

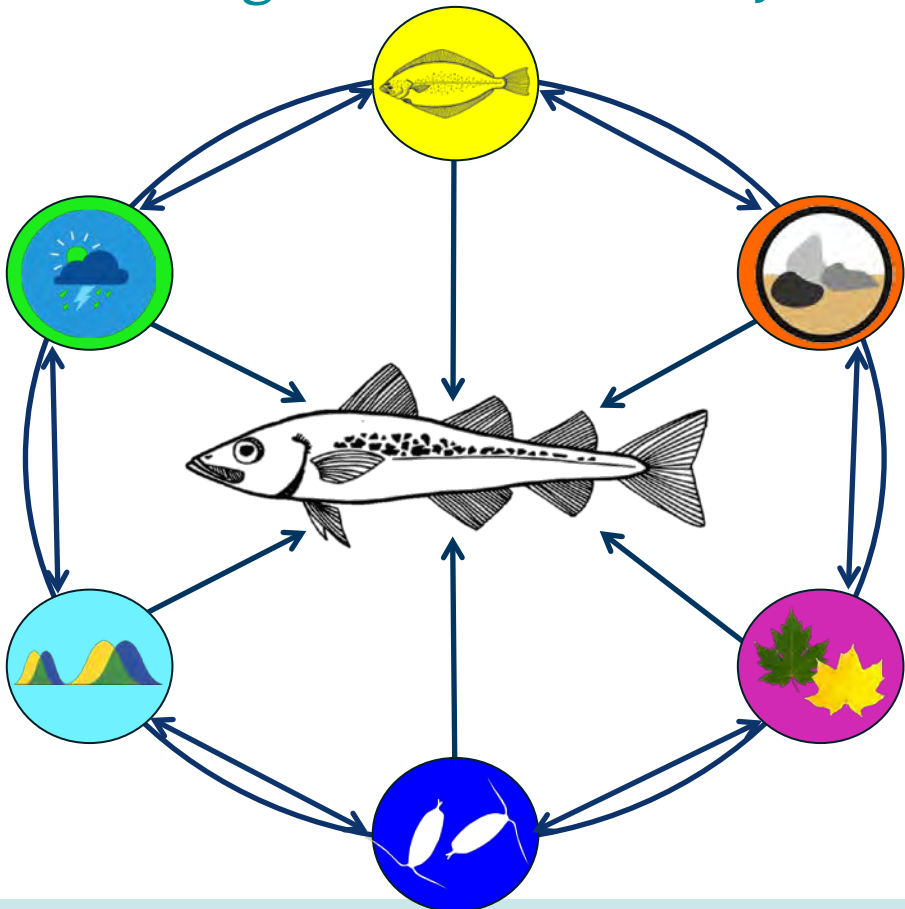


# Climate conditions and spatial overlap structure condition and recruitment of walleye pollock in the eastern Bering Sea

Elizabeth Siddon, Tayler Jarvis, Kirstin Holsman, and Alex Andrews  
Alaska Fisheries Science Center

