

Science, Service, Stewardship



A tale of two fisheries: Climate change and fisher behavior in the Bering Sea pollock trawl and BSAI Pacific cod longline fisheries

Presentation summary

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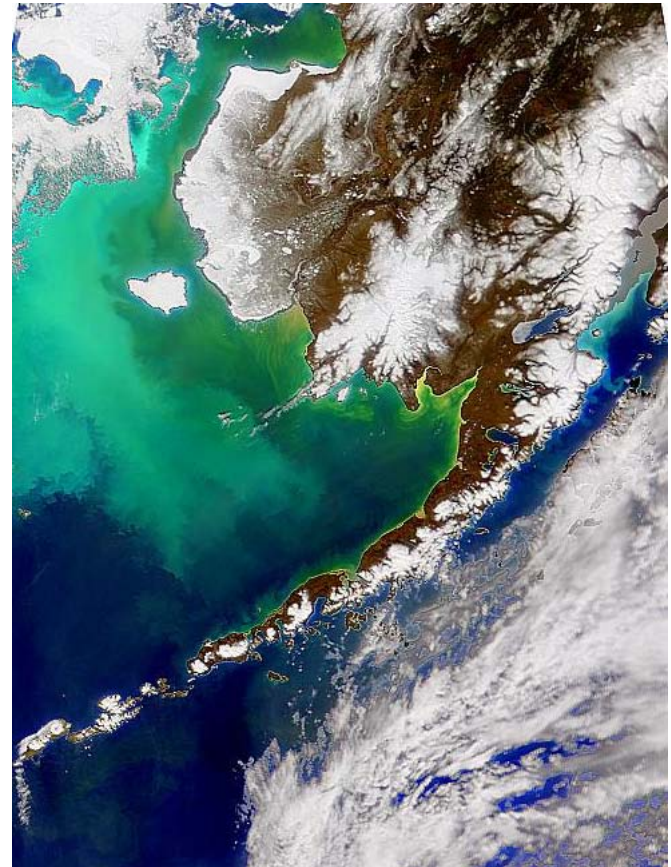
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Introduction

How climate affects *fisheries* is not necessarily the same as how it affects fish.

