

Marine Ecology of the Arctic

Connectivity, change, and resilience

Arny Blanchard

Institute of Marine Science

University of Alaska Fairbanks

Oceanography 2015

Philadelphia, PE, June 22, 2015

Alaska's Arctic is striking



Alaska's Arctic is resource rich



http://hqworld.net/gallery/data/media/154/gates_of_the_arctic_national_park_and_preserve__alaska.jpg



www.trbimg.com



www.northwestern.edu/magazine

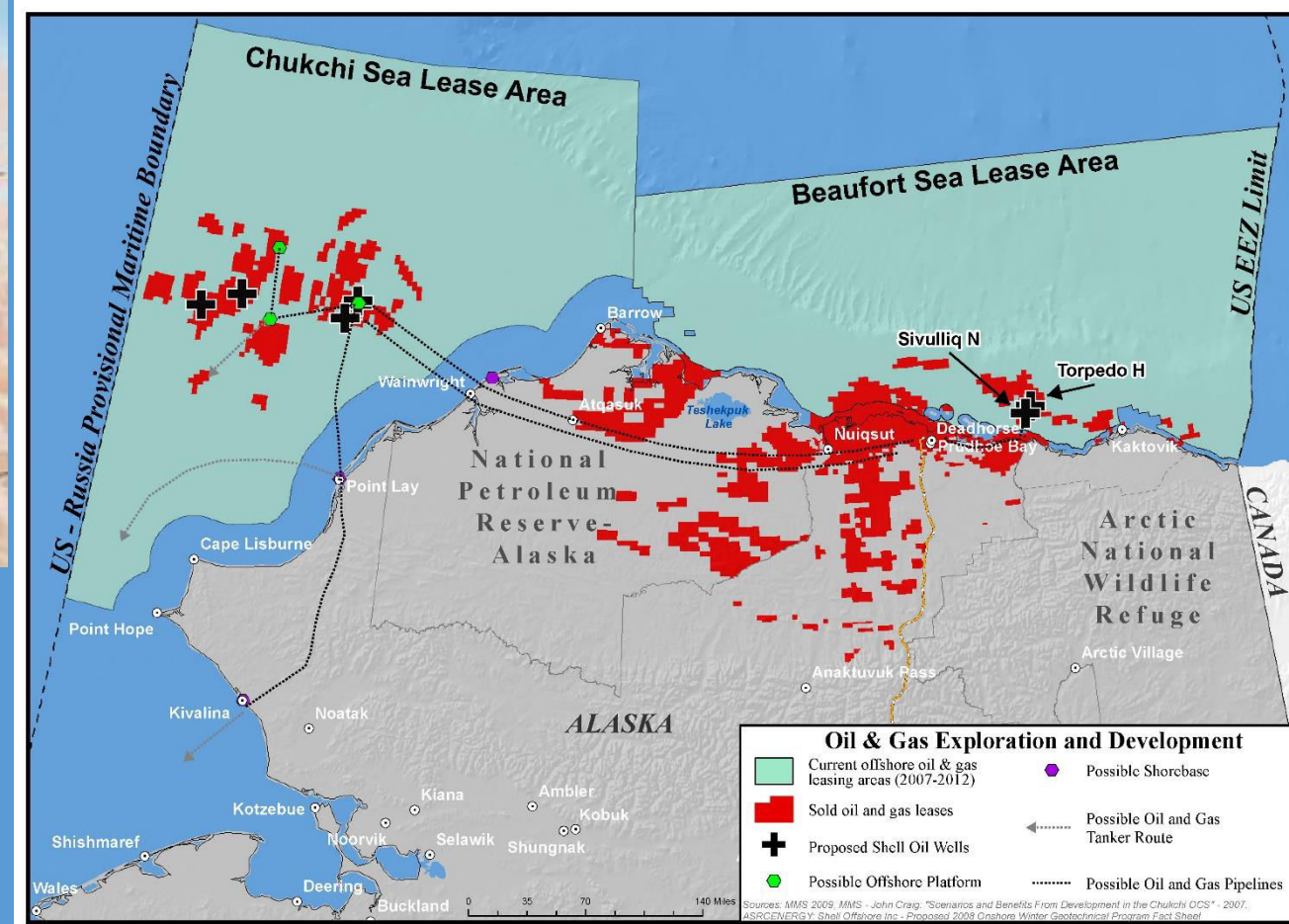
Alaska's marine Arctic systems are resource rich



onpost.com/wp-apps/imrs.php?src=https://img.washingtonpost.com/rf/image_908w/2010-
st/2010/12/17/Health-Environment-Science/Images/polarbear.JPG&w=1484

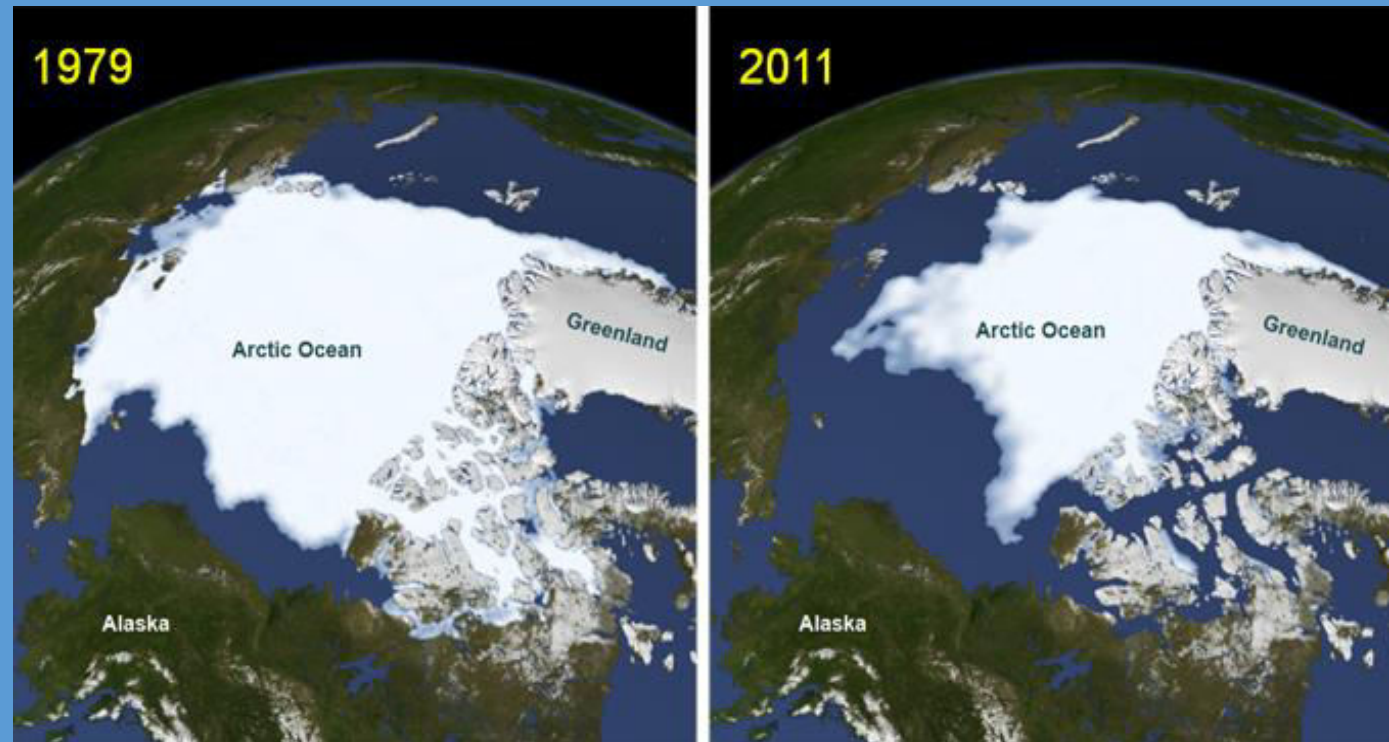
<http://img841.imageshack.us/img841/7918/walruspup2010norsemansa.jpg>

