NOAA Fisheries
University of Maryland Center for Environmental Science

The value of research involved in stock assessment

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Objective of the study

Goal of the project:

present appropriate performance metrics to evaluate a range of data acquiring decisions in terms of economic welfare while achieving the predefined management target of the probability of overfishing

How to design a management system

- How often to conduct stock assessments?
- How long should the assessment and management process take?

Empirical application:

Mid-Atlantic Summer Flounder

State by state TAC with fixed state ratios

60% commercial & 40% recreational

SA interval: ca. 3 years (full assessment vs. update)

DML: ca. 1 year

Image: www.greateratlantic.fisheries.noaa.gov

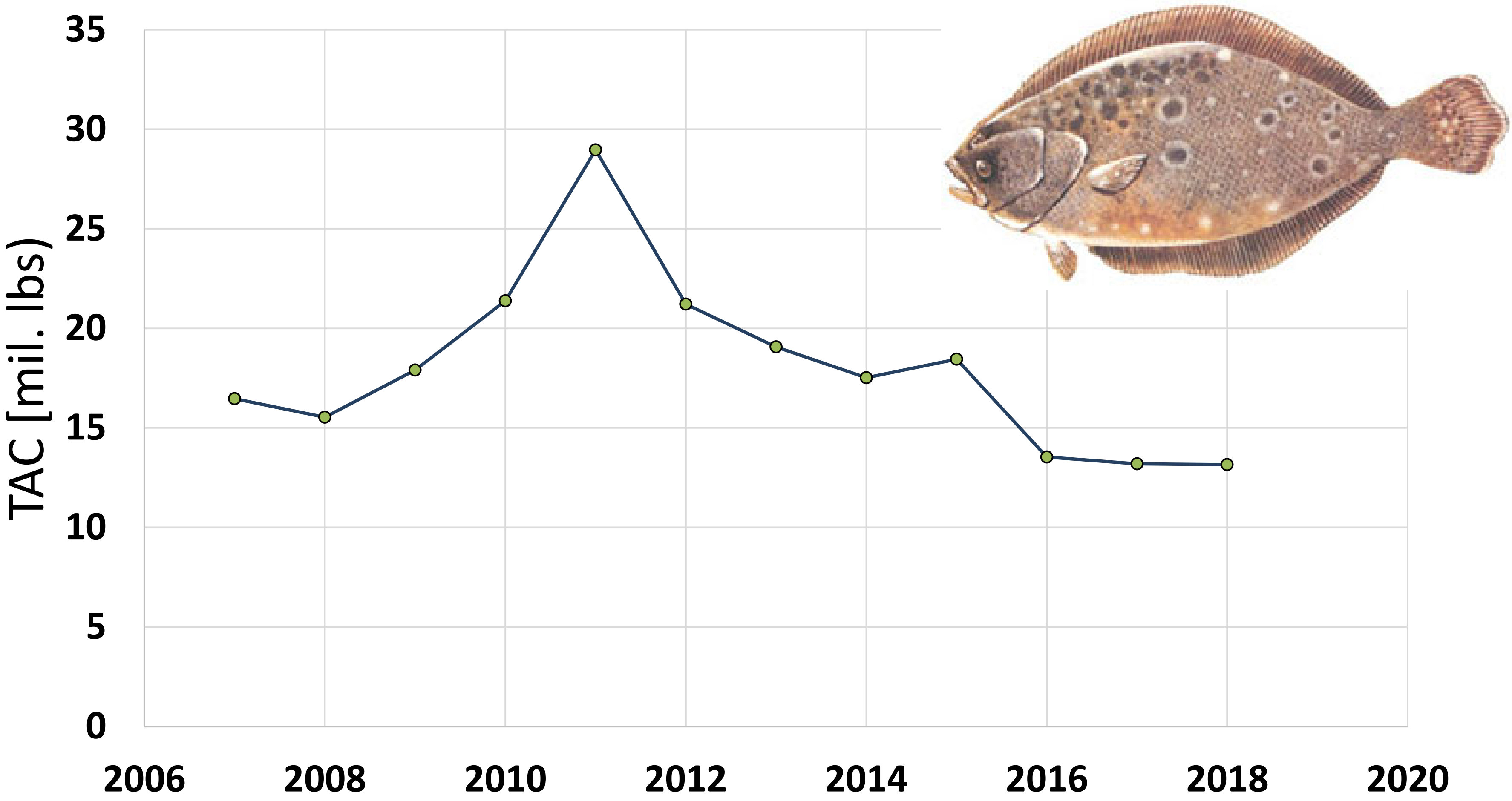
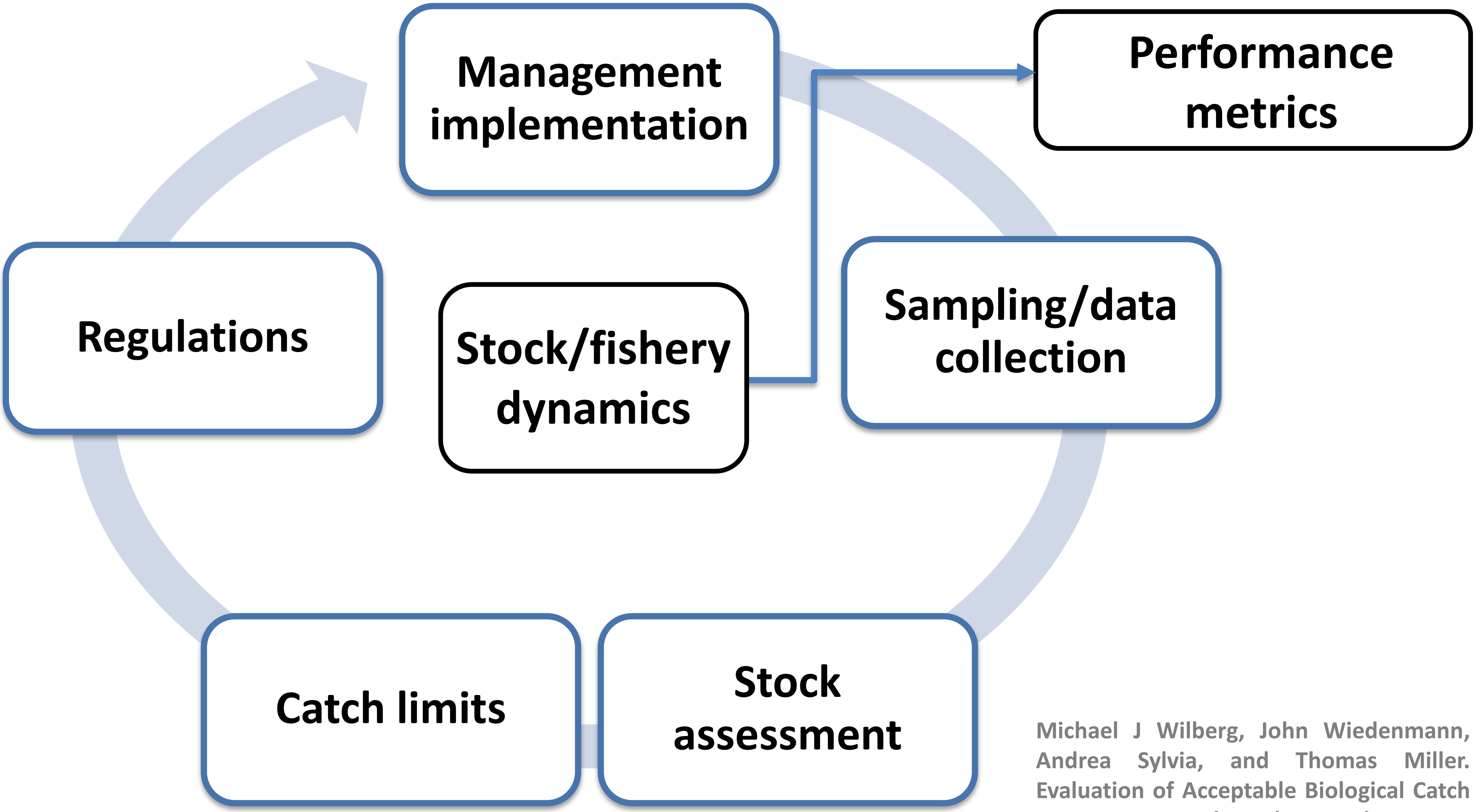


