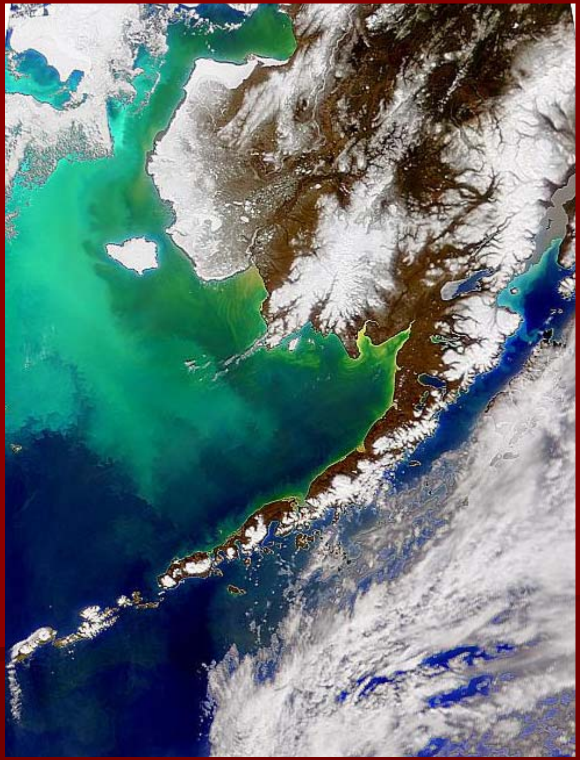
Fisher Behavior with Area Closures & Economic Rationalization



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Overview

- Assessing the costs of a closure
  - How we model fisher behavior
  - Pollock & Steller sea lions
  - Description of modeling approach
  - Predictions & welfare results
- Important impacts of rationalization
- Bio-economic considerations

Defining the problem: Assessing the impact of an area closure

- Historically a number of areas were open to fishing

- Now an MPA or other closure has shut some of these areas to fishing

Defining the problem: Assessing the impact of an area closure

- What do fishers do in response?
- What is the cost of this response?
- Can alternative & less expensive closures achieve the same conservation objectives?

Why go fishing?

- For recreational fishers, it may be scenic views, the best fishing close to one’s favorite bar, etc.

- For commercial fishers, it’s about fish=$$$
  - Note: $$$, not catch alone!

Fishers trade-off catch and costs

- Fishers seek the best combination of biological abundance and access
  - Implies that the area with the most fish may not be fished at all
  - However, with mobile fleets (i.e. "low" travel costs), abundance and concentration will be highly correlated

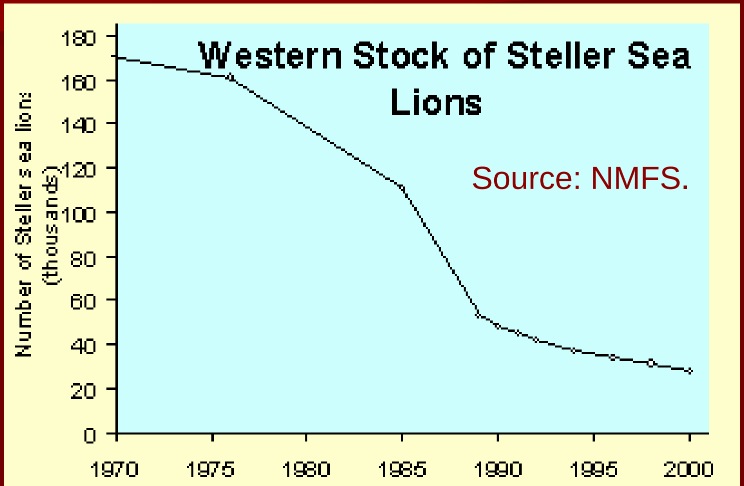
How do we model location choice?

- A fisher makes a discrete choice of a zone
- The zone is chosen as a function of
  - Expected catch/revenue in the zone
  - Travel costs (fuel, time, wages, the opportunity cost of not using the boat elsewhere)
  - Boat characteristics