Alaska's Arctic encompasses 3 seas



Arctic systems are in flux

- Arctic marine ecosystems are experiencing rapid change.
 - Reductions in sea ice overall.
 - Reductions in seasonal ice cover.
 - Earlier meltback dates



Arctic systems are in flux with high costs



<http://neven1.typepad.com/.a/6a0133f03a1e37970b017c317598c6970b-pi>



<http://i.huffpost.com/gen/2370076/images/o-SHISHMAREF-facebook.jpg>

Arctic systems are in flux with high costs



Characteristics of arctic marine ecosystems

- Sea ice systems.
- High seasonality.
- Connections to lower latitudes.

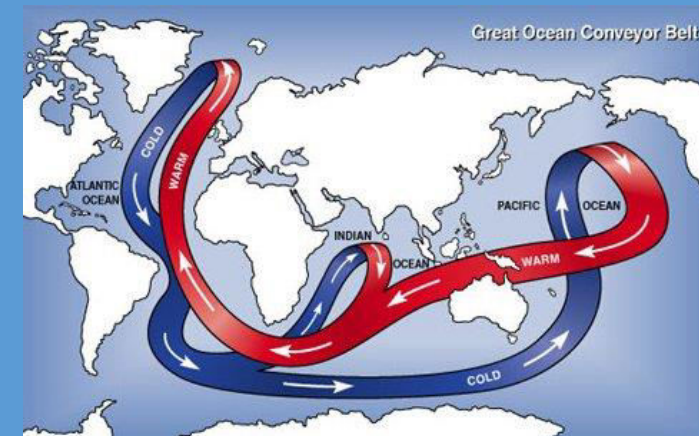


Arctic ecosystems are important:

- High productivity supporting commercial and subsistence harvests.
- Sites of human activities.
- Transportation pathways.
- Exports of water to ocean basins promoting global heat and nutrient exchanges.
- Bellweather of coming change.



<http://images.latinpost.com/data/images/full/18014/alaska-arctic-ocean-climate-change.jpg?w=600>



http://science.nasa.gov/media/medialibrary/2004/03/01/05mar_arctic_resources/currents1.jpg

Concerns for arctic ecosystems:

- Resiliencies to rapid change.
- Novel ecosystem interactions.
- Variations in connectivity.
- Feedback cycles with lower latitudes.
- Population-level effects on migratory avian and mammal predators.

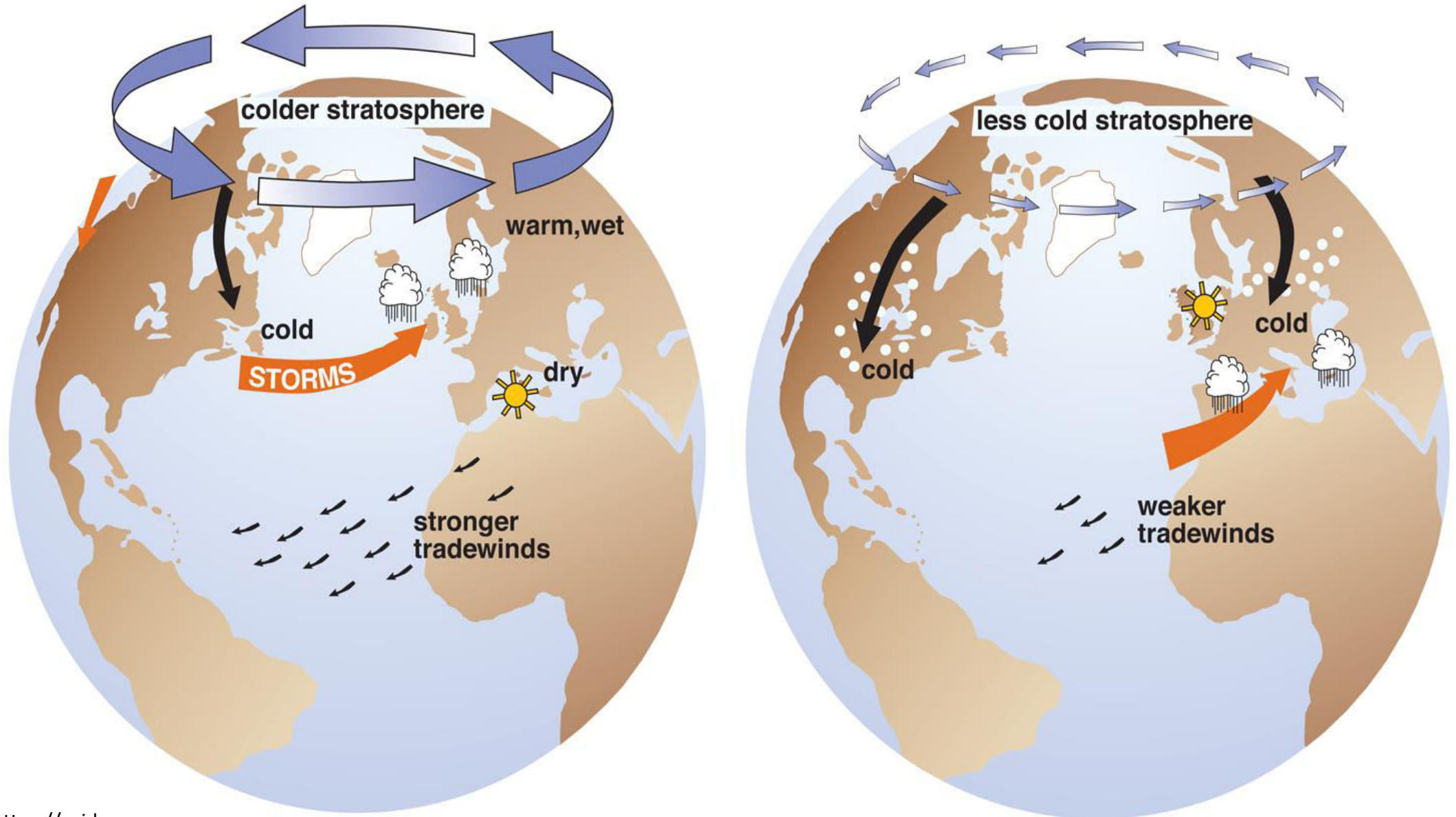


http://images.nationalgeographic.com/wpf/media-live/photos/000/037/custom/3711_1600x1200-wallpaper-cb1267712147.jpg

