

# Economic Risks to Alaska Communities from Ocean Acidification

Steve Colt

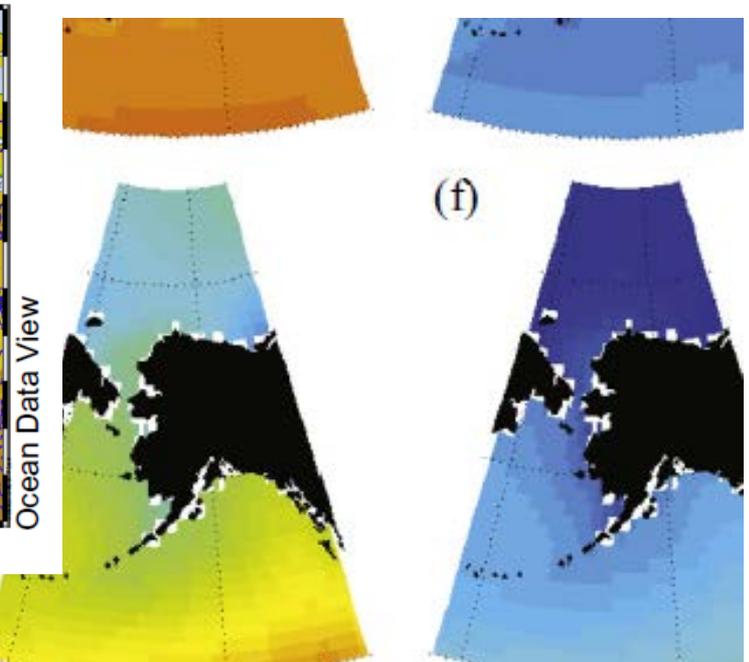
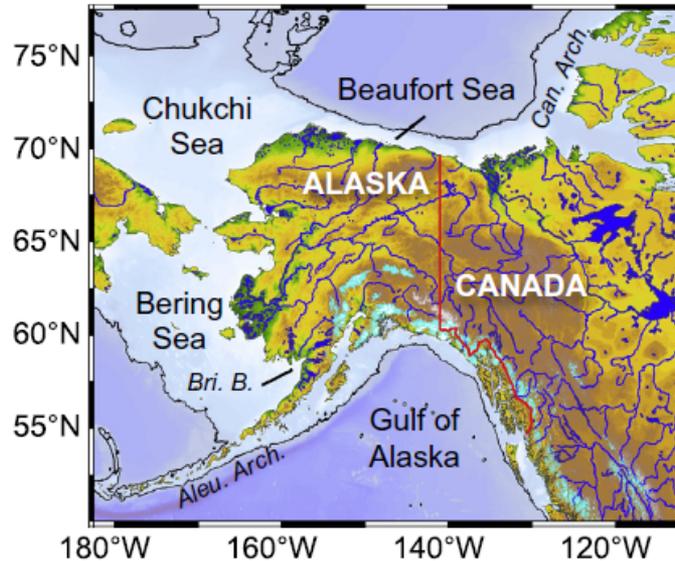
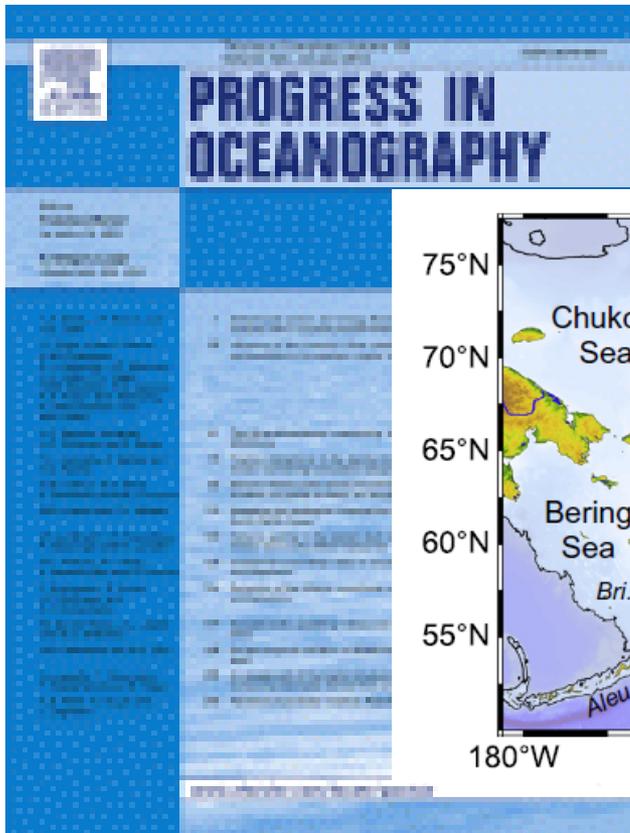
Institute of Social & Economic Research  
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Ocean Acidification Symposium  
Anchorage  
December 2, 2014

# These slides based on:

Mathis, J.T.; Cooley, S.R.; Lucey, N.; Colt, S.; Ekstrom, J.; Hurst, T.; Hauri, C.; Evans, W.; Cross, J.N.; Feely, R.A. 2014. Ocean Acidification Risk Assessment for Alaska's Fishery Sector.