Pollock

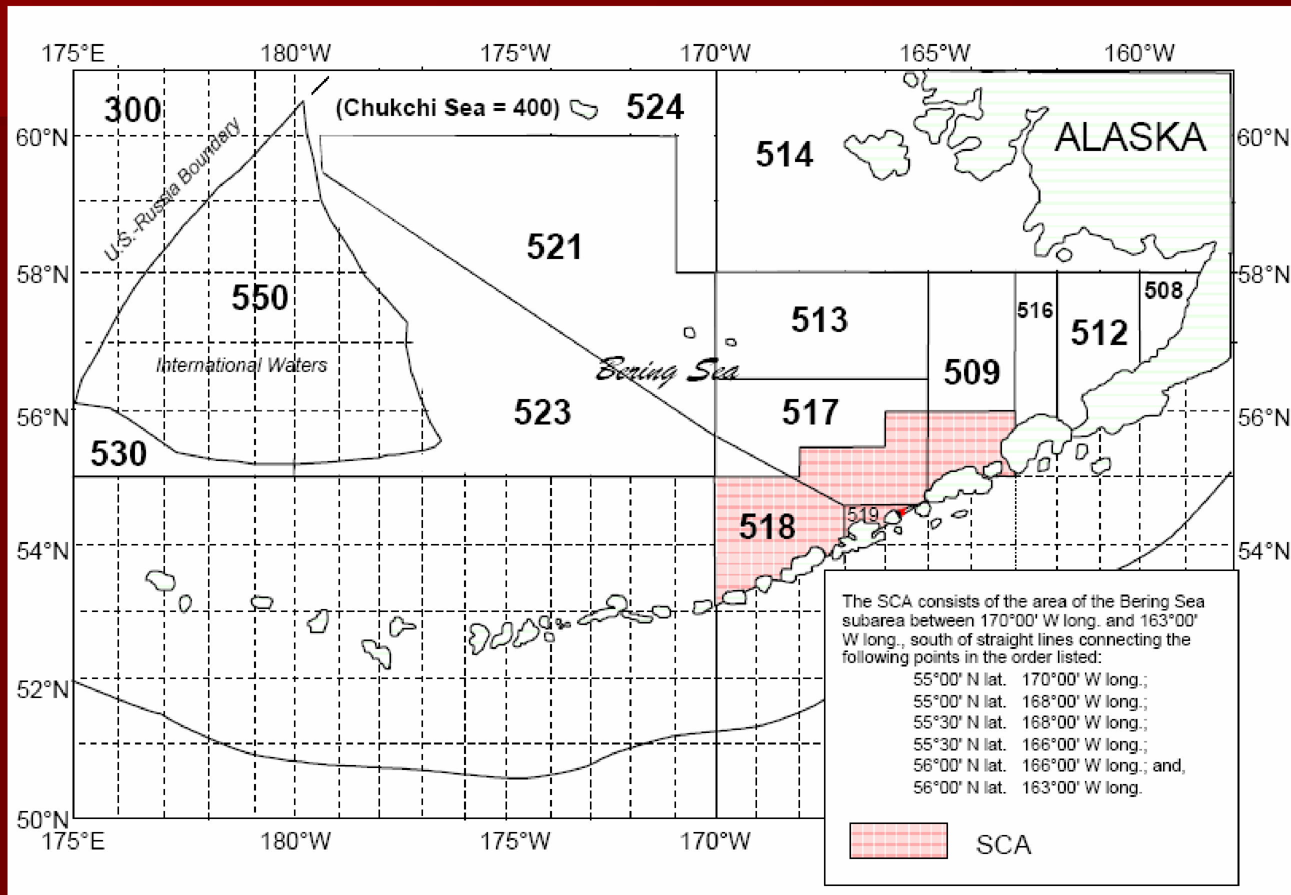
- Pollock make up approximately 30 percent of the fish and shellfish landed in the US
- About 75% of Alaska groundfish fishery

Steller Sea Lions Have Declined



- Stellers declared endangered in 1990

Steller Sea Lion Conservation Area (SCA)



Emergency Closure of SCA put in place in summer 2000.

Standard Discrete Choice Formulation

- Fishers (i = 1…n) choose the zone (j = 1…n) with the highest utility

$$U_{ij} = X_{ij}\beta + v_{ij}$$

- Two-stage expected catch (or revenue) is typically employed

- Usually a conditional or nested logit is employed. For example, for a binomial conditional logit model:

$$\Pr(Y=1) = \frac{e^{\left(\frac{X_{i1}\beta}{\sigma_\varepsilon}\right)}}{e^{\left(\frac{X_{i1}\beta}{\sigma_\varepsilon}\right)} + e^{\left(\frac{X_{i2}\beta}{\sigma_\varepsilon}\right)}}$$

Expected Profit Model (EPM)

- Based on joint work with David Layton at the University of Washington
- Main idea: jointly endogenously estimate expected catch/profit
- Because of the fact that we actually observe prices and because of the separability of the discrete portion of likelihood, all parameters are potentially identifiable.
- The EPM lets us directly estimate how fishermen trade off expected revenues with travel costs

