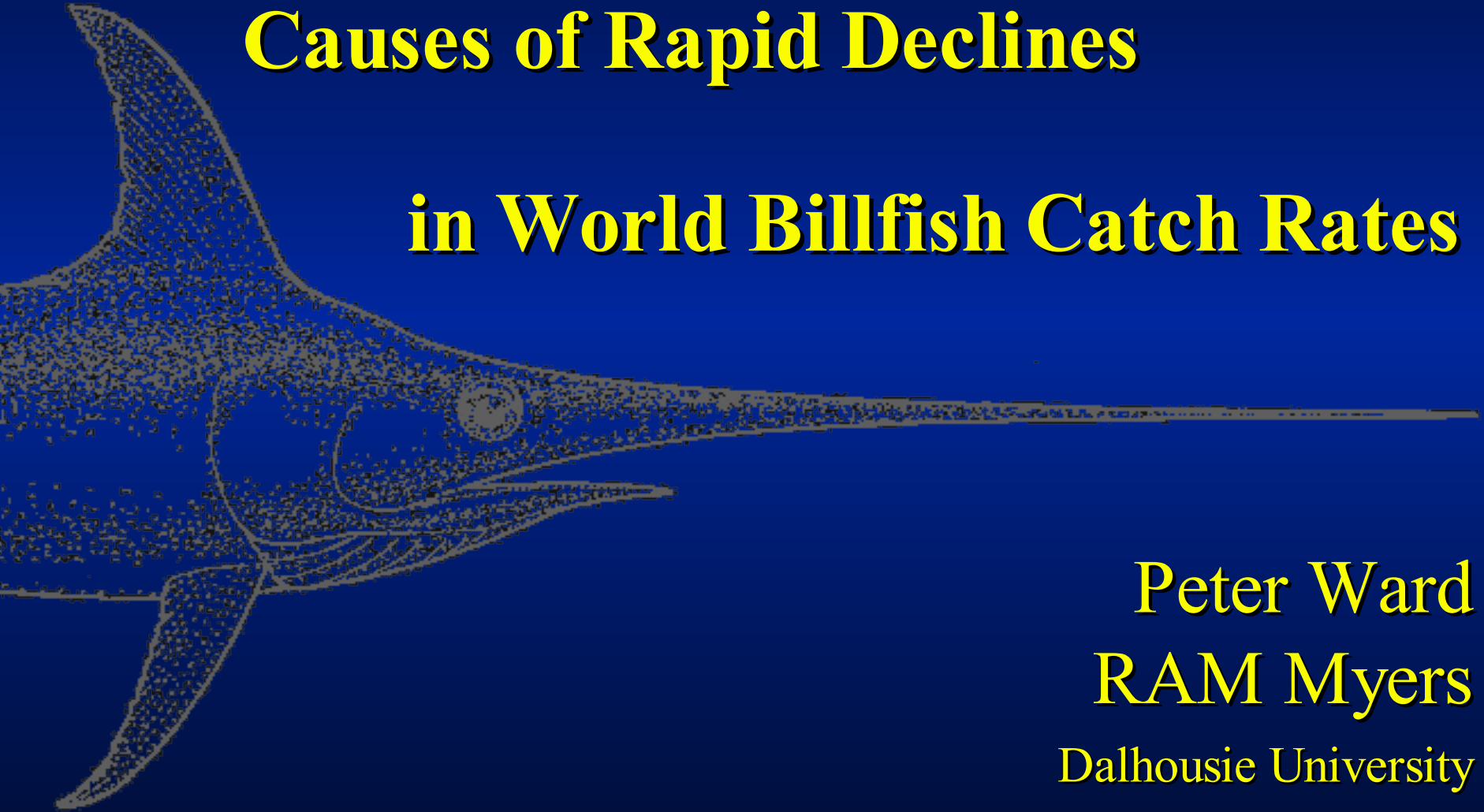


Causes of Rapid Declines

in World Billfish Catch Rates



Peter Ward

RAM Myers

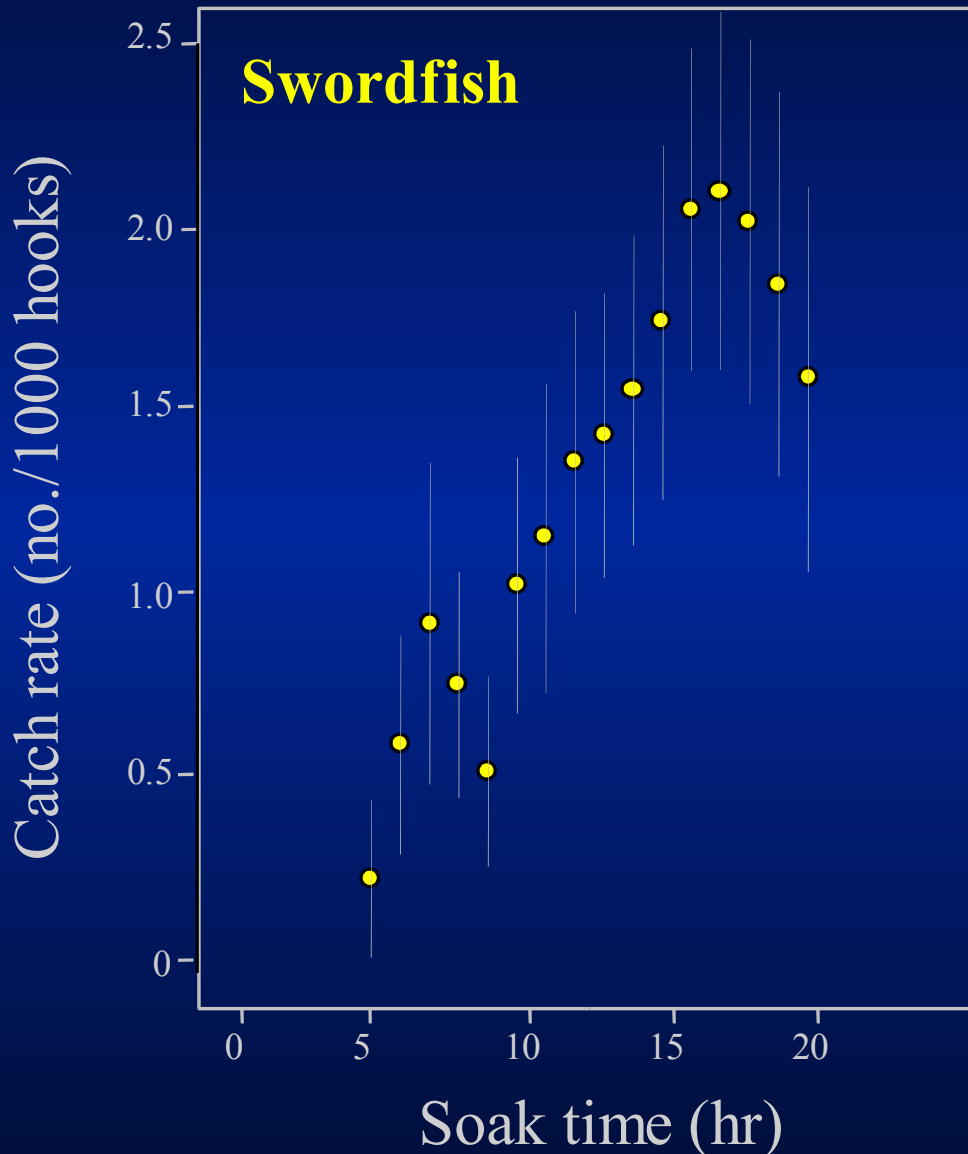
Dalhousie University

Components

1. The effects of soak time on longline catches
2. Comparison of 1950s and 1990s pelagic fish communities



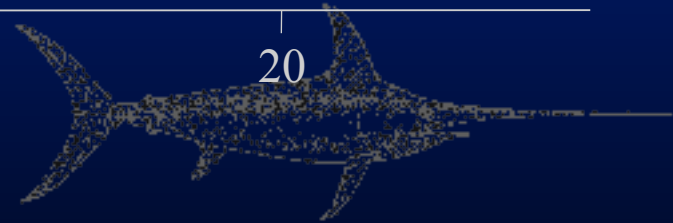
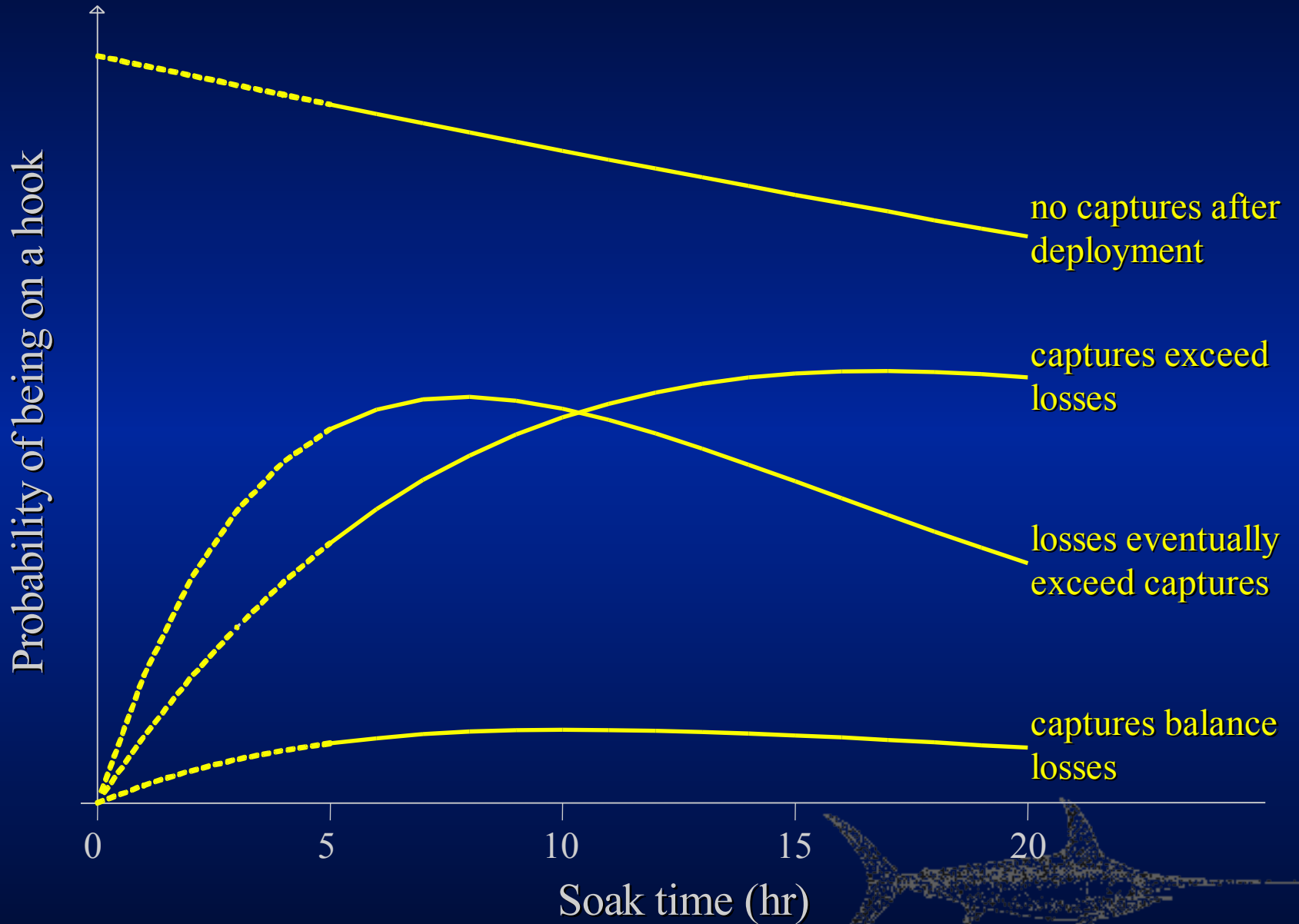
(1) Effects of soak time



- Likely to affect catch rates
- Observer records of time when each fish was brought on board
- Logistic model with random effects



Effects of soak time



Key results

- Soak time effect varied between species
- Catch rates of “live species” increased with soak time
- Catch rates of “dead species” declined, so their mortality is underestimated