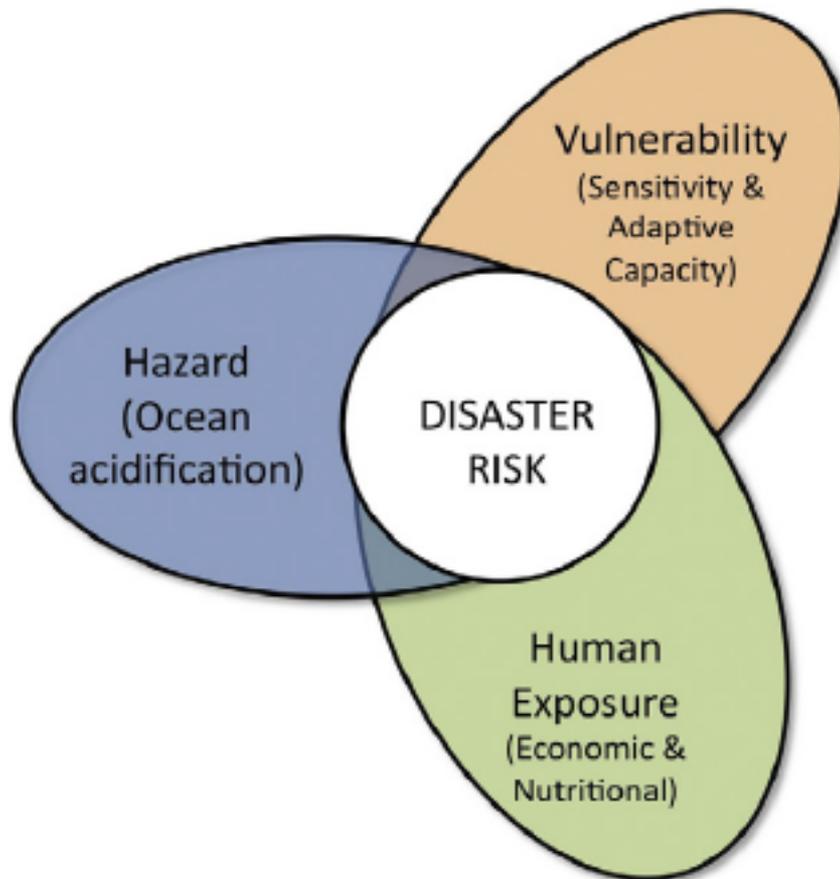
*Progress in Oceanography* (2014), doi: <http://dx.doi.org/10.1016/j.pocean.2014.07.001>



# Outline

- What do we mean by risk?
- How are we measuring risk?
- Components of the OA Risk Index
- Results
- Two surprises

# What do we mean by risk?



Consistent with IPCC SREX (2012)

# How are we measuring risk?

Construct an index:

