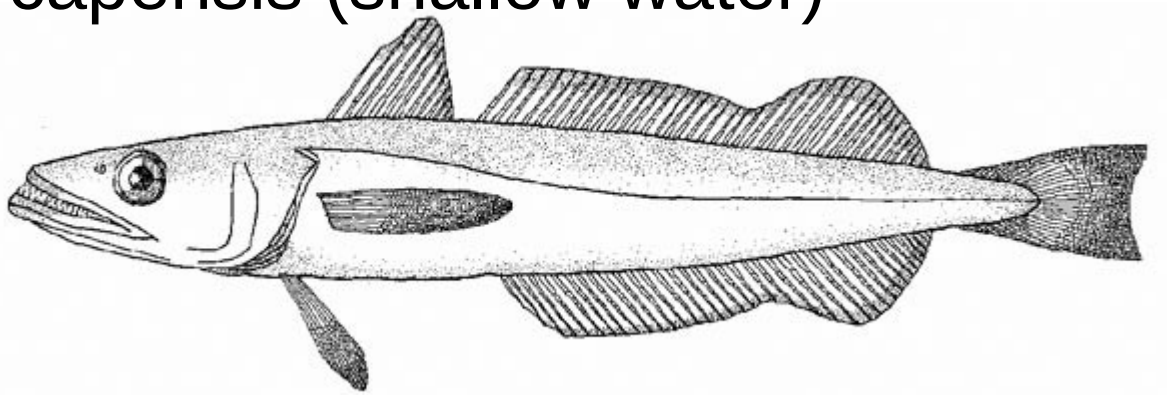
Hake cannibalism and inter-species predation

Updating the Rademeyer and Butterworth (2014) hake model to take into account the effects of hake cannibalism and inter-sepcies predation for two Cape hake species *Merluccius capensis and M. paradoxus*

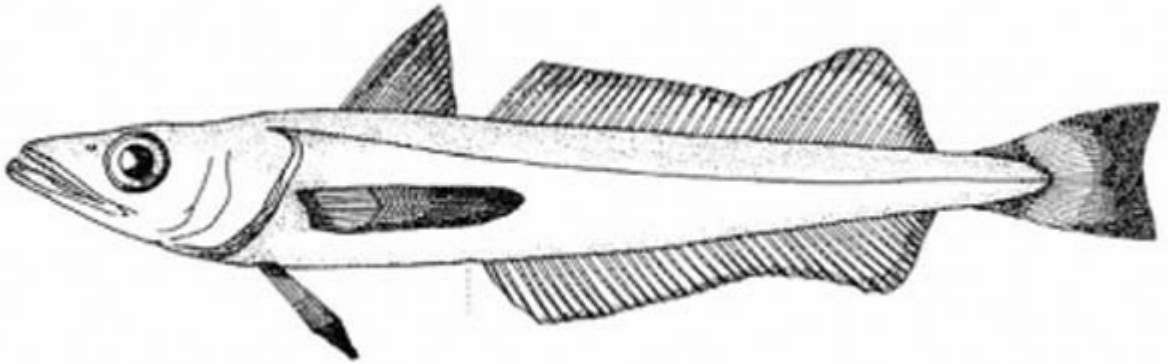
Andrea Ross-Gillespie

Background

- Two morphologically similar species
  - M. capensis (shallow water)



  - M. paradoxus (deep water)



Background

- *M. capensis* found inshore of *M. paradoxus*
  - Species overlap between 150-440m depths
- Juveniles predominate inshore of adults
  - Size of fish increases with depth
- Hake are opportunistic feeders
  - Substantial predation of larger *M. capensis* on smaller *M. paradoxus,* as well as same-species cannibalism
- Hake is eaten by many organisms but because it is the dominant organism in its habitat, its major predator is probably other hake