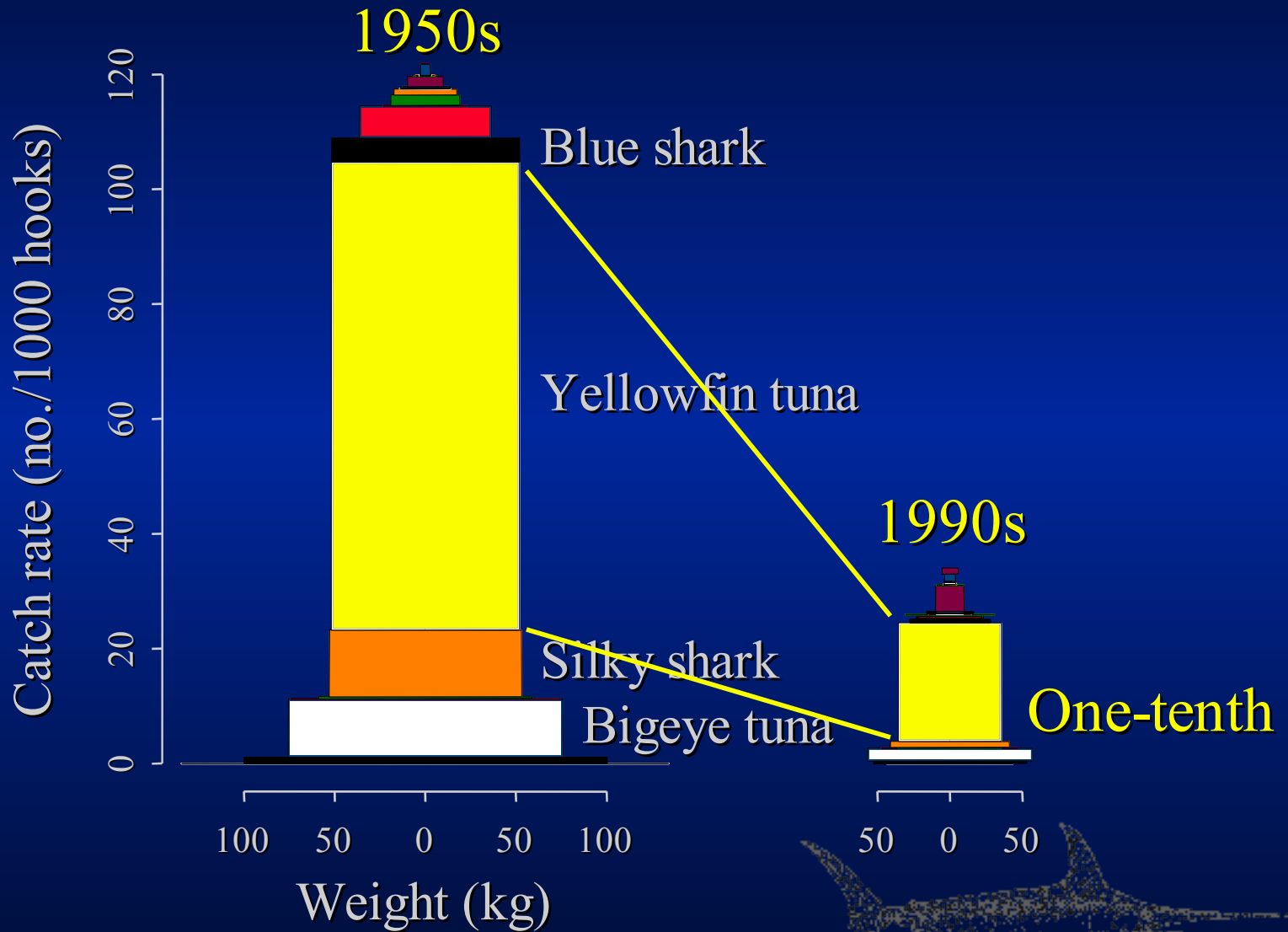
(2) Changes in pelagic fish communities

Comparison of 1990s and 1950s longline data:

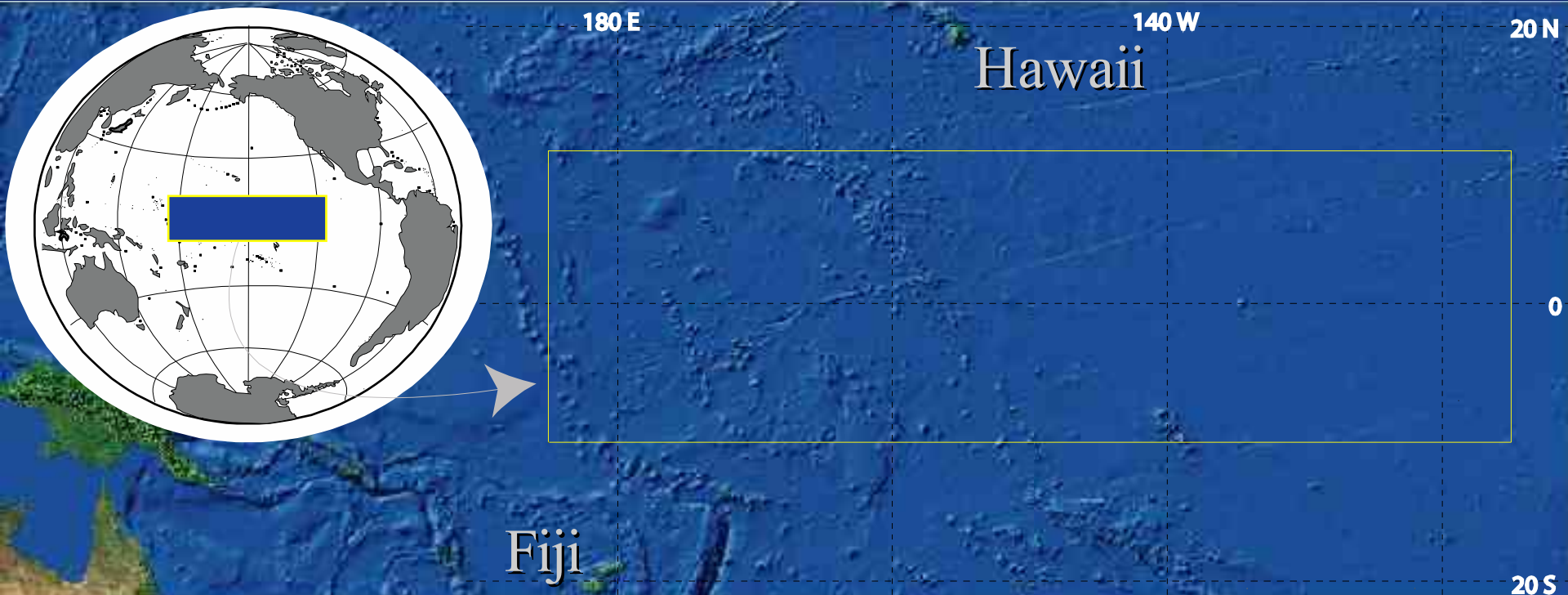
- standardized catch rate
- body size
- total weight or “mass”