Figure 1: Summer flounder TAC size over time (commercial + recreational, sum for all states)

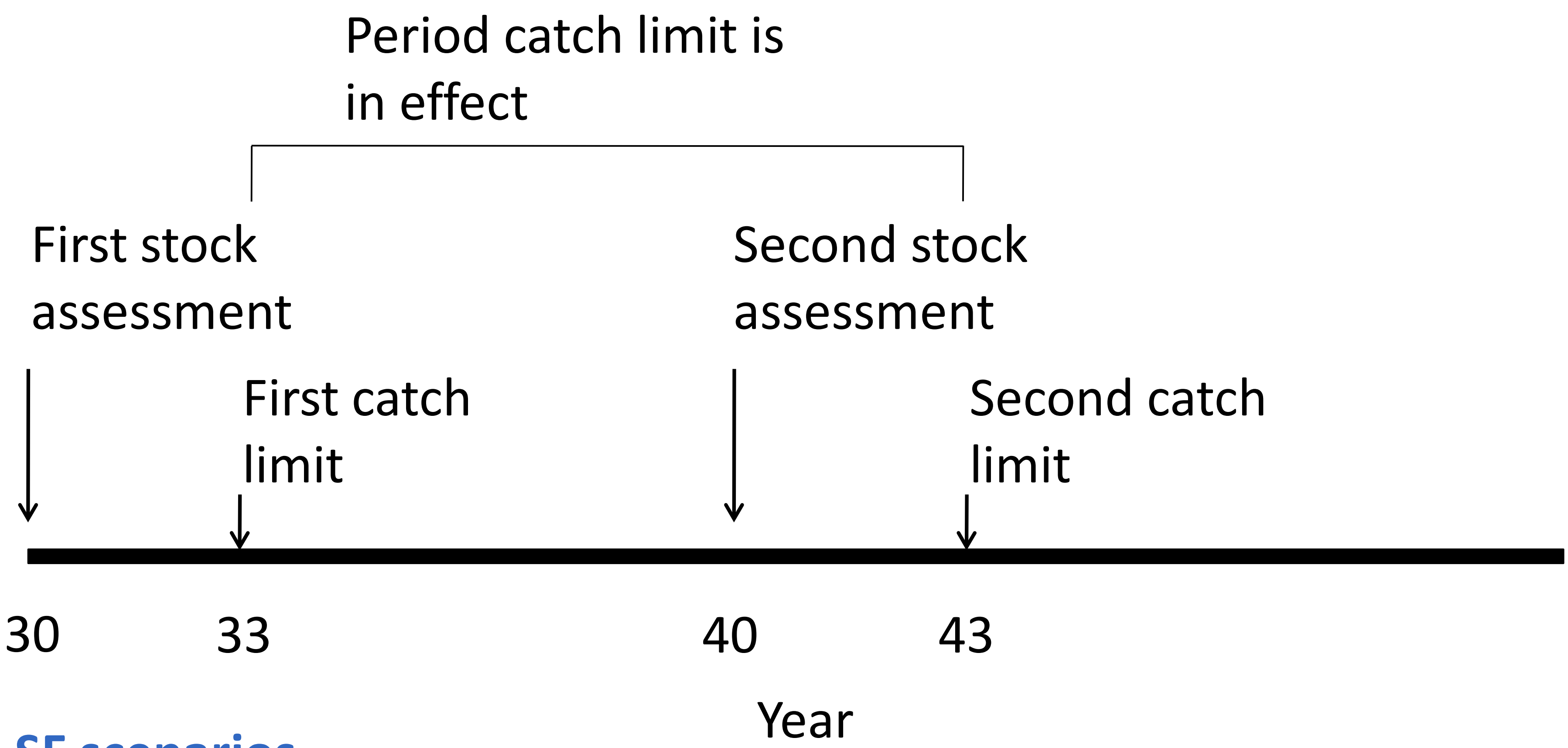
Image: www.greateratlantic.fisheries.noaa.gov

