

Mortality of shrimp *Pandalus borealis*: Local influence of predation in the Gulf of Maine

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Main Issues

- Localized fishery in GoM
- Challenge to sample and assess
- Possibility of enhancing assessment by including predatory demand:
 - Analyze food habits data and existing estimates of finfish stock biomass to estimate annual biomass of northern shrimp consumed by major predators.
 - Compare consumption estimates with removals implied by currently assumed measures of natural mortality for shrimp.

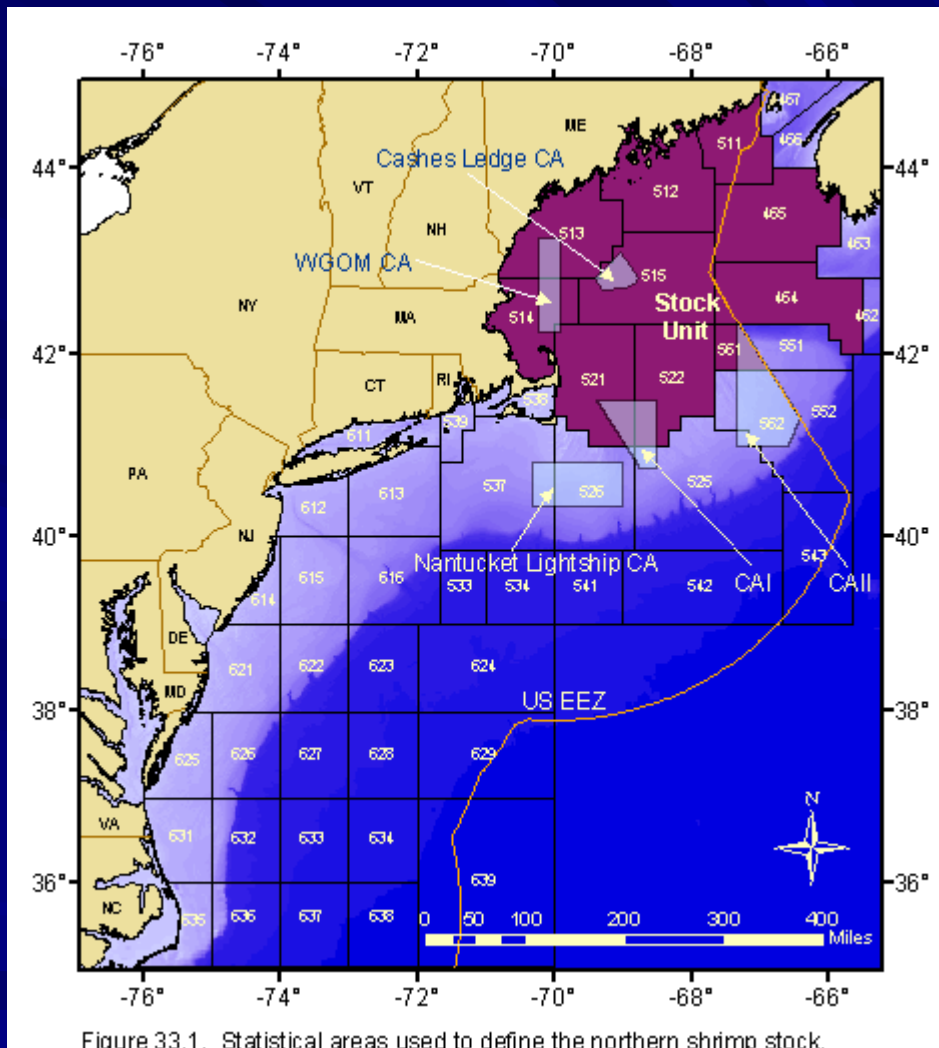


Figure 33.1. Statistical areas used to define the northern shrimp stock.