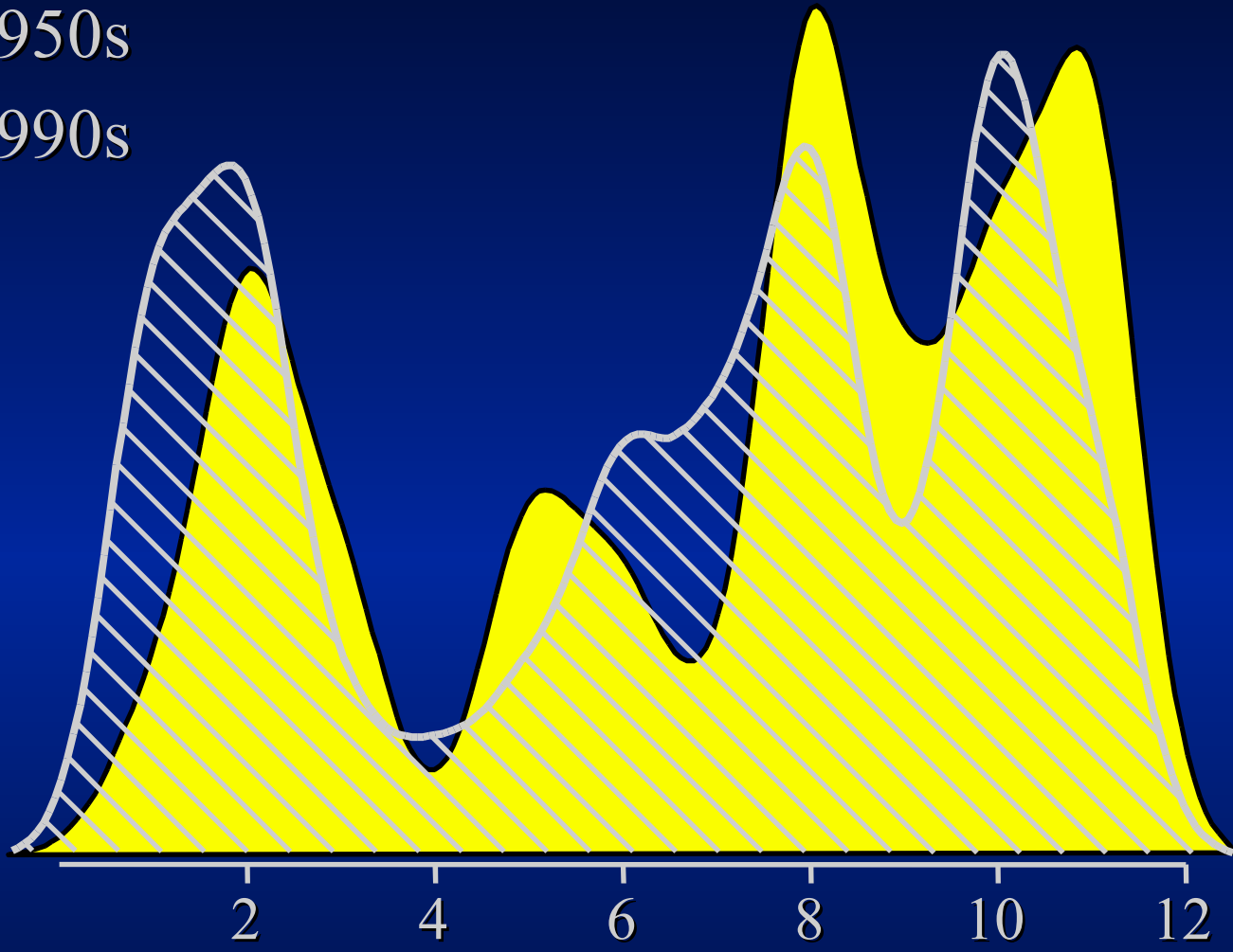


Change in mass



Study area



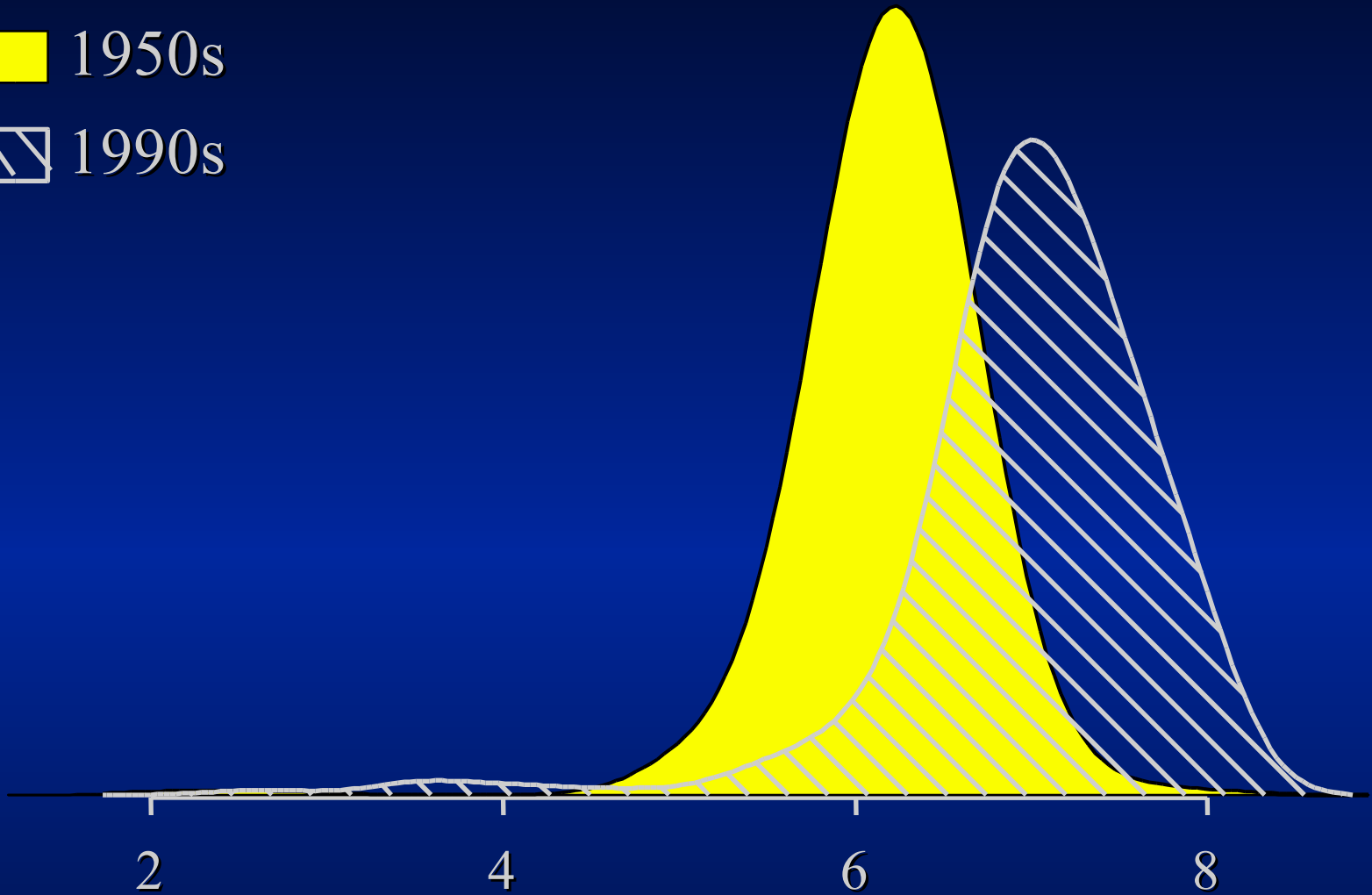


Month



■ 1950s