Management Strategy Evaluation (MSE)



Michael J Wilberg, John Wiedenmann, Andrea Sylvia, and Thomas Miller. Evaluation of Acceptable Biological Catch Harvest Control Rules and Factors Affecting Their Performance. WP, 2015.

Example for SA interval =10 years and DML=3 years



SF scenarios

- SA – 1, 2, 3, 4, 5 years
- DML – 1, 2, 3 years

Model variations based on:

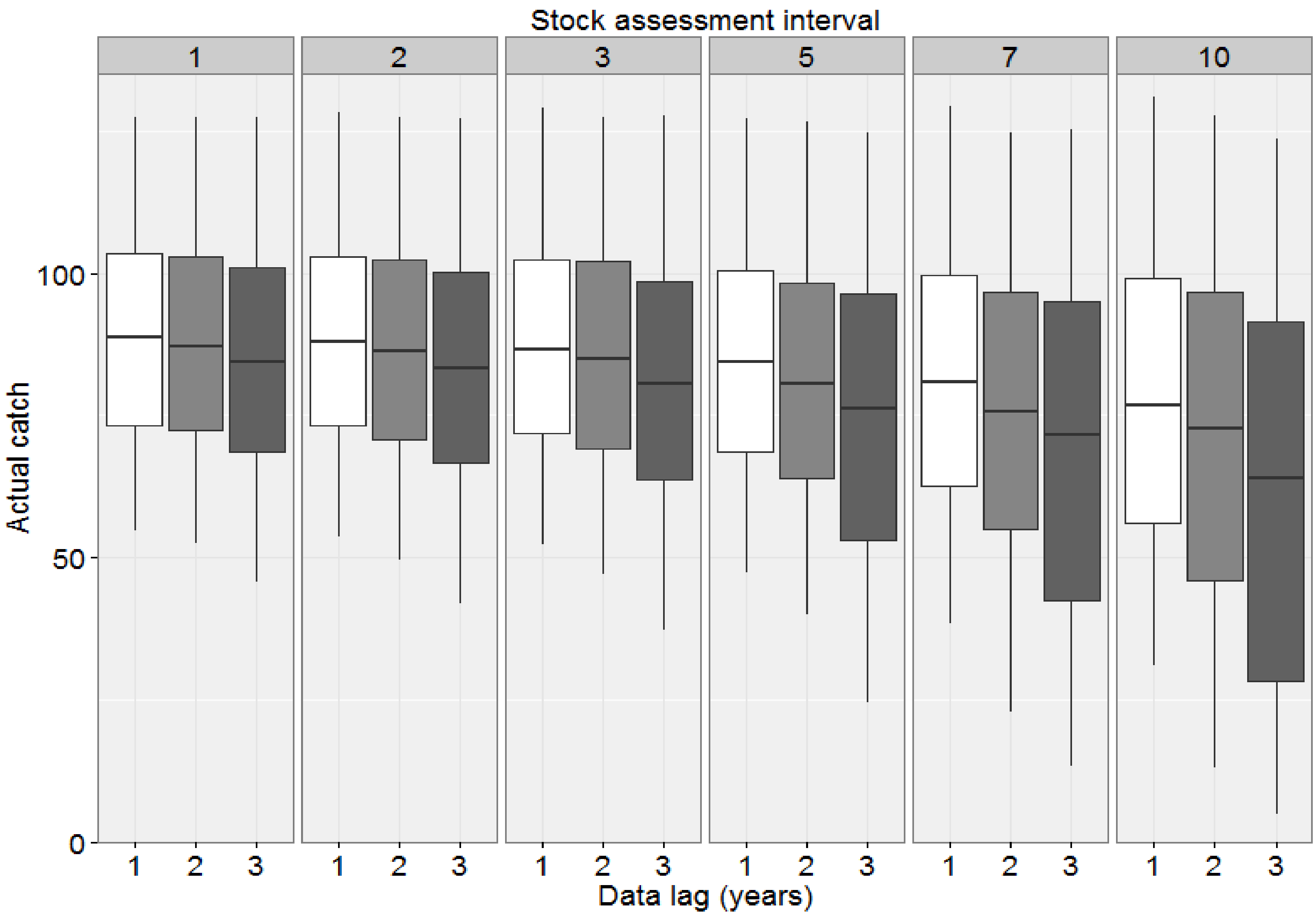
- Life history (slow, medium, long)
- Data quality
- Recruitment variability