June 4, 2018

# Mechanistic understanding of recruitment dynamics



# Eastern Bering Sea ecosystem

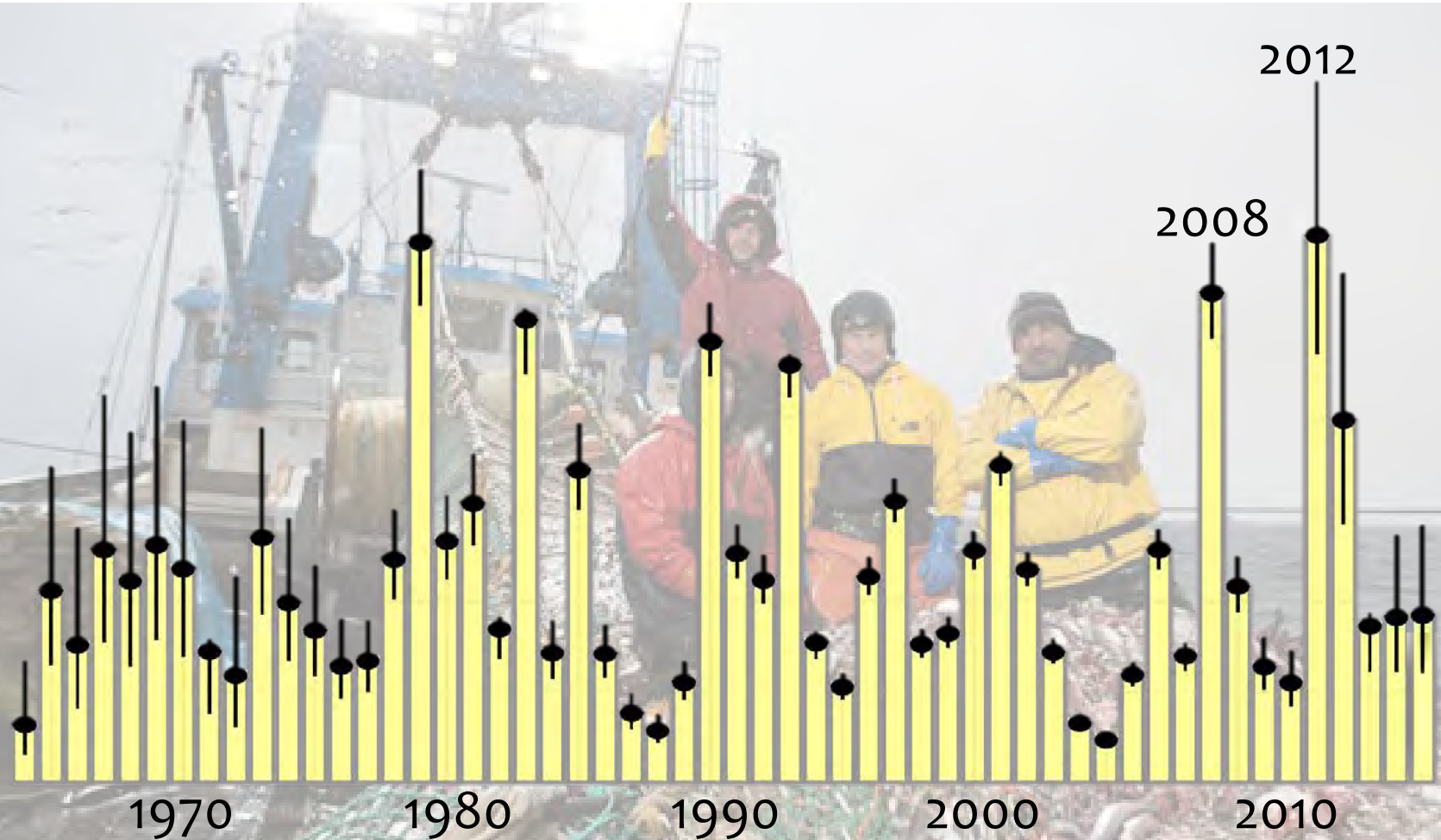


2 billion \$ per yr

2 million tons per yr