*Hazard x Exposure x Vulnerability*

where,

*Vulnerability = Sensitivity x Adaptive Capacity*

follows IPCC Working Group 1

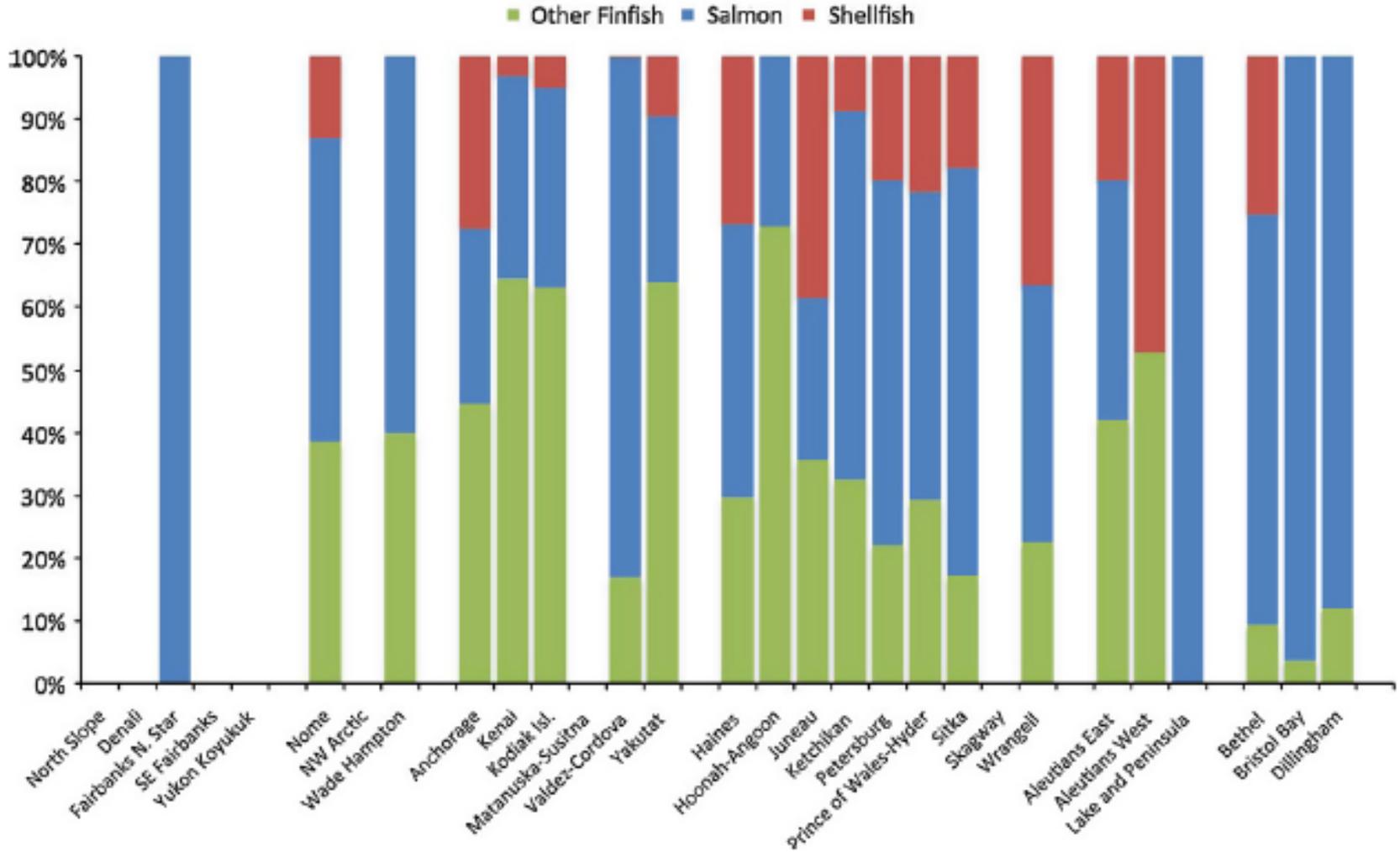
Hazard  $\sim$  chemistry

Exposure  $\sim$  OA susceptible share of commercial  
and subsistence fisheries

Vulnerability  $\sim$  fishery share of economy and “ability to cope”