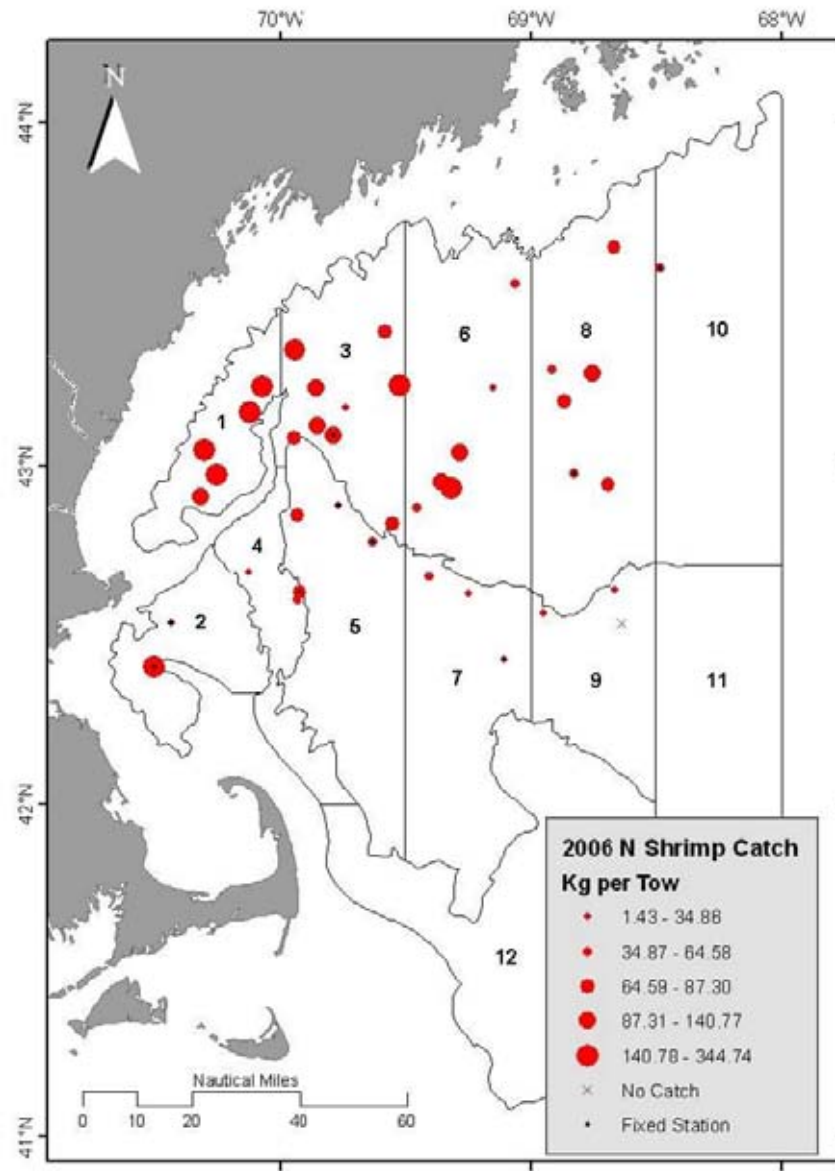


Figure 6a. Northern shrimp survey strata and observed distribution of catch per tow (kg) of northern shrimp collected during 2006 in the western Gulf of Maine aboard the R/V Gloria Michelle, July 24 - August 11, 2006.