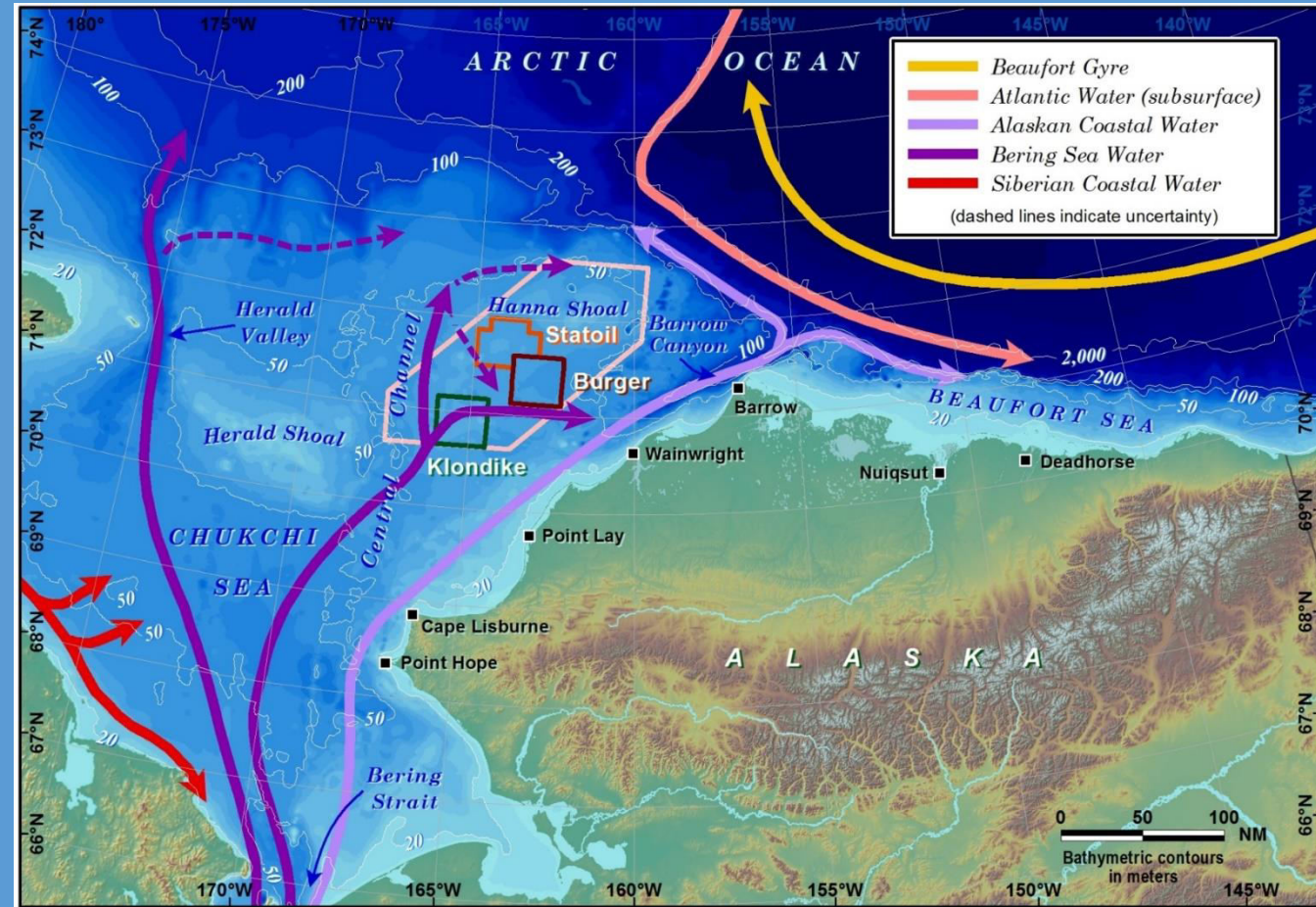


http://news.bbc.co.uk/nol/shared/spl/hi/pop_ups/07/sci_t_beasts_of_the_deep/img/5.jpg