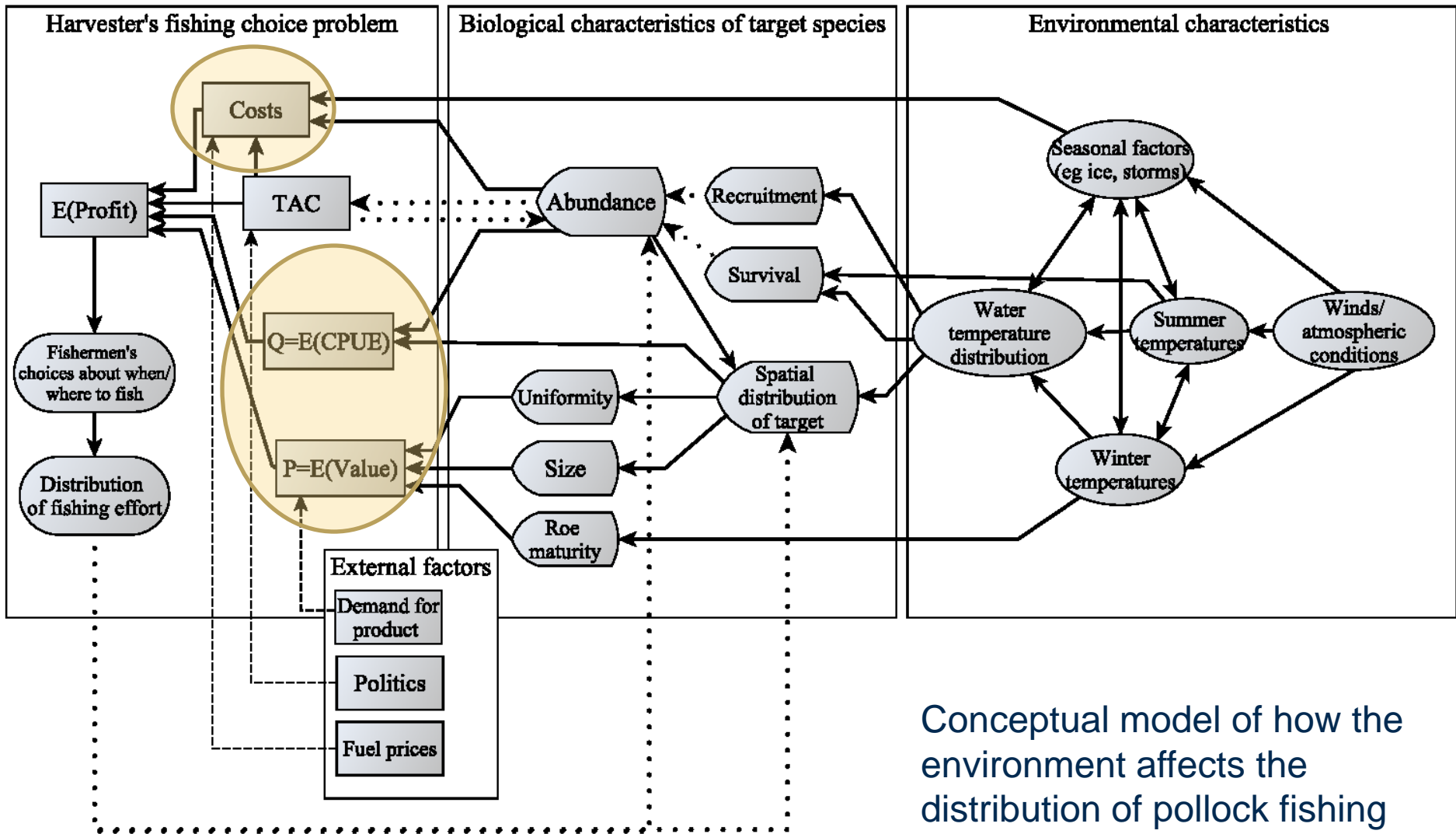
How do observed differences in climate variation impact the Bering Sea pollock fishery and the Bering Sea Aleutian Island Pacific cod fisheries?



Background: Fishery Details



| | Pollock trawl | Pacific cod longline |
|---------------------------------|---------------------------------|--|
| Vessel length | 201-367 ft (61-112 m) | 98-196 ft (30-60 m) |
| Average days in a trip | 14 days | 16 days |
| Average trip distance | 2 085 km | 1 915 km |
| CPUE | 41 mt/hr | 0.62 mt/hr |
| Revenue/day (mean of 2002-2009) | | |
| Winter A season | \$315 390/day | \$39 337/day |
| Summer B season | \$206 572/day | \$24 186/day |
| Management | Cooperative since 1999 | Cooperative since 2010 B season |
| Products | Fillet, surimi, roe, byproducts | Headed and gutted (“eastern” and “western” cuts), byproducts |