EPM

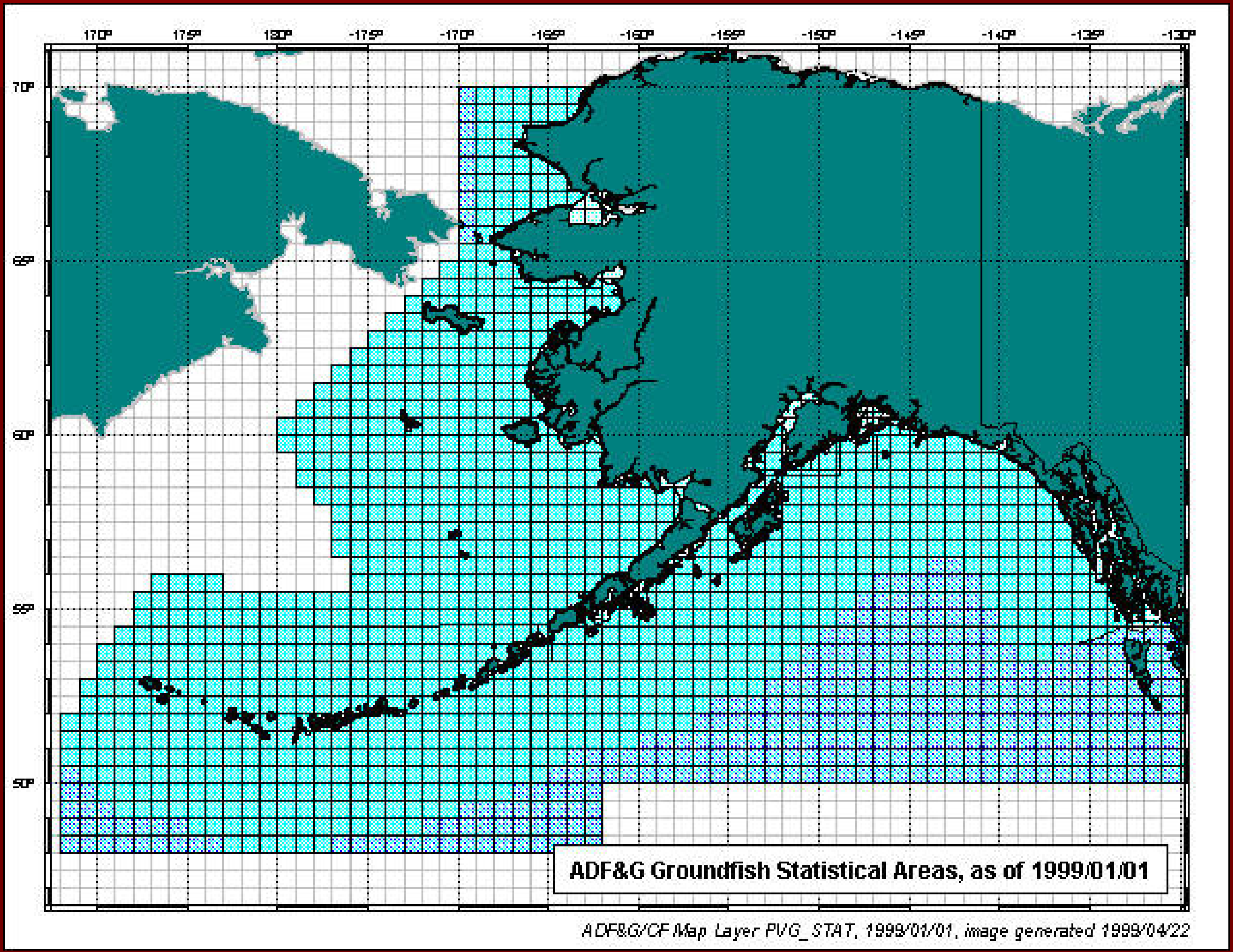
$$\ell_j = \underbrace{\frac{1}{\sigma_{\nu_j}\sqrt{2\pi}} \exp\left[-\frac{1}{2}\left(\frac{Y_{ij} - \alpha_j}{\sigma_{\nu_j}}\right)^2\right]}_{c} \underbrace{\frac{e^{\left(\frac{P_j \alpha_j - X_j \beta}{\sigma_\varepsilon}\right)}}{\sum_k e^{\left(\frac{P_{ik}\alpha_k - X_{ik}\beta}{\sigma_\varepsilon}\right)}}}_{d}$$

- σ_{vj}= zone specific variance in catch
- Y_{ij}= actual catch
- Alphas = endogenously estimated average catch
- X's = miles and boat characteristics
- σ_ε = scale factor on the logit

