Integrated Ecosystem Assessment of the Central Arctic Ecosystem – ICES/PICES/PAME WGICA

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ICES/PICES/PAME WGICA

- Working Group on Integrated Ecosystem Assessment of the Central Arctic Ocean
- ICES – International Council for Exploration of the Sea
  - Science and Advice
- PICES – North Pacific Science Organization
- PAME – Protection of the Arctic Marine Environment
- Established 2015 – 3-year period: 2016-2018
- 3 co-chairs:
  - John Bengtson, NOAA, USA
  - Sei-Ichi Saito, Univ. of Hokkaido, Japan
  - Hein Rune Skjoldal, IMR, Norway
- 3rd meeting in St. John’s, Newfoundland, Canada
  - [http://www.ices.dk/community/groups/Pages/WGICA.aspx](http://www.ices.dk/community/groups/Pages/WGICA.aspx)
EA Framework
Integrated Ecosystem Assessment Groups in ICES
IEA report for the CAO

• Integrated Ecosystem Assessment of the Central Arctic Ocean: Ecosystem Description and Vulnerability Characterization

• Ecosystem description with emphasis on spatial aspects and trophic (food-web) connections

• Oceanography, plankton, ice biota, benthos, fish, birds and marine mammals

• Vulnerability
  • general aspects (concepts, terminology, methodology)
  • Initial considerations of vulnerability to human activities – climate, pollution, fisheries,

• Shipping
Water masses – 4 vertical layers

• **Top layer** (ca 50 m)
  • Seasonal dynamics – sea ice formation and melting
• **Gradient layer** (**cold halocline**) – ca 50-200 m
  • Atlantic and Pacific origins
• **Atlantic layer** – ca 200-1000 m
  • Two branches – Fram Strait and Barents
• **Deep layer** - >1.000 m
Circulation and ice drift

• Top layer
  • Beaufort Gyre
  • Trans-Polar Drift

• Halocline
  • Origin and spread of Atlantic water
  • Spread of Pacific winter and summer water

• Atlantic layer
  • Counter-clockwise
  • Circulation cells in basins
  • Pathways for Fram Strait and Barents branches
Primary production by phytoplankton and ice algae

• **Light limitation** due to sea ice and high latitude, also **CDOM**
• **Nutrient limitation** (Nitrogen) due to strong vertical stratification – low replenishment, low winter values
• Phytoplankton dominated by small flagellates (and centric diatoms)
• Ice algae dominated by pennate diatoms
• Level of primary production is generally low

• **Microbial loop** – bacteria, heterotrophic flagellates and dinoflagellates, protozoans, small copepods, a.o.
Zooplankton and sea ice amphipods

• Four dominant ‘herbivorous’ copepods – *Calanus hyperboreus, C. glacialis, Meridia longa* and *C. finmarchicus*
• Smaller copepods are omnivores – *Oithona, Microcalanus*
• Limited reproduction by the herbivores – 4 hotspots?
• Ice amphipods live associated with the underside of the ice – mainly omnivores. Over-summering, colonization of new ice
• Expatriates from the Pacific side – *Neocalanus, Eucalanus bungeii, Metridia pacifica*
• *Themisto libellula* – ecological equivalent of pelagic fish??
Arctic cod
*Arctogadus glacialis*

Polar cod
*Boreogadussaida*
Swedish ice-breaker ‘Oden’, 2016 cruise

Pauline S. Lejonmalm et al. - manuscript
USFWS survey data, 2006-2017 (Kuletz, unpubl data); maps by D. Cushing
Blue whale
Fin whale
Bowhead – Spitsbergen stock
Beluga - Eastern Chukchi Beaufort