Climate and Fisheries

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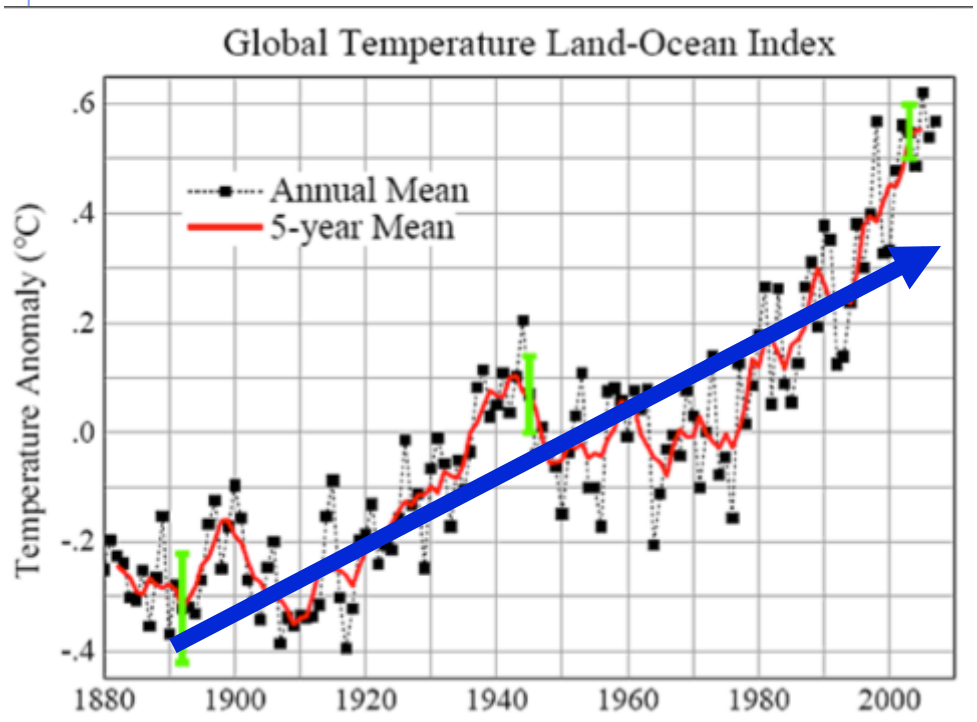
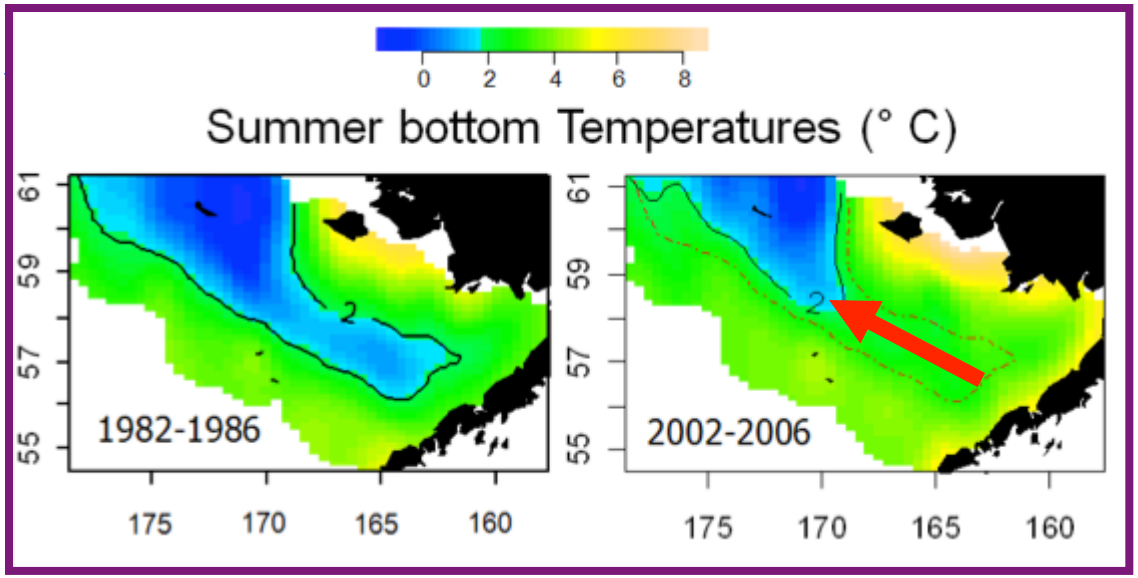
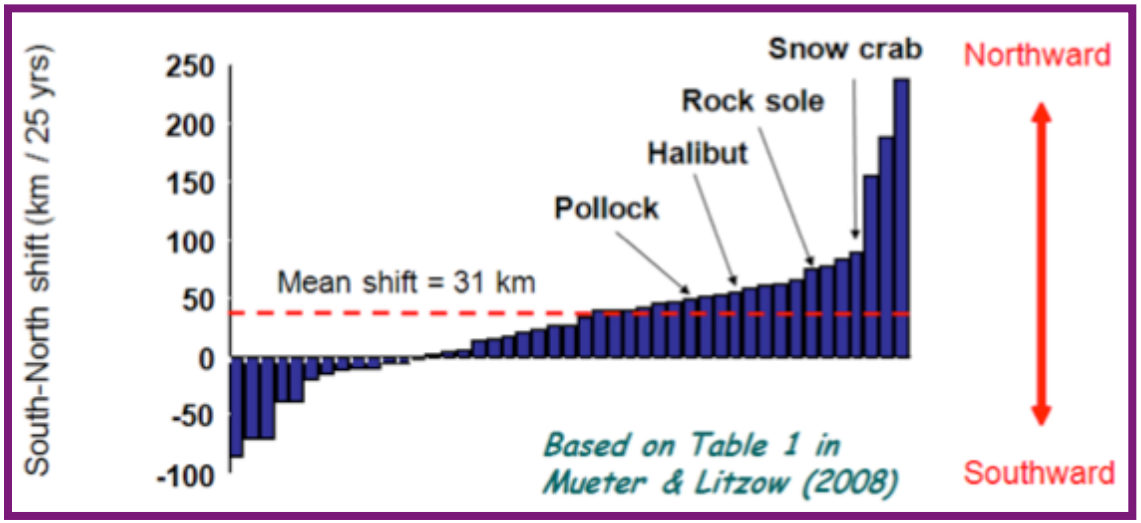
Fish respond to temperature long-term trend and its variability