Summer flounder adapted version:

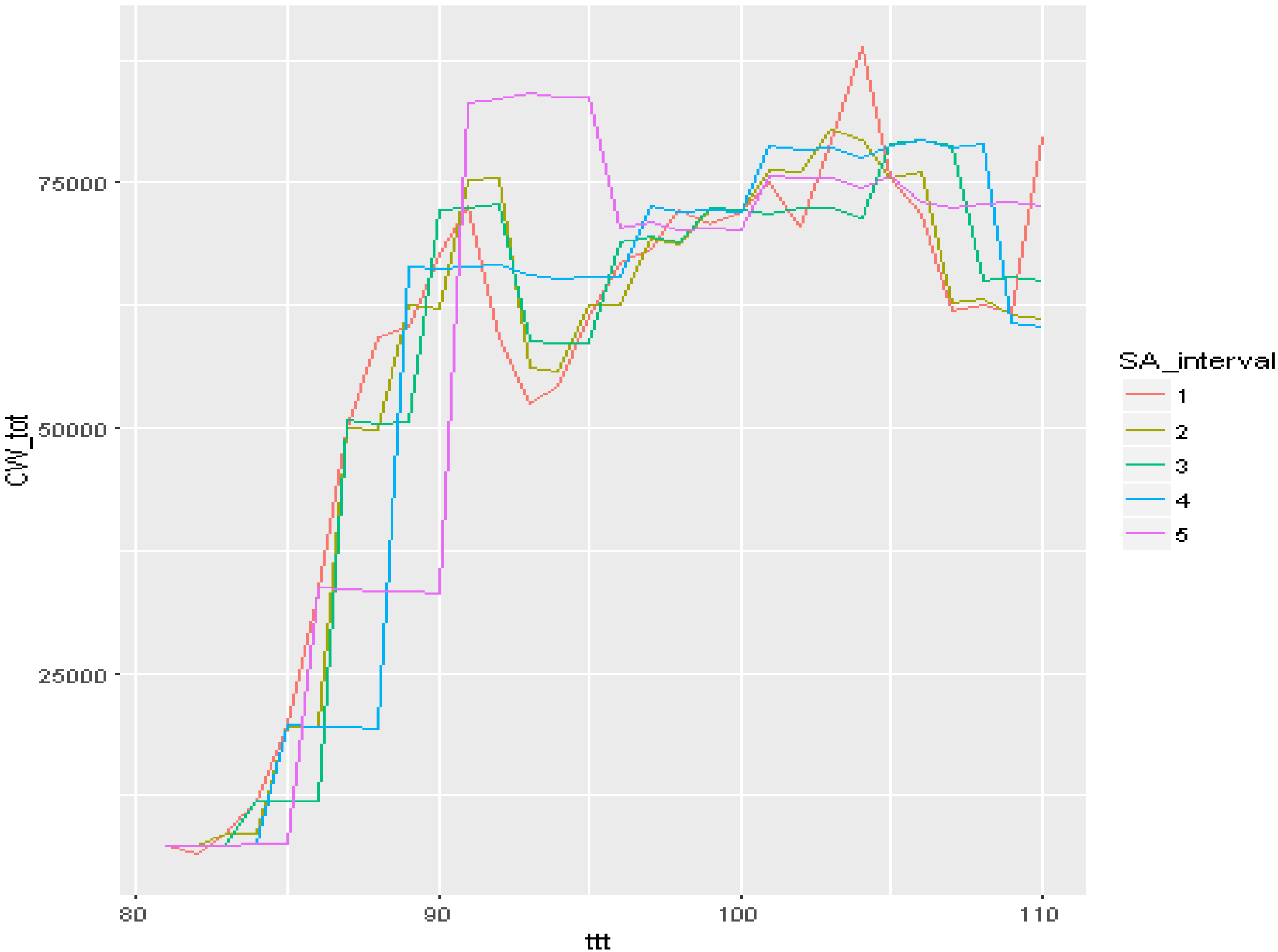
- Adjusted based on observed biomass history