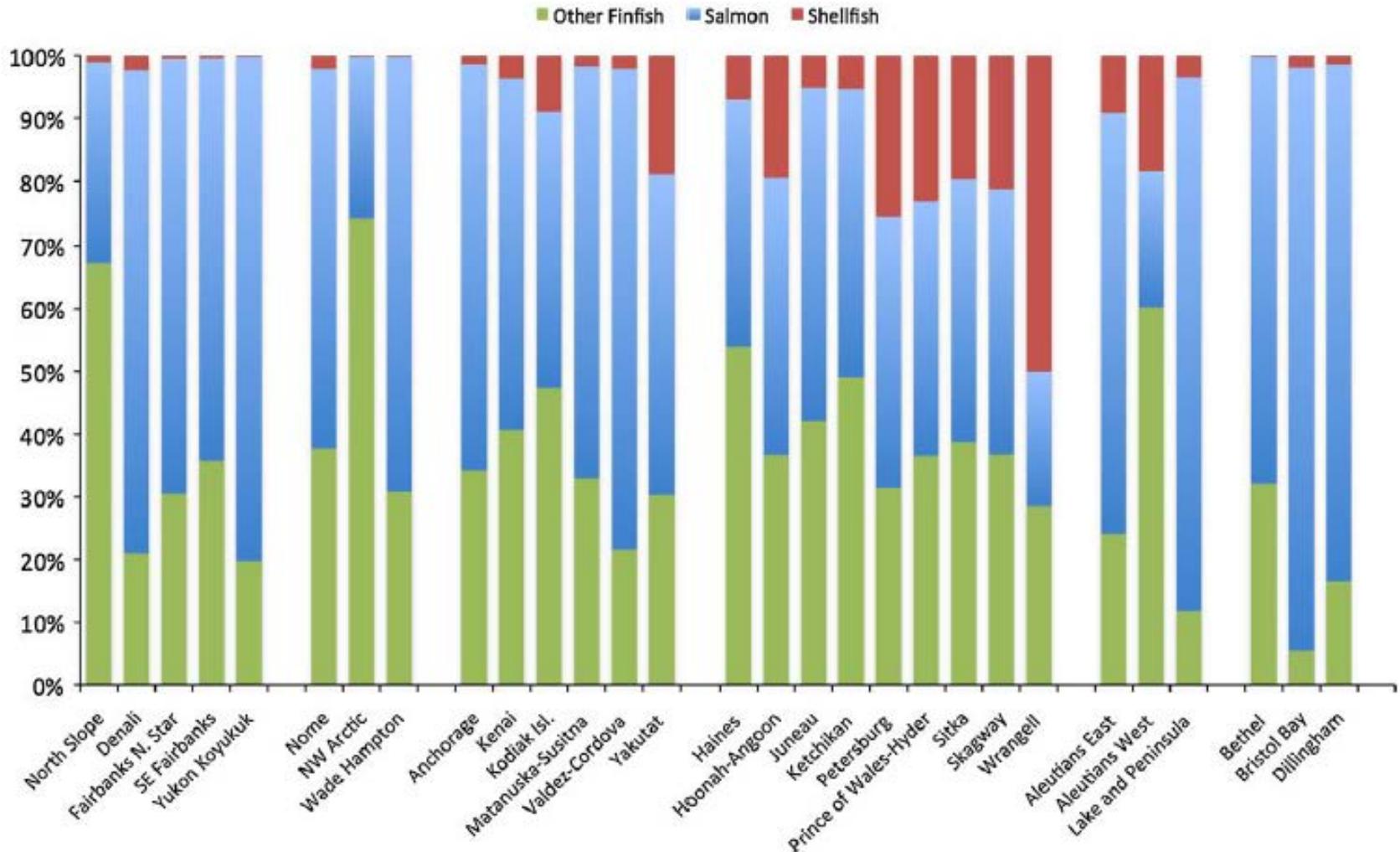
# Why does risk vary?