- Long-term global warming trend
- Decadal variability (PDO, 20-30 years)
- Interannual variability (El Niño, 2-7 years)
- Seasonal variability

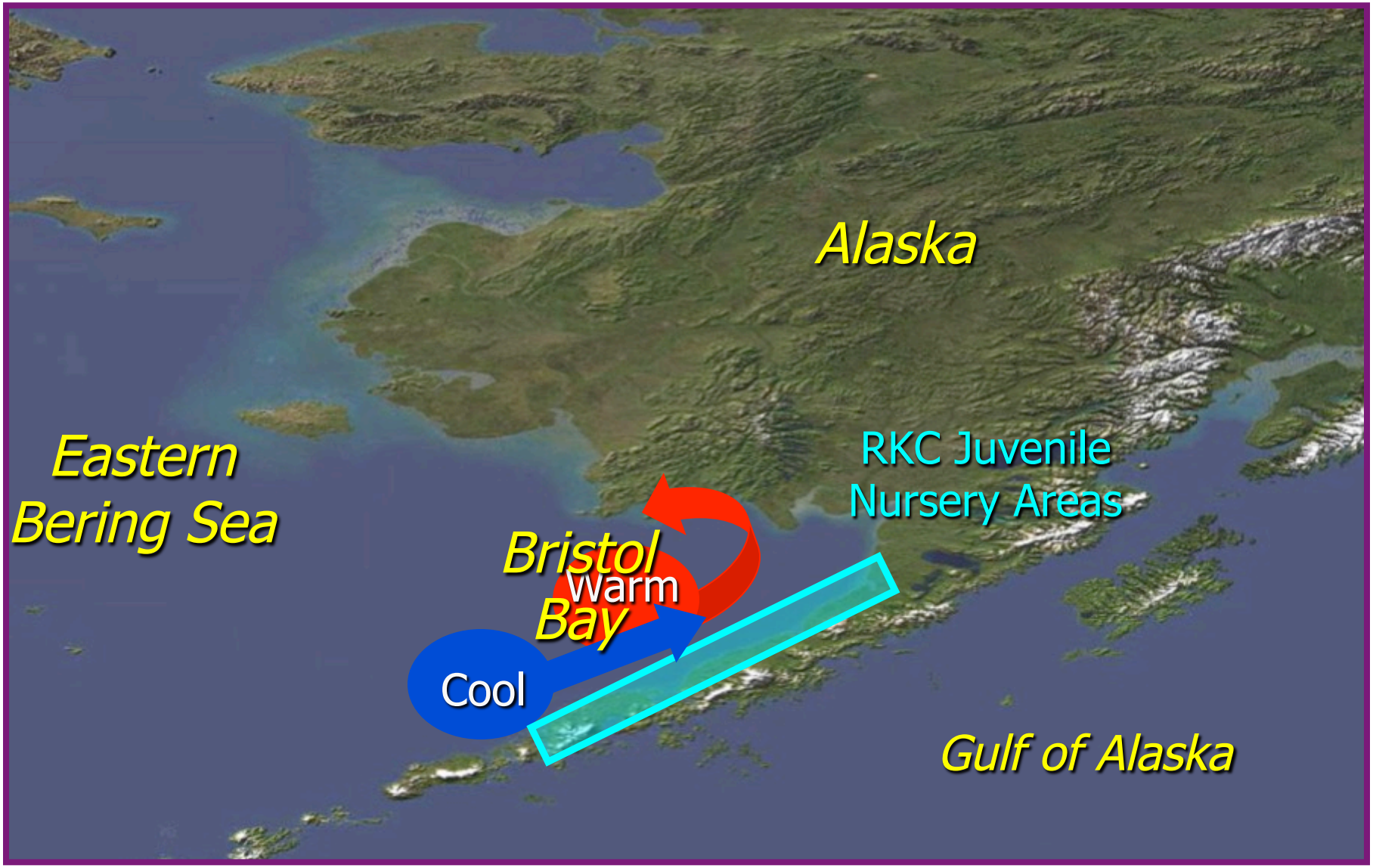
Common effect: Species shift north



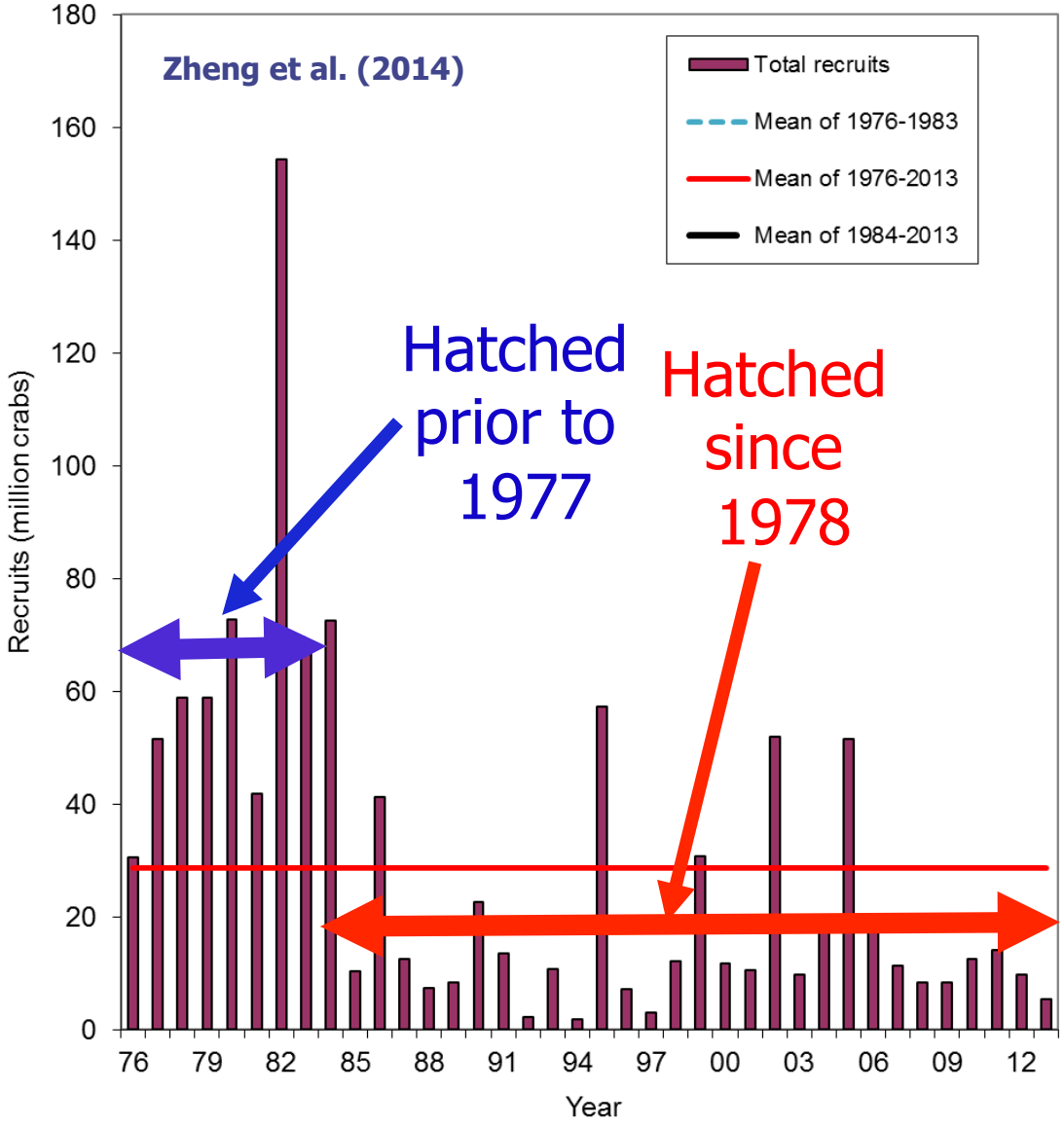


- Southern edge of cold pool shifted 230 km (143 miles) north