40% of all US fish landed

Recruitment estimates (age-1)



# Interacting mechanisms

Sea ice



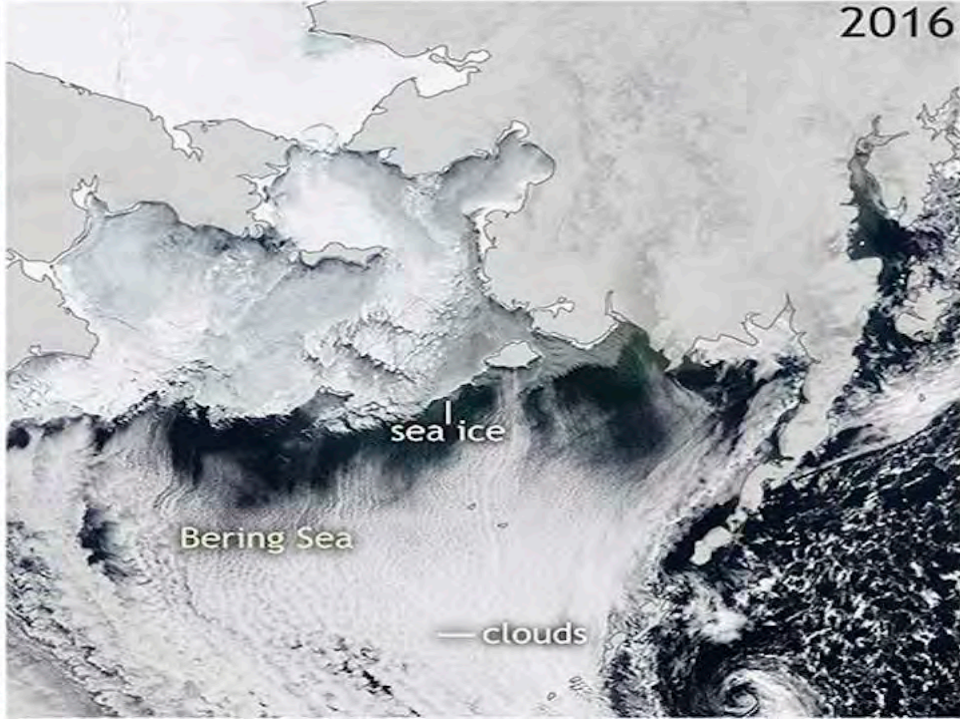
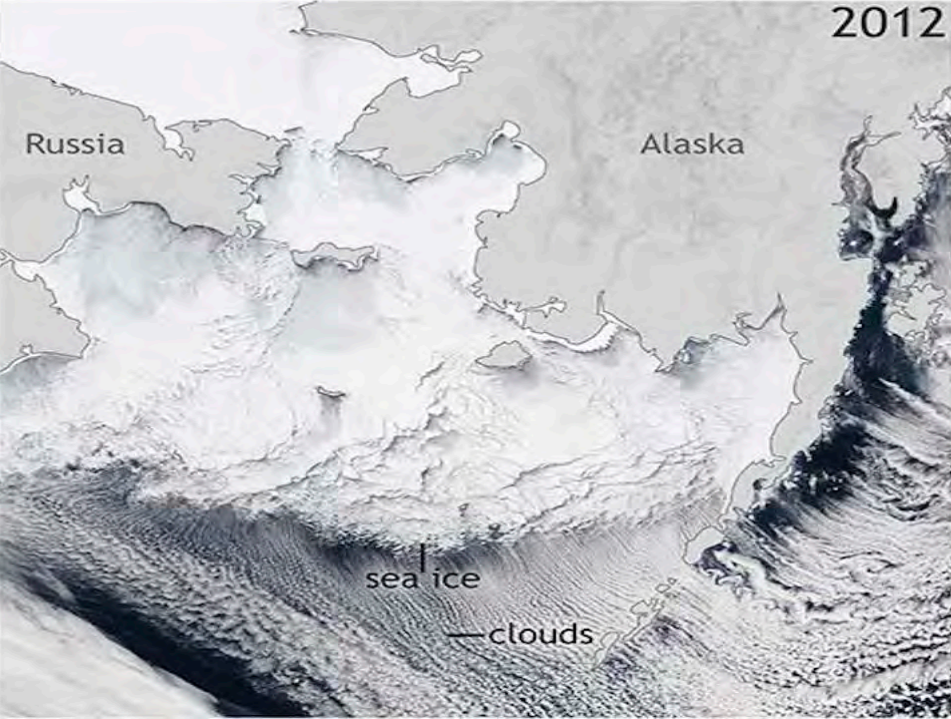
Match mismatch