Climatic connectivity and the Arctic

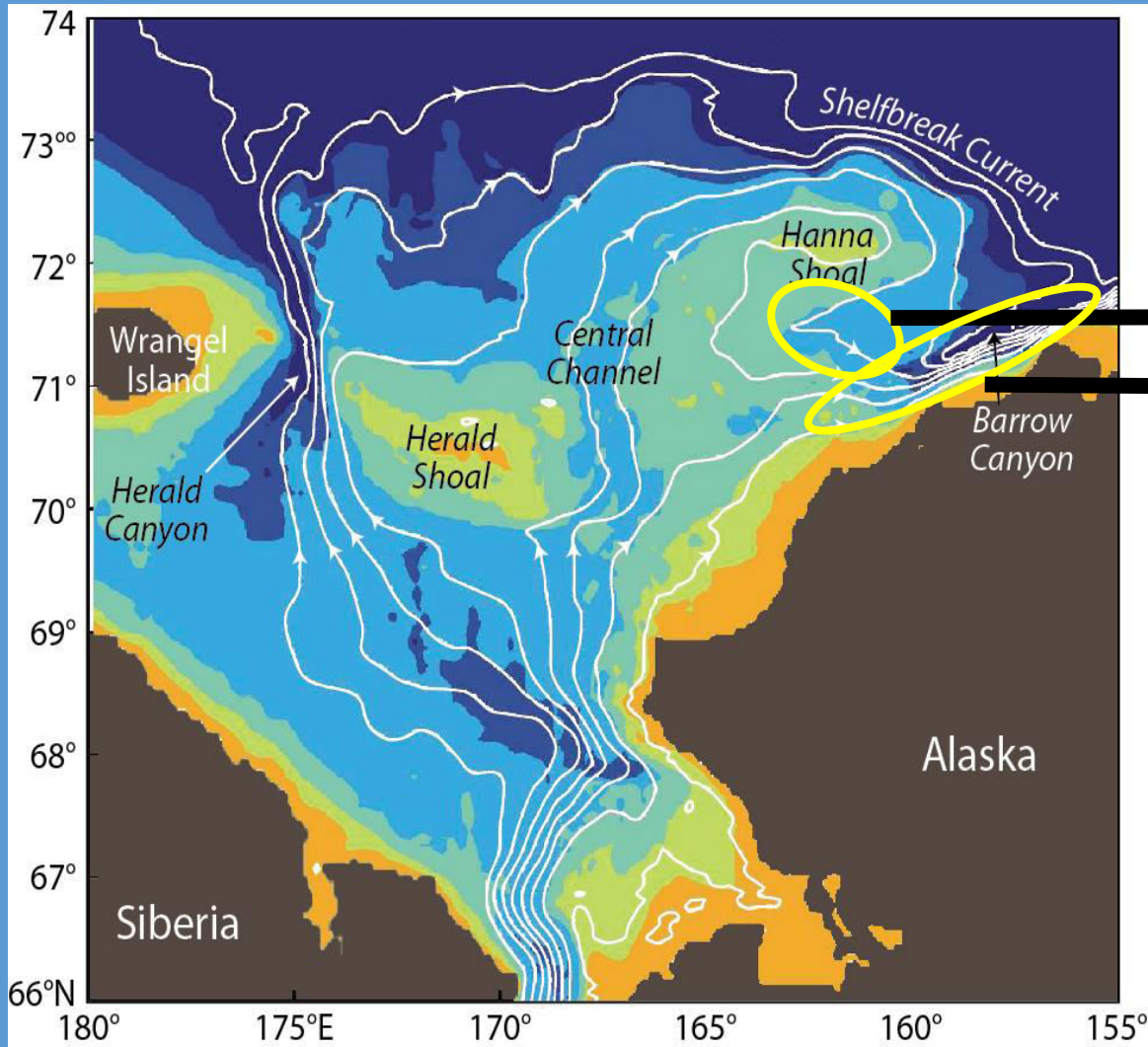


Oceanographic connectivity in the Arctic

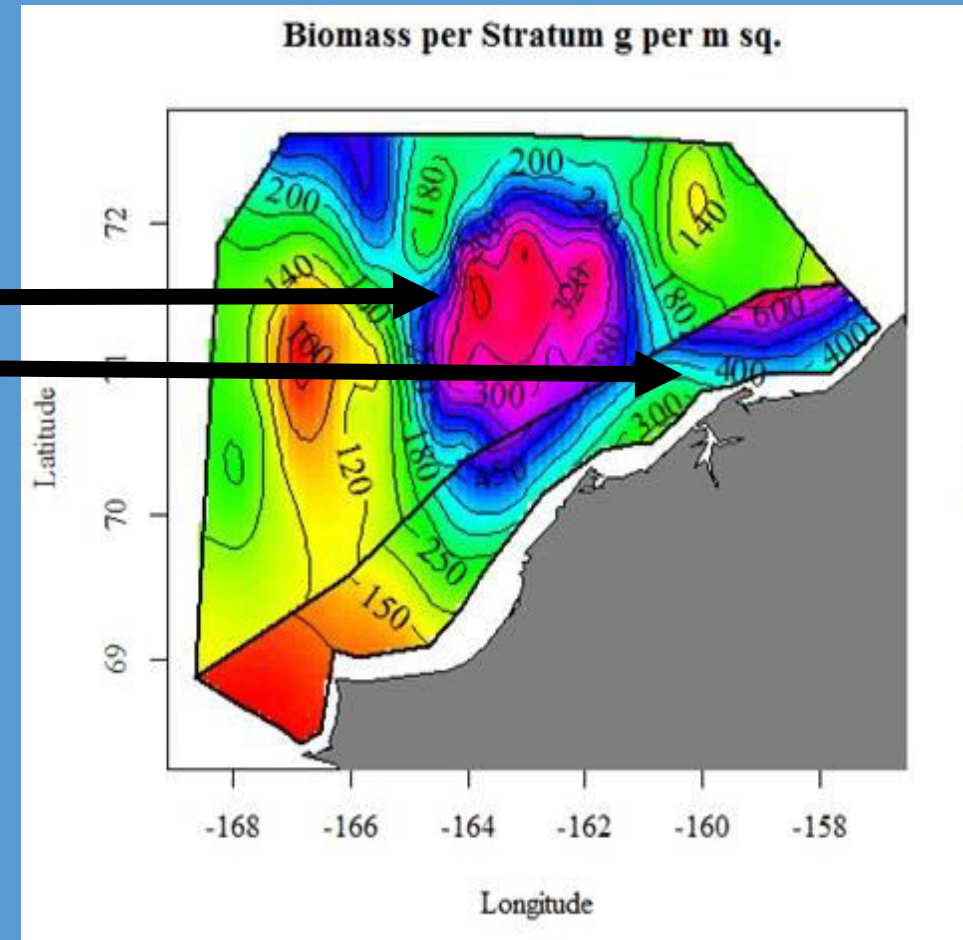


Courtesy of T. Weingartner, S. Danielson, and R. H. Day

Spatial drivers of change



(Spall, 2007)