Evacuation Rate Models

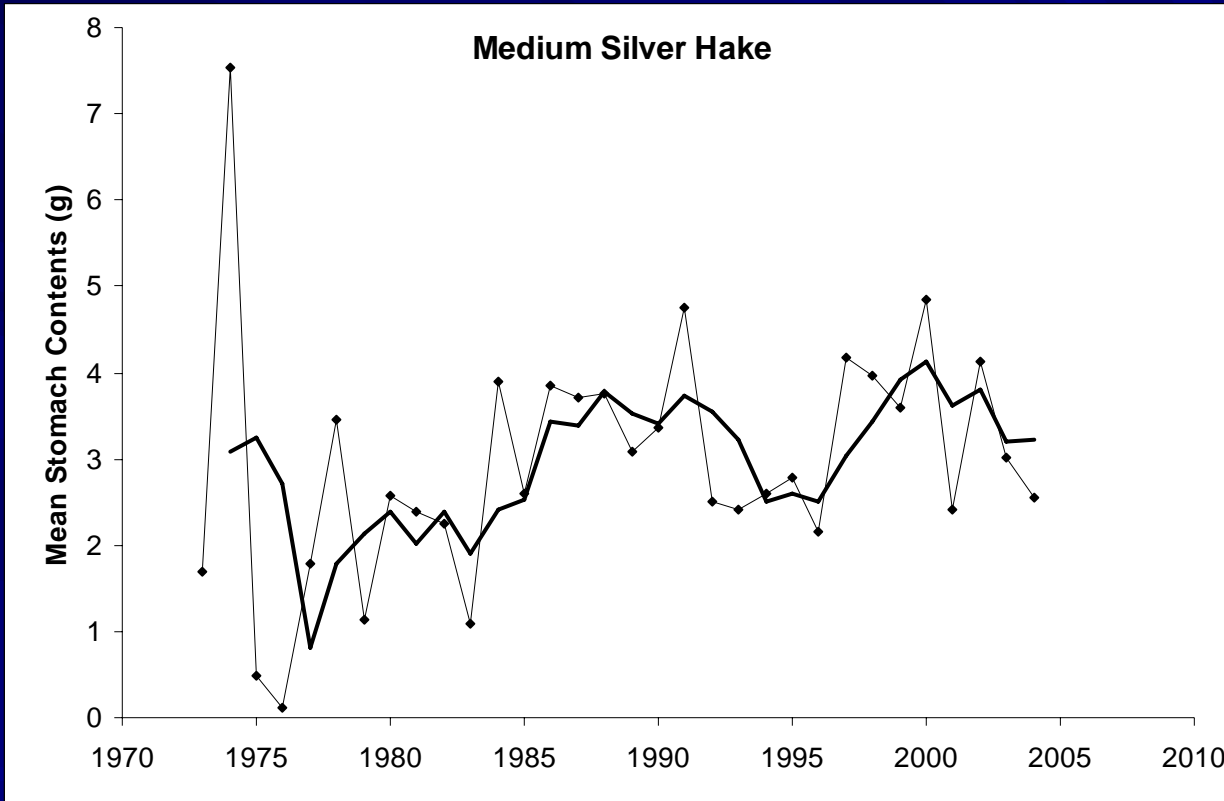
- $C = 24 E \bar{S}$

- $E = \alpha e^{\beta T}$

- Scaled to season/annum

- Scaled to total stock size

An Example Data/Calculation



Fall

An Example Data/Calculation

- $E = \alpha e^{\beta T}$

$$\alpha = 0.04$$

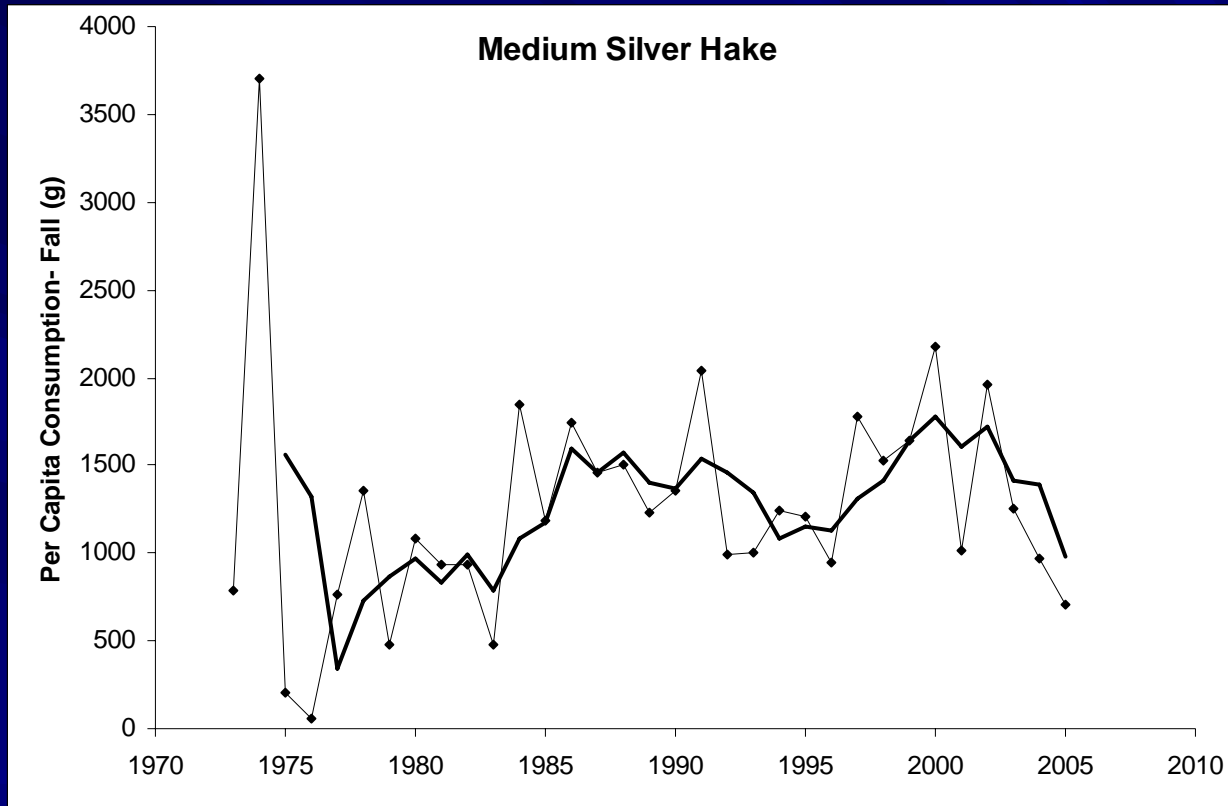
$$\beta = 0.11$$

T fall time series

then;