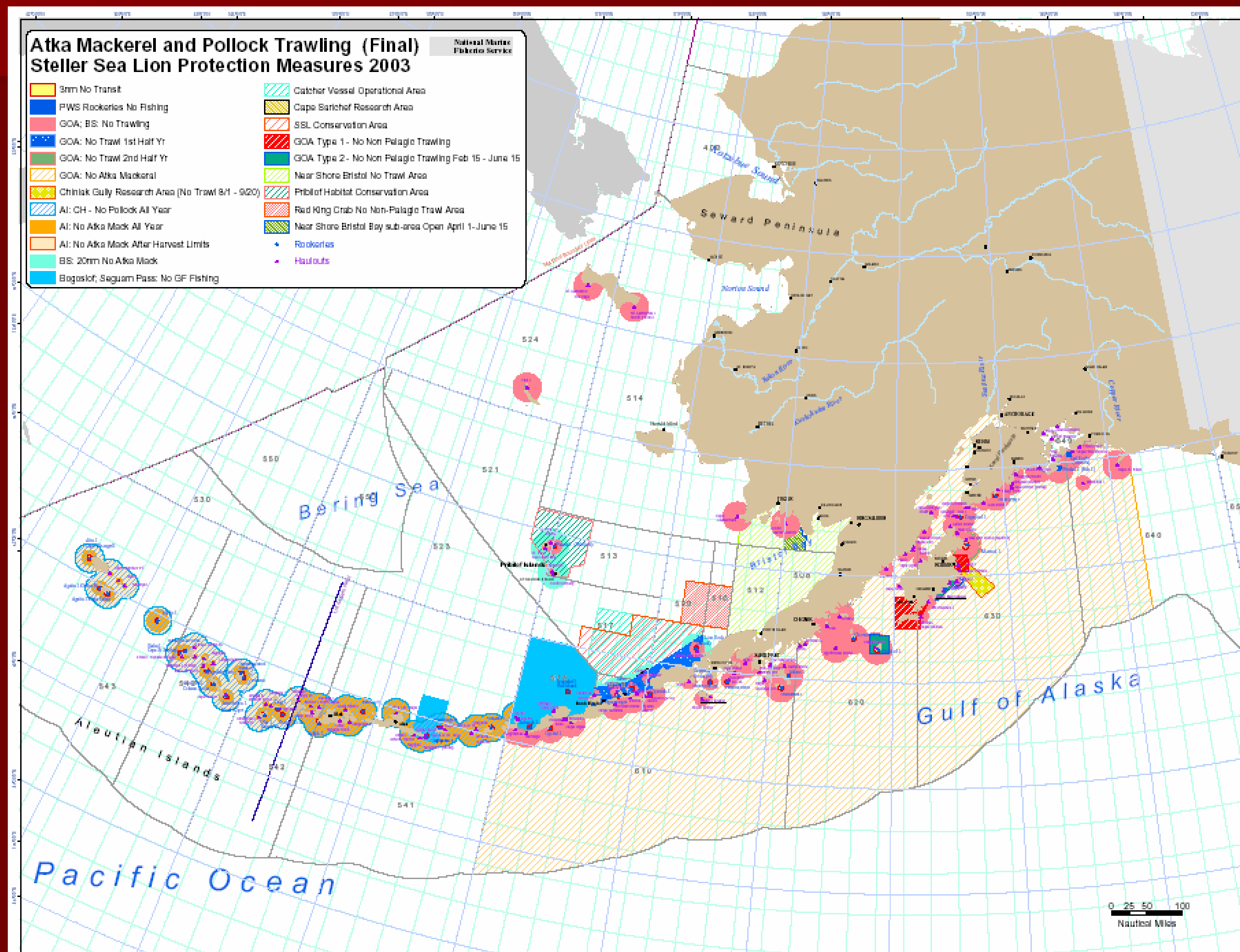
Summary of Data

- Observer data for years 1995-2002 (summer season)
  - Catch and location for all hauls
  - Miles from port to catch sites
- Hauls are used to find centroid and are grouped into discrete half-degree zones (STAT6 areas)
- 1995-1998 data(2265 trips) used to predict impact for 1999-2000 closures and to predict location choice for 2001 and 2002

STAT6 Areas in the Bering Sea



When catch data are at a fine scale, zones can be redefined to any shape or size



Comments on Predictions

- EPM and zonal logit do very well with predictions.
- In-sample predictions are the best, but predictions after the closure was lifted are comparably good.