Commercial harvest revenue estimates, 2011

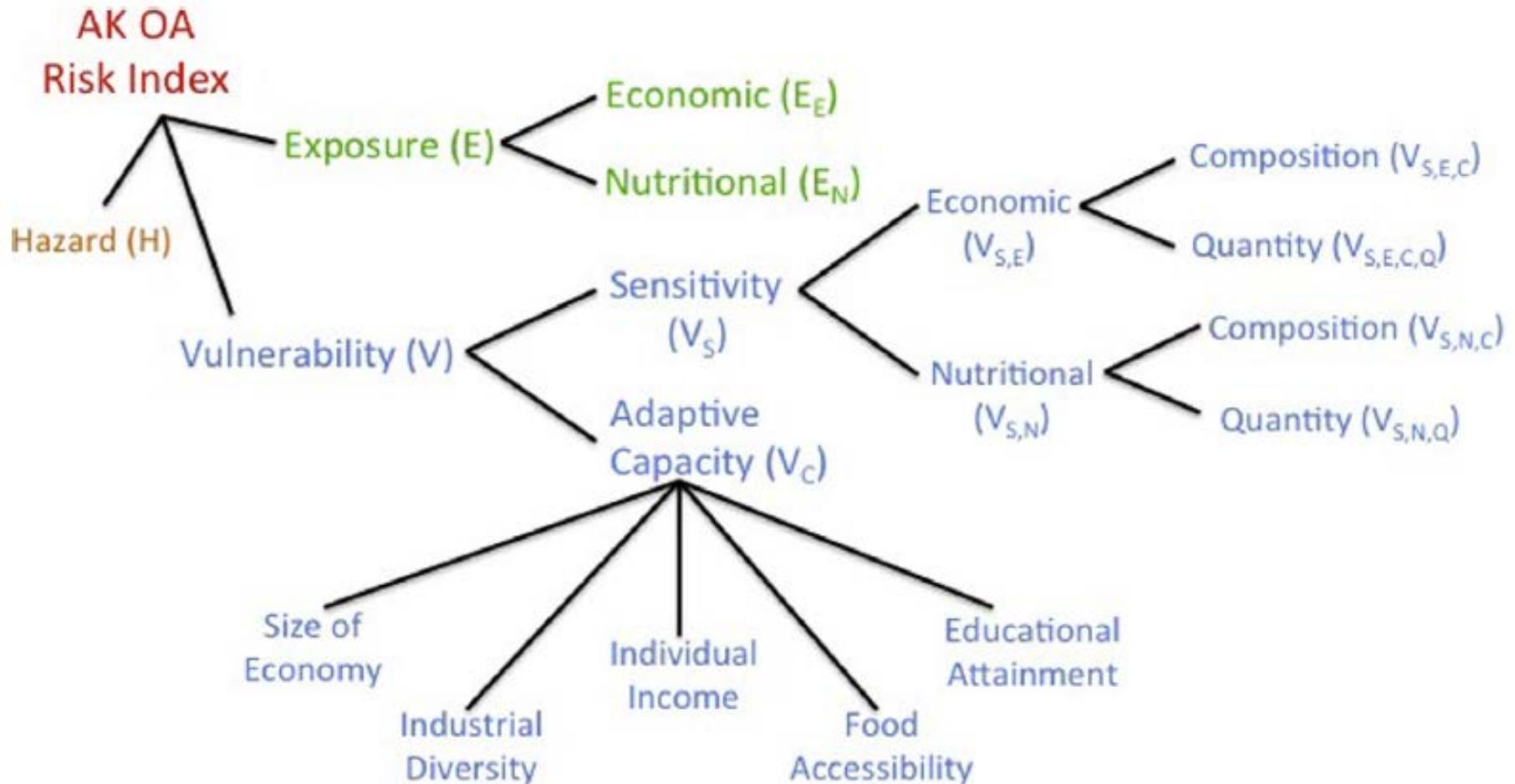


# Why does risk vary?

Subsistence catch composition, by weight



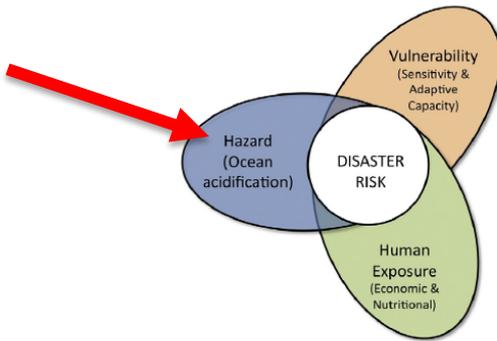
# How are we measuring risk?



Heavy use of quartiles

Everybody Got  
it?

(that's a joke: any  
index is a somewhat  
arbitrary combination  
of variables)



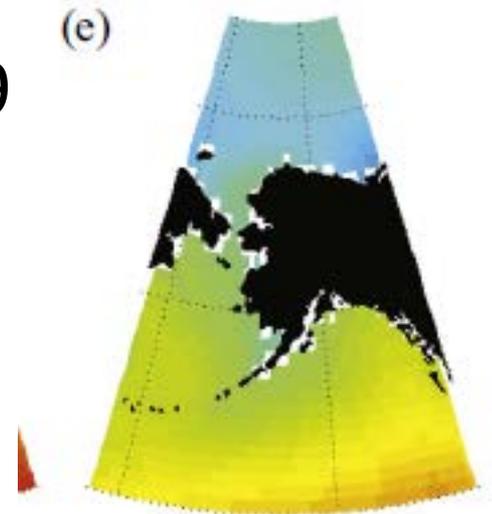
Consistent with IPCC SREX (2012)

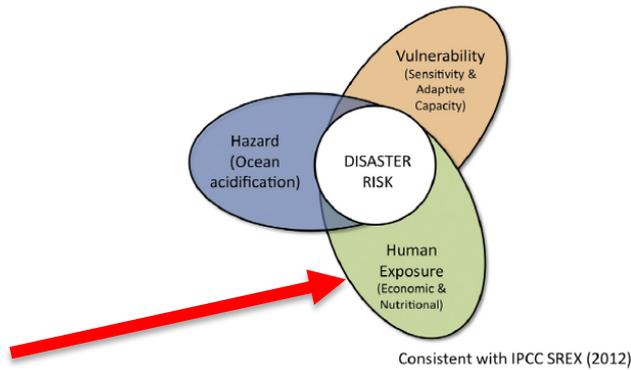
# Hazard

For four ocean regions (Gulf of AK, East Bering Sea/Aleutians, Chukchi, Beaufort),

Projected decrease in decadal mean aragonite saturation state ( $\Delta \Omega_{\text{arag}}$ ),