Image: www.nefsc.noaa.gov

Ecological model output example



Ecological model output - iteration

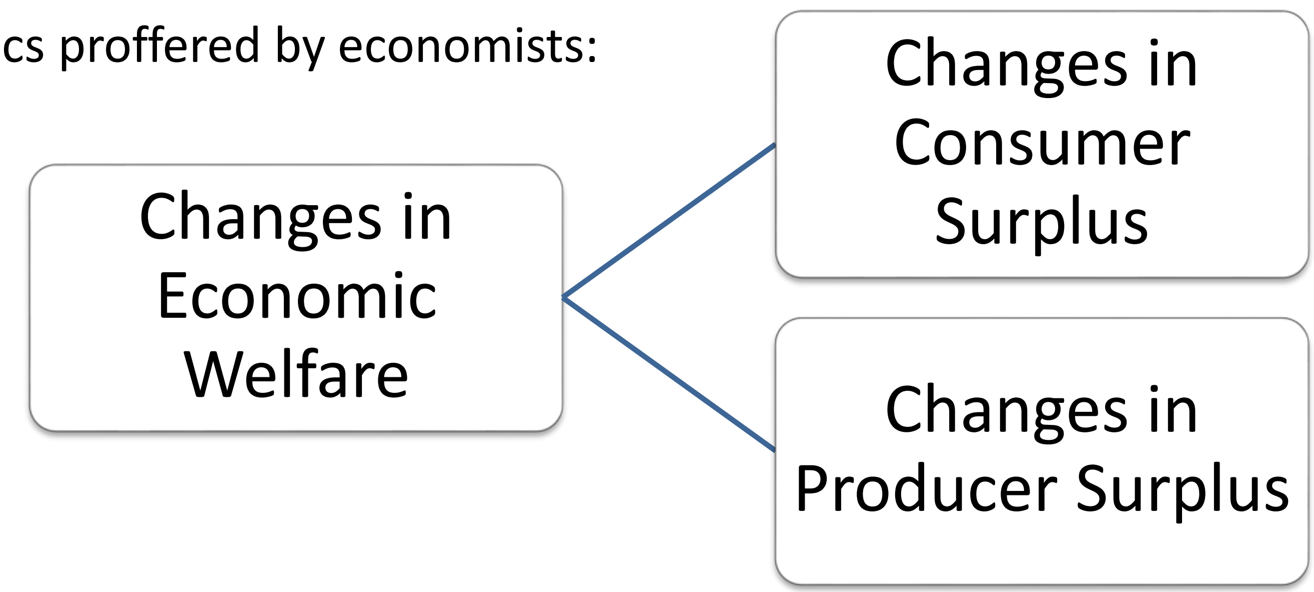


Economic performance metrics

Performance metrics used by biologists/ecologists

- Probability of overfishing
- Average catch and biomass
- Average annual variability of the catch

Performance metrics proffered by economists:



CS – based on Inverse Demand Model

i: - domestic summer flounder

- domestic other flatfish
- domestic groundfish
- imports of flatfish
- imports of groundfish

$$w_{it}\Delta lnv_{it} = \alpha_i + \sum_{j=1}^{n} \pi_{ij}\Delta lnq_{jt} + \pi_i \Delta lnQ_t - \theta_1 w_{it}\Delta lnQ_t - \theta_2 w_{it}\Delta \ln(\frac{q_{it}}{Q}_t) + \varepsilon_{it}$$

Uncompensated price flexibilities evaluated at mean quantities and prices for domestic summer flounder: **-0.228** (p=0.014)