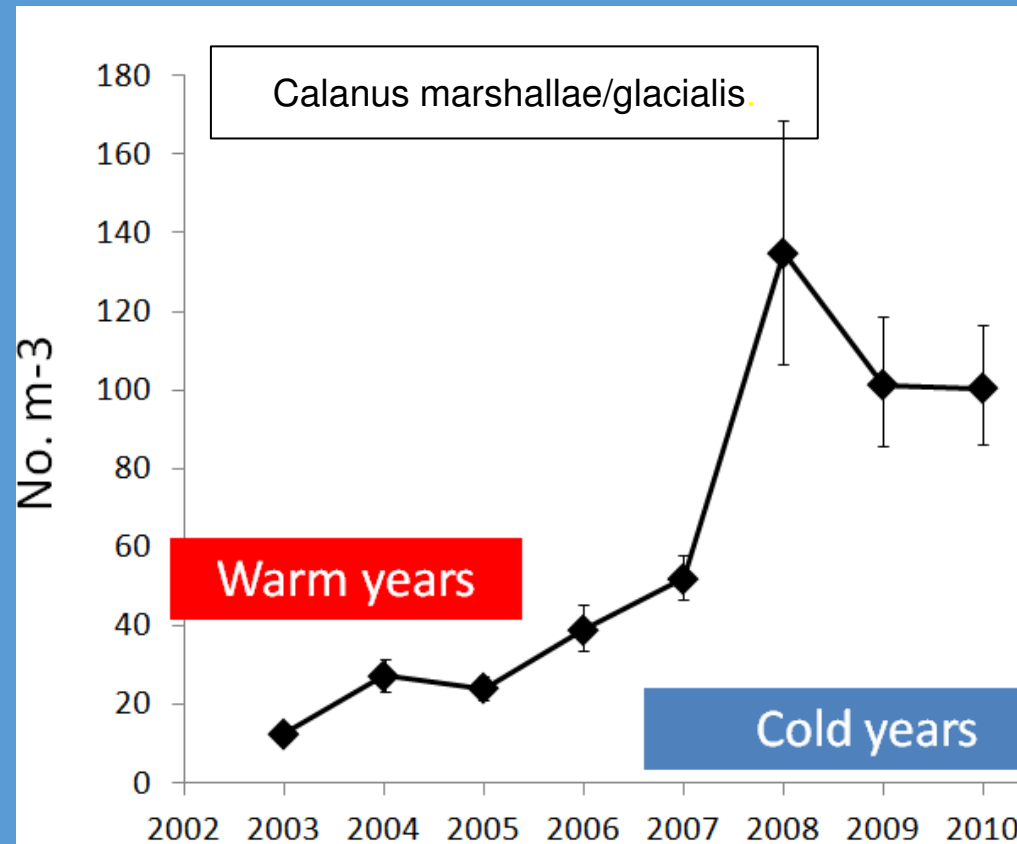
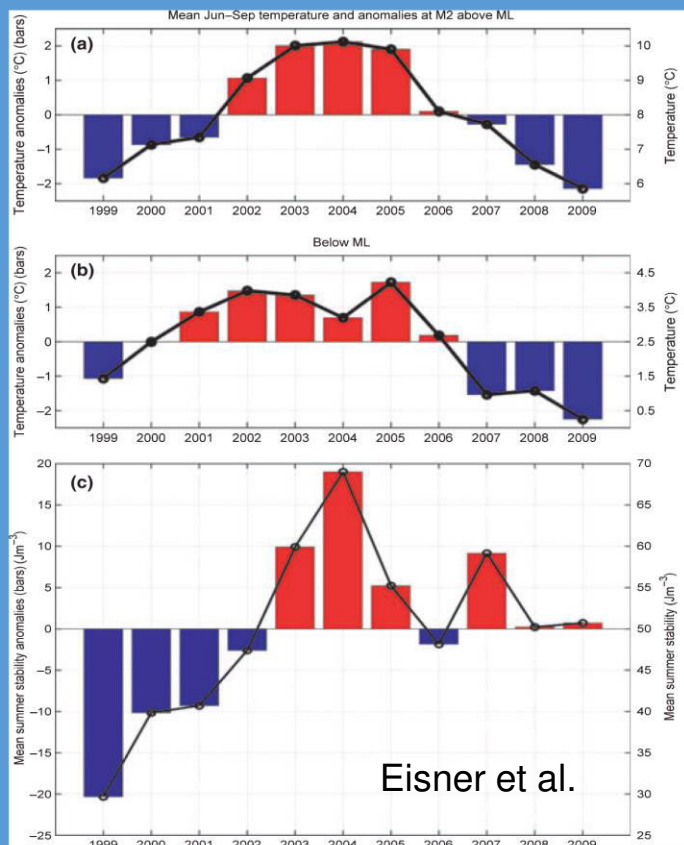


(Blanchard et al, in prep.)

Temporal drivers of change: climatic influences

- Pelagic community characteristics linked to climate variations.

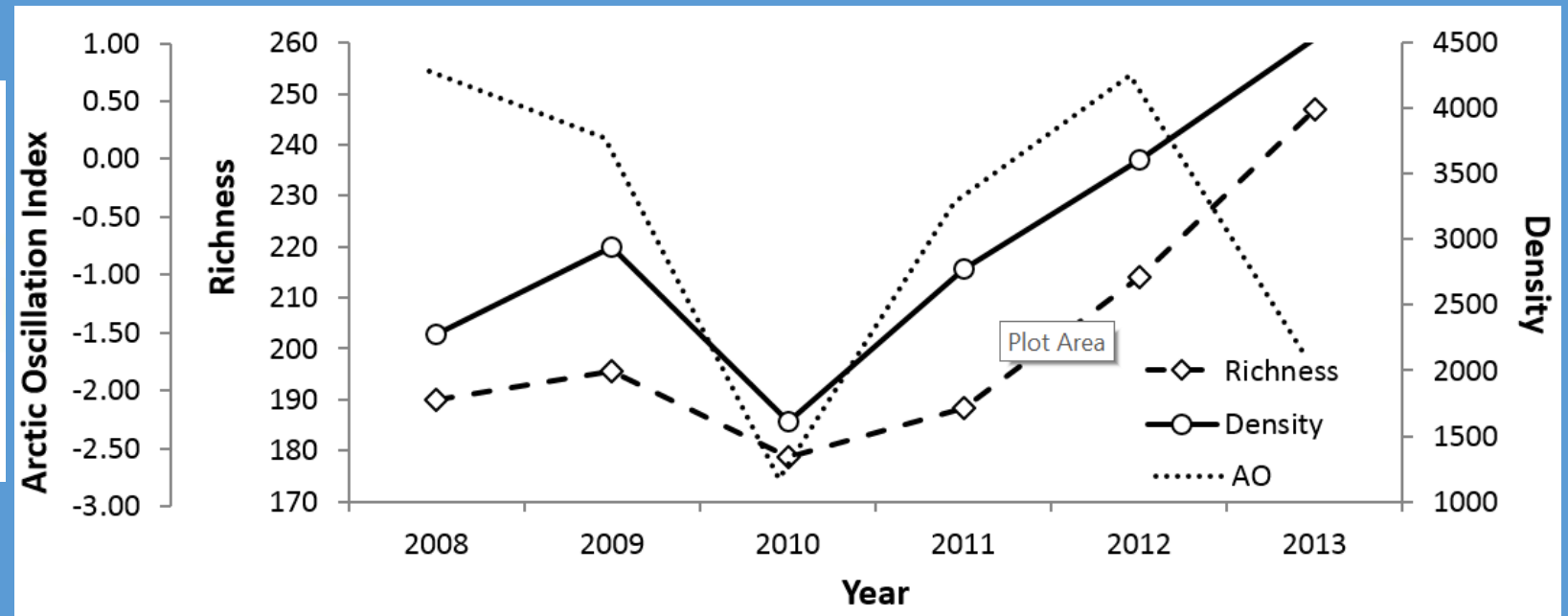
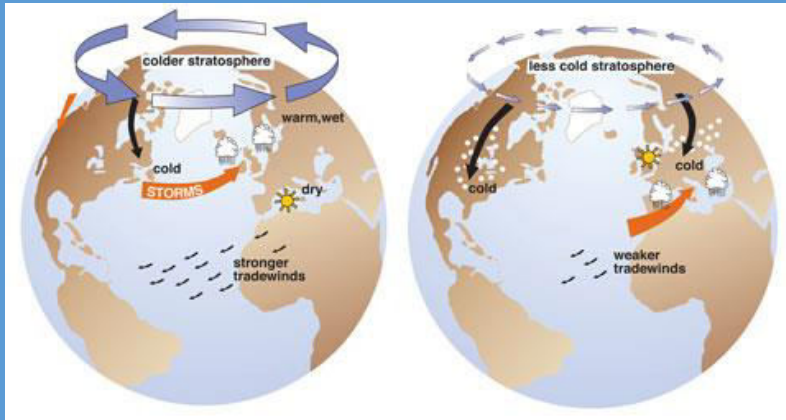
Copepods in the Southeastern Bering Sea (<60°N)



