

ARCTIC FISHERIES

DR. COURTNEY CAROTHERS

ASSOCIATE PROFESSOR OF FISHERIES

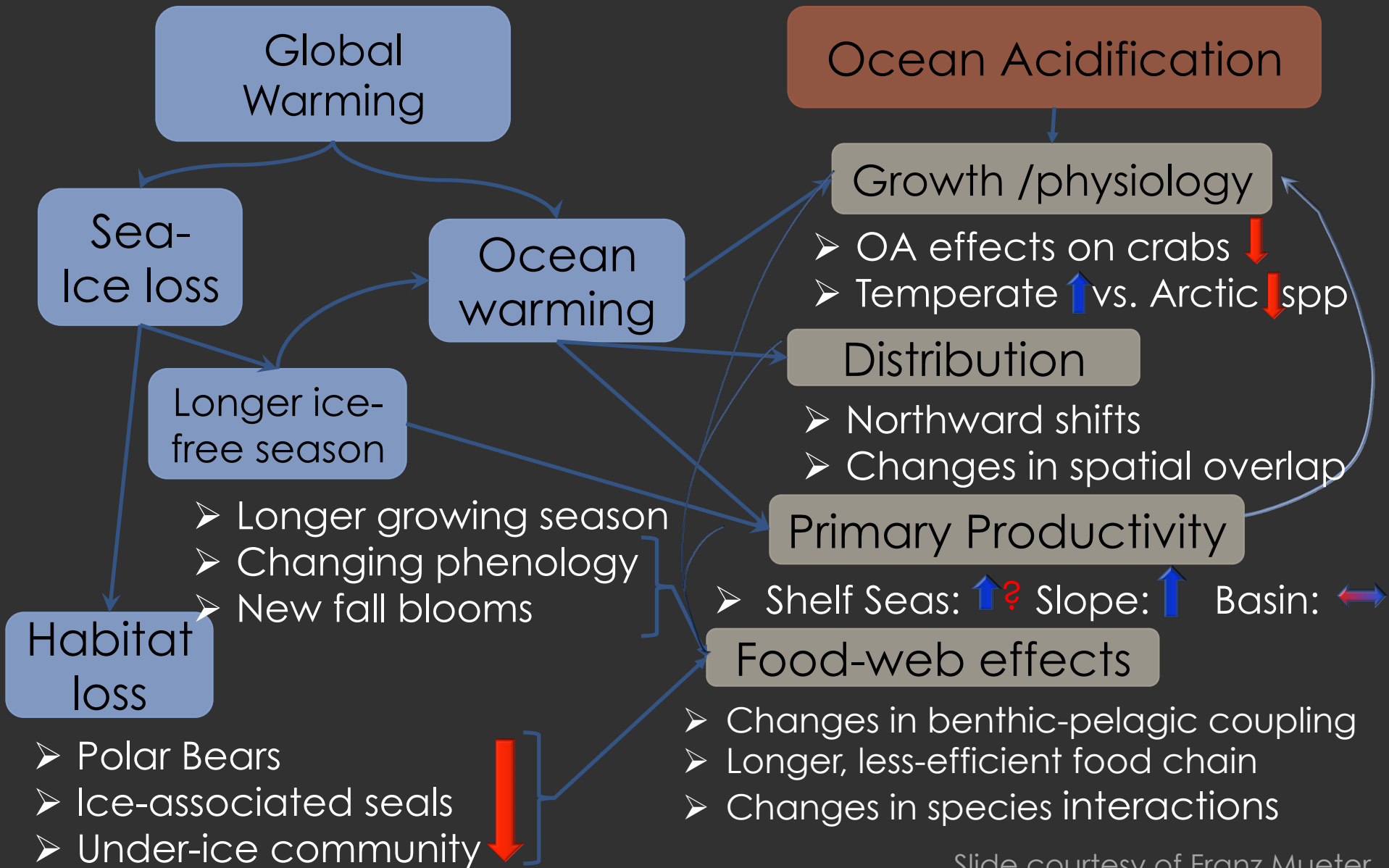
SCHOOL OF FISHERIES AND OCEAN SCIENCES

UNIVERSITY OF ALASKA FAIRBANKS

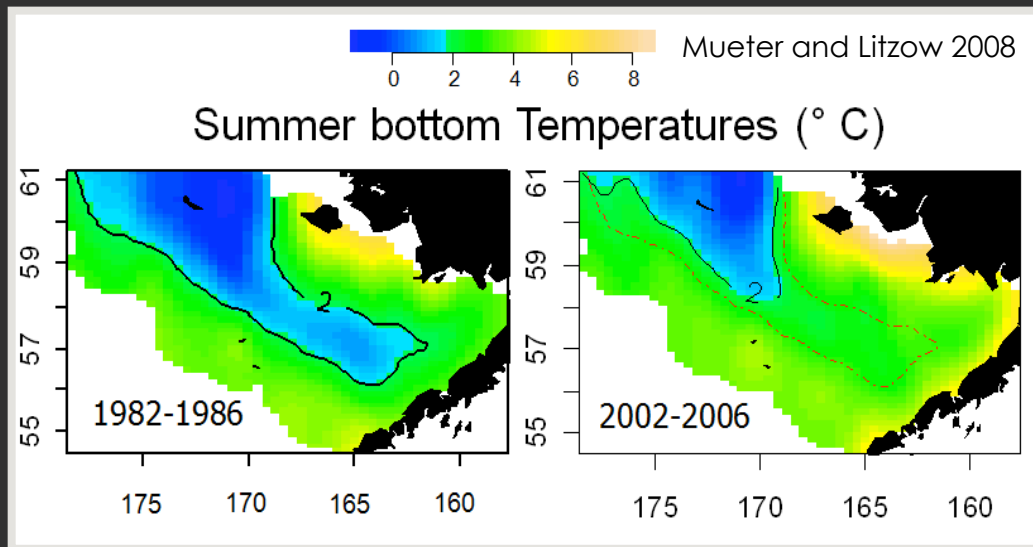
ALASKA CLIMATE SCIENCE BRIEFING, AUGUST 22, 2016