Consumer Surplus

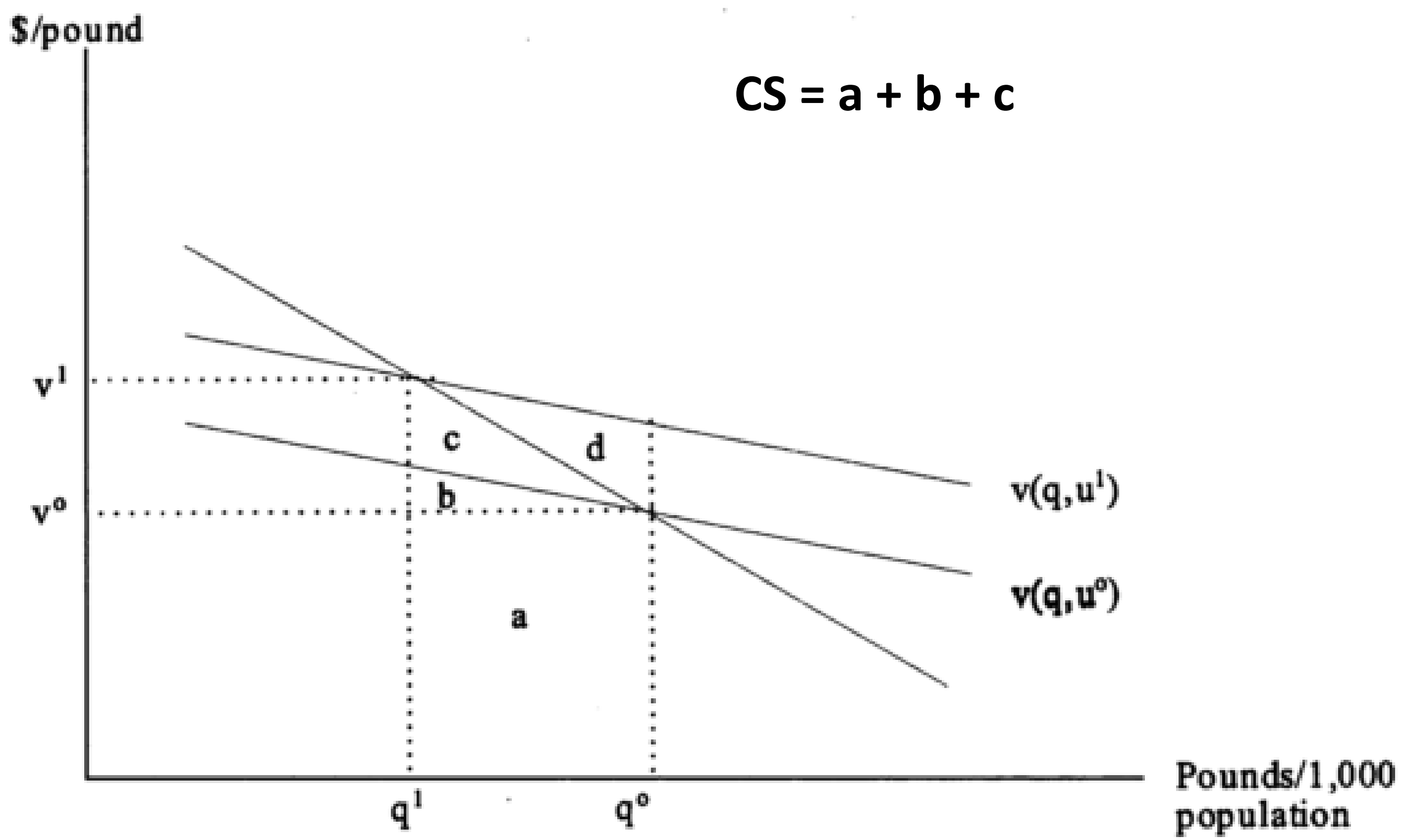


Figure 1: Inverse Demand Curves and Welfare Measures in Inverse Demand System (Kim, 1997; Park, Thurman and Easley 2004)

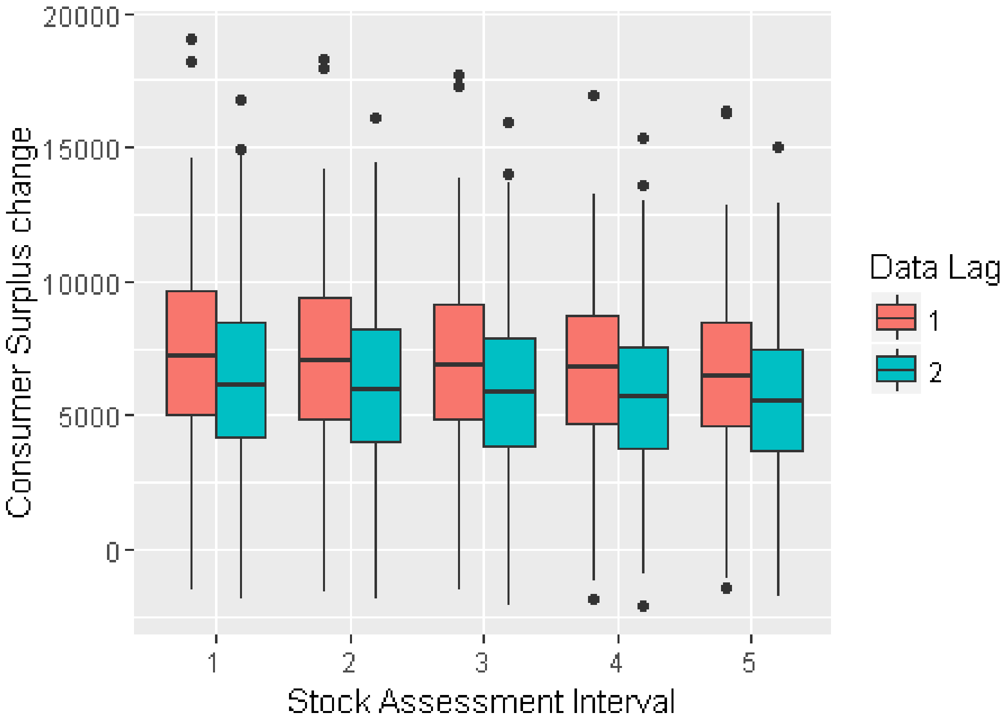
Consumer Surplus results

- Consumer surplus per 1000 East Coast inhabitants in 2014 USD
- Total for 30 years (starting at 2014) discounted at 4% constant rate