Between 2003-2012 and 2090-2099





# Exposure

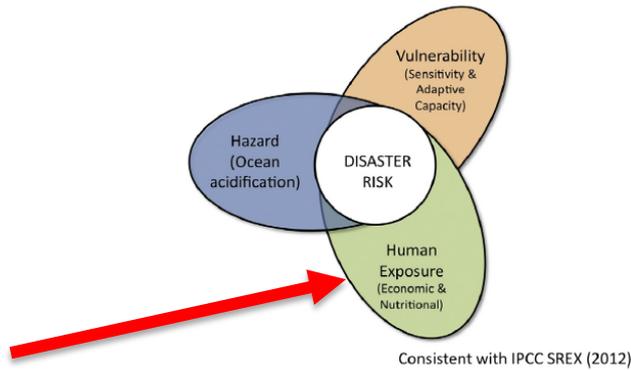
Economic exposure ( $E_E$ )

= 2 x (shellfish share of commfish revenue)

+ 1 x (salmon share of commfish revenue)

Example: Bristol Bay Borough:

$$2 \times (0) + 1 \times (.96) = 0.96$$



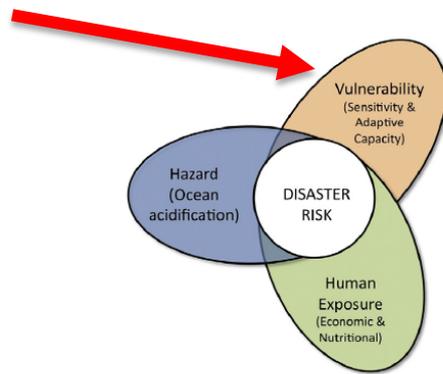
# Exposure

Nutritional exposure ( $E_N$ )

= 2 x (shellfish share of subsistence fish weight)  
+ 1 x (salmon share of subsistence fish weight)

Example: Kodiak:

$$2 \times (.09) + 1 \times (.44) = 0.42$$



Consistent with IPCC SREX (2012)

# Vulnerability: Economic Sensitivity

Economic Sensitivity ( $V_{SE}$ )

= 50% x **quartiled (!)**

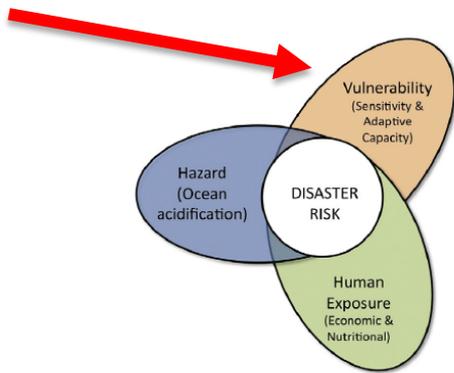
Average revenue per worker in the [harvesting plus processing] fish “industry”

+ 50% x **quartiled (!)**

Share of population working in fish x share of shellfish & salmon in total fish weight

Example: Anchorage: (\$66,131 and .001180)

$$.5 \times (4) + .5 \times (2) = 3$$



Consistent with IPCC SREX (2012)

# Vulnerability: Nutritional Sensitivity

Nutritional Sensitivity ( $V_{SN}$ )

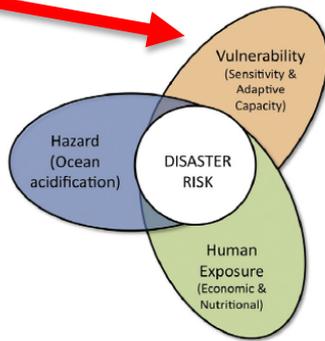
= 50% x **quartiled:**

2 x (shellfish share of per capita subsistence fish weight)

+ 1 x (salmon share of subsistence fish weight)

+ 50% x **quartiled:**

Total subsistence fish pounds per capita



Consistent with IPCC SREX (2012)

# Vulnerability: Adaptive Capacity

Weighted sum of **normalized (0-1)**:

per capita personal income

poverty rate (.33)