Top-down & Bottom-up

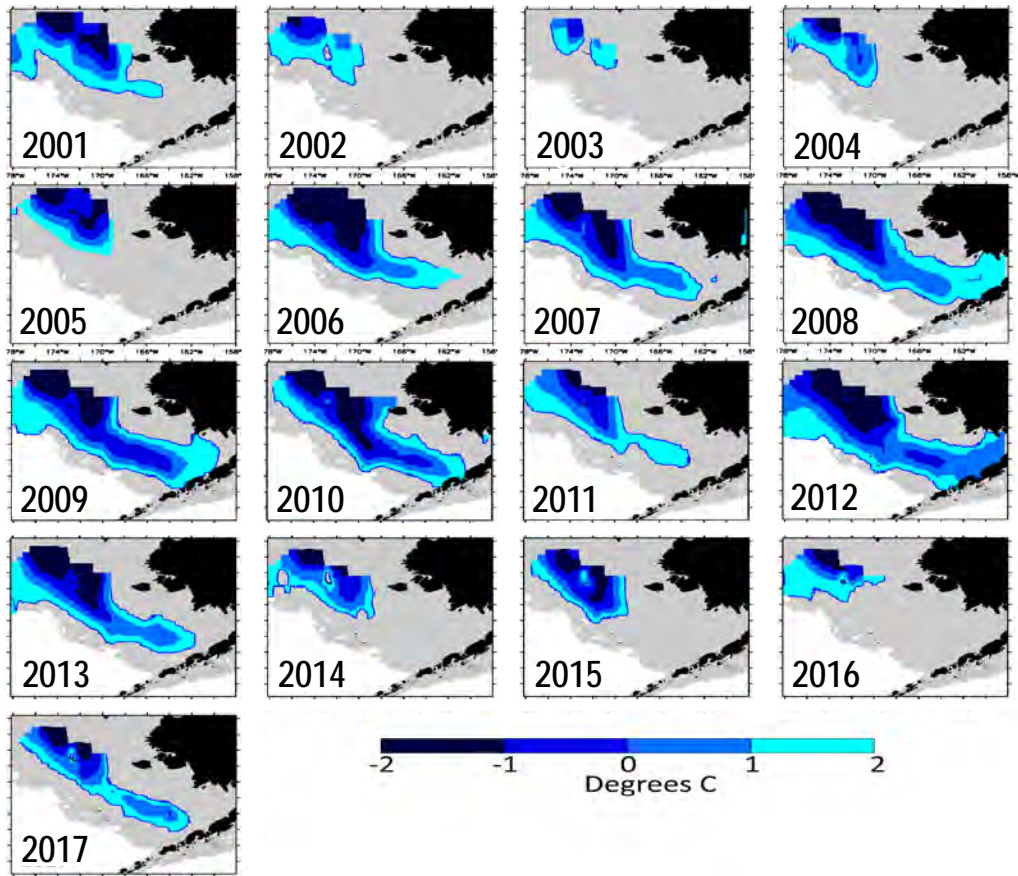


# Seasonal sea ice: a defining characteristic of the Bering Sea shelf

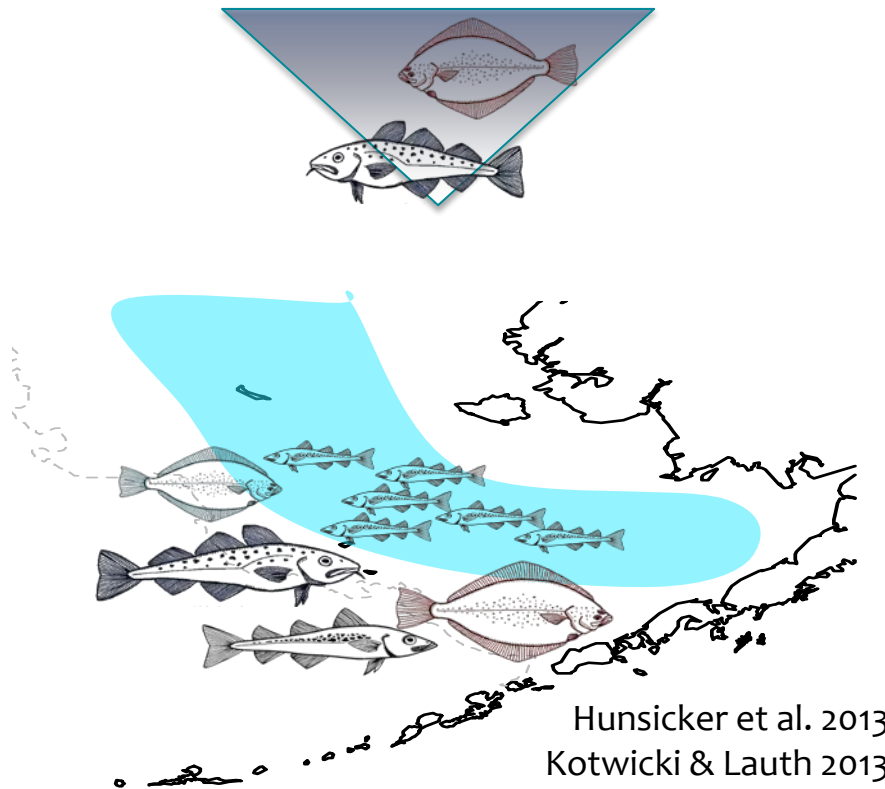


NOAA Climate.gov  
Arctic Report Card 2017

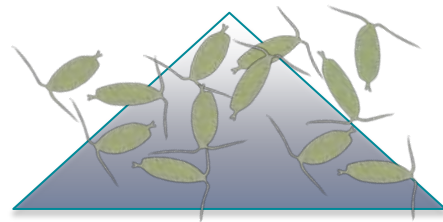
# Cold pool (<math><2^{\circ}\text{C}</math>) structures the Bering Sea shelf ecosystem



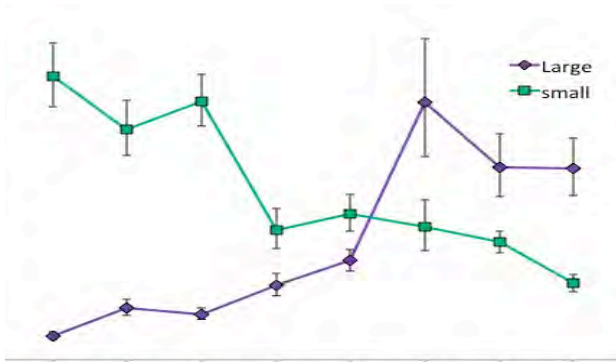
# Cold pool (<math><2^{\circ}\text{C}</math>) structures the Bering Sea shelf ecosystem