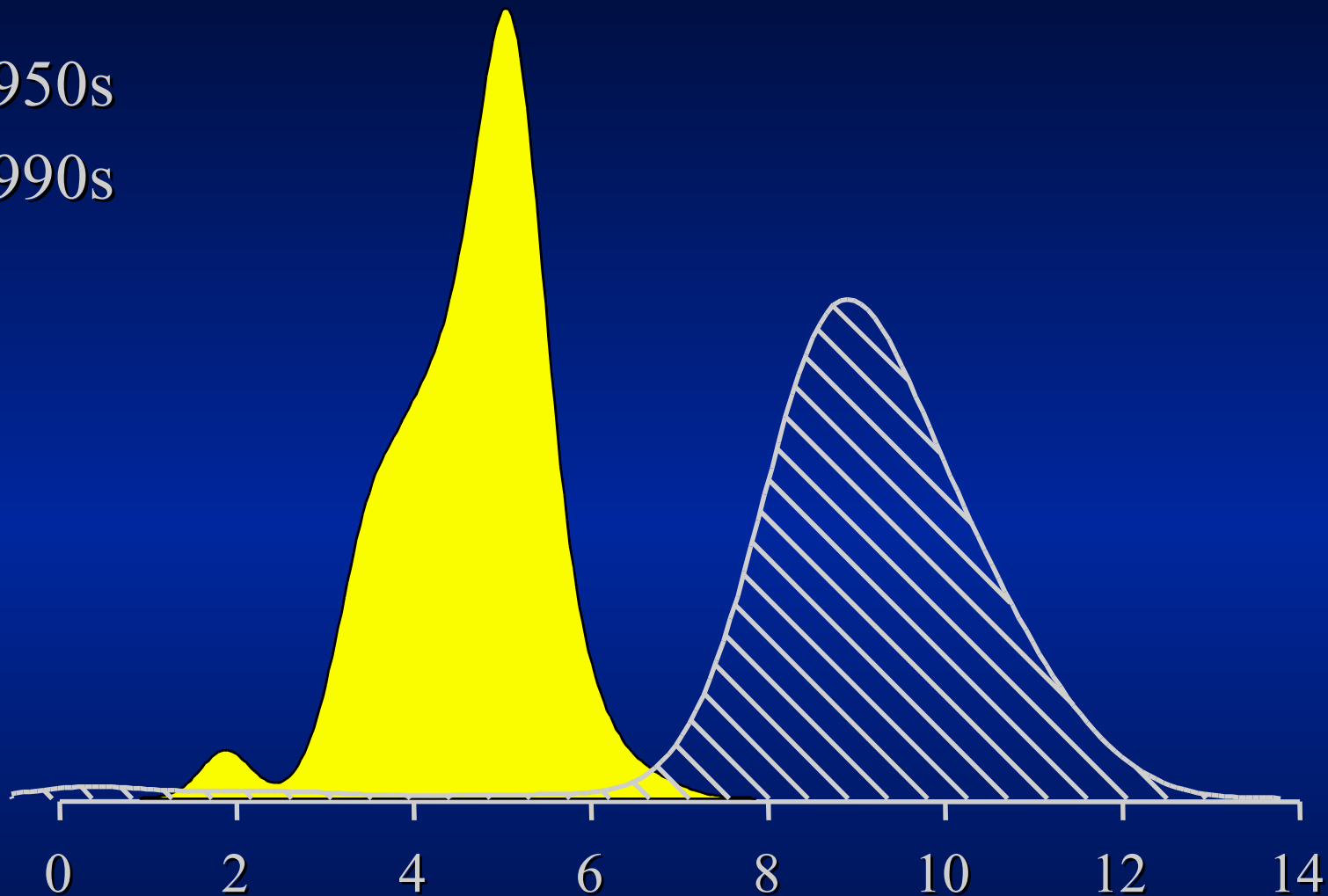
▨ 1990s



Deployment time

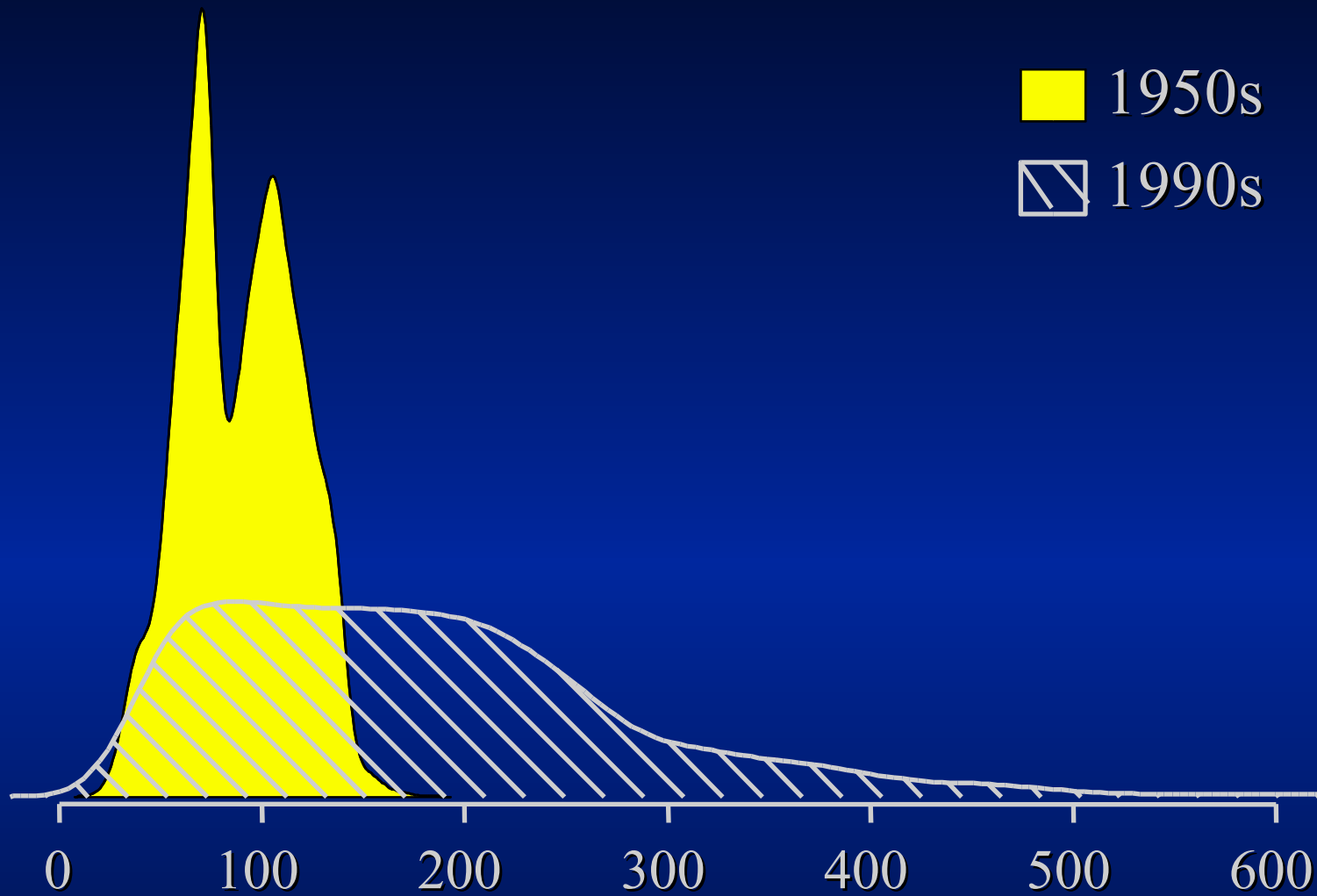


■ 1950s
▨ 1990s



Soak time (hr)





Hook depth (m)