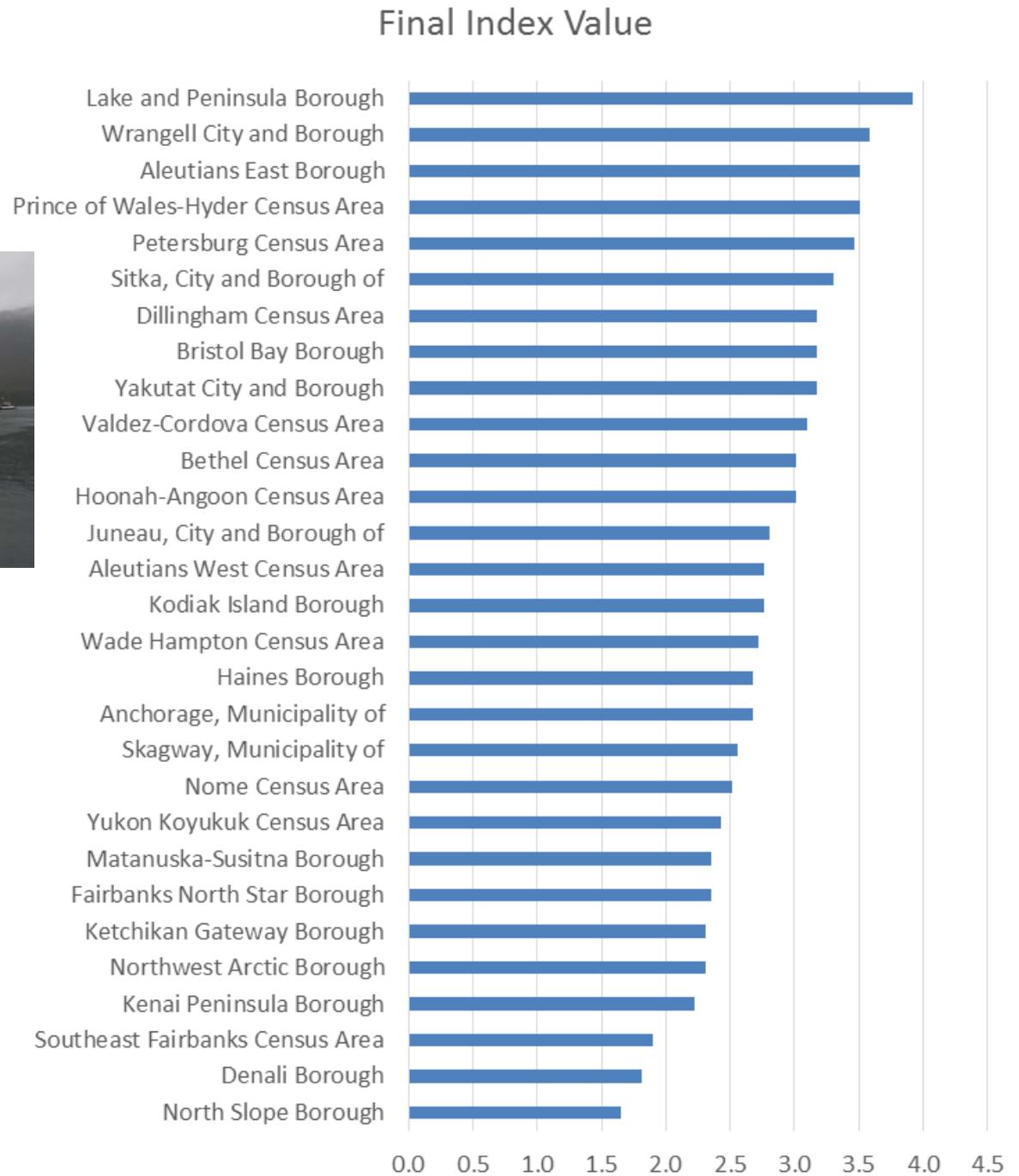
unemployment rate (.33)

% HH income from AK Permanent Fund Dividend  
(.33)