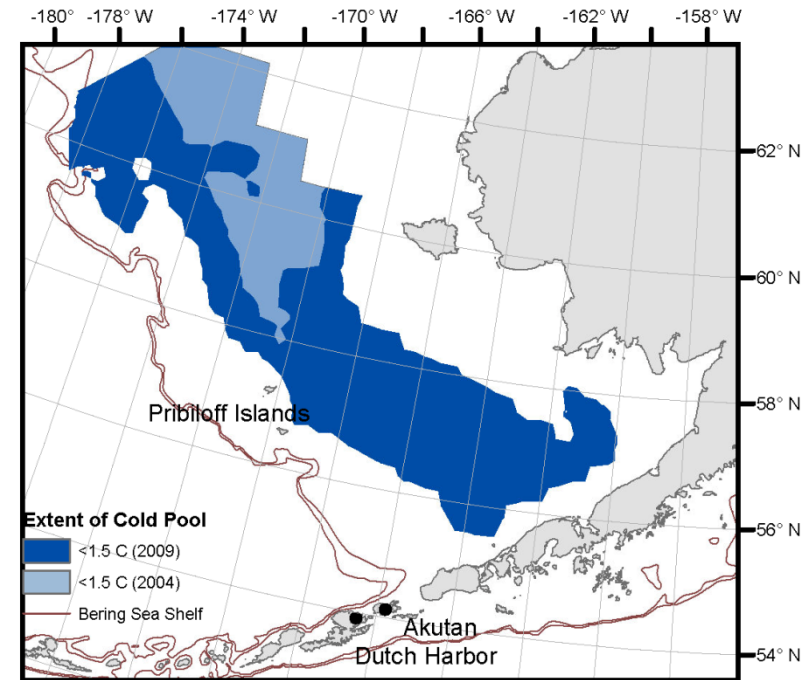


Conceptual model of how the environment affects the distribution of pollock fishing effort. (from Haynie and Pfeiffer *ICES J. of Mar. Sci.* 2012). 4



Background on the climate of the Bering Sea

- The extent of winter ice varies by year. Ice retreats in Apr-May, but it leaves behind a pool of Arctic (<1.5 deg. C) water.
- Pollock and Pacific cod are subarctic species, and avoid the cold pool waters.





What influences where and when vessels fish?

Commercial fisheries attempt to maximize profits, which are a function of an *individual vessel's*:

1. Expected catch-per-unit-effort (**CPUE**) – where are the fish are likely to be located?
2. **Prices** (and relative prices for different species)
3. Fishing **costs**.

Management institutions impact how vessels trade-off CPUE, prices, and costs

- In fisheries with individual quotas vessels attempt to maximize \$/ton of fish.
 - Fishers target value/fish
- In fisheries with common-pool quota fish not caught by a vessel on a day of search or travel is shared with others in the fleet.
 - Fishers attempt to maximize \$/day and place more emphasis on CPUE (especially when catch history may impact future quota allocation).

Catch per unit effort (CPUE): Cold pool causes increase in North/South ratio of CPUE, driving effort north in cold years

- Cod CPUE was highest during the cold years which had low abundance
 - Provides confidence that high CPUE was due to cold pool, not increased abundance
- Pollock CPUE ratio (north to south) was highest during cold, low abundance years; it is difficult to tell if the low CPUE in the south was due to low abundance or a large cold pool

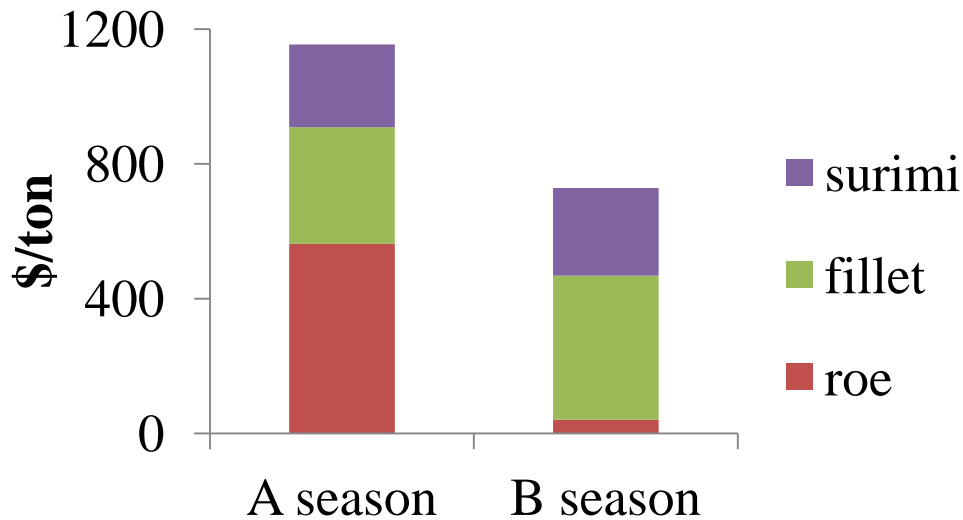


Prices: pollock vessel response to fillet and surimi price variation

- Fish from the north are *more* likely to be processed into surimi
 - Surimi was *less* valuable (/MT catch) in the pre-2005 period
- Value penalty from fishing in north pre-2005 increased the propensity to fish in southern regions
- Surimi prices have increased, leading to increased value of fish caught in the north.