- Subarctic species expand north
- Arctic species retreat north
- Sea ice explains 57% of variability in snow crab catch
- Decline of Bering Sea snow crab fishery?

Expected changes: Red king crab

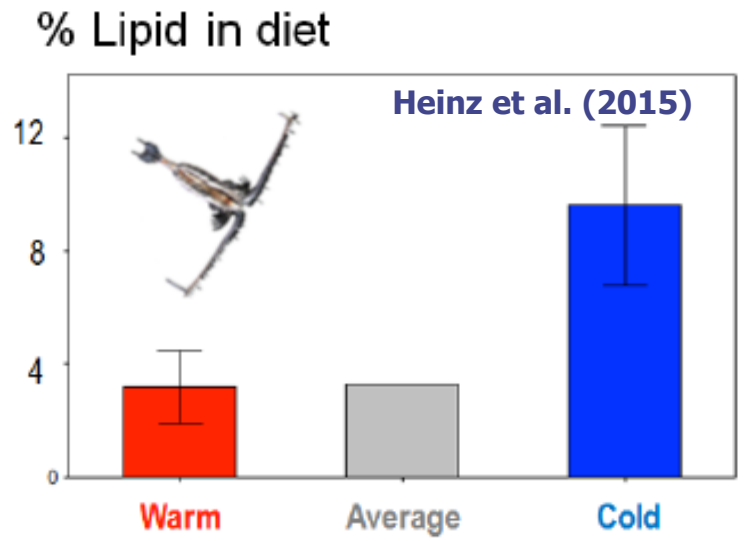


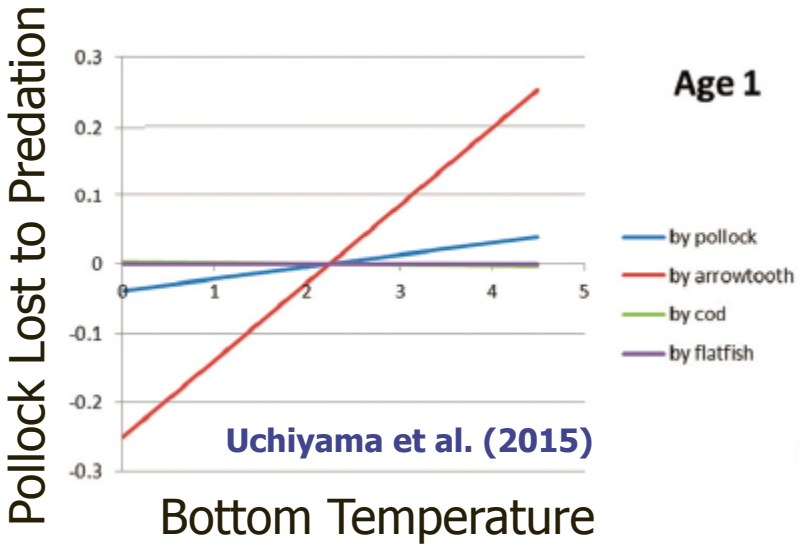
Expected changes: Red king crab



- Numbers of juvenile crabs decline with warmer temperatures
- Crab larvae carried beyond prime habitats
- Early sea ice melt causes late spring bloom → poor feeding conditions for crab larvae
- Ocean acidification poses additional threats to crabs