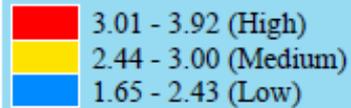
industrial diversity

food accessibility

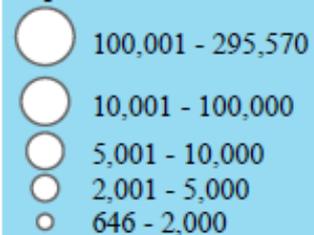
# Results



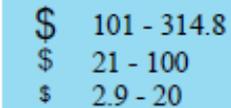
### Final Index Value



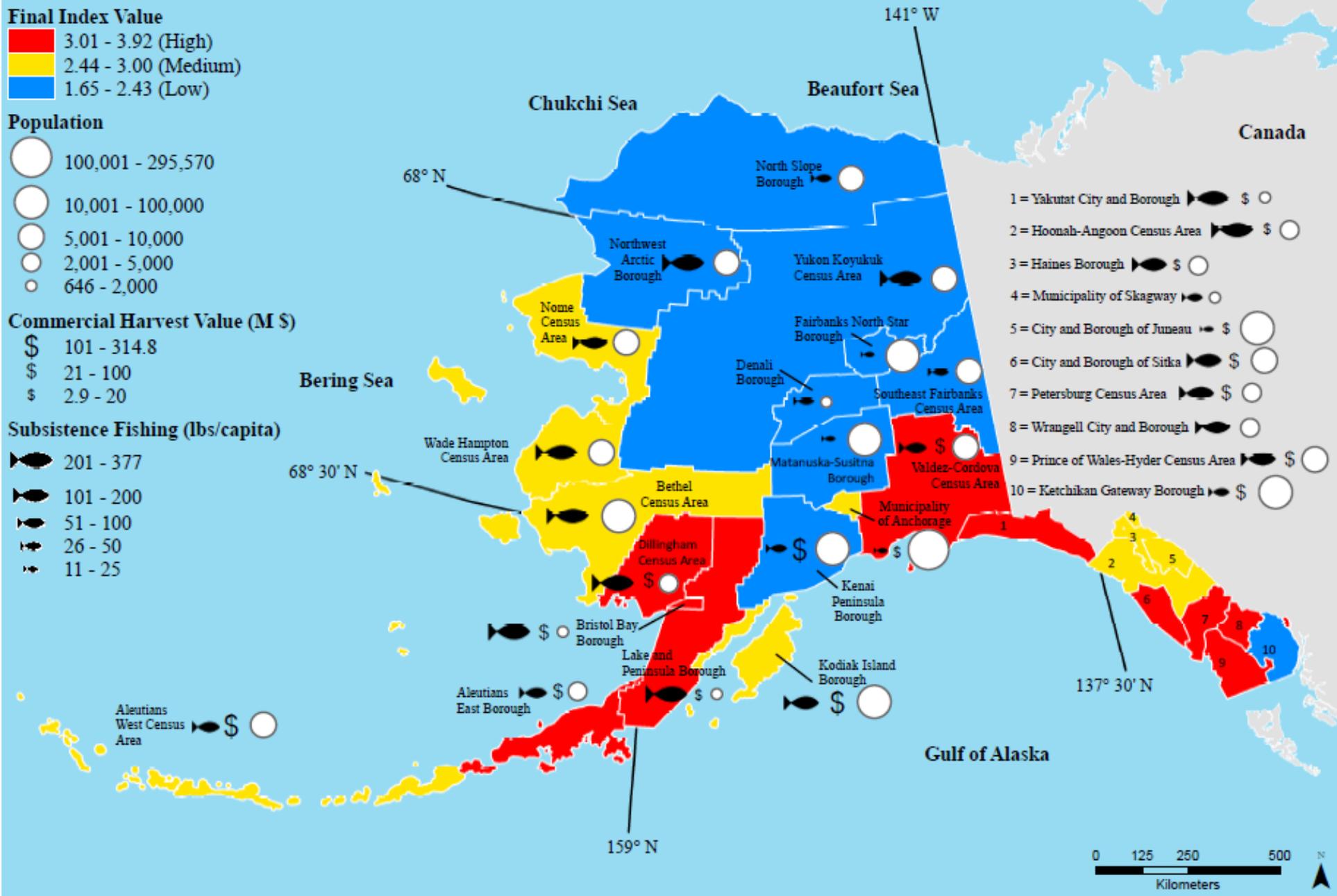
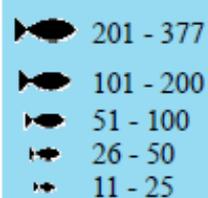
### Population



### Commercial Harvest Value (M \$)



### Subsistence Fishing (lbs/capita)



# Surprise: Anchorage

Ranked 17 of 29 (where rank of 1 = most at risk)

Why so high?

High fish income per fish worker

And,

High share of OA-susceptible fish

And, ?

# Surprise: Kodiak

Ranked 14 of 29

Why ranked so low (compared to other coastal fishing regions)?

Low share of OA-susceptible fish in both commercial and subsistence fisheries.

# So What?

- We're all in this together – places like Anchorage are not immune
- We hope other authors will jump all over this initial attempt;
- Especially to move from relative risk assessment to potential absolute dollar impacts to both commercial and subsistence fisheries.
- We need not postpone action to promote reduced CO2 emissions while waiting for more data and results.

# References

Mathis, J.T.; Cooley, S.R.; Lucey, N.; Colt, S.; Ekstrom, J.; Hurst, T.; Hauri, C.; Evans, W.; Cross, J.N.; Feely, R.A. 2014. Ocean Acidification Risk Assessment for Alaska's Fishery Sector. *Progress in Oceanography* (2014), doi: <http://dx.doi.org/10.1016/j.pocean.2014.07.001>