For DML=1

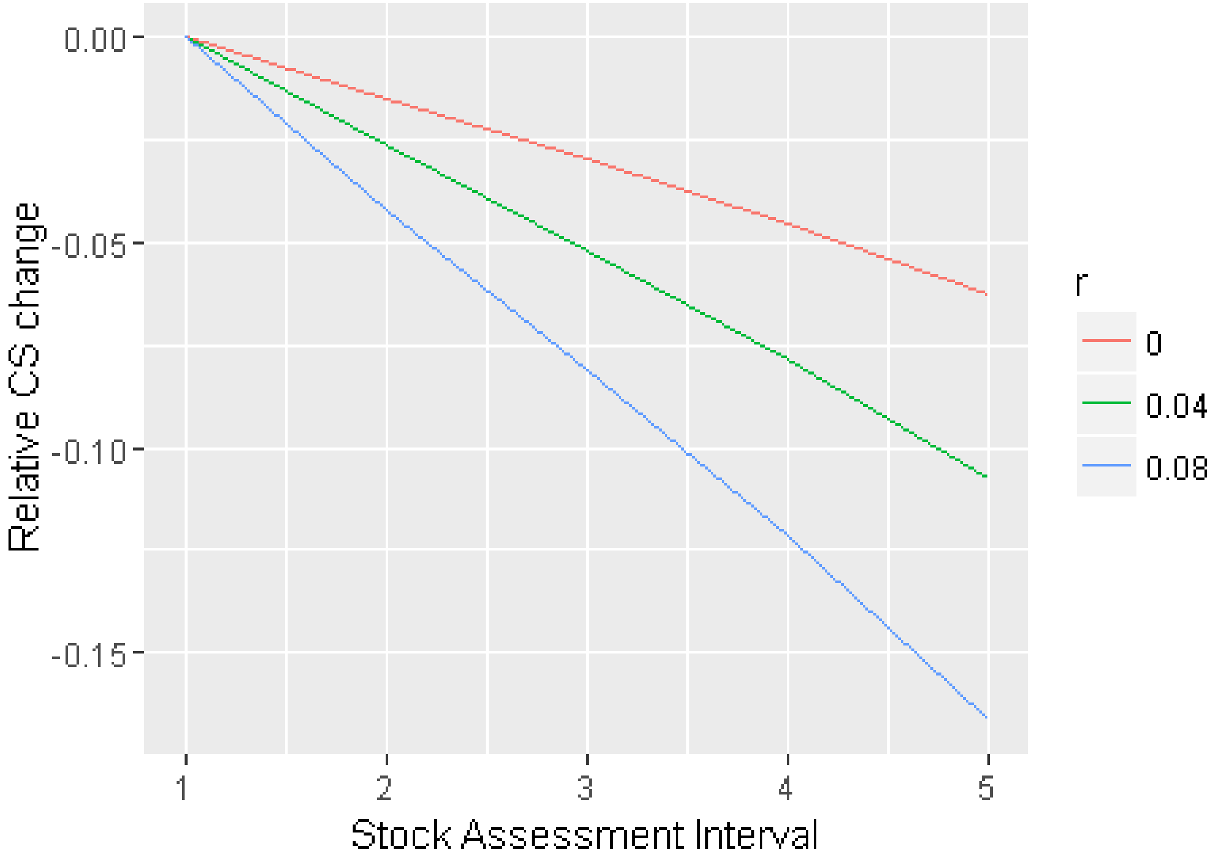
Average decrease: 1.5% per 1 year of increased SA interval

Average decrease is getting higher with



Impact of discount rate

DML=1

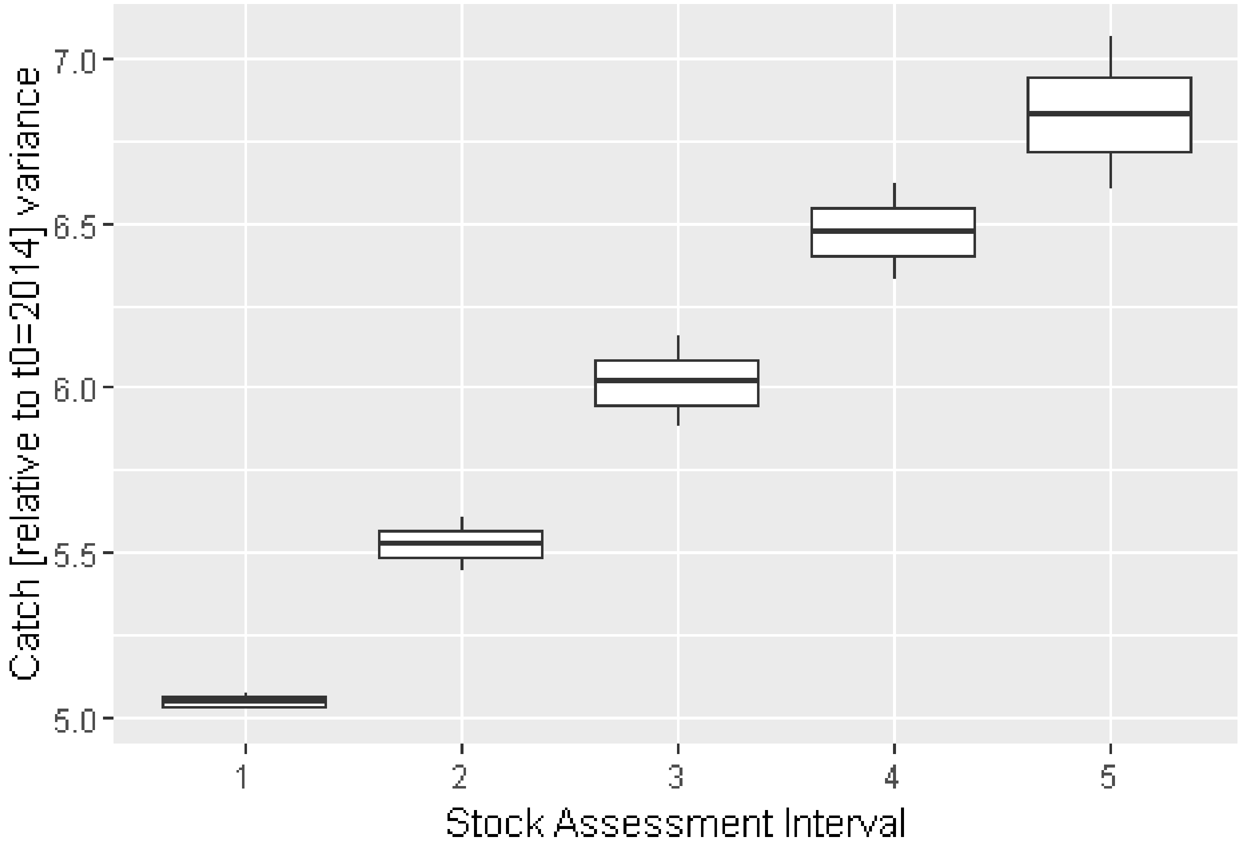


Data lag and stock assessment frequency matter to fisheries management

- For example, each year less between assessments improves CS change by about 1.5%