Hunsicker et al. 2013  
Kotwicki & Lauth 2013  
Spencer et al. 2016



Large zooplankton



Small zooplankton

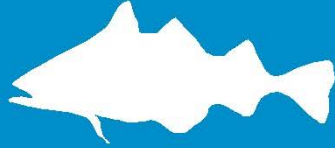
2002 2004 2006 2008 2010

Eisner et al. 2013



**COLD  
REGIME**

Higher  
Overwinter  
Survival



◀ COLD YEARS

**REGIME SHIFT**

Lower  
Overwinter  
Survival



2014 2015 PREDICTED WARM YEARS ▶

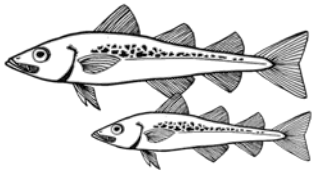
**WARM  
REGIME**

Ecological Response to Climate ▲



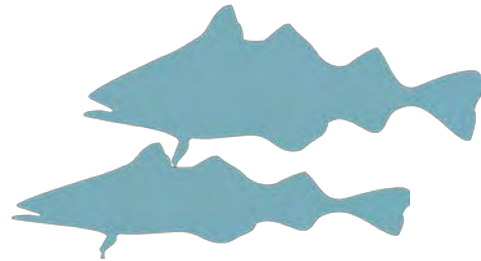
NOAA FISHERIES