- $C_{\text{fall}} = (24 E \bar{S}) * 182.5$

An Example Data/Calculation

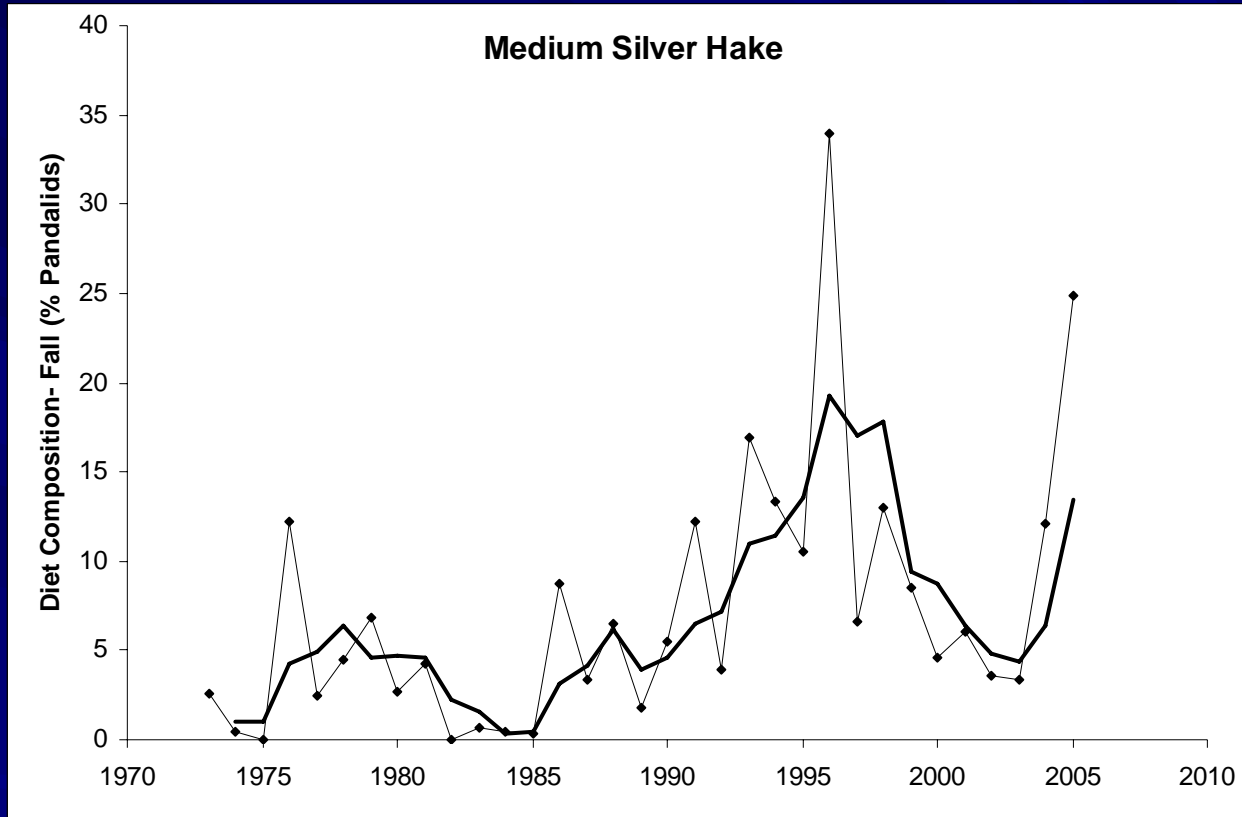


Fall

An Example Data/Calculation

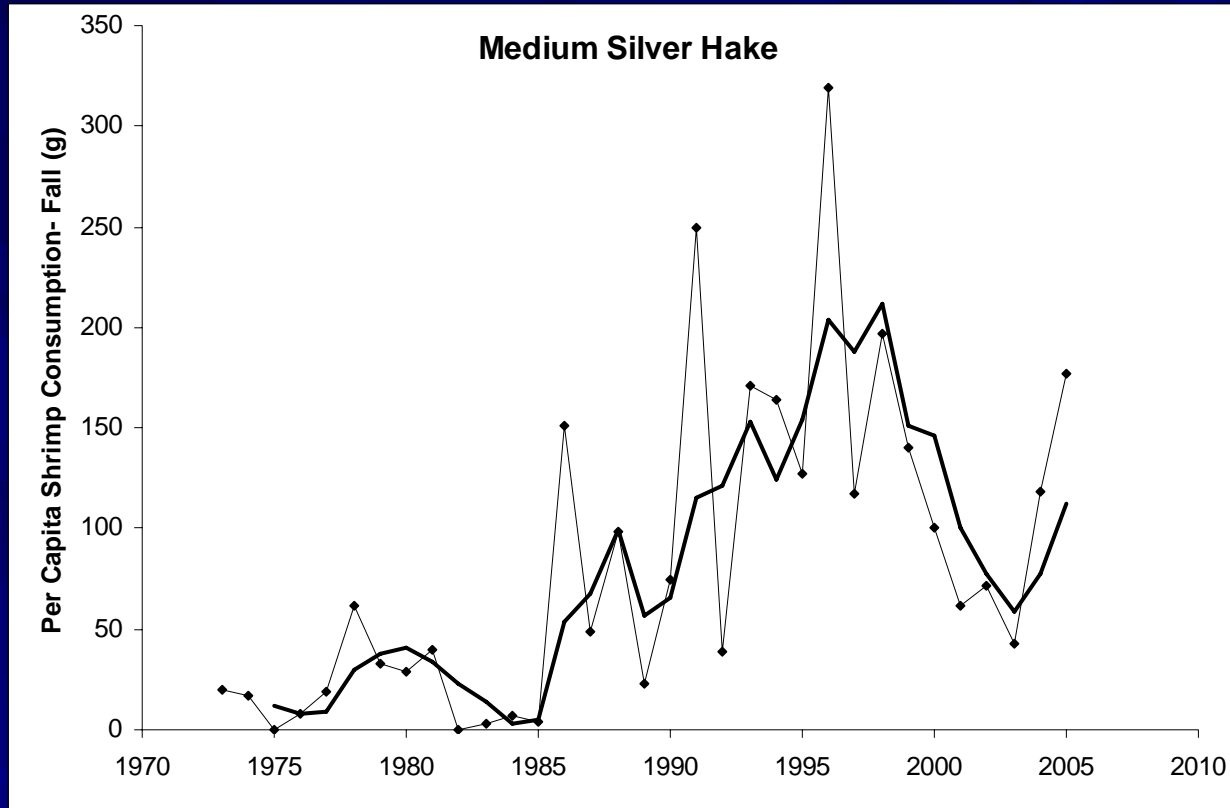
- $C_{\text{fall shrimp}} = C_{\text{fall}} * \% \text{ Diet Comp Shrimp}$