Summary

Similar

- gear
- area
- season
- deployment time

Different

- depth range
- soak time
- number of hooks
- targeting

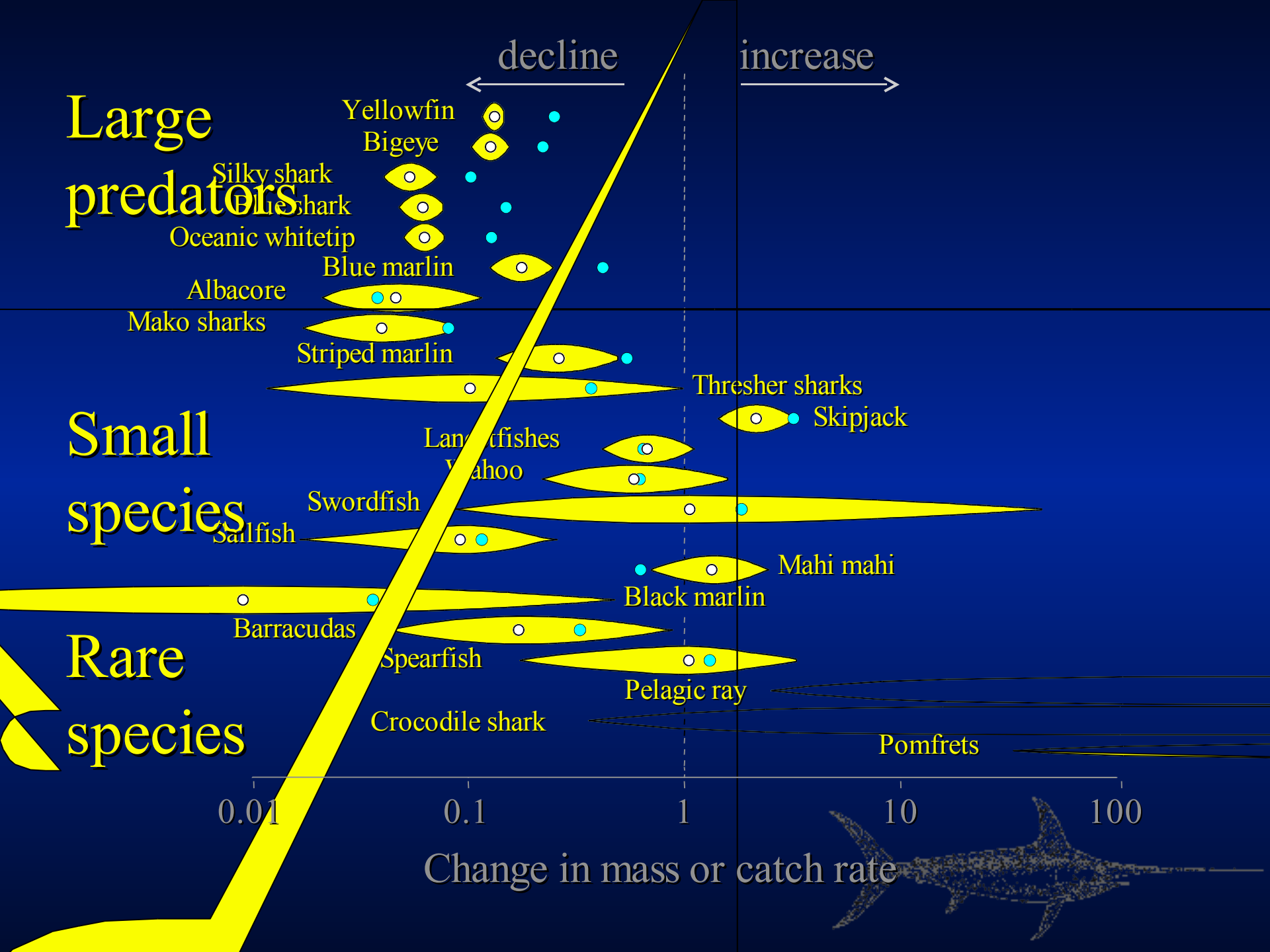


Generalized linear model:

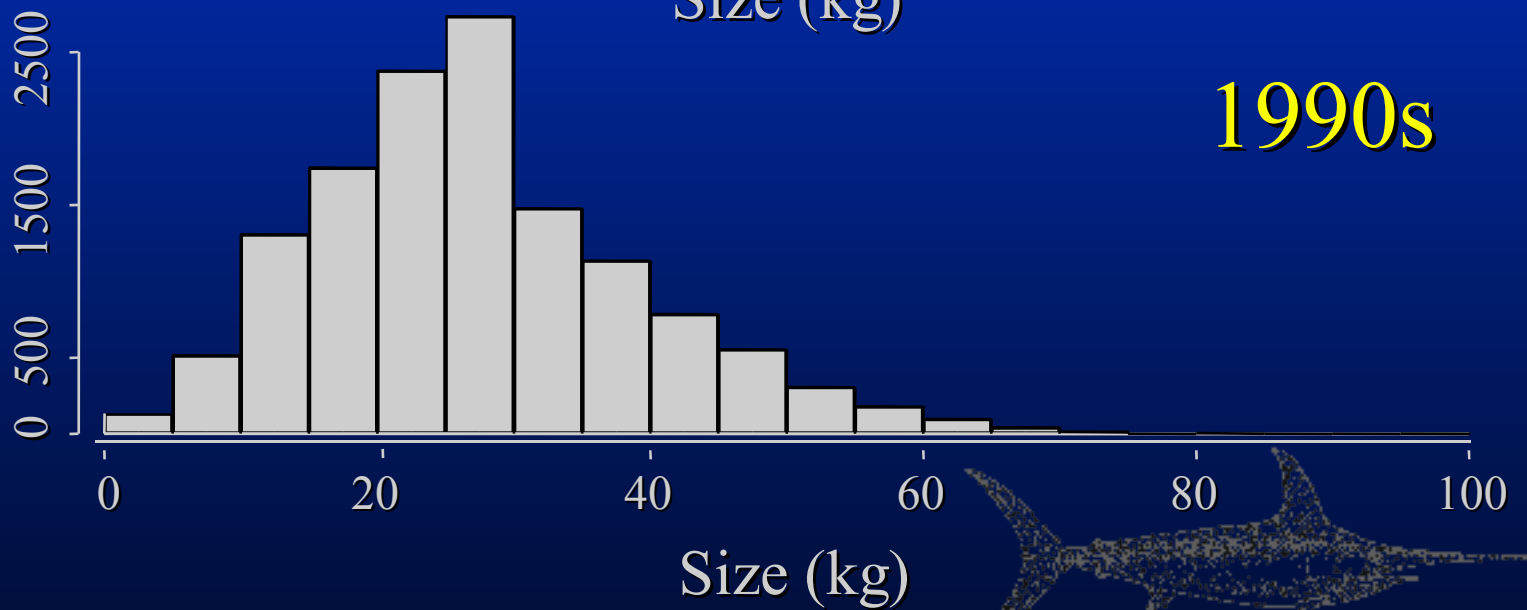
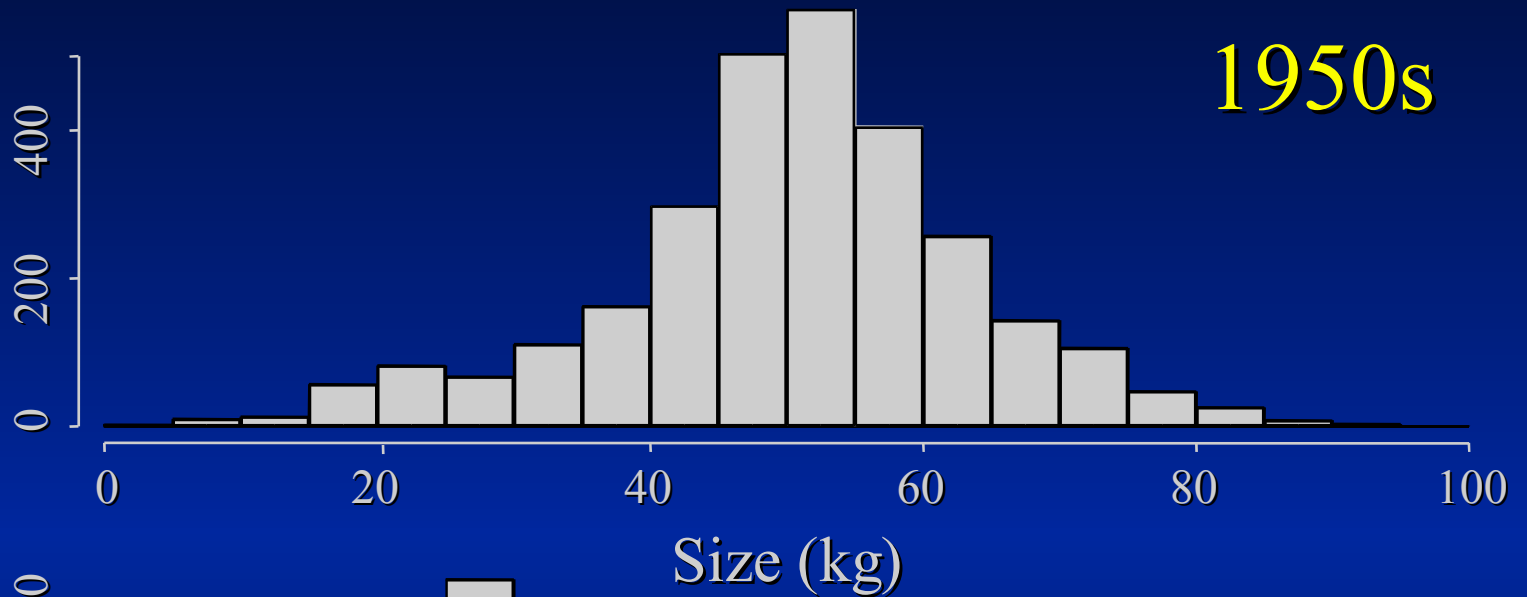
$$\log(\mu_{i,s}) = \beta_0 + \beta_1 P_{i,s} + \beta_2 N_{i,s} + \beta_3 E_{i,s} + \beta_4 T_{i,s} + \beta_5 D_{i,s} + \log(h_{i,s})$$