# Spatially explicit bioenergetics growth model

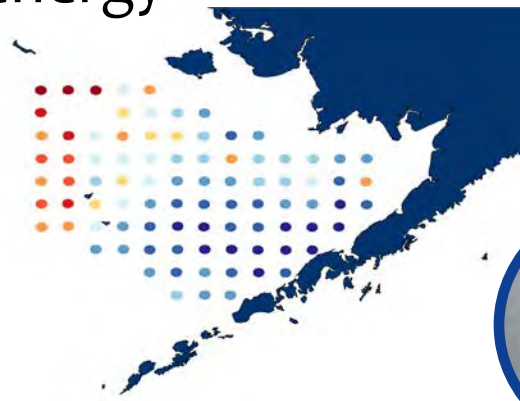


Weight  
of the fish

$$C_{d,kt}^{max} = \alpha W_{d-1}^{\beta} \cdot f(T_{d,kt})$$



Fish  
energy



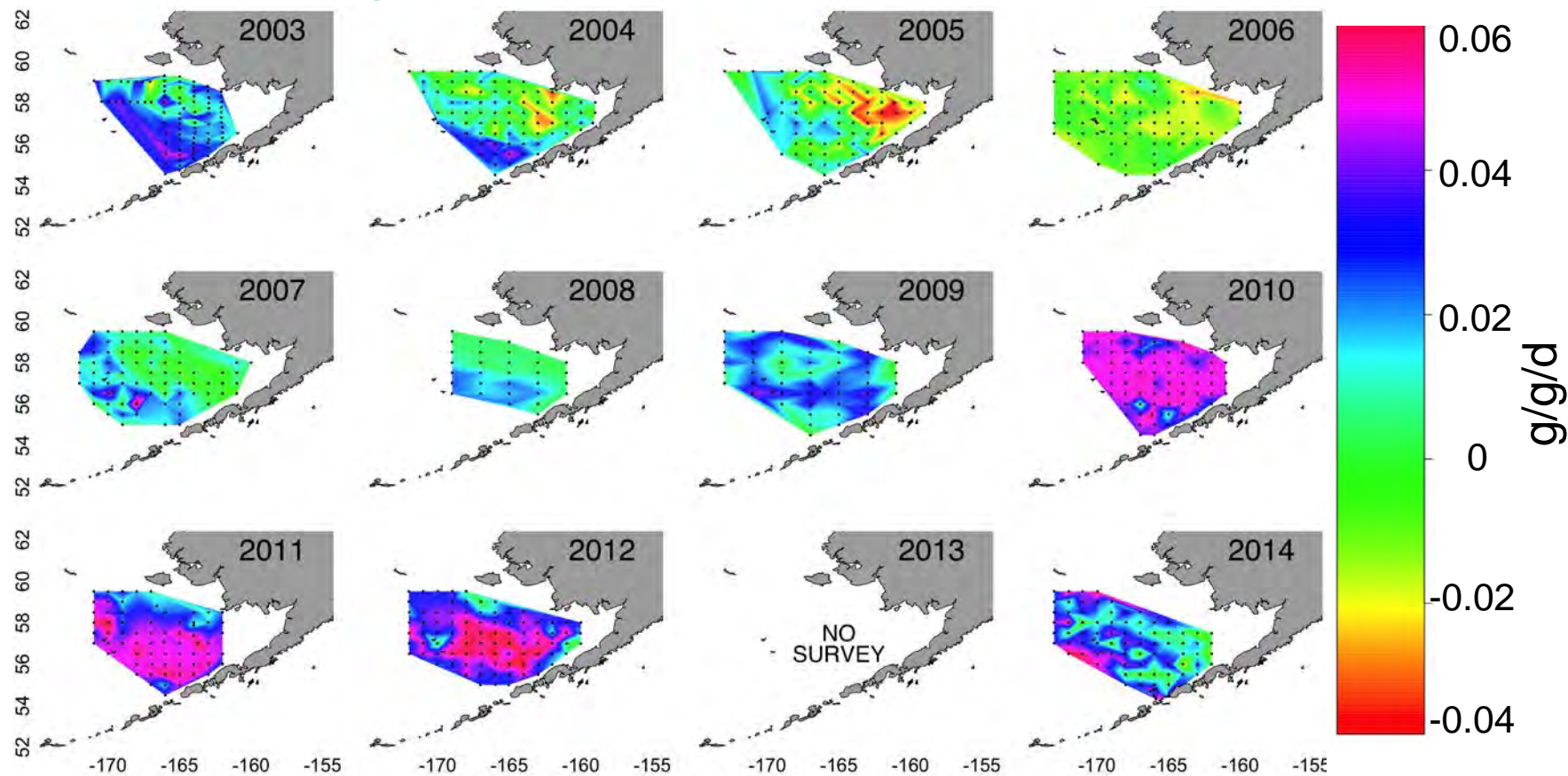
Water  
temperature



Prey  
energy

Modified from Ciannelli et al. 1998

# Juvenile pollock growth potential



# Quantify spatial overlap



Diet  
information



Zooplankton  
biomass



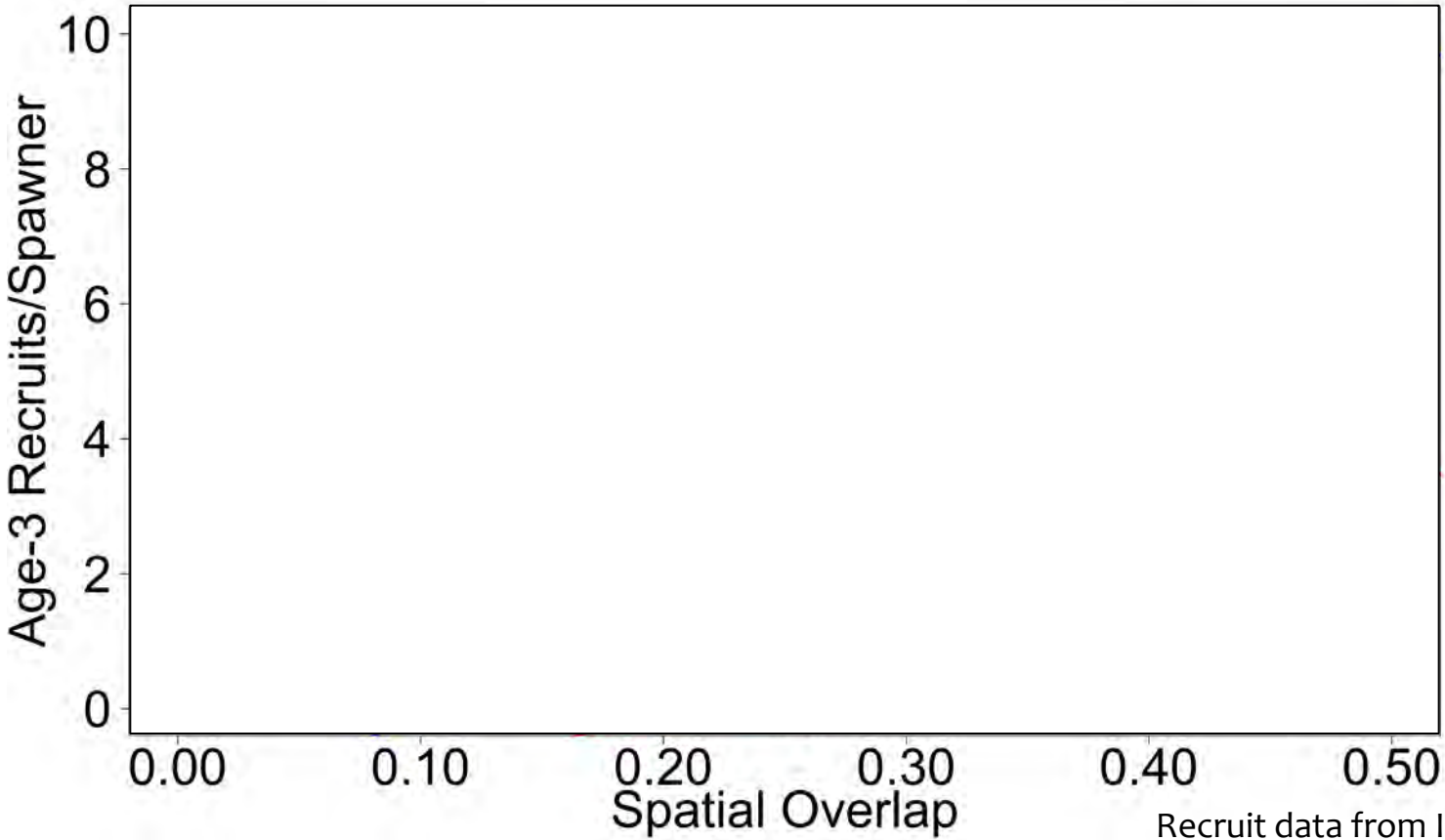
Lipid content