An Example Data/Calculation



Fall

An Example Data/Calculation



Fall

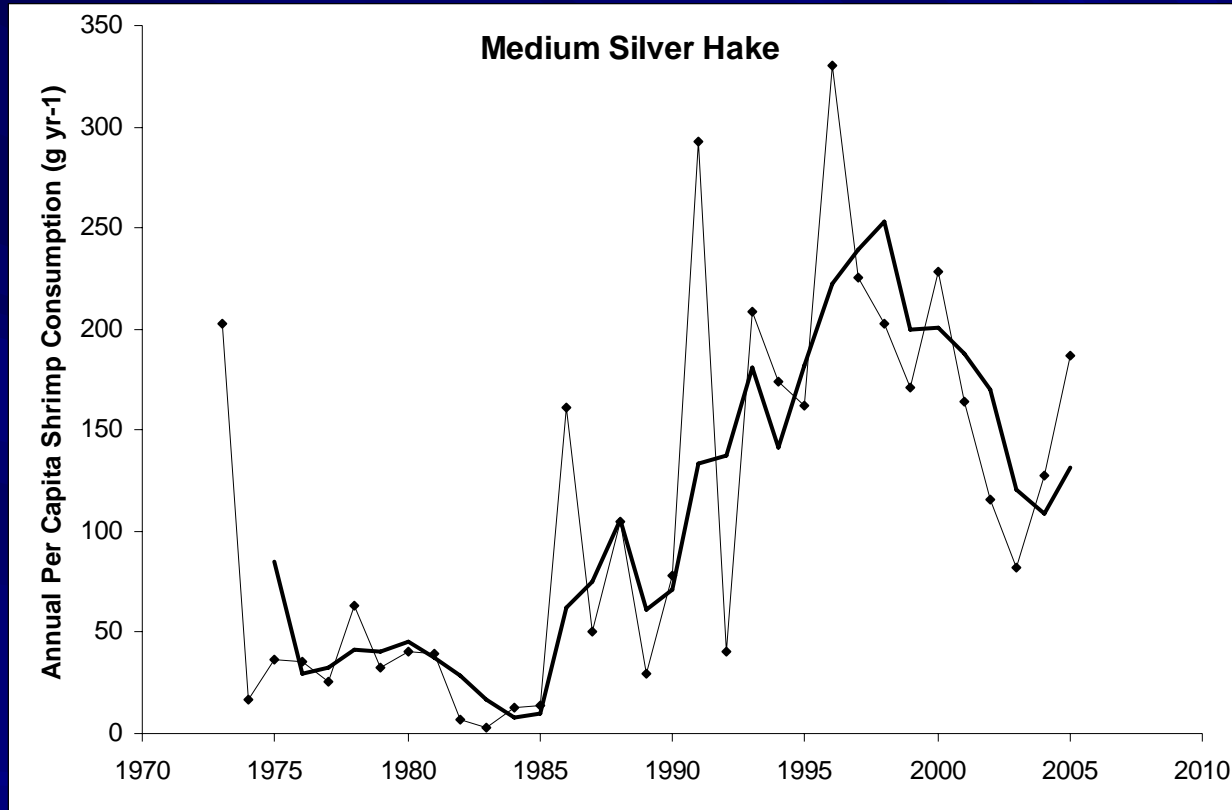
An Example Data/Calculation

- $C_{\text{annual}}^{\text{shrimp}} = C_{\text{fall}}^{\text{shrimp}} + C_{\text{spring}}^{\text{shrimp}}$

still on a per capita basis

accounts for different temperatures in these seasons for this strata set

An Example Data/Calculation



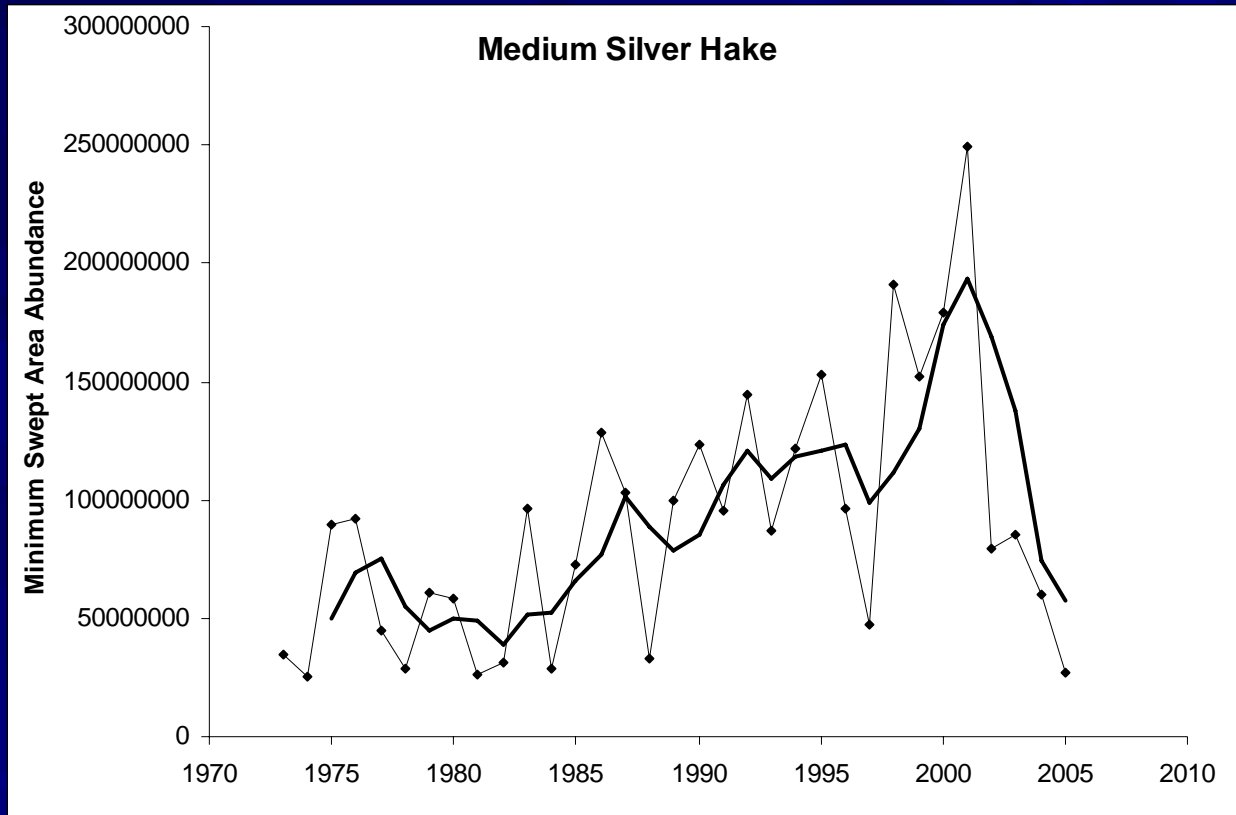
An Example Data/Calculation

- Total Shrimp Consumed by predator = $C_{\text{annual}}^{\text{shrimp}} * \text{Predator Abundance}$