In the winter season, pollock fishers target valuable roe



Fishers trade-off roe recovery rates and roe value to maximize net economic benefits.

- Pollock catcher processor mean seasonal center of effort

- Changes in ice cover have little impact on the spatial extent of the pollock fishery because vessels target valuable roe located in the south (Pfeiffer and Haynie 2012 *ICES*, in press).

- Cod catcher processor mean seasonal center of effort

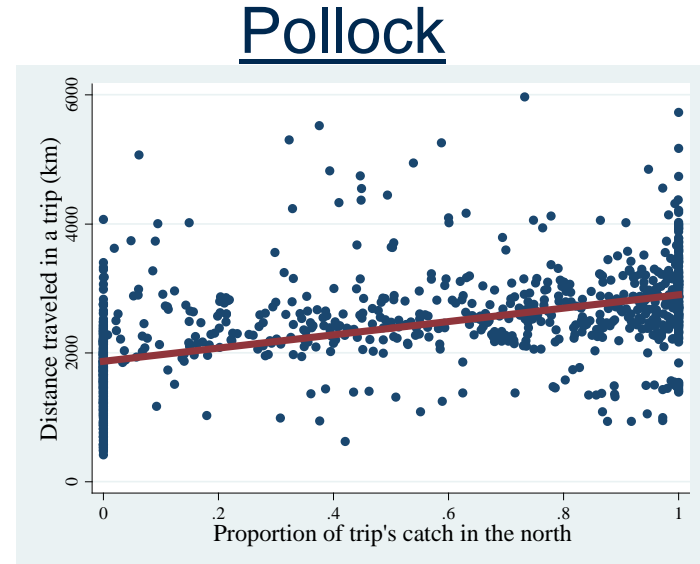
- Observed northward shift in winter Pacific cod fishery that is positively correlated with the ice extent.

- No such statistically significant relationship exists in the summer season.

Costs: Trip length – Climate impacts

Pollock fishery: trip

length \uparrow in colder years
because change in
CPUE ratio causes more
fishing in north



Pacific cod fishery: more fishing in the north in colder years, but fewer moves

- The effect of fewer moves is stronger; total distance traveled is smaller in cold years.

Summary



- Catch rates, fishery-specific fishing behavior, and prices all impact how fishers respond to changing climate.
- Management matters!
- Cold years lead to higher CPUE and more fishing in north, except in the pollock winter roe fishery.
- Fisheries with large spatial differences in prices are more likely to target value and to be less responsive to changes in CPUE.

What should we expect for pollock under future, warmer climate conditions?

- Roe value will keep winter fishing in the south unless there is a change in spawning grounds.
- In the summer, there has been a shift of fishing to the north, but abundance and temperature both impact this
 - Significant uncertainty about future because we have not observed warm, low-abundance periods.
 - More data should be informative.

What should we expect for Pacific cod under future, warmer climate conditions?

- Warmer years have higher travel costs and lower CPUE after controlling for abundance.
- Cooperative fishing began in summer 2010 and we expect that there will be increased targeting of different sized fish in response to changes in product price differences.
 - The fleet will be able to adapt in different ways because of the flexibility that cooperatives provide about when to fish.



FishSET -- Spatial Economics Toolbox for Fisheries

- This is a project led by NOAA Fisheries that will provide improved tools to analyze & predict how fishermen respond a changing environment and fisheries management actions.
- Behavioral economic models in FishSET come from the robust fisher location choice literature which has evolved steadily since the first papers in the early 1980's
- FishSET will make it considerably easier to test hypotheses about how climate affects fisheries.



Thank you. Any questions?