More on predictions

- Models work very well to predict what will happen in well-fished areas. Predicting what will happen in rarely-visited areas is much more difficult.
  - Fishers choose popular areas because the fishing is good there most of the time.
  - People fish in infrequently fished areas for a wide variety of reasons.

Calculating welfare benefits

- When cost data are available, we have pretty good tools to determine economic impact of a closure (e.g. Curtis and Hicks, Hicks et al.)
- EPM research – can estimate costs by examining how people trade off expected catch and distances throughout a season
- Distributional impacts can be estimated

Estimated costs of the SCA emergency closure

Expected profit or net revenue	**$/Trip**
Before SCA closure	56,420
With SCA closure	50,028
Net loss from closure	6,392
Percentage loss per trip	11.3%

Rationalization Impacts

- Economic restructuring can make spatial closures much less costly
  - Temporal flexibility reduces costs
  - Increased profits outweigh new costs
- Commercial fishers are more accepting of spatial restriction if they gain flexibility in time and product output

Key Impacts of Pollock Cooperatives

- Limitation of number of vessels in fishery
- The end of "the race for fish" or "Olympic fishery"
- Large focus on producing value from fishery
  - Goal of fishers moves from catching as many fish as possible to maximizing the $ per fish

Net results of SCA and Pollock rationalization

- Large increase in value from the fishery
- Combing MPA development with economic restructuring can increase marine protection *and* make fishermen better off
  - Though the emergency closure was lifted and current restrictions are less costly.

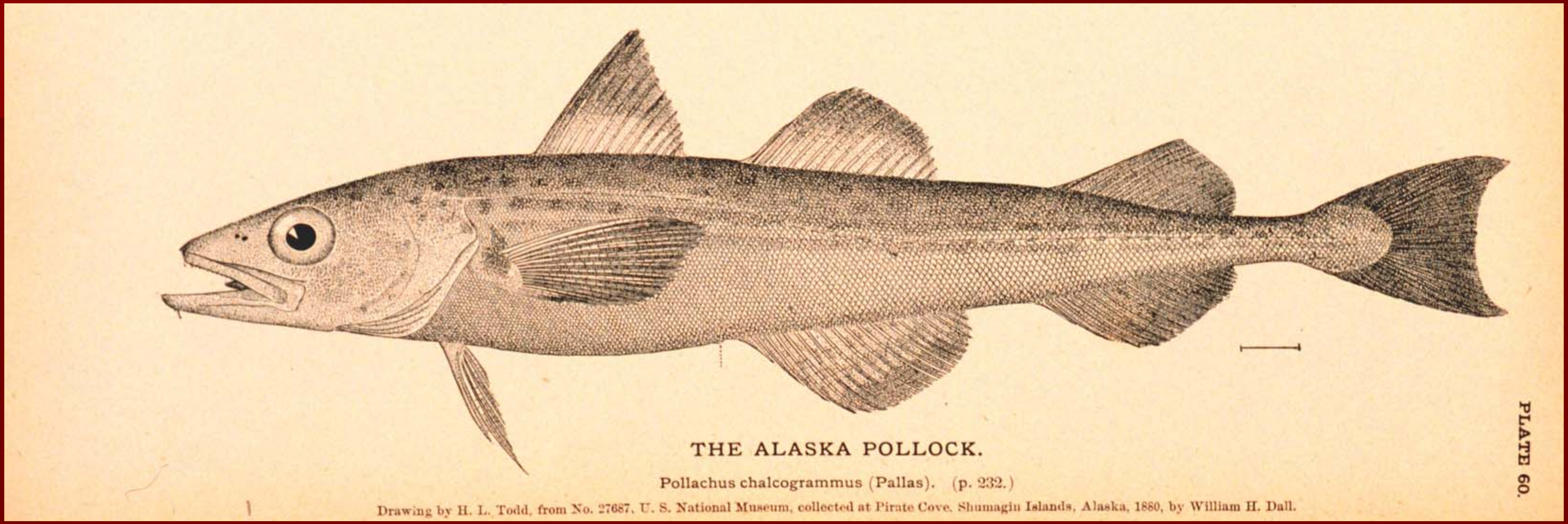
Integration with biological models

- Bio-economic models can be made for sessile species
  - We can assess the biological impacts of fleet reallocation in response to a closure
- Seasonality is an important factor
- Including economics can change the expected biological impacts of marine reserves (Smith; Smith and Wilen 2003)

One punch line: important data for this type of analysis

- Spatial catch data at a high degree of resolution
- Price data
- Trip-level data
  - Port of departure and landing
  - Time of travel
  - Distance
- Ideally, trip level cost data!!!

The End



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