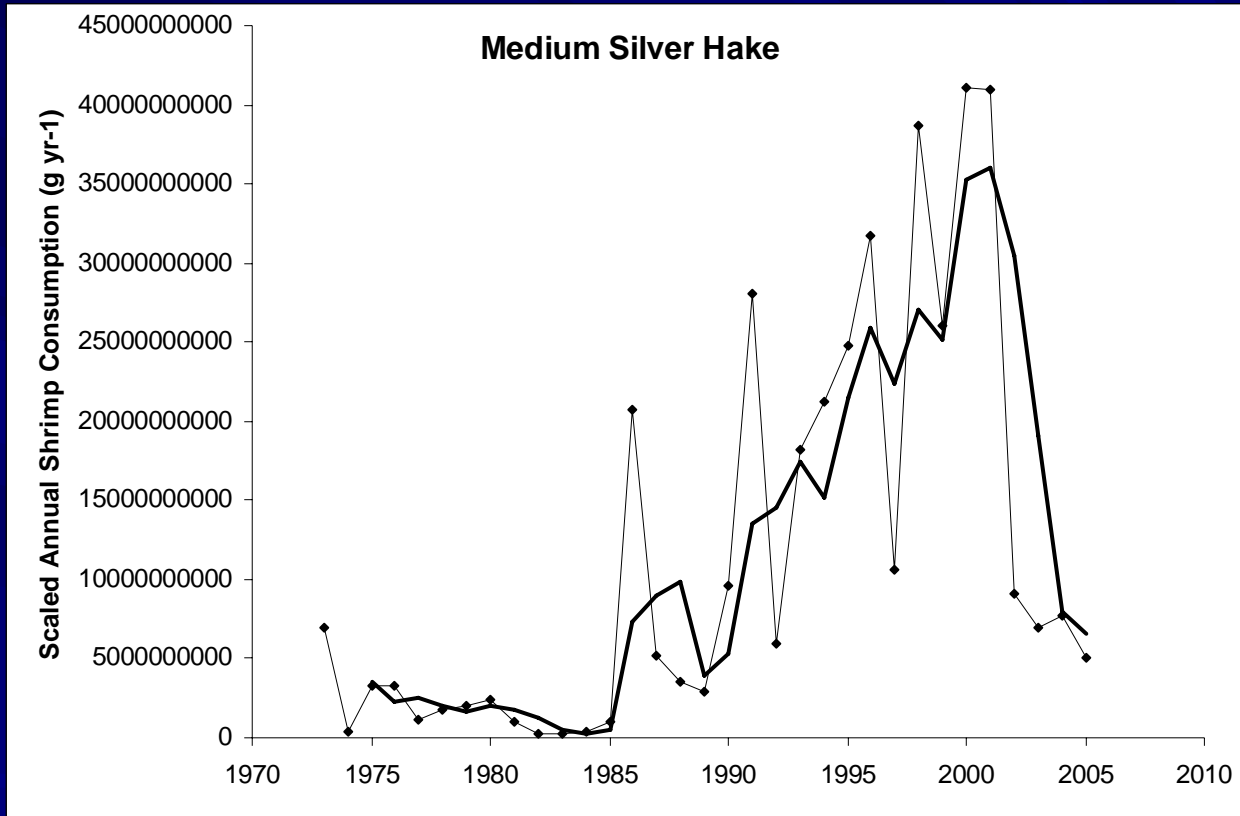
Scales to all predators in size-species-strata group

Uses a minimum swept area abundance estimator from Bottom Trawl Survey

An Example Data/Calculation



An Example Data/Calculation



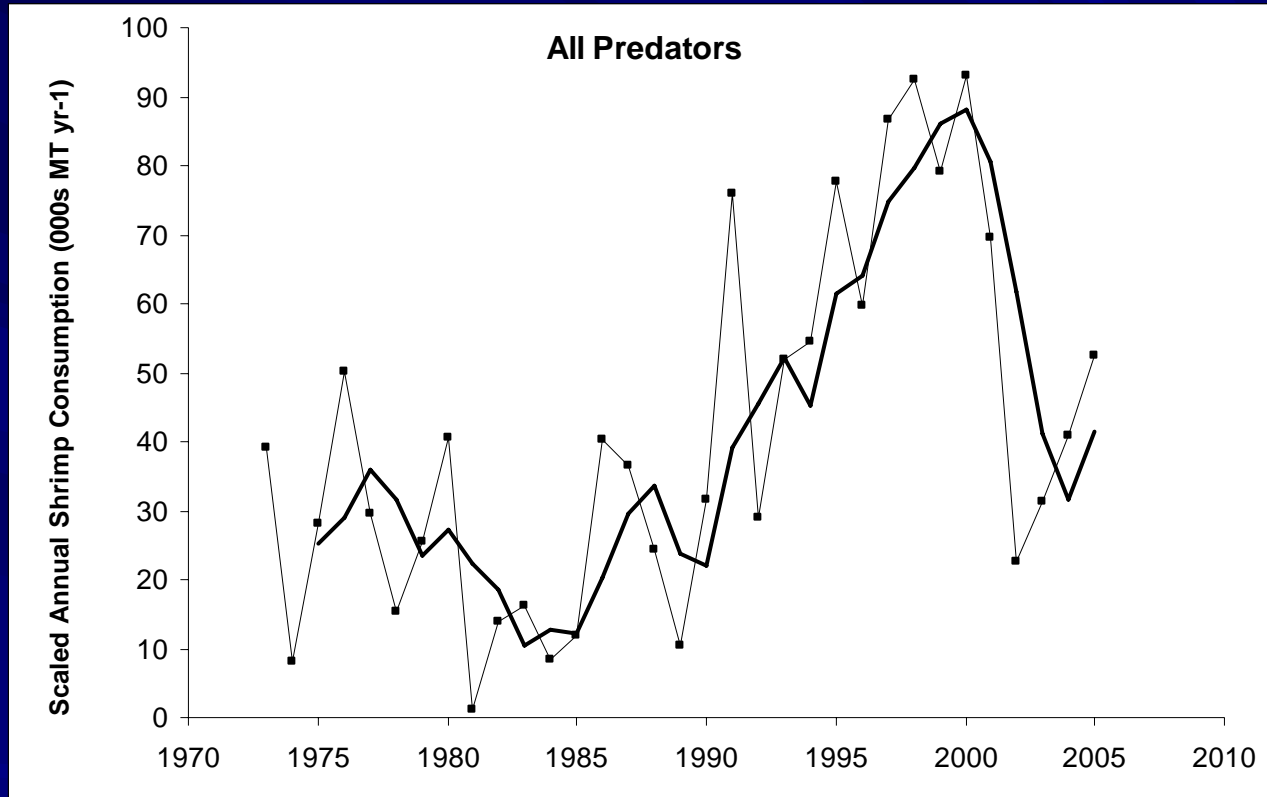
An Example Data/Calculation

- Summed for all species that consistently eat pandalid shrimp

All Predators that Consistently Eat Pandalid Shrimp

- S Sea Raven
- S & M Longhorn Sculpin
- M Windowpane
- M 4-spot Flounder
- M & L Red Hake
- M & L White Hake
- M & L Pollock
- M & L Cod
- S & M Silver Hake
- M, L & XL Thorny Skate