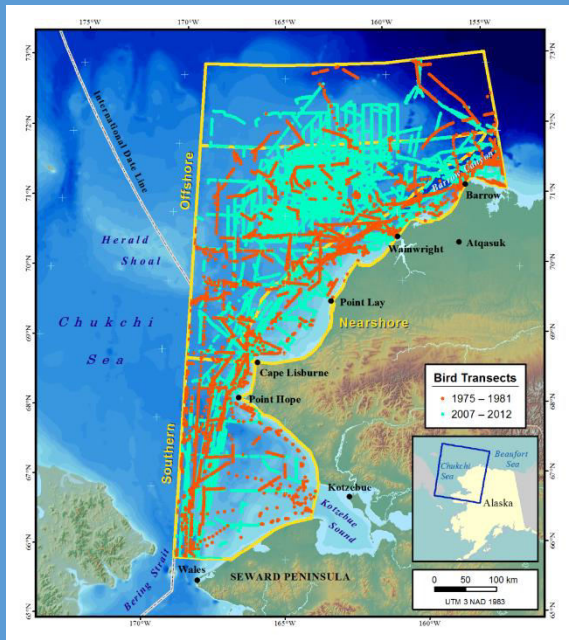
Courtesy of R. Hopcroft

Temporal drivers of change: climatic influences

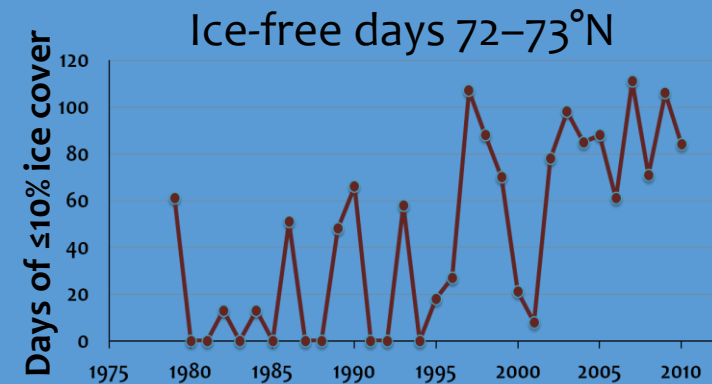
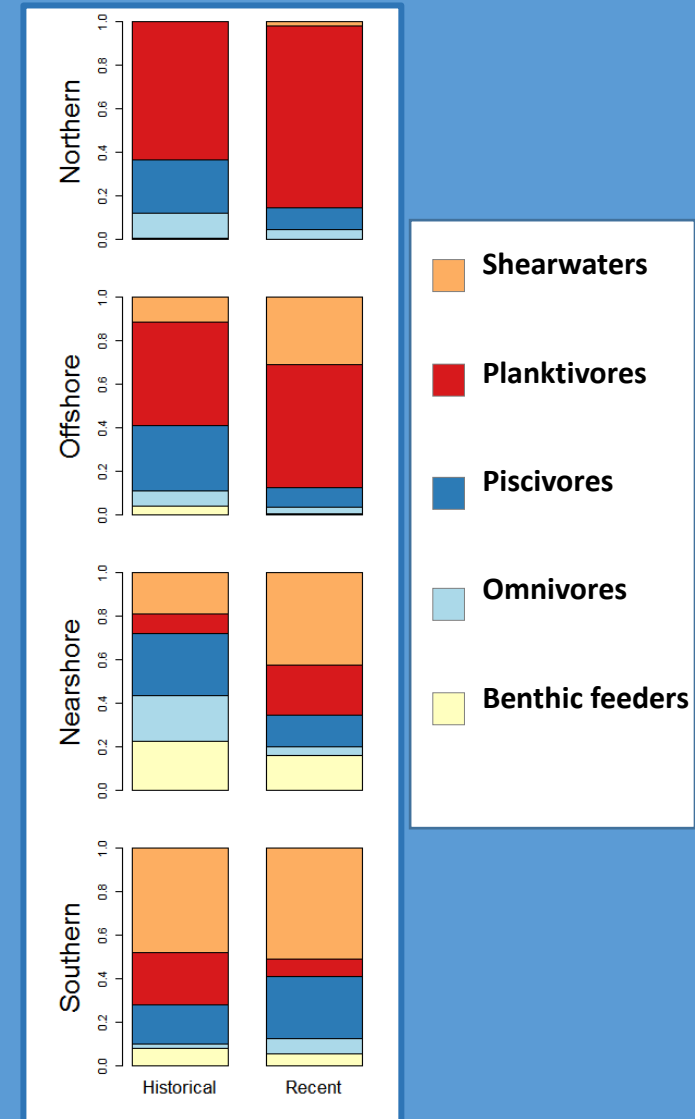
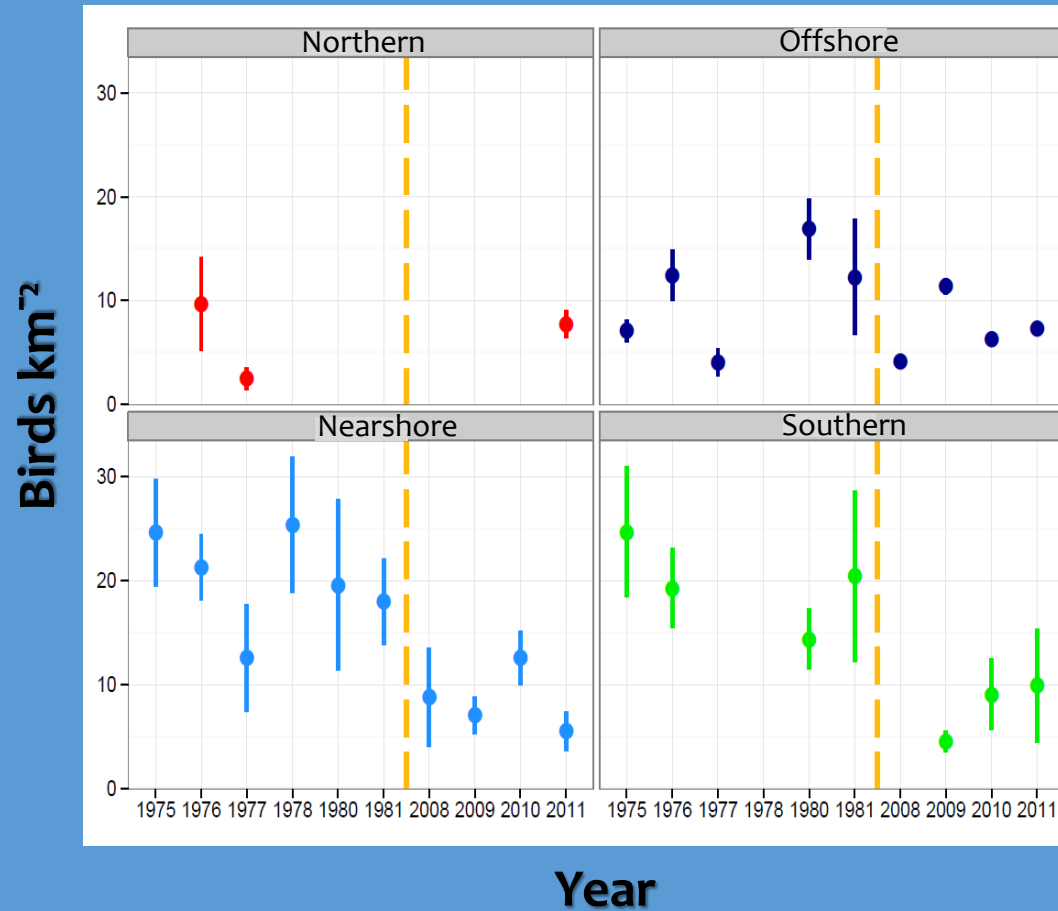
- Benthic community characteristics linked to climate variations, likely through water circulation.