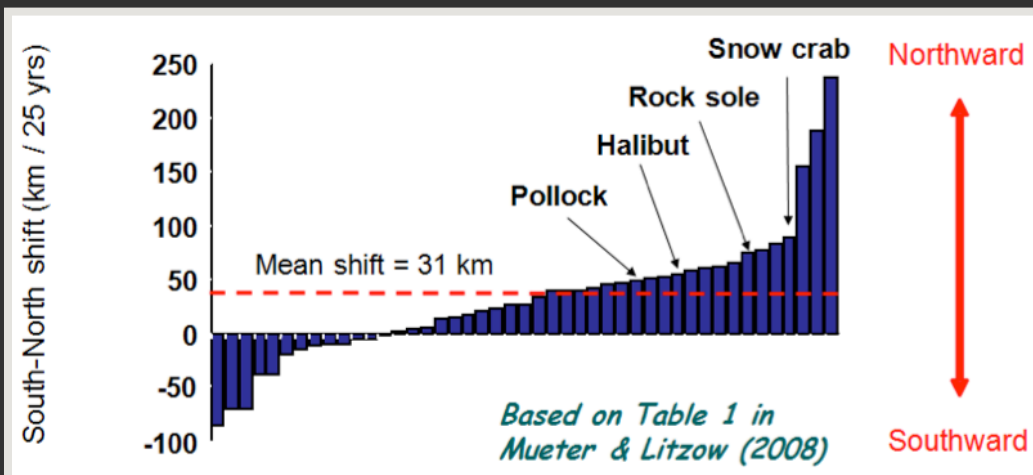
Expected effects of increasing CO₂



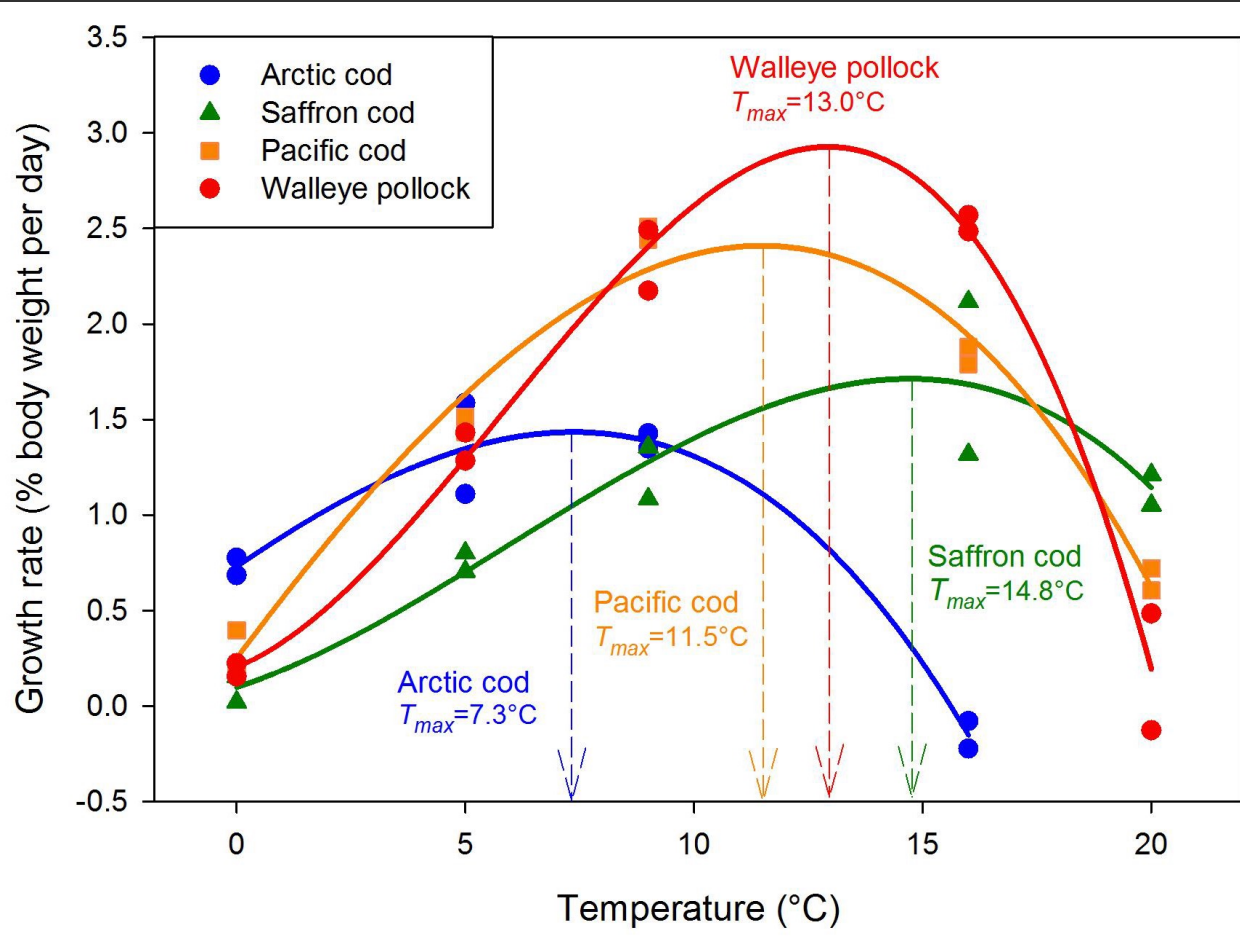
Fish species shifting north



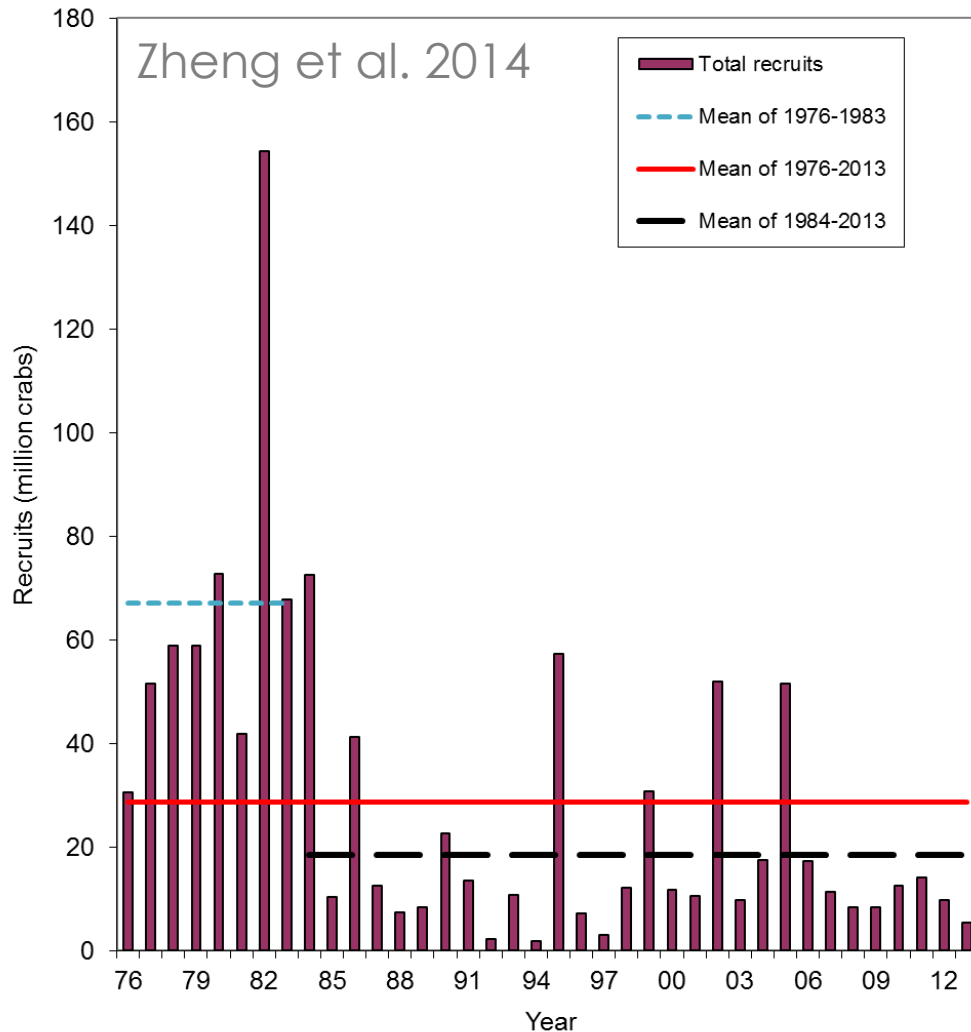
- Southern edge of cold pool shifted ~ 150 miles north
- Subarctic species expand north
- Arctic species retreat north
- Decline of snow crab fishery in Bering Sea?