An Example Data/Calculation

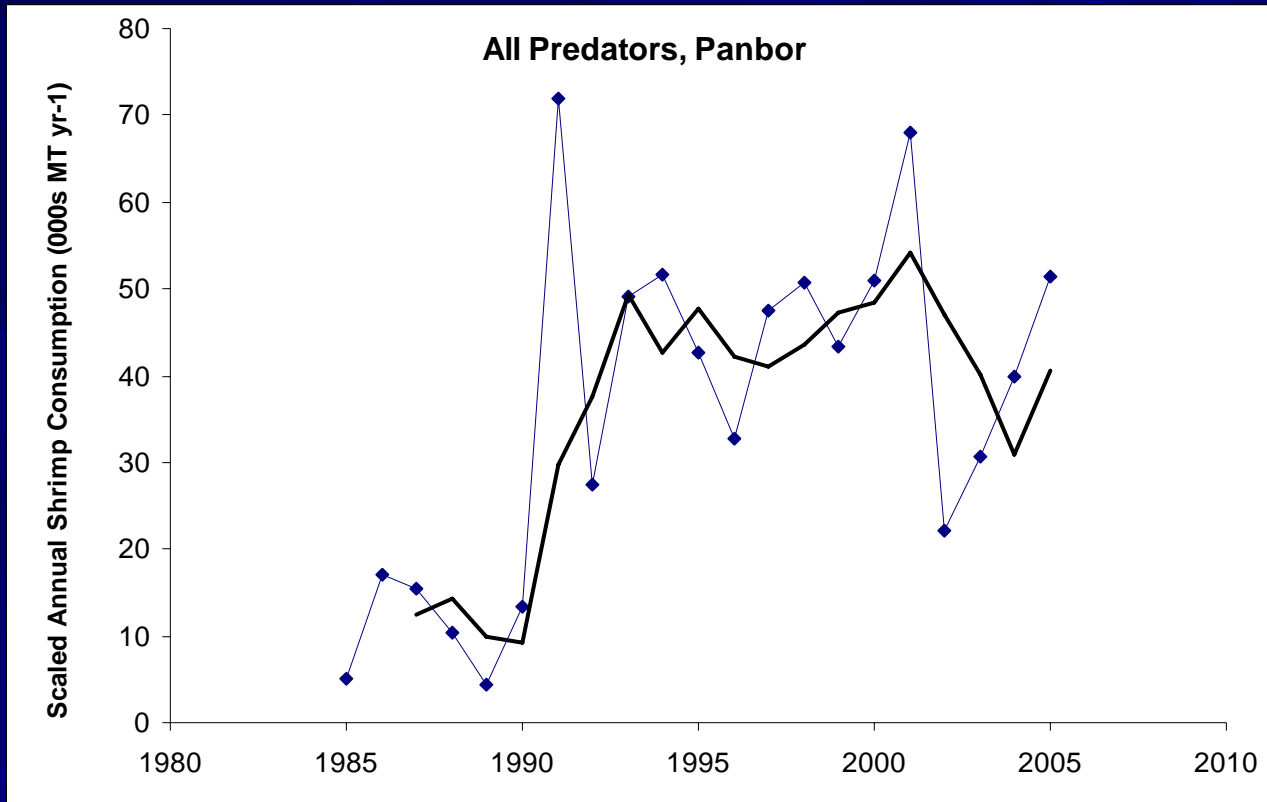


An Example Data/Calculation

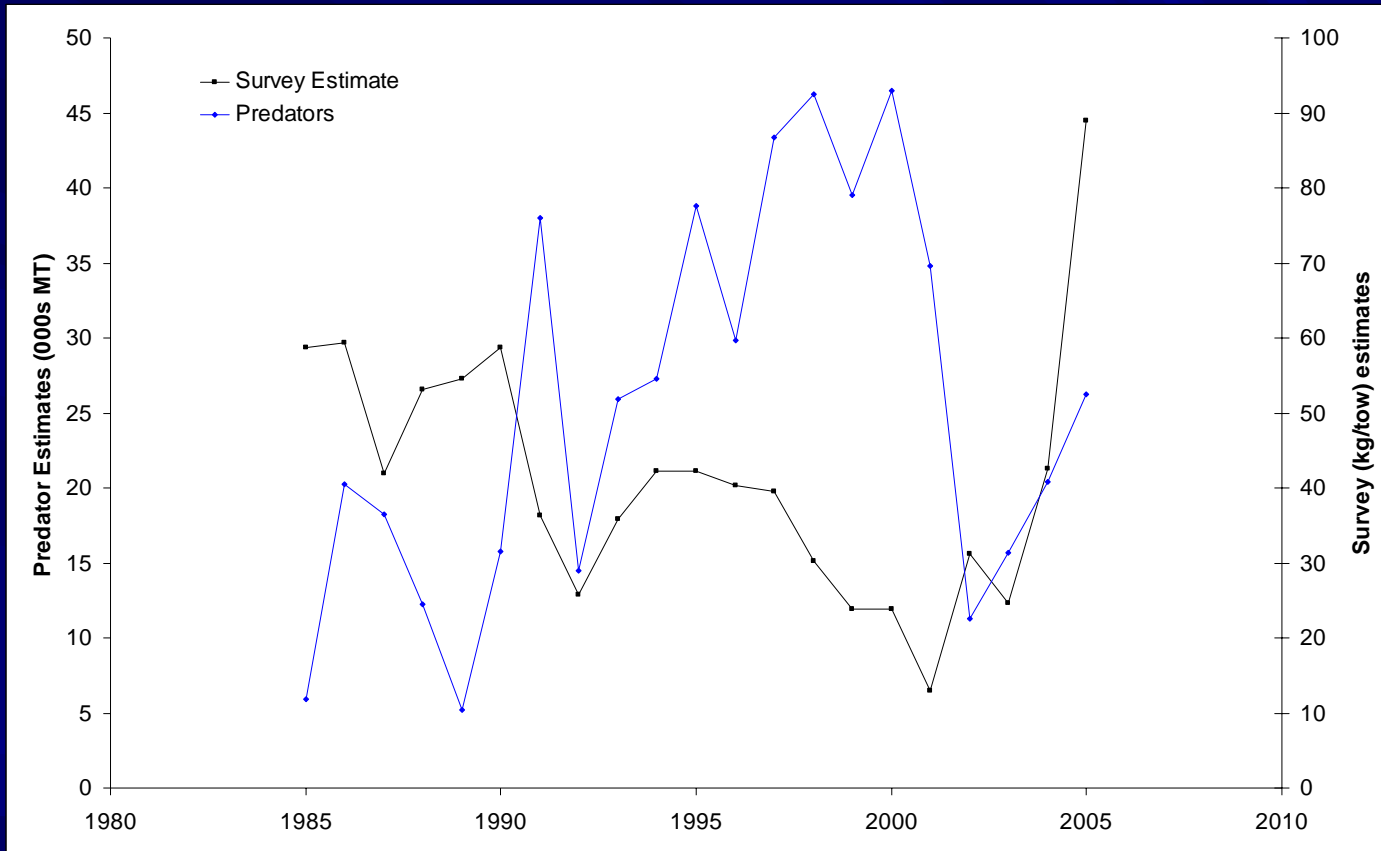
- Scaled by the proportion of northern shrimp:

Pandalus borealis/All Pandalids

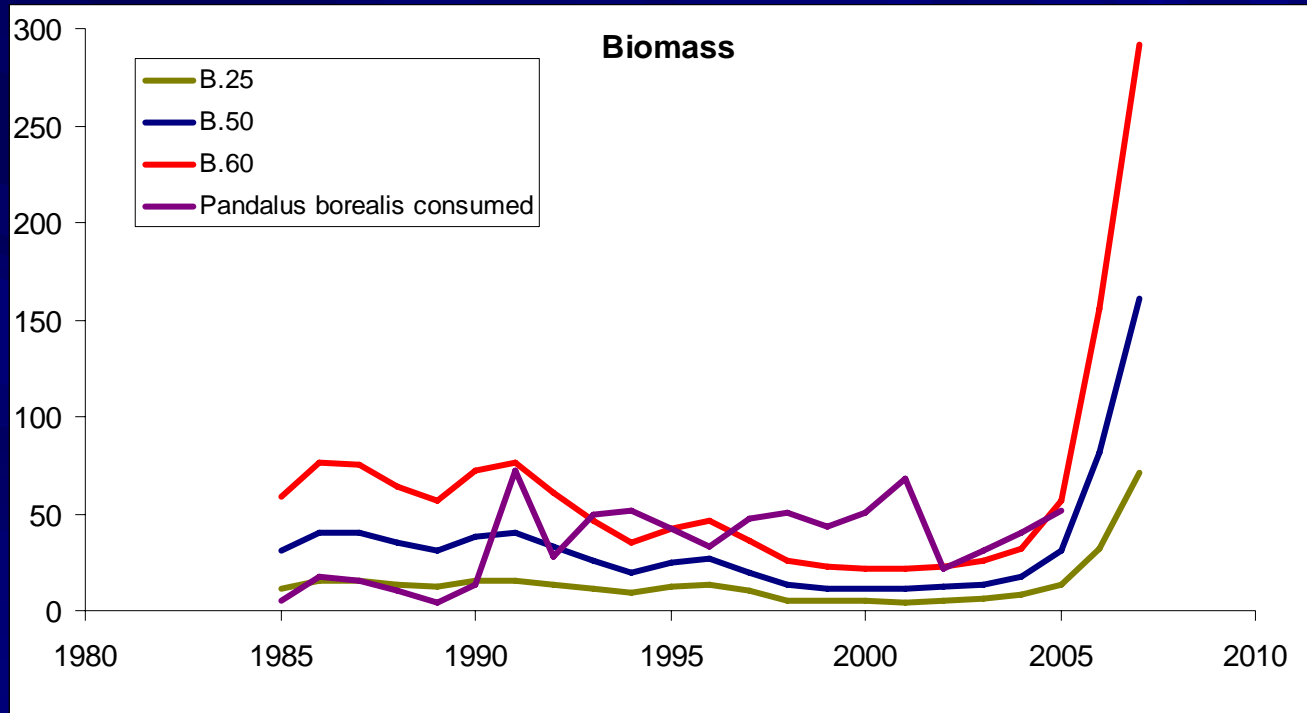
An Example Data/Calculation



Context



Context



Observations

- Total consumption of shrimp on the same order of magnitude of independent estimates of stock biomass, but can be a bit higher
- Total consumption of shrimp exhibits similar trends as other biomass estimates
- Suggests there is more shrimp biomass in the ecosystem than previously thought
- Total consumption of shrimp suggestive of a higher M than the 0.25 previously used

Conclusions

- At least, should be able to be used as a qualitative index in shrimp assessment, providing context
- Further justification for modifying (increasing) M in assessment model
- May be useful as a scaling index