mass = mean weight x catch rate

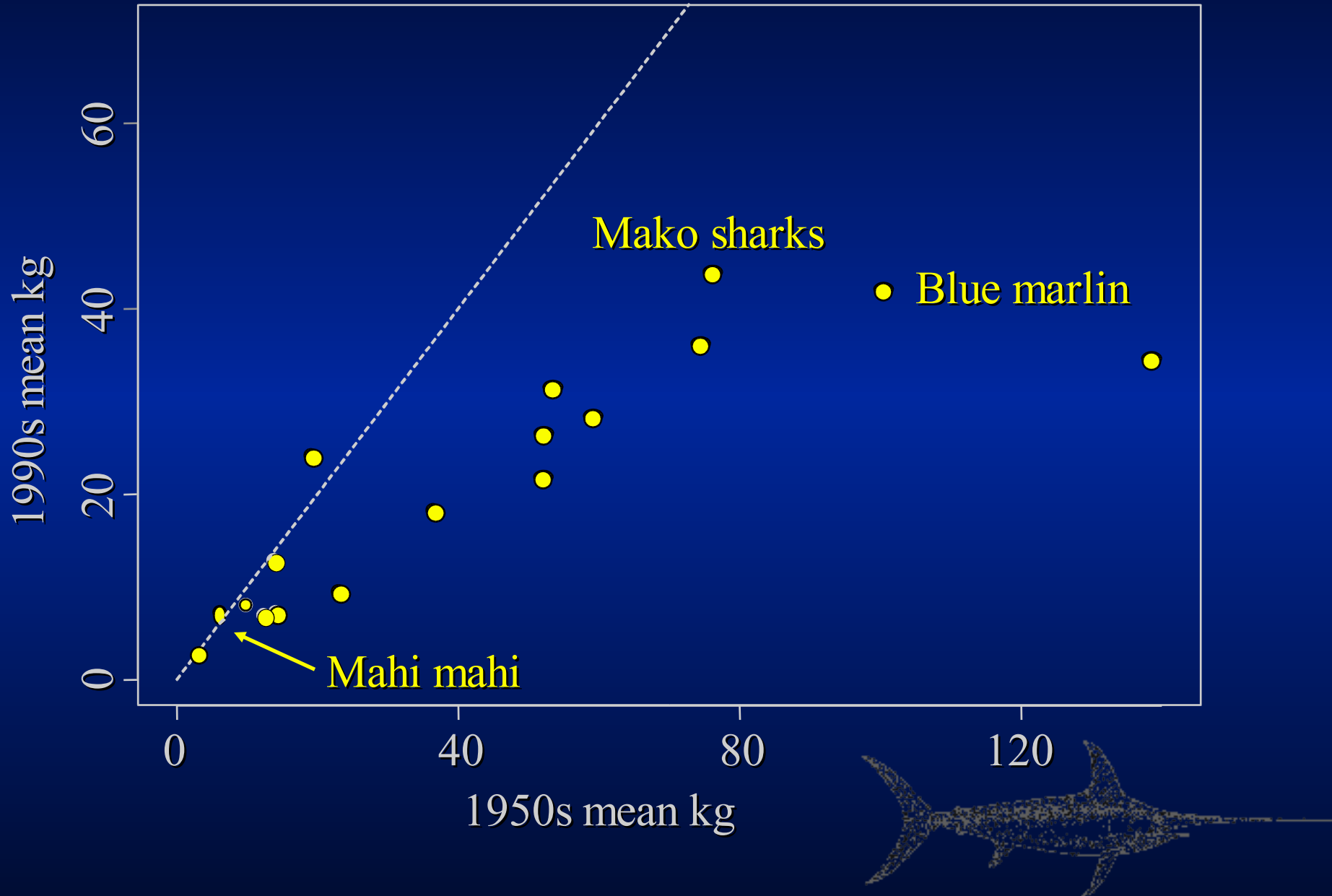




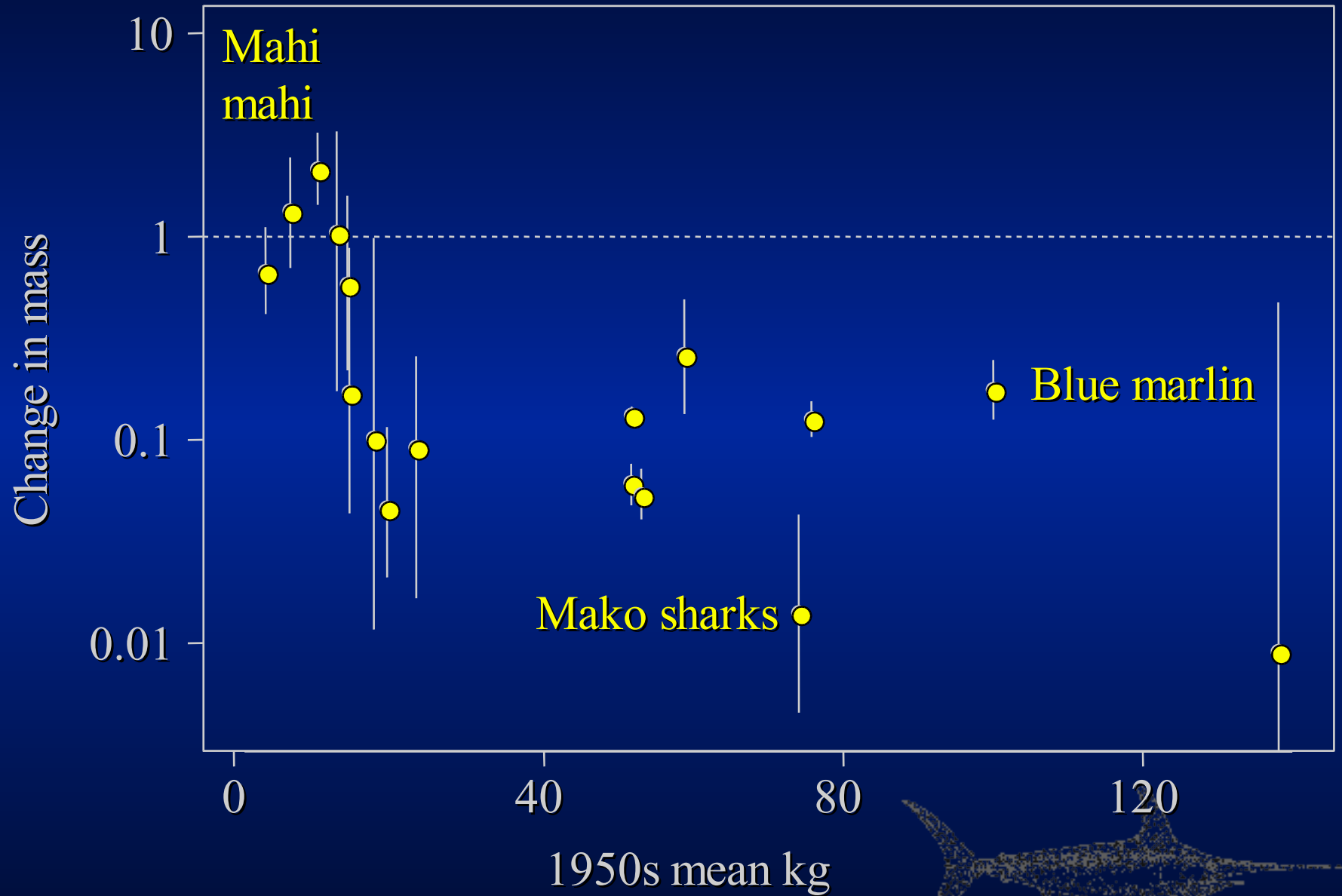
Yellowfin tuna size



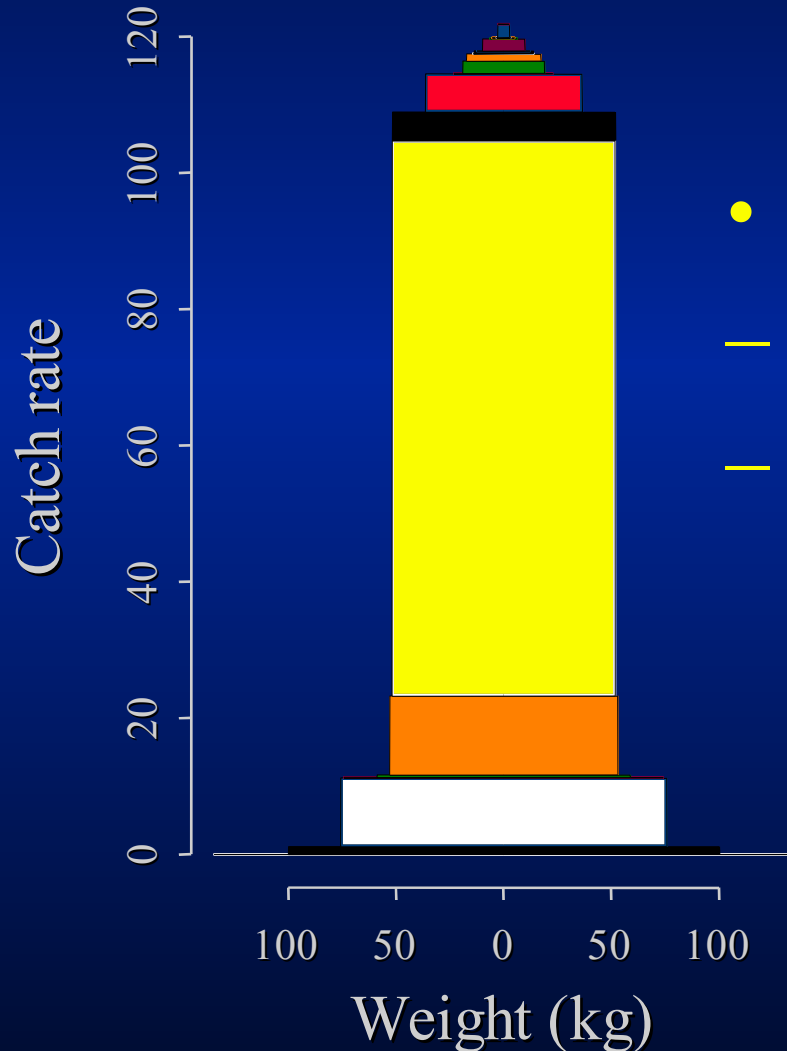
Change in body size



Change in mass with size



Implications



- No evidence of species extirpation
- Does cpue = abundance?
 - Has catchability changed?
 - Are we dealing with a remnant fish community?



Conclusions

- Reductions in body size and catch rate of large predators
- Modest increases in small and rare species
- Reduction in mass of pelagic fish available to longline



The logit model

π is the probability of catching a fish:

$$\pi = \frac{e^{\eta}}{1 + e^{\eta}}$$

or the ‘log odds of catching a fish’:

$$\log\left(\frac{\pi}{1 - \pi}\right) = \eta$$

η is the linear predictor:

$$\eta = \beta_0 + \beta_1 t$$