Age-0 pollock  
biomass

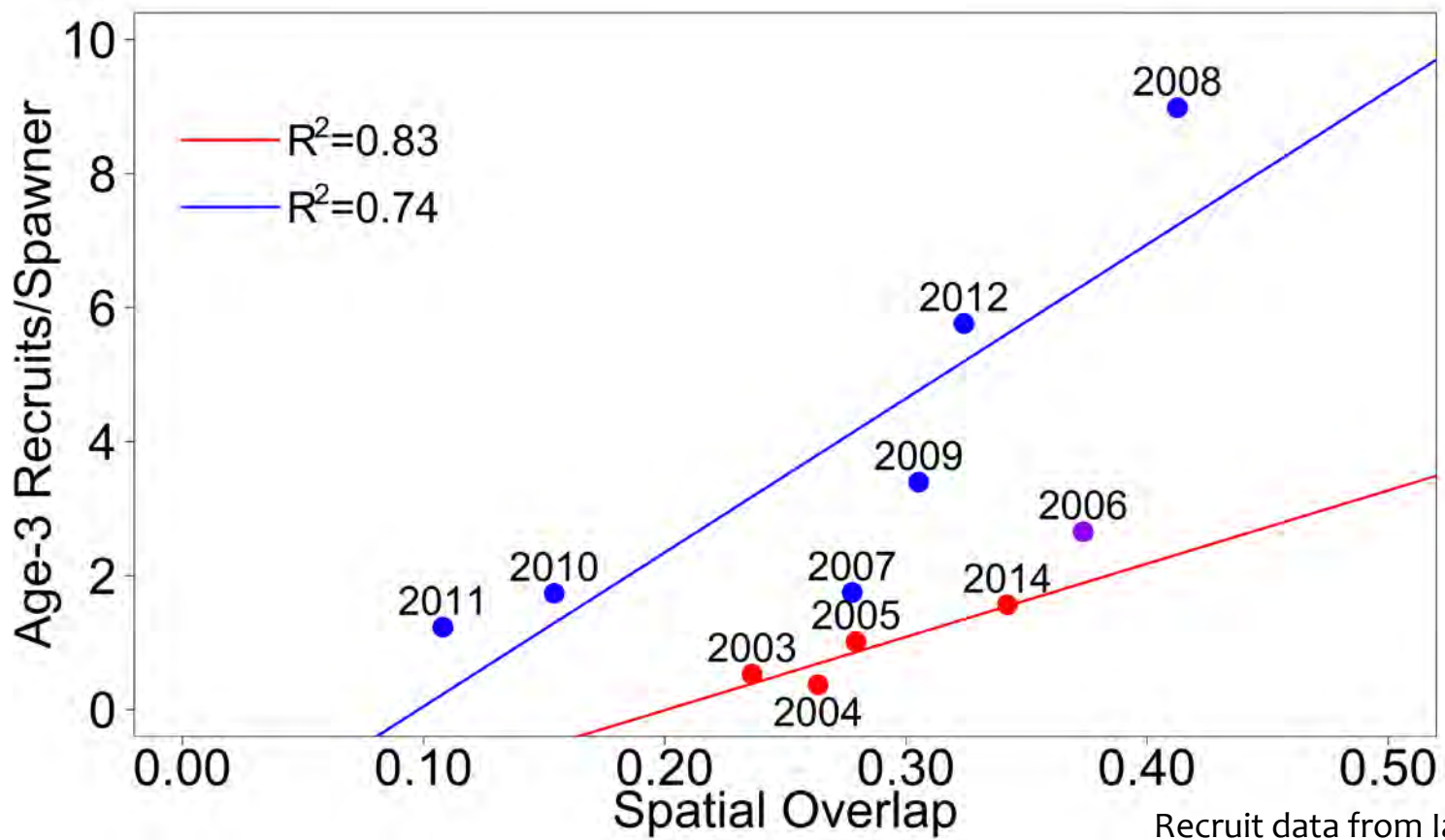
Slobodchikoff & Schulz 1980

# Bottom-up effects



Recruit data from Ianelli et al. 2017

# Bottom-up effects



Recruit data from Ianelli et al. 2017

# Quantify spatial overlap



Age-0 pollock biomass



Adult pollock biomass



Pacific cod biomass

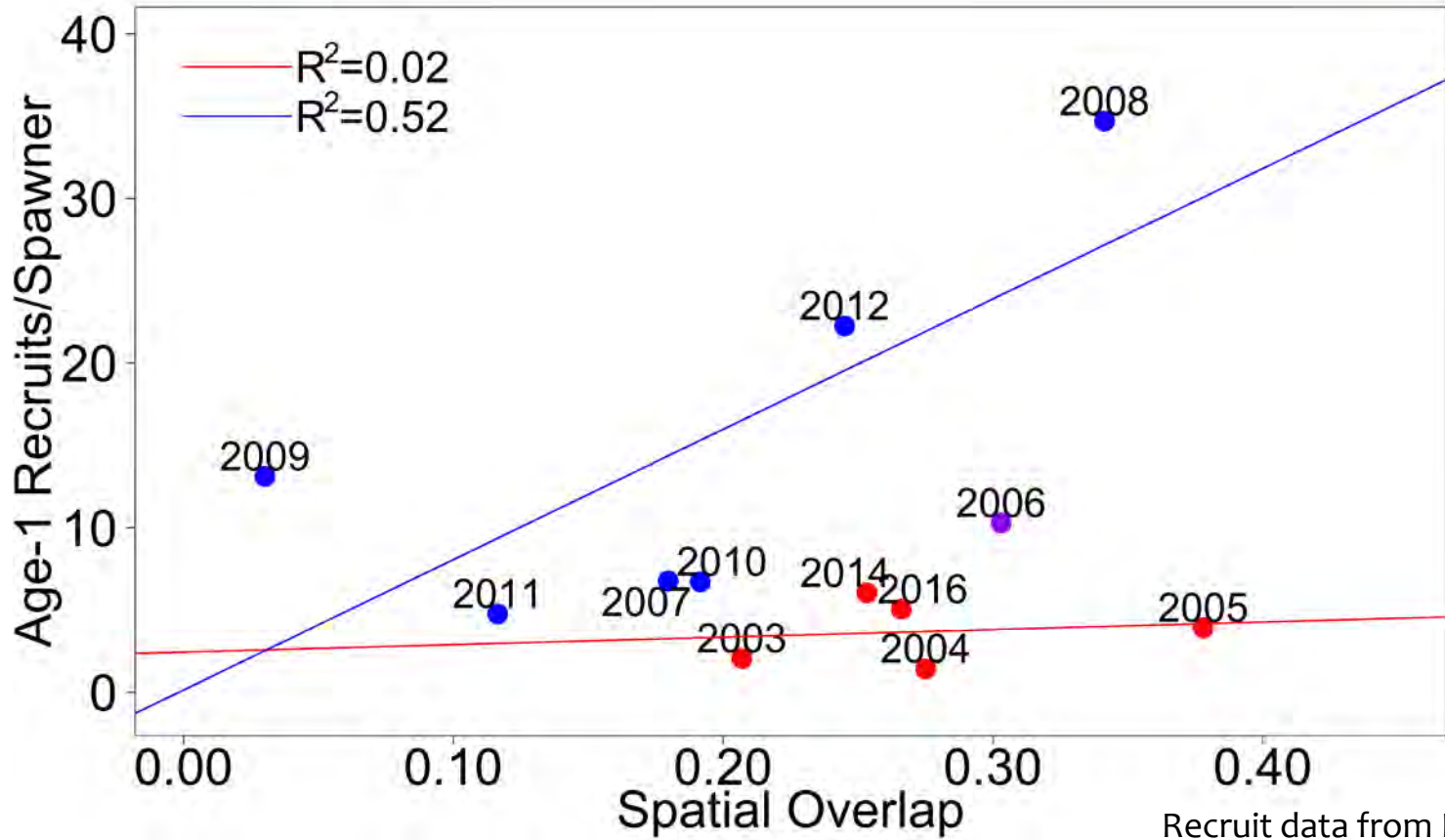


Arrowtooth biomass



Halibut biomass

# Top-down effects

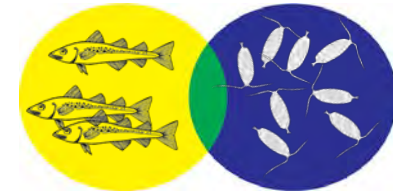
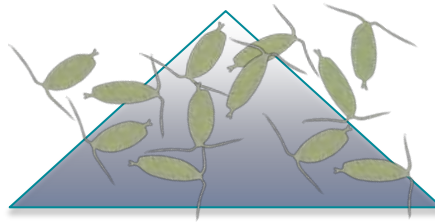