Temperature-dependent growth

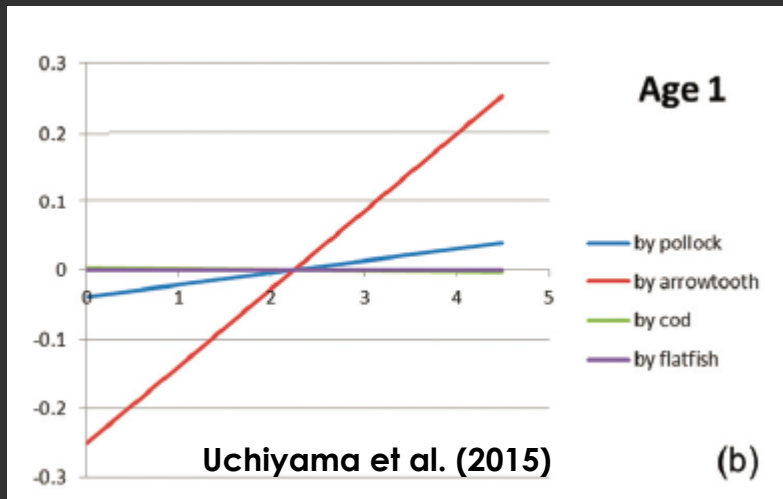
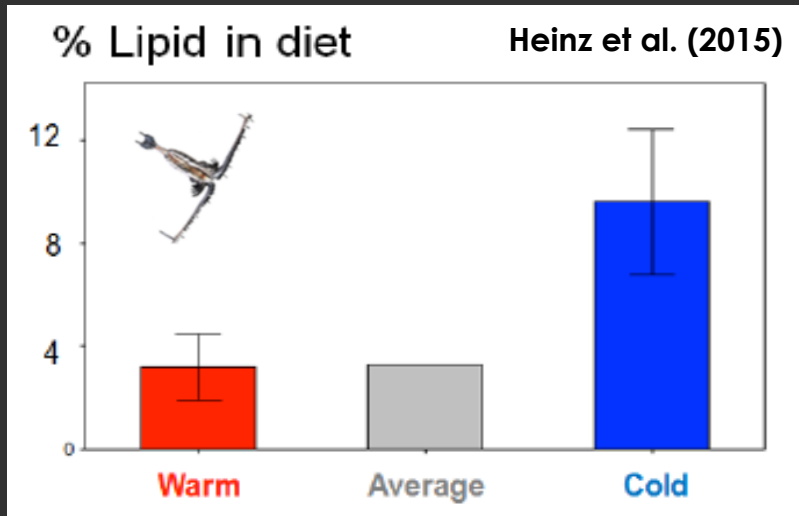


Expected changes: Red King Crab



- Numbers of juvenile crabs decline in warmer temps
- Early sea ice melt causes late spring bloom = poor feeding conditions for crab larvae