Modelling predation

- Take predation into account in natural mortality

$$Z_{say} = M_{sa} \quad \rightarrow \quad Z_{say} = M_s^{basal} + P_{say}$$

- Number of hake lost to predation affected by:
  - Number of predators
  - Number of prey
  - Preference a predator exhibits for prey of different species and age classes

$$P_{say} = \sum_{s_p a_p} N_y^{s_p a_p} \gamma_{sa}^{s_p a_p} \frac{\nu_s^{s_p} \theta^{s_p a_p}}{1 + \sum_{sa} \tilde{\nu}_s^{s_p} N_{say} \gamma_{sa}^{s_p a_p} + \tilde{\nu}_{other}^{s_p} O_{other}^{s_p a_p}}$$

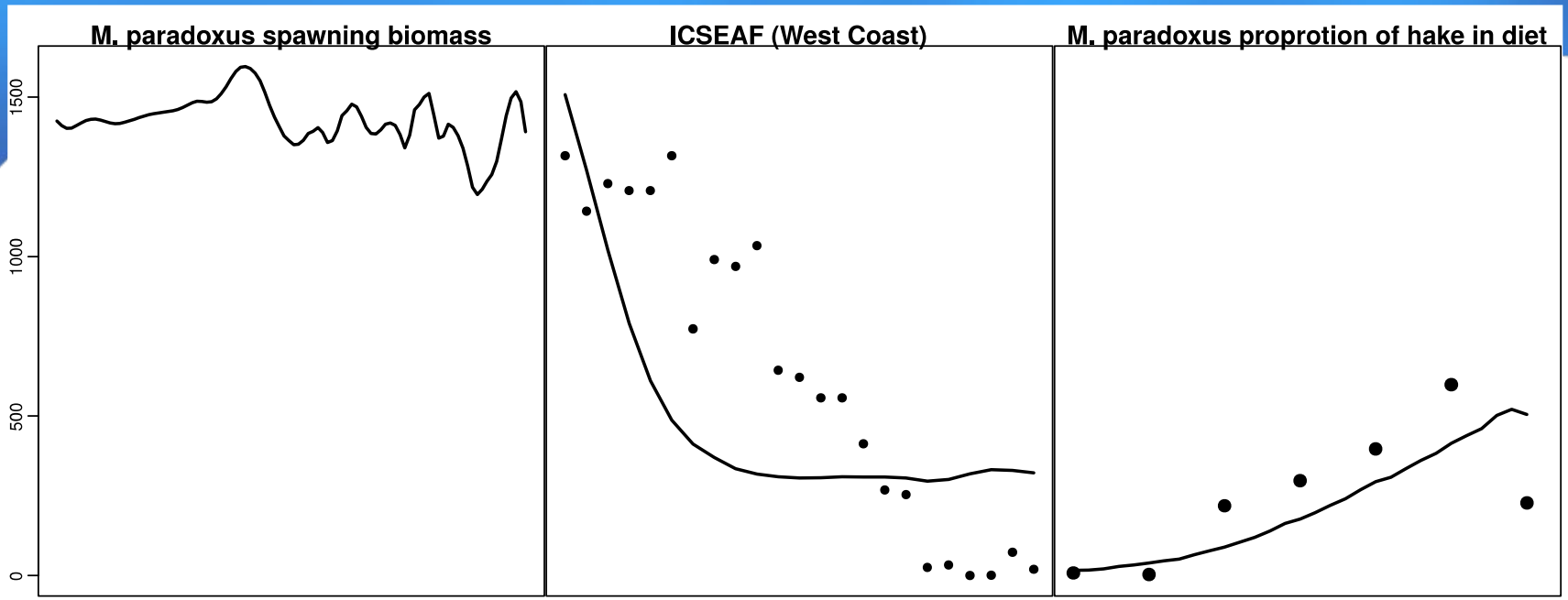
Diet data

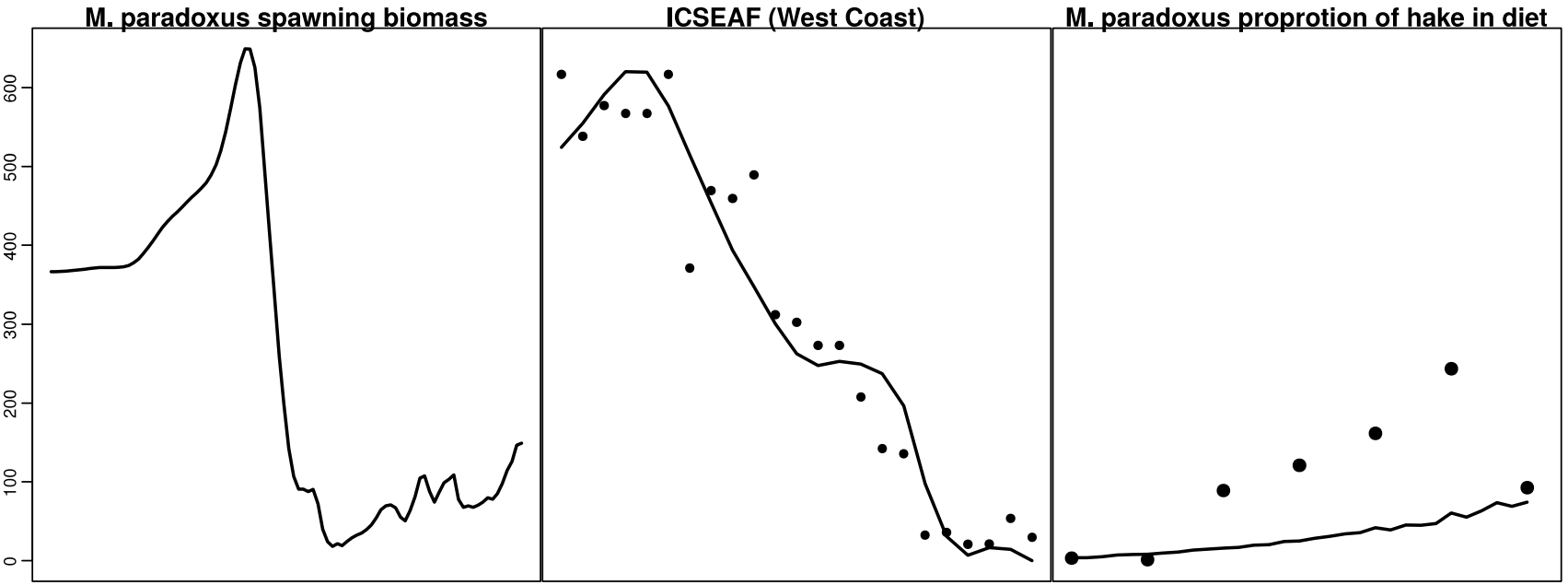
- Proportion of hake in diet of hake predators
- Predator preference for prey by prey species and size
- No direct estimate for daily ration – use rough guideline of 1-4 % of body mass

Results thus far

- *M. paradoxus* biomass increases when the *M. capensis* population is reduced by the fishery
  - *M. paradoxus* depletion levels according to the predation model are not as low as indicated by the non-predation model
- Model battles to fit both the *M. paradoxus* proportion of hake in diet and the historical CPUE data simultaneously

Results thus far





Something that could help...

- Proporiton of hake in diet from diet data = counts of non-empty stomachs that contain >50% hake prey against the total number of non-empty stomachs.
- Proporiton of hake in diet from model = the total mass of hake consumed divided by the total mass of prey consumed.
- These two quantities are not directly comparable

Potential solution ?

- Option (A): Leave the diet data as are, and calculate the model-predicted proportion of hake in diet by numbers.
- Option (B): Leave the model proportions as are, and weight the diet data by prey length to give more weight to larger prey items.