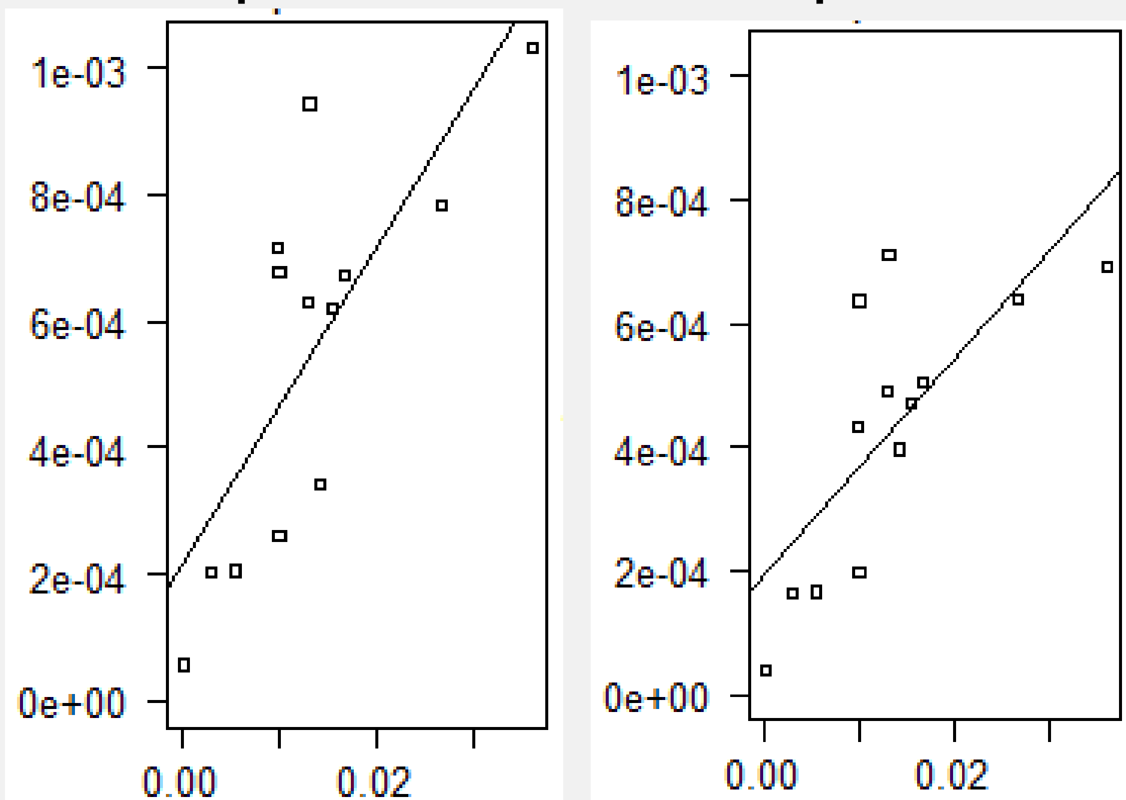
Mean observed density (individuals / m^2)

λ and observed density

UNDERWATER
r^2 = 0.60
slope = 0.025

DECK
r^2 = 0.56
slope = 0.018

λ_{YE}



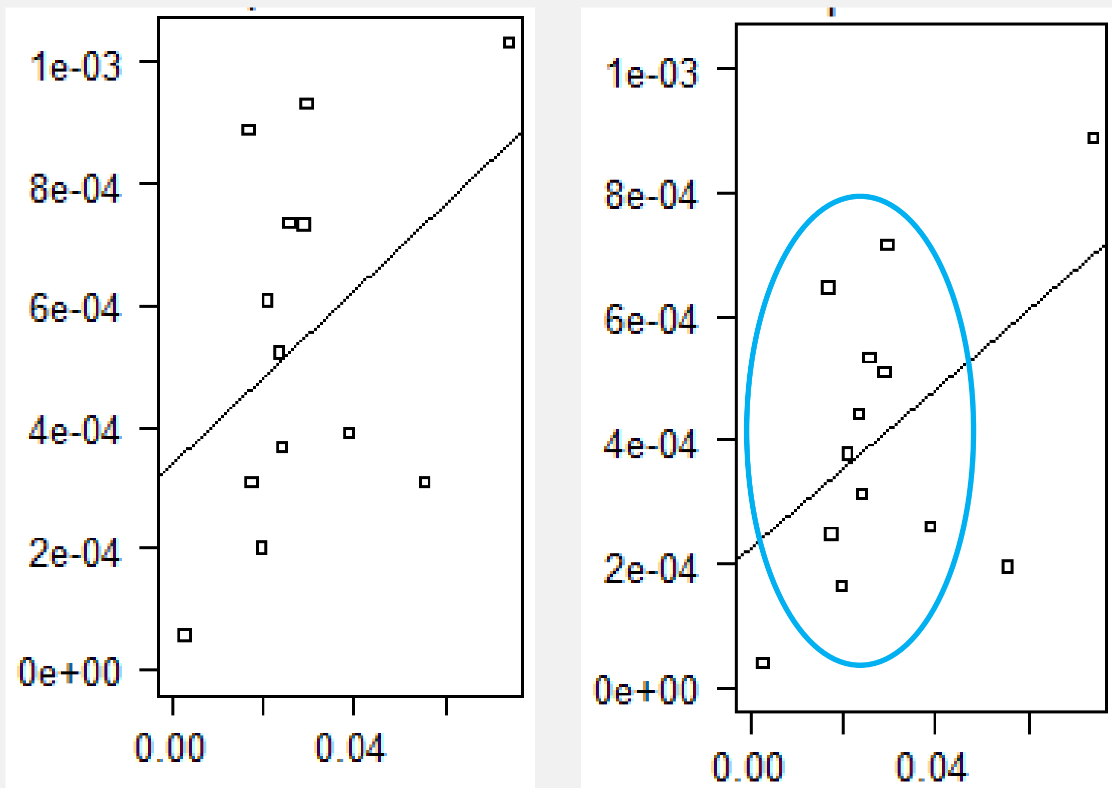
Mean observed density (individuals / m^2)