Climate and temporal change at higher levels



Total abundance



Courtesy of A. Gall

Linkages

- **30% similarity** between faunal composition of benthic fauna between Port Valdez, a glacial fjord in Prince William Sound, Alaska, and the Chukchi Sea.
 - Many invertebrate fauna are widely distributed from California and Oregon to the Chukchi Sea.
 - Many seabirds and marine mammals travel great distances to feed in the Arctic.



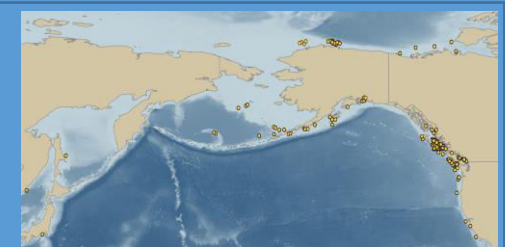
Mytilus trossulus
(mussel)



Semibalanus balanoides
(barnacle)



Ctenodiscus crispatus
(seastar)

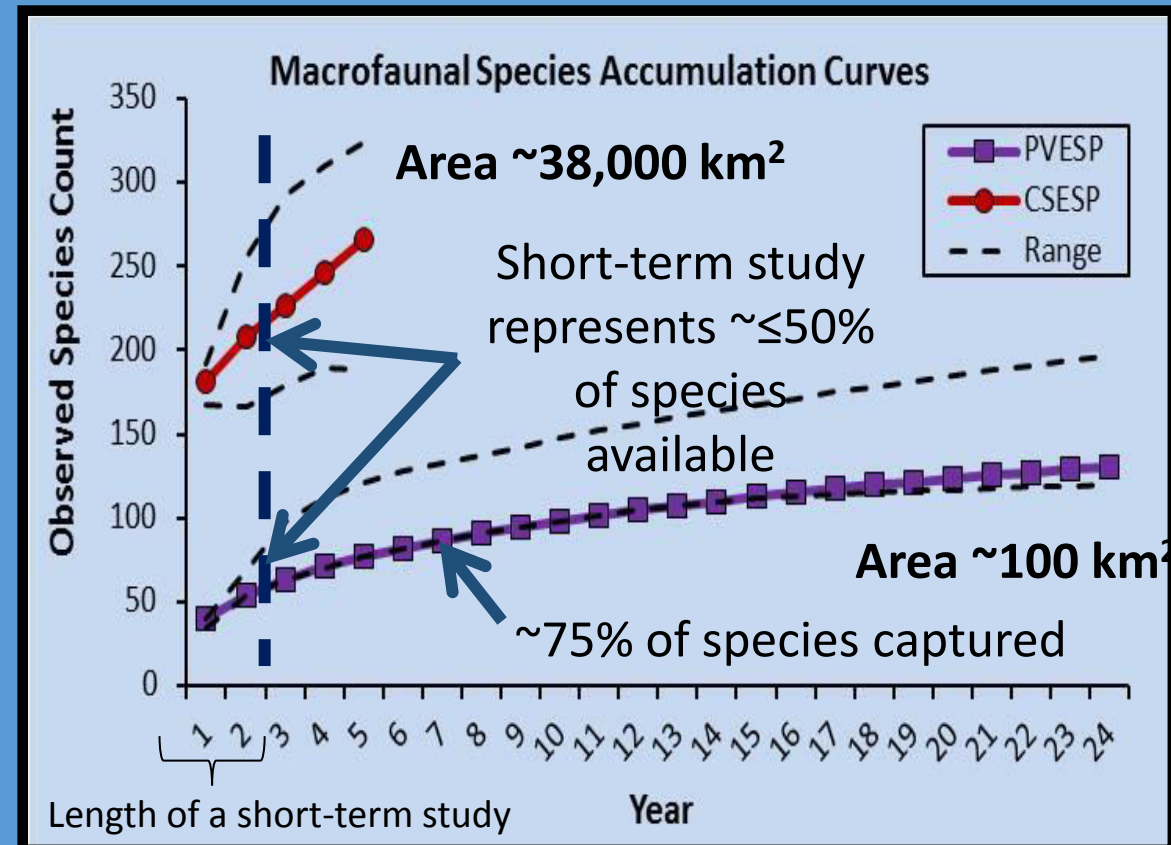


Resiliences

- Connectivities are both challenges to and sources for resiliency.
 - Connectivities are major sources of change via heat transport.
 - Connectivities also provide long-term sources for key fauna, nutrients, carbon, etc.
 - Connectivities poorly known.
- Resiliencies of the Arctic poorly studied.
 - AK infauna studied with respect to dredging, sediment dumping, fish wastes, and long-term discharges.
 - Some components highly resilient.