Recruit data from Ianelli et al. 2017

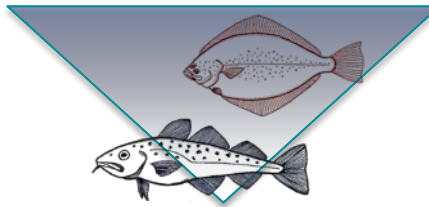


# Conclusions

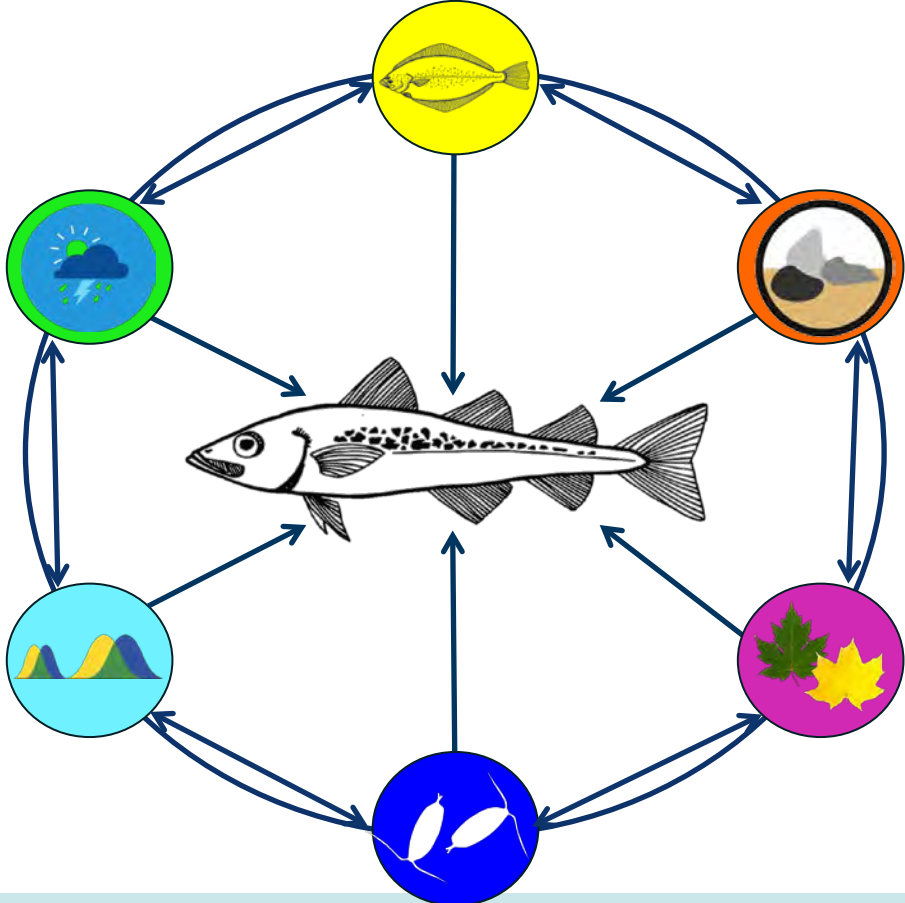
- Spatial overlap of prey availability and juvenile pollock helps to explain recruitment variability in the eastern Bering Sea.



- Top-down processes contribute to cold year dynamics

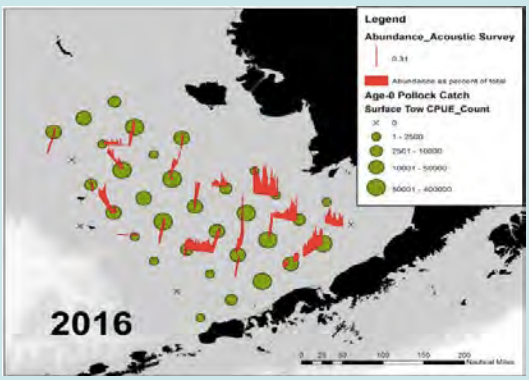


# Mechanistic understanding of recruitment dynamics

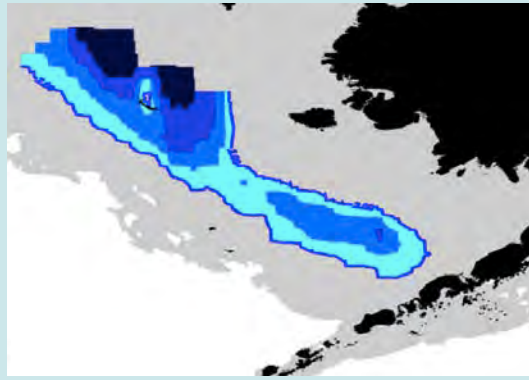


# Next steps...

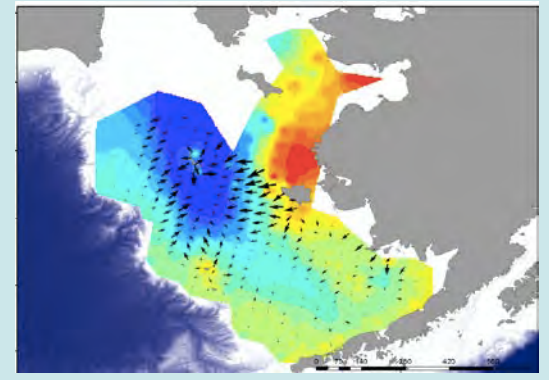
## Vertical distribution of age-0 pollock



## Sea ice characteristics



## Cold pool dynamics



... questions?