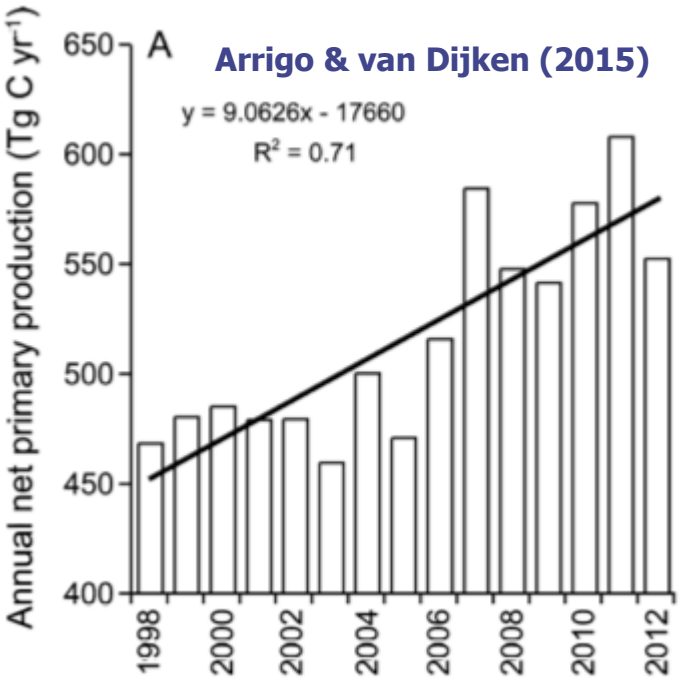
Other expectations: walleye pollock

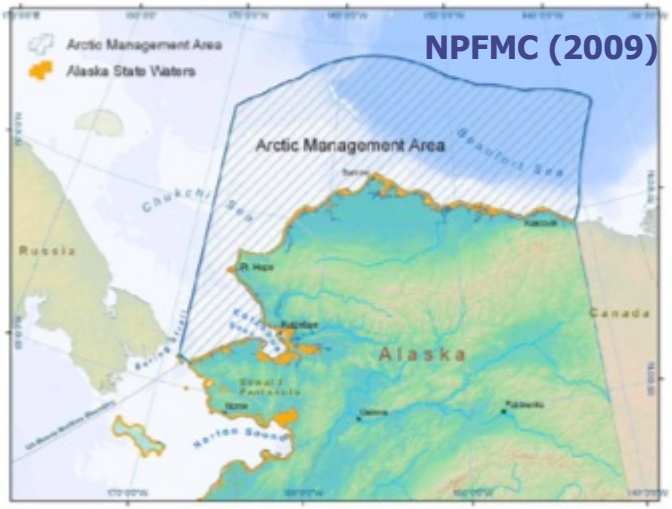




- World's largest fishery
- Age-0 pollock consume lipid-rich diets in cold years
- Years of lipid-poor diets lead to low survival of age-0 pollock
- Higher rates of cannibalism of age-0 pollock in warm years
- More age-1 pollock are lost to predation (arrowtooth flounder, adult pollock) with higher temperature
- Pollock outlook appears bleak under warming climate

Other expectations: More productive Arctic





- Net primary productivity increased 30% over 1998-2012
- Triggered by reduced sea ice and longer growing season
- New Arctic autumn plankton bloom
- However, increased freshwater runoff limits mixing of deep nutrients to surface
- Now, phytoplankton are smaller and may have limited nutritional benefits to fish, birds and mammals
- Ecosystem changes will benefit some species and not others
- Large uncertainty in outcomes

Need for adaptation

- Unusual Bristol Bay salmon fishery in 2015
  - From bust to boom: late season run
  - Delayed by warm ocean?
  - Limited fish processing capacity
- Expect more unusual seasonal migrants and potential new residents
- Fishery management needs to be adaptive to deal with both expected & unexpected changes