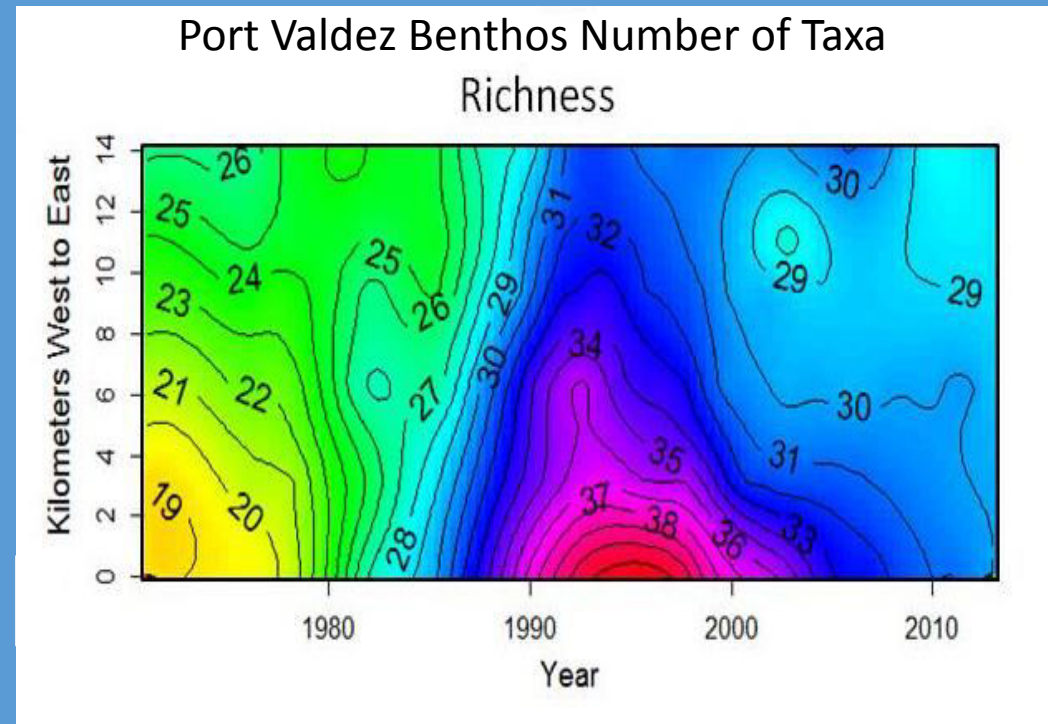
What we don't know

- In spite of great effort, we still have inadequate knowledge arctic ecosystems.
- We have inadequate information on:
 - Biodiversity and drivers.
 - Ecosystem resiliencies.



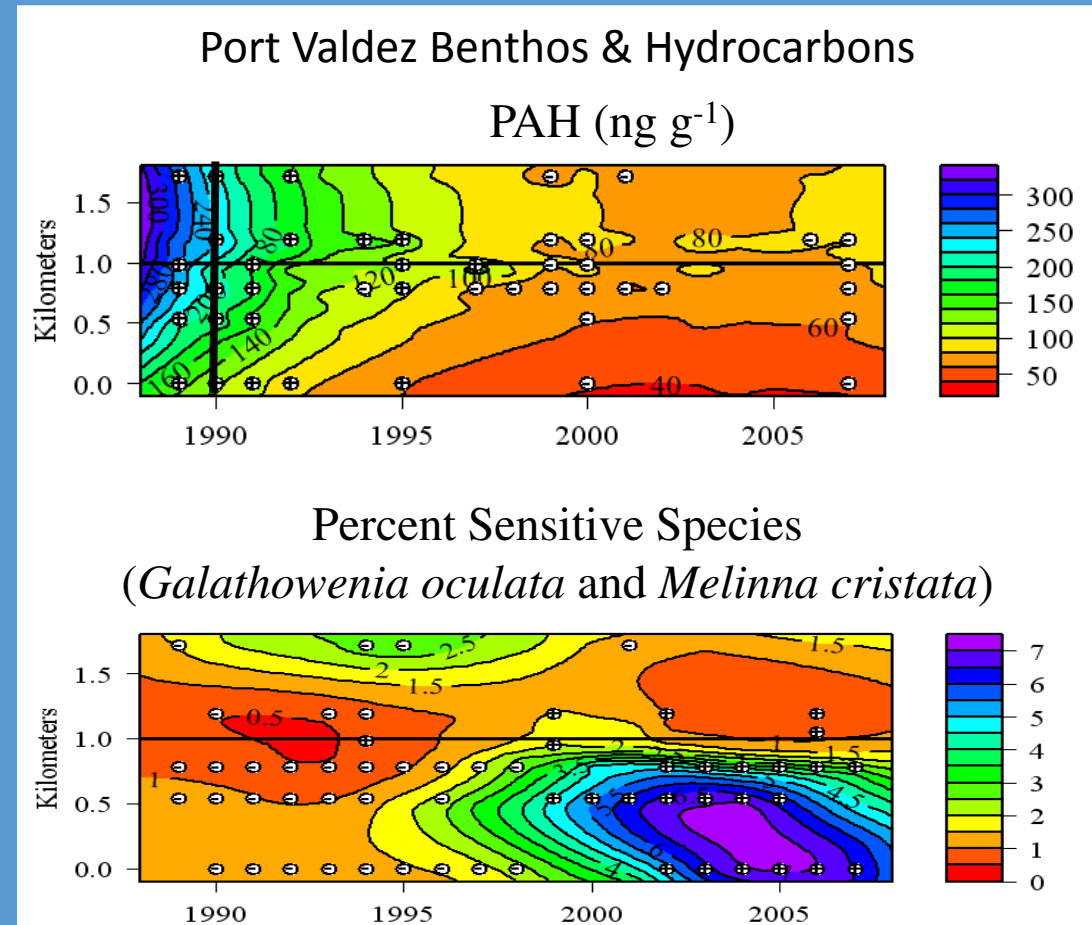
What we don't know

- In spite of great effort, we still have inadequate knowledge arctic ecosystems.
- We have inadequate information on:
 - Biodiversity and drivers.
 - Ecosystem resiliencies.
 - Long-term variations.



What we don't know

- In spite of great effort, we still have inadequate knowledge arctic ecosystems.
- We have inadequate information on:
 - Biodiversity and drivers.
 - Ecosystem resiliencies.
 - Long-term variations.
 - Potential anthropogenic effects.
 - And many other topics.



Thoughts

- Statistically designed long-term monitoring efforts are needed.
 - Pre-existing programs can provide guidance.
- New directions, new thoughts needed.
 - Spatial and temporal interactions between geomorphology, oceanography, climate, and biota may provide unexpected but highly significant sources for change.
- Resiliencies and conservation of their sources may be important.
- Connectivity among seas, climate, and biota plays a major role in ecological characteristics of arctic marine ecosystems.
- Effects extend backwards as well.