Expected changes: Walleye Pollock



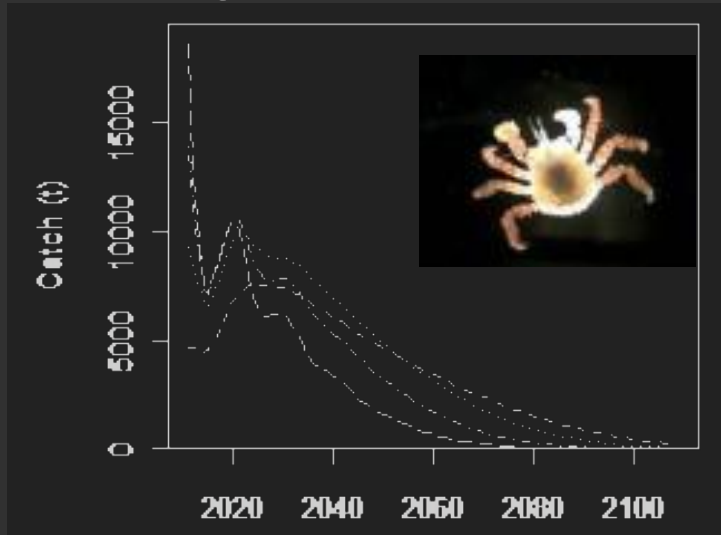
Pollock Lost to
Predation

Bottom Temperature

- World's largest volume fishery
- In warm years, lipid-poor diets lead to low survival of age-0 pollock
- Warmer waters lead to:
 - Higher rates of cannibalism of age-0 pollock
 - Higher predation of age-1 pollock
- Pollock outlook bleak under warming climate

Ocean acidification impacts

Red King Crab: **Very sensitive**



- At 7.8 pH stocks decline
- Under current catch levels, fishery would close by 2100

[Punt et al. 2014]

Northern Rock Sole: **More sensitive**



Trend toward higher mortality at high CO₂ levels [Hurst et al., in review]

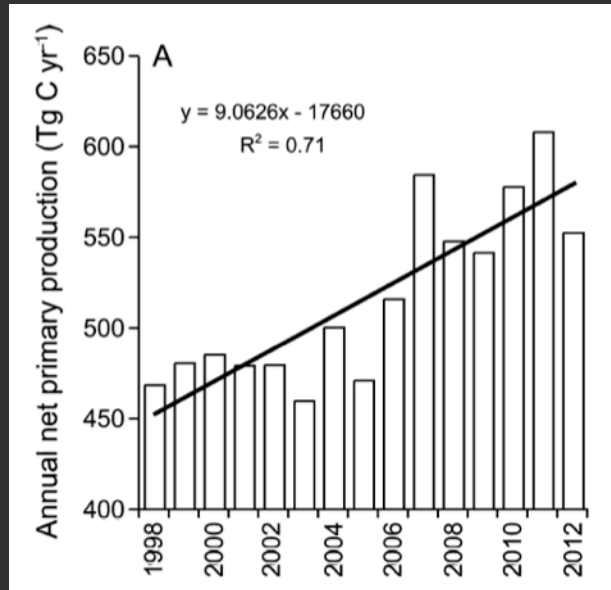
Walleye Pollock: **More resilient**



- No effect on survival to hatch
- No effect on larval survival

[Hurst et al. 2012 and 2013]

Expectation: More productive Arctic



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

Arctic commercial fisheries



- Arctic fisheries harvest ~ 10% of global catch
- About 1/3 each in:
 - Barents/Norwegian Sea
 - Iceland/Greenland
 - Bering Sea
- Commercial fisheries in the (western) Arctic Basin?
 - Most agree not in foreseeable future

Arctic subsistence fisheries



- Indigenous communities highly dependent on subsistence species
- Climate change widely perceived and is affecting subsistence
- However, environmental change experienced in alongside other pronounced social and political change
- Protection of local rights & community wellbeing

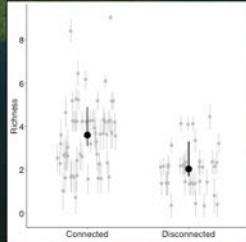
Current research @ SFOS

- Please refer to handout
- <http://www.uaf.edu/sfos/people/faculty>

Slide courtesy of Sarah Laske

Fish of Alaska's coastal plain

- Fish species richness & distribution in Arctic lakes is dependent on surface water access
- Climate induced changes in surface water hydrology will change species access & distribution patterns



Laske et al. 2016 *Freshwater Biology*

Slide courtesy of Morgan Sparks

Sockeye salmon – embryonic responses to warming temperatures

- Survival did not vary suggesting climate scenarios had minimal impact on survival
- Hatching timing varied from two to six month from coldest to warmest treatments
- Families have genetic differences in timing