λ and observed density

UNDERWATER
$r^2 = 0.19$
slope = 0.0071

DECK
$r^2 = 0.23$
slope = 0.0064

λ_{QB}



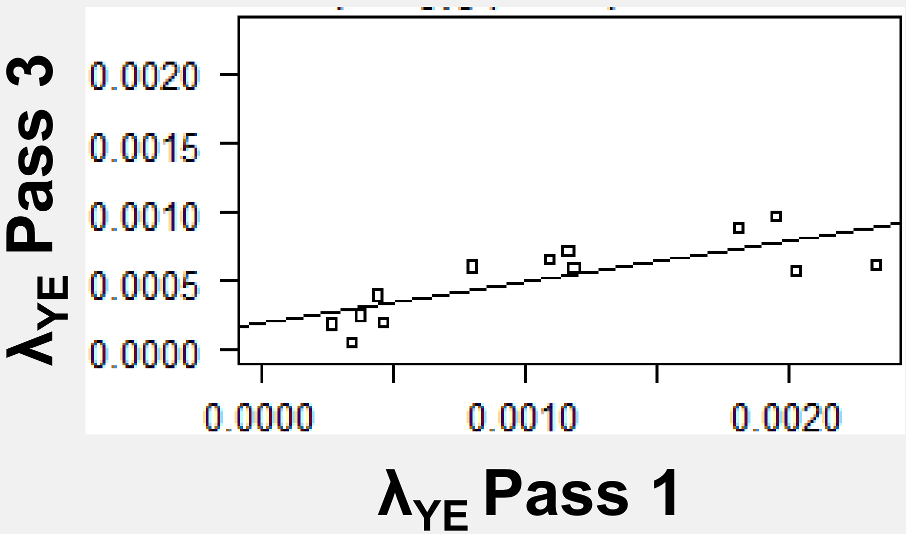
Mean observed density (individuals / m^2)

ROV observation of the longline

Estimating λ at different times during the set

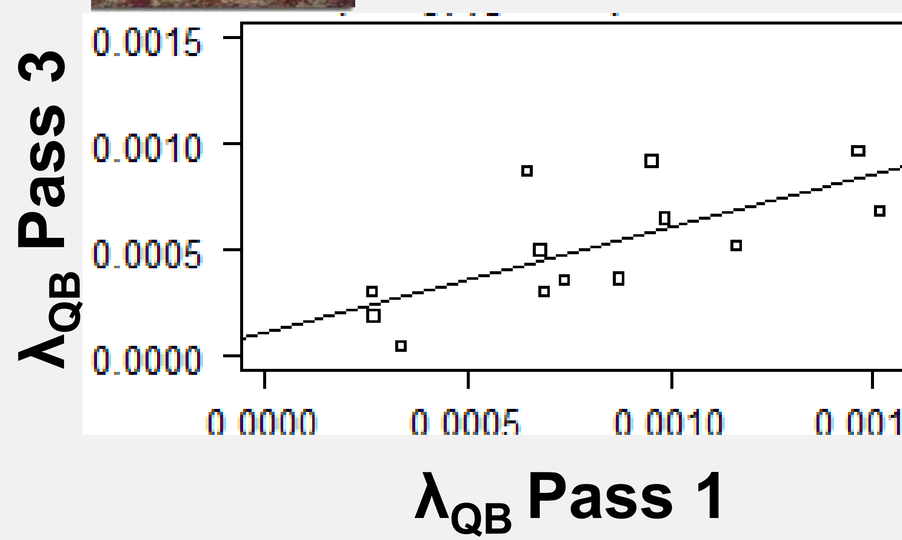
$r^2 = 0.61$

slope = 0.30



$r^2 = 0.49$

slope = 0.49



Pass 1 ~ 30-60 minutes soak time
Pass 3 ~90-120 minutes soak time

Main findings

- For yelloweye, λ has a better fit than CPUE with observed density, but not for quillback (under low hook occupancy).

- There appears to be little added value from underwater information. Deck data performs well!

- Estimates of λ change over the soak time.

Future work

- Are the results representative of performance at higher levels of competition?
  - August 2010 experiments

- Why do the relative abundance indices perform poorly for quillback with low hook occupancy?
  - Size selectivity?
  - Fine-scale spatial behaviour?
  - Dominance between species?

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