Understanding pattern & change in the Arctic: can we get there from here?

Russell Hopcroft, Ksenia Kosobokova
The Problem

- Increasing desire to know the “status” of the Arctic: IF it is changing, WHAT will it look like in the future
- There are two fundamental requirements for this:
  1. we know/understand baseline patterns
  2. we need consistent time-series observations
Caveat: that Greatest biodiversity data density in Pacific-Arctic
Through CoML, we now understand biodiversity in the basins based on consistent methods.
Community patterns: hierarchical clustering of Bray-Curtis Similarity coefficient
Multidimensional Scaling Projection

- **Depth**
  - 0-25
  - 25-50
  - 50-100
  - 100-200
  - 200-300
  - 300-500
  - 500-1K
  - 1K-2K
  - 2K-5K

- **Similarity**
  - 60
  - 70
  - 75
  - 80

- **Epipelagic**
- **Mesopelagic**
- **Bathypelagic**

- **“Arctic”**
- **“Atlantic”**

2D Stress: 0.06
Patterns hold for entire Arctic with some regional variation

(e.g. from 3 cruises)
Basin communities are distinctive, but can we make progress on Arctic Shelves where interannual variability is high?
Chukchi & Beaufort Shelves

- Sampling from 2004-2014, ~Aug-Sept
- Consistent collection (vertical 150µm nets) with integration to bottom (or 200m)
- Consistent processing
- ~700 samples available for analysis (subset used)
- Community structure analyzed using Bray-Curtis similarity, subjected to Clustering and nMDS
A structured mess

Major clusters at 60-65% similarity (using ~350 samples)
• Chukchi and Beaufort are distinct
• East Siberian is more like Chukchi than Beaufort
• Cross shelf & along-shelf patterns in Beaufort, with distinct communities from Mackenzie River
• Temperature & salinity explain up to 50% within-study
Caveat: interannual difference can be large, but needs to be less than regional differences e.g. the northeastern Chukchi.
The Consolidation Challenge

- Collection gear is not standardized (mesh size)
- Taxonomic resolution and SKILL are variable (plus taxonomy itself has changed)
- Few long-term consistently sampled locations (improvement since ~2000)
- Most published works do not include raw data for reanalysis
- General reluctance to share
- ~925 samples for analysis (150-180 µm mesh) from 1930-2014
First cut at a pan-arctic shelf analysis

- Clusters at 35% similarity suggest major differences between regions?
• Although we can’t rule out differences do exist....
• most clusters are heavily confounded by the source of the data (most scientist work regionally)
• Different data sets have different ‘quality’
• Collections are seldom archived for re-analysis
Change often happens by shuffling sibling species, so a lack of taxonomic detail (or latter reduction) has major consequences for defining regions and detecting regions and change.
• We are trying to use older data for purposes it was never intended
• Fiddling with data ongoing >> improvement?

• To establish pattern and detect change, we need consistent methodology....
• .... and a long-term commitment to regular observations and time-series
However, all is not lost. On a species-by-species basis, it is possible to show systematic changes over time in regional historical data.

Iceland & Norway ~1960, but species-level begins 1990

Greenland Fjords late 1990s

Svalbard Fjords

Faroe Islands

Canada Basin & Beaufort Sea (in progress)
GIS-based approaches to predicting contemporary species “niche” occurrence & abundance ...... and predicting future based on climate models
Questions?