- Estimation of stock assessment cost for Cost-Benefit Analysis

- Adding capital adjustment cost to analysis



Costly capital adjustment

(Singh, Weninger and Doyle 2006)

Costly capital adjustment, and more generally, diminishing marginal returns to the current period harvest, creates an incentive to smooth the catch over time

The wedge between the purchase and resale price is assumed to result from refitting costs that are incurred when switching between fisheries

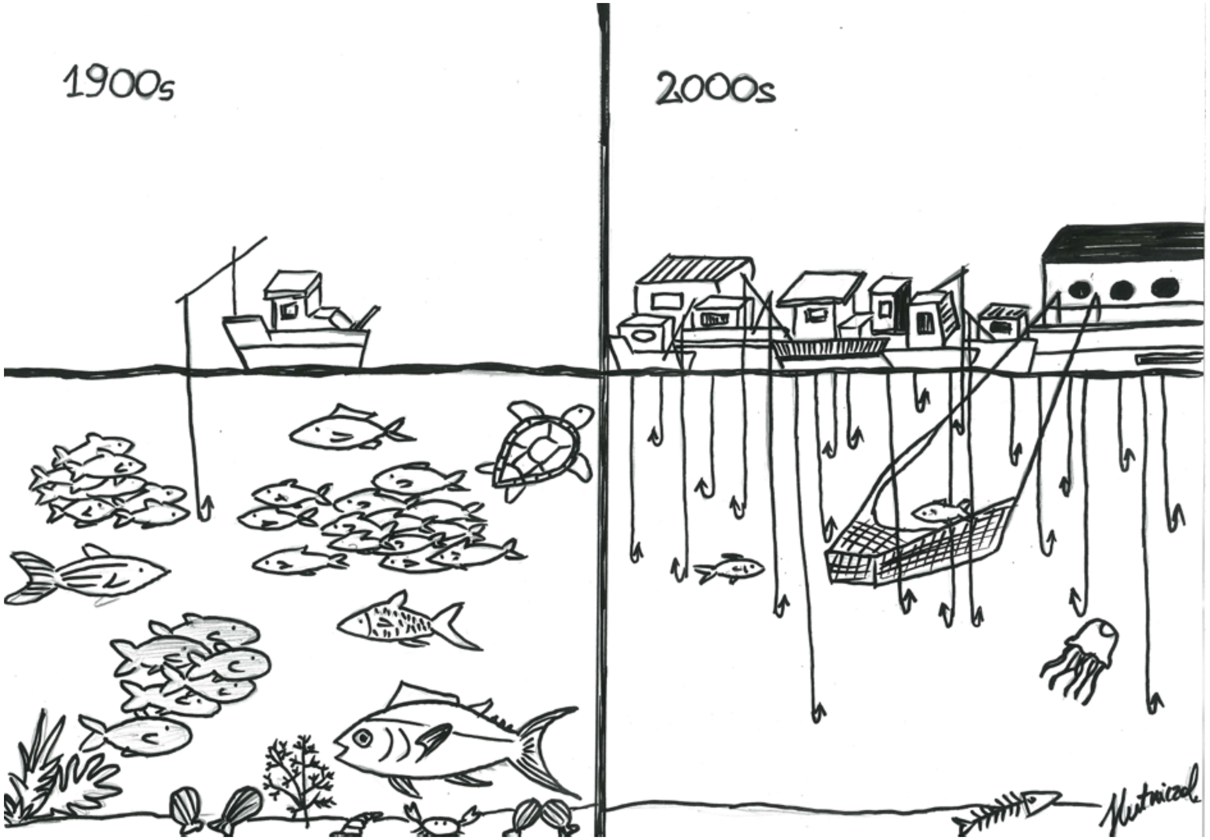
Pacific halibut trawl fishery: 27 000 – 85 000, used 76 500 us (236 500 usd vs. 1600 000 usd)

$$k_{t+1} = (1-\delta)k_t + i_t$$

δ – capital depreciation rate
i – investment

p_k^+ - capital purchase price
p_k^- - capital resale price

$$p_k \begin{cases} p_k^+ \; if \; k_{t+1} > (1-\delta)k_t \\ p_k^- \; if \; k_{t+1} < (1-\delta)k_t \end{cases}$$


1900s
2000s
Hutniczak

	Summer flounder – domestic (G1)	Other flatfish – domestic (G2)	Groundfish – domestic (G3)	Flatfish – import (G4)	Groundfish – import (G5)
G1	-0.228 (0.014)	-0.223 (0.015)	-0.119 (0.013)	-0.230 (0.017)	-0.288 (0.024)
G2	-0.135 (0.009)	-0.443 (0.028)	-0.176 (0.015)	-0.113 (0.018)	-0.317 (0.015)
G3	-0.042 (0.006)	-0.105 (0.011)	-0.318 (0.019)	-0.076 (0.016)	-0.383 (0.013)
G4	-0.073 (0.006)	-0.048 (0.010)	-0.067 (0.012)	-0.376 (0.012)	-0.408 (0.015)
G5	-0.018 (0.002)	-0.027 (0.004)	-0.081 (0.005)	-0.097 (0.004)	-0.765 (0.006)

Table 1: Uncompensated price flexibilities evaluated at mean quantities and prices (standard errors in parentheses, not significant, i.e. p>0